RN131/171 PICtail™/PICtail Plus Daughter Board User's Guide

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

Derek Carlson
VP Development Tools

16-July-2013
Date

NOTES:

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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 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 RN131/171 PICtail™/PICtail Plus Daughter Board User's Guide. 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 document describes how to use the RN131/171 PICtail/PICtail Plus Daughter Board. The manual layout is as follows:

- **Chapter 1. "Overview"** – This chapter describes how to use the RN131/171 PICtail/PICtail Plus Daughter Board connected to a PIC18 Explorer Development Board to associate with a Wi-Fi® network and communicate with other devices within a LAN. Communication with other LAN devices is performed using Telnet.
- **Chapter 2. "Getting Started"** – This chapter describes the hardware and software requirements for getting started with the RN131/171 PICtail/PICtail Plus Daughter Board is plugged into the PIC18 Explorer Development Board to run the sample demo applications.
- **Chapter 3. "Application Design"** – This chapter introduces developers to design sample demo application and shows some of the APIs that can be used to communicate with RN131/171 module.

- **Appendix A. RN131/171 PICtail™/PICtail Plus Daughter Board Schematic** – This appendix provides the RN131/171 PICtail/PICtail Plus Daughter Board schematics, PCB layout and Bill of Materials (BOM).

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
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 you 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 RN131/171 PICtail/PICtail Plus Daughter Board. The following Microchip documents are available from the Microchip web site (http://www.microchip.com), and are recommended as supplemental reference resources.

RN131 Module Data Sheet (DS75085)

RN171 Module Data Sheet (DS75084)

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

Explorer 16 Development Board User's Guide (DS51589)

WiFly Command Reference, Advanced Features and Applications User's Guide

THE MICROCHIP WEB SITE

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- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
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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 programmers 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 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 our web site at: http://support.microchip.com

DOCUMENT REVISION HISTORY

Revision A (August 2013)

This is the initial released version of the document.

NOTES:

Chapter 1. Overview

1.1 INTRODUCTION

The RN-131 and RN-171 Wi-Fi® Wireless modules are complete, standalone wireless Local Area Network (LAN) access devices. Each module contains a TCP/IP stack and related applications. After the module is configured, the radio can access the Wi-Fi network automatically and transmit and receive data over a UART. The RN131/171 PICtail™/PICtail Plus Daughter Board is a development and demonstration board for:

- RN131 802.11 b/g Wi-Fi Wireless module or
- RN171 802.11 b/g Wi-Fi Wireless module

The RN131/171 PICtail/PICtail Plus Daughter Board can be plugged into multiple Microchip Technology demonstration and development boards. The 8-bit MCU application development can be plugged into the PIC18 Explorer Development Board (DM183032) while the16-bit/32-bit MCU application development can be plugged into the Explorer 16 Development Board (DM240001).

The daughter boards are preloaded with firmware to simplify integration and minimize time and effort in application development. In the simplest configuration, the hardware only requires four connections (PWR, TX, RX and GND) to create a wireless data connection. The PIC® MCU can communicate with the boards through the UART interface, and can drive LEDs, wake the boards and reset them. The RN131 and RN171 wireless modules are controlled with a simple ASCII command language. The modules can be setup to scan and find an access point, associate, authenticate and connect to any Wi-Fi network.

This document describes how to use the RN131/171 PICtail/PICtail Plus Daughter Board connected to a PIC18 Explorer Development Board to associate with a Wi-Fi network and communicate with other devices within a LAN. Communication with the other LAN devices is performed using Telnet.

This chapter discusses the following topics:

1.2 RN131/171 PICtail™/PICtail PLUS DAUGHTER BOARD FEATURES

1.2.1 RN131 PICtail/PICtail Plus Daughter Board

The RN131 PICtail/PICtail Plus Daughter Board has the following features:

- Adds wireless capability to designs targeting the Microchip development eco-system
- Supports FCC/CE/IC certified 2.4 GHz IEEE 802.11b/g RN131 module
- Wi-Fi Alliance certified for WPA2-PSK and RoHS compliant
- Compatible with 8-bit,16-bit and 32-bit PIC MCUs
- Plugs into Microchip's Explorer 16 Development Board (through 30-pin card edge connector) and PIC18 Explorer Development Board (through 28-pin connector)
- Complete on-board TCP/IP networking stack

- Supports Ad hoc and Infrastructure networking modes along with SoftAP mode
- Built-in networking applications: TCP/IP, DHCP, DNS, ARP, ICMP, UDP, Telnet, FTP client and HTML client
- Configuration over Wi-Fi or UART using simple ASCII commands
- High throughput: 921 Kbps TX, 500 Kbps RX data rate with TCP/IP and WPA2 over UART
- The RN131 module PCB includes an on-board ceramic chip antenna and a U.FL. connector
- Size – 56 mm x 40 mm x 15 mm
- Weight – approx. 25g

1.2.2 RN171 PICtail/PICtail Plus Daughter Board

The RN171 PICtail/PICtail Plus Daughter Board has the following features:

- Adds wireless capability to designs targeting the Microchip development eco-system
- Supports FCC/CE/IC certified 2.4 GHz IEEE 802.11b/g RN171 module
- Wi-Fi Alliance certified for WPA2-PSK and RoHS compliant
- Compatible with 8-bit, 16-bit and 32-bit MCUs
- Plugs into Microchip's Explorer 16 Development Board (through 30-pin card edge connector) and PIC18 Explorer Development Board (through 28-pin connector)
- Complete on-board TCP/IP networking stack
- Supports Ad hoc and Infrastructure networking modes along with SoftAP mode
- Built-in networking applications: TCP/IP, DHCP, DNS, ARP, ICMP, UDP, Telnet, FTP client and HTML client
- Configuration over Wi-Fi or UART using simple ASCII commands
- High throughput: 921 Kbps TX, 500 Kbps RX data rate with TCP/IP and WPA2 over UART
- Trace antenna included on the RN171 module PCB
- Size – 56 mm x 40 mm x 17 mm
- Weight – approx. 25g

1.3 RN131/171 PICtail™/PICtail PLUS DAUGHTER BOARD KIT CONTENTS AND PART DETAILS

Depending on the development tool ordered, the package contents will contain one of the development boards:

- RN-131-PICTAIL or RN-171-PICTAIL Board, along with
- Two jumpers (used with the PIC18 Explorer Development Board only).

Table 1-1 lists the part number of RN-131/171-PICTAIL Daughter Board.

TABLE 1-1: RN1x1 PICtail™/PICtail PLUS DAUGHTER BOARD

Description	Part Number
RN131 PICtail™/PICtail Plus Daughter Board	RN-131-PICTAIL
RN171 PICtail™/PICtail Plus Daughter Board	RN-171-PICTAIL

1.4 RN131/171 PICtail™/PICtail PLUS DAUGHTER BOARD CONTENTS

Figure 1-1 and Figure 1-2 illustrate the RN131/171 PICtail/PICtail Plus Daughter Board kit components, respectively.

CAUTION

Power to the RN131/171 PICtail/PICtail Plus Daughter Board must be in the range of 2.4–3.6V. Ensure that the daughter board plugged into the development board meets this voltage requirement. Otherwise, damage to the RN-131-PICTAIL and RN-171-PICTAIL may occur.

FIGURE 1-1: RN131 PICtail™/PICtail PLUS DAUGHTER BOARD

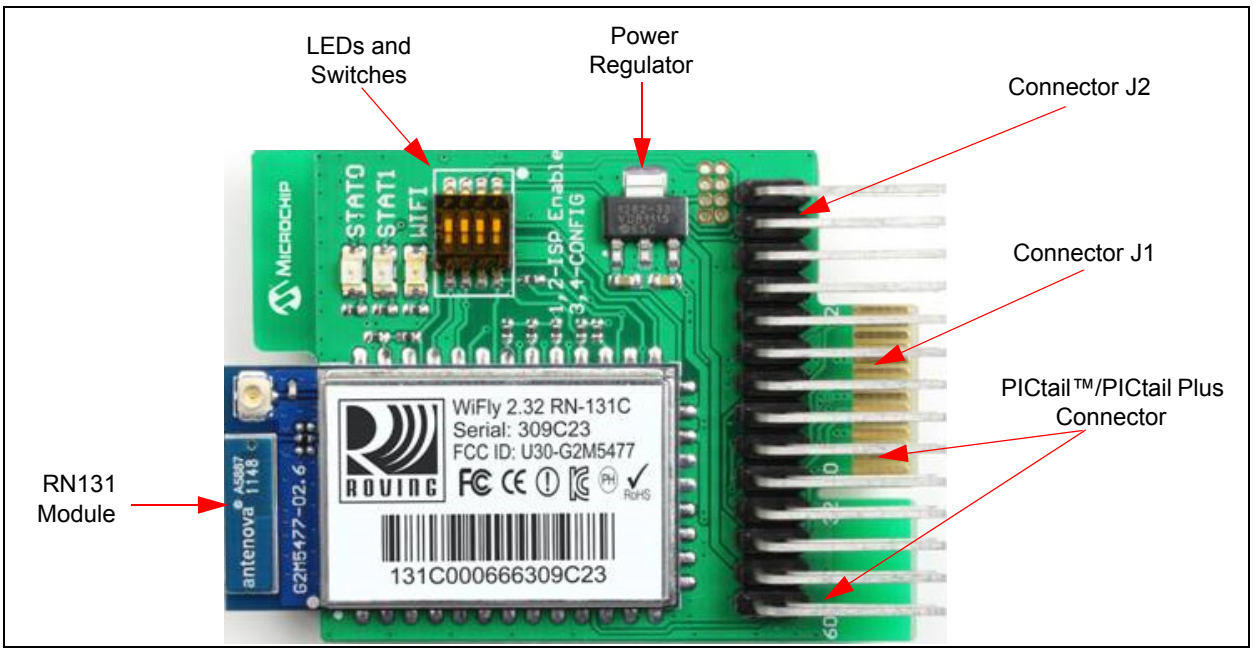
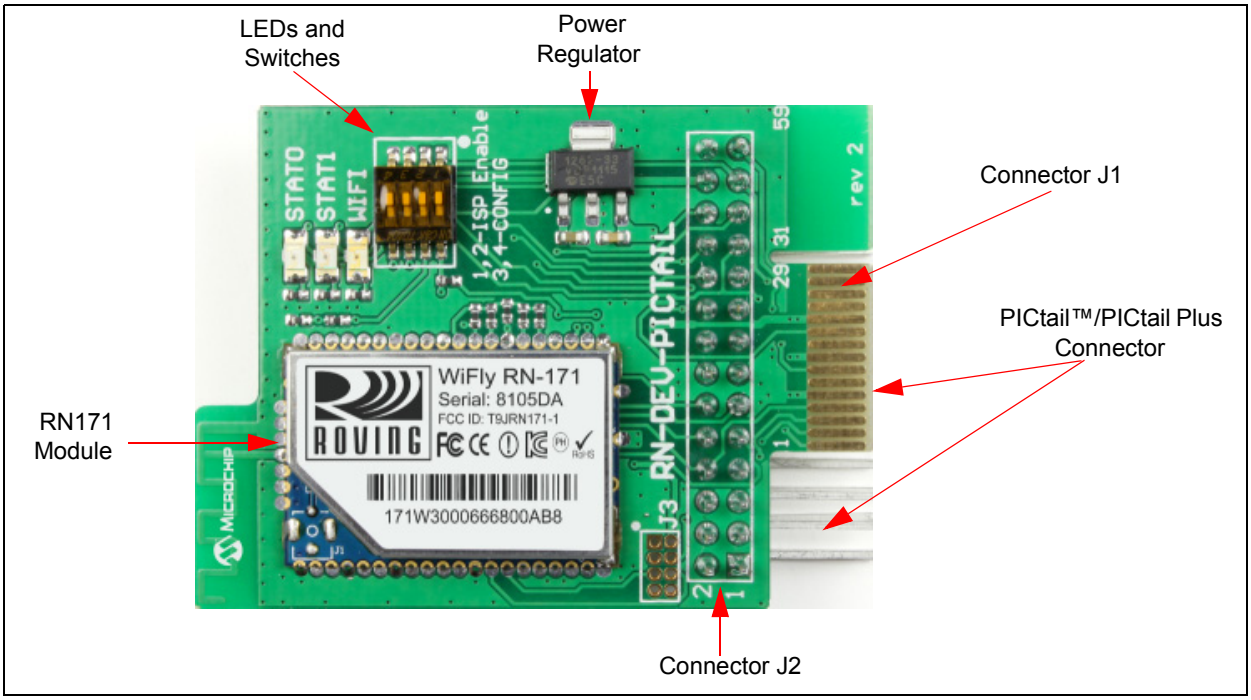


FIGURE 1-2: RN171 PICtail™/PICtail PLUS DAUGHTER BOARD



PICtail Connector (J1) – 28-pin right angle connector to connect to 8-bit development boards' PICtail connector.

PICtail Plus Connector (J2) – 30-pin card edge connector for connecting into 16-bit/32-bit development boards' PICtail plus connector.

LEDs (D6, D5 and D4) – For indications of Yellow for STAT0, Red for STAT1 as status LEDs and Green for Wi-Fi indicating connection status.

Switch (S2) – For TX, RX and Sensor connections

Power Regulator (U2) – Regulates power from 5.0–3.3V for RN131/171 module.

1.5 RN131/171 PICtail™/PICtail PLUS DAUGHTER BOARD RELATED DEMO APPLICATIONS

The example applications provided with this document include the MPLAB X project and two pre-compiled .hex files.

- The MPLAB® X project files provide a sample 8-bit application framework that user can customize to configure and control the RN131/171 module from an 8-bit Microchip PIC MCU.
- Use the pre-compiled sample application `ConfigureInCmdMode.hex` file to configure the RN131/171 module.
- `SampleTelnetApp.hex` file accepts specific Telnet commands from a remote device and turns ON/OFF the LEDs on either the RN131/171 PICtail/PICtail Plus Daughter Board or the PIC18 Explorer Development Board.

Chapter 2. Getting Started

2.1 INTRODUCTION

The RN131/171 PICtail/PICtail Plus Daughter Board can be plugged into multiple Microchip Technology demonstration and development boards. This enables the developer to select a low-cost PIC MCU that best suits the customer's application environment.

The PICtail connector right angle header, P2, can plug into 8-bit demonstration and development boards, such as the PIC18 Explorer Development Board (DM183032). The PICtail card edge connector, P1, can plug into Explorer 16 Development Board (DM240001).

This chapter discusses the hardware and software requirements for getting started with RN131/171 PICtail/PICtail Plus Daughter Board and also shows how the boards can be plugged into the PIC18 Explorer Development Board to run the sample demo applications.

This chapter discusses the following topics:

- Hardware Requirements
- Software/Utility Requirements
- Sample Application Code
- Running Demo Applications with RN131/171 PICtail™/PICtail Plus Daughter Board on PIC18 Explorer Development Board

2.2 HARDWARE REQUIREMENTS

The following hardwares are required to run the demo applications:

- RN-131-PICTAIL or RN-171-PICTAIL Board
- PIC18 Explorer Development Board equipped with a PIC18F87J11 PIM (MA180020)

CAUTION
Ensure that the PIC18F87J11 PIM is plugged into the PIC18 Explorer Development Board. This sets the system VDD voltage to 3.3V, which is required by the RN131/171 PICtail/PICtail Plus Daughter Board.

- Microchip programmer (For example., PICkit 3 programmer, MPLAB ICD3 or MPLAB REAL ICE in-circuit emulator)
- Two jumper wires to configure jumpers J4 and J13 on the PIC18 Explorer Development Board
- IEEE 802.11b/g-compliant Wi-Fi access point
- Serial cable or USB-to-Serial converter cable

Note: Do not use the default jumper settings for J4 and J13 that come with the PIC18 Explorer Development Board. Instructions for jumper settings are provided in the section **"Running Demo Applications with RN131/171 PICtail/PICtail Plus Daughter Board on PIC18 Explorer Development Board"**.

2.3 SOFTWARE/UTILITY REQUIREMENTS

The following software tools/applications are required to run the demo applications:

- Terminal Emulator Application such as TeraTerm (for Windows OS) or CoolTerm (for MAC OS)

> **Note:** Terminal Emulator program is used to send configuration commands to the module over a UART interface. The emulator also displays information transmitted from the module.

- MPLAB X IDE Version 1.2 or higher – Microchip's Integrated Development Environment is used by the programmer to load the application (.hex file) into the PIC MCU when the application is customized or modified.
- XC8 v1.10 Compiler or higher – This is used to compile/build a customized application.

2.4 SAMPLE APPLICATION CODE

To download the sample application code, refer to the Microchip web site: http://www.microchip.com/RN-131-PICTAIL or http://www.microchip.com/RN-171-PICTAIL.

> **Note:** RN131/171 module firmware can be upgraded to the latest version through FTP update. For additional information on FTP update, refer to "*WiFly Command Reference, Advanced Features and Applications User's Guide*" from the Microchip web site http://www.microchip.com.

2.5 RUNNING DEMO APPLICATIONS WITH RN131/171 PICtail™/PICtail PLUS DAUGHTER BOARD ON PIC18 EXPLORER DEVELOPMENT BOARD

This section demonstrates how to use the demo applications to accomplish the following tasks:

- Configure the module to join a known user-specified access point automatically.
- Communicate with the module through a Telnet session to turn ON/OFF LEDs using a command set that the application running on the PIC MCU recognizes.

2.5.1 Hardware Setup

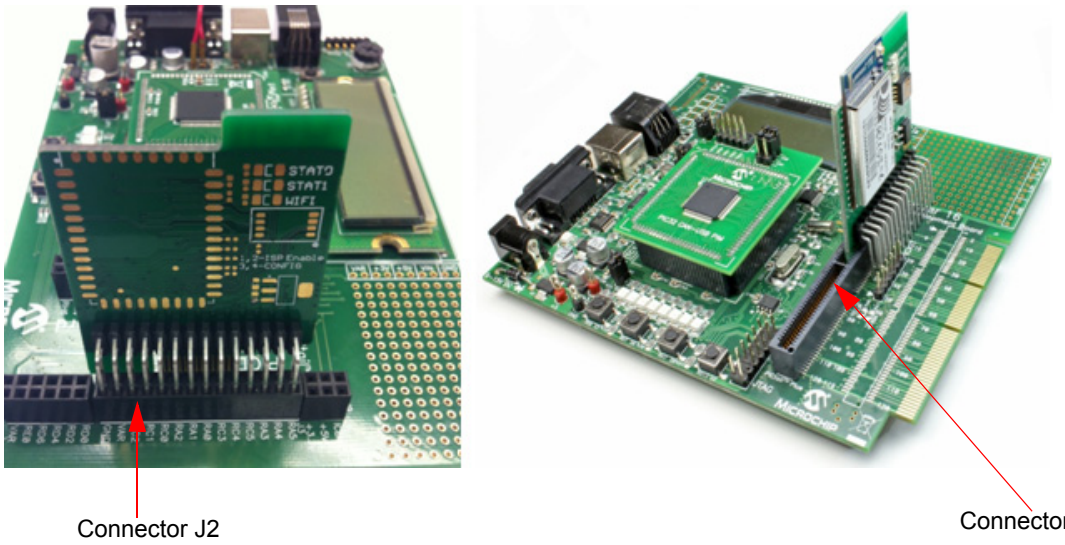
The following are the steps to setup and prepare the hardware for initial configuration:

1. Plug the RN-131-PICTAIL/RN-171-PICTAIL Board into the PIC18 Explorer Development Board's PICtail connector as illustrated in Figure 2-1.

FIGURE 2-1: DAUGHTER CARDS CONNECTED TO MICROCHIP DEVELOPMENT BOARDS

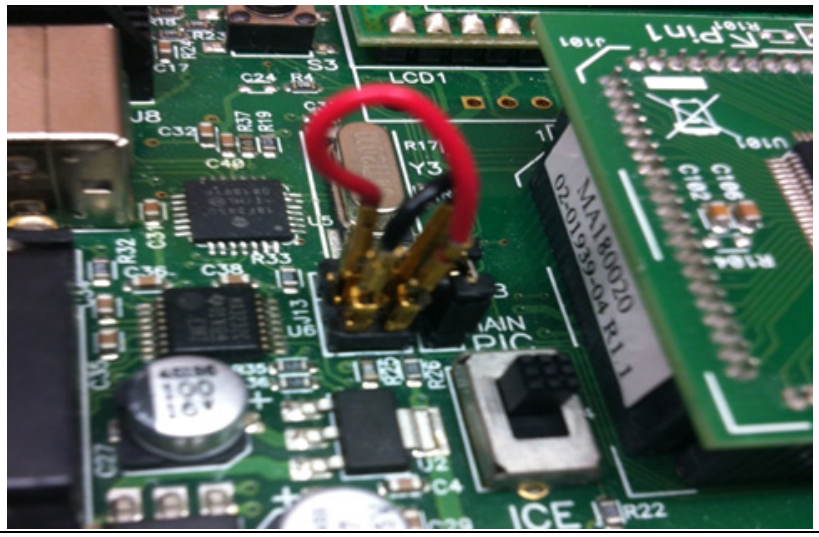
RN171 PICtail™/PICtail Plus Connected to the PIC18 Explorer Development Board

RN131 PICtail™/PICtail Plus Connected to the Explorer 16 Development Board



2. Configure the PIC18 Explorer Development Board's J4 and J13 jumpers as illustrated in Figure 2-2. This configuration is for command mode operation.

FIGURE 2-2: JUMPER SELECTION FOR COMMAND MODE OPERATION



3. Connect a serial cable from the PIC18 Explorer Development Board's DE9 connector to the PC. When using a system that does not have a serial connector, use an USB-to-Serial cable to connect to the systems through serial port.
4. Connect the programmer to the PIC18 Explorer Development Board and apply power.

Note: Determine the COM port that needs to be assigned. For Windows OS, find the COM port number using the Windows Device Manager from the PC system tools. From the Device Manager, browse and expand the selection for Ports (COM and LPT), and then use TeraTerm for other configuration settings and monitoring. For MAC OS, if the user is using CoolTerm, it is possible to view and select the port from within the application.

2.5.2 Program the PIC18F87J11 and Configure the RN131/171 Module

The procedural steps are to configure the RN131/171 board to enable automatic search and join a preferred access point. The following steps are used to program the PIC18F87J11 with software that allows the RN131/171 board to be configured for its current operating environment.

The following steps are specific to the PIC18 Explorer Development Board based on the UARTs connections:

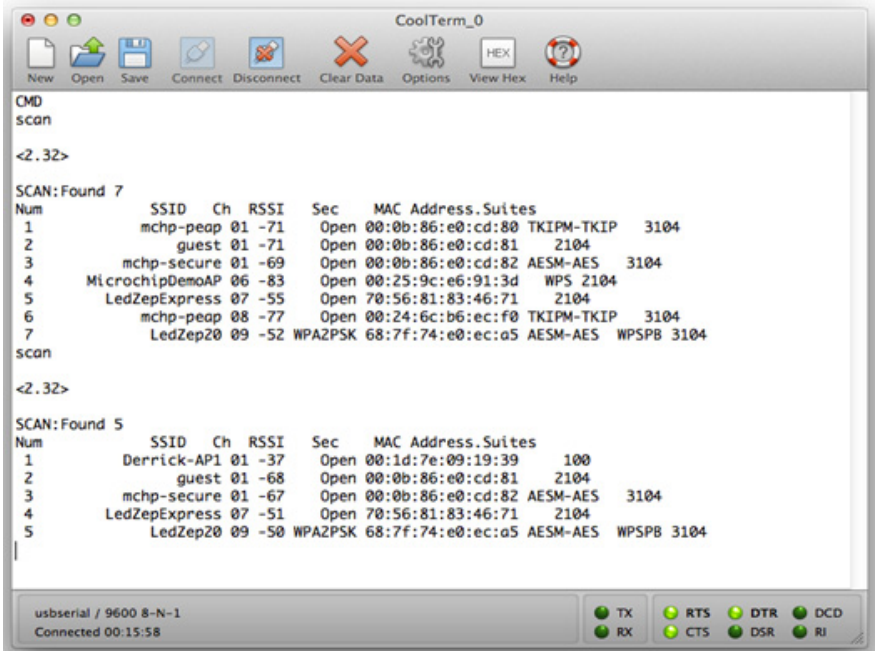
1. Using the MPLAB X IDE and the programmer, load the `ConfigureInCmd-Mode.hex` file into the PIC18F87J11. The application performs the following two important tasks:
   - Configures the PIC18F87J11 I/O pins appropriately.
   - Allows the UART signal to traverse from the PIC18 Explorer Development Board's DE9 connector to the RN131/171 PICtail/PICtail Plus Daughter Board; temporarily bypassing the PIC MCU (this step is specific to the PIC18 Explorer Development Board).
2. Open terminal emulator program for accessing COM port of the RN131/171 PICtail/PICtail Plus Daughter Board through the PIC18 Explorer Development Board.
3. The serial port with the required settings are as follows:
   - Baud: 9600
   - Data bits: 8
   - Parity: None
   - Stop bits: 1
   - Flow control: None
4. Type the commands in the console of through terminal emulator program as listed in Table 2-1.

TABLE 2-1: BASIC RN131 AND RN171 MODULE COMMAND LIST

Command	Description
`$$$`	This command places the RN131/171 module in Command mode.
`scan <cr>`	The device scans for networks and produces a list of available access points (Example list is as shown in Figure 2-3). The access point to be connected must be part of the list. Otherwise, repeat the scan command.
`join # XX <cr>`	Associate with the access point, where XX is the access point's number as illustrated Figure 2-3.
`leave <cr>`	This command asks the device to leave the network.

Note: For more details on command related to RN131 and RN171 modules, refer to "*WiFly Command Reference, Advanced Features and Applications User's Guide*" from the Microchip web site http://www.microchip.com.

FIGURE 2-3: ACCESS POINT LIST



5. Store the NETWORK _SSID and NETWORK_PASS parameters from step 3 if required into the RN131/171 module's non-volatile memory to enable the use of these parameters in the next application to run on the PIC18F87J11.
6. Type the commands in the console of terminal emulator program as listed in Table 2-2.

TABLE 2-2: NETWORK SETUP/CONNECTION COMMAND LIST

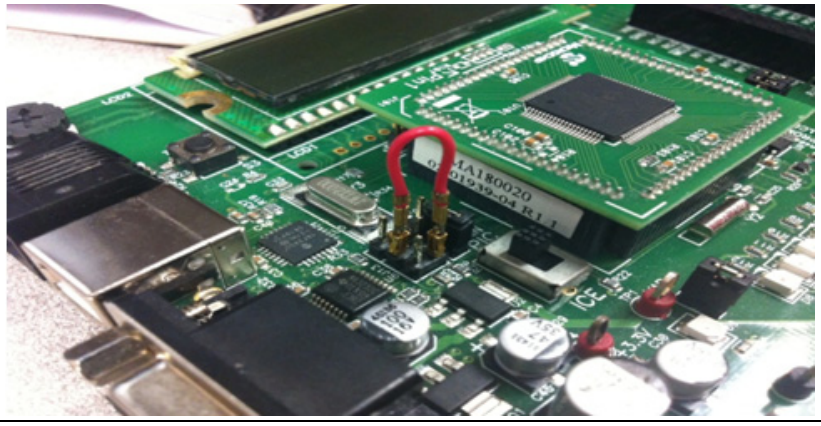
Command	Description
`set wlan ssid <string> <cr>`	Set the network's SSID where `<string>` is the SSID (For example., `set wlan ssid RovingNET`)
`set wlan pass <string> <cr>`	Set the passphrase to use when joining where `<string>` is the passphrase (For example., `set wlan pass duckmauifries`)
`set wlan join 1 <cr>`	Enables auto join. In firmware version 2.36 (Ad hoc mode), the auto join feature is enabled to maintain backwards compatibility. In version 2.45 (AP mode), auto join is disabled and must be explicitly enabled using the `set wlan join 1` command.
`save <cr>`	Save the settings to persistent storage; reused when joining
`reboot <cr>`	Reboot the module so that the settings take effect

2.5.3 Data Mode Operation

The following procedure describes the loading of an application into the PIC18F87J11 that allows the RN131/171 module to operate in Data mode and accepts a Telnet connection request. Additionally, the application also controls the module LEDs by sending specific PIC MCU commands.

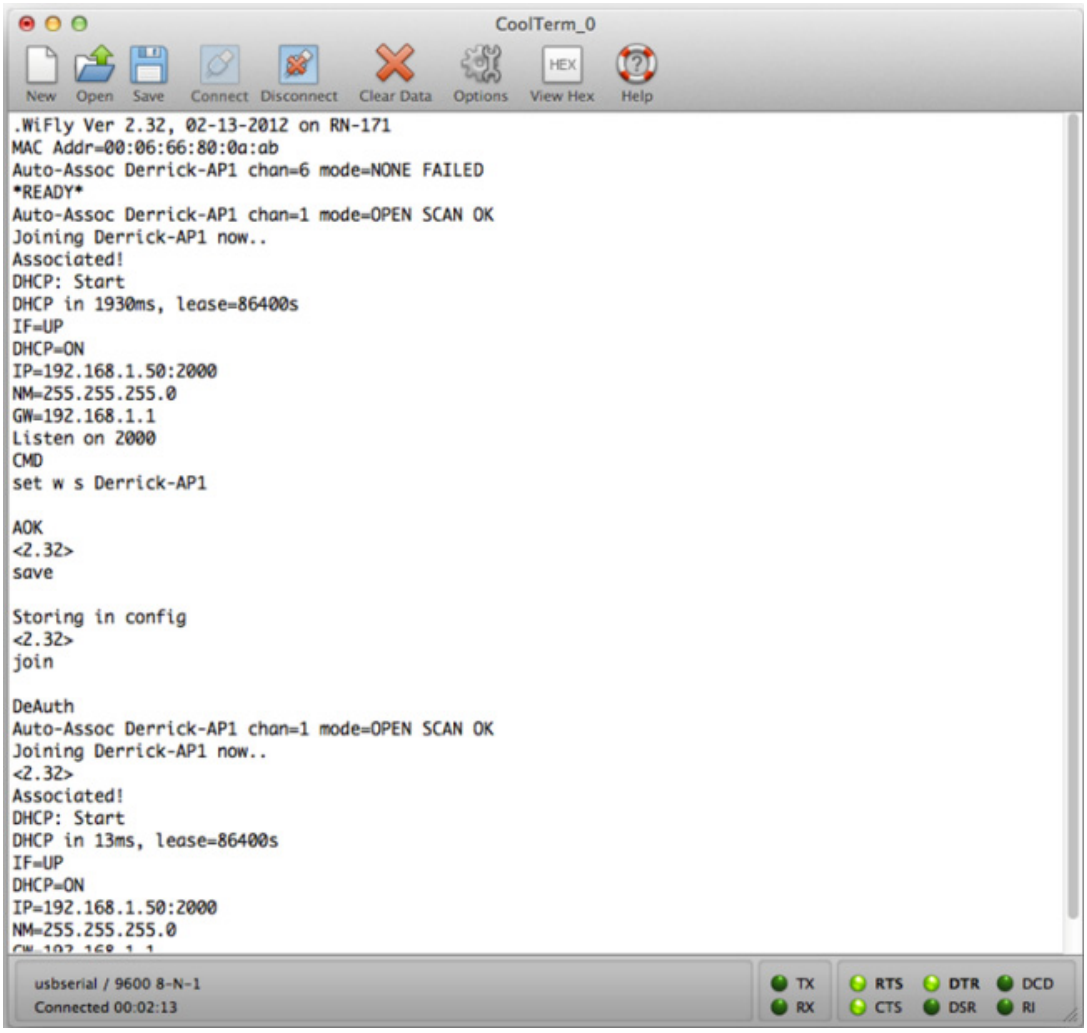
1. Configure the jumpers J4 and J13 as illustrated in Figure 2-4. This setting allows the PIC MCU UART to communicate with RN131/171 module's UART through the PICtail connector, and also allows the module's transmitted data to echo back to the terminal emulator's console (setting is specific to the PIC18 Explorer Development Board).

FIGURE 2-4: JUMPER SELECTION FOR DATA MODE OPERATION



2. Use the MPLAB X IDE and the available programmer to load the `SampleTelnetApp.hex` file demo application into the PIC18F87J11.
3. Press the $\overline{\text{MCLR}}$ reset button on the PIC18 Explorer Development Board and observe the output transaction on the terminal emulator console. A normal association sequence is similar to that illustrated in Figure 2-5 (i.e., the device is associated with the designated access point, and the Yellow LED on the RN-131-PICTAIL/RN-171-PICTAIL is illuminated).
4. In the console, take note of the IP address that the access point assigns to the RN131/171 module. The IP address is unique to each wireless environment's DHCP server. Use this IP address to open a Telnet session with the device.

FIGURE 2-5: RN131/171 ASSOCIATION START UP SEQUENCE



Note: The application source code includes a file called `ConfigApp.h`. Two parameters in this file establish which SSID and passphrase is used if the default access point cannot be found.

#define NETWORK_SSID “xxxstringxxx”

#define NETWORK_PASS “yyystringyyy”

The parameters NETWORK_SSID and NETWORK_PASS can be changed to match local network environment. If NETWORK_SSID and NETWORK_PASS are modified, the user has to rebuild the application, and then reload the modified application. In case the default device parameters stored in the device cannot be found, the application uses settings from Table 2-2 to search for the access point to join. However, if found, association is not allowed.

The RN131/171 module is now associated to an access point and is operating in Data mode. Use the following steps to open a Telnet session with the device and execute respective commands:

1. Associate the computer's Wi-Fi connection with the same access point as the RN131/171 module.
2. Type the following command in the command line session:

```
telnet <address> 2000
```

where <address> is the IP address of the RN131/171 module.

For example, `telnet 192.168.1.50 2000`

Where `2000` is the port number on which the RN131/171 module listens for Telnet session commands.

3. The Telnet console must display the echoed response `*HELLO*`.
4. Any character typed in the Telnet console, followed by a `<cr>`, is echoed on the RN131/171 module's console. Type some random strings and observe the echoing.
5. The PIC18F87J11 connected to the RN131/171 module can recognize and provide response for the following commands:

```
MOD_TON_GRN - Turn ON module's green LED.
MOD_TOFF_GRN - Turn OFF module's green LED.
EXP_TON_LED1 - Turn ON PIC18 Explorer Development Board's D8 LED.
EXP_TOFF_LED1 - Turn OFF PIC18 Explorer Development Board's D8 LED.
EXP_TON_LED2 - Turn ON PIC18 Explorer Development Board's D7 LED.
EXP_TOFF_LED1 - Turn OFF PIC18 Explorer Development Board's D7 LED.
```

Type one of these commands in the Telnet console, either by itself or embedded in a longer string, followed by a `<cr>`. Observe that it is now possible to turn ON or OFF the appropriate LEDs on either the RN131/171 PICtail/PICtail Plus Daughter Board or on PIC18 Explorer Development Board.

Chapter 3. Application Design

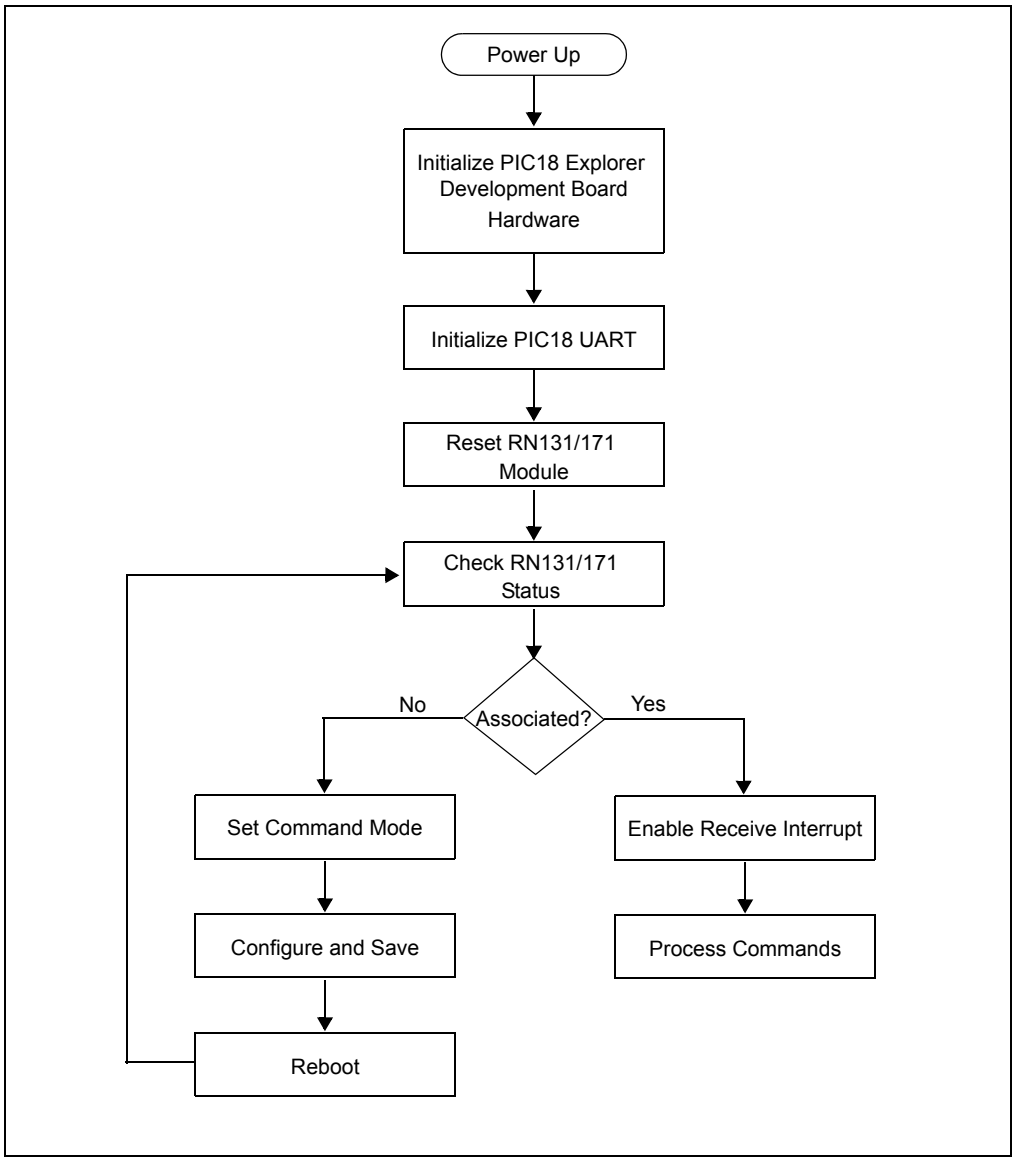
3.1 INTRODUCTION

This chapter provides a high-level introduction to developers to design sample demo application and shows some of the APIs that can be used to communicate with RN171 module. But a similar method works for RN131 module based card also.

3.2 DEMO APPLICATION FLOW DIAGRAM

Figure 3-1 illustrates the demo application flow diagram.

FIGURE 3-1: APPLICATION DIAGRAM



3.2.1 Initialize the PIC18 Explorer Development Board Hardware

During initialization stage, the `void BoardIint(void)` API function performs the following tasks:

- Selects the external 10 MHz crystal as the clock source
- Configures the ports/pins as digital and selects their direction to match the functional requirements of the PICtail connector
- Turns OFF the LEDs
- Clears an interrupt flags
- Disables the peripheral interrupts

3.2.2 Initialize the PIC MCU's UART

The `void ConsoleInit(void)` API function initializes the PIC MCU's UART1 which communicates with the RN131/171 module. It sets UART's baud rate to 9600 baud, 8 bits data, 1 stop bit, no parity and no flow control. These settings are the default for the RN131/171 module and PIC MCU. To change the baud rate, modify the `#define BAUD_RATE 9600` macro in the `console.h` file, and re-initialize the UART.

The `ConsoleInit( )` function enables both transmit and receive UART capabilities, but their respective interrupts are disabled until the application is prepared to receive them. Only Receive interrupts are enabled. Transmit interrupts remain disabled.

3.2.3 Reset the RN131/171 Module

The PICtail connector has an active-low reset pin (RB1) that is used to reset the RN131/171 module after the PIC18 Explorer Development Board and UART are properly initialized. The `void rn_reset_wifi(void)` API function is used for module reset operation. The function transitions the reset pin from high-to-low, holds the pin low for 10 ms and then returns it high. This reset action triggers the module to begin its joining procedure, if enabled (implies Join equals 1).

3.2.4 Check Module's Status

When the module is reset, the PIC MCU's UART receiver interrupt is enabled. This process prepares the PIC MCU to receive an information that is transmitted from the RN131/171 module's UART as it goes through its start-up procedure.

The PIC MCU analyzes the RN131/171 module output and explores for the module's IP address, if the association with an access point is successful. If a valid IP address is received, an assumption is made that the device is safely on a network and is in Data mode. In this case, the PIC MCU waits to receive commands from the RN131/171 module in an endless loop. The PIC MCU acts on each valid command it receives.

3.2.5 Command Mode

If the PIC MCU application detects that the RN131/171 module is not successful in its start-up attempt to associate with an access point, the PIC MCU's application attempts to instruct the module to associate with a specific access point. The PIC MCU application sends the commands to the module in sequence as listed in Table 3-1.

TABLE 3-1: BASIC COMMAND LIST

Command	Description
`$$$`	Put module into Command mode
`set wlan ssid <string>`	Set the network's SSID where `<string>` is the SSID
`set wlan join 1 <cr>`	Enables auto join. In firmware version 2.36 (Ad hoc mode), the auto join feature is enabled to maintain backwards compatibility. In version 2.45 (AP mode), auto join is disabled and must be explicitly enabled using the `set wlan join 1` command.
`set wlan pass <string>`	Set the passphrase to use when joining, where `<string>` is the passphrase
`save`	Save the settings to persistent storage; reused when joining
`reboot`	Reboot the module so that the settings take effect

The module reboots and associates with the specified access point when the connection is successful.

3.2.6 Primary Module Communication API Functions

The API function from PIC MCU that drives the module to go into Command mode is:

```
err_t module_send_cmd(const char *response, const char *fmt,
...)
```

This function accepts two or more parameters (i.e., a variable length parameter list). The first parameter, response, is the reply expected from the RN131/171 module after it has processed the command. The command is carried in the `fmt` parameter. For example, if the function is called as follows:

```
retValue = err_t module_send_cmd("CMD", "$$$");
```

The command is `$$$` and the expected return is `CMD`. For a more complex representation such as:

```
retValue = module_send_cmd(CMD_AOK,"set wlan ssid %s",
NETWORK_SSID)...
```

The variable parameter list is essential to properly resolve the `%s` into the value of the `NETWORK_SSID` macro.

The next API demonstrates how the user can combine individual commands inside a single function to carry out a more complex operation, such as joining a network.

The following API function forces the device into Command mode, saves the SSID and passphrase and reboots the module:

```
err_t module_network_connect(void);
```

Internally, it sends a total of five commands:

```
module_send_cmd("CMD", "$$$")
module_send_cmd(CMD_AOK, "set w s %s", NETWORK_SSID)
module_send_cmd(CMD_AOK, "set w p %s", NETWORK_PASS)
module_send_cmd(NULL, "save")
module_send_cmd(NULL, "join")
```

This function represents a typical API that sends a sequence of commands to the RN131/171 module to carry out a complex task. Most applications follow a similar pattern.

NOTES:

Appendix A. RN131/171 PICtail™/PICtail Plus Daughter Board Schematic

A.1 INTRODUCTION

This appendix provides the RN131/171 PICtail/PICtail Plus Daughter Board schematics, PCB layout and Bill of Materials (BOM).

- RN131/171 PICtail™/PICtail Plus Daughter Board Schematic
- RN131/171 PICtail™/PICtail Plus Daughter Board PCB Layout
- RN131/171 PICtail™/PICtail Plus Daughter Board Bill of Materials

A.2 RN131/171 PICtail™/PICtail PLUS DAUGHTER BOARD SCHEMATIC

Figure A-1 and Figure A-2 illustrate the RN131/171 PICtail/PICtail Plus Daughter Board schematics.

FIGURE A-1: RN131 PICtail™/PICtail PLUS DAUGHTER BOARD SCHEMATIC

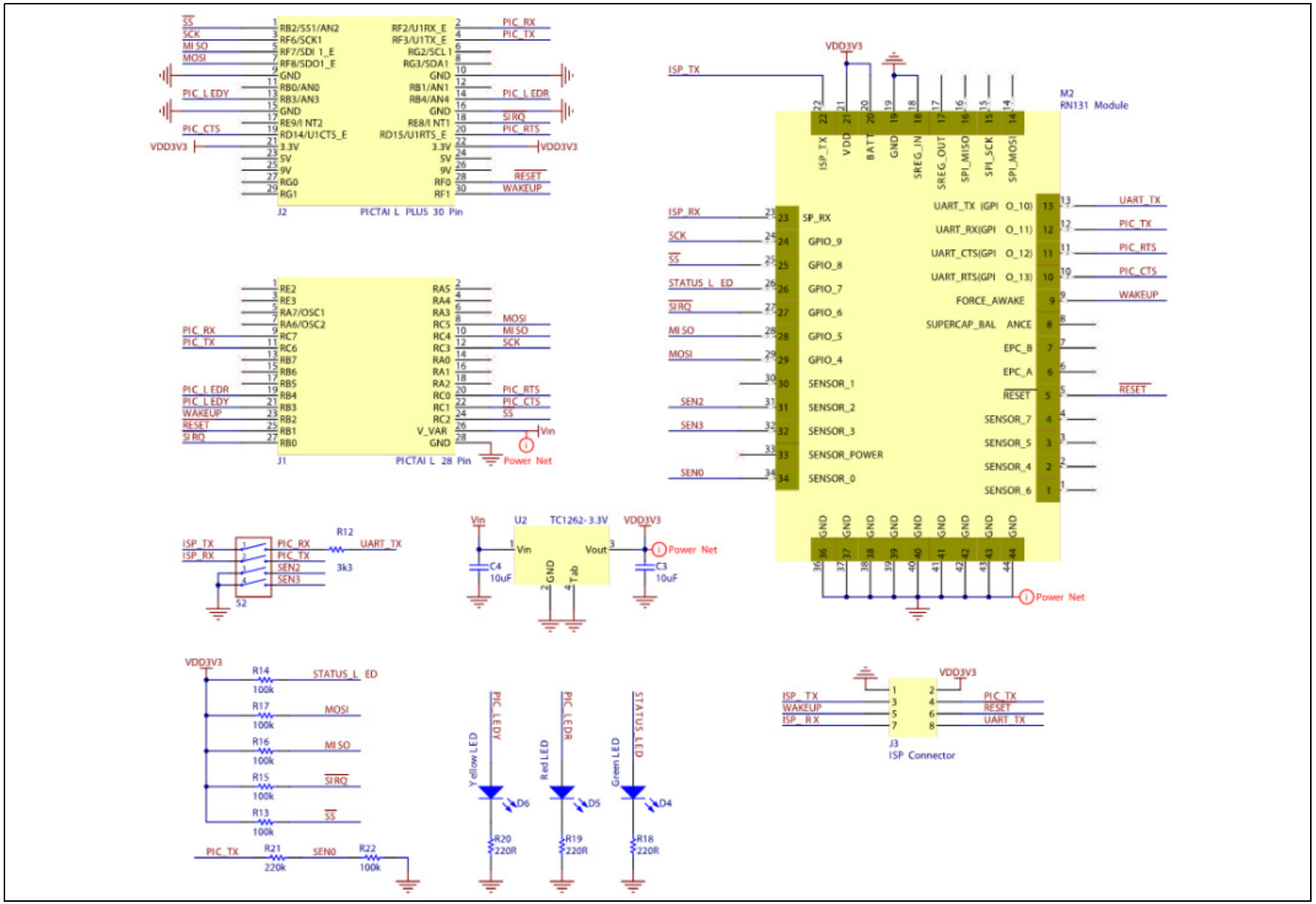
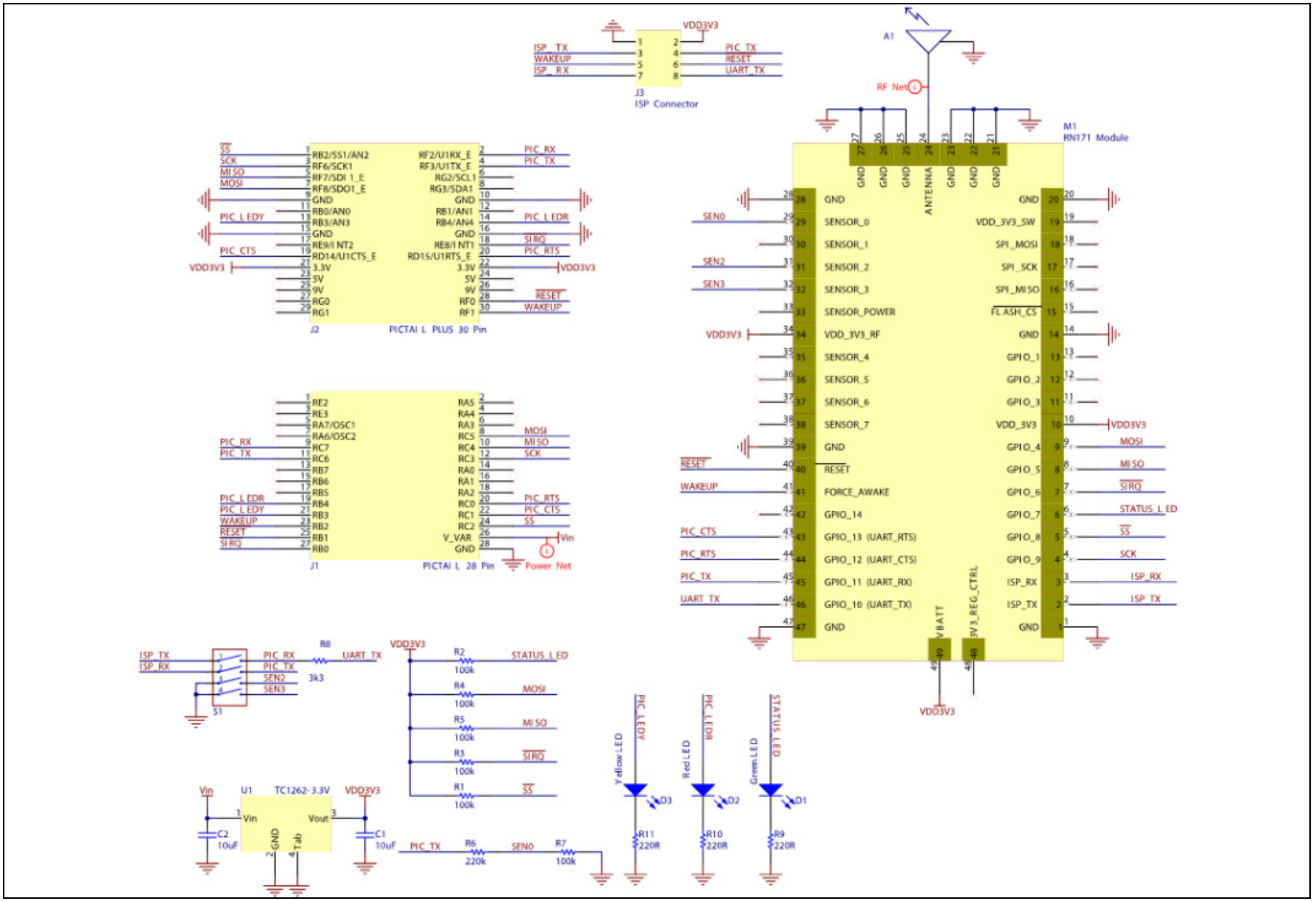


FIGURE A-2: RN171 PICtail™/PICtail PLUS DAUGHTER BOARD SCHEMATIC



A.3 RN131/171 PICtail™/PICtail PLUS DAUGHTER BOARD PCB LAYOUT

The RN131/171 PICtail/PICtail Plus Daughter Board is a 2-layer, FR4, 0.062 inch, plated through hole PCB construction. Figure A-3 through Figure A-10 illustrate the PCB layers.

FIGURE A-3: RN131/171 PICtail™/PICtail PLUS DAUGHTER BOARD SILKSCREEN

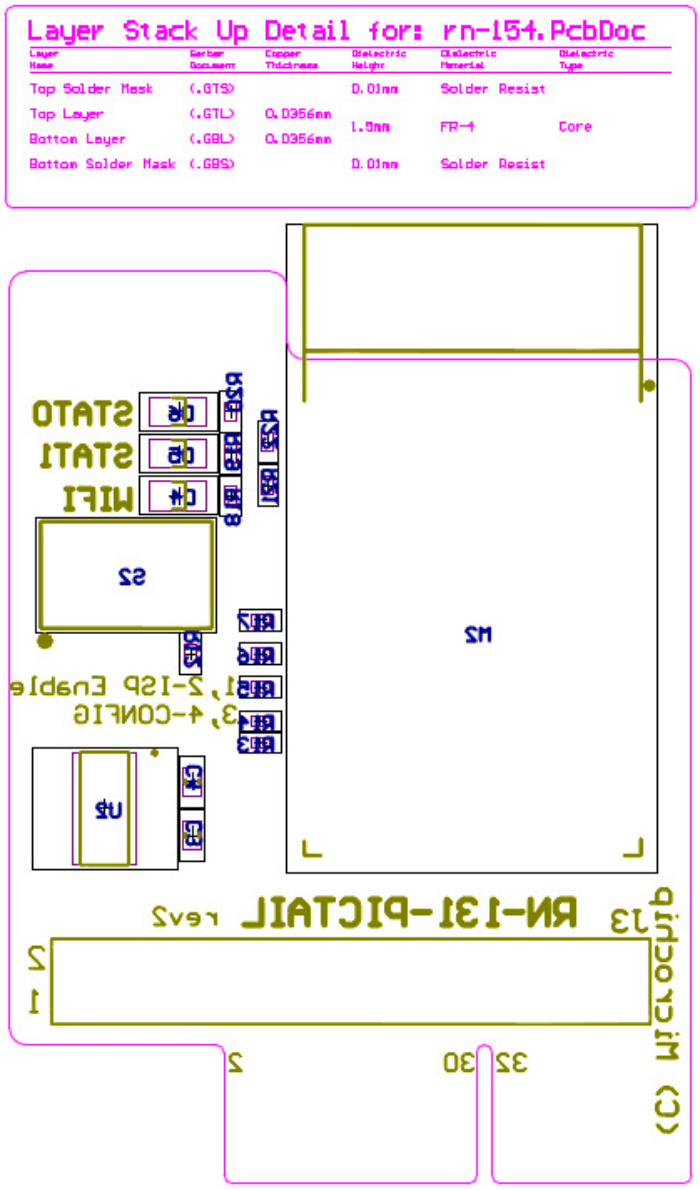


FIGURE A-4: RN131/171 PICtail™/PICtail PLUS DAUGHTER BOARD TOP COPPER

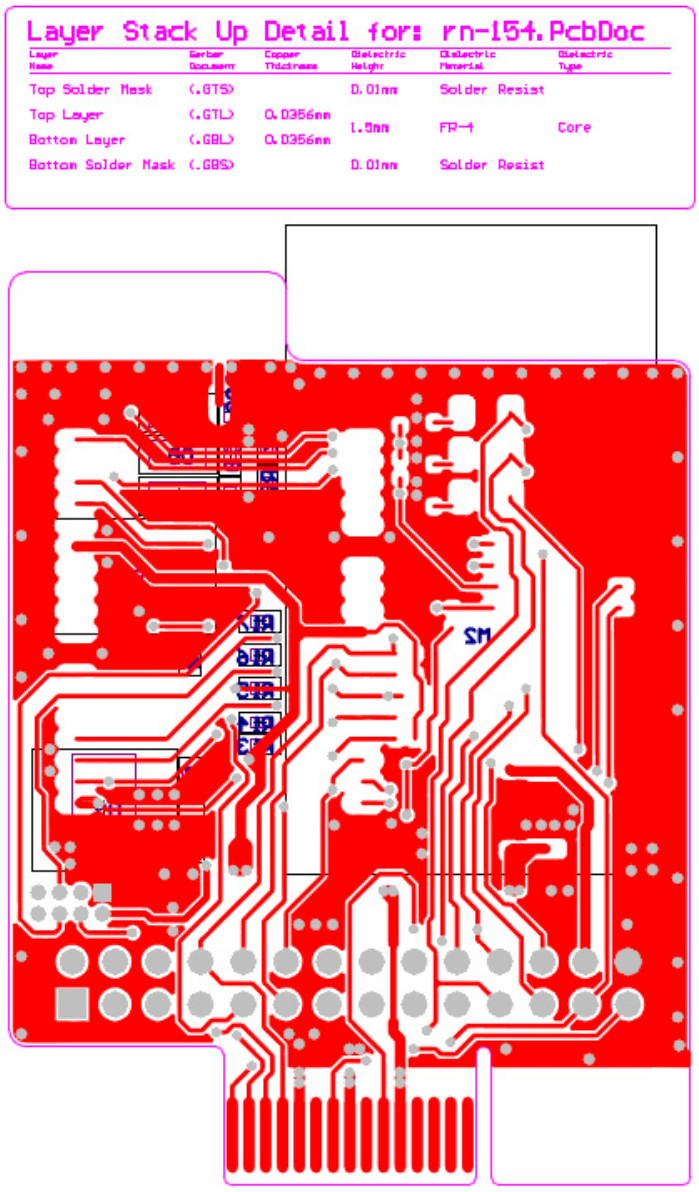


FIGURE A-5: RN131/171 PICtail™/PICtail PLUS DAUGHTER BOARD BOTTOM COPPER

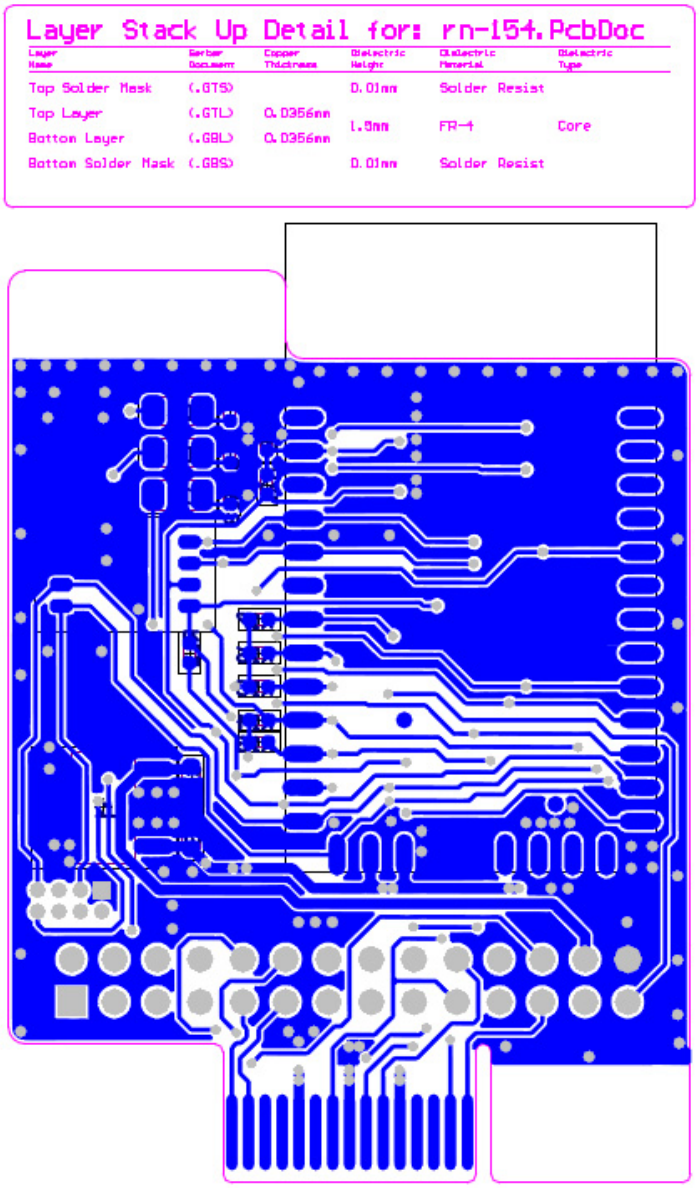


FIGURE A-6: RN131/171 PICtail™/PICtail PLUS DAUGHTER BOARD BOTTOM SILKSCREEN

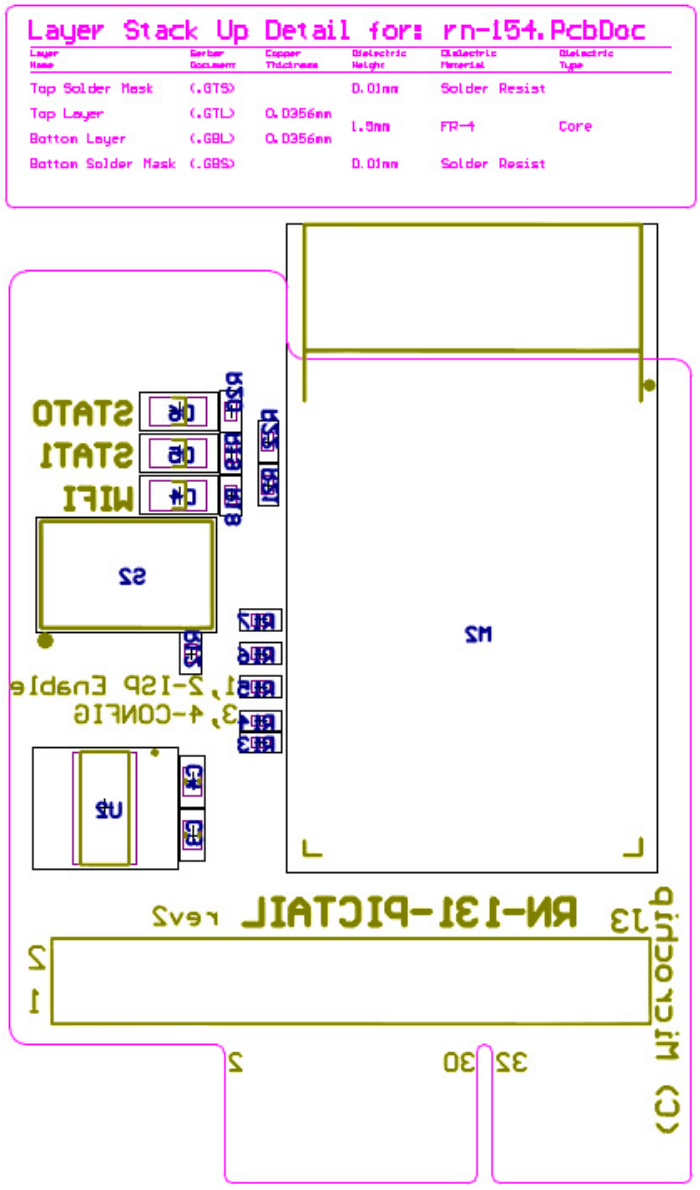


FIGURE A-7: RN131 PICtail™/PICtail PLUS DAUGHTER BOARD TOP ASSEMBLY DRAWING

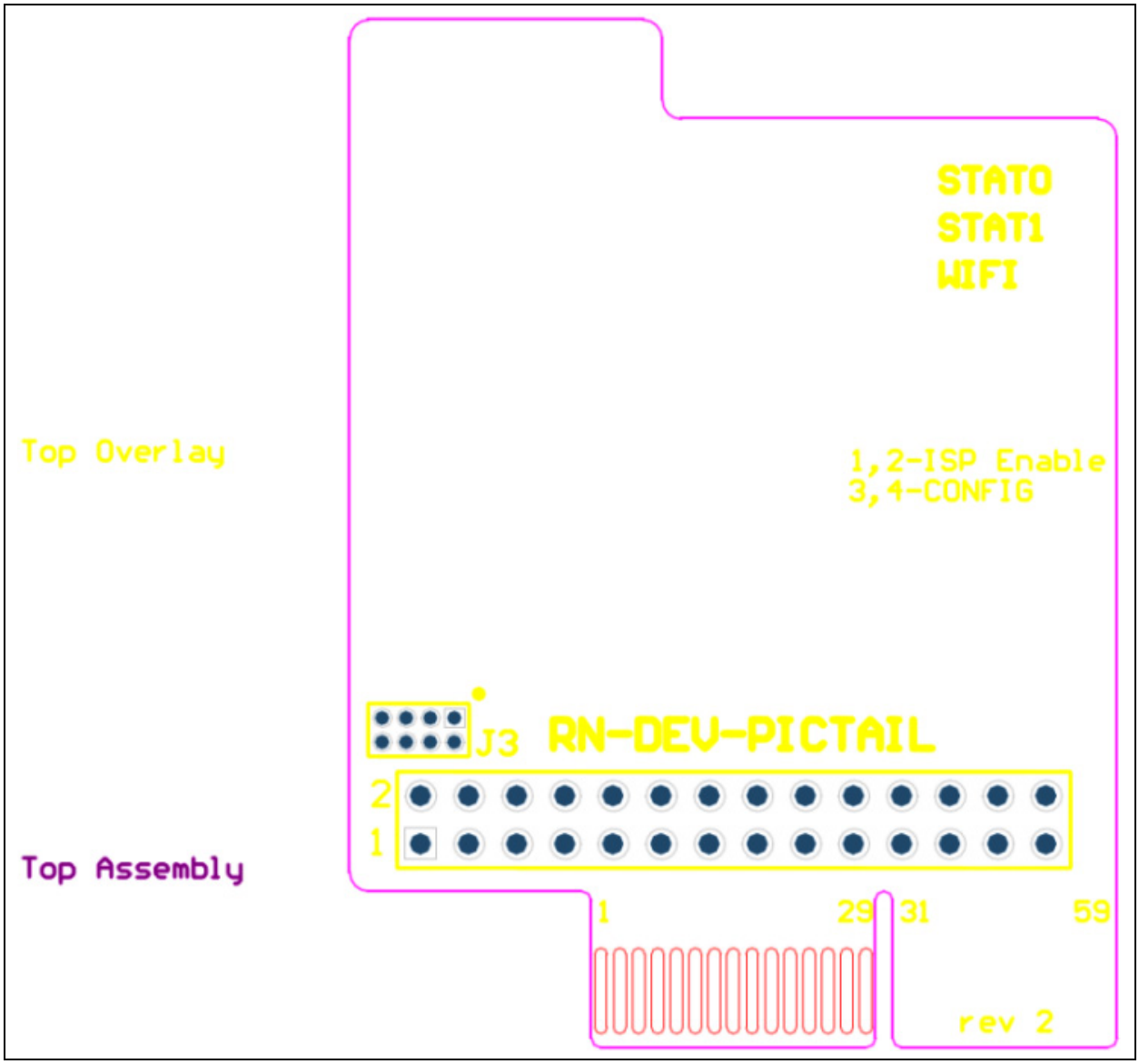


FIGURE A-8: RN131 PICtail™/PICtail PLUS DAUGHTER BOARD BOTTOM ASSEMBLY DRAWING

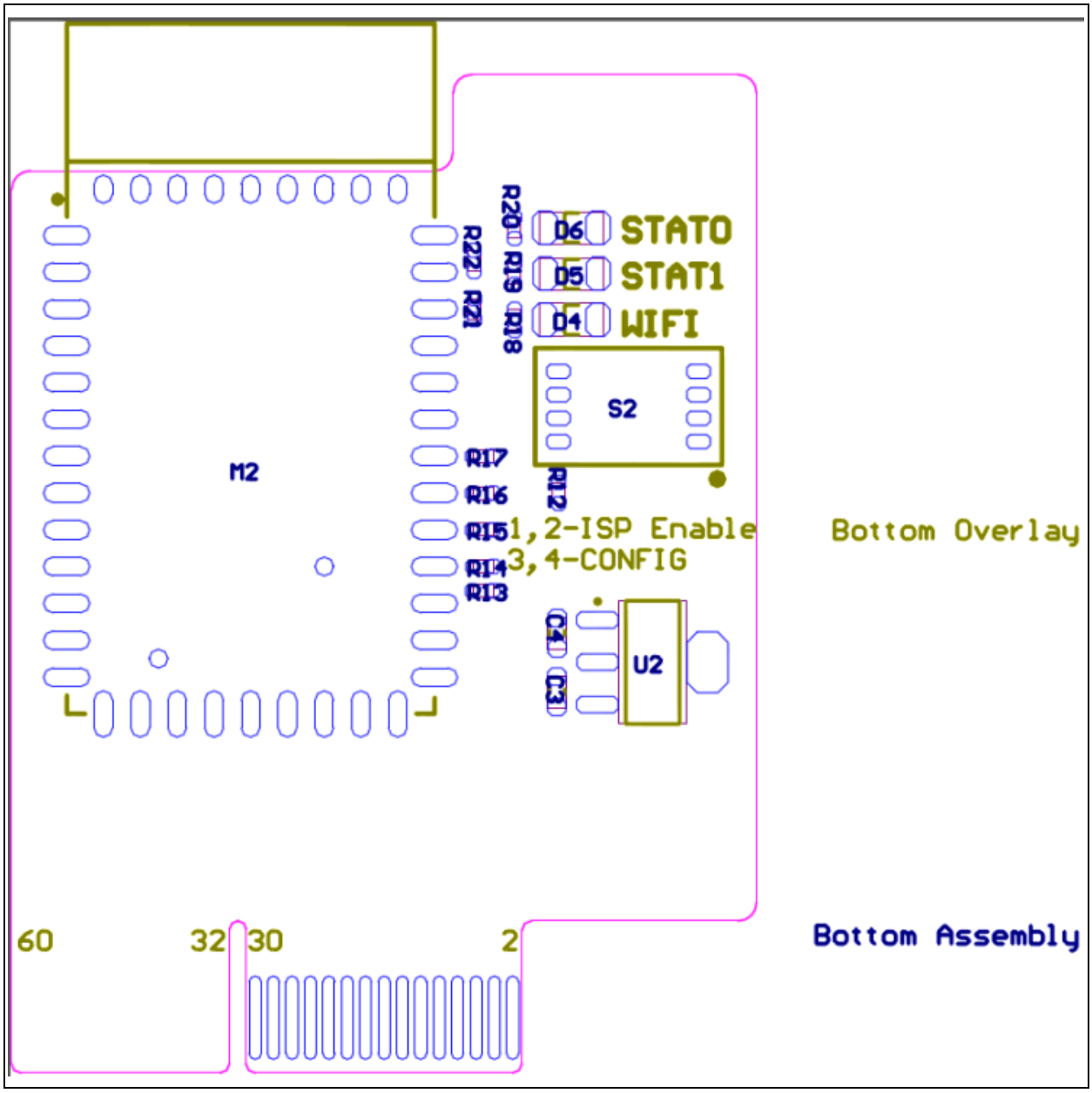


FIGURE A-9: RN171 PICtail™/PICtail PLUS DAUGHTER BOARD TOP ASSEMBLY DRAWING

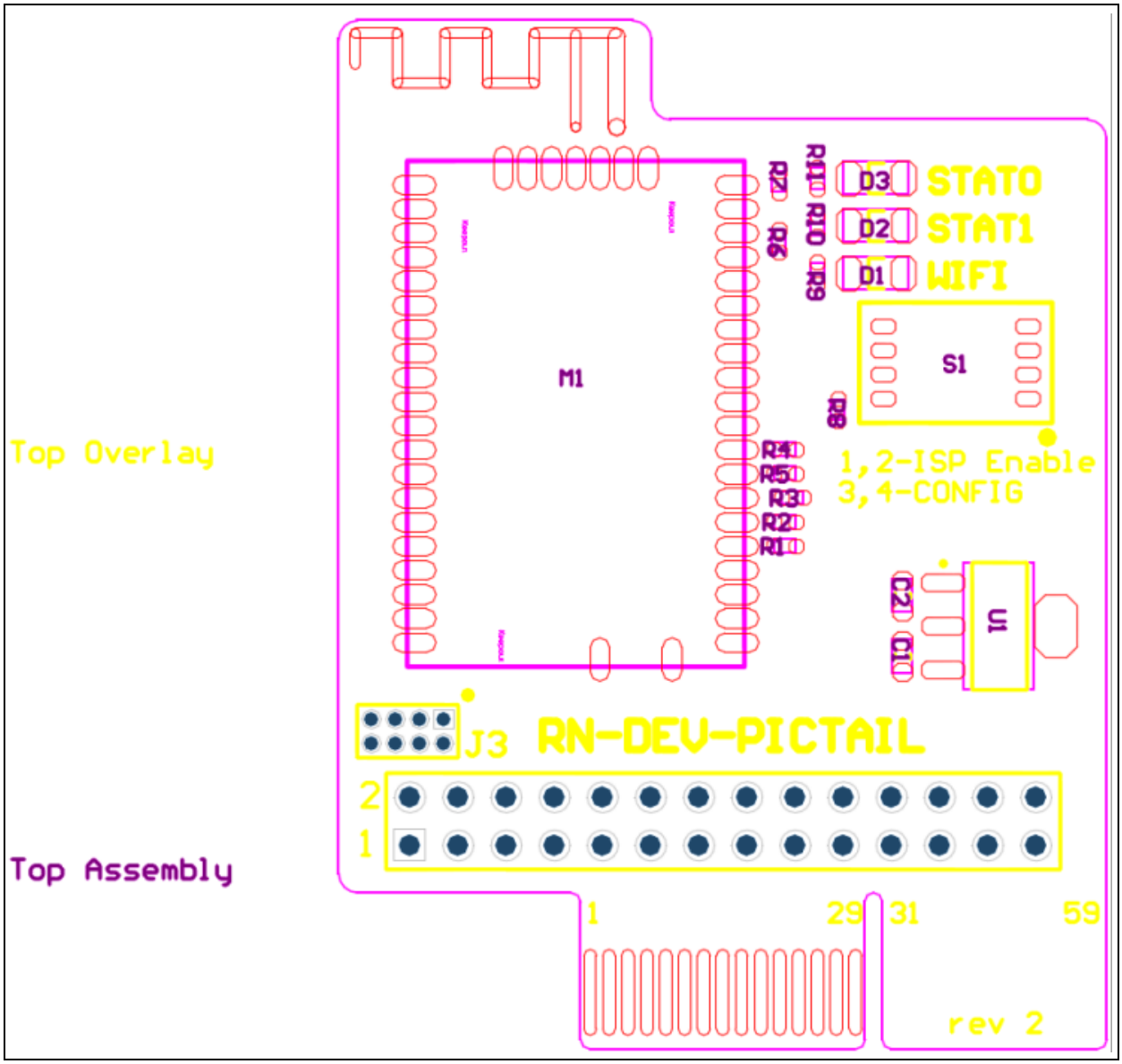
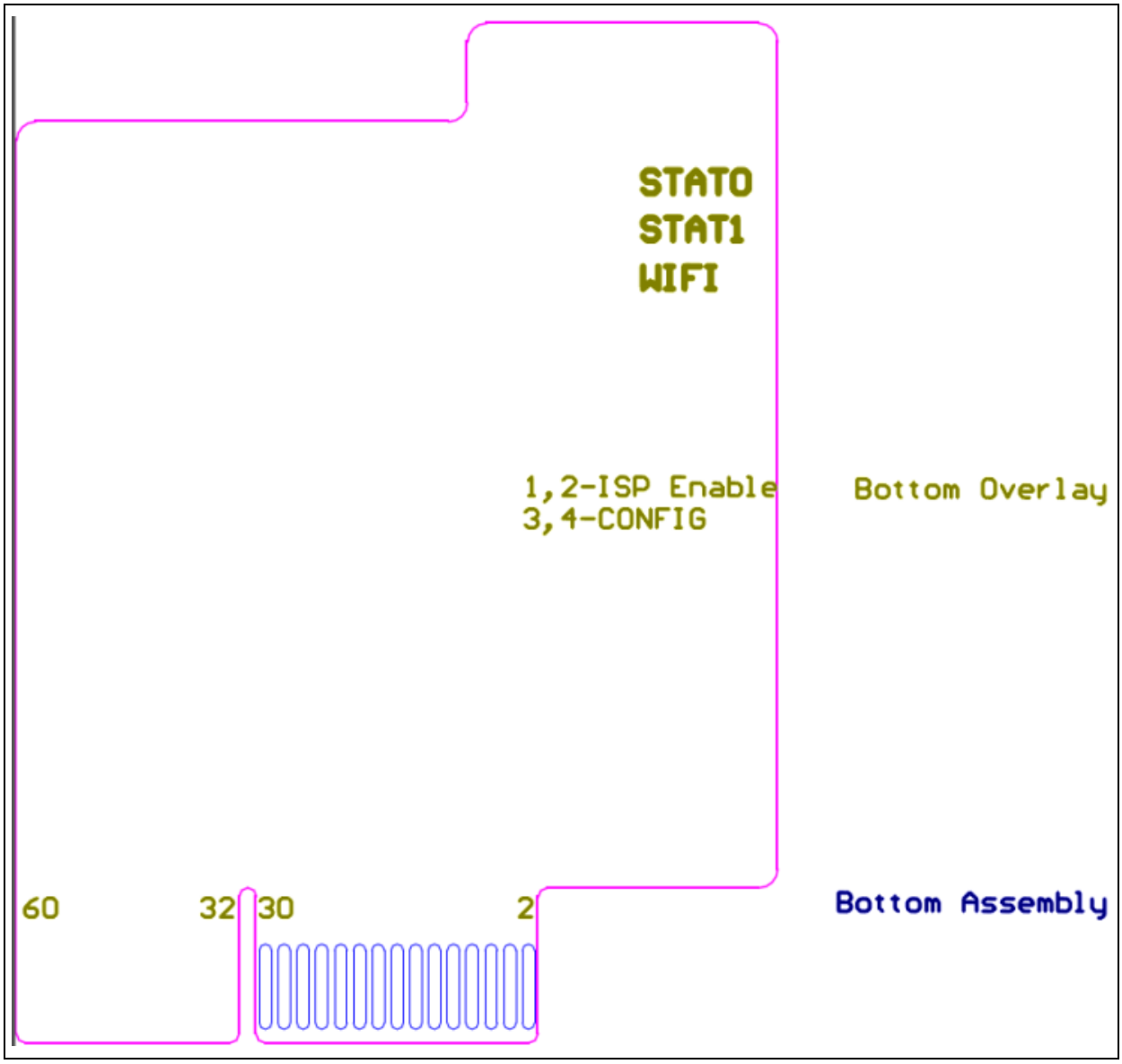


FIGURE A-10: RN171 PICtail™/PICtail PLUS DAUGHTER BOARD BOTTOM ASSEMBLY DRAWING



A.4 RN131/171 PICtail™/PICtail PLUS DAUGHTER BOARD BILL OF MATERIALS

TABLE A-1: RN131 PICtail™/PICtail PLUS DAUGHTER BOARD BILL OF MATERIALS (BOM)

Reference	Value	Description	Vendor	Vendor P/N
C3	10 uF	Cap ceramic, 20%, 6.3V, X5R, 0603	TDK Corporation	C1608X5R0J106M
C4	10 uF	Cap ceramic, 20%, 6.3V, X5R, 0603	TDK Corporation	C1608X5R0J106M
D4	Green LED	Clear, Green LED, 10 mA, 2.1V, 569 nm, 130 degrees, 1206	Lite-On Inc	LTST-C150GKT
D5	Red LED	Clear, Red LED, 10 mA, 1.8V, 638 nm, 130 degrees, 1206	Lite-On Inc	LTST-C150CKT
D6	Yellow LED	Clear, Yellow LED, 10 mA, 2.1V, 588 nm, 130 degrees, 1206	Lite-On Inc	LTST-C150YKT
J3	—	CONN HEADER .050" 8POS DL PCB AU	Sullins Connector Solutions	GRPB042VWVN-RC
M2	—	RN131 Module	Microchip	RN-131
R12	3k3	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ332X
R13	100k	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ104X
R14	100k	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ104X
R15	100k	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ104X
R16	100k	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ104X
R17	100k	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ104X
R18	220R	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ221X
R19	220R	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ221X
R20	220R	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ221X
R21	220k	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ224X
R22	100k	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ104X
S2	4 x DIP Switch	SWITCH DIP 4POS HALF PITCH SMD	C&K Components	TDA04H0SB1R
U2	TC1262-3.3V	Linear Voltage Regulator	Microchip	TC1262-3.3VDBTR

TABLE A-2: RN171 PICtail™/PICtail PLUS DAUGHTER BOARD BILL OF MATERIALS (BOM)

Reference	Value	Description	Vendor	Vendor P/N
C1	10 uF	Cap ceramic, 20%, 6.3V, X5R, 0603	TDK Corporation	C1608X5R0J106M
C2	10 uF	Cap ceramic, 20%, 6.3V, X5R, 0603	TDK Corporation	C1608X5R0J106M
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, 1.8V, 638 nm, 130 degrees, 1206	Lite-On Inc	LTST-C150CKT
D3	Yellow LED	Clear, Yellow LED, 10 mA, 2.1V, 588 nm, 130 degrees, 1206	Lite-On Inc	LTST-C150YKT
J3	—	CONN HEADER .050" 8POS DL PCB AU	Sullins Connector Solutions	GRPB042VWVN-RC
M1	—	RN171 Module	Microchip	RN-171
R1	100k	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ104X
R2	100k	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ104X
R3	100k	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ104X
R4	100k	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ104X
R5	100k	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ104X
R6	220k	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ224X
R7	100k	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ104X
R8	3k3	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ332X
R9	220R	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ221X
R10	220R	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ221X
R11	220R	Res, 5%, 0.1W, 0402	Panasonic - ECG	ERJ-2GEJ221X
S1	4 x DIP Switch	SWITCH DIP 4POS HALF PITCH SMD	C&K Components	TDA04H0SB1R
U1	TC1262-3.3V	Linear Voltage Regulator	Microchip	TC1262-3.3VDBTR

NOTES:

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