
Low-Power Long Range LoRa® Technology Transceiver Module

Features

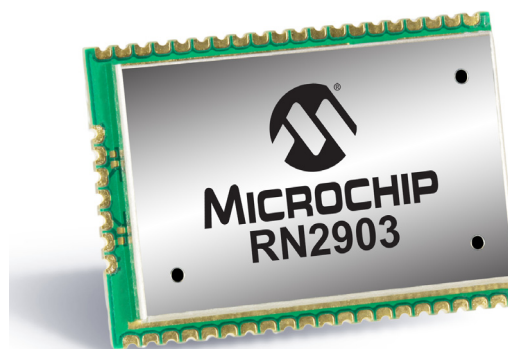
- On-Board LoRaWAN™ Protocol Stack
- ASCII Command Interface over UART
- Compact Form Factor: 17.8 x 26.7 x 3.34 mm
- Castellated SMT Pads for Easy and Reliable PCB Mounting
- Environmentally Friendly, RoHS Compliant
- Compliance:
 - Modular Certified for the United States (FCC) and Canada (IC)
 - Taiwan
- Device Firmware Upgrade (DFU) over UART, see *RN2903 LoRa® Technology Module Command Reference User's Guide* (DS40001811)

Operational

- Single Operating Voltage: 2.1V to 3.6V (3.3V typical)
- Temperature Range: -40°C to +85°C
- Low-Power Consumption
- Programmable RF Communication Bit Rate up to 300 kbps with FSK Modulation, 12500 bps with LoRa® Technology Modulation
- Integrated MCU, Crystal, EU1-64 Node Identity Serial EEPROM, Radio Transceiver with Analog Front End, Matching Circuitry
- 14 GPIOs for Control and Status, Shared with 13 Analog Inputs

RF/Analog Features

- Low-Power Long Range Transceiver Operating in the 915 MHz Frequency Band
- High Receiver Sensitivity: Down to -146 dBm
- TX Power: Adjustable up to +18.5 dBm High Efficiency PA
- FSK, GFSK and LoRa Technology Modulation
- IIP3 = -11 dBm
- Up to 15 km Coverage at Suburban and up to 5 km Coverage at Urban Area



General Description

Microchip's RN2903 Low-Power Long Range LoRa Technology Transceiver module provides an easy to use, low-power solution for long range wireless data transmission. The advanced command interface offers rapid time-to-market.

The RN2903 module complies with the LoRaWAN Class A and Class C protocol specifications. It integrates RF, a baseband controller and command Application Programming Interface (API) processor, making it a complete long range solution.

The RN2903 module is suitable for simple long range sensor applications with external host MCU.

Applications

- Automated Meter Reading
- Home and Building Automation
- Wireless Alarm and Security Systems
- Industrial Monitoring and Control
- Machine to Machine (M2M)
- Internet of Things (IoT)

Table of Contents

| | | |
|--|------------------------------------|----|
| 1.0 | Device Overview | 3 |
| 2.0 | General Specifications | 6 |
| 3.0 | Typical Hardware Connections | 8 |
| 4.0 | Physical Dimensions | 10 |
| 5.0 | Application Information | 11 |
| 6.0 | Regulatory Approval | 14 |
| Appendix A: Revision History | | 19 |
| The Microchip WebSite | | 21 |
| Customer Change Notification Service | | 21 |
| Customer Support | | 21 |
| Product Identification System | | 23 |

TO OUR VALUED CUSTOMERS

It is our intention to provide our valued customers with the best documentation possible to ensure successful use of your Microchip products. To this end, we will continue to improve our publications to better suit your needs. Our publications will be refined and enhanced as new volumes and updates are introduced.

If you have any questions or comments regarding this publication, please contact the Marketing Communications Department via E-mail at docerrors@microchip.com. We welcome your feedback.

Most Current Data Sheet

To obtain the most up-to-date version of this data sheet, please register at our Worldwide Website at:

<http://www.microchip.com>

You can determine the version of a data sheet by examining its literature number found on the bottom outside corner of any page. The last character of the literature number is the version number, (e.g., DS30000000A is version A of document DS30000000).

Errata

An errata sheet, describing minor operational differences from the data sheet and recommended workarounds, may exist for current devices. As device/documentation issues become known to us, we will publish an errata sheet. The errata will specify the revision of silicon and revision of document to which it applies.

To determine if an errata sheet exists for a particular device, please check with one of the following:

- Microchip's Worldwide Website; <http://www.microchip.com>
- Your local Microchip sales office (see last page)

When contacting a sales office, please specify which device, revision of silicon and data sheet (include literature number) you are using.

Customer Notification System

Register on our website at www.microchip.com to receive the most current information on all of our products.

1.0 DEVICE OVERVIEW

The RN2903 transceiver module features LoRa Technology RF modulation, which provides long range spread spectrum communication with high interference immunity.

Using the LoRa Technology modulation technique, RN2903 can achieve a receiver sensitivity of -146 dBm. The high sensitivity combined with the integrated +18.5 dBm output power amplifier yields industry-leading link budget, which makes it optimal for applications requiring extended range and robustness.

LoRa Technology modulation also provides significant advantages in both blocking and selectivity compared to the conventional modulation techniques, solving the traditional design compromise between extended range, interference immunity and low-power consumption.

The RN2903 module delivers exceptional phase noise, selectivity, receiver linearity and IIP3 for significantly lower power consumption. The level of conductive harmonics is below -70 dBm. [Figure 1-1](#), [Figure 1-2](#) and [Figure 1-3](#) show the top view, the pinout and the block diagram of the module.

FIGURE 1-1: RN2903 TOP VIEW

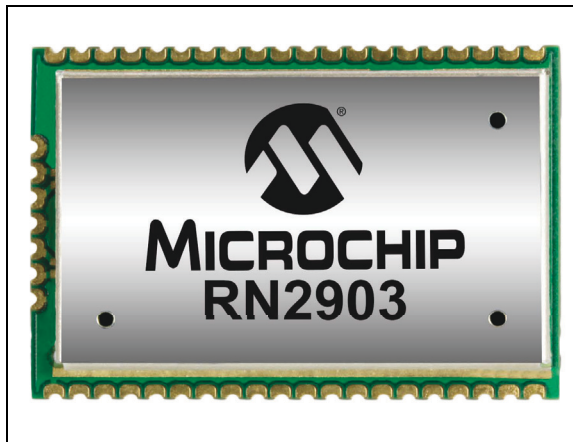


FIGURE 1-2: RN2903 PIN DIAGRAM

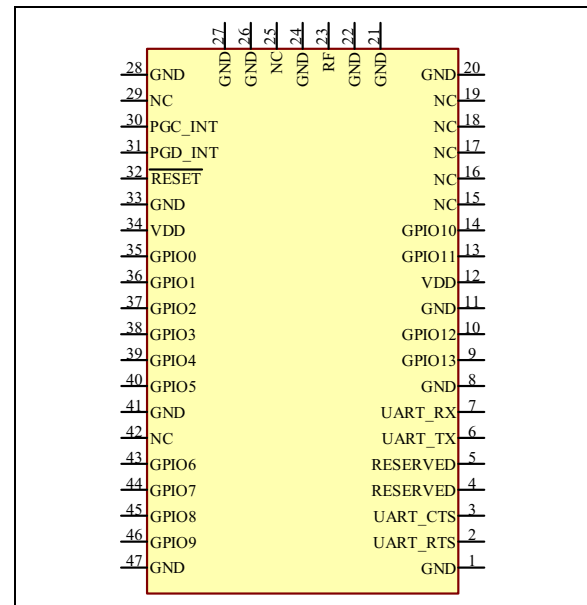
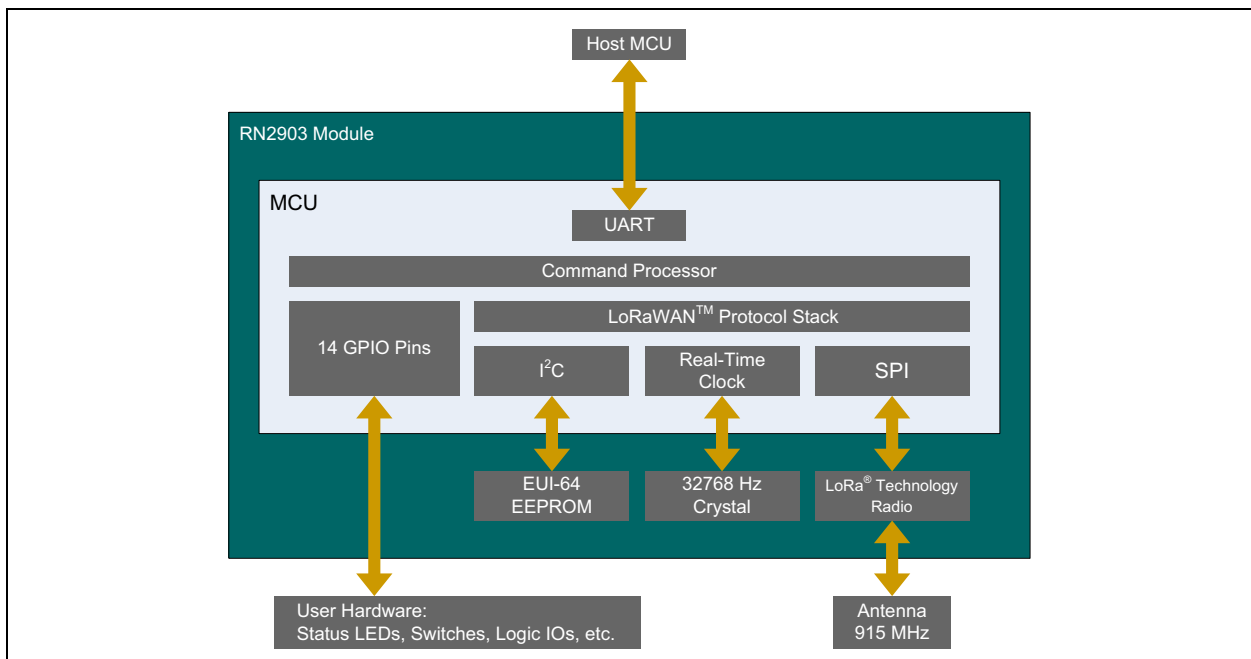


FIGURE 1-3: RN2903 BLOCK DIAGRAM



RN2903

Table 1-1 describes the RN2903 pins.

TABLE 1-1: PIN DESCRIPTION

| Pin | Name | Type | Description |
|-----|----------|--------------|--|
| 1 | GND | Power | Ground supply terminal |
| 2 | UART_RTS | Output | Communication UART RTS signal ⁽¹⁾ or GPIO |
| 3 | UART_CTS | Input | Communication UART CTS signal ⁽¹⁾ or GPIO |
| 4 | RESERVED | — | Do not connect |
| 5 | RESERVED | — | Do not connect |
| 6 | UART_TX | Output | Communication UART Transmit (TX) |
| 7 | UART_RX | Input | Communication UART Receive (RX) |
| 8 | GND | Power | Ground supply terminal |
| 9 | GPIO13 | Input/Output | General purpose I/O pin or analog input |
| 10 | GPIO12 | Input/Output | General purpose I/O pin or analog input |
| 11 | GND | Power | Ground supply terminal |
| 12 | VDD | Power | Positive supply terminal |
| 13 | GPIO11 | Input/Output | General purpose I/O pin or analog input |
| 14 | GPIO10 | Input/Output | General purpose I/O pin or analog input |
| 15 | NC | — | Not connected |
| 16 | NC | — | Not connected |
| 17 | NC | — | Not connected |
| 18 | NC | — | Not connected |
| 19 | NC | — | Not connected |
| 20 | GND | Power | Ground supply terminal |
| 21 | GND | Power | Ground supply terminal |
| 22 | GND | Power | Ground supply terminal |
| 23 | RF | RF analog | RF signal pin |
| 24 | GND | Power | Ground supply terminal |
| 25 | NC | — | Not connected |
| 26 | GND | Power | Ground supply terminal |
| 27 | GND | Power | Ground supply terminal |
| 28 | GND | Power | Ground supply terminal |
| 29 | NC | — | Not connected |
| 30 | PGC_INT | Input/Output | Internal MCU ICSP program clock or general purpose I/O pin |
| 31 | PGD_INT | Input/Output | Internal MCU ICSP program data or general purpose I/O pin |
| 32 | RESET | Input | Active-low device Reset input |
| 33 | GND | Power | Ground supply terminal |
| 34 | VDD | Power | Positive supply terminal |
| 35 | GPIO0 | Input/Output | General purpose I/O pin or analog input |
| 36 | GPIO1 | Input/Output | General purpose I/O pin or analog input |
| 37 | GPIO2 | Input/Output | General purpose I/O pin or analog input |
| 38 | GPIO3 | Input/Output | General purpose I/O pin or analog input |
| 39 | GPIO4 | Input/Output | General purpose I/O pin |
| 40 | GPIO5 | Input/Output | General purpose I/O pin or analog input |
| 41 | GND | Power | Ground supply terminal |
| 42 | NC | — | Not connected |
| 43 | GPIO6 | Input/Output | General purpose I/O pin or analog input |

TABLE 1-1: PIN DESCRIPTION (CONTINUED)

| Pin | Name | Type | Description |
|-----|-------|--------------|---|
| 44 | GPIO7 | Input/Output | General purpose I/O pin or analog input |
| 45 | GPIO8 | Input/Output | General purpose I/O pin or analog input |
| 46 | GPIO9 | Input/Output | General purpose I/O pin or analog input |
| 47 | GND | Power | Ground supply terminal |

Note 1: Optional handshake lines are supported in future firmware releases.

2.0 GENERAL SPECIFICATIONS

Table 2-1 provides the general specifications for the module. Table 2-2, Table 2-3 and Table 2-4 provide the electrical characteristics, current consumption and

dimensions of the module, respectively. Table 2-5 shows the RF output power calibration data. Table 2-6 shows the RF output power at different supply voltages and temperatures.

TABLE 2-1: GENERAL SPECIFICATIONS

| Specification | Description |
|--------------------------------------|--|
| Frequency Band | 902.000 MHz to 928.000 MHz |
| Modulation Method | FSK, GFSK and LoRa® Technology modulation |
| Maximum Over-the-Air Data Rate | 300 kbps with FSK modulation; 12500 bps with LoRa Technology modulation |
| RF Connection | Board edge connection (castellated PCB pads for reliable soldering) |
| Interface | UART |
| Operation Range | Up to 15 km coverage at suburban; up to 5 km coverage at urban area ⁽²⁾ |
| Sensitivity at 1% PER | -146 dBm ⁽¹⁾ |
| RF TX Power | Adjustable up to max. +18.5 dBm on 915 MHz band ⁽³⁾ |
| Generated Conductive Harmonics Level | Below -70 dBm |
| Temperature (operating) | -40°C to +85°C |
| Temperature (storage) | -40°C to +115°C |
| Humidity | 10% ~ 90% non-condensing |

Note 1: Dependent on modulation settings, Receiver Bandwidth (RBW) and Spreading Factor (SF).

2: Subject to environmental conditions.

3: TX power is adjustable. For more information, refer to the *RN2903 LoRa® Technology Module Command Reference User's Guide* (DS40001811).

TABLE 2-2: ELECTRICAL CHARACTERISTICS

| Parameter | Min. | Typ. | Max. | Units |
|--|-----------|------|------------|-------|
| Supply Voltage | 2.1 | — | 3.6 | V |
| Voltage on any pin with respect to VSS (except VDD and RESET) | -0.3 | — | VDD + 0.3 | V |
| Voltage on VDD with respect to VSS | -0.3 | — | 3.9 | V |
| Voltage on RESET with respect to VSS | 0 | — | +11 | V |
| Input Clamp Current (IIK) (VI < 0 or VI > VDD) | — | — | +/-20 | mA |
| Output Clamp Current (IOK) (VO < 0 or VO > VDD) | — | — | +/-20 | mA |
| GPIO sink/source current each | — | — | 25/25 | mA |
| Total GPIO sink/source current | — | — | 200/185 | mA |
| RAM Data Retention Voltage (in Sleep mode or Reset state) | 1.5 | — | — | V |
| VDD Start Voltage to ensure internal Power-on Reset signal | — | — | 0.7 | V |
| VDD Rise Rate to ensure internal Power-on Reset signal | 0.05 | — | — | V/ms |
| Brown-out Reset Voltage | 1.75 | 1.9 | 2.05 | V |
| Logic Input Low Voltage | — | — | 0.15 x VDD | V |
| Logic Input High Voltage | 0.8 x VDD | — | — | V |
| Input Leakage at <25°C (VSS < VPIN < VDD, Pin at high-impedance) | — | 0.1 | 50 | nA |
| Input Leakage at +60°C (VSS < VPIN < VDD, Pin at high-impedance) | — | 0.7 | 100 | nA |
| Input Leakage at +85°C (VSS < VPIN < VDD, Pin at high-impedance) | — | 4 | 200 | nA |
| RF Input Level | — | — | +10 | dBm |

TABLE 2-3: CURRENT CONSUMPTION

| Mode | Temperature (°C) | Typical Current (mA) | | |
|------------|------------------|----------------------|------------|------------|
| | | VDD = 2.1V | VDD = 3.3V | VDD = 3.6V |
| Idle | -40 to +85 | 1.8 | 2.8 | 3.1 |
| Transmit | -40 to +85 | 105 | 121 | 122 |
| Deep Sleep | -40 | 0.0009 | 0.0010 | 0.0012 |
| | 25 | 0.0011 | 0.0013 | 0.0014 |
| | 85 | 0.0026 | 0.0032 | 0.0036 |
| Receive | -40 to +85 | 12.71 | 14.38 | 14.74 |

TABLE 2-4: MODULE DIMENSIONS

| Parameter | Value |
|------------|-----------------------|
| Dimensions | 17.8 x 26.7 x 3.34 mm |
| Weight | 2.05g |

TABLE 2-5: OUTPUT POWER OF TX POWER SETTING

| TX Power Setting | Output Power (dBm) | Typical Supply Current at 3.3V (mA) |
|------------------|--------------------|-------------------------------------|
| 2 | 3.0 | 42.6 |
| 3 | 4.0 | 44.8 |
| 4 | 5.0 | 47.3 |
| 5 | 6.0 | 49.6 |
| 6 | 7.0 | 52.0 |
| 7 | 8.0 | 55.0 |
| 8 | 9.0 | 57.7 |
| 9 | 10.0 | 61.0 |
| 10 | 11.0 | 64.8 |
| 11 | 12.0 | 73.1 |
| 12 | 13.0 | 78.0 |
| 14 | 14.7 | 83.0 |
| 15 | 15.5 | 88.0 |
| 16 | 16.3 | 95.8 |
| 17 | 17.0 | 103.6 |
| 20 | 18.5 | 124.4 |

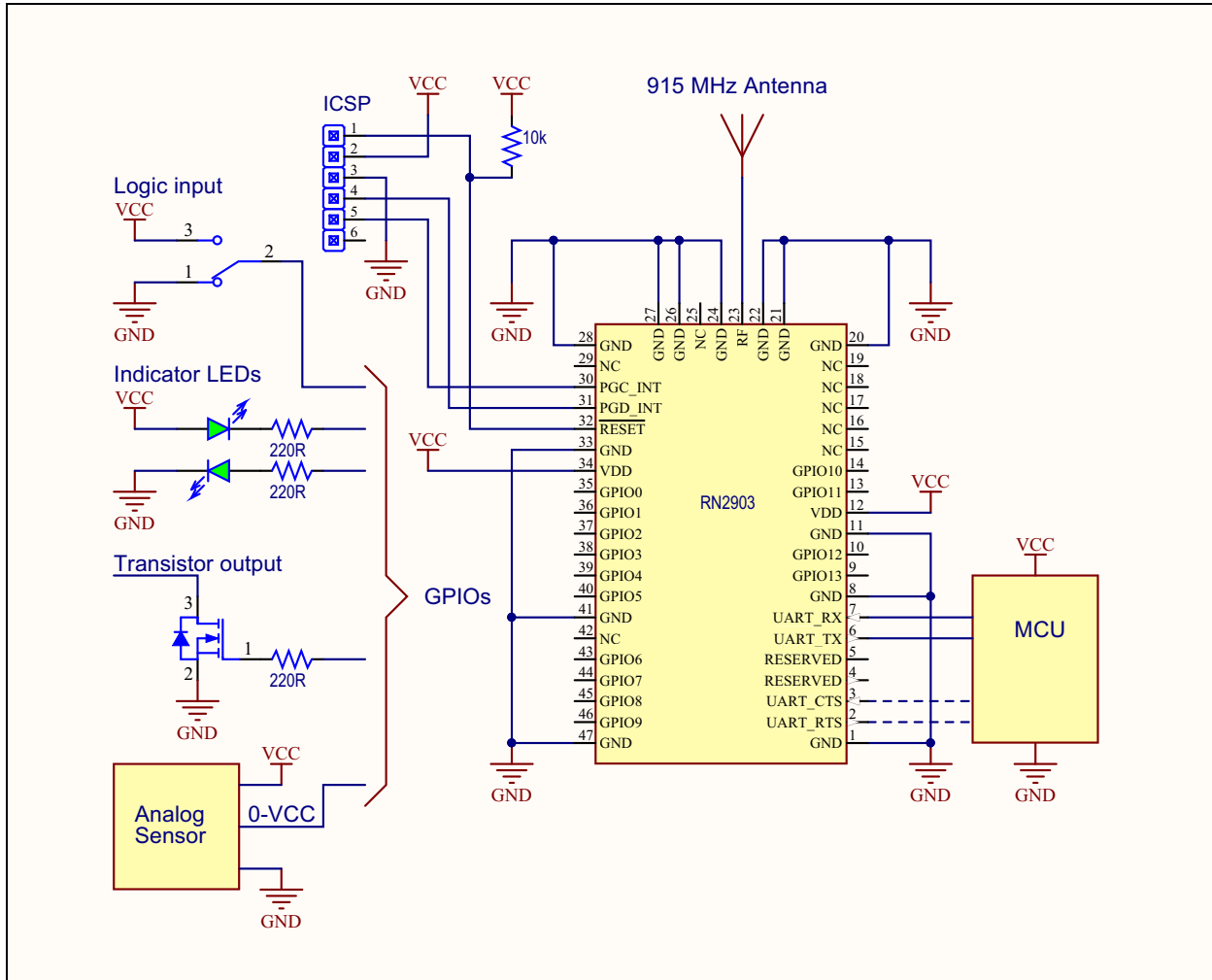
TABLE 2-6: OUTPUT POWER OF SUPPLY VOLTAGE AND TEMPERATURE

| Temperature (°C) | Typical Output Power (dBm) | | |
|------------------|----------------------------|------------|------------|
| | VDD = 2.1V | VDD = 3.3V | VDD = 3.6V |
| -40 | 18.0 | 18.6 | 18.7 |
| 25 | 17.1 | 18.0 | 18.1 |
| 85 | 16.3 | 17.3 | 17.3 |

3.0 TYPICAL HARDWARE CONNECTIONS

Figure 3-1 shows the typical hardware connections.

FIGURE 3-1: HARDWARE CONNECTIONS



3.1 Interface to Host MCU

The RN2903 module has a dedicated UART interface to communicate with a host controller. Optional handshake lines are supported in future firmware releases. The *RN2903 LoRa® Technology Module Command Reference User's Guide* (DS40001811) provides a detailed UART command description. Table 3-1 shows the default settings for the UART communication.

TABLE 3-1: DEFAULT UART SETTINGS

| Specification | Description |
|-----------------------|-------------|
| Baud Rate | 57600 bps |
| Packet Length | 8 bit |
| Parity Bit | No |
| Stop Bits | 1 bit |
| Hardware Flow Control | No |

3.2 GPIO Pins (GPIO0–GPIO13)

The module has 14 GPIO pins. These lines can be connected to switches, LEDs and relay outputs. The pins can be either logic inputs or outputs, and some pins (see Table 1-1) have analog input capability that can be accessed via the module firmware. These pins have limited sink and source capabilities. Electrical characteristics are described in Table 2-2. For more information, see the *RN2903 LoRa® Technology Module Command Reference User's Guide* (DS40001811).

3.3 RF Connection

When routing RF path, use proper strip lines with an impedance of 50 Ohm.

3.4 RESET Pin

The $\overline{\text{RESET}}$ pin of the module is an active-low logic input. An internal weak pull-up resistor is enabled when the pin is configured as the MCLR input.

3.5 Power Pins

It is recommended to connect power pins (Pin 12 and Pin 34) to a stable supply voltage with sufficient source current. [Table 2-3](#) shows the current consumption.

Additional filtering capacitors are not required but used to ensure stable supply voltage in a noisy environment.

3.6 Internal Program Pins

PGC_INT (Pin 30) and PGD_INT (Pin 31) are internal program pins used during manufacturing. For normal operation, these pins can be left unconnected.

The normal firmware upgrade method is through the internal bootloader of the module via the UART. The method is documented in the *RN2903 LoRa® Technology Module Command Reference User's Guide* (DS40001811).

However, for backup firmware update purposes the user can place a 6-pin ICSP header on their host PCB with PGC_INT (Pin 30), PGD_INT (Pin 31), $\overline{\text{RESET}}$ (Pin 32), power and ground.

During High Voltage In-Circuit Serial Programming mode, the $\overline{\text{RESET}}$ pin is driven with high-voltage (9V), therefore protection may be necessary for sensitive devices.

| |
|--|
| <p>Note: Only official Microchip Technology firmware released for the RN2903 module shall be used to maintain FCC and IC certification.</p> |
|--|

4.0 PHYSICAL DIMENSIONS

Figure 4-1 and Figure 4-2 illustrate the physical dimensions and the recommended PCB layout for the RN2903 module.

FIGURE 4-1: RN2903 PHYSICAL DIMENSIONS

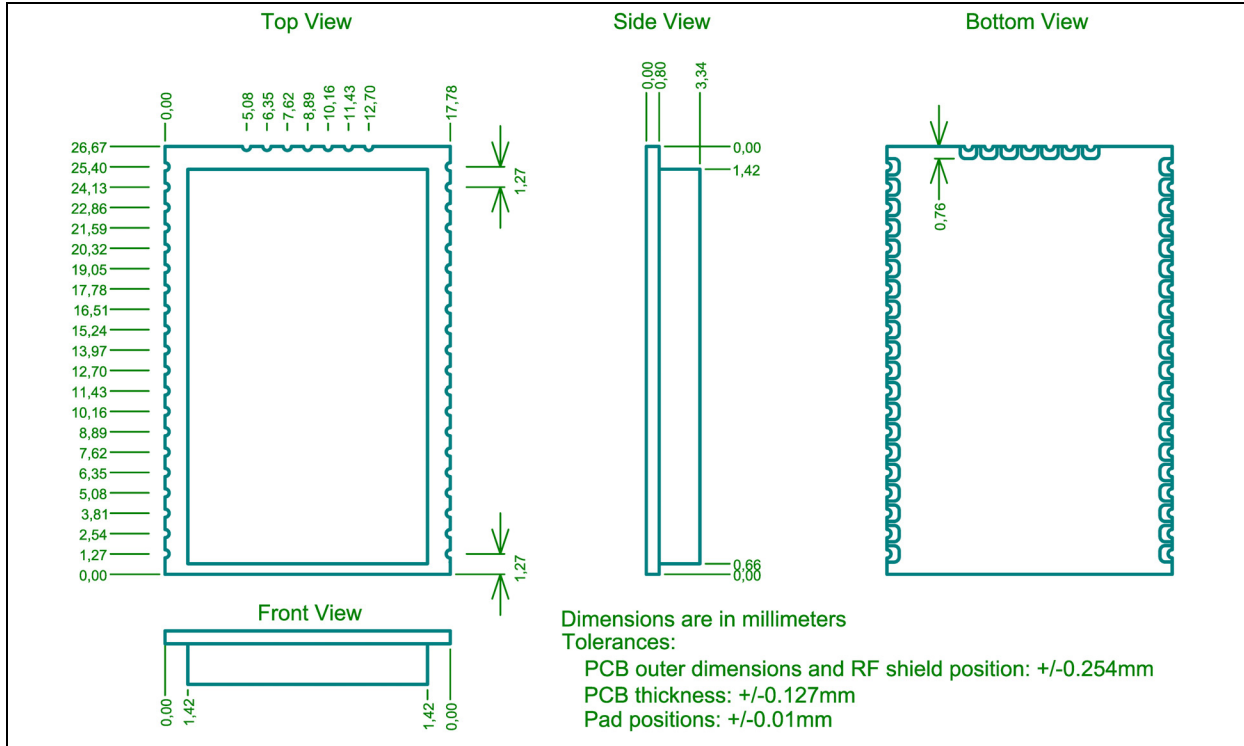
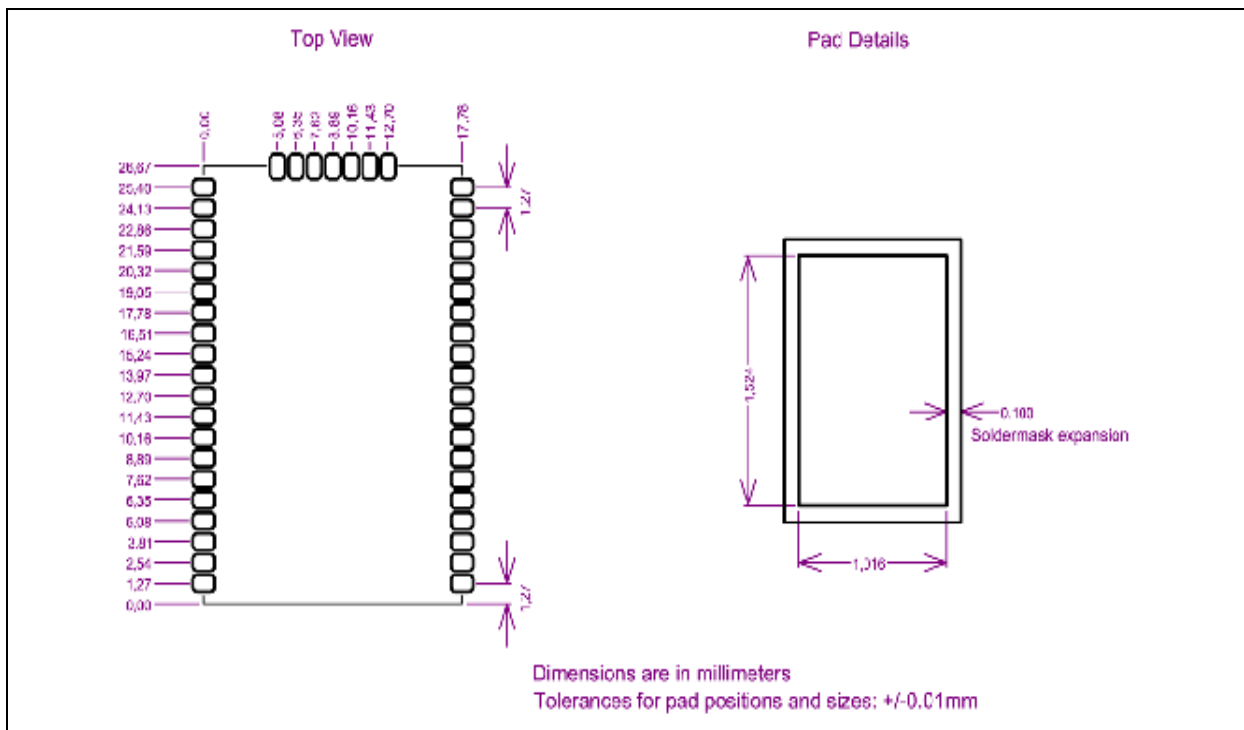


FIGURE 4-2: RECOMMENDED PCB FOOTPRINT



5.0 APPLICATION INFORMATION

5.1 RF Trace Layout Design

The RN2903 modular transmitter is certified with a PCB edge SMA connector and micro-strip trace layout as shown in [Figure 5-1](#) and [Figure 5-2](#). The left side RF

path is not used for this module. The host PCB can follow these trace designs to maintain compliance under the modular grant (FCC) and certificate (IC). Gerber files are available on the RN2903 product web page at www.microchip.com/rn2903.

FIGURE 5-1: RF TRACE ROUTING (TOP LAYER)

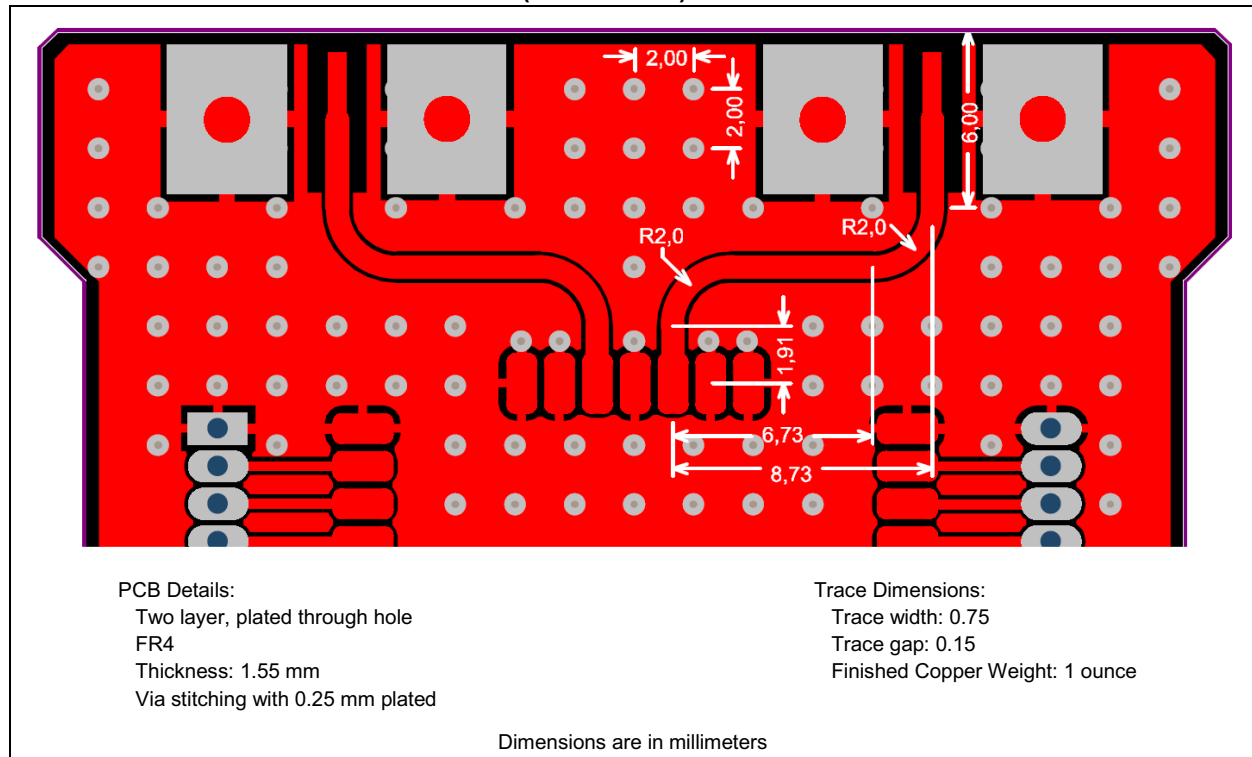
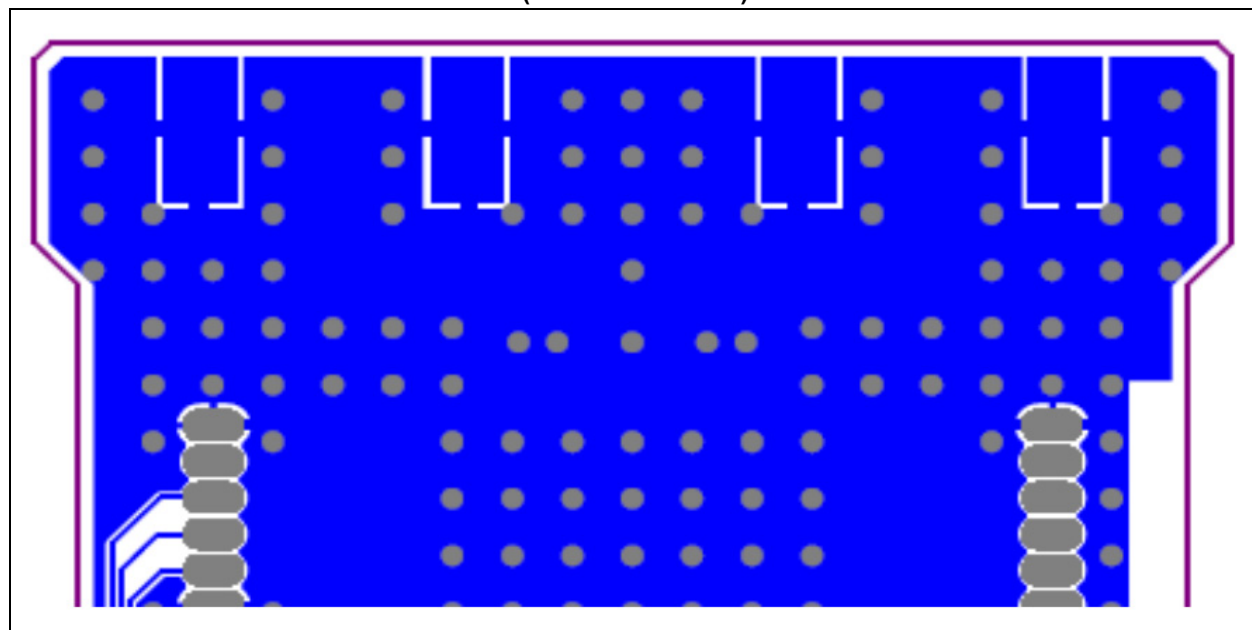


FIGURE 5-2: RF TRACE ROUTING (BOTTOM LAYER)



5.2 PCB Trace Antenna

Modular certification of the RN2903 module is performed with the PCB trace antenna as shown in [Figure 5-3](#). The exact dimensions of the trace antenna must be followed. The PCB trace antenna is fabricated on the top copper layer and covered in solder mask. The layers below the antenna do not have copper trace. The PCB material is FR4 and the thickness is 0.062 inches (1.6 mm). The antenna has 50 ohm impedance and no matching is required. The supporting board must be 84 mm long and 53 mm wide in order to generate that impedance and the average gain of 1.3 dB. Gerber files for the PCB trace antenna are available on the RN2903 product web page at <http://www.microchip.com/rn2903>.

The antenna patterns plotted in [Figure 5-4](#) through [Figure 5-5](#) are the simulated results of the PCB antenna.

[Figure 5-4](#) illustrates the two-dimensional (2D) radiation pattern. The calculated average gain is 1.3 dBi. The radiation pattern for the XZ plane is shown in red, whereas the YZ plane is shown in blue. The most powerful radiation occurs in the YZ plane as represented by the blue pattern.

[Figure 5-5](#) illustrates the three-dimensional (3D) radiation pattern. The radiation pattern shows the relative position of the 3D radiation “donut” with reference to the module orientation. This is a very useful guide for placement of the module to obtain the maximum range.

FIGURE 5-3: PCB TRACE ANTENNA MEASUREMENTS

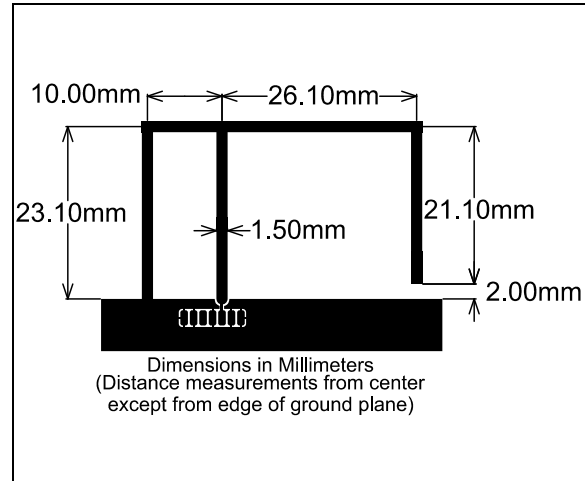


FIGURE 5-4: SIMULATED TWO-DIMENSIONAL RADIATION PATTERN

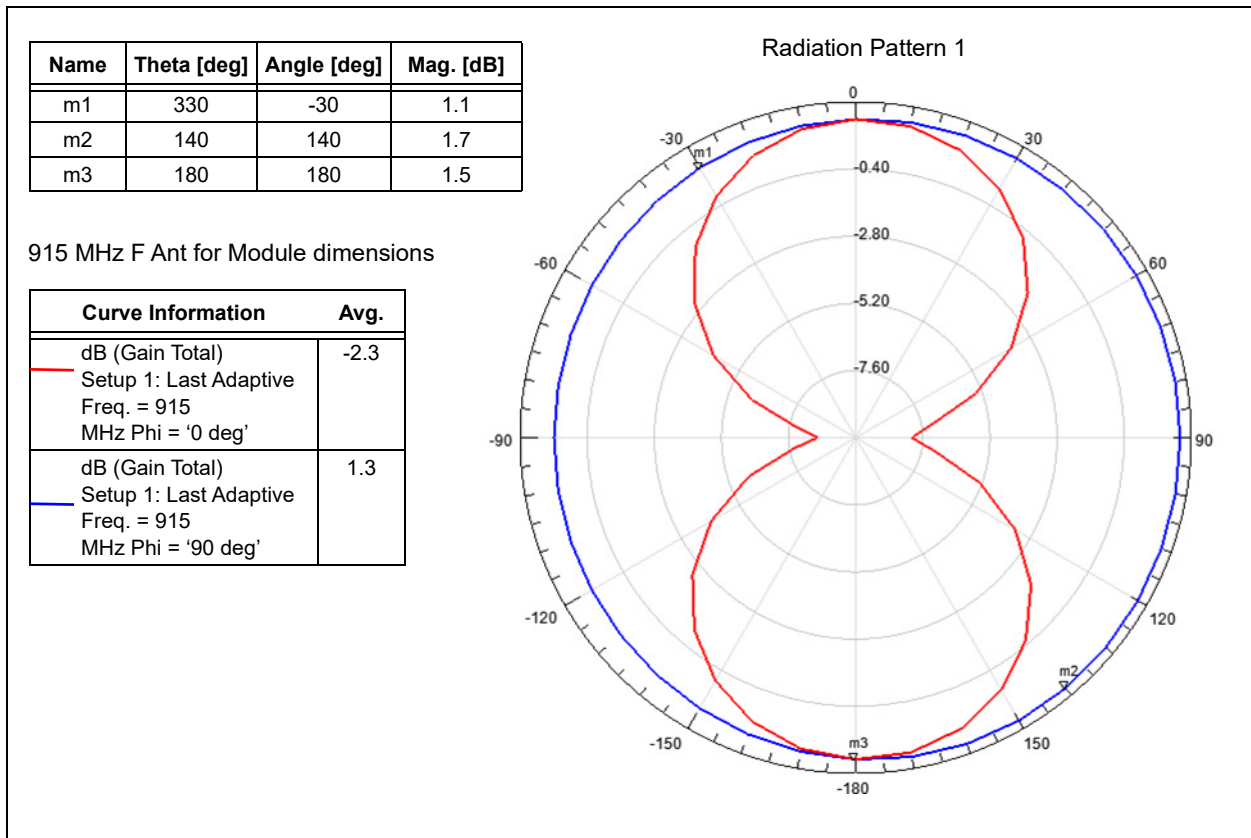
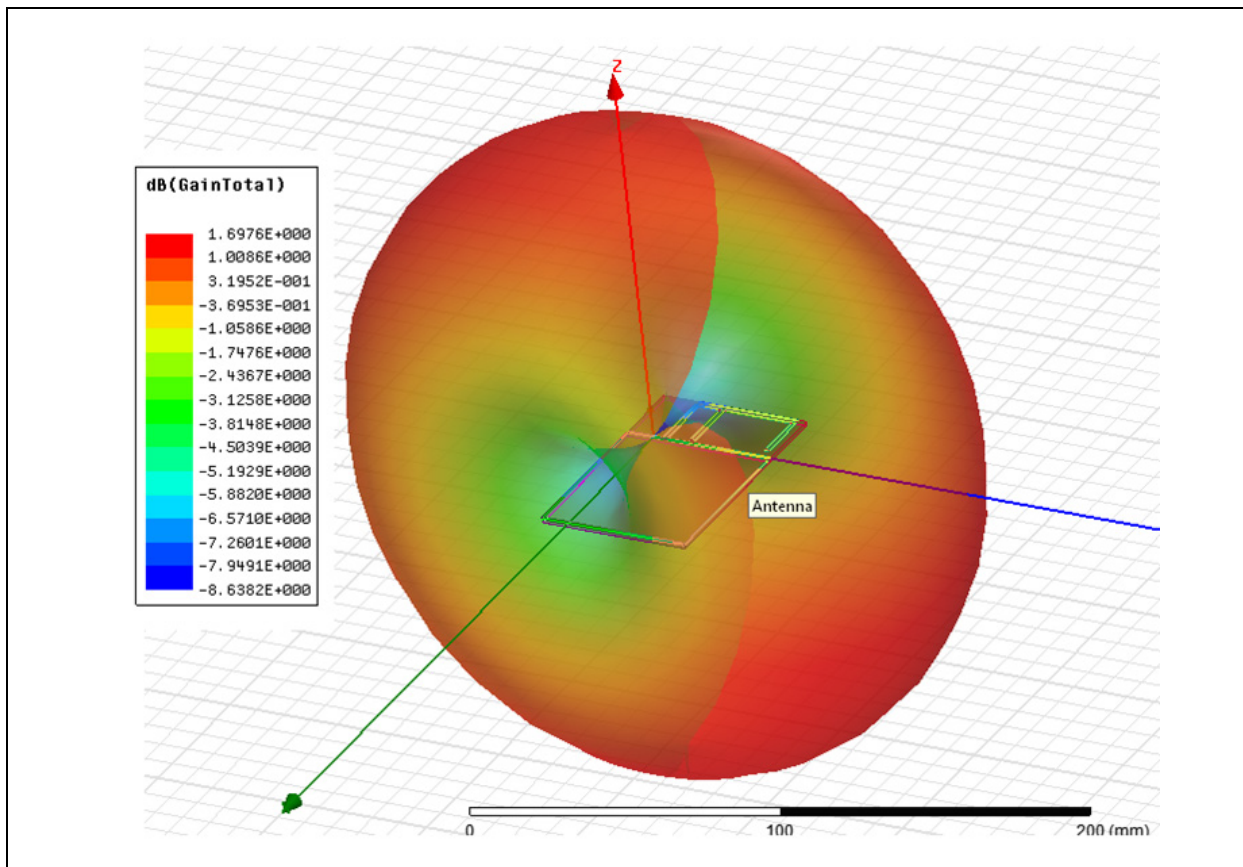


FIGURE 5-5: SIMULATED THREE-DIMENSIONAL RADIATION PATTERN



5.3 Approved Antennas

Modular certification of the RN2903 module is performed with the external antenna type in [Table 5-1](#). For specific regulatory requirements by country, refer to [Section 6.0 "Regulatory Approval"](#).

TABLE 5-1: TESTED EXTERNAL ANTENNA TYPES

| Type | Gain (dBi) |
|---------------|------------|
| Sleeve Dipole | 6 |
| PCB Trace | 1.7 |

- 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 final flow.

5.4 Reflow Profile Information

The RN2903 module can be soldered to the host board using standard leaded or lead free solder reflow profiles. To avoid damaging the module, adhere to the following recommendations:

- For Solder Reflow Recommendations, refer to the Solder Reflow Recommendation Application Note ([AN233](#)).
- Do not exceed a peak temperature (TP) of 250°C.
- Refer to the solder paste data sheet for the specific reflow profile recommendations from the vendor.
- Use no-clean flux solder paste.

6.0 REGULATORY APPROVAL

This section outlines the regulatory information for the RN2903 module for the following countries:

- United States
- Canada
- Taiwan

6.1 United States

The RN2903 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 RN2903 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.

6.1.1 LABELING AND USER INFORMATION REQUIREMENTS

The RN2903 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: T9JRN2903
or

Contains FCC ID: T9JRN2903

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 finished 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)
<https://apps.fcc.gov/oetcf/kdb/index.cfm>.

6.1.2 RF EXPOSURE

All transmitters regulated by FCC must comply with RF exposure requirements. KDB 447498 General RF Exposure Guidance provides guidance 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).

From the RN2903 FCC Grant: Output power listed is conducted. This grant is valid only when the module is sold to OEM integrators and must be installed by the OEM or OEM integrators. This transmitter is restricted for use with the specific antenna(s) tested in this application for Certification and must not be co-located or operating in conjunction with any other antenna or transmitters within a host device, except in accordance with FCC multi-transmitter product procedures.

6.1.3 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 manufacturer provided the same antenna type and antenna gain (equal to or less than) is used.

Testing of the RN2903 module was performed with the antenna types listed in [Table 5-1](#) Tested External Antenna Types.

6.1.4 HELPFUL WEBSITES

Federal Communications Commission (FCC):
<http://www.fcc.gov>

FCC Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB):
<https://apps.fcc.gov/oetcf/kdb/index.cfm>

6.2 Canada

The RN2903 module has been certified for use in Canada under Industry Canada (IC) Radio Standards Specification (RSS) RSS-210 and RSS-Gen. Modular approval permits the installation of a module in a host device without the need to recertify the device.

6.2.1 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-RN2903.

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.

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.

6.2.2 RF EXPOSURE

All transmitters regulated by IC must comply with RF exposure requirements listed in RSS-102 - Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands). Currently this device is approved for use for when 20 cm can be maintained between the antenna and users.

Specific Absorption Rate (SAR) evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm. Exceptions are listed in RSS-102. Note that integration < 20 cm will require further certification with IC such as a Multiple Listing and Class IV Permissive Change application.

6.2.3 APPROVED EXTERNAL ANTENNA TYPES

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

The RN2903 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.

Testing of the RN2903 module was performed with the antenna types listed in [Table 5-1](#) Tested External Antenna Types.

6.2.4 HELPFUL WEBSITES

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

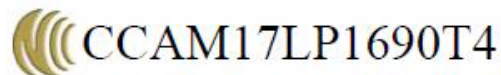
6.3 Taiwan

The RN2903 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.

6.3.1 LABELING AND USER INFORMATION REQUIREMENTS

The RN2903 module is labeled with its own NCC mark and certificate number as below:



The user's manual should contain below warning (for RF device) in traditional Chinese:

注意！

依據 低功率電波輻射性電機管理辦法

第十二條 經型式認證合格之低功率射頻電機，非經許可，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。

第十四條 低功率射頻電機之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。前項合法通信，指依電信規定作業之無線電信。

低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

6.4.2 HELPFUL WEBSITES

ANATEL: <http://www.anatel.gov.br>

6.3.2 HELPFUL WEBSITES

National Communications Commission (NCC):

<http://www.ncc.gov.tw>

6.4 Brazil

Operating Frequency Band 902.0-907.5 MHz and 915.0-928.0 MHz.

The RN2903 module has received compliance approval in accordance with the Telecommunications Act of the Federal Republic of Brazil National Telecommunications Agency (ANATEL).

6.4.1 LABELING AND USER INFORMATION REQUIREMENTS

Modelo: RN2903A



06998-21-08759

"Este equipamento não tem direito à proteção contra interferência prejudicial e não pode causar interferência em sistemas devidamente autorizados".

The end product (Host) manual must include the following statement:

Este produto contém a placa Modelo RN2903A código de homologação ANATEL 06998-21-08759.

RN2903

NOTES:

APPENDIX A: REVISION HISTORY

Revision A (July 2015)

This is the initial release of this document.

Revision B (December 2015)

This revision includes the following updates:

- Updated Deep Sleep value in [Table 2-3](#)
- Updated Dimensions value in [Table 2-4](#)
- Updated [Figure 4-1](#)
- Updated [Figure 4-2](#)
- Updated [Figure 5-2](#)
- Updated information for [Section 5.1 “RF Trace Layout Design”](#).

Revision C (February 2017)

This revision includes the following updates:

- Updated [Figure 1-2](#) and [Figure 3-1](#)
- Updated [Table 1-1](#), [Table 2-2](#), [Table 2-3](#), [Table 2-5](#) and [Table 5-1](#)
- Added [Table 2-6](#)
- Updated [Section 3.4 “RESET Pin”](#)
- Added [Section 3.6 “Internal Program Pins”](#), [Section 5.2 “PCB Trace Antenna”](#) and [Section 6.2.2 “RF EXPOSURE”](#)
- Deleted Section “5.4 Application Schematic”.

Revision D (October 2017)

This revision includes the following updates:

- Removed Australia and New Zealand from [Section 6.0 “Regulatory Approval”](#).
- Updated General Features section to remove Australia and New Zealand.
- Updated General Features section to add Taiwan.
- Added Taiwan to [Section 6.0 “Regulatory Approval”](#).

Revision E (January 2018)

This revision includes the following updates:

- Updated [Section 6.0 “Regulatory Approval”](#) to correct information for Taiwan.

Revision F (May 2018)

This revision includes the following updates:

- Updated [Figure 4-2](#).

Revision G (February 2019)

This revision includes the following update:

- Added Class C in the [Section “General Description”](#).

Revision H (September 2019)

This revision includes the following update:

- Added Brazil to [Section 6.0 “Regulatory Approval”](#).

Revision J (June 2020)

- Updated [Table 2-3](#)

Revision K (June 2021)

This revision includes the following updates:

- Updated RF Connection Description, added a footnote (2) in the [Table 2-1](#).
- Added [Section 5.4 “Reflow Profile Information”](#).
- Updated Anatel ID in [Section 6.4 “Brazil”](#).

RN2903

NOTES:

THE MICROCHIP WEBSITE

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

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQ), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

CUSTOMER CHANGE NOTIFICATION SERVICE

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

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

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or Field Application Engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the website at: <http://microchip.com/support>

RN2903

NOTES:

PRODUCT IDENTIFICATION SYSTEM

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

| <u>PART NO.</u> | | | | | |
|--|---|---------|-------------------------------|--------------------------|--|
| Device | Temperature Range | Package | Regional Parameter (Optional) | Firmware Revision Number | |
| Examples: RN2903A-I/RM: Industrial temperature, US902-928 RN2903A-I/RMSA: Industrial temperature, AU915-928 | | | | | |
| Device: | RN2903A: Low-Power Long Range LoRa® Technology Transceiver module | | | | |
| Temperature Range: | I | = | -40°C to +85°C (Industrial) | | |
| Package: | RM | = | Radio Module | | |

RN2903

NOTES:

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

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods being used in attempts to breach the code protection features of the Microchip devices. We believe that these methods require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Attempts to breach these code protection features, most likely, cannot be accomplished without violating Microchip's intellectual property rights.
- Microchip is willing to work with any customer who is concerned about the integrity of its code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is "unbreakable." Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Information contained in this publication is provided for the sole purpose of designing with and using Microchip products. Information regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications.

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL OR CONSEQUENTIAL LOSS, DAMAGE, COST OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AnyRate, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, chipKIT, chipKIT logo, CryptoMemory, CryptoRF, dsPIC, FlashFlex, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Kleer, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PackTime, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

AgileSwitch, APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, FlashTec, Hyper Speed Control, HyperLight Load, IntelliMOS, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet-Wire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, WinPath, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, Augmented Switching, BlueSky, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, IdealBridge, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, Inter-Chip Connectivity, JitterBlocker, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SMART-I.S., storClad, SQI, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, TSHARC, USBCheck, VariSense, VectorBlox, VeriPHY, ViewSpan, WiperLock, XpressConnect, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

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

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, and Symmcom are registered trademarks of Microchip Technology Inc. in other countries.

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

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

© 2015-2021, Microchip Technology Incorporated, All Rights Reserved.

ISBN: 978-1-5224-8370-0

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
<http://www.microchip.com/support>
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Austin, TX
Tel: 512-257-3370

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Novi, MI
Tel: 248-848-4000

Houston, TX
Tel: 281-894-5983

Indianapolis
Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453
Tel: 317-536-2380

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608
Tel: 951-273-7800

Raleigh, NC
Tel: 919-844-7510

New York, NY
Tel: 631-435-6000

San Jose, CA
Tel: 408-735-9110
Tel: 408-436-4270

Canada - Toronto
Tel: 905-695-1980
Fax: 905-695-2078

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733

China - Beijing
Tel: 86-10-8569-7000

China - Chengdu
Tel: 86-28-8665-5511

China - Chongqing
Tel: 86-23-8980-9588

China - Dongguan
Tel: 86-769-8702-9880

China - Guangzhou
Tel: 86-20-8755-8029

China - Hangzhou
Tel: 86-571-8792-8115

China - Hong Kong SAR
Tel: 852-2943-5100

China - Nanjing
Tel: 86-25-8473-2460

China - Qingdao
Tel: 86-532-8502-7355

China - Shanghai
Tel: 86-21-3326-8000

China - Shenyang
Tel: 86-24-2334-2829

China - Shenzhen
Tel: 86-755-8864-2200

China - Suzhou
Tel: 86-186-6233-1526

China - Wuhan
Tel: 86-27-5980-5300

China - Xian
Tel: 86-29-8833-7252

China - Xiamen
Tel: 86-592-2388138

China - Zhuhai
Tel: 86-756-3210040

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444

India - New Delhi
Tel: 91-11-4160-8631

India - Pune
Tel: 91-20-4121-0141

Japan - Osaka
Tel: 81-6-6152-7160

Japan - Tokyo
Tel: 81-3-6880-3770

Korea - Daegu
Tel: 82-53-744-4301

Korea - Seoul
Tel: 82-2-554-7200

Malaysia - Kuala Lumpur
Tel: 60-3-7651-7906

Malaysia - Penang
Tel: 60-4-227-8870

Philippines - Manila
Tel: 63-2-634-9065

Singapore
Tel: 65-6334-8870

Taiwan - Hsin Chu
Tel: 886-3-577-8366

Taiwan - Kaohsiung
Tel: 886-7-213-7830

Taiwan - Taipei
Tel: 886-2-2508-8600

Thailand - Bangkok
Tel: 66-2-694-1351

Vietnam - Ho Chi Minh
Tel: 84-28-5448-2100

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4485-5910
Fax: 45-4485-2829

Finland - Espoo
Tel: 358-9-4520-820

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Garching
Tel: 49-8931-9700

Germany - Haan
Tel: 49-2129-3766400

Germany - Heilbronn
Tel: 49-7131-72400

Germany - Karlsruhe
Tel: 49-721-625370

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Germany - Rosenheim
Tel: 49-8031-354-560

Israel - Ra'anana
Tel: 972-9-744-7705

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Italy - Padova
Tel: 39-049-7625286

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Norway - Trondheim
Tel: 47-7288-4388

Poland - Warsaw
Tel: 48-22-3325737

Romania - Bucharest
Tel: 40-21-407-87-50

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

Sweden - Gothenberg
Tel: 46-31-704-60-40

Sweden - Stockholm
Tel: 46-8-5090-4654

UK - Wokingham
Tel: 44-118-921-5800
Fax: 44-118-921-5820