

OVERVIEW

- Host data rates up to 921 Kbps TX, 500 Kbps RX for the UART, up to 2 Mbps over the SPI slave
- Intelligent, built-in power management with programmable wakeup
- Real-time clock for time stamping, auto-sleep, and auto-wakeup
- Configuration using simple ASCII commands
- Software controlled transmit power (0 to 10 dBm) for ultra-low-power applications
- Memory: 128-KB RAM, 2-MB ROM, 2-KB battery-backed memory, 8-Mbit flash
- Secure Wi-Fi authentication using WEP-128, WPA-PSK (TKIP), and WPA2-PSK (AES)
- Built-in networking applications: DHCP, UDP, DNS, ARP, ICMP, TCP, and HTML client
- 802.11 power save and roaming functions
- Castellated pads for reliable soldering

The module's moisture sensitivity level (MSL) is 1. The modules size and weight are:

- *Size*—1.06 x 0.70 x 0.12 inches (27 x 18 x 3.1 mm)
- *Weight*—0.09 oz

Tables 1 through 5 provide detailed specifications for the module.

Table 1. Environmental Conditions

Parameter	RN-171
Temperature Range (Operating)	-40 °C ~ +85 °C
Temperature Range (Storage)	-40 °C ~ +85 °C
Relative Humidity (Operating)	≤90%
Relative Humidity (Storage)	≤90%

Table 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		uA
Standby (doze)		-	15	-	mA
Connected (idle, RX)			40		mA
Connected (TX)*	0 dBm		120		mA
	12 dBm		190		mA

Table 3. Analog Sensor Inputs

Parameter	Value
Sensor 0, 1, 2, 3 wakeup detection threshold	500 mV
AD sensor 0 - 7 measurement range	0 - 400 mV (Do not exceed 1.2-V DC)
Resolution	14 bits = 12uV
Accuracy	5% un-calibrated, .01% calibrated
Minimum conversion time	35 us (5 kHz over Wi-Fi)
Sensor power (pin 33) output resistance 3.3V	10 ohms, maximum current = 50 mA

Table 4. Radio Characteristics

Parameter	Specifications
Frequency	2,402 ~ 2,480 MHz
Modulation	802.11b compatibility: DSSS (CCK-11, CCK-5.5, DQPSK-2, DBPSK-1) 802.11g: OFDM (default)
Channel intervals	5 MHz
Channels	1 – 14
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. Transmit Power

Output Power	802.11 b (2 Mbps) Current in mA <i>Note (1)</i>	802.11 g (24 Mbps) Current in mA <i>Note (1)</i>
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 3.3-V DC VCC. The power consumption is the average power, active during actual power consumption.

TYPICAL APPLICATION SCHEMATIC

Figure 2 shows a typical application schematic with a battery boost circuit; Figure 3 shows a typical schematic with a linear regulator.

Figure 2. Application Schematic with Battery Boost Circuit

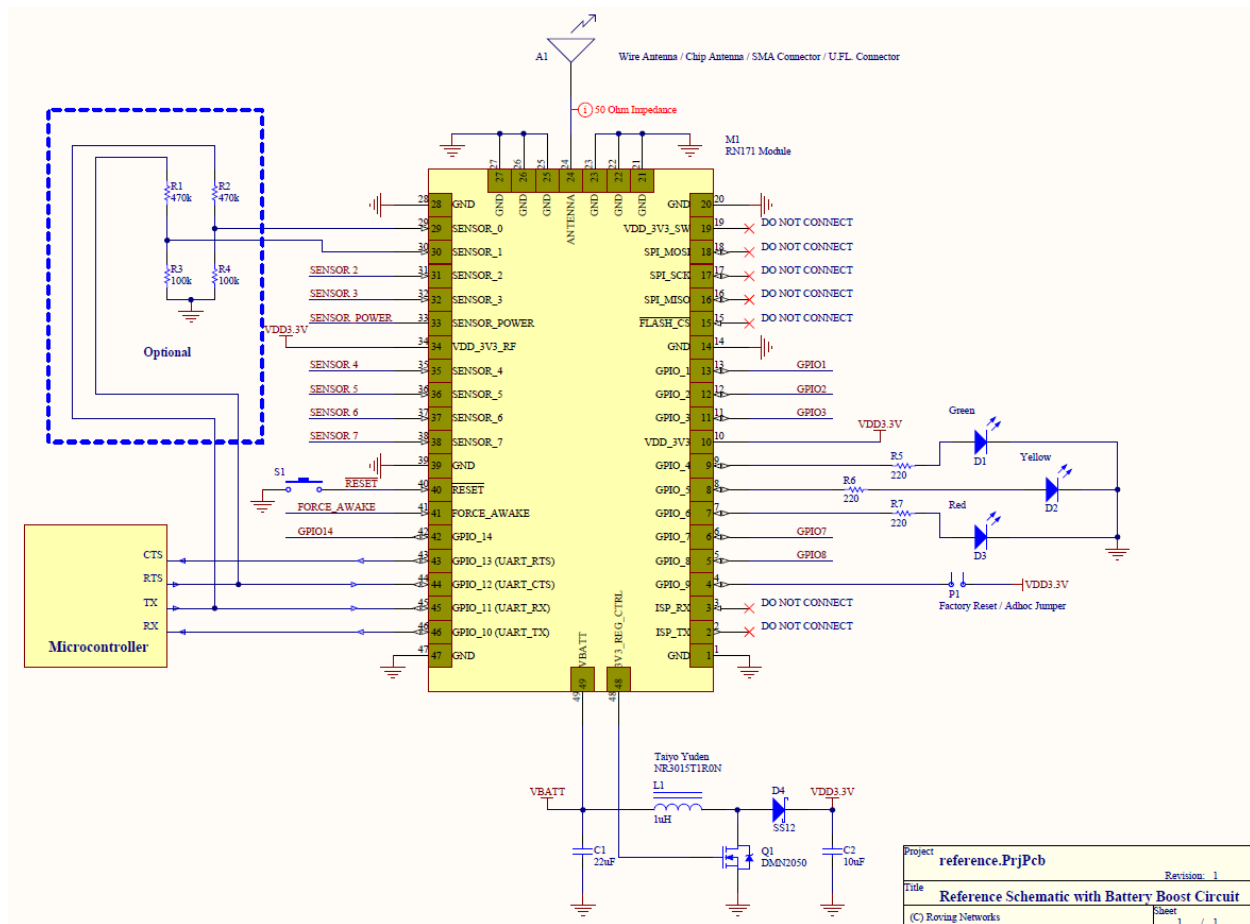


Figure 3. Typical Application Circuit with Linear Regulator

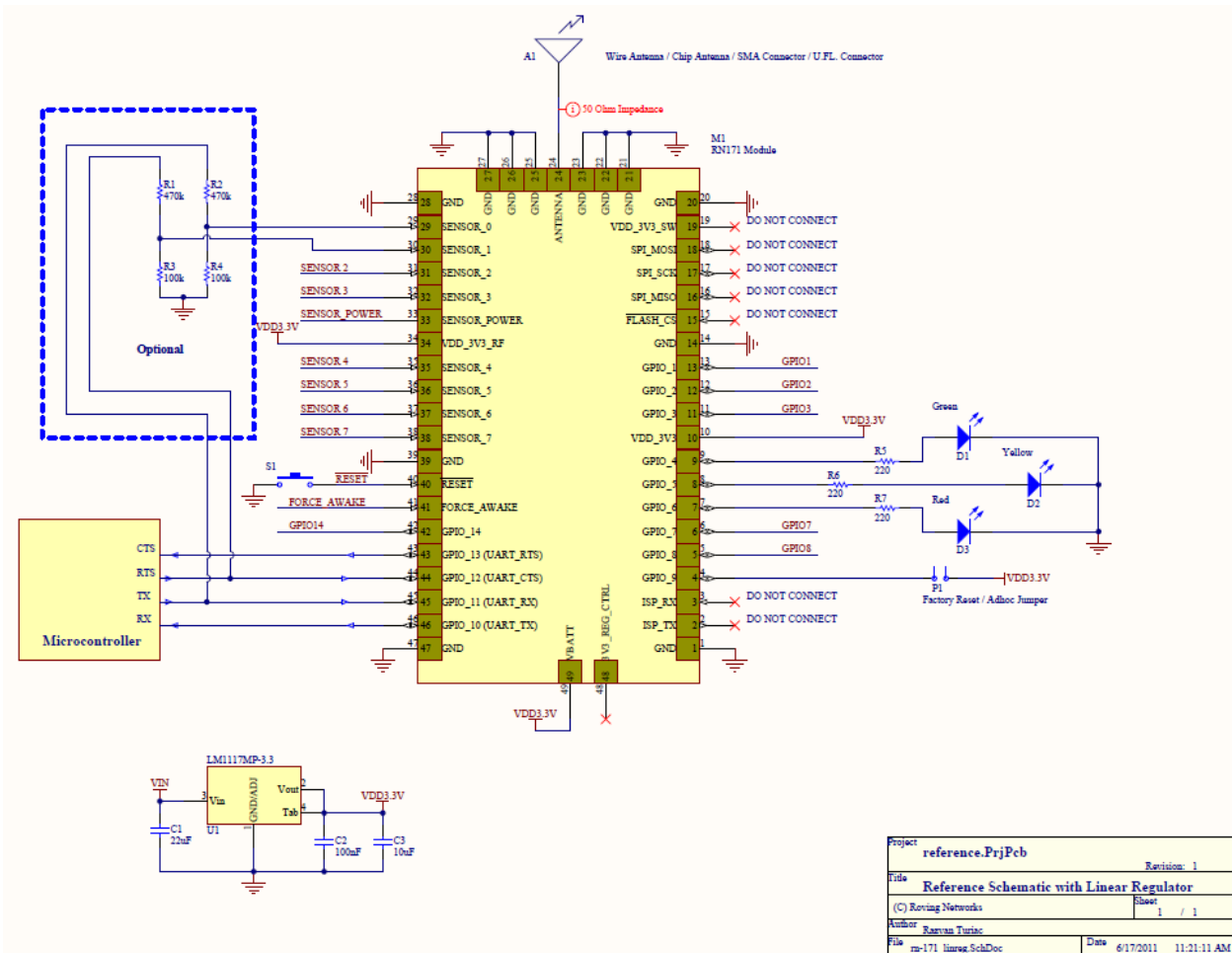


Figure 4 shows the pin pads and Table 6 describes the pins.

Figure 4. Pin Pads

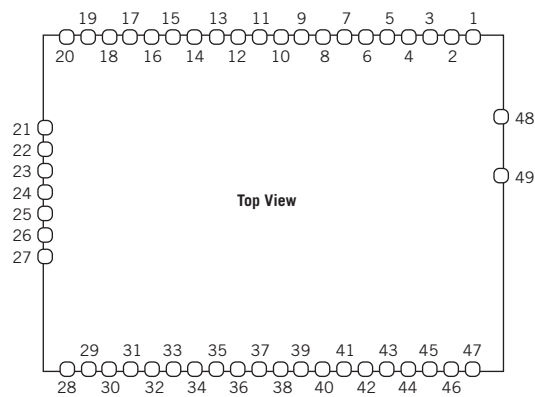


Table 6. Pin Description

Pad Number	Signal Name	Description	Optional Function	Direction Note (1)
1	GND	Ground.		-
2	Unused	Do not connect.		No Connect
3	Unused	Do not connect.		No Connect
4	GPIO9	Enable ad hoc mode, restore factory defaults, 8 mA drive, 3.3-V tolerant.		I/O
5	GPIO8	GPIO, 24-mA drive, 3.3-V tolerant. The RN-171 drives GPIO8 HIGH on powerup, which overrides software configured powerup values, such as set sys value 0x0000 on GPIO8.		I/O
6	GPIO7	GPIO, 24-mA drive, 3.3-V tolerant.		I/O
7	GPIO6	GPIO, 24-mA drive, 3.3-V tolerant, connection status on Roving Networks' firmware.	Status of access point association	I/O
8	GPIO5	GPIO, 24-mA drive, 3.3-V tolerant.	Data Tx/Rx status	I/O
9	GPIO4	GPIO, 24-mA drive, 3.3-V tolerant.	Connected over TCP status	I/O
10	VDD_3.3V	3.3-V power supply.		
11	GPIO3	GPIO, 8-mA drive, 3.3-V tolerant.		I/O
12	GPIO2	GPIO, 8-mA drive, 3.3-V tolerant.		I/O
13	GPIO1	GPIO, 8-mA drive, 3.3-V tolerant.		I/O
14	GND	Ground.		-
15	Unused	Do not connect.		No Connect
16	Unused	Do not connect.		No Connect
17	Unused	Do not connect.		No Connect
18	Unused	Do not connect.		No Connect
19	Unused	Do not connect.		No Connect
20	GND	Ground.		-
21, 22, 23	GND	Ground.		-
24	ANTENNA	802.11b/g 2.4-GHz antenna.		-
25, 26, 27	GND	Ground.		-
28	GND	Ground.		-
29	SENSOR 0 (2), (3)	Sensor interface, analog input to module, 1.2-V tolerant .		Input
30	SENSOR 1 (2), (3)	Sensor interface, analog input to module, 1.2-V tolerant .		Input
31	SENSOR 2 (2), (3)	Sensor interface, analog input to module, 1.2-V tolerant .		Input
32	SENSOR 3 (2), (3)	Sensor interface, analog input to module, 1.2-V tolerant .		Input
33	SENSOR POWER	Output voltage from module, 3.3 V max.		-
34	VDD_3.3V_RF	3.3-V RF power supply (connect to 3.3-V rail).		-
35	SENSOR 4 (3)	Sensor interface, analog input to module, 1.2-V tolerant .		Input
36	SENSOR 5 (3)	Sensor interface, analog input to module, 1.2-V tolerant .		Input
37	SENSOR 6 (3)	Sensor interface, analog input to module, 1.2-V tolerant .		Input
38	SENSOR 7 (3)	Sensor interface, analog input to module, 1.2-V tolerant .		Input
39	GND	Ground.		-
40	RESET	<i>Optional</i> module reset signal (active low), 100-k pull up, apply pulse of at least 160 us, 3.3-V tolerant.		Input
41	FORCE_AWAKE	<i>Optional</i> module awake signal (active high), 100-k pull down, apply pulse of at least 260 us, 3.3-V tolerant.		Input
42	GPIO 14	GPIO, 8 mA drive, 3.3-V tolerant.		I/O

Pad Number	Signal Name	Description	Optional Function	Direction Note (1)
43	UART_RTS	UART RTS flow control, 8-mA drive, 3.3-V tolerant.		Output
44	UART_CTS	UART CTS flow control, 3.3-V tolerant.		Input
45	UART_RX	UART RX, 3.3-V tolerant.		Input
46	UART_TX	UART TX, 8-mA drive, 3.3-V tolerant.		Output
47	GND	Ground.		-
48	SREG_3V3_CTRL	Boost regulator control.		Output
49	VDD-BATT	Battery input, 2.0 - 3.3 V with boost regulator in use, connect to VDD if not using boost regulator.		-

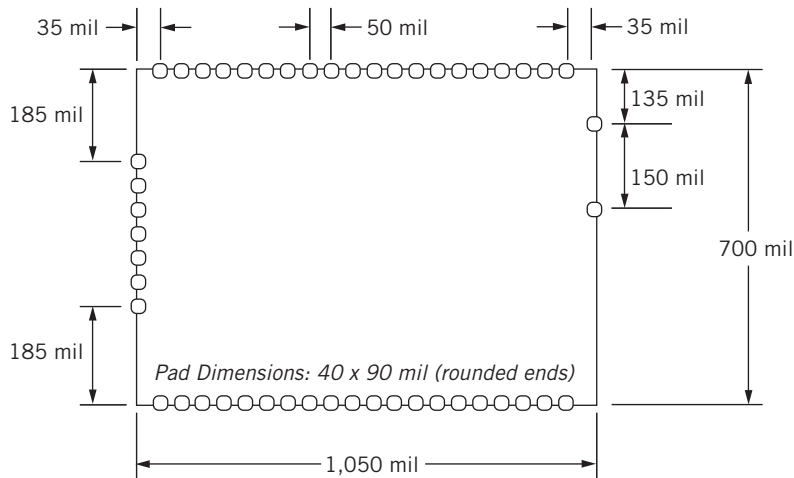
Notes:

1. Signals marked as input are inputs to the RN-171 module. Signals marked as output are outputs from the module.
2. Any of the sensors 0 - 3 can be used to wake the module. The sensor pins are 1.2-V tolerant. DO NOT apply 3.3-V on these pins. DO NOT apply 3.3-V on any of sensor pins.
3. When sensor pins are used as sensor inputs, they saturate at 400 mV. Sensor pins will accept input voltages up to 1.2 V but will saturate at 400 mV. DO NOT apply 3.3 V on any of sensor pins.

Figure 5 shows the module's physical dimensions.

Figure 5. Module Physical Dimensions

1 mil = 0.0254 millimeters



DESIGN CONCERNS

The following sections provide information on designing with the RN-171 module, including antenna design, solder reflow, boost regulator, etc.

Antenna Design

The RN-171 supports several antenna designs, including a PCB trace antenna, chip antenna, wire antenna, and U.FL connector.

PCB Trace Antenna

Figure 6 shows Roving Networks' recommended PCB trace antenna pattern. The antenna ground should be connected to the ground plane and/or ground polygon on both the top and bottom layers with at least 2 vias. The ground plane should come close to the antenna, exactly as shown in Figure 6; the distance is critical. There should be no ground plane/trace under the antenna under any circumstances.

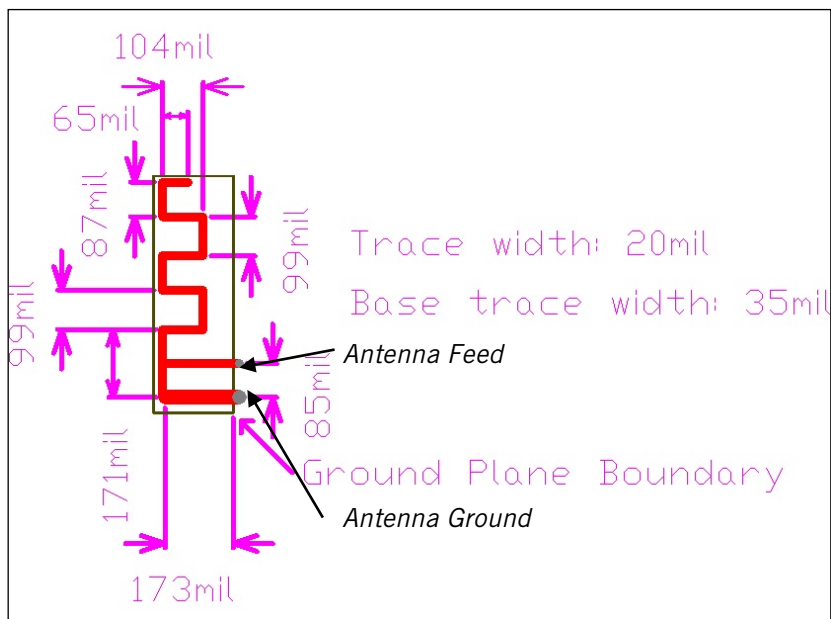
The antenna feed goes through the polygon on a 50-ohm impedance trace to the source of the signal. Unless the antenna trace is exactly 50 ohms and the source has a 50-ohm output impedance, you should use a matching PI filter (2 capacitors and an inductor).

The left side of the antenna should be placed on the PCB edge. If that is not possible, leave at least 1 inch of clearance from any trace or ground plane. The top and bottom of the antenna (the shorter side) should be placed on the PCB edge or should have at least 1-inch clearance from any trace or ground plane.

To control the impedance of the antenna feed the board should be 4 layers with a dedicated ground plane and a thickness of around 8 - 14 mils between the ground plane and the top layer (where the antenna feed is routed).

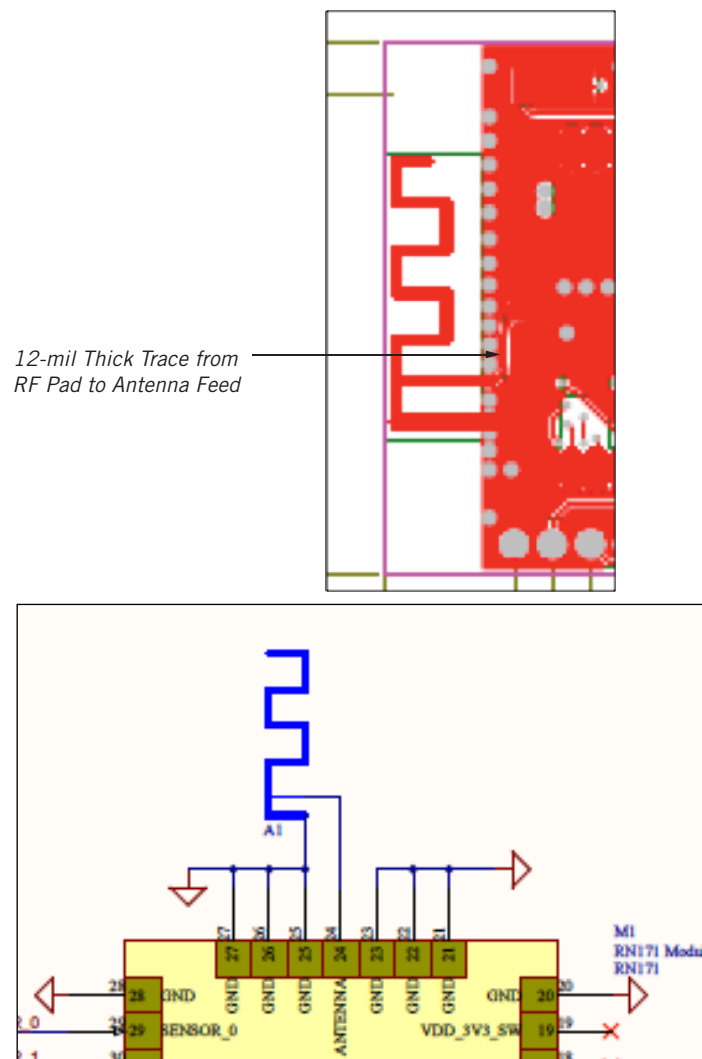
A 2-layer board would not be thin enough to obtain the desired impedance using an acceptable trace width.

Figure 6. PCB Trace Antenna Pattern



The trace from the RF pad to the antenna feed should be 12 mils thick on a 4-layer PCB to achieve 50 ohms of impedance matching as shown in Figure 7.

Figure 7. Trace from RF Pad to Antenna Feed

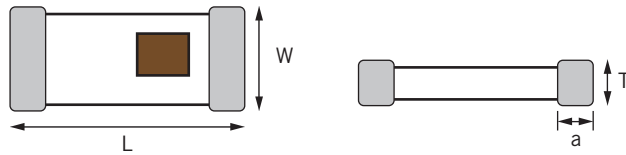


Chip Antenna

If your design uses a chip antenna, Roving Networks recommends the 2450AT42A100 manufactured by Johanson. Refer to the antenna's data sheet for additional information such as dimensions, mounting considerations, and radiation patterns. Figure 8 shows the antenna dimensions.

Figure 8. 450AT42A100 Chip Antenna Dimensions

	Inches	mm
L	0.197 ± 0.0008	5.00 ± 0.20
W	0.079 ± 0.0008	2.00 ± 0.20
T	0.043 ± 0.0008	1.10 ± 0.20
a	0.020 ± 0.0012	0.50 ± 0.30



Terminal Configuration	
No.	Function
1	Feeding Point
2	No Connect

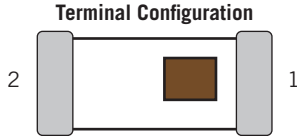


Figure 9 shows the chip antenna's mounting considerations.

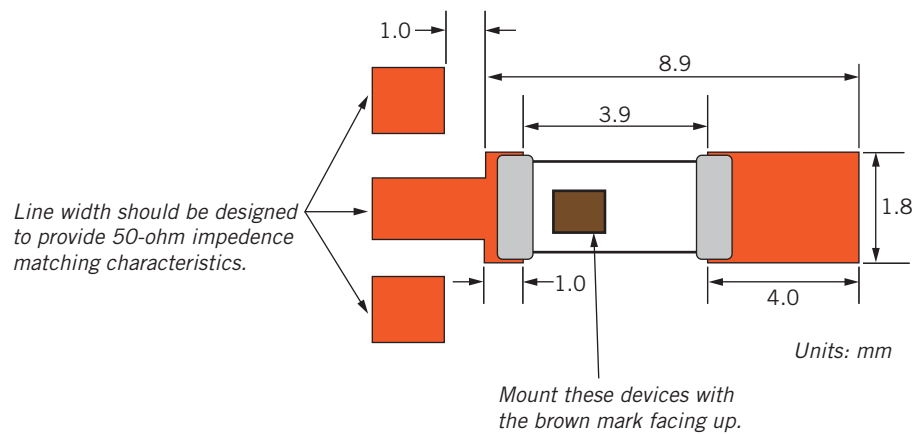
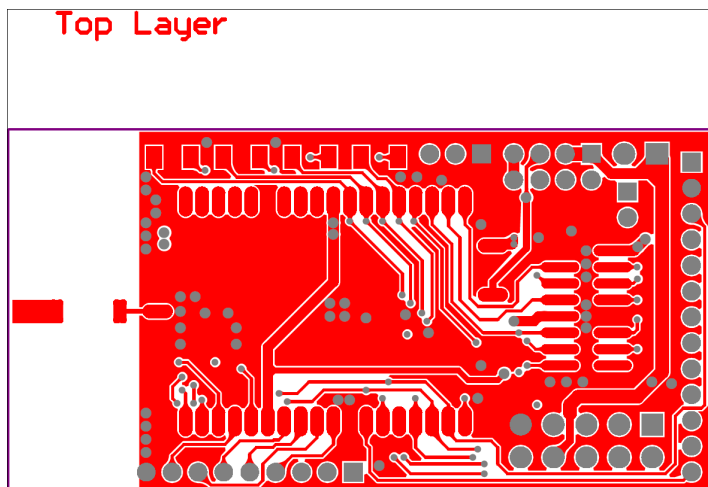
Figure 9. Chip Antenna Mounting Considerations


Figure 10 shows the recommended chip antenna layout.

Figure 10. Recommended Chip Antenna Layout


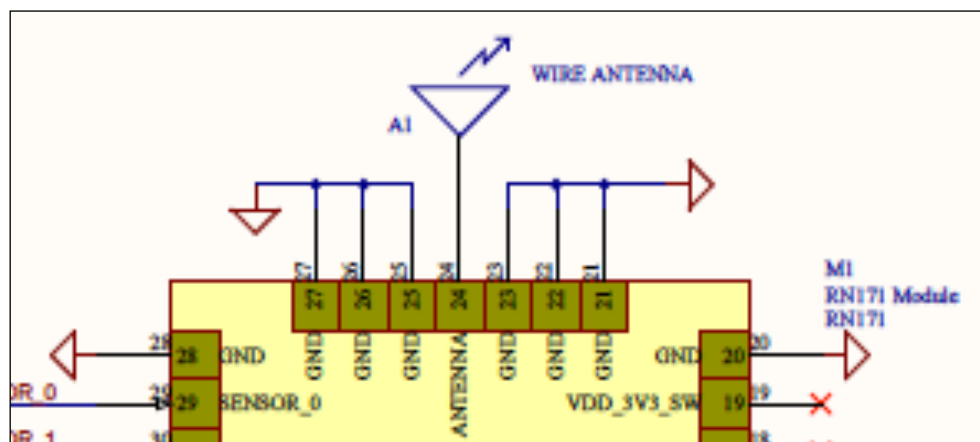
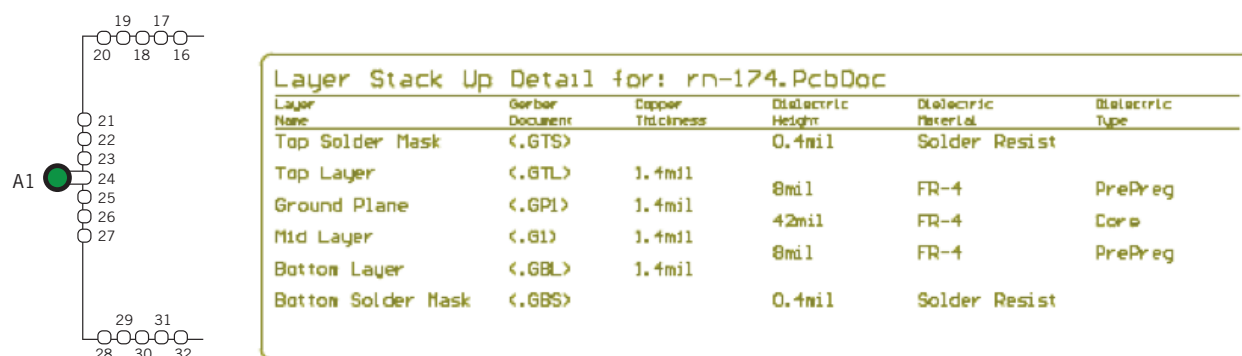
The feed connecting the antenna to the RF pad must be 50 ohm in impedance. If this feed is shorter than 0.2" the board can be 2 layers and the thickness of the feed is the same as described in the manufacturer's data sheet. If the trace is longer, you need a 4-layer board with controlled impedance, i.e., a ground plane directly under the top layer. The thickness should be calculated accordingly.

Wire Antenna

To implement a wire antenna, drill a hole through the board on the RF pad (pin 24) to place the wire antenna. To provide 50 ohms of impedance matching, the RF path from the RF pad (Pin 24) to the location of the wire antenna should be 12 mils thick on a 4-layer PCB. See Figure 11. Roving Networks recommends that you use an 18-gauge wire with a length of 1 inch \pm 0.25. For best performance, the wire antenna should be perpendicular to the ground plane.

NOTE: There should be no thermal relief connectors on GND for RF path and on the ground plane.

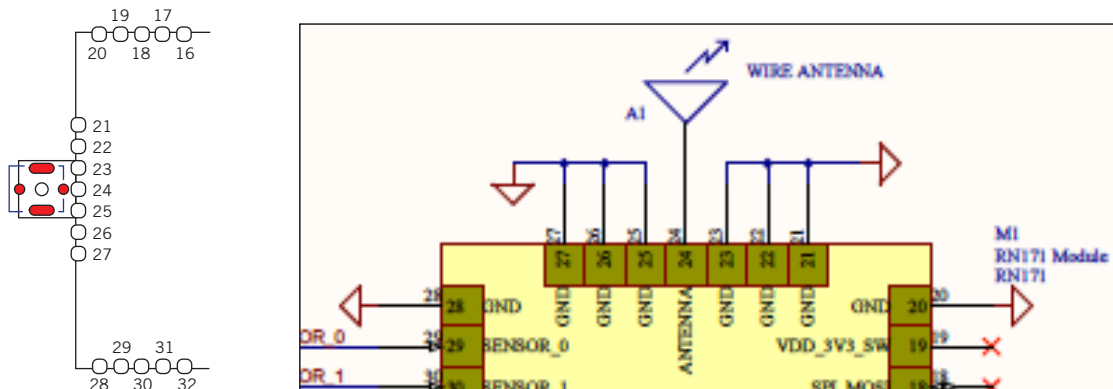
Figure 11. Wire Antenna Location



U.FL Connector

Figure 12 shows one option for implementing a U.FL connector. The trace from the RF pad to the U.FL connector should be 12 mils thick to achieve 50 ohms of impedance matching on a 4-layer board. The part number of the U.FL connector used for certification of the module is U.FL-R-SM from Hirose.

Figure 12. U.FL Connector



Layer Stack Up Detail for: rn-174.PcbDoc

Layer Name	Gerber Document	Copper Thickness	Dielectric Height	Dielectric Material	Dielectric Type
Top Solder Mask	<.GTS>		0.4mil	Solder Resist	
Top Layer	<.GTL>	1.4mil	8mil	FR-4	PrePreg
Ground Plane	<.GPI>	1.4mil	42mil	FR-4	Core
Mid Layer	<.GI>	1.4mil	8mil	FR-4	PrePreg
Bottom Layer	<.GBL>	1.4mil			
Bottom Solder Mask	<.GBS>		0.4mil	Solder Resist	

Using Batteries

The RN-171 module does not have a boost regulator circuit. The battery choice is absolutely critical because if the battery voltage drops below 3 V, the module performance starts to degrade. One possible battery of choice is the 3.6-V ER14505 battery, which has a long battery life. If this battery is used to power the module, Roving Networks recommends that you use a 1,000 – 3,000 uF bypass capacitor because the ER14505 battery has high output impedance.

Boost Regulator

The RN-171 does not have an on-board boost regulator. Figure 13 shows a recommended circuit for the boost regulator.

Designs that include the boost regulator will provide good power supply to the flash memory even when the battery voltage drops close to 1.8 V. If a board containing the RN-171 does not include a boost regulator, it SHOULD include a 2.7-V under-voltage reset circuit to prevent the module from accessing the flash memory when the supply voltage falls below 2.7 V. All supported flash chips are rated for a minimum VDD of 2.7 V.

Figure 13. Boost Regulator Circuit

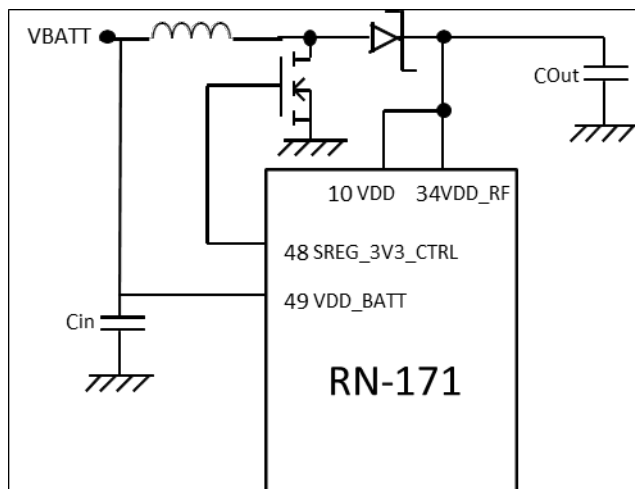


Table 7 shows the recommended components for the boost regulator circuit.

Table 7. Boost Regulator Circuit Components

Designator	Description	Value	Manufacturer	Manufacturer Part Number	Vendor	Vendor Part Number
D	Diode Schottky 1A 20V SMA	SS12	Micro Commercial Co	SS12-TP	DigiKey	SS12-TPCT-ND
L	Inductor 1.0uH 30% SMD	1uH	Taiyo Yuden	NR3015T1R0N	DigiKey	587-1647-1-ND
Q	MOSFET N-CH 20V 5.9 A	DMN2050L	Diodes Inc.	DMN2050L-7	DigiKey	DMN2050LDICT-ND

Roving Networks recommends that you use a low voltage detector circuit, such as the XC61 from Torex, tied to the RN-171 module's RESET pin to protect from low voltage.

Powering from a 3.3-V Regulated Source

Apply 3.3 V regulated power to pins 10, 34, and 49. Leave pin 48 (SREG_3V3_CTRL) unconnected.

NOTE: Do not connect pin 48 to ground. Leave it unconnected.

Solder Reflow

The reflow temperature must not exceed 220° C. To reflow solder the RN-171 module onto a PCB, Roving Networks recommends a RoHS compliant solder paste equivalent to the NIHON ALMIT paste or OMNIX OM-310 solder paste from Alpha metals. The module pads must have a solder past thickness of 5 mil.

NOTE: Use no clean flux. Do NOT water wash!

The temperature profile is based on the IC level and other components level only (without the shield can). From the perspective of the module only, a profile above 245° C should be acceptable. See Figures 14 and 15.

Figure 14. Solder Reflow Temperature Profile

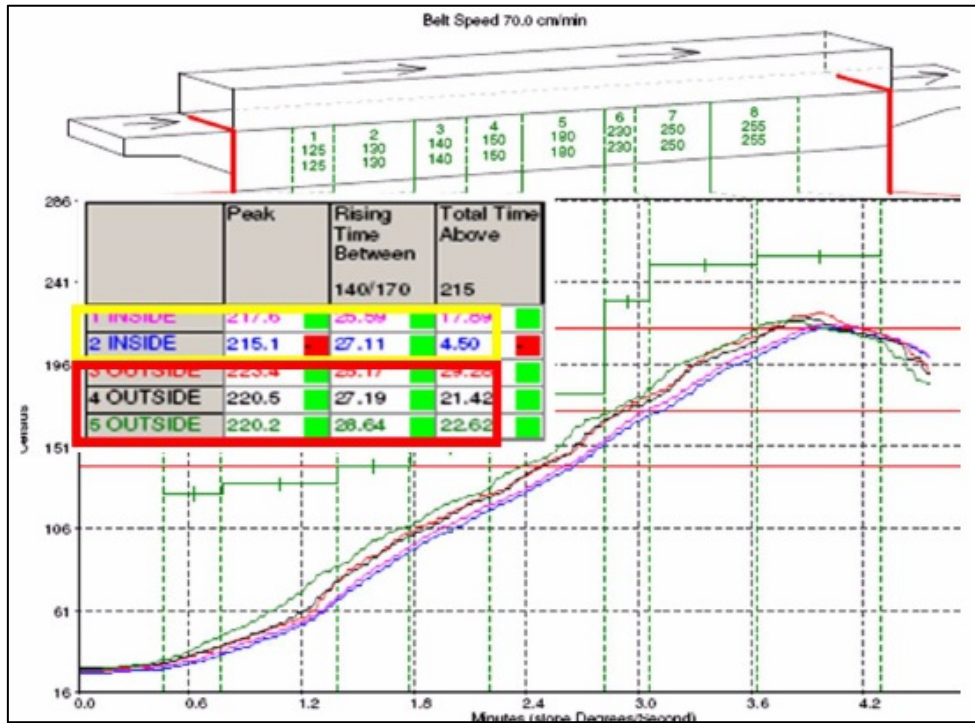
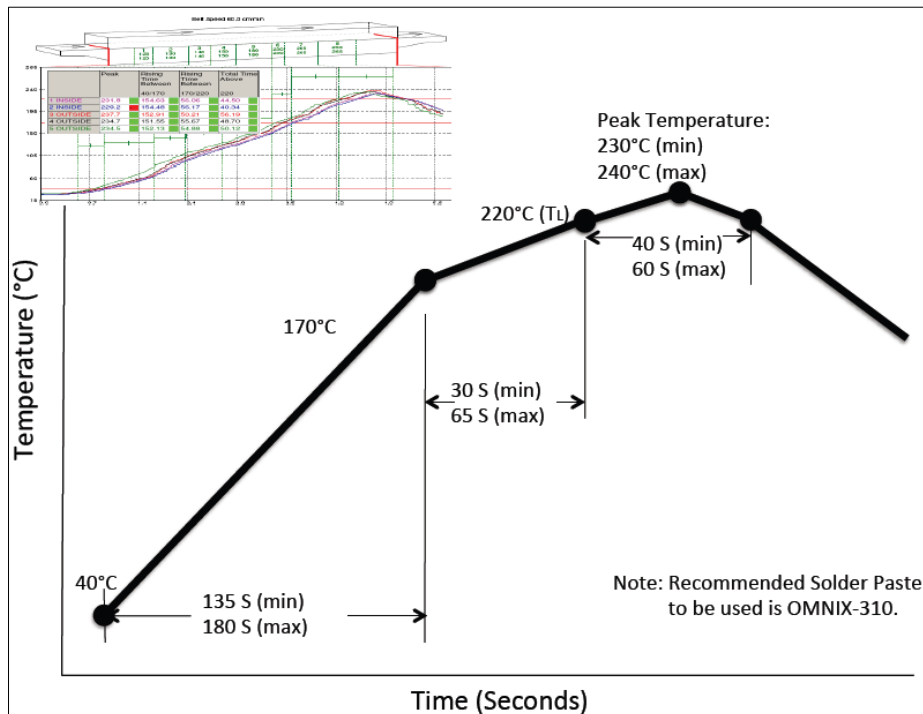


Figure 15. Solder Reflow Curve



COMPLIANCE INFORMATION

Table 8 describes the module's compliance information.

Table 8. Compliance Information

Specification	Compliance
FCC	Part 15.247 FCC T9J-RN171
IC	RSS-210 low-power communication device
CE	ID # 0681
REG	U9M21103-4249-C
RADIO	EN 300328 V1.7.1 (10/2006)
EMC	EN 301489-1 V1.8.1 (04/2008) EN 301489-17 V2.1.1 (05/2009)
SAFETY	EN 60950-1:2006+A11:2010 EN 50371 2002-03
RoHs	Compliant

ORDERING INFORMATION

Table 9 provides ordering information.

Table 9. Ordering Information

Part Number	Description
RN-171	Industrial Temperature (- 40 to + 85 C) with RF pad for external antenna.
RN-174	Development board for RN-171 module containing an RS-232 and TTL UART hardware interface, status LEDs, power regulator, and sensor connections.
RN-SMA4-RP	4" external antenna with reverse polarity SMA connector. Used with RN-UFL-SMA6.
RN-UFL-SMA6	6" cable with U.FL connector on one end and SMA on the other.
For other configurations, contact Roving Networks directly.	

Go to <http://www.rovingnetworks.com> for current pricing and a list of distributors carrying Roving Networks products.

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