



Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China





MICROCHIP

**RN4870/71 PICtail™/PICtail
Plus Daughter Board
User's Guide**

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

**QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
= ISO/TS 16949 =**

Trademarks

The Microchip name and logo, the Microchip logo, AnyRate, AVR, AVR logo, AVR Freaks, BeaconThings, BitCloud, CryptoMemory, CryptoRF, dsPIC, FlashFlex, flexPWR, Helder, JukeBlox, KEELOQ, KEELOQ logo, Klear, LANCheck, LINK MD, maXStylus, maXTouch, MediaLB, megaAVR, MOST, MOST logo, MPLAB, OptoLyzer, PIC, picoPower, PICSTART, PIC32 logo, Prochip Designer, QTouch, RightTouch, SAM-BA, SpyNIC, SST, SST Logo, SuperFlash, tinyAVR, UNI/O, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

ClockWorks, The Embedded Control Solutions Company, EtherSynch, Hyper Speed Control, HyperLight Load, IntelliMOS, mTouch, Precision Edge, and Quiet-Wire are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, BodyCom, chipKIT, chipKIT logo, CodeGuard, CryptoAuthentication, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, EtherGREEN, In-Circuit Serial Programming, ICSP, Inter-Chip Connectivity, JitterBlocker, KlearNet, KlearNet logo, Mindi, MiWi, motorBench, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PureSilicon, QMatrix, RightTouch logo, REAL ICE, Ripple Blocker, SAM-ICE, Serial Quad I/O, SMART-I.S., SQI, SuperSwitcher, SuperSwitcher II, Total Endurance, TSHARC, USBCheck, VariSense, ViewSpan, WiperLock, Wireless DNA, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

Silicon Storage Technology is a registered trademark of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2016, Microchip Technology Incorporated, All Rights Reserved.
ISBN: 978-1-5224-1246-5

Object of Declaration: RN4870/71 PICtail™/PICtail Plus Daughter Board

EU Declaration of Conformity

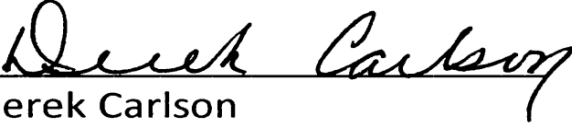
This declaration of conformity is issued by the manufacturer.

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. For information regarding the exclusive, limited warranties applicable to Microchip products, please see Microchip's standard terms and conditions of sale, which are printed on our sales documentation and available at www.microchip.com.

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


Derek Carlson

VP Development Tools

11-NOV-16
Date

RN4870/71 PICtail™/PICtail Plus Daughter Board User's Guide

NOTES:



RN4870/71 PICtail™/PICtail PLUS DAUGHTER BOARD USER'S GUIDE

Table of Contents

Preface	7
Chapter 1. Overview	
1.1 Introduction	13
1.2 RN4870/71 PICtail™/PICtail Plus Daughter Board Description	13
1.3 Features	14
Chapter 2. Interface Description	
2.1 Introduction	15
2.2 RN4870 PICtail/PICtail Plus Daughter Board	15
2.3 RN4871 PICtail/PICtail Plus Daughter Board	17
2.4 Sensor Board	18
Chapter 3. Quick Start Guide	
3.1 Overview	19
3.2 Connecting the RN4870/71 PICtail/PICtail Plus Daughter Board to a Host PC	19
3.3 Changing Settings Using ASCII Commands	21
3.4 Connecting to the RN4870/71 Using SmartDiscover App	22
3.5 Creating Custom GATT Services	24
3.6 Accessing GATT Service Using UART Commands and SmartDiscover App	25
3.7 Reading Sensor Board Peripheral IO Ports Using UART Commands	27
Chapter 4. RN4870 Sensor Board	
4.1 Overview	29
4.2 Configuring the RN4870 Module Settings	29
4.3 Sensor Board GATT Service	30
4.4 Transferring Sensor Data into GATT Service Using Scripting	32
4.5 BLESensorApp Smartphone App	34
4.6 Provision Utility	36
Chapter 5. PIC Configuration Library	
5.1 Overview	39
5.2 Using BM7x Configuration Library with PICtail Board	39
Appendix A. Updating PICtail Firmware	
A.1 Overview	43
Appendix B. Schematics and BOM	
B.1 Introduction	45
B.2 RN4870 PICtail Schematic	46
B.3 RN4870 PICtail BOM	47

RN4870/71 PICtail™/PICtail Plus Daughter Board User's Guide

B.4 RN4871 PICtail Schematic	49
B.5 RN4871 PICtail BOM	50
B.6 RN4870 Sensor Board Schematic	52
B.7 RN4870 Sensor Board BOM	52
Appendix C. Bluetooth Low Energy Primer	
C.1 GAP Roles: Peripheral and Central	53
C.2 GATT Service: Client and Server	53
Appendix D. Sensor Board Configuration Command Text	
D.1 Overview	55
Worldwide Sales and Service	57

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 website (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 “DSXXXXXXXXA”, where “XXXXXXXX” 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 online help. Select the Help menu, and then Topics to open a list of available online help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the RN4870/71 PICtail™/PICtail Plus Daughter board. Items discussed in this chapter include:

- [Document Layout](#)
- [Conventions Used in this Guide](#)
- [Recommended Reading](#)
- [The Microchip Website](#)
- [Development Systems Customer Change Notification Service](#)
- [Customer Support](#)
- [Document Revision History](#)

DOCUMENT LAYOUT

This document describes how to use the RN4870/71 PICtail™/PICtail Plus Daughter board as a development tool to emulate and debug firmware on a target board, as well as how to program devices. The document is organized as follows:

- **Chapter 1. “Overview”** – This chapter introduces the RN4870/71 PICtail™/PICtail Plus Daughter board and provides an overview of its various features.
- **Chapter 2. “Interface Description”** – This chapter illustrates and describes the various components and the interfaces available on the PICtail/PICtail Plus Daughter board and the Sensor board.
- **Chapter 3. “Quick Start Guide”** – This chapter describes how to connect the RN4870/71 PICtail/PICtail Plus Daughter board to the Host PC (via USB and connecting and communicating with a smartphone using the SmartDiscover app), how to create and access GATT services, and how to read the Sensor Board Peripheral IO ports.
- **Chapter 4. “RN4870 Sensor Board”** – This chapter describes the procedure to set up the RN4870 to use the various sensors on the Sensor board and also

explains how to connect and communicate with the BLE Sensor app on the iOS smartphone.

- **Chapter 5. “PIC Configuration Library”** – This chapter provides information on how to use the Configuration Library to configure the RN4870/71 module using a host MCU over UART.
- **Appendix A. “Updating PICtail Firmware”** – This appendix shows the steps to update the firmware on the RN4870/71 PICtail/PICtail Plus Daughter board.
- **Appendix B. “Schematics and BOM”** – This appendix shows the schematics and BOM for the RN4870/71 PICtail/PICtail Plus Daughter board and the Sensor board.
- **Appendix C. “Bluetooth Low Energy Primer”** – This Appendix provides a brief summary of GAP roles and GATT services
- **Appendix D. “Sensor Board Configuration Command Text”** – This appendix provides an example of a script that can be used to control and communicate with the Sensor board.

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	<i>MPLAB[®] IDE User's Guide</i>
	Emphasized text	...is the <i>only</i> 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	<u><i>File>Save</i></u>
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	<i>file.o</i> , where <i>file</i> can be any valid filename
Square brackets []	Optional arguments	mcc18 [options] <i>file</i> [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) { ... }

RECOMMENDED READING

This user's guide describes how to use the RN4870/71 PICtail™/PICtail Plus Daughter Board. Other useful documents are listed below. The following Microchip documents are recommended as supplemental reference resources.

RN4870/71 Bluetooth® 4.2 Low Energy Module Data Sheet (DS50002489)

This document provides the technical specifications for the RN4870/71 module and is available for download from the Microchip website (www.microchip.com).

RN4870/71 Bluetooth® Low Energy Module User's Guide (DS50002466)

This document provides information for configuring the RN4870/71 module including a command reference, scripting features and connection examples.

THE MICROCHIP WEBSITE

Microchip provides online support via our website at www.microchip.com. This website is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the website contains the following information:

- **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; and listings of Microchip sales offices, distributors and factory representatives

DEVELOPMENT SYSTEMS CUSTOMER CHANGE NOTIFICATION SERVICE

Microchip's customer notification service helps keep customers current on Microchip products. Subscribers will receive e-mail notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, access the Microchip website at www.microchip.com, click on **Customer Change Notification** and follow the registration instructions.

The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers and other language tools
- **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 X IDE** – The latest information on Microchip MPLAB X IDE, the Windows® Integrated Development Environment for development systems tools
- **Programmers** – The latest information on Microchip programmers including the PICkit™ 3 development programmer

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 website at:

<http://www.microchip.com/support>.

DOCUMENT REVISION HISTORY

Revision A (December 2016)

This is the initial release of this document.

NOTES:

Chapter 1. Overview

1.1 INTRODUCTION

This document describes the hardware and software requirements for the RN4870/71 PICtail™/PICtail Plus board, part numbers: RN-4870-SNSR and RN-4871-PICtail.

The RN4870/71 PICtail™/PICtail Plus Daughter Board enables the designer to evaluate and demonstrate the capabilities of the RN4870/71 Bluetooth® 4.2 RF module.

The RN4870/71 PICtail/PICtail Plus Daughter board include the following key features:

- Integrated configuration and programming interface
- LED and push button bank for prototype user inputs
- MCP2200 USB to UART bridge for plug-and-play connectivity to host

An additional daughter board is included in the RN-4870-SNSR to demonstrate peripheral access using Bluetooth Low Energy (BLE).

In addition to RN4870/71 PICtail/PICtail Plus Daughter board hardware, several smartphone applications are provided to demonstrate Bluetooth data connections to the on-board RN4870/71 module.

The demonstration apps are available on Apple AppStore® and Google Play™ Store and include:

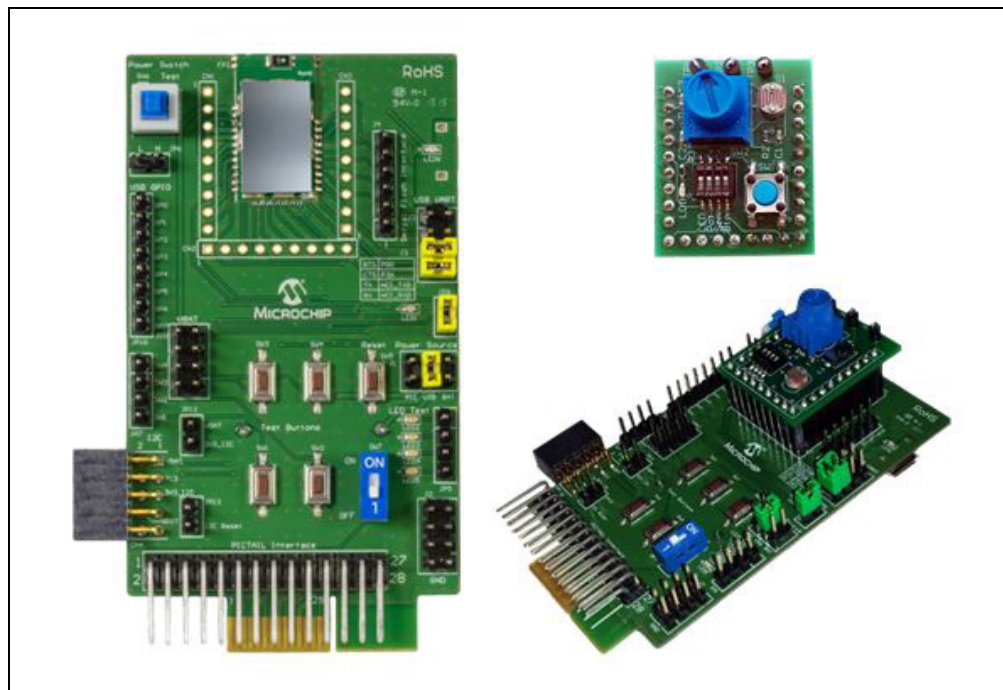
- SmartDiscover
- SmartData
- BLESensorApp

For more information on the RN487x commands and specifications, refer to the “*Bluetooth® 4.2 Low Energy Module Data Sheet*” (DS50002489) and the “*Bluetooth® Low Energy Module User’s Guide*” (DS50002466) available for download from the Microchip product web page at www.microchip.com/RN4870.

1.2 RN4870/71 PICtail™/PICtail PLUS DAUGHTER BOARD DESCRIPTION

The RN4870/71 PICtail/PICtail Plus Daughter board provides rapid prototyping and developing for Bluetooth data applications for Bluetooth Low Energy. It can be powered via USB host or through the Microchip PICtail Plus interface. The RN4870/71 PICtail/PICtail Plus Daughter board uses the RN4870/71 module, a fully certified Bluetooth 4.2 Low Energy module. The RN4870/71 PICtail/PICtail Plus Daughter board provides a USB-UART converter allowing flexible interface to a host PC, a PC terminal utility and smartphone apps to drive both BLE serial data connections and custom BLE services. The RN4870/71 PICtail/PICtail Plus Daughter board also provides Microchip PICtail and PICtail Plus interfaces to be able to interface with the Microchip PIC® micro-controllers using standard Microchip development tools.

FIGURE 1-1: RN4870/71 PICtail™/PICtail PLUS DAUGHTER BOARD AND SENSOR BOARD



1.3 FEATURES

The RN4870/71 PICtail/PICtail Plus Daughter board has the following features:

- Fully certified Bluetooth Low Energy 4.2 RF module
- +2 dBm maximum TX power
- On-Board Dual In-Line Package (DIP) switch block to set operating modes
- PICtail Plus and PICtail interfaces to fully access RN4870 pins using the external PIC MCU
- Embedded MCP2200 USB-UART converter to enable Application mode and programming interface to update firmware and configuration settings

Chapter 2. Interface Description

2.1 INTRODUCTION

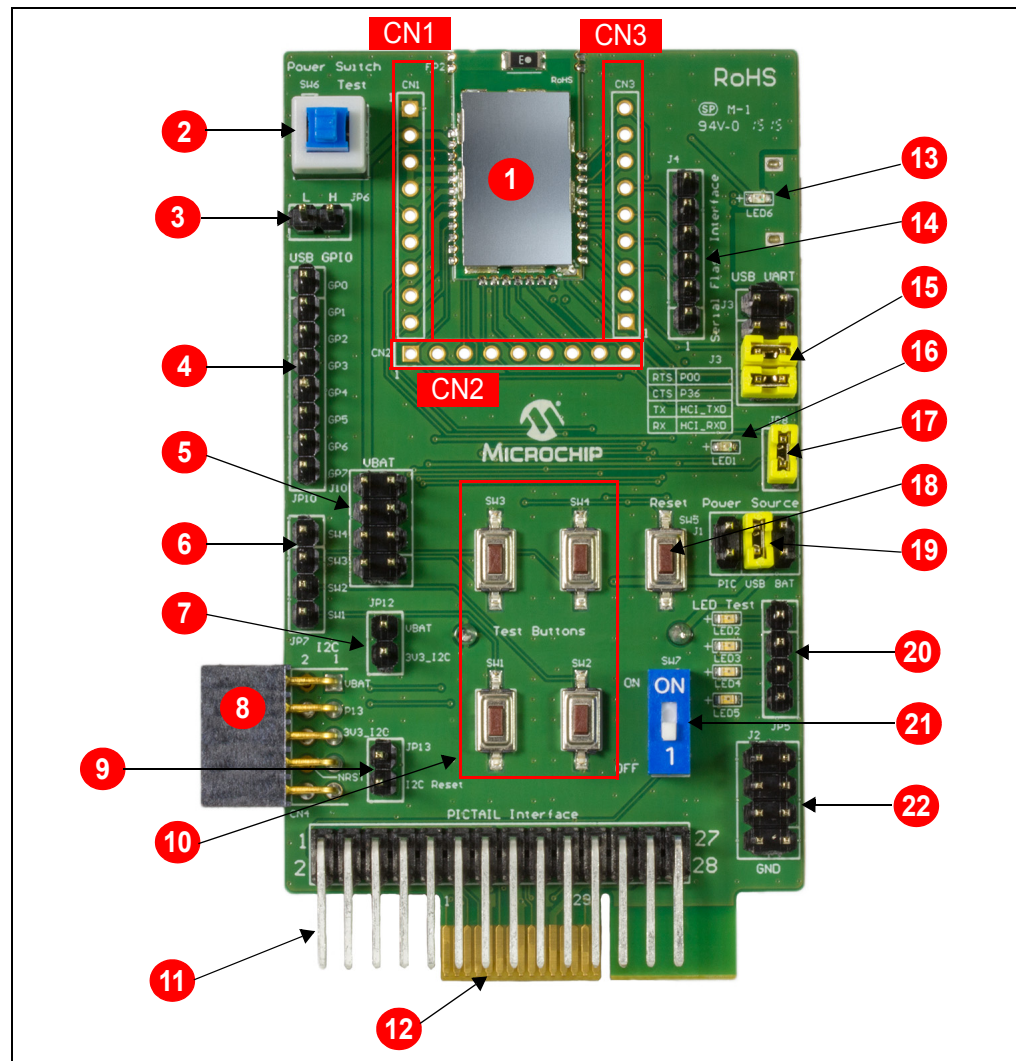
This chapter contains the board and interface descriptions of the following boards:

- [RN4870 PICtail/PICtail Plus Daughter Board](#)
- [RN4871 PICtail/PICtail Plus Daughter Board](#)
- [Sensor Board](#)

2.2 RN4870 PICtail/PICtail PLUS DAUGHTER BOARD

Figure 2-1 shows the interfaces of the RN4870 PICtail/PICtail Plus Daughter board. The PICtail board can be used in Standalone mode powered from either an external USB host, coin-cell battery, or from the PIC® Explorer Development board.

FIGURE 2-1: RN4870



2.2.1 Interface Description

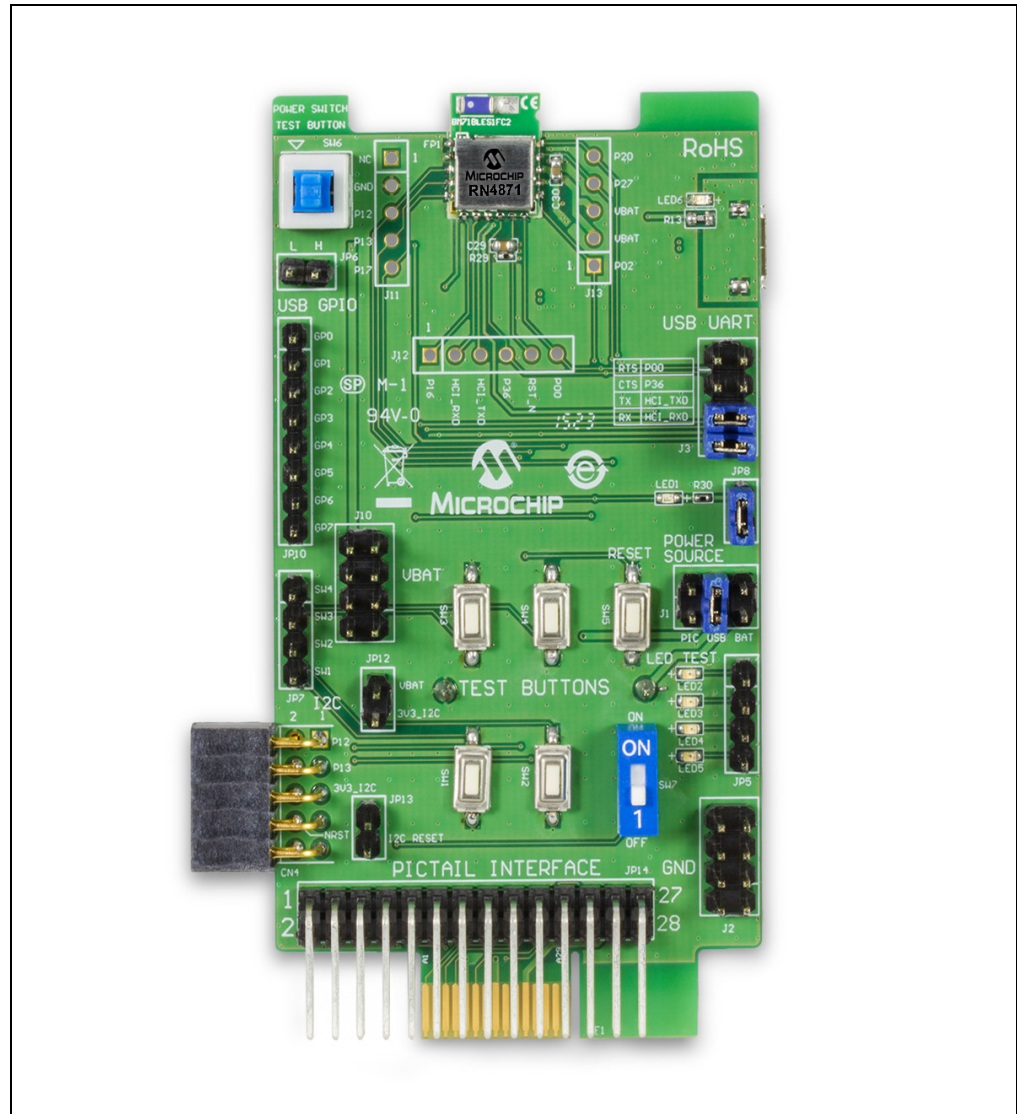
1. RN4870 module
 2. Power switch to wake-up the module from deep sleep (SW6)
 3. Power test point (JP6)
 4. Interface to MCP2200 USB/UART bridge (JP10)
 5. VBAT supply and test point (J10)
 6. Test button interface to SW1-SW4 (JP7)
 7. Power to I²C bus (JP12); I²C features depend on firmware revision
 8. Connector to I²C bus on RN4870 (CN4); I²C features depend on firmware revision
 9. I²C reset (JP13); I²C features depend on firmware revision
 10. SW1-SW4 test buttons
 11. PICtail Interface (2x14 right-angle header pin) for PIC18 Explorer board
 12. PICtail Plus Interface (edge connector) for PIC16 Explorer board
 13. External power from USB host (LED6)
 14. SPI Serial Flash Interface (J4)
 15. UART connections (J3); RTS/CTS jumpers must be closed when hardware flow control is enabled on module
 16. Status indicator LED (LED1); for blink rate descriptions, refer to the “*Bluetooth® 4.2 Low Energy Module Data Sheet*” (DS50002489)
 17. LED1 power jumper; disconnects LED from the RN4870 module if an external MCU is monitoring this pin
 18. Hardware Reset line to RN4870 (SW5)
 19. Power options for PICtail (J1); PIC Explorer board, USB host, Battery (coin-cell CR2032) on the back of the board
 20. Connections to test LEDs 1-4 (JP5). The LEDs can be connected to PIO lines or to an external MCU
 21. Operating mode switch (SW7); 1: Application mode runtime, ON: Programming or Configuration mode to update firmware or configuration settings
 22. Ground Test Connector (J2)
- CN1, CN2 and CN3 are header pins to the RN4870 module pins. The headers are used either to connect the Sensor board to the PICtail board or as test points.

2.3 RN4871 PICtail/PICtail PLUS DAUGHTER BOARD

The RN4871 PICtail uses the RN4871 BLE module as shown in [Figure 2-2](#). Due to its smaller footprint, the RN4871 has less IO pins than the full size RN4870 module. For the specific pinouts of the RN4870 and the RN4871 modules, refer to the “*Bluetooth® 4.2 Low Energy Module Data Sheet*” (DS50002489).

Although the module sizes are different, the command interface is very similar. The “*Bluetooth® Low Energy Module User’s Guide*” (DS50002466) describes the difference between the RN4870 and the RN4871 command pins.

FIGURE 2-2: RN4871 PICtail™/PICtail PLUS DAUGHTER BOARD

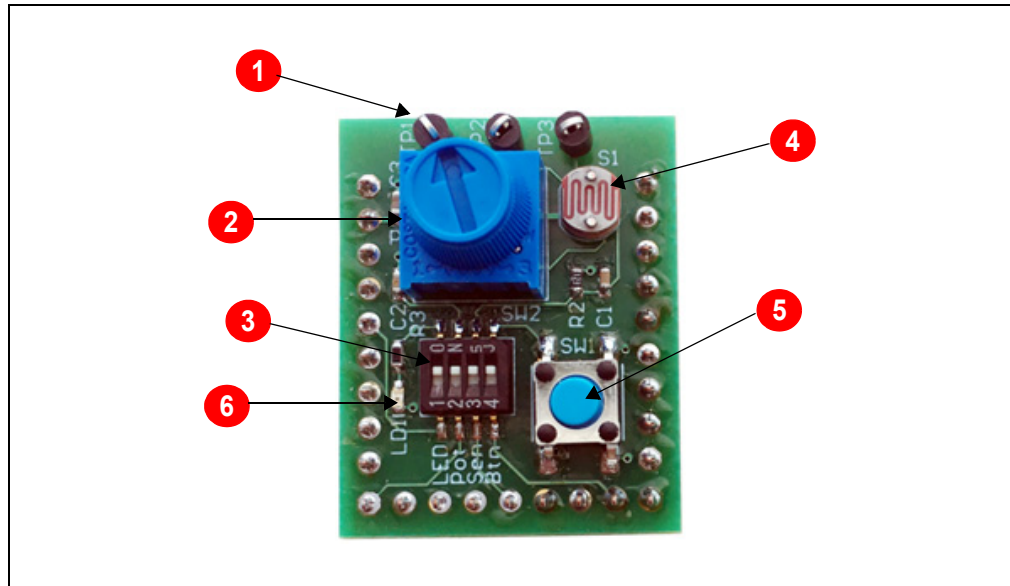


2.4 SENSOR BOARD

The RN4870/71 PICtail/PICtail Plus Daughter board is provided with the Sensor board to demonstrate the peripheral IO capabilities. The Sensor board interfaces are illustrated in [Figure 2-3](#).

The Sensor board is an accessory designed for the RN4870 PICtail/PICtail Plus Daughter board to demonstrate digital and analog IO capabilities over Bluetooth Low Energy connections. In order to use the Sensor board with the RN4870, it must be configured as described in [Chapter 4. "RN4870 Sensor Board"](#).

FIGURE 2-3: RN4871 PICtail SENSOR BOARD



2.4.1 Interface Descriptions

1. Test Point for ADC channels
2. Variable Resistor to drive ADC0 input
3. DIP Switch block to connect or disconnect sensors from the RN4870 module
4. Light Sensor to drive ADC1
5. Push Button for PIO2
6. LED connected to pin P22

Chapter 3. Quick Start Guide

3.1 OVERVIEW

The simplest method to access the RN4870/71 is to connect it to a PC host that supports USB CDC virtual COM (serial) ports. Simple ASCII commands can be sent to the RN4870/71 module by using a terminal emulator application.

To interact directly with the RN4870/71 module, the following softwares are needed:

- PC Host supporting USB CDC virtual serial port
 - The RN4870/71 PICtail uses MCP2200 USB/UART bridge. The drivers can be downloaded from www.microchip.com/MCP2200.
- Terminal Emulator Application
 - TeraTerm or CoolTerm is recommended
- Microchip SmartDiscover App for iOS® or Android
 - Available on AppStore® (for iOS) or Google Play™ Store (Android)
- RN-4870-SNSR Support Package (RN4870-Sensor-Board-Support.zip)
 - This is a collection of files and utilities to assist in configuring the Sensor board. The files can be downloaded from the www.microchip.com/RN4870 product page.

3.2 CONNECTING THE RN4870/71 PICtail/PICtail PLUS DAUGHTER BOARD TO A HOST PC

To connect the RN4870/71 PICtail/PICtail Plus Daughter board to a host PC, perform the following steps:

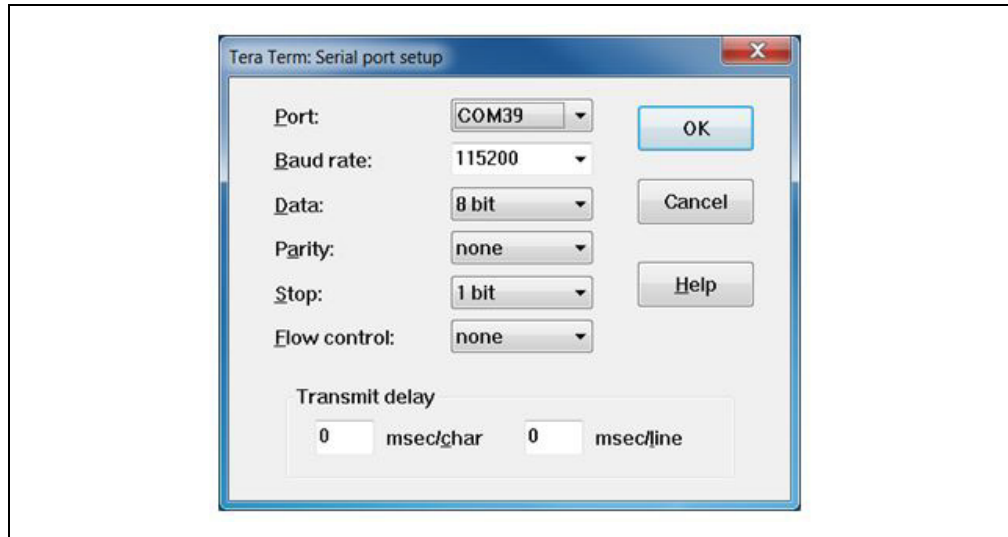
1. Ensure that the RN4870/71 PICtail/PICtail Plus Daughter board is configured as follows:
 - a) Middle jumper on J1 is closed to select USB power option
 - b) Operating mode switch (SW7) is in position 1 to enable Application runtime mode
 - c) TX and RX jumpers (J3) are in closed position

Note: If hardware flow control is enabled then RTS and CTS jumpers must be installed.

2. Connect the RN4870/71 PICtail/PICtail Plus Daughter board to the host PC using micro USB cable. Perform the following steps:
 - a) Verify that the virtual COM port is enumerated on the host PC. If the COM port does *not* enumerate, the MCP2200 drivers may be missing from the host PC. The drivers can be downloaded from the www.microchip.com/MCP2200 web page.
 - b) Ensure that LED2 (blue) is in ON position indicating USB power
 - c) Press **Reset** button (SW5) and verify that LED1 is flashing slowly

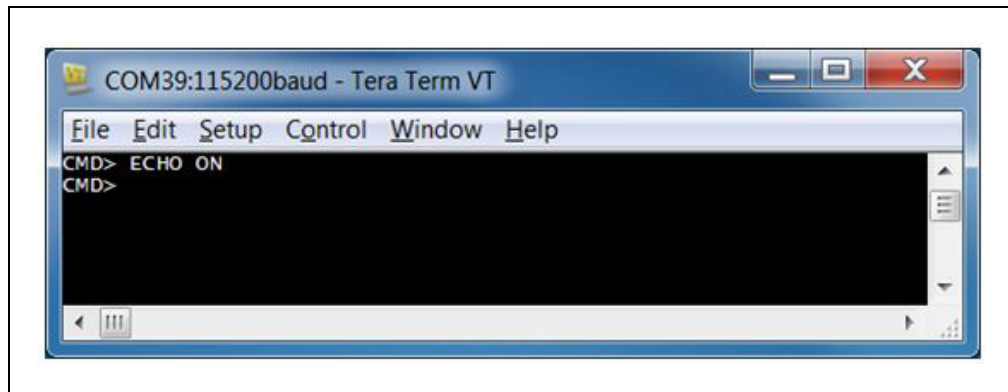
3. Start the Terminal Emulator software. In this example, TeraTerm is used. Configure the serial port settings using the enumerated COM port as shown in [Figure 3-1](#).

FIGURE 3-1: COM PORT SETTINGS FOR TERMINAL EMULATOR



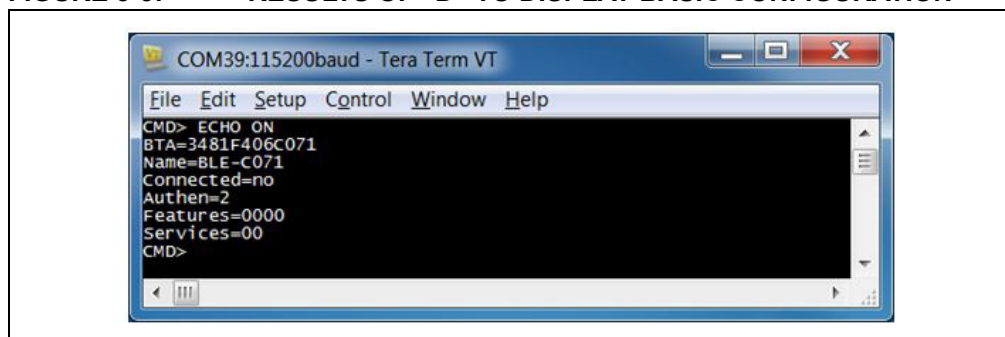
4. Enter Command mode by sending the command escape sequence \$\$\$\$. Pressing the dollar sign (\$) three times puts the RN4870/71 into Command mode and CMD> prompt is displayed. When interacting directly with the RN4870/71 using terminal emulator, enable local echo feature on the RN4870/71. Enter the + character on the command prompt. The ECHO ON response is displayed as shown in [Figure 3-2](#). Any character sent to the RN4870/71 is echoed back to the sender to improve interactivity.

FIGURE 3-2: COMMAND PROMPT AND ECHO ON RESPONSE



5. To display the basic configuration settings, press the letter **D** followed by <Enter> key (\r). The configuration settings can be modified using ASCII commands. Refer to the “RN4870/71 Bluetooth® Low Energy Module User’s Guide” (DS50002466) for a detailed explanation of the commands.

FIGURE 3-3: RESULTS OF “D” TO DISPLAY BASIC CONFIGURATION



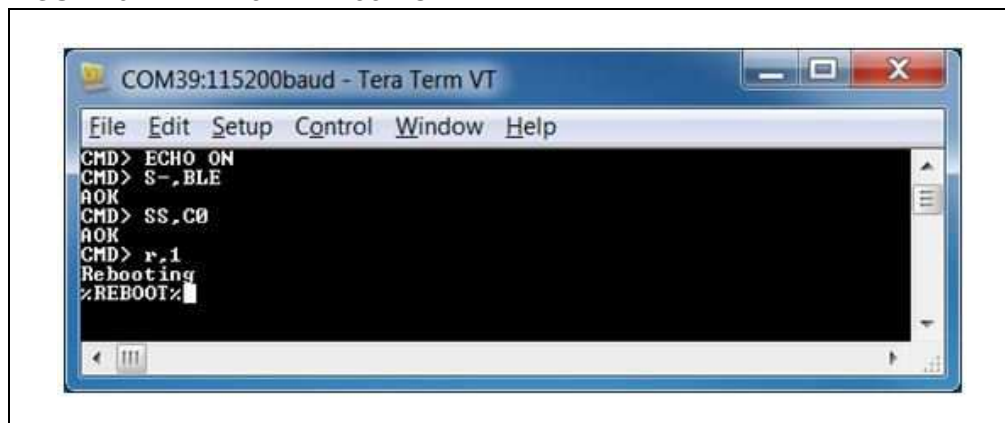
3.3 CHANGING SETTINGS USING ASCII COMMANDS

The RN4870/71 PICtail is shipped with a default configuration *not* including GATT services as noted by the result of the previous command **D** (display basic configuration). The services value is set to `Services=00`. The RN4870 module can be discovered using Bluetooth SmartDiscover App. The SmartDiscover App is available for iOS® devices on Apple AppStore. Check the Google Play Store for Android version.

To enable built-in services and connect to the RN4870/71 module, perform the following steps:

1. Connect the RN4870/71 PICtail to the host PC USB port:
 - a) Using Terminal Emulator, open the COM port to the RN4870/71 module
 - b) Type `$$$` to enter Command mode
 - c) Enter `+` to turn on ECHO. Refer to [Figure 3-2](#)
2. To change the default name and enable GATT services (Device Information Service and Transparent UART), send the following commands:
 - a) `S-,BLE` to create a unique serialized name based on Bluetooth (BT) address of the device
 - b) `SS,C0` to enable Device Information Profile and Transparent UART services
 - c) `R,1` to reboot the module and enable the configuration commands to take effect. Refer to [Figure 3-4](#).

FIGURE 3-4: s- AND ss COMMAND EXAMPLE

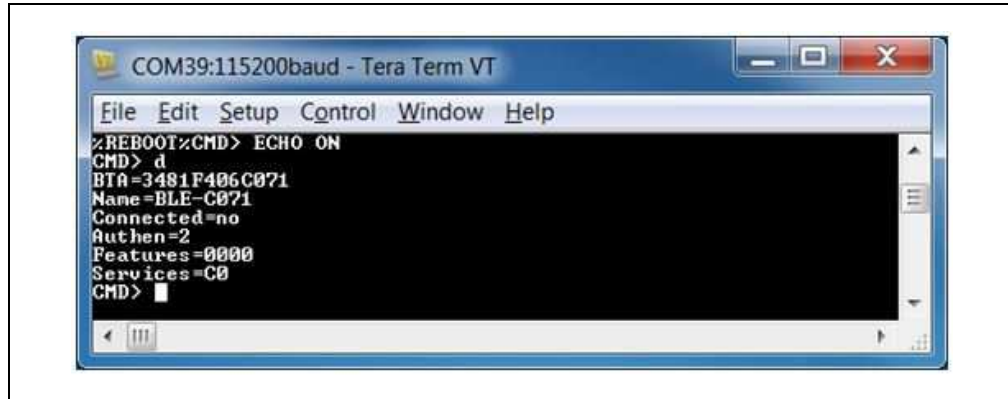


3. After any Set commands issued, the RN4870/71 module needs a device reboot (R, 1) for the changes to take effect.

To verify the configuration settings, perform the following steps:

- a) Type \$\$\$ to enter Command mode
- b) Enter + to turn on local echo
- c) Issue command D to display the settings
- d) Note the name of the device BLE-b1b0 where b1b0 are the low order bytes of the BT address; in this example, the Bluetooth is set to BLE-C071
- e) Verify that the services field is set to C0; refer to [Figure 3-5](#)

FIGURE 3-5: CONFIRM NEW SETTINGS IN COMMAND MODE



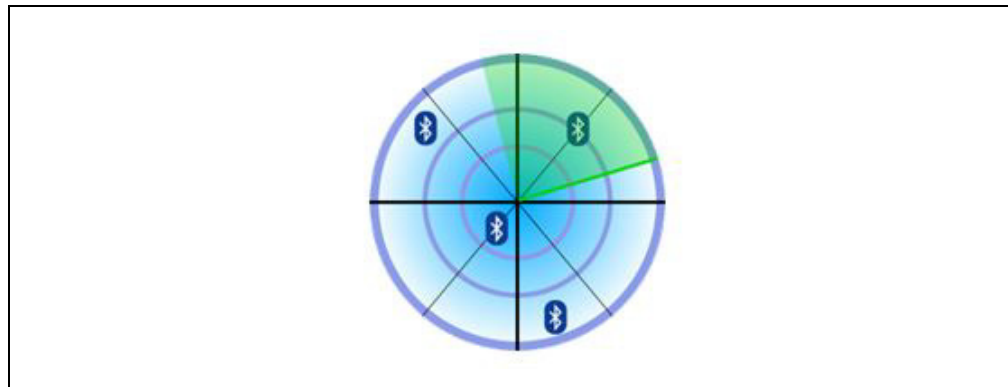
3.4 CONNECTING TO THE RN4870/71 USING SMARTDISCOVER APP

The RN4870/71 features can be demonstrated by using the SmartDiscover App.

To connect the RN4870/71 using SmartDiscover App, perform the following steps:

1. Configure the RN4870/71 PICtail according to the steps in [Section 3.3 "Changing Settings Using ASCII Commands"](#). Connect it to the host PC and type \$\$\$ to enter Command mode.
2. Download and install the SmartDiscover App on your device. See [Figure 3-6](#) for example of SmartDiscover App icon.

FIGURE 3-6: SMART DISCOVER ICON



3. Launch the SmartDiscover App. Refer to [Figure 3-7](#) for examples on how to demonstrate the SmartDiscover App on an iOS device.

FIGURE 3-7: SMART DISCOVER (iOS)



4. Verify that the RN4870/71 device name, BLE-b1b0, is displayed. In this example, the device name is BLE-C071 as shown in [Figure 3-7](#).
5. Click the RN4870/71 device from the list to initiate a connection.
6. Ensure that the connection is established. The GATT service view is illustrated in [Figure 3-8](#). The connection is also verified by the %CONNECT, 1, <MAC> status message returned by the RN4870/71 UART. The <MAC> is the address of the remote BT device that initiated the connection. The response in the terminal emulator is shown in [Figure 3-9](#).

FIGURE 3-8: GATT SERVICE VIEW WHEN CONNECTED

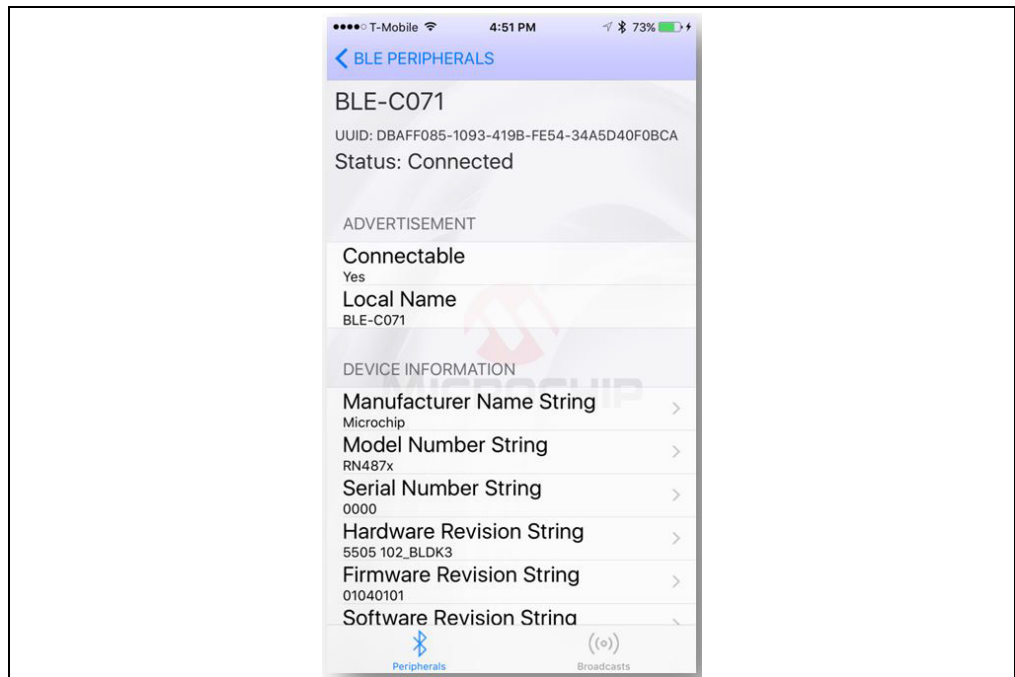
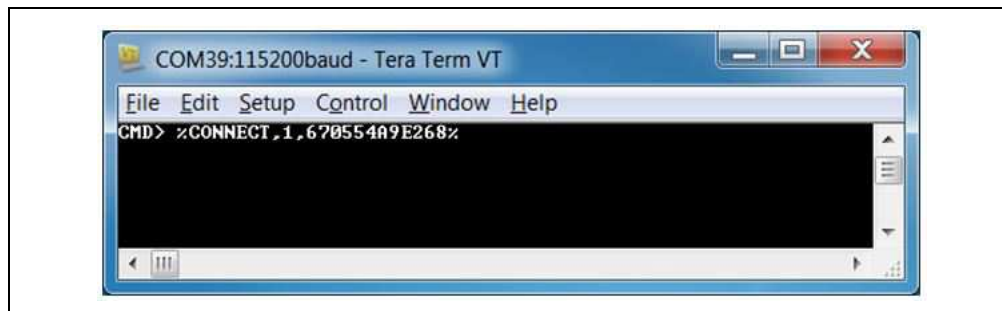


FIGURE 3-9: CONNECTED STATUS MESSAGE



3.5 CREATING CUSTOM GATT SERVICES

The RN4870/71 module supports custom (or private) GATT services. Public GATT services are defined by specifications published by the Bluetooth Special Interest Group (SIG). Private GATT services are defined by the user to host information stored in the GATT characteristics. For more information on GATT services, refer to [Appendix C. "Bluetooth Low Energy Primer"](#).

To create a private GATT service, enter the configuration commands listed in Step 3. The commands can be entered as shown in this user guide, or copied from configuration files and pasted into the terminal emulator. The cut and paste method saves time and minimizes keyboard entry errors. The configuration text files are included in the RN4870 Sensor board Support package that can be downloaded from the product web page at www.microchip.com/RN4870.

1. Connect the RN4870 PICtail to the host PC USB port
 - a) Using Terminal Emulator, open the COM port to the RN4870/71 module
 - b) Type \$\$\$ to enter Command mode
 - c) Enter + to turn on ECHO
2. Set Factory Default values
 - a) Enter SF, 1
 - b) Verify that the module reboots after the command is entered
3. Create the private GATT service with three characteristics by entering the following commands:

```
PS, 4D6963726F636869702D524E34383730
PC, BF3FBD80063F11E59E690002A5D5C501, 02, 02
PC, BF3FBD80063F11E59E690002A5D5C502, 02, 02
PC, BF3FBD80063F11E59E690002A5D5C503, 18, 04
```

These commands can be entered manually by typing each line followed by the <Enter> key from the file 3.4-GATT-service.txt, or each line copied and pasted one by one into the terminal emulator.

Command PS creates the GATT service, identified by the 16-byte value private UUID: 4D6963726F636869702D524E34383730. This command must be called before command PC.

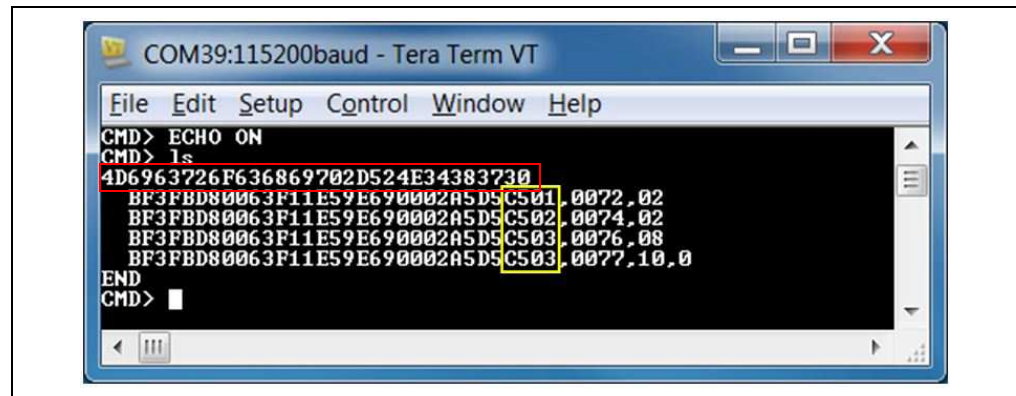
Command PC sets the private characteristics. Each characteristic is identified by the following UUIDs:

```
BF3FBD80063F11E59E690002A5D5C501,
BF3FBD80063F11E59E690002A5D5C502,
BF3FBD80063F11E59E690002A5D5C503.
```

Command PC expects three parameters. The first parameter is the UUID, the second parameter is the characteristic property (refer to Table C-1 in Appendix C. “Bluetooth Low Energy Primer”), and the third parameter is the size of the data value of the characteristic.

4. Reboot the module using command R, 1 to ensure that the new GATT service takes effect
5. Verify that the GATT service is correctly configured.
6. Enter Command mode (\$\$\$) after rebooting the module.
7. Issue the LS command to list the GATT server services and their characteristics. The response is illustrated in Figure 3-10.

FIGURE 3-10: PRIVATE SERVICES DISPLAY FROM LS COMMAND



3.6 ACCESSING GATT SERVICE USING UART COMMANDS AND SMARTDISCOVER APP

The result of the command LS is shown in Figure 3-10. A custom GATT service (UUID: 4D69637226F636869702D524E34383730) with three characteristics identified by low-order bytes C501, C502 and C503 from the 128-bit UUID. A 16-bit handle is assigned to each characteristic. Handles are used to reference and identify 128-bit characteristic UUIDs more efficiently in the GATT service.

Note that there are two references for C503 characteristic. In the first case, in reference 0076, the property value 08 has the write property enabled (refer to Table C-1 in Appendix C. “Bluetooth Low Energy Primer”). Likewise, reference 0077 has the notification property 10 enabled. This means that to write a value to characteristic C503, reference 0076 is used. To enable Client notifications on this characteristic, reference 0077 is used.

The following examples show how to read and write GATT characteristic values by using UART commands:

1. To write a value to the GATT Server characteristic C501, use the Server Handle Write (SHW) and the Server Handle Read (SHR) commands with reference 0072 as first parameter, following by hex-byte values as shown in Figure 3-11.