RN171

2.4 GHz IEEE Std. 802.11 b/g Wireless LAN Module

Features:

- Complete, Embedded 2.4 GHz IEEE 802.11 b/g Wireless LAN Module
- 14 General Purpose Input/Output (GPIO) Pins (Four GPIOs shared with UART)
- Eight Analog Sensor Inputs
- Small Surface-Mount Module: 1.050” x 0.700” x 0.125” (26.67 mm x 17.78 mm x 3.18 mm)
- Integrated Crystal, Internal Voltage Regulator, Matching Circuitry, Power Amplifier
- Integrates Easily into Final Product – Minimizes Product Development, Provides Quicker Time to Market
- Configured using Simple ASCII Commands
- Networking:
  - Supports Infrastructure and SoftAp Networking Modes
  - Built-in Networking Applications: TCP, UDP, DHCP, DNS, ICMP, ARP, HTTP Client, and FTP Client
  - Complete On-Board TCP/IP Networking Stack
  - Unique MAC Address
  - Upgrade Firmware Over the Air using FTP
  - Supports Wi-Fi® Protected Setup (WPS)

Power Management:

- Ultra Low-Power Sleep Mode (4 uA)
- Perfect for Portable Battery Operated Devices
- Battery Boost Control Circuitry
- Real-Time Clock for Time Stamping, Auto-Sleep, and Auto-Wake

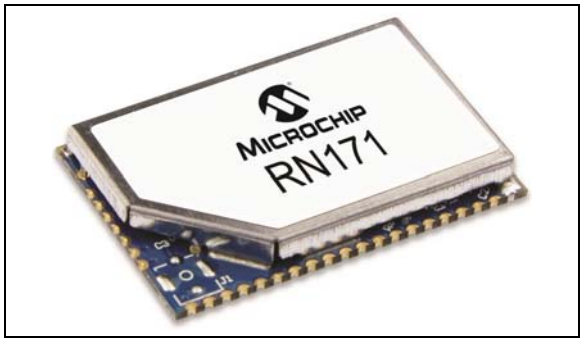
Antenna:

- External Antenna Connection via RF Pad
- Certified Antenna Types: Chip, Whip, PCB Trace, and Wire

Compliance:

- Modular Certified for the United States (FCC) and Canada (IC)
- European R&TTE Directive Assessed Radio Module
- Australia, New Zealand, Korea, Taiwan

FIGURE 1: RN171 MODULE



Media Access Control (MAC)/Baseband Features:

- Security: WEP-128, WPA-PSK (TKIP), WPA2-PSK (AES)

Operational:

- Operating Voltage: 3.3V (typical)
- Temperature Range: -40C to +85C Industrial
- Low-Current Consumption:
  - Rx mode: 40 mA
  - Tx mode: 120 mA at 0 dBm
  - Sleep: 4 µA

RF/Analog Features:

- Frequency: 2.412 to 2.462 GHz
- Modulation:
  - 802.11b Compatibility: DSSS (CCK-11, CCK-5.5, DQPSK-2, DBPSK-1)
  - 802.11g: OFDM
  - Receive Sensitivity: -83 dBm Typical
  - Power Output: 0 to +12 dBm

Over-the-Air Data Rate:

- 1-11 Mbps for 802.11b
- 6-54 Mbps for 802.11g

Applications:

- Remote Equipment Monitoring
- Telemetry
- Industrial Sensors
- Home Automation

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1.0 DEVICE OVERVIEW

The RN171 is a standalone, embedded 802.11 b/g Wireless Local Area Network (WLAN) module. The module incorporates an on-board TCP/IP networking stack, cryptographic accelerator, power management subsystem, real-time clock, versatile sensor interface, 2.4 GHz transceiver, and RF power amplifier (see Figure 1-1). With the RN171, designers can embed Wi-Fi and networking functionality rapidly into virtually any device.

The RN171 provides cost and time-to-market savings as a self-contained internet-enabling solution. The module has been designed to provide designers with a simple Wi-Fi solution that features:

- Ease of integration and programming
- Vastly reduced development time
- Minimum system cost
- Long battery life
- Maximum value in a range of applications

The RN171 is configured with a simple ASCII command language. The "*WiFly Command Reference, Advanced Features and Applications User's Guide*" (DS50002230) contains a complete listing and instructions of the ASCII command interface.

In the simplest configuration, the module requires only power, ground, and UART TX and RX connections. The RN171 module can interface to low-cost microcontrollers using only two wires, UART TX and RX.

The RN171 has a versatile sensor interface that can be used to monitor analog signals such as temperature, audio, motion, and acceleration.

The module has a small form factor, which makes it easy to integrate. Additionally, the module is compatible with standard pick-and-place equipment.

The RN171 is ideal for a vast range of applications that require long battery life, moderate processing power, moderate data throughput and occasional Wi-Fi connectivity, such as:

- Real-Time Locationing Systems (RTLS)
- Industrial and home automation
- Health and fitness monitoring
- Telemetry
- Security

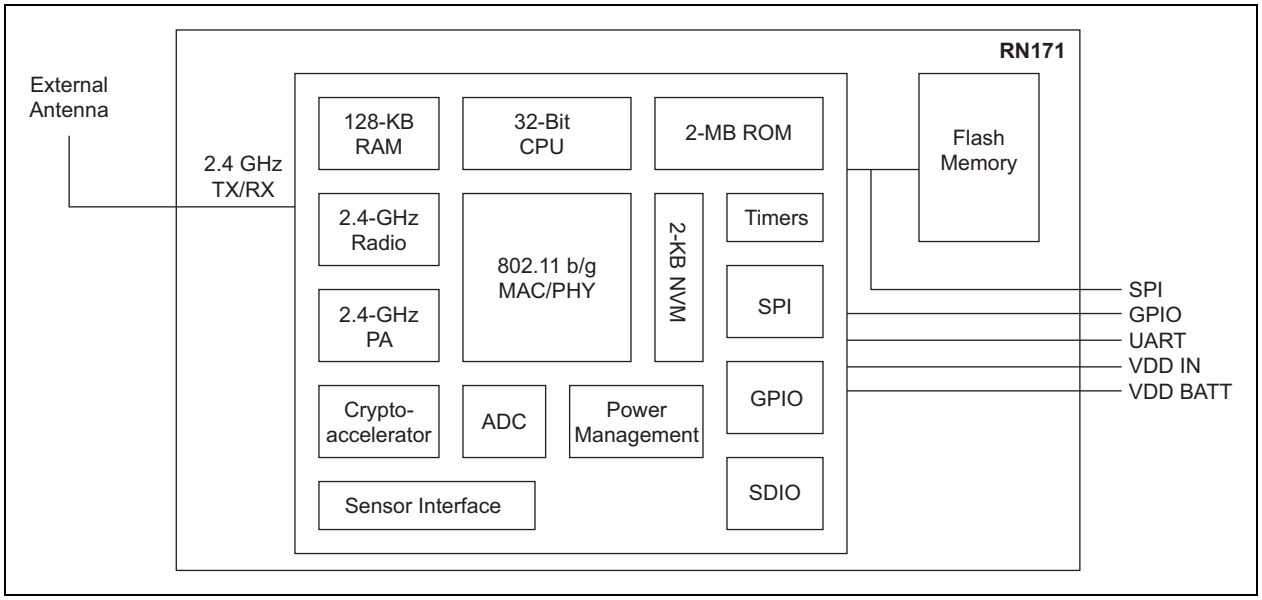
Additionally, the module is perfect for mobile wireless applications such as asset monitoring and sensor applications.

The RN171 can independently maintain a low-power wireless network connection. Ultra-low power usage and flexible power management maximize the module's lifetime in battery-operated devices. A wide operating temperature range allows use in indoor and outdoor environments (industrial temperature range).

When operating in Sleep mode, the module minimizes battery usage while still being able to respond to certain events, including internal timers and events on the sensor interfaces. Applications that make efficient use of the sleep state can extend battery life to multiple years.

The RN171 has modular device approval for operation in the United States (FCC) and Canada (IC). The RN171 module is an R&TTE Directive assessed radio module for operation in Europe.

FIGURE 1-1: RN171 BLOCK DIAGRAM



1.1 ASCII Command & Data Interface

The "*WiFly Command Reference, Advanced Features and Applications User's Guide*" (DS50002230) provides a complete description of the ASCII command and data interface for the RN171 module.

1.2 Interface Description

Figure 1-1 shows the RN171 pin diagram. Figure 1-3 shows the microcontroller to RN171 interface. Table 1-1 describes the RN171 pins.

FIGURE 1-2: RN171 PIN DIAGRAM

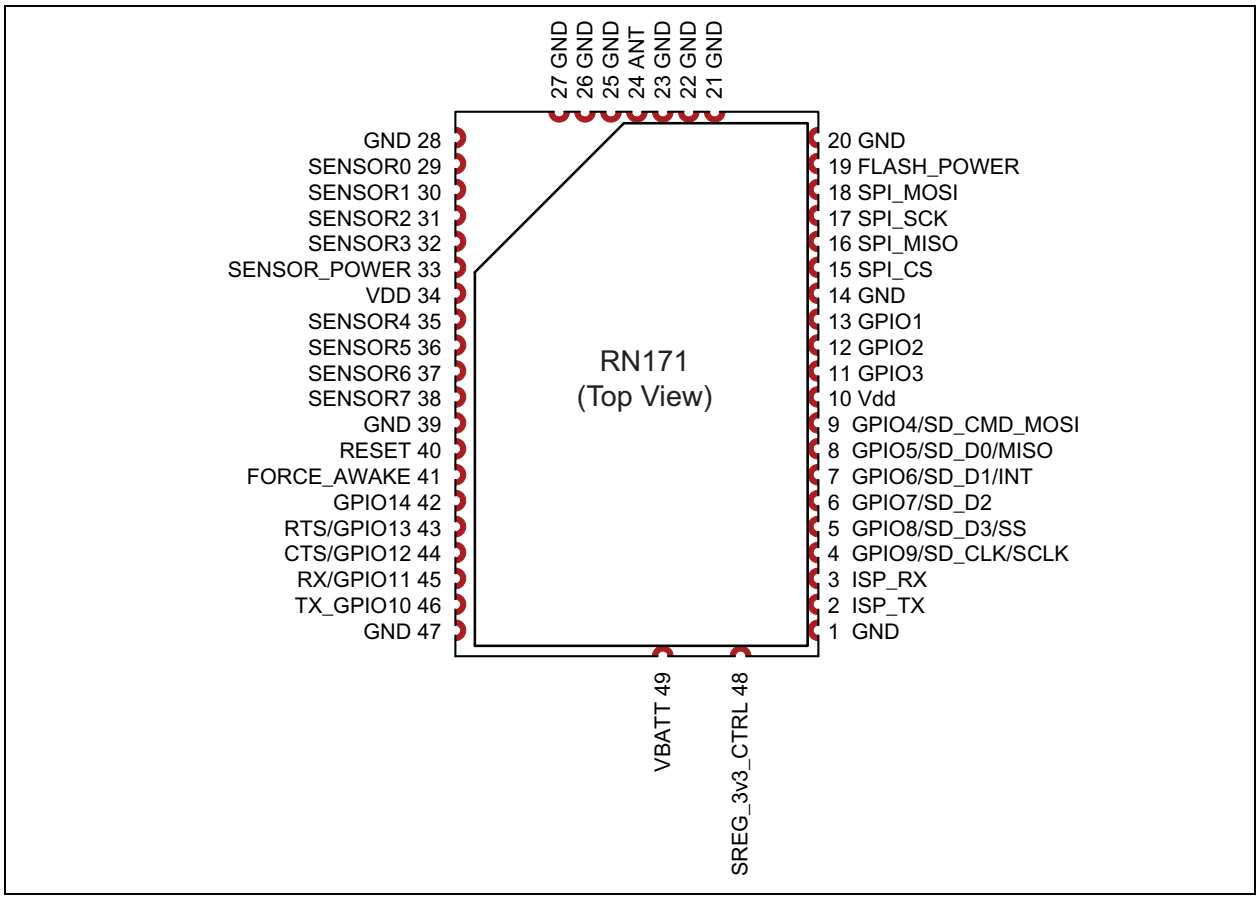
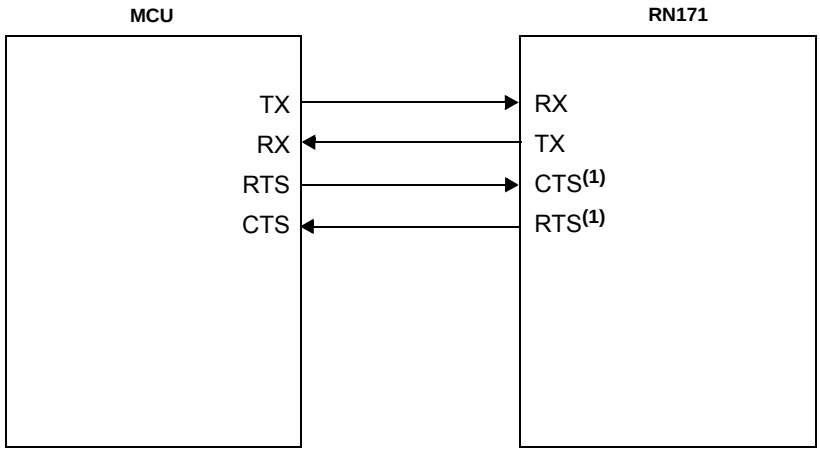


FIGURE 1-3: MICROCONTROLLER TO RN171 INTERFACE



Note 1: Hardware flow control signals CTS and RTS should be used for baud rates of 115200 or greater.

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TABLE 1-1: PIN DESCRIPTION

Pin	Symbol	Type	Description
1	GND	Power	Ground reference
2	ISP_TX	DO	In-system programming transmit
3	ISP_RX	DI	In-system programming receive
4	GPIO9/SD_CLK/SCLK	DIO	General purpose I/O 9[2,3]/SDIO clock/SD-SPI slave SCLK
5	GPIO8/SD_D3/SS	DIO	General purpose I/O 8[2,4]/SDIO D3/SD-SPI slave select
6	GPIO7/SD_D2	DIO	General purpose I/O 7[2,4]/SDIO D2
7	GPIO6/SD_D1/INT	DIO	General purpose I/O 6[2,4]/SDIO D1/SD-SPI slave INT
8	GPIO5/SD_D0/MISO	DIO	General purpose I/O 5[2,4]/SDIO D0/SD-SPI slave MISO
9	GPIO4/SD_CMD/MOSI	DIO	General purpose I/O 4[2,4]/SDIO CMD/SD-SPI slave MOSI
10	VDD	Power	Positive supply
11	GPIO3	DIO	General purpose I/O 3[2,3]
12	GPIO2	DIO	General purpose I/O 2[2,3]
13	GPIO1	DIO	General purpose I/O 1[2,3]
14	GND	Power	Ground reference
15	$\overline{\text{SPI_CS}}$	DO	SPI master chip select to internal Flash memory chip select. (Do not connect.)
16	SPI_MISO	DI	SPI master data Input to internal Flash memory data output. (Do not connect.)
17	SPI_SCK	DO	SPI master clock to internal Flash memory clock. (Do not connect.)
18	SPI_MOSI	DO	SPI master data output to internal Flash memory data input. (Do not connect.)
19	FLASH_POWER	Power	Internal Flash memory power. (Do not connect.)
20	GND	Power	Ground reference
21	GND	Power	Ground reference
22	GND	Power	Ground reference
23	GND	Power	Ground reference
24	ANT	AIO	RF antenna. 50Ω impedance
25	GND	Power	Ground reference
26	GND	Power	Ground reference
27	GND	Power	Ground reference
28	GND	Power	Ground reference
29	SENSOR0	AI	Sensor interface 0[5]
30	SENSOR1	AI	Sensor interface 1[5]
31	SENSOR2	AI	Sensor interface 2[5]
32	SENSOR3	AI	Sensor interface 3[5]
33	SENSOR_POWER	Power	Sensor power
34	VDD	Power	Positive supply

Note 1: Pin type abbreviation: A = Analog, D = Digital, I = Input, O = Output.

2: Refer to Electrical Specifications for GPIO voltage and current limitations.

3: Digital input/output (bidirectional) 8 mA drive, ~83 K internal pull-down. 3.3V tolerant. Reset State: Pull-down.

4: Digital input/output (bidirectional) 24 mA drive, no internal pull-down. 3.3V tolerant. Reset State: High-Z. Do not allow to float.

5: Analog input. 0-400 mV (Do not exceed 1.2V DC)

TABLE 1-1: PIN DESCRIPTION

35	SENSOR4	AI	Sensor interface 4(5)
36	SENSOR5	AI	Sensor interface 5(5)
37	SENSOR6	AI	Sensor interface 6(5)
38	SENSOR7	AI	Sensor interface 7(5)
39	GND	Power	Ground reference
40	$\overline{\text{RESET}}$	DI	Module Reset. Internal 100 kΩ pull-up resistor. Apply a pulse of at least 160 μs
41	FORCE_AWAKE	DI	Module force awake. Internal 100 kΩ pull-down resistor. Apply pulse for at least 245 μs. While FORCE_AWAKE is asserted the module is prevented from sleeping
42	GPIO14	DIO	General purpose I/O 14(2,3)
43	RTS/GPIO13	DO/DIO	UART asynchronous output/general purpose I/O(2,3)
44	CTS/GPIO12	DI/DIO	UART asynchronous input/general purpose I/O(2,3)
45	RX/GPIO11	DI/DIO	UART asynchronous input/general purpose I/O(2,3)
46	TX/GPIO10	DO/DIO	UART asynchronous output/general purpose I/O(2,3)
47	GND	Power	Ground reference
48	SREG_3V3_CTRL	Power	Battery boost circuit control
49	VBATT	Power	Battery voltage

Note 1: Pin type abbreviation: A = Analog, D = Digital, I = Input, O = Output.

2: Refer to Electrical Specifications for GPIO voltage and current limitations.

3: Digital input/output (bidirectional) 8 mA drive, ~83 K internal pull-down. 3.3V tolerant. Reset State: Pull-down.

4: Digital input/output (bidirectional) 24 mA drive, no internal pull-down. 3.3V tolerant. Reset State: High-Z. Do not allow to float.

5: Analog input. 0-400 mV (Do not exceed 1.2V DC)

1.3 Mounting Details

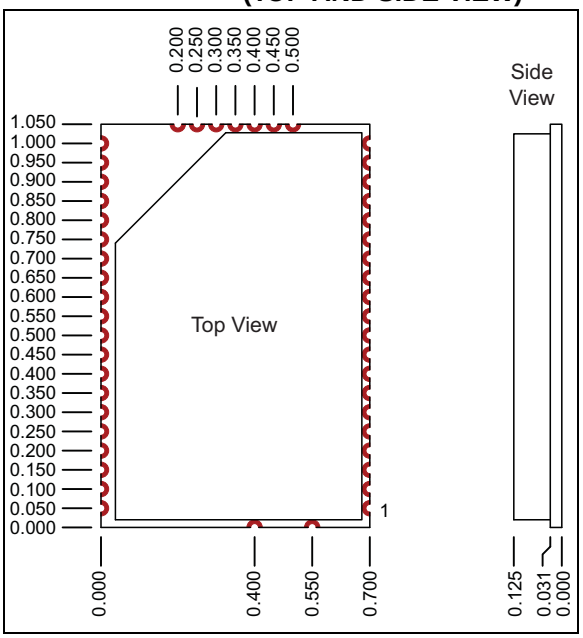
Figure 1-4 and Figure 1-5 show the module's physical dimensions. Figure 1-6 shows the recommended host PCB layout.

1.4 Soldering Recommendations

The RN171 wireless module was assembled using a standard lead-free reflow profile as shown in Figure 1-7. The module is compatible with standard lead-free solder reflow profiles. To avoid damaging the module, the following recommendations are given:

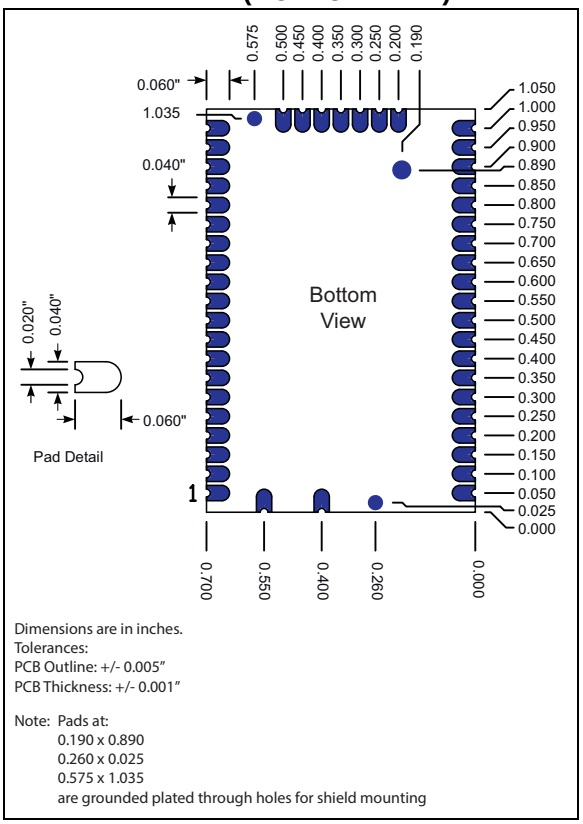
- Figure 1-8 gives a recommended reflow profile for this module
- Refer to the solder paste data sheet for specific reflow profile recommendations
- Use no-clean flux solder paste
- Do not wash as moisture can be trapped under the shield
- Use only one flow. If the PCB requires multiple flows, apply the module on the last flow

FIGURE 1-4: RN171 MODULE PHYSICAL DIMENSIONS (TOP AND SIDE VIEW)



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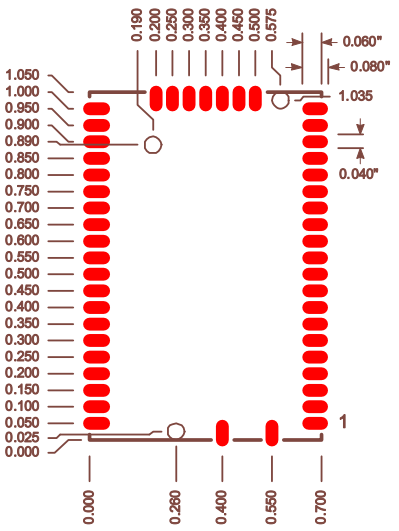
FIGURE 1-5: RN171 MODULE PHYSICAL DIMENSIONS (BOTTOM VIEW)



Dimensions are in inches.
Tolerances:
PCB Outline: +/- 0.005"
PCB Thickness: +/- 0.001"

Note: Pads at:
0.190 x 0.890
0.260 x 0.025
0.575 x 1.035
are grounded plated through holes for shield mounting

FIGURE 1-6: RECOMMENDED HOST PCB FOOTPRINT



Note: Pads at
0.190 x 0.890
0.260 x 0.025
0.575 x 1.035
are grounded plated through holes for shield mounting .

Recommend keeping host PCB top layer signal traces away (0.050" diameter).

FIGURE 1-7: SOLDER REFLOW TEMPERATURE PROFILE

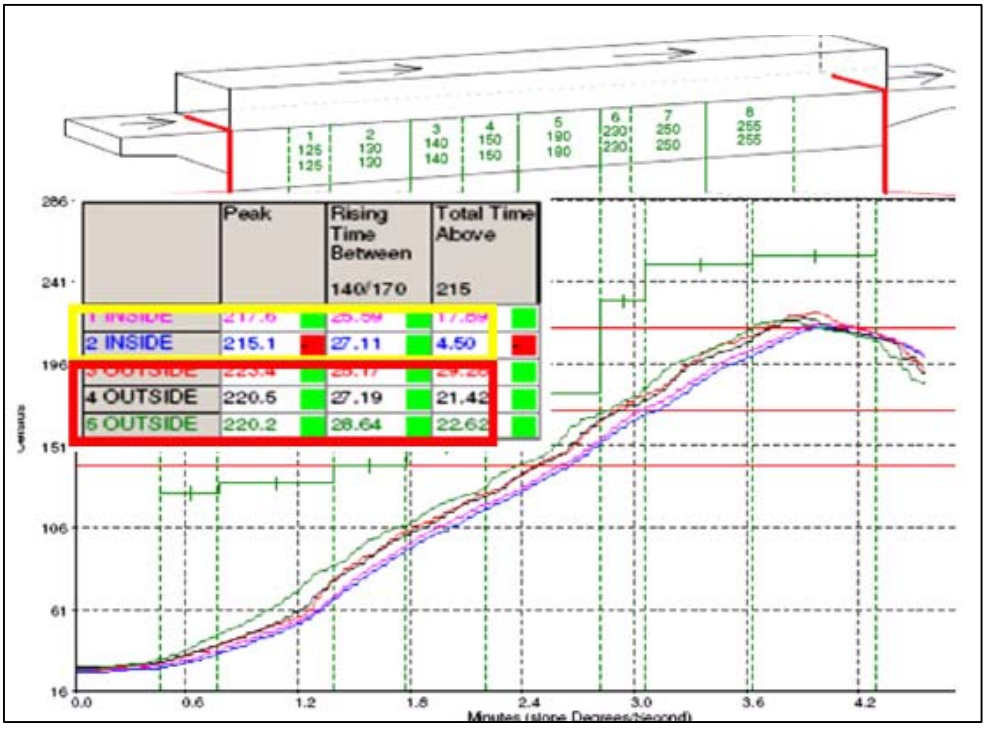
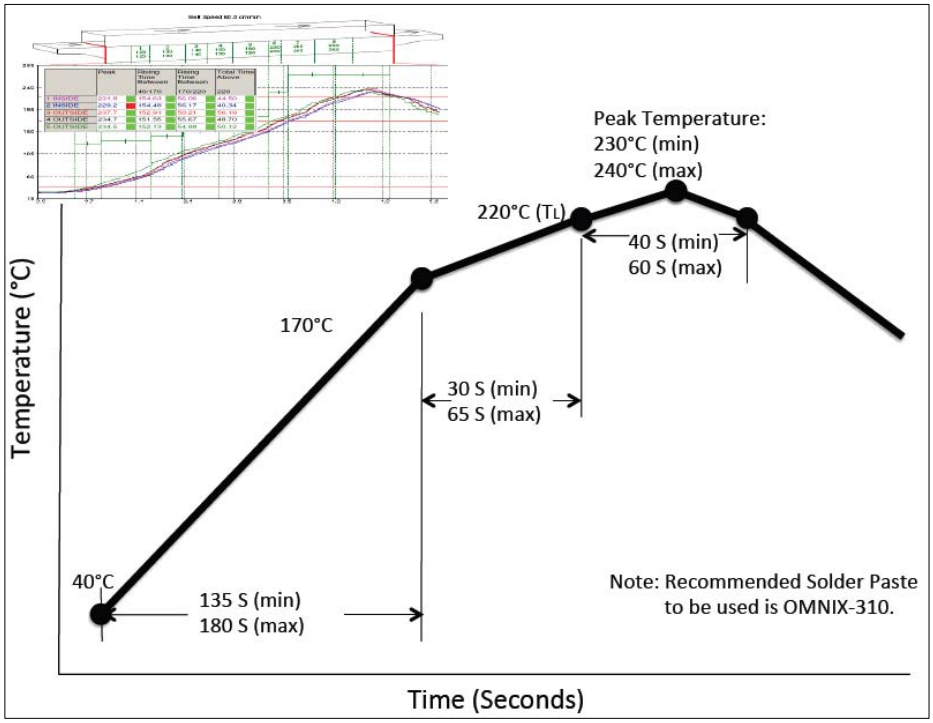


FIGURE 1-8: SOLDER REFLOW CURVE



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2.0 CIRCUIT DESCRIPTION (HARDWARE INTERFACE)

The following sections describe the module's hardware interface.

2.1 UART Interface

The UART interface supports 2-wire (RX, TX) and 4-wire configurations with hardware flow control (RX, TX, CTS, and RTS). The logic levels are CMOS voltage levels (not RS-232 voltage levels). The UART interface supports baud rates of 2,400; 4,800; 9,600; 19,200; 38,400; 115,200; and 230,400 bits per second. Refer to the "*WiFly Command Reference, Advanced Features and Applications User's Guide*" (DS50002230) for UART configuration information.

Note:	Use hardware flow control for baud rates of 115,200 and higher.

2.2 SPI Master Interface

The RN171 module contains a master SPI interface (SPI_CS, SPI_CLK, SPI_MISO, and SPI_MOSI) that is connected to an internal Flash memory. Do not connect these pins on the host PCB.

2.3 SDIO Client Interface

The RN171 modules contain an SDIO client with SD-SPI mode and interface (SD_CLK/SCLK, SD_D3/SS, SD-D2, SD_D1/INT, SD_D0/MISO, and SD_CMD/MOSI). This interface is not currently implemented in the WiFly command reference.

2.4 In-System Programming (ISP)

The ISP_TX, ISP_RX, and other pins allow in-system programming of the module. The module's firmware can be upgraded via ISP using a *.bin file.

Note:	The over-the-air FTP update image file (*.img) is not compatible with the ISP.

Though it is optional, it is recommended to place the ISP header on the host PCB to facilitate firmware upgrades during development and manufacturing. The header is two row by 8-pin with 0.050 inch space and pitch (Samtech P/N FTSH-108-01-F-DV-K). Refer to Figure 3-3 for information about connecting to the module for ISP. The RN-ISP in-system programming interface connects to the module for ISP. Refer to the RN-ISP product page on the Microchip web site for more information.

2.5 Analog Sensor Interface

Sensors (0-3) can be used to wake the module. The sensor pins are 1.2V tolerant. When sensor pins are used as sensor inputs, they accept input voltages up to 1.2V but saturate at 400 mV.

⚠ WARNING

DO NOT apply voltages greater than 1.2V on any of the sensor pins.

The 14-bit ADC requires a 35 ms conversion time with 0.01% linearity.

Additionally, the module has a low-power interface for interfacing sensors such as push buttons, accelerometers, security seals, and motion sensors.

2.6 Sensor Interface

The sensor can interface to:

- Four switch sensors
- A motion sensor for use with external ball-in-tube
- A pulsed comparator
- A Sample Measurement Unit (SMU) ADC
- A current generator for measurement

The switch sensors, motion sensors, and pulsed comparator are available when the module is awake or asleep. The SMU ADC is only available when the module is awake. The sensor elements share the module's eight sensor pins.

When the module is asleep, the sensor interface can be used to detect events such as a switch opening or closing, motion, or an analog voltage moving outside of a preset window. When the module is awake, the SMU can digitize the analog signals and make high-precision analog measurements.

2.7 General Purpose Input/Output (GPIO) Pins

The RN171 has 14 GPIO (GPIO1 through GPIO14) pins that can be commanded by ASCII commands. GPIO10 through GPIO14 pins have secondary functions for the UART (TX, RX, CTS, and RTS), while others can control connection modes, LEDs, etc.

Refer to the "*WiFly Command Reference, Advanced Features and Applications User's Guide*" (DS50002230) for information on configuring and controlling the module.

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2.8 Power Management

The module supports an ultra-low power sleep state, from which it can wake for a range of detected reasons. It transitions from asleep to CPU-active in 1.7 ms, and CPU active to network connection in less than 35 ms (typical). The RN171 also supports a keep-alive doze state that provides an instant transition to a wake state.

2.8.1 FORCE AWAKE

The RN171 may be forced awake by asserting the FORCE_AWAKE pin for at least 245 ms. If the FORCE_AWAKE pin remains asserted, the module is prevented from sleeping or dozing.

2.8.2 POWER SUPPLY

For supply voltages in the range of 3.0 to 3.7 volts, connect the module using the power supply (no boost circuit). Refer to Figure 3-1 for an example.

2.8.3 BATTERY BOOST CONTROL CIRCUIT

The RN171 includes a battery boost control circuitry for battery voltages in the range of 1.8 to 3.3V. Five external components as shown in Figure 3-2 make up the battery boost circuit.

⚠ WARNING

The battery boost circuit should not be operated with battery supply voltages above 3.3 volts.

2.9 Module Reset

There are several ways to Reset the module:

- A Power-On Reset is generated automatically when power is applied. This Reset is intended to initialize the module when a new battery is connected.
- Perform an external Power-On Reset by pulling the RESET pin low.
- Perform a soft Power-On Reset using software commands.
- A Reset can be triggered by a critical event, such as a brownout, generated if the supply voltage drops below the minimum operating voltage

2.9.1 BROWN-OUT DETECTION

The RN171 includes a brown-out detector that holds the module in Reset if the battery voltage falls below the minimum operating voltage.

Note: If the RN171 module is used in battery applications, it is highly recommended that a voltage supervisory device be employed.

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3.0 APPLICATION INFORMATION

The following sections provide application information, such as an application schematic and antenna information.

3.1 Schematic

Figure 3-1 and Figure 3-2 shows the RN171 application schematic for direct power and battery boost modes, respectively. Figure 3-3 shows a diagram with the optional ISP header.

FIGURE 3-1: RN171 APPLICATION SCHEMATIC – DIRECT POWER MODE

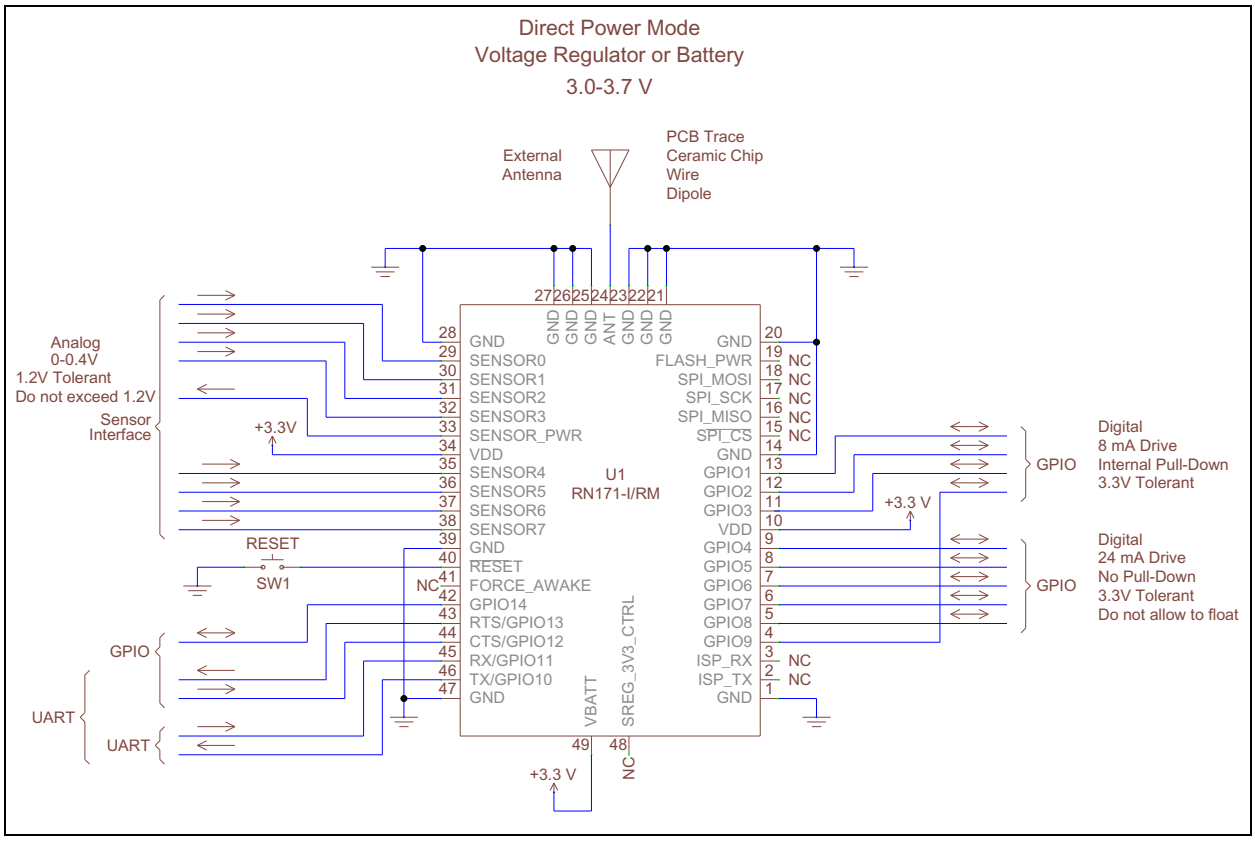


FIGURE 3-2: RN171 APPLICATION SCHEMATIC – BATTERY BOOST POWER MODE

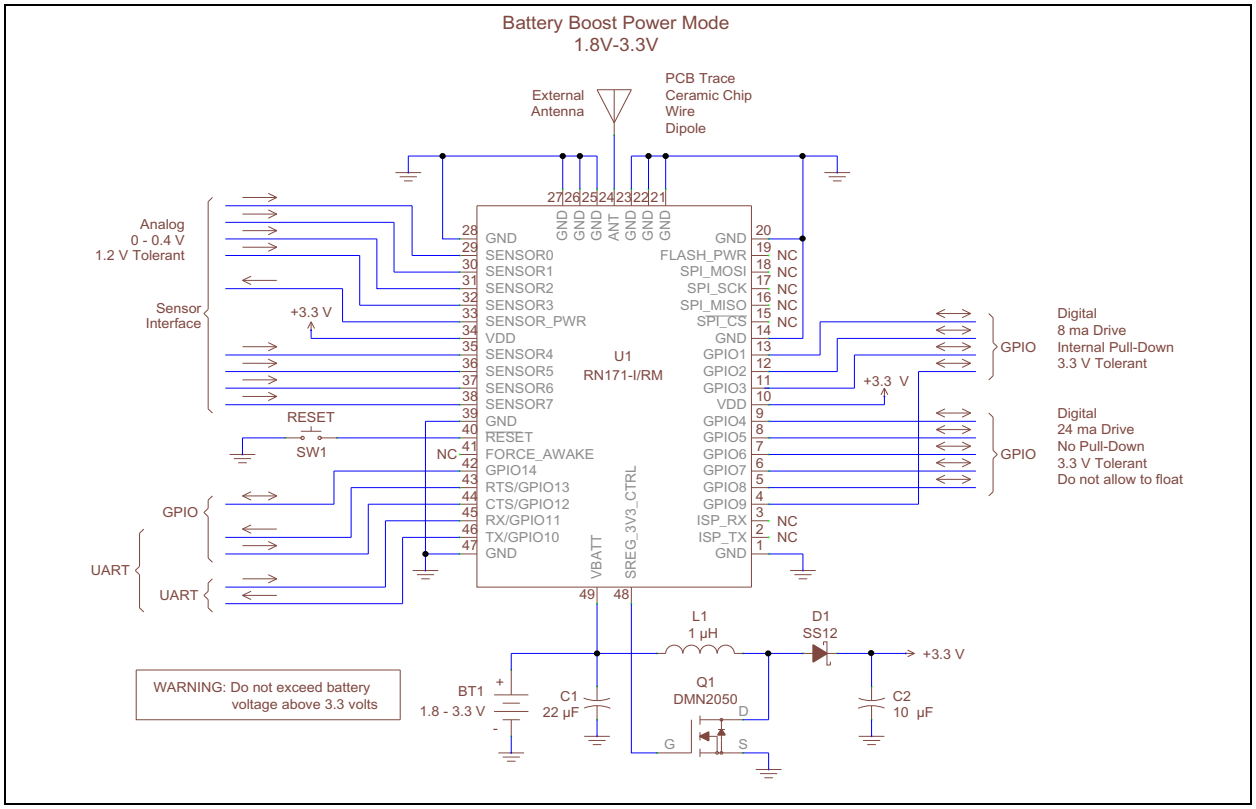
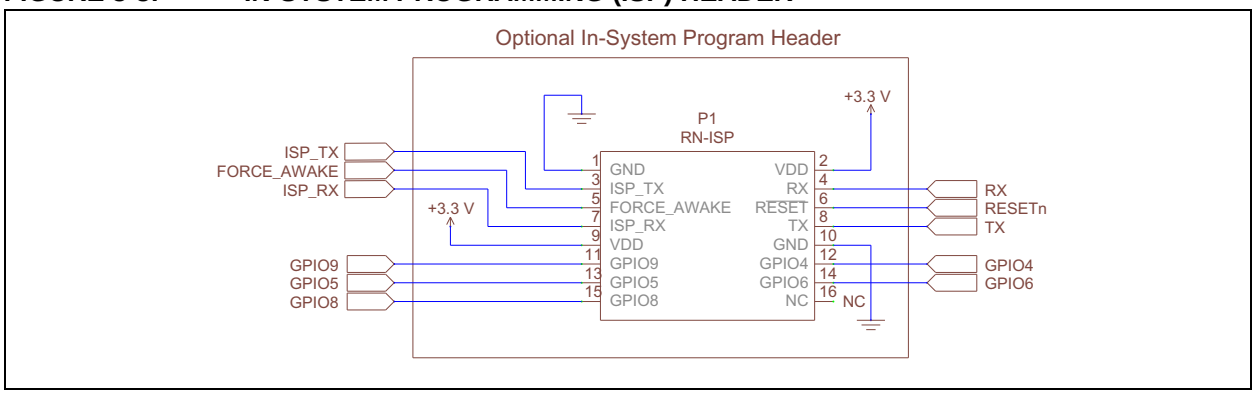


FIGURE 3-3: IN-SYSTEM PROGRAMMING (ISP) HEADER



3.2 External Antenna Types

The RN171 module has a 50Ω antenna connection on pin 24. Connect to an antenna through a host PCB micro-strip trace layout to an external connector, PCB trace antenna, or component (chip) antenna. This trace can be extended to include passive parts for antenna attenuation padding, impedance matching, or to provide test ports. Other components, such as amplifiers and active drivers, are not considered part of the trace layout and may void the RN171's modular certification.

It is recommended that the trace layout from pin 24 to the external connector or antenna be as short as possible for minimum loss and best impedance matching. If the trace layout is longer, it should be a 50Ω impedance microstrip or coplanar waveguide PCB trace.

Adjacent ground pins 21-23 and 25-27 should be connected to a low-impedance ground plane on the host PCB.

Modular certification of the RN171 module was performed with the external antenna types listed in Table 3-1. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Refer to Section 4.0, Regulatory Approval for specific regulatory requirements by country.

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TABLE 3-1: TESTED EXTERNAL ANTENNA TYPES

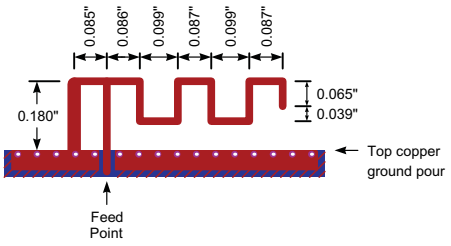
Type	Gain
PCB Trace	0 dBi
Chip	1.07 dBi
Wire	0 dBi
Whip	2.2 dBi

Note 1: An antenna type comprises antennas having similar in-band and out-of-band radiation patterns.

3.2.1 PCB TRACE ANTENNA

Modular certification of the RN171 module was performed with the PCB trace antenna shown in Figure 3-4. The exact dimensions of the trace antenna must be followed. Gerber files for the PCB trace antenna are available on the RN171 product web page on the Microchip web site at http://www.microchip.com/rn171.

FIGURE 3-4: PCB TRACE ANTENNA



Dimensions are in inches.

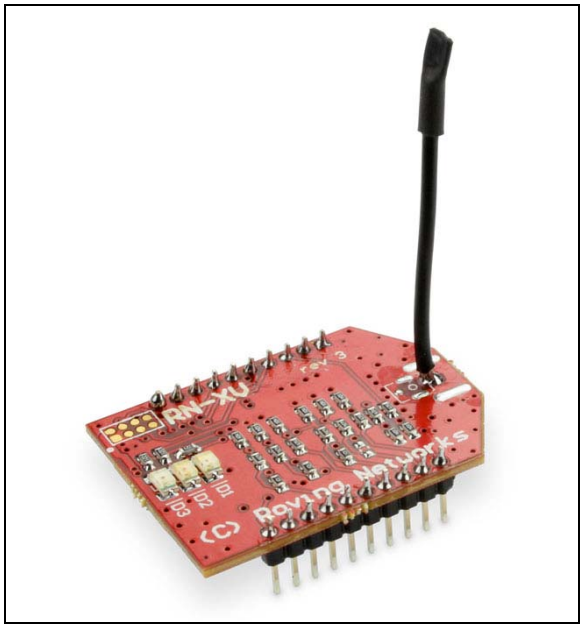
3.2.2 CHIP ANTENNA

Modular certification of the RN171 module was performed with the fractus (http://www.fractus.com) chip antenna part number FR05-S1-N-0-104. Peak gain listed in the data sheet is 1.07 dBi. Any chip antenna type may be used with the RN171 module provided the gain is equal to or less than 1.07 dBi, and having similar in-band and out-of-band radiation patterns as the fractus antenna. For proper operation of the chip antenna, refer to the data sheet for PCB footprint details and mounting considerations.

3.2.3 WIRE ANTENNA

Modular certification of the RN171 module was performed with the wire antenna shown in Figure 3-5.

FIGURE 3-5: WIRE ANTENNA

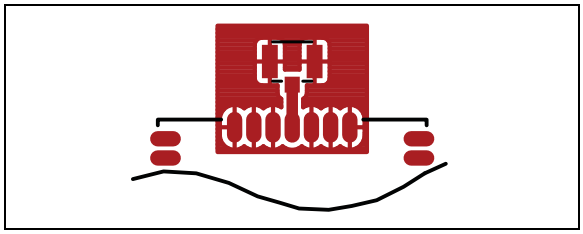


The antenna is an 18-gauge wire with a length of 1 inch ± 0.25. For best performance, the wire antenna should be perpendicular to a generous ground plane, preferably at least ¼ wavelength of 2.4 GHz (1.2 inches/30 mm).

3.2.4 WHIP ANTENNA

Modular certification of the RN171 module was performed with a whip antenna with a peak gain of 2.2 dBi. Any whip antenna type may be used with the RN171 module provided the gain is equal to or less than 2.2 dBi, and having similar in-band and out-of-band radiation patterns. Connection to the whip antenna can be by a U.FL. Figure 3-6 shows a suggested PCB layout for a U.FL connector.

FIGURE 3-6: U.FL CONNECTOR



NOTES:

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4.0 REGULATORY APPROVAL

This section outlines the regulatory information for the RN171 module for the following countries:

- United States
- Canada
- Europe
- Australia
- New Zealand
- Korea
- Other Regulatory Jurisdictions

4.1 United States

The RN171 module has received Federal Communications Commission (FCC) CFR47 Telecommunications, Part 15 Subpart C “Intentional Radiators” modular approval in accordance with Part 15.212 Modular Transmitter approval. Modular approval allows the end user to integrate the RN171 module into a finished product without obtaining subsequent and separate FCC approvals for intentional radiation, provided no changes or modifications are made to the module circuitry. Changes or modifications could void the user’s authority to operate the equipment. The end user must comply with all of the instructions provided by the Grantee, which indicate installation and/or operating conditions necessary for compliance.

The finished product is required to comply with all applicable FCC equipment authorizations regulations, requirements and equipment functions not associated with the transmitter module portion. For example, compliance must be demonstrated to regulations for other transmitter components within the host product; to requirements for unintentional radiators (Part 15 Subpart B “Unintentional Radiators”), such as digital devices, computer peripherals, radio receivers, etc.; and to additional authorization requirements for the non-transmitter functions on the transmitter module (i.e., Verification, or Declaration of Conformity) (e.g., transmitter modules may also contain digital logic functions) as appropriate.

4.1.1 LABELING AND USER INFORMATION REQUIREMENTS

The RN171 module has been labeled with its own FCC ID number, and if the FCC ID is not visible when the module is installed inside another device, then the outside of the finished product into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording as follows:

> Contains Transmitter Module FCC ID: T9J-RN171
>
> or
>
> Contains FCC ID: T9J-RN171
>
> This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

A user’s manual for the product should include the following statement:

> This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
>
> - Reorient or relocate the receiving antenna.
> - Increase the separation between the equipment and receiver.
> - Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
> - Consult the dealer or an experienced radio/TV technician for help.

Additional information on labeling and user information requirements for Part 15 devices can be found in KDB Publication 784748 available at the FCC Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB):
http://apps.fcc.gov/oetcf/kdb/index.cfm

4.1.2 RF EXPOSURE

All transmitters regulated by FCC must comply with RF exposure requirements. OET Bulletin 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, provides assistance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to Radio Frequency (RF) fields adopted by the Federal Communications Commission (FCC). The bulletin offers guidelines and suggestions for evaluating compliance.

If appropriate, compliance with exposure guidelines for mobile and unlicensed devices can be accomplished by the use of warning labels and by providing users with information concerning minimum separation distances from transmitting structures and proper installation of antennas.

The following statement must be included as a CAUTION statement in manuals and OEM products to alert users of FCC RF exposure compliance:

> To satisfy FCC RF Exposure requirements for mobile and base station transmission devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during operation. To ensure compliance, operation at closer than this distance is not recommended.
>
> The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other

If the RN171 module is used in a portable application (i.e., the antenna is less than 20 cm from persons during operation), the integrator is responsible for performing Specific Absorption Rate (SAR) testing in accordance with FCC rules 2.1091.

4.1.3 APPROVED EXTERNAL ANTENNA TYPES

To maintain modular approval in the United States, only the antenna types that have been tested shall be used. It is permissible to use different antenna manufacturers provided the same antenna type that has similar in-band and out-of-band radiation patterns and antenna gain (equal to or less than) is used.

Modular approval testing of the RN171 module was performed with the antenna types listed in Table 3-1.

4.1.4 HELPFUL WEB SITES

- Federal Communications Commission (FCC): http://www.fcc.gov
- FCC Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB): http://apps.fcc.gov/oetcf/kdb/index.cfm

4.2 Canada

The RN171 module has been certified for use in Canada under Industry Canada (IC) Radio Standards Specification (RSS) RSS-210 and RSSGen. Modular approval permits the installation of a module in a host device without the need to recertify the device.

4.2.1 LABELING AND USER INFORMATION REQUIREMENTS

Labeling Requirements for the Host Device (from Section 3.2.1, RSS-Gen, Issue 3, December 2010): The host device shall be properly labeled to identify the module within the host device.

The Industry Canada certification label of a module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labeled to display the Industry Canada certification number of the module, preceded by the words “Contains transmitter module”, or the word “Contains”, or similar wording expressing the same meaning, as follows:

> Contains transmitter module IC: 6514A-RN171

User Manual Notice for License-Exempt Radio Apparatus (from Section 7.1.3 RSS-Gen, Issue 3, December 2010): User manuals for license-exempt radio apparatus shall contain the following or equivalent notice in a conspicuous location in the user manual or alternatively on the device or both:

> This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.
>
> Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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Transmitter Antenna (from Section 7.1.2 RSS-Gen, Issue 3, December 2010): User manuals for transmitters shall display the following notice in a conspicuous location:

> Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.
>
> Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

The above notice may be affixed to the device instead of displayed in the user manual.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

> This radio transmitter (identify the device by certification number, or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.
>
> Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi) and required impedance for each.

4.2.2 APPROVED EXTERNAL ANTENNA TYPES

Transmitter Antenna (from Section 7.1.2 RSS-Gen, Issue 3, December 2010):

The RN171 module can only be sold or operated with antennas with which it was approved. Transmitter may be approved with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest gain antenna of each combination of transmitter and antenna type for which approval is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type having equal or lesser gain as an antenna that had been successfully tested with the transmitter, will also be considered approved with the transmitter, and may be used and marketed with the transmitter.

When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. For transmitters of output power greater than 10 milliwatts, the total antenna gain shall be added to the measured RF output power to demonstrate compliance to the specified radiated power limits.

Modular approval testing of the RN171 module was performed with the antenna types listed in Table 3-1.

4.2.3 HELPFUL WEB SITES

Industry Canada: http://www.ic.gc.ca/

4.3 Europe

The RN171 module is an R&TTE Directive assessed radio module that is CE marked and has been manufactured and tested with the intention of being integrated into a final product.

The RN171 module has been tested to R&TTE Directive 1999/5/EC Essential Requirements for Health and Safety (Article (3.1(a)), Electromagnetic Compatibility (EMC) (Article 3.1(b)), and Radio (Article 3.2) and are summarized in Table 4-1. A Notified Body Opinion has also been issued. All test reports are available on the RN171 product web page at http://www.microchip.com.

The R&TTE Compliance Association provides guidance on modular devices in document Technical Guidance Note 01 available at: http://www.rtteca.com/html/download_area.htm

Note: To maintain conformance to the testing listed in Table 4-1, the module shall be installed in accordance with the installation instructions in this data sheet and shall not be modified.

When integrating a radio module into a completed product the integrator becomes the manufacturer of the final product and is therefore responsible for demonstrating compliance of the final product with the essential requirements of the R&TTE Directive.

4.3.1 LABELING AND USER INFORMATION REQUIREMENTS

The label on the final product which contains the RN171 module must follow CE marking requirements. The R&TTE Compliance Association Technical Guidance Note 01 provides guidance on final product CE marking.

4.3.2 EXTERNAL ANTENNA REQUIREMENTS

From R&TTE Compliance Association document Technical Guidance Note 01:

Provided the integrator installing an assessed radio module with an integral or specific antenna and installed in conformance with the radio module manufacturer's installation instructions requires no further evaluation under Article 3.2 of the R&TTE Directive and does not require further involvement of an R&TTE Directive Notified Body for the final product. [Section 2.2.4]

The European Compliance Testing listed in Table 4-1 was performed using the antenna types listed in Table 3-1.

4.3.3 HELPFUL WEB SITES

A document that can be used as a starting point in understanding the use of Short Range Devices (SRD) in Europe is the European Radio Communications Committee (ERC) Recommendation 70-03 E, which can be downloaded from the European Radio Communications Office (ERO) at: http://www.ero.dk/.

Additional helpful web sites are:

- Radio and Telecommunications Terminal Equipment (R&TTE): http://ec.europa.eu/enterprise/rtte/index_en.htm
- European Conference of Postal and Telecommunications Administrations (CEPT): http://www.cept.org
- European Telecommunications Standards Institute (ETSI): http://www.etsi.org
- European Radio Communications Office (ERO): http://www.ero.dk
- The Radio and Telecommunications Terminal Equipment Compliance Association (R&TTE CA): http://www.rtteca.com/

TABLE 4-1: EUROPEAN COMPLIANCE TESTING

Certification	Standard	Article	Laboratory	Report Number	Date
Safety	EN 60950-1:2006+A11:2009+A1:2010+A12:2011	(3.1(a))	Worldwide Testing Services (Taiwan)	W6R21403-14023-62479	2014-05-13
Health	EN 62479(2010)			W6R21403-14023-L	2014-05-13
EMC	EN 301 489-1 : V1.9.2 (2011)	(3.1(b))		W6R21403-14023-E-16	2014-05-13
	EN 301 489-17: V2.2.1 (2012)				
Radio	EN 300 328 : V1.8.1 (2012)	(3.2)		W6R21403-14023-T-45	2014-05-13
Notified Body Opinion	CE0681		Eurofins	U9M21103-4249-C	2011-04-13

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4.4 Australia

The Australia radio regulations do not provide a modular approval policy similar to the United States (FCC) and Canada (IC). However, RN171 module RF transmitter test reports can be used in part to demonstrate compliance in accordance with ACMA Radio communications “Short Range Devices” Standard 2004 (The Short Range Devices standard calls up the AS/NZS 4268:2008 industry standard). The RN171 module test reports can be used as part of the product certification and compliance folder. For more information on the RF transmitter test reports, contact Microchip Technology Australia sales office.

To meet overall Australian final product compliance, the developer must construct a compliance folder containing all relevant compliance test reports e.g. RF, EMC, electrical safety and DoC (Declaration of Conformity) etc. It is the responsibility of the integrator to know what is required in the compliance folder for ACMA compliance. All test reports are available on the RN171 product web page at http://www.microchip.com. For more information on Australia compliance, refer to the Australian Communications and Media Authority web site http://www.acma.gov.au/.

4.4.1 EXTERNAL ANTENNA REQUIREMENTS

The compliance testing listed in Table 4-1 was performed using the antenna types listed in Table 3-1.

4.4.2 HELPFUL WEB SITES

The Australian Communications and Media Authority: www.acma.gov.au/.

4.5 New Zealand

The New Zealand radio regulations do not provide a modular approval policy similar to the United States (FCC) and Canada (IC). However, RN171 module RF transmitter test reports can be used in part to demonstrate compliance against the New Zealand “General User Radio License for Short Range Devices”. New Zealand Radio communications (Radio Standards) Notice 2010 calls up the AS / NZS 4268:2008 industry standard. The RN171 module test reports can be used as part of the product certification and compliance folder. All test reports are available on the RN171 product web page at http://www.microchip.com. For more information on the RF transmitter test reports, contact Microchip Technology sales office.

Information on the New Zealand short range devices license can be found in the following web links:

- http://www.rsm.govt.nz/cms/licensees/types-oflicence/general-user-licences/short-range-devices
- http://www.rsm.govt.nz/cms/policy-and-planning/spectrum-policy-overview/legislation/gazette-notices/product-compliance/

To meet overall New Zealand final product compliance, the developer must construct a compliance folder containing all relevant compliance test reports e.g. RF, EMC, electrical safety and DoC (Declaration of Conformity) etc. It is the responsibility of the developer to know what is required in the compliance folder for New Zealand Radio communications. For more information on New Zealand compliance, refer to the web site http://www.rsm.govt.nz/.

4.5.1 EXTERNAL ANTENNA REQUIREMENTS

The compliance testing listed in Table 4-1 was performed using the antenna types listed in Table 3-1.

4.5.2 HELPFUL WEB SITES

Radio Spectrum Ministry of Economic Development: http://www.rsm.govt.nz/.

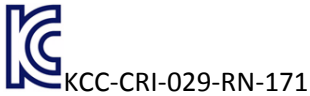
4.6 Korea

The RN171 module has received certification of conformity in accordance with the Radio Waves Act. Integration of this module into a final product does not require additional radio certification provided installation instructions are followed and no modifications of the module are allowed.

4.6.1 LABELING AND USER INFORMATION REQUIREMENTS

The label on the final product which contains the RN171 module must follow KC marking requirements. The integrator of the module should refer to the labeling requirements for Korea available on the Korea Communications Commission (KCC) website.

The RN171 module is labeled with its own KC mark. The final product requires the KC mark and certificate number of the module:



4.6.2 EXTERNAL ANTENNA REQUIREMENTS

The Korea compliance testing was performed using the antenna types listed in Table 3-1.

4.6.3 HELPFUL WEB SITES

- Korea Communications Commission (KCC): http://www.kcc.go.kr
- National Radio Research Agency (RRA): http://rra.go.kr

4.7 Taiwan

The RN171 module has received compliance approval in accordance with the Telecommunications Act. Customers seeking to use the compliance approval in their product should contact Microchip Technology sales or distribution partners to obtain a Letter of Authority.

Integration of this module into a final product does not require additional radio certification provided installation instructions are followed and no modifications of the module are allowed.

4.8 Other Regulatory Jurisdictions

Should other regulatory jurisdiction certification be required by the customer, or the customer need to recertify the module for other reasons, a certification utility is available. For further regulatory certification utility and documentation, contact your local Microchip Technology sales office.

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5.0 ELECTRICAL CHARACTERISTICS

TABLE 5-1: ENVIRONMENTAL CONDITIONS

Parameter	Value
Temperature Range (Operating)	-40° C-85° C
Temperature Range (Storage)	-40° C-85° C
Relative Humidity (Operating)	≤ 90%
Relative Humidity (Storage)	≤ 90%
Moisture Sensitivity Level	1

TABLE 5-2: ELECTRICAL CHARACTERISTICS (PROVISIONAL)

Supply Voltage	Min	Typ	Max	Units
Supply Voltage (VBATT Option)	3.0	3.3	3.7	VDC
Digital Input				
Input Logic High VIH	2.3			VDC
Input Logic Low VIL			1.0	VDC
Digital Output Drive				
GPIO 4, 5, 6, 7, 8		24		mA
GPIO 9, 10, 11, 12, 13		8		mA
Power Consumption				
Sleep		4		µA
Standby (Doze)		15		mA
Connected (Idle, RX)		40		mA
Connected (TX) 0 dBm		120		mA
Connected (TX) 12 dBm		190		mA

TABLE 5-3: MODULE DIMENSIONS

Parameters	Dimensions	Units
Size	26.67 x 17.78 x 3.18	mm

TABLE 5-4: ANALOG SENSOR INPUTS

Parameters	Value
Sensor 0, 1, 2, 3 Wakeup Detection Threshold	500 mV
AD Sensor 0-7 Measurement Range	0-400 mV **(Do not exceed 1.2V DC)**
Resolution	14 bits = 12 µV
Accuracy	5% Uncalibrated, 0.01% Calibrated
Minimum Conversion Time	35 µs (5 kHz over Wi-Fi)
Sensor Power (Pin 33) Output Resistance 3.3V	10 Ω, Maximum Current = 50 mA

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TABLE 5-5: RADIO CHARACTERISTICS

Parameters	Specification
Frequency	2.412 to 2.462 GHz
Modulation	802.11b Compatibility: DSSS (CCK-11, CCK-5.5, DQPSK-2, DBPSK-1) 802.11g: OFDM
Channel Intervals	5 MHz
Channels	1-11
Transmission Rate (Over the Air)	1-11 Mbps for 802.11b/6-54 Mbps for 802.11g
Receive Sensitivity	-83 dBm Typical
Output Level (Class1)	-2 dBm to +12 dBm (Configurable via Software)

TABLE 5-6: TRANSMITTER AC CHARACTERISTICS

Output Power	802.11 b (2 Mbps) Current in mA(1)	802.11 g (24 Mbps) Current in mA(1)
0	120	135
2	130	150
4	170	190
6	175	200
8	180	210
10	185	225
12	190	240

Note 1: Measured at 3.3V DC VCC. The power consumption is the average power, active during actual power consumption.

TABLE 5-7: BOOST (3.3V) REGULATOR CHARACTERISTICS

Parameter	Min.	Typ.	Max.	Units	Test Conditions/Comments
Input Voltage	1.8	—	3.3	V	
Output Voltage (VDD_3V3)	—	3.3	—	V	
Maximum Output Current	—	—	350	mA	
Conversion Efficiency	—	80	—	%	
Switching Frequency	—	500	—	kHz	
Load Capacitance	—	20	—	µF	Ceramic X5R or X7R
Switch Element Drive Current	—	100	—	mA	

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APPENDIX A: REVISION HISTORY

A.1 Revision A (February 2014)

This is the initial released version of the document in the Microchip format. This replaces Roving Networks RN171 Data Sheet.

A.2 Revision B (September 2016)

This revision includes the following changes.

TABLE A-1: MAJOR SECTION UPDATES

Section	Update Description
"Compliance:"	Updated Figure 1.
4.0"Regulatory Approval"	Updated Table 4-1.

NOTES:

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

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

NOTES:

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PRODUCT IDENTIFICATION SYSTEM

To order parts, including industrial, or obtain information, for e.g., on pricing or delivery, refer to the factory or the listed sales office.

PART NO.	I	RM	XXX
Device	Temp Range	Radio Module	Firmware Revision Number

Device	RN171; VDD range 3.0V to 3.7V
Temperature Range	I = -40°C to +85°C (Industrial Temperature)

Examples:

a) RN171-I/RM = Industrial Temp

NOTES:

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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.
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