# RN2483

## Low-Power Long Range LoRa® Technology Transceiver Module

### General Features

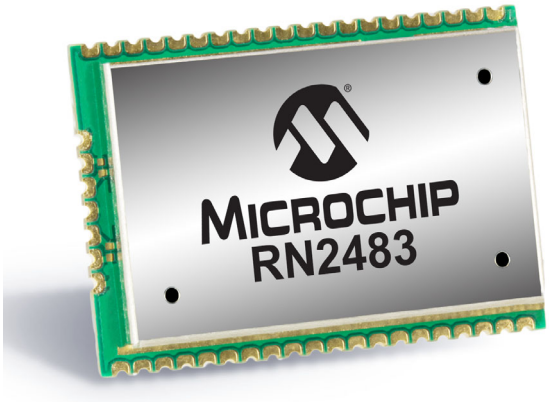
- On-Board LoRaWAN™ Protocol Stack
- ASCII Command Interface over UART
- Compact Form Factor: 17.8 x 26.7 x 3.34 mm
- Castellated SMT Pads for Easy and Reliable PCB Mounting
- Environmentally Friendly, RoHS Compliant
- European RED Certified Radio Module
- Device Firmware Upgrade (DFU) over UART, see *"RN2483 LoRa® Technology Module Command Reference User's Guide"* (DS40001784)

### 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, 10937 bps with LoRa Technology Modulation
- Integrated MCU, Crystal, EUI-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 433 MHz and 868 MHz Frequency Bands
- High Receiver Sensitivity: Down to -146 dBm
- TX Power: Adjustable up to +14 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




### Description

Microchip's RN2483 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 RN2483 module complies with the LoRaWAN Class A protocol specifications. It integrates RF, a baseband controller, command Application Programming Interface (API) processor, making it a complete long range solution.

The RN2483 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)

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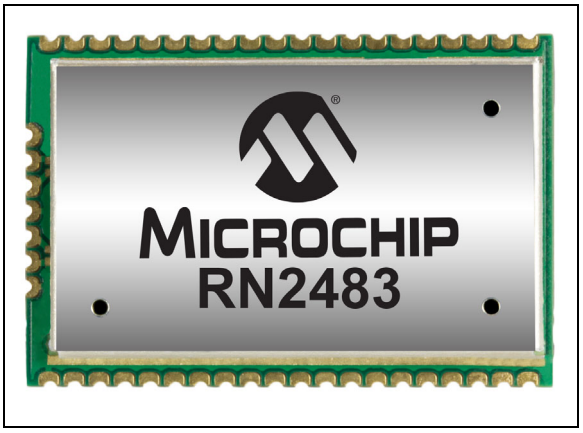
## 1.0 DEVICE OVERVIEW

The RN2483 transceiver module features LoRa Technology RF modulation, which provides long range spread spectrum communication with high interference immunity.

Using LoRa Technology modulation technique, RN2483 can achieve a receiver sensitivity of -146 dBm. The high sensitivity combined with the integrated +14 dBm power amplifier yields industry leading link budget, which makes it optimal for applications requiring extended range and robustness.

**FIGURE 1-1: RN2483 TOP VIEW**




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 RN2483 module delivers exceptional phase noise, selectivity, receiver linearity, and IIP3 for significantly lower power consumption. Figure 1-1, Figure 1-2, and Figure 1-3 show the top view, the pinout, and the block diagram of the module.

**FIGURE 1-2: RN2483 PIN DIAGRAM**

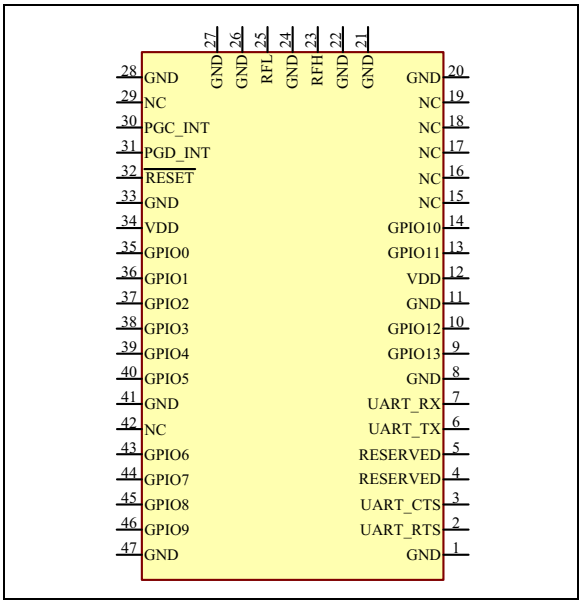



**FIGURE 1-3: RN2483 BLOCK DIAGRAM**

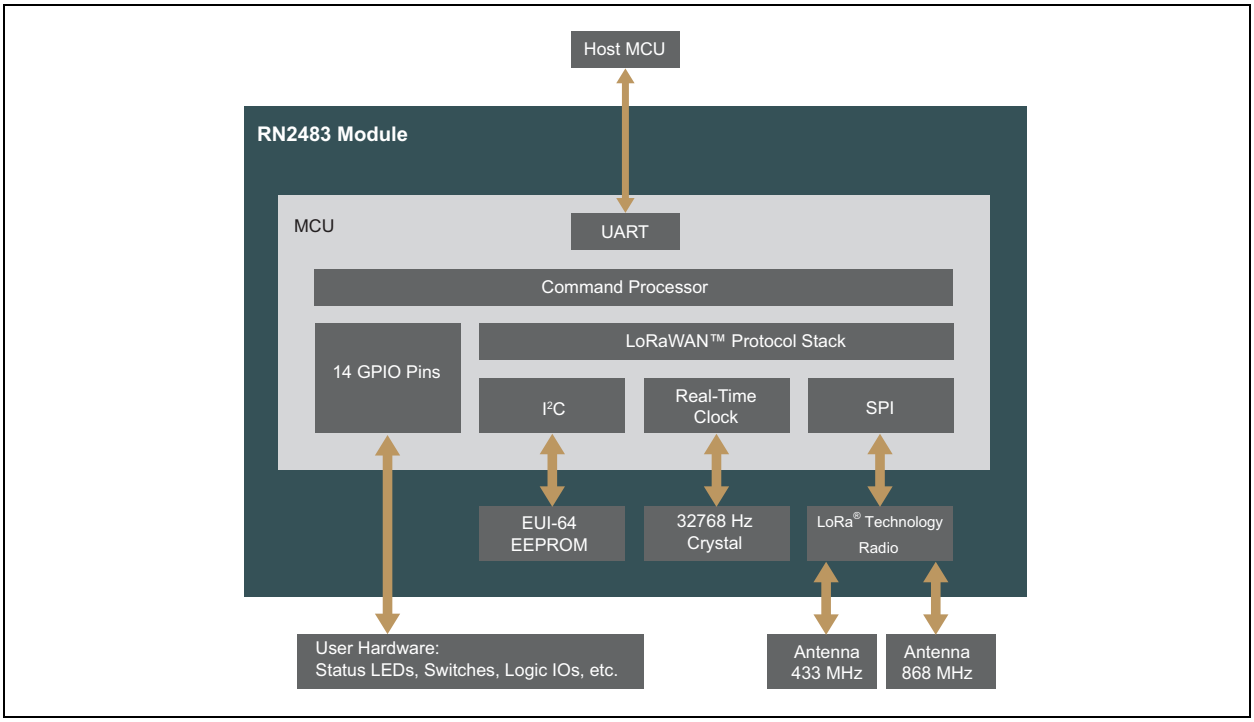


Table 1-1 describes the RN2483 pins.

**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 | RFH | RF analog | RF signal pin for high band |
| 24 | GND | Power | Ground supply terminal |
| 25 | RFL | RF analog | RF signal pin for low band |
| 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(2) |
| 31 | PGD_INT | Input/Output | Internal MCU ICSP program data or general purpose I/O pin (2) |
| 32 | $\overline{\text{RESET}}$ | 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 |

**TABLE 1-1: PIN DESCRIPTION (CONTINUED)**

| Pin | Name | Type | Description |
|---|---|---|---|
| 43 | GPIO6 | Input/Output | General purpose I/O pin or analog input |
| 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:** The *"RN2483 LoRa® Technology Module Command Reference User's Guide"* (DS40001784) uses the pin name TEST0 for PGC_INT and TEST1 for PGD_INT.

## 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 | 863.000 MHz to 870.000 MHz; 433.050 MHz to 434.790 MHz |
| Modulation Method | FSK, GFSK, and LoRa® Technology modulation |
| Maximum Over-the-Air Data Rate | 300 kbps with FSK modulation; 10937 bps with LoRa Technology modulation |
| RF Connection | Board edge connection |
| Interface | UART |
| Operation Range | Up to 15 km coverage at suburban; up to 5 km coverage at urban area |
| Sensitivity at 1% PER | -146 dBm(1) |
| RF TX Power | Adjustable up to max. 10 dBm on 433 MHz band (limited to meet regulations); max. 14 dBm on the 868 MHz band(2) |
| 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:** TX power is adjustable. For more information, refer to the *"RN2483 LoRa® Technology Module Command Reference User's Guide"* (DS40001784).

**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 $\overline{\text{RESET}}$ | -0.3 | — | VDD + 0.3 | V |
| Voltage on VDD with respect to VSS | -0.3 | — | 3.9 | V |
| Voltage on $\overline{\text{RESET}}$ 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 | 1.7 | 2.8 | 3.1 |
| Transmit | 25 | 28.6 | 38.9 | 44.5 |
| Sleep | -40 | 0.0011 | 0.0013 | 0.0014 |
| | 25 | 0.0015 | 0.0016 | 0.0016 |
| | 85 | 0.002 | 0.0026 | 0.0026 |
| Receive | -40 to +85 | 12.96 | 14.22 | 14.69 |

**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**

| Band | TX Power Setting | Output Power (dBm) | Typical Supply Current at 3.3V (mA) |
|---|---|---|---|
| 868 MHz | -3 | -4.0 | 17.3 |
| | -2 | -2.9 | 18.0 |
| | -1 | -1.9 | 18.7 |
| | 0 | -1.7 | 20.2 |
| | 1 | -0.6 | 21.2 |
| | 2 | 0.4 | 22.3 |
| | 3 | 1.4 | 23.5 |
| | 4 | 2.5 | 24.7 |
| | 5 | 3.6 | 26.1 |
| | 6 | 4.7 | 27.5 |
| | 7 | 5.8 | 28.8 |
| | 8 | 6.9 | 30.0 |
| | 9 | 8.1 | 31.2 |
| | 10 | 9.3 | 32.4 |
| | 11 | 10.4 | 33.7 |
| | 12 | 11.6 | 35.1 |
| | 13 | 12.5 | 36.5 |
| | 14 | 13.5 | 38.0 |
| | 15 | 14.1 | 38.9 |

**TABLE 2-5: OUTPUT POWER OF TX POWER SETTING (CONTINUED)**

| Band | TX Power Setting | Output Power (dBm) | Typical Supply Current at 3.3V (mA) |
|---|---|---|---|
| 433 MHz | -3 | -3.5 | 14.7 |
| | -2 | -2.3 | 15.1 |
| | -1 | -1.3 | 15.6 |
| | 0 | -2.3 | 15.8 |
| | 1 | -1.2 | 16.4 |
| | 2 | -0.1 | 17.0 |
| | 3 | 1.0 | 17.7 |
| | 4 | 2.1 | 18.5 |
| | 5 | 3.2 | 19.4 |
| | 6 | 4.3 | 20.3 |
| | 7 | 5.4 | 21.4 |
| | 8 | 6.5 | 22.3 |
| | 9 | 7.6 | 23.3 |
| | 10 | 8.8 | 24.5 |
| | 11 | 9.9 | 25.8 |
| | 12 | 10.9 | 27.3 |
| | 13 | 11.9 | 28.8 |
| | 14 | 12.9 | 30.7 |
| | 15 | 13.6 | 32.9 |

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

| Temperature (°C) | Typical Output Power at 868 MHz (dBm) | | |
|---|---|---|---|
| | VDD = 2.1V | VDD = 3.3V | VDD = 3.6V |
| -40 | 10.5 | 13.8 | 13.7 |
| 25 | 10.0 | 14.1 | 14.6 |
| 85 | 9.1 | 13.4 | 13.7 |

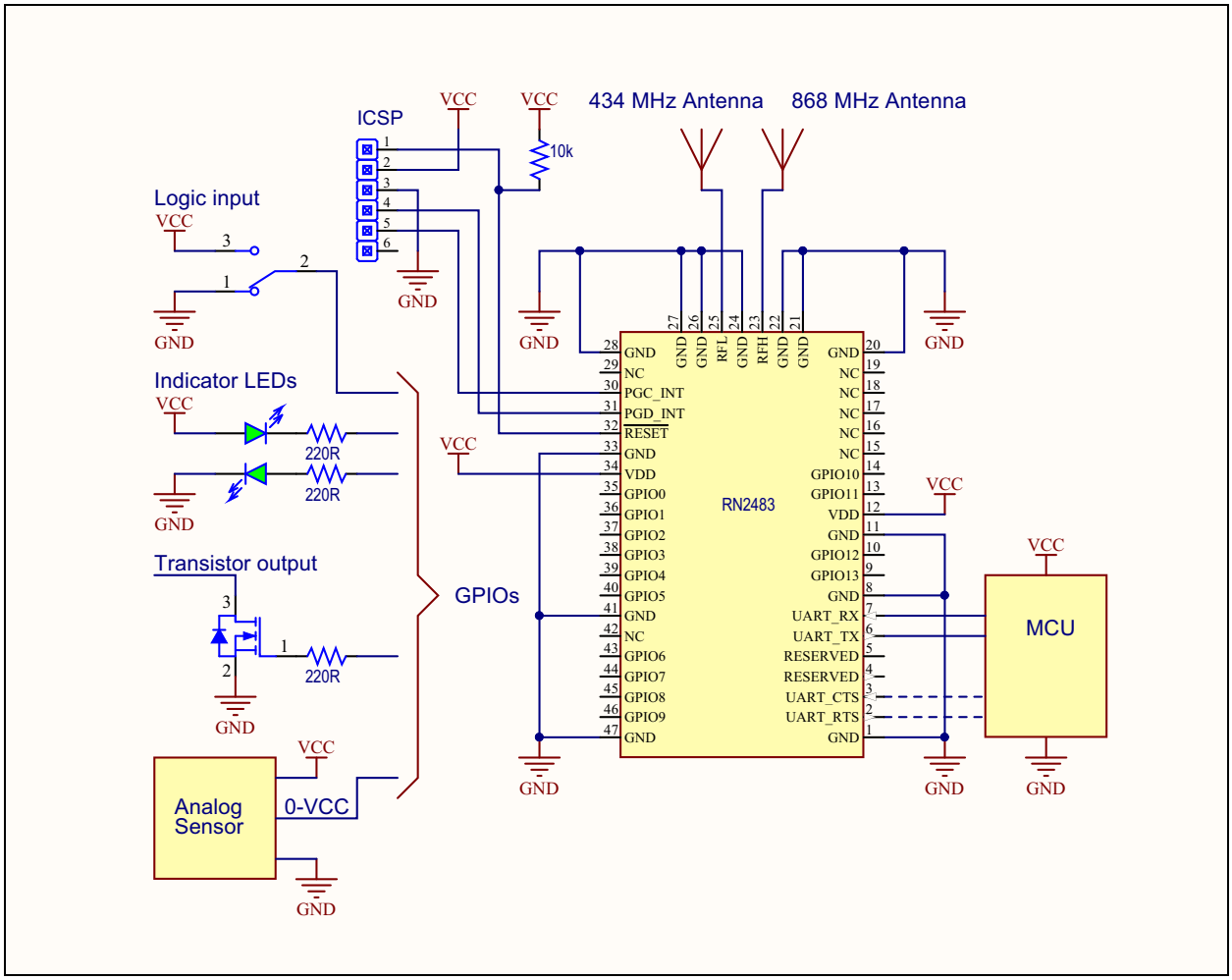
**TABLE 2-7: OUTPUT POWER OF SUPPLY VOLTAGE AND TEMPERATURE**

| Temperature (°C) | Typical Output Power at 434 MHz (dBm) | | |
|---|---|---|---|
| | VDD = 2.1V | VDD = 3.3V | VDD = 3.6V |
| -40 | 10.1 | 13.2 | 13.2 |
| 25 | 9.7 | 13.6 | 14.2 |
| 85 | 9.3 | 13.0 | 13.4 |

## 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 RN2483 module has a dedicated UART interface to communicate with a host controller. Optional handshake lines are supported in future firmware releases. The *"RN2483 LoRa® Technology Module Command Reference User's Guide"* (DS40001784) 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 *"RN2483 LoRa® Technology Module Command Reference User's Guide"* (DS40001784).

### 3.3 RF Connections (RFL, RFH)

RFL is the RF analog port for the lower frequency band (433 MHz) while RFH is for the higher frequency band (868 MHz). When routing RF paths, use proper strip lines with an impedance of 50 Ohm.

## 3.4 $\overline{\text{RESET}}$ 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 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 *"RN2483 LoRa® Technology Module Command Reference User's Guide"* (DS40001784).

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.

## 4.0 PHYSICAL DIMENSIONS

Figure 4-1 and Figure 4-2 illustrate the physical dimensions and the recommended PCB layout for the RN2483 module.

**FIGURE 4-1: RN2483 PHYSICAL DIMENSIONS**

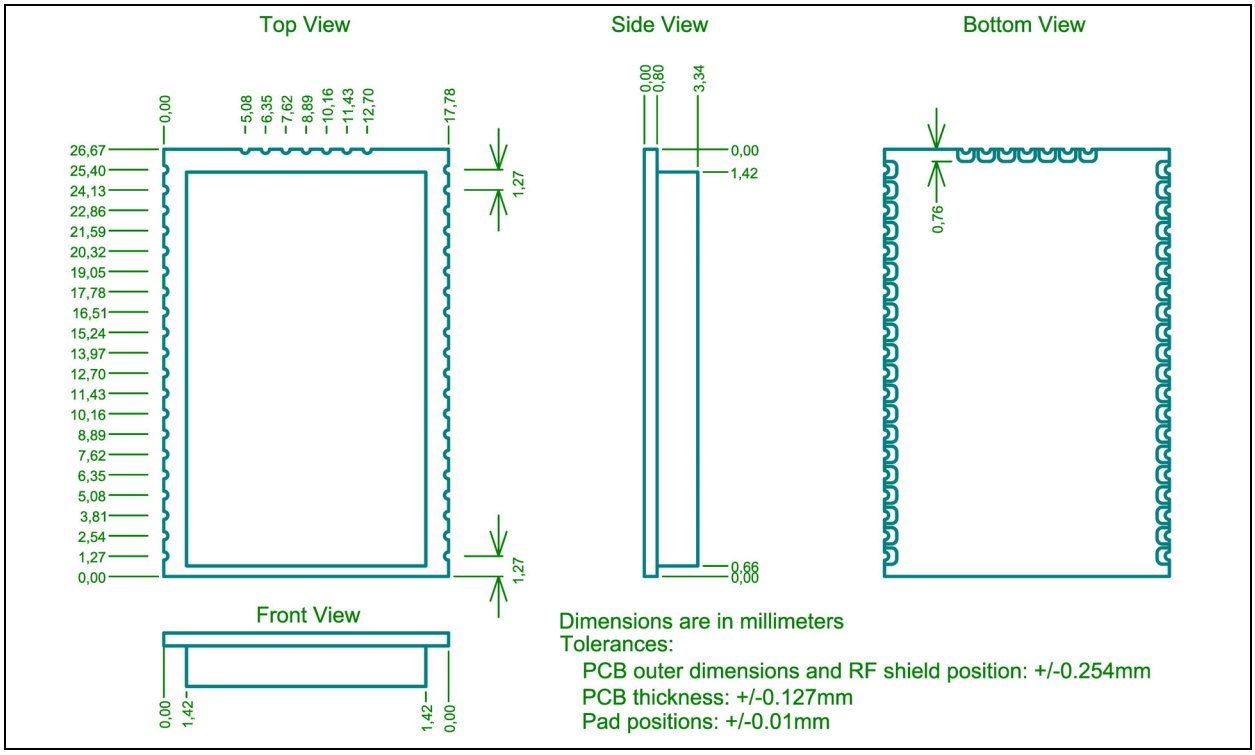
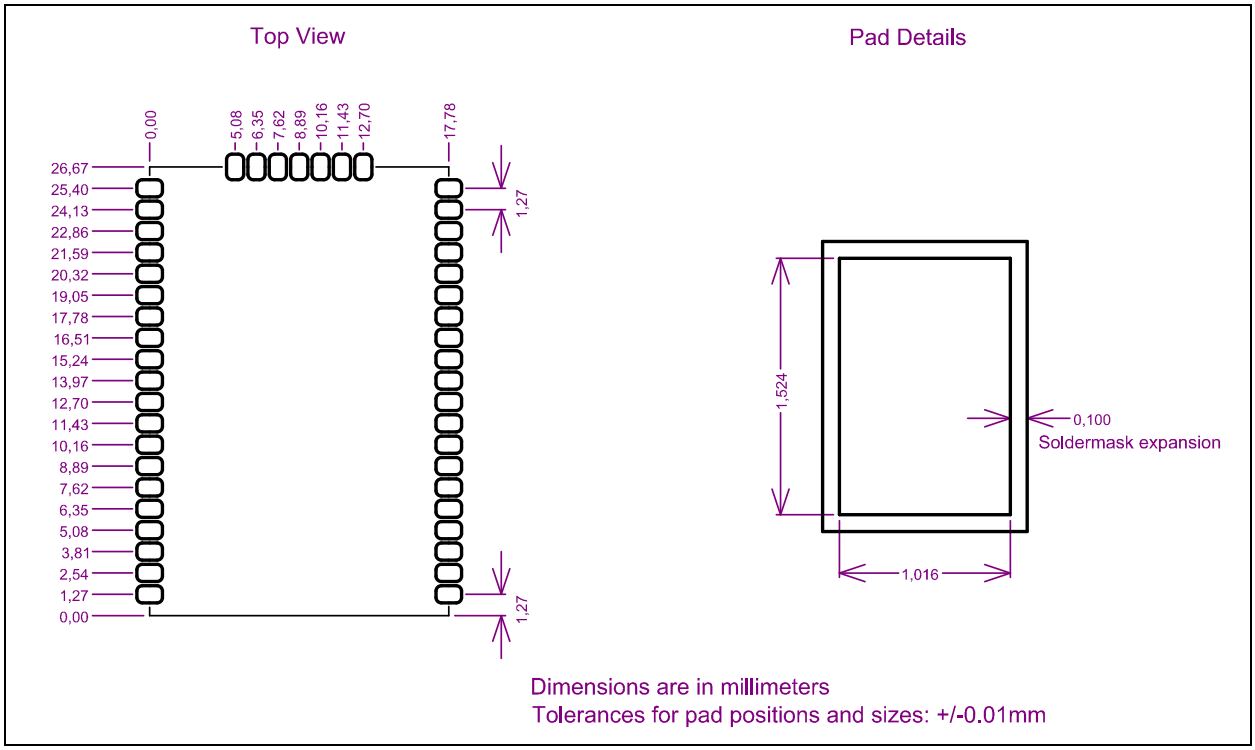



**FIGURE 4-2: RECOMMENDED PCB FOOTPRINT**

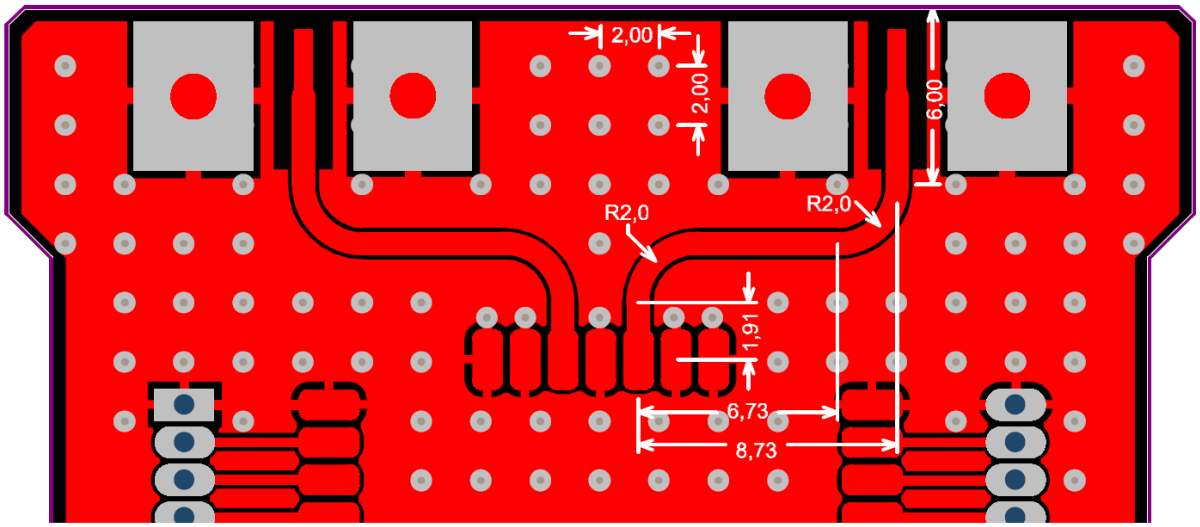


## 5.0 APPLICATION INFORMATION

### 5.1 RF Trace Layout Design

The RN2483 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 two RF paths are axisymmetric with the same linear dimensions. Gerber files are available on the RN2483 product web page at www.microchip.com/RN2483.

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

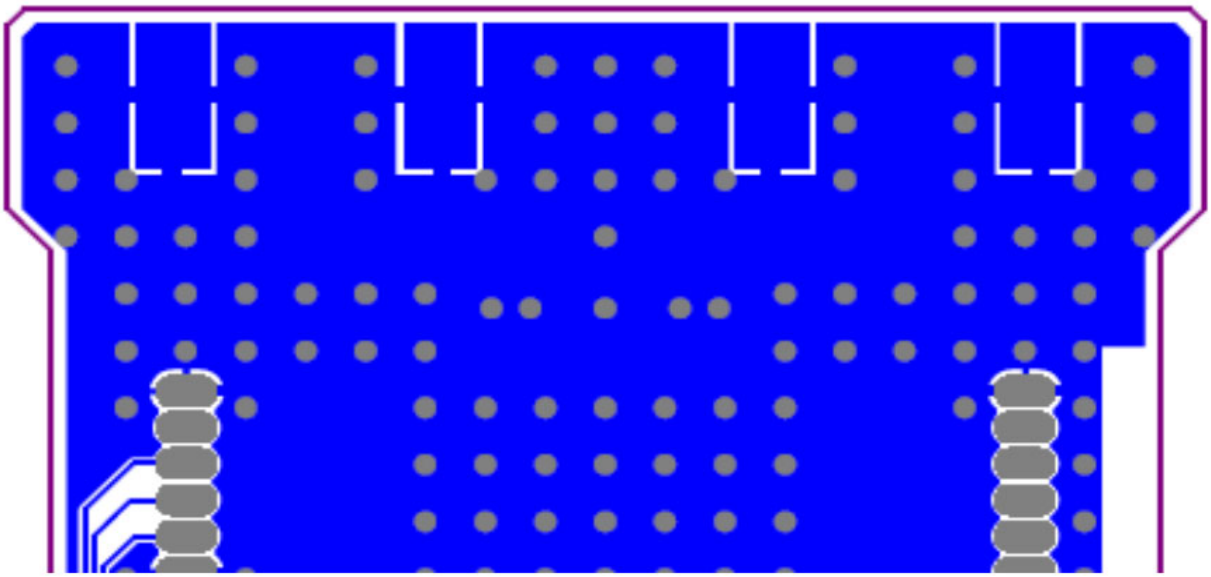



PCB Details:
- Two layer, plated through hole
- FR4
- Thickness: 1.55 mm
- Via stitching with 0.25 mm plated

Trace Dimensions:
- Trace width: 0.75
- Trace gap: 0.15
- Finished Copper Weight: 1 ounce

Dimensions are in millimeters

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



## 6.0 REGULATORY APPROVAL

This section outlines the regulatory information for the RN2483 module for Europe.

### 6.1 Europe

The RN2483 module is an Radio Equipment Directive (RED) assessed radio module that is CE marked and has been manufactured and tested with the intention of being integrated into a final product.

The RN2483 module has been tested to RED 2014/53/EU Essential Requirements for Health and Safety (Article (3.1(a)), Electro Magnetic Compatibility (EMC) (Article 3.1(b)), and Radio (Article 3.2) and are summarized in Table 6-1.

The ETSI provides guidance on modular devices in "*Guide to the application of harmonised standards covering Article 3.1(b) and Article 3.2 of the Directive 2014/53/EU RED to multi-radio and combined radio and non-radio equipment*" document available at http://www.etsi.org/deliver/etsi_eg/203300_203399/203367/01.01.01_60/eg_203367v010101p.pdf.

| | |
|---|---|
| **Note:** | To maintain conformance to the testing listed in Table 6-1, the module shall be installed in accordance with the installation instructions in this datasheet 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 against the RED. |

#### 6.1.1 LABELING AND USER INFORMATION REQUIREMENTS

The label on the final product which contains the RN2483 module must follow CE marking requirements.

**TABLE 6-1: EUROPEAN COMPLIANCE TESTING**

| Certification | Standards | Article | Laboratory | Report Number | Date |
|---|---|---|---|---|---|
| Safety | EN 60950-1:2006 / A11:2009 / A1:2010 / A12:2011 / A2:2013 | [3.1(a)] | TUV Rheinland, Taiwan | 10062010 002 | 18 Sept 2017 |
| Health | EN62479:2010 | | | 50105982 001 | 2 Jul 2018 |
| EMC | EN 301 489-1 V2.1.1<br>EN 301 489-1 V2.2.0 | [3.1(b)] | | 10061415 002 | 10 Jul 2018 |
| | EN 301 489-3 V1.6.1<br>EN 301 489-3 V2.1.1 | | | | |
| Radio | EN 300 220-1 V3.1.1<br>EN 300 220-2 V3.1.1 | (3.2) | | 50105982 001<br>50105982 002 | 2 Jul 2018<br>13 Dec 2019 |

#### 6.1.2 CONFORMITY ASSESSMENT

From ETSI Guidance Note EG 203367, section 6.1 Non-radio products are combined with a radio product:

If the manufacturer of the combined equipment installs the radio product in a host non-radio product in equivalent assessment conditions (i.e. host equivalent to the one used for the assessment of the radio product) and according to the installation instructions for the radio product, then no additional assessment of the combined equipment against article 3.2 of the RED is required.

The European Compliance Testing listed in Table 6-1 was performed using the Integral PCB antenna listed in Table 6-2.

**TABLE 6-2: ANTENNAS**

| Sino | P/N | Vendor | Antenna Gain @ 824 ~ 960MHz band | Antenna type |
|---|---|---|---|---|
| 1 | AL-A80355-UB701 | Alead Technology | 2 dBi | Dipole |
| 2 | RFA-ZW-C55-B70-D034 | Alead Technology | 2 dBi | Dipole |

### 6.1.3 SIMPLIFIED EU DECLARATION OF CONFORMITY

Hereby, Microchip Technology Inc. declares that the radio equipment type RN2483 is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity, for this product, is available at: http://www.microchip.com/design-centers/wireless-connectivity.

### 6.1.4 HELPFUL WEBSITES

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 Communications Committee (ECC) at: http://www.ecodocdb.dk/

Additional helpful web sites are:

- Radio Equipment Directive (2014/53/EU): https://ec.europa.eu/growth/single-market/european-standards/harmonised-standards/red_en
- European Conference of Postal and Telecommunications Administrations (CEPT): http://www.cept.org
- European Telecommunications Standards Institute (ETSI): http://www.etsi.org
- The Radio Equipment Directive Compliance Association (REDCA): http://www.redca.eu/

**NOTES:**

**NOTES:**

# APPENDIX A: REVISION HISTORY

## Revision A (March 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
- Added Figure 5-2
- Updated information for **Section 5.1 "RF Trace Layout Design"**.

## Revision C (April 2017)

This revision includes the following updates:

- Updated Figure 1-2 and Figure 3-1
- Updated Table 1-1, Table 2-2, and Table 2-3
- Added Table 2-6 and Table 2-7
- Updated **Section 3.4 "RESET Pin"**
- Added **Section 3.6 "Internal Program Pins"**
- Deleted Section "5.2 Application Schematic".

## Revision D (March 2019)

This revision includes the following update:

- Updated Section 6.1, Europe.
- Updates to Trademarks and Worldwide Sales and Service pages.

## Revision E (June 2020)

- Updated Table 2-3
- Updated Table 6-1 and Table 6-2

**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:

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**NOTES:**

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| PART NO. | I | RM | XXX |
|---|---|---|---|
| Device | Temperature Range | Package | Firmware Revision Number |

| | | | |
|---|---|---|---|
| **Device:** | RN2483: | | Low-Power Long Range LoRa® Technology Transceiver module |
| **Temperature Range:** | I | = | -40°C to +85°C (Industrial) |
| **Package:** | RM | = | Radio Module |

**Examples:**

RN2483A-I/RM: Industrial temperature

**NOTES:**

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

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
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**Trademarks**



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