RN-131-PICTAIL & RN-171-PICTAIL Web-Server Demo Application

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RN-131/171-PICTAIL-UM Version 1.0 1/8/2013

USER MANUAL

OVERVIEW

The RN-131 and RN-171 WiFly radio modules are complete, standalone wireless LAN access devices. Each module contains a TCIP/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.

General Description

The RN-131-PICTAIL and RN-171-PICTAIL evaluation boards work seamlessly with the Microchip Technology PIC18 Explorer Development Board. The evaluation boards plug into the PICtail™ modular connector on the PIC18 Explorer Board, and add wireless functionality to PIC18-based microcontroller designs.

The evaluation boards are preloaded with firmware to simplify integration and minimize application development. In the simplest configuration, the hardware only requires four connections (PWR, TX, RX, and GND) to create a wireless data connection. The microcontroller can communicate with the boards via the UART and SPI interfaces, and can drive LEDs, wake the boards, and reset them. The evaluation boards are updated and controlled with a simple ASCII command language. Once the boards are set up, they can scan to find an access point, associate, authenticate, and connect over any Wi-Fi network.

The Explorer 16 Board (DM240001) is a development platform equipped with a 28-pin PICtail connector and PIM that can accommodate various versions of the 16-bit PIC24 and PIC232 microcontroller families. The Explorer 16 Board's 16-bit microcontroller communicates with the RN-131-PICTAIL/RN-171-PICTAIL evaluation board via the PICtail connector.

This document describes how to use the RN-131-PICTAIL/RN-171-PICTAIL evaluation board connected to an Explorer 16 Board to associate with a Wi-Fi network and communicate with other devices within a LAN. Communication with other internet based cloud devices is done via an http-client application that runs inside the PIC.

RN-131-PICTAIL/RN-171-PICTAIL Module Features

- FCC/CE/IC certified 2.4-GHz IEEE 802.11b/g transceiver
- Plugs into the PICtail Plus connector on the PIC18 Explorer and Explorer 16 Development Boards
- Adds wireless capability to designs targeting the PIC18 Explorer and Explorer 16 boards
- Configurable transmit power: 0 to 10 dBm (RN-171-PICTAIL)
- PCB trace antenna (RN-171-PICTAIL) and on-board ceramic chip antenna (RN-131-PICTAIL)
- Ultra-low power
  - 4-uA sleep, 38-mA Rx, 120-mA Tx at 0 dBm (RN-171-PICTAIL)
  - 4 uA sleep, 40 mA Rx, 210 mA Tx (RN-131-PICTAIL)
- High throughput: 921 Kbps TX, 500 Kbps RX data rate with TCP/IP and WPA2 over UART, up to 2 Mbps over SPI slave
- UART interface with hardware flow control
- SPI interface with slave interrupt
- Real-time clock for wakeup and time stamping
- 3 status LEDs (2 configurable)
- Powered by PIC18 Explorer and Explorer 16 boards
- Supports ad hoc and infrastructure networks
- Wi-Fi Alliance certified for WPA2-PSK
- Complete on-board TCP/IP networking stack

- Environmentally friendly: RoHS compliant

Demo Applications

The example applications provided with this document include 2 MPLAB X projects.

- The MPLAB X project files provide a sample 16-bit application framework that you can customize to configure and control the RN-131/RN-171 from an 16-bit Microchip microcontroller.
- You use the ***wifly_pas_thru_exp16_p24*** sample application to configure the RN-131/RN-171 module via a command line interface.
- **The wifly_config** sample application uses a PIC based webserver application to configure the RN-131/RN-171 from a web browser. After the RN-131/RN-171 is configured, the wifly_config application switches and executes as an http-client, allowing the module to connect to an access point and exchanges data with a cloud server.

The following sections describe these applications in detail.

GETTING STARTED

This section describes how to setup up the Explorer 16 Board and to run the sample demo applications.

Hardware Requirements

To run the demo applications, you need the following hardware:

- RN-131-PICTAIL or RN-171-PICTAIL evaluation board
- Explorer 16 Development Board equipped with a PIC24FJ128GA010 PIM (MA240001)
- Microchip programmer (e.g., ICD3 or Real Ice)
- 802.11b/g-compliant Wi-Fi access point
- Serial cable or USB-to-serial converter cable

Software Requirements

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

- *Terminal emulator application such as TeraTerm or CoolTerm* — You will use the terminal emulator to send configuration commands to the module over a UART interface. The emulator also displays information transmitted from the module.
- *MPLAB X version 1.2 or higher*—You will use this application along with the programmer to load both applications into the PIC, and to modify and customize them as desired.
- *XC16 v1.10 compiler*—You will use the compiler to build a customized the applications.

Sample Application Code

You can obtain the sample application code described in this user manual at www.microchip.com/wireless.

Demo Applications

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

- Communicate with the module via a uart based terminal session.
- Configure the module using a web browser.
- Configure the module to associate with a cloud server, and exchange both data and the status of the onboard LEDs.

Set *Up Hardware*

Perform the following steps to set up the hardware and prepare it for configuration:

1. Plug the RN-131-PICTAIL/RN-171-PICTAIL evaluation board into the Explorer 16 Board's PICtail connector. See Figure 1.

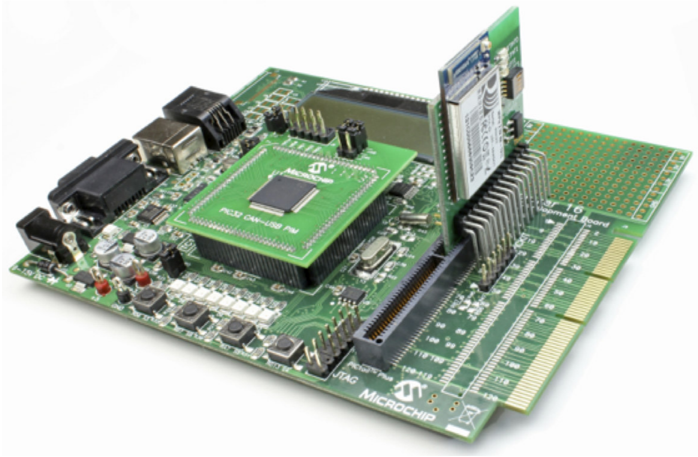


Figure 1: RN-131 and Explorer 16 Board

2. Connect a serial cable from the Explorer 16 Board's DE9 connector to the PC. If you are using a laptop that does not have a serial connector, use an USB-to-serial converter cable to connect the serial cable to the laptop's USB port.
3. Connect the programmer to the Explorer 16 Board.
4. Connect a 9V power supply to the Explorer 16 Board.

Program the PIC24FJ128GA010 & Configure the RN-131/RN-171

In this step you will configure the RN-131/RN-171 module so you can operate it in the pass-through mode, where commands entered from the terminal console are passed directly to the module to be processed by the WiFly code.

First, use the following steps to program the PIC24FJ128GA010 with software that allows the RN-131/RN-171 to operate in the pass-through mode.

1. Using the MPLAB X IDE and the programmer, open the project wifly_pass_thru_exp16_p24, build the project and load the file into the PIC24FJ128GA010. This application performs two important tasks:

   - It configures the PIC24FJ128GA010 I/O pins appropriately.
   - It allows commands that are typed on the console to be transmitted by the UART over to the module. Data received from the module is echoed back on the console. An example of a PIC based UART driver can be found in the *wifly_drv.c* file.

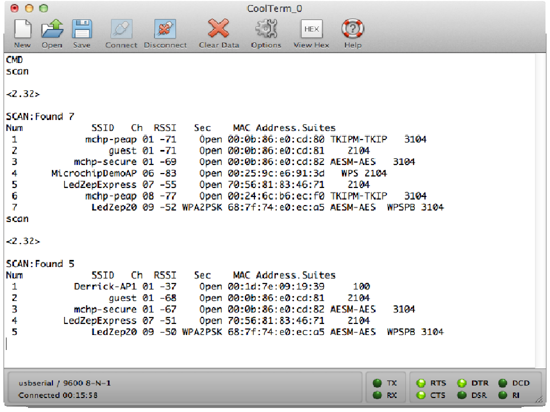
2. Open terminal emulator to the COM port of the Explorer 16 Board/RN-131-PICTAIL/RN-171-PICTAIL. The serial port settings are 9600 baud, 8-bits data, no parity, 1-stop bit, and no flow control.

3. Type the following commands in the console of your terminal emulator to test out the operation of the software:

   $$$ Command places the RN-131/RN-171 module in command mode.

   scan The device scans for networks and produces a list of available access points (see Figure 3 for an example). The access point to which you wish to connect should be listed. If it is not, repeat the **scan** command.

Figure 2. Access Point List



```
CMD
scan

<2.32>

SCAN:Found 7
Num            SSID   Ch  RSSI   Sec    MAC Address.Suites
 1            mchp-peap 01 -71    Open 00:0b:86:e0:cd:80 TKIPM-TKIP   3104
 2                guest 01 -71    Open 00:0b:86:e0:cd:81    2104
 3          mchp-secure 01 -69    Open 00:0b:86:e0:cd:82 AESM-AES   3104
 4      MicrochipDemoAP 06 -83    Open 00:25:9c:e6:91:3d   WPS 2104
 5        LedZepExpress 07 -55    Open 70:56:81:83:46:71    2104
 6            mchp-peap 08 -77    Open 00:24:6c:b6:ec:f0 TKIPM-TKIP   3104
 7             LedZep20 09 -52 WPA2PSK 68:7f:74:e0:ec:a5 AESM-AES  WPSPB 3104
scan

<2.32>

SCAN:Found 5
Num            SSID   Ch  RSSI   Sec    MAC Address.Suites
 1          Derrick-AP1 01 -37    Open 00:1d:7e:09:19:39     100
 2                guest 01 -68    Open 00:0b:86:e0:cd:81    2104
 3          mchp-secure 01 -67    Open 00:0b:86:e0:cd:82 AESM-AES   3104
 4        LedZepExpress 07 -51    Open 70:56:81:83:46:71    2104
 5             LedZep20 09 -50 WPA2PSK 68:7f:74:e0:ec:a5 AESM-AES  WPSPB 3104
```

usbserial / 9600 8-N-1
Connected 00:15:58

4. Users are encouraged to evaluate the module's operation in command mode by experimenting with some the some of the commands that are described in the document *WiFly Command Reference, Advance Features & Applications User's Guide* (DS52098).

5. After step 4 above has been completed, the module should be restored to its original factory settings by issuing the following commands:

$$$	Place the mode RN-131/RN-171 module in command mode.
factory R	Reset the module to factory default conditions.
reboot	Reboot the device**.**
$$$	Go back to command mode.

6. Prepare the module to be configured via a web browser by locating the …/framework/apps/*wifly_test.txt* file and use either TeraTerm or CoolTerm to load the file into the module, or alternatively type each of the commands listed from the console.

Soft Access Point Mode and Web Serving

In the following steps, you will load an application into the PIC24FJ128GA010. The application allows the RN-131/RN-171 module to operate as an Access Point and accepts TCP connection requests from a web browser. Concurrently, the application running on the PIC will behave as a web server. The html pages and related javascript files that are served by the PIC, will be used to configure the module.

Following the configuration phase, the module is reset, associates with the designated Access Point, and operates as an http client device. In its role of an http client, the module will exchange data with a cloud based server.

In order for the module to communicate with a cloud based server, it must first be registered with that server.

The overall processes of registering, configuring and associating the module with a cloud server that is described below, will include the following steps:

A. Registering the module with the cloud server application.

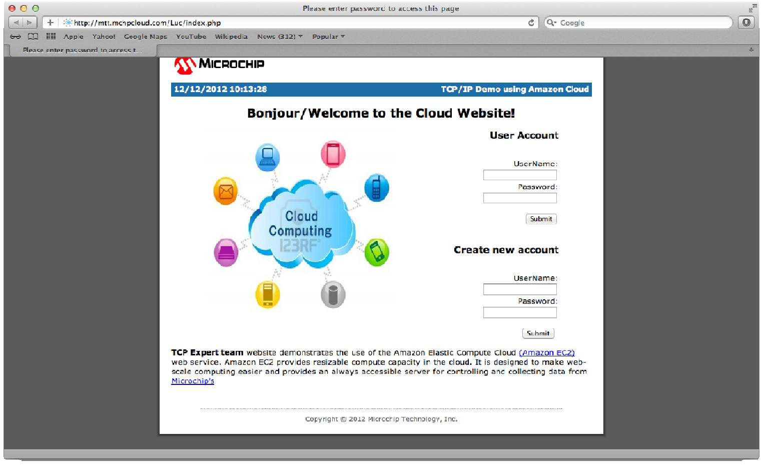
B. Configuring the RN-171/131 module via a browser

C. Running the module as a http client that is connected to the cloud server and is exchanging data with it.

The following steps describe how to register the module with a cloud base server that is set up by Microchip for module testing purposes.

1. Browse to the website: http://mtt.mchpcloud.com and follow the instructions on the page to create an account.

Figure 3: Module Registration Form


Please enter password to access this page

http://mtt.mchpcloud.com/Luc/index.php

12/12/2012 10:13:28 TCP/IP Demo using Amazon Cloud

Bonjour/Welcome to the Cloud Website!

User Account

UserName:

Password:

Submit

Create new account

UserName:

Password:

Submit

TCP Expert team website demonstrates the use of the Amazon Elastic Compute Cloud (Amazon EC2) web service. Amazon EC2 provides resizable compute capacity in the cloud. It is designed to make web-scale computing easier and provides an always accessible server for controlling and collecting data from Microchip's

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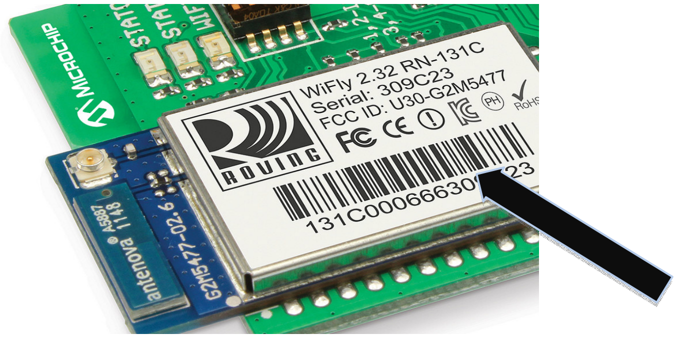
2. Log into the created account and follow the instructions to register the MAC address of the module. Also give Explorer 16/RN-171/131 platform combination a name, for example MYRNMODULE06. Later you will use this named reference as a means of connecting the http client application that is running on the physical hardware, to the cloud server. The MAC address of the module address is the last 6 hex-bytes of in the number sequence that is shown below the barcode on the module.



Now that the module's MAC address is registered with the cloud server, the next steps are to configure the module to do two primary things. The first, is to give the module the credentials so that is can properly associate with an Access Point. Secondly, to tell the module which webserver it should open a TCP session.

To configure the module via the browser, please follow these steps:

1. Plug in the RN-171/131 module into the Explorer 16 board as shown in Figure 1. Connect the programmer, power, and optional serial cable, to the Explorer 16, and the laptop respectively.

2. From the MPLAB X file menu, navigate to the wifly_config project. Build and then load the application into the PIC24FJ128GA010.

3. Press the MCLR reset button on the Explorer 16 board and observe the output that is displayed on the Explorer 16's LCD screen.   Optionally, if a terminal console is connected to the Explorer 16, additional progress information will be display there as well.

4. The device will attempt to associate with its default Access Point for 10 seconds. The message "Associating . . ." will be displayed on the LCD and module's Yellow LED will be flashing at a rate of once-per-second.

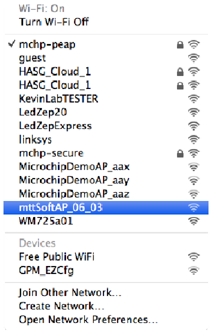
5. After 10 seconds has expired, if the module has not successfully associated with an Access Point, it becomes an Access Point. Both the Yellow and Green LEDs will now be flashing. The message "Config w/Browser http://5.16.71.1" will now be displayed on the Explorer 16's LCD display.

The module is now established as an Access Point, and the application that is executing inside the PIC is operating as a webserver. The PIC's state machine is now awaiting connection requests from a browser.

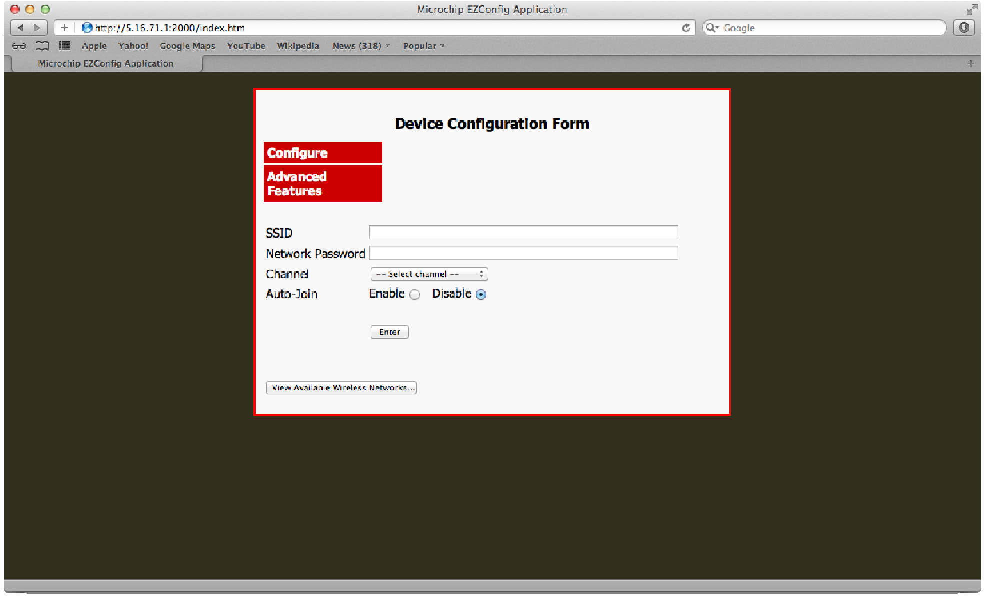
As an Access Point, the module's IP address is 5.16.71.1. Its ssid is mttSoftAP_xx_yy, where xx & yy, are the last two hex bytes of the module's MAC address(for example mttSoftAP_03_06). The module is listening for TCP connections on port 2000. Its opening default html page is called index.html.

The following steps will demonstrate how to use these pieces of information to configure the module via a browser.

1. Change the PC's wireless connection to join the access point mttSoftAP_xx_yy.



2. Open a browser (IE, Safari, Firefox) etc, and enter http://5.16.71.1:2000/index.html into the browser window. Within 1 to 2 seconds the following page should be transmitted from the module, to the browser and be displayed. This is main page that is used to configure the module.


Microchip EZConfig Application
http://5.16.71.1:2000/index.htm
Google
Apple Yahoo! Google Maps YouTube Wikipedia News (318) Popular
Microchip EZConfig Application

Device Configuration Form

Configure

Advanced Features

SSID

Network Password

Channel -- Select channel --

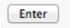
Auto-Join Enable ○ Disable ●

Enter

View Available Wireless Networks...

3. Click into, and fill out the fields for the SSID, Password, channel and auto-join.

4. After the credential fields have been filled out, click on the “Enter” button.

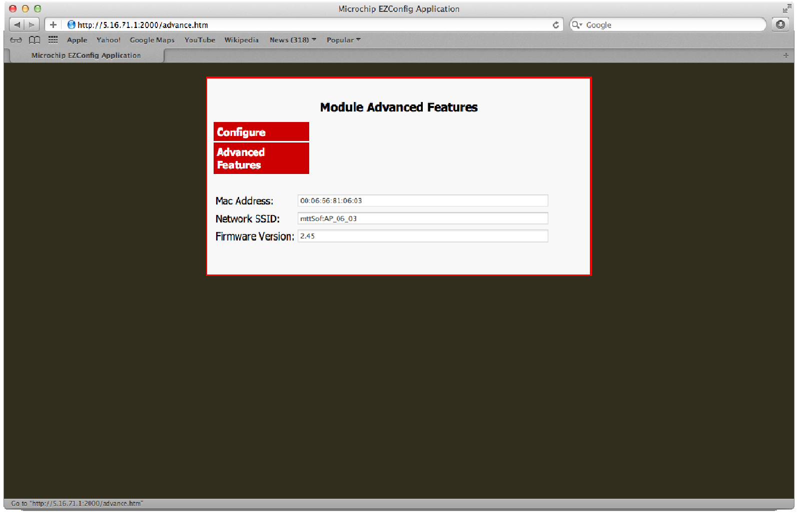


This will cause the name-value pairs of data to be posted back to the PIC based web server application. The PIC will use this information to configure the module, then reset it and have the module restart as http client device. Its important that the selected access point have direct access to the internet.

5. Prior to entering data into the credential form above, for a list of available access points, please click on the “View Available Wireless network….” button.

6. After the available list of AP is displayed, hovering over, and then clicking on one of the listed access point, will populate the SSID field with the name of the selected access point.

7. Clicking on the “Advanced Features” hyper-link, causes the PIC’s web server to send an informational page to the browser. The module’s MAC address, SSID, and firmware version are displayed on this page. Clicking on the “Configure” hyper-link, returns the user to the configure page.


Microchip EZConfig Application
http://5.16.71.1:2000/advance.htm
Google
Apple
Yahoo!
Google Maps
YouTube
Wikipedia
News (318)
Popular
Microchip EZConfig Application
Configure
Advanced Features
Go to "http://5.16.71.1:2000/advance.htm"

Module Advanced Features

Mac Address: 00:06:56:81:06:03
Network SSID: mttSoftAP_06_03
Firmware Version: 2.45

8. After coming out of reset, the module will associate to the directed access point, and then open a connection with the cloud server. If the MAC address of the module was registered with the cloud server as described earlier, then the module will begin to exchange data with the server. The status of the Explorer 16 LEDs, and the value of its potentiometer is the data that is exchanged between the cloud server and module.

9. The new IP address of the module, that was assigned by the access point to which its associated, along with the module's MAC address will be displayed on the Explorer 16 LCD screen.

The RN-131/RN-171 module is now associated to an access point and is operating in data mode as a http client.

For customers who desire to connect the module to a cloud server of their own choosing, instead of of the default mtt.mchpcloud.com, the changes required to the demo http-client application are quite simple. Follow these steps to change the cloud server:

1. In the MPLAB X IDE, open the project wifly_config. Locate the following lines of code in the wifly_util.h file:

```
#define NAME_VALUE         "mtt.mchpcloud.com"   // DNS name of host
```

2. Change the value of the NAME_VALUE macro to the new designated cloud server, and re-build the project. The module, after associating with an access point that is connected to the Internet will, open a socket connection with the new cloud server and begin to make data requests.

For customers who desire to build a more customized web-server and http client application, are encouraged to carefully review the file sys_task.c, and specifically the function TCPTasks(). The TCPTasks() function is essentially a state machine. It sequences the module through all its phases of operation, from initialization, configuration, association, connection to server to operation as a http client.

The current implementation of the wify_config demo does not have a file system, so all the html web pages are pre-loaded in to memory, with the sys_task.c file.

RESOURCES & RELATED DOCUMENTS

For more information, refer to the following sources, which are available on the Support page on the Roving Networks website at http://www.rovingnetworks.com/support.php:

- *RN-171 Data Sheet*
- *RN-131 Data Sheet*
- *Advanced User Manual*
- *WiFly Training Presentation*
- Drivers, tools, and utilities

NOTES

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