

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

Key Features:

- Complete, Embedded 2.4 GHz IEEE 802.11 b/g Wireless LAN Module
- 14 General Purpose Input/Output (GPIO) Pins (Four GPIO pins shared with the 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, 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 μ A)
- 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 and New Zealand

FIGURE 1: RN1723 MODULE



Media Access Control (MAC)/Baseband:

- Security:
 - WEP-128
 - WPA-PSK (TKIP)
 - WPA2-PSK (AES)
 - TLS 1.0, 1.1, and 1.2 (with external microprocessor)

Operational:

- Operating Voltage: 3.3V (typical)
- Temperature Range: -40°C to +85°C Industrial
- Low Current Consumption:
 - RX mode: 40 mA
 - TX mode: 120 mA at 0 dBm
 - Sleep mode: 4 μ A
 - Doze mode: 15 mA

RF/Analog:

- 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
- Low-Power Battery Operations

Table of Contents

1.0	Device Overview	3
2.0	Circuit Description (Hardware Interface)	9
3.0	Application Information	15
4.0	Regulatory Approval	17
5.0	Electrical Characteristics	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 Web site 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 Web site; <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 web site at www.microchip.com to receive the most current information on all of our products.

1.0 DEVICE OVERVIEW

The RN1723 is a stand-alone, 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 RN1723, designers can embed Wi-Fi and networking functionality rapidly into virtually any device.

The RN1723 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 RN1723 is configured with a simple ASCII command language. The “*WiFly Command Reference, Advanced Features and Applications User’s Guide*” (DS50002230), which is available for download from www.microchip.com, contains a complete listing and instructions of the ASCII command interface.

In the simplest configuration, the module requires only power, ground, and UART Transmit (TX) and Receive (RX) connections. The RN1723 module can interface to low-cost microcontrollers using only two wires, UART TX and RX.

The RN1723 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 RN1723 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

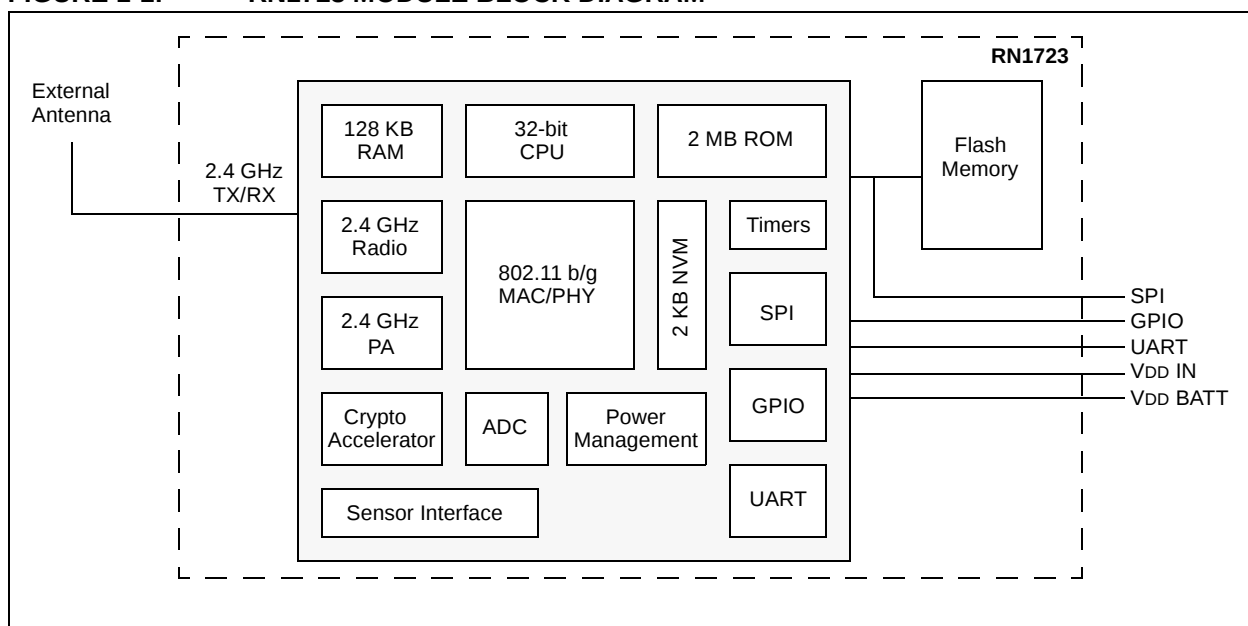
Additionally, the module is perfect for mobile wireless applications, such as asset monitoring and sensors.

The RN1723 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 (i.e., 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 RN1723 has modular device approval for operation in the United States (FCC) and Canada (IC). The RN1723 module is an R&TTE Directive assessed radio module for operation in Europe. Refer to [Section 4.0 “Regulatory Approval”](#) for more information.

FIGURE 1-1: RN1723 MODULE BLOCK DIAGRAM



RN1723

1.1 ASCII Command & Data Interface

A complete description of the ASCII command and data interface for the RN1723 module is provided in the “WiFly Command Reference, Advanced Features and Applications User’s Guide” (DS50002230).

1.2 Interface Description

Figure 1-1 shows the RN1723 pin diagram. Figure 1-3 shows the microcontroller to RN1723 interface. Table 1-1 describes the RN1723 pins.

FIGURE 1-2: RN1723 PIN DIAGRAM

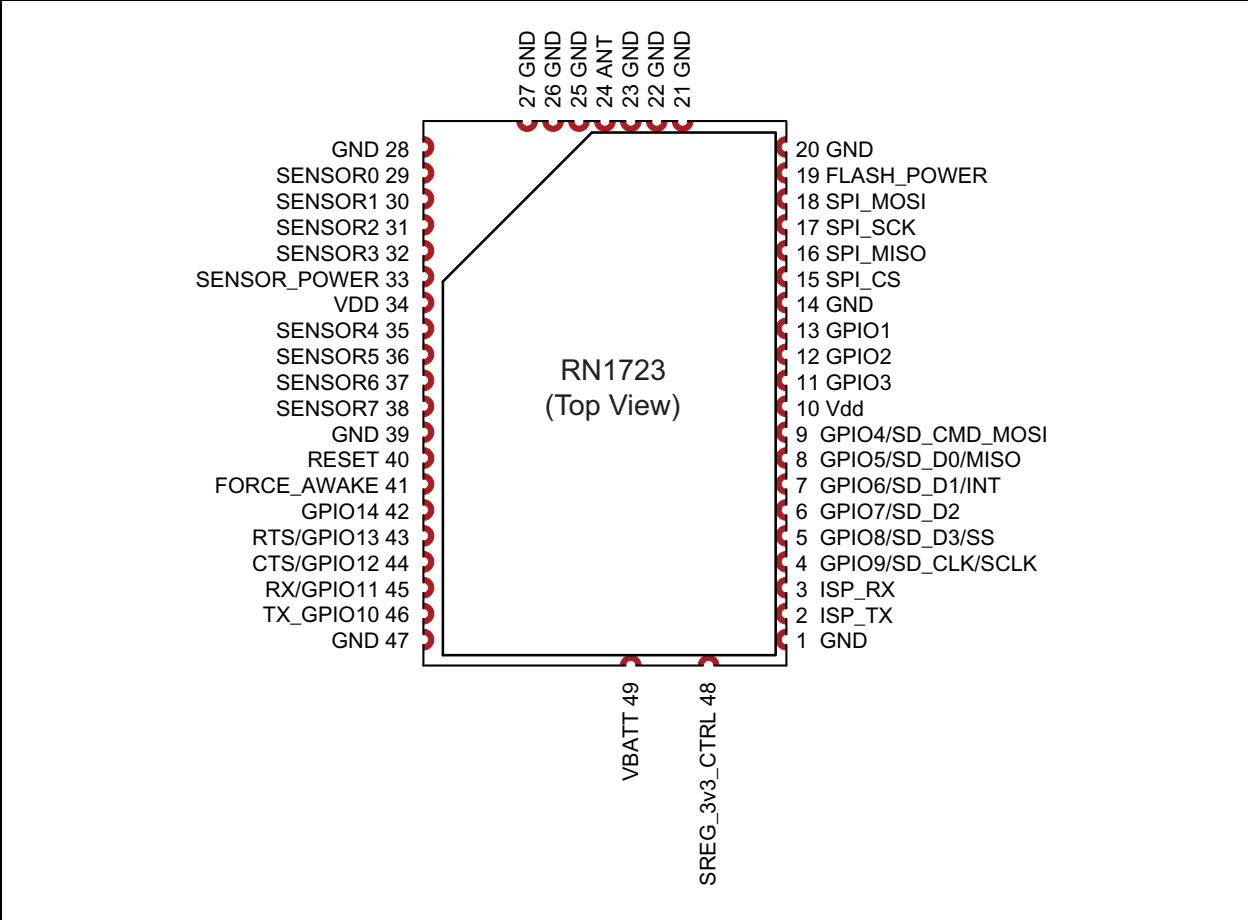


FIGURE 1-3: MICROCONTROLLER TO RN1723 INTERFACE

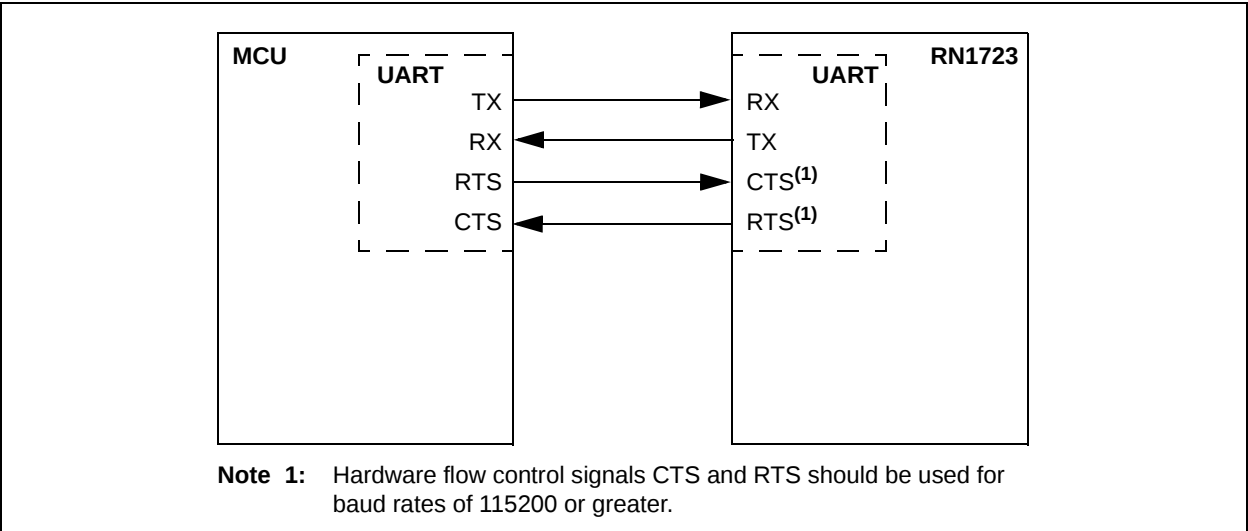


TABLE 1-1: PIN DESCRIPTIONS

Pin #	Name	Type	Description
1	GND	P	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 ^(1,2) /SDIO clock/SD-SPI slave SCLK
5	GPIO8/SD_D3/SS	DIO	General purpose I/O 8 ^(1,3) /SDIO D3/SD-SPI slave select
6	GPIO7/SD_D2	DIO	General purpose I/O 7 ^(1,3) /SDIO D2
7	GPIO6/SD_D1/INT	DIO	General purpose I/O 6 ^(1,3) /SDIO D1/SD-SPI slave INT
8	GPIO5/SD_D0/MISO	DIO	General purpose I/O 5 ^(1,3) /SDIO D0/SD-SPI slave MISO
9	GPIO4/SD_CMD/MOSI	DIO	General purpose I/O 4 ^(1,3) /SDIO CMD/SD-SPI slave MOSI
10	VDD	P	Positive supply
11	GPIO3	DIO	General purpose I/O 3 ^(1,1)
12	GPIO2	DIO	General purpose I/O 2 ^(1,2)
13	GPIO1	DIO	General purpose I/O 1 ^(1,2)
14	GND	P	Ground reference
15	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	P	Internal Flash memory power
20	GND	P	Ground reference
21	GND	P	Ground reference
22	GND	P	Ground reference
23	GND	P	Ground reference
24	ANT	AIO	RF antenna. 50Ω impedance
25	GND	P	Ground reference
26	GND	P	Ground reference
27	GND	P	Ground reference
28	GND	P	Ground reference
29	SENSOR0	AI	Sensor interface 0 ⁽⁴⁾
30	SENSOR1	AI	Sensor interface 1 ⁽⁴⁾
31	SENSOR2	AI	Sensor interface 2 ⁽⁴⁾
32	SENSOR3	AI	Sensor interface 3 ⁽⁴⁾
33	SENSOR_POWER	P	Sensor power
34	VDD	P	Positive supply
35	SENSOR4	AI	Sensor interface 4 ⁽⁴⁾
36	SENSOR5	AI	Sensor interface 5 ⁽⁴⁾

Legend: A = Analog; D = Digital; I = Input; O = Output P = Power

Note 1: Refer to [Section 5.0 “Electrical Characteristics”](#) for the GPIO voltage and current limitations.

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

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

4: Analog input. 0-400 mV (do not exceed 1.2V DC).

TABLE 1-1: PIN DESCRIPTIONS (CONTINUED)

Pin #	Name	Type	Description
37	SENSOR6	AI	Sensor interface 6 ⁽⁴⁾
38	SENSOR7	AI	Sensor interface 7 ⁽⁴⁾
39	GND	P	Ground reference
40	RESET	DI	Module Reset. Internal 100 k Ω pull-up resistor. Apply a pulse of at least 160 μ s
41	FORCE_AWAKE	DI	Module force awake. Internal 100 k Ω pull-down resistor. Apply pulse for at least 245 μ s. While FORCE_AWAKE is asserted, the module is prevented from sleeping
42	GPIO14	DIO	General purpose I/O 14 ^(1,2)
43	RTS/GPIO13	DO/DIO	UART asynchronous output/general purpose I/O ^(1,2)
44	CTS/GPIO12	DI/DIO	UART asynchronous input/general purpose I/O ^(1,2)
45	RX/GPIO11	DI/DIO	UART asynchronous input/general purpose I/O ^(1,2)
46	TX/GPIO10	DO/DIO	UART asynchronous output/general purpose I/O ^(1,2)
47	GND	P	Ground reference
48	SREG_3V3_CTRL	P	Battery boost circuit control
49	VBATT	P	Battery voltage

Legend: A = Analog; D = Digital; I = Input; O = Output P = Power

Note 1: Refer to [Section 5.0 “Electrical Characteristics”](#) for the GPIO voltage and current limitations.

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

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

4: Analog input. 0-400 mV (do not exceed 1.2V DC).

1.3 Mounting Details

Figure 1-4 and Figure 1-5 show the physical dimensions of the RN1723 module. Figure 1-6 shows the recommended host PCB layout.

FIGURE 1-4: RN1723 MODULE PHYSICAL DIMENSIONS (TOP AND SIDE VIEW)

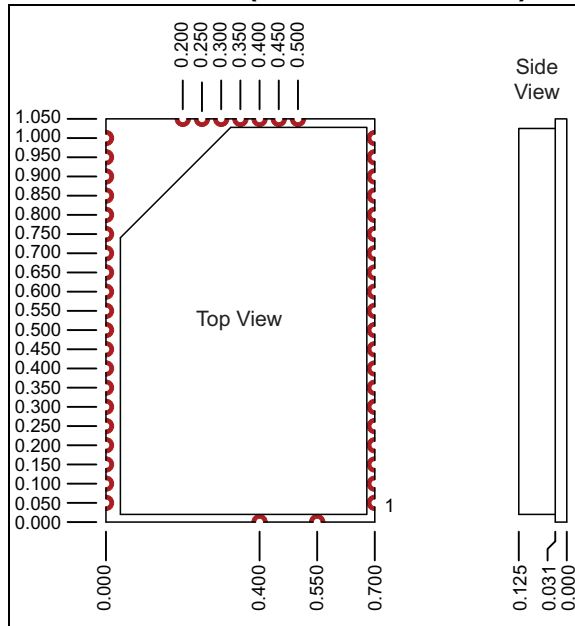


FIGURE 1-5: RN1723 MODULE PHYSICAL DIMENSIONS (BOTTOM VIEW)

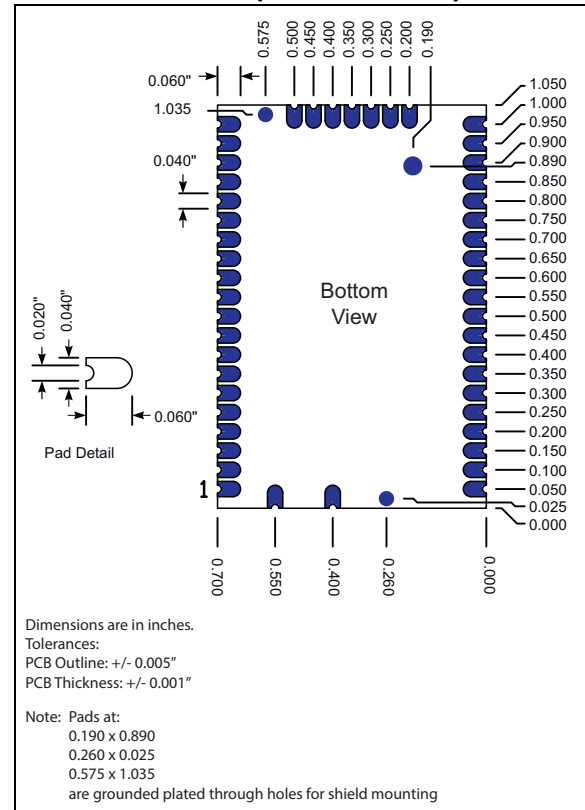
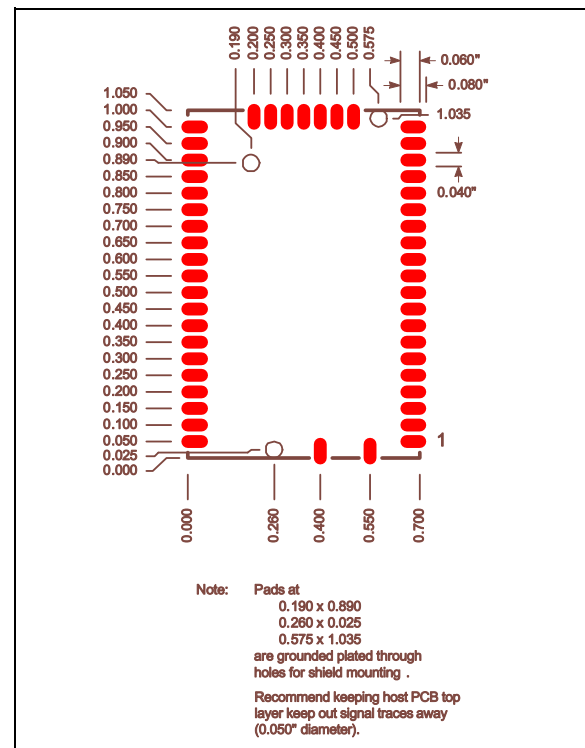


FIGURE 1-6: RECOMMENDED HOST PCB FOOTPRINT



1.4 Soldering Recommendations

The RN1723 wireless module was assembled using the IPC/JEDEC J-STD-020 Standard lead-free reflow profile. However, the RN1723 module can be soldered to the host PCB using standard leaded and lead-free solder reflow profiles.

To avoid damaging the module, it is recommended to adhere to the following:

- Solder reflow recommendations are provided in the Microchip application note, AN233 *"Solder Reflow Recommendation"* (DS00233)
- Do not exceed a peak temperature (Tp) of 250°C
- Refer to the vendor's 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 final flow.

2.0 CIRCUIT DESCRIPTION (HARDWARE INTERFACE)

2.1 UART Interface

The UART interface supports 2-wire (RX and TX) and 4-wire (RX, TX, CTS, and RTS) configurations with hardware flow control. The logic levels are CMOS voltage levels (not RS-232 voltage levels).

The UART interface supports the following baud rates in bits per second:

- 2,400
- 4,800
- 9,600
- 19,200
- 38,400
- 115,200
- 230,400

Refer to the “WiFly Command Reference, Advanced Features and Applications User’s Guide” (DS50002230) for UART configuration information.

Note: The use of flow control is highly recommended to ensure proper data integrity.

2.2 SPI Master Interface

The RN1723 module contains a master Serial Peripheral Interface (SPI), 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 RN1723 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 application.

2.4 In-System Programming (ISP)

The ISP_TX, ISP_RX, and other pins allow in-system programming of the module. The RN1723 module firmware can be upgraded by ISP using a *.bin file.

Note: The over-the-air FTP update files (*.img or *.mif) are not compatible with the ISP.

Optionally, it is recommended to place the ISP header on the host PCB to facilitate firmware upgrades during development and manufacturing. The header is two rows by 8 pins with a 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. In addition, refer to the RN-ISP product page on the Microchip web site for more information.

2.5 The Sensor Interface

External sensor devices can connect to the RN1723 module via its sensor interface. There are a total of 8 sensor interface inputs available. They are labeled SENSOR_IF[0] – SENSOR_IF[7], on the RN1723 Pin diagram, as shown in [Figure 1-2](#).

The sensor interface is suitable for, but not limited to, connecting the following type of devices:

- Analog-to-Digital Conversion sensors
- Switch sensor
- Vibration sensors, motion sensors, and ball-and-tube sensors

In addition to providing data input to the RN1723 module, some of the sensors can be used to wake-up the module from sleep. A typical use case would have one sensor input wake up the module, while another sensor input provides it with external data that can be transmitted wirelessly.

2.6 Analog Sensor Inputs

Eight sensor interface input pins, SENSOR_IF0 through SENSORIF7, can be used as analog sensor inputs. The sensor pins are 1.2V tolerant and can 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. Failure to heed this warning could result in permanent damage to the module.

The RN1723 14-bit Analog-to-Digital Converter (ADC) requires a 35 ms conversion time, with 0.01% linearity. The pertinent analog sensor input specifications are provided in [Table 2-1](#).

TABLE 2-1: ANALOG SENSOR INPUTS

Parameter	Value
AD SENSOR_IF[0 – 7] measurement range	0-400 mV (not to exceed 1.2 V _{DC})
Resolution	14 bits = 12 μ V
Accuracy	5% uncalibrated; 0.01% calibrated
Minimum conversion time	35 μ s (5 kHz over Wi-Fi®)

For additional instructions on how to read and manage the data from the analog sensor inputs, please refer to the show q <value> command in the “WiFly Command Reference, Advanced Features and Applications User’s Guide” (DS50002230).

RN1723

2.6.1 SWITCH SENSORS

The RN1723 module has four switch sensor input pins – SENSOR_IF[0 – 4]. These sensor pins can be used to wake the module from sleep.

During sleep, the module can be configured to continuously monitor the present state of the pins. Any transition (low-to-high or high-to-low) will generate a module wake-up signal.

A typical use case is to place the module into Sleep mode, and use one of the switches to trigger a wake-up event of the module. After waking up, the module can then send a UDP/TCP packet.

Figure 2-1 shows an example schematic of how a designer might connect both a simple Reed Switch and tilt-vibe motion sensor (SQ_SEN-200-C) to SENSOR_IF[0] and SENSOR_IF[3], respectively. When properly enabled, any transition activity on either sensor will wake up the RN1723.

Please refer to the “WiFly Command Reference, Advanced Features and Applications User’s Guide” (DS50002230A), and the section on the set sys trigger <mask> command for instructions on how to enable the switch sensor inputs on the module. Table 2-2 shows the specific value of the ‘mask’ that is required to enable any of the SENSOR_IF[0 – 3] inputs to act as module wake-up signals.

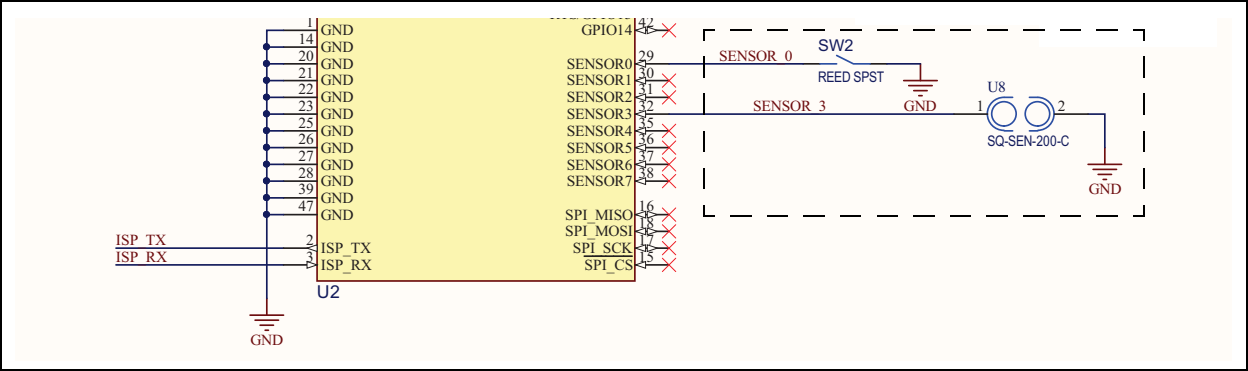
TABLE 2-2: SENSOR INPUT ENABLE

Wake On Sensor Input	Value	Command
0	1	Set sys trigger 1
1	2	Set sys trigger 2
2	4	Set sys trigger 4
3	8	Set sys trigger 8

WARNING

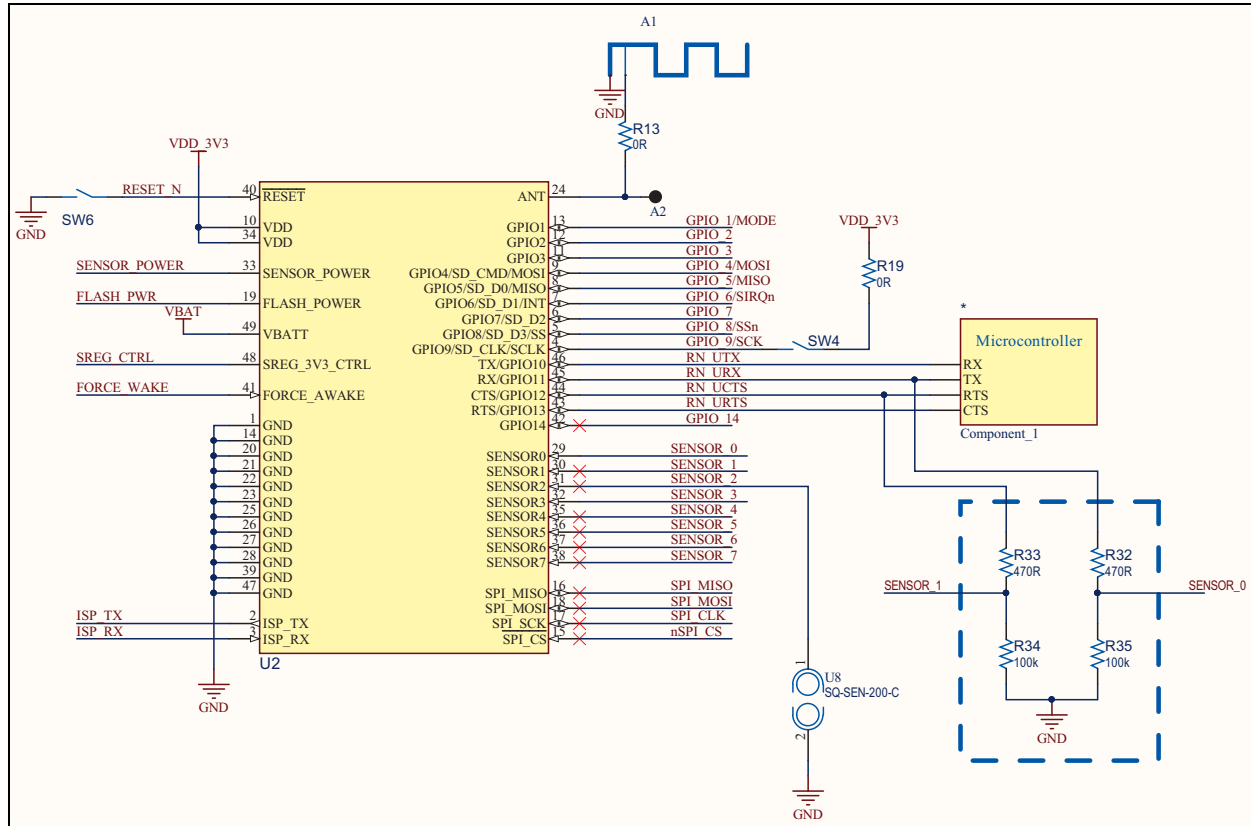
The voltage on any sensor input **CANNOT** exceed 1.2V DC. Failure to heed this warning could result in permanent damage to the module.

FIGURE 2-1: CONNECTING A REED SWITCH AND MOTION SENSOR EXAMPLE



Another common usage case for the RN1723 module is to put it to sleep and only wake the module when there is data present on its UART RX line, as illustrated in [Figure 2-2](#).

FIGURE 2-2: WAKE ON UART RECEIVE



2.7 General Purpose Input/Output (GPIO) Pins

The RN1723 module 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.

2.8 Flash Voltage Supply

The FLASH_POWER pin on the RN1723 module is used to power the internal Flash memory of the module. However, it can also supply other external components, up to a limit of 25 mA total current. When the RN1723 is in Sleep mode, it does not drive this supply.

2.9 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 sleep to CPU active in 1.7 ms, and from CPU active to network connection in less than 35 ms (typical). The RN1723 also supports a Doze state that provides an instant transition from Sleep to a Wake state.

2.9.1 FORCE AWAKE

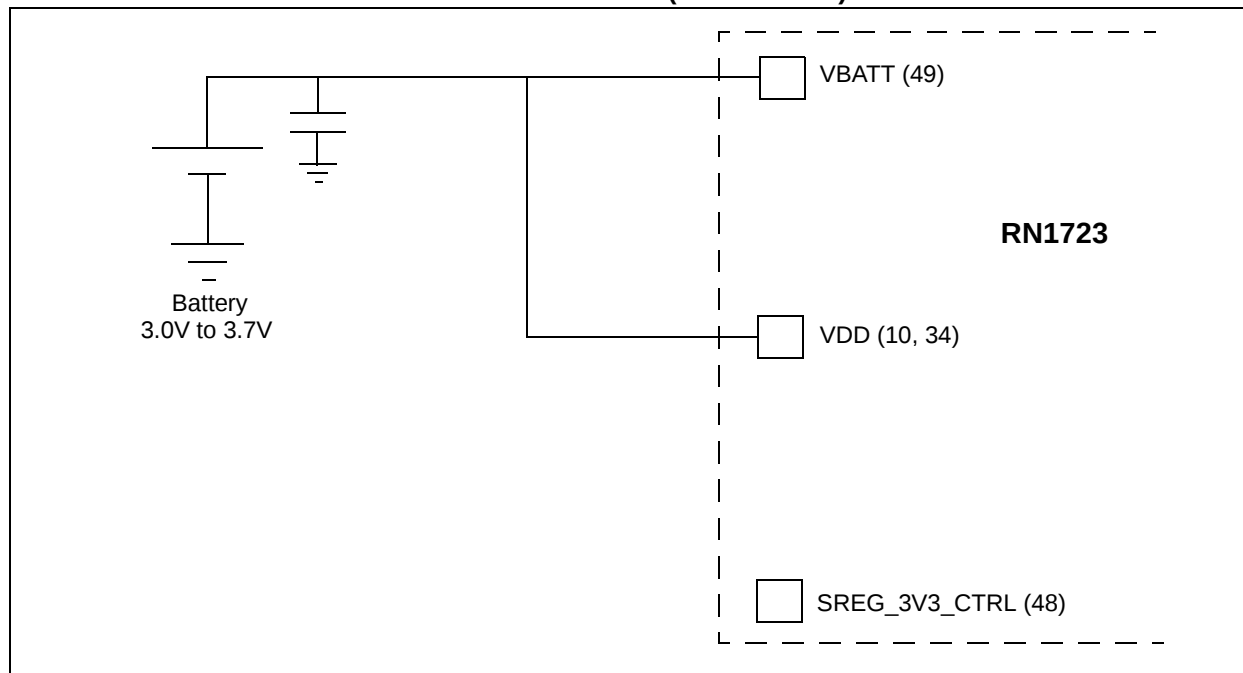
The RN1723 module may be forced awake by asserting the FORCE_AWAKE pin for at least 245 ms. If the FORCE_AWAKE pin remains asserted, the module is prevented from sleeping or dozing.

2.9.2 POWER SUPPLY

The RN1723 module is designed to operate with a wide range of batteries, as well as a linear power supply.

A power source that supplies a constant voltage greater than 3.0V can drive the module directly, as shown in [Figure 2-3](#).

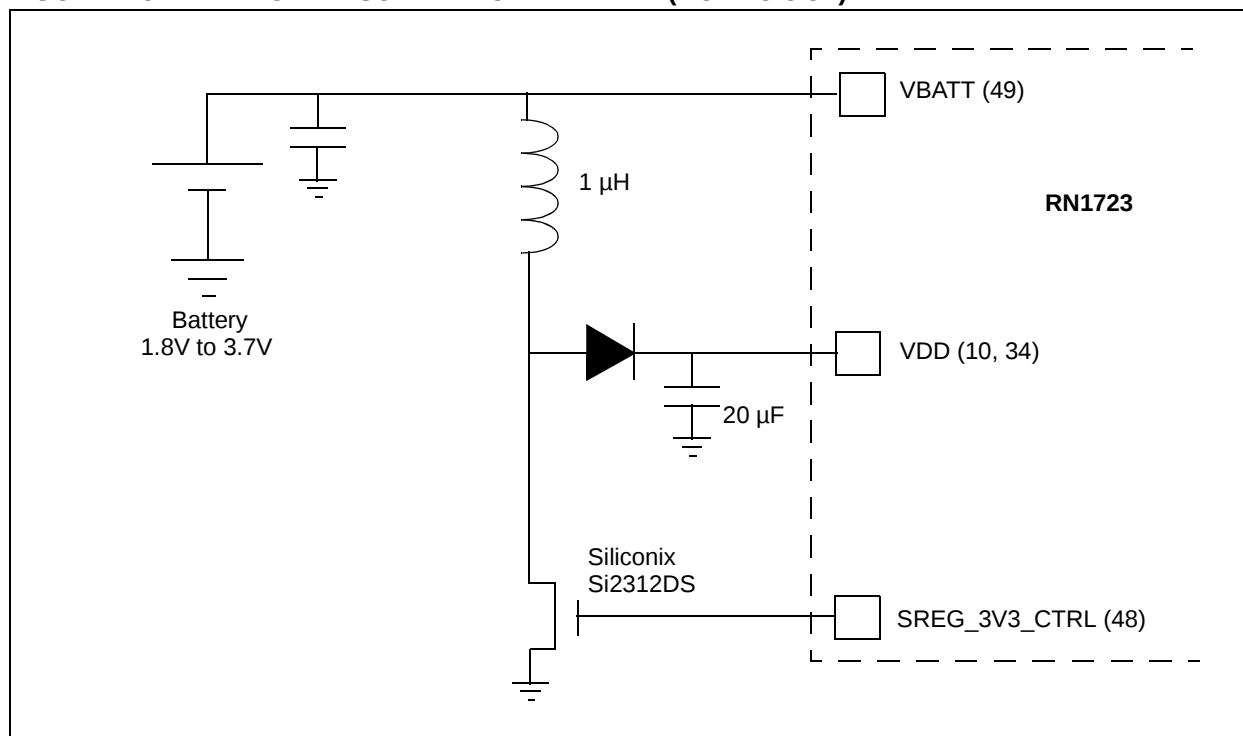
FIGURE 2-3: POWER SUPPLY FOR BATTERY (3.0V TO 3.7V)



RN1723

The stand-alone boost circuitry is shown in [Figure 2-5](#).

FIGURE 2-5: POWER SUPPLY FOR BATTERY (1.8V TO 3.3V)



2.10 Module Reset

There are several ways to Reset the module:

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

2.10.1 BROWN-OUT DETECTION

The RN1723 includes a brown-out detector that holds the module in Reset if the battery voltage falls below the minimum operating voltage.

Note: If the RN1723 module is used in battery applications, it is highly recommended that a voltage supervisory device be employed.

3.0 APPLICATION INFORMATION

3.1 External Antenna Types

The RN1723 module has a 50Ω antenna connection on pin 24. Connect to an antenna through a host PCB microstrip 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.

Note: Other components, such as amplifiers and active drivers, are not considered part of the trace layout and may void the modular certification of the RN1723 module.

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 co-planar 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 RN1723 module was performed with the external antenna types listed in Table 3-1. An antenna type comprises of antennas having similar in-band and out-of-band radiation patterns. Refer to Section 4.0 “Regulatory Approval” for specific regulatory requirements by country.

TABLE 3-1: TESTED EXTERNAL ANTENNA TYPES

Type ⁽¹⁾	Gain
PCB Trace	0 dBi
Chip	1.07 dBi
Wire	0 dBi
Whip	2.2 dBi

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

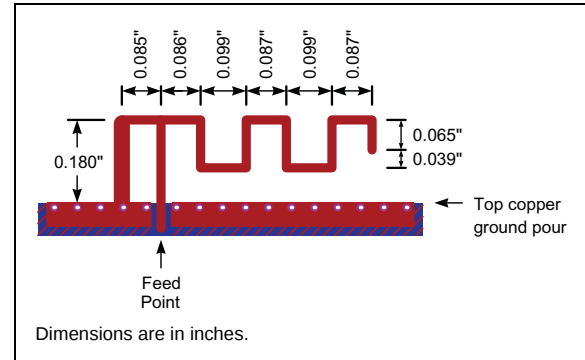
3.1.1 PCB TRACE ANTENNA

Modular certification of the RN1723 module was performed with the PCB trace antenna shown in Figure 3-1. The exact dimensions of the trace antenna must be followed.

Gerber files for the PCB trace antenna are available on the RN1723 module product page:

<http://www.microchip.com/rn1723>

FIGURE 3-1: PCB TRACE ANTENNA



3.1.2 CHIP ANTENNA

Modular certification of the RN1723 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 RN1723 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 vendor data sheet for PCB footprint details and mounting considerations.

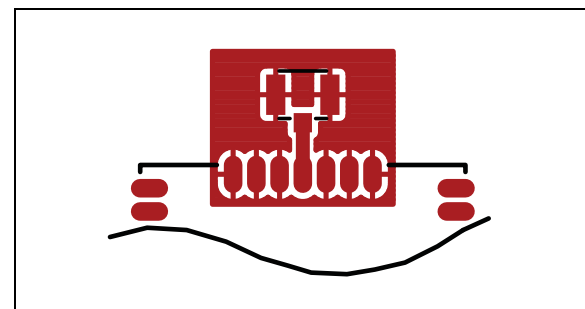
3.1.3 WHIP ANTENNA

Modular certification of the RN1723 module was performed with a whip antenna with a peak gain of 2.2 dBi.

Any whip antenna type may be used with the RN1723 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 3-2 shows a suggested PCB layout for a U.FL connector.

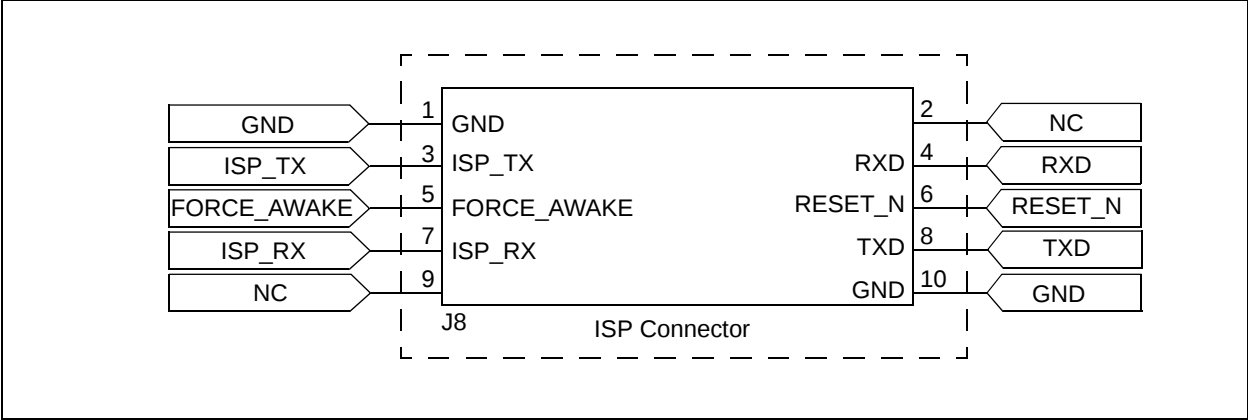
FIGURE 3-2: U.FL CONNECTOR



3.2 Optional ISP Header Schematic

Figure 3-3 shows a diagram with the optional ISP header.

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



4.0 REGULATORY APPROVAL

This section outlines the regulatory information for the RN1723 module for the following countries:

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

4.1 United States

The RN1723 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 RN1723 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 RN1723 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: OA3RN1723
or

Contains FCC ID: OA3RN1723

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. 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 FCC Grant: Modular approval. Output power listed is conducted. This module may only be installed by the OEM or an OEM integrator. Only antenna(s) documented in this filing may be used with this transmitter. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter within a host device, except in accordance with FCC multi-transmitter product procedures. OEM integrators and End-users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

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 RN1723 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 RN1723 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: 7693A-RN1723

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.

4.2.2 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).

4.2.3 APPROVED EXTERNAL ANTENNA TYPES

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

The RN1723 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 RN1723 module was performed with the antenna types listed in [Table 3-1](#).

4.2.4 HELPFUL WEB SITES

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

4.3 Europe

The RN1723 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 RN1723 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 RN1723 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 RN1723 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, refer to 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) Co., Ltd.	W6R21403-14023-L	2014-05-13
Health	EN 62479 (2010)			W6R21403-14023-62479	2014-05-09
EMC	EN 301 489-1 V1.9.2 (2011-09)	(3.1(b))		W6R21403-14023-E-16	2014-05-08
	EN 301 489-17 V2.2.1 (2012-09)				
Radio	EN 300 328 V1.8.1 (2012-06)	(3.2)		W6R21403-14023-T-45	2014-05-09
Notified Body Opinion			Eurofins Product Service GmbH	U9M-1406-3898-C-V01	2014-06-17

4.4 Australia

The Australia radio regulations do not provide a modular approval policy similar to the United States (FCC) and Canada (IC). However, RN1723 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 RN1723 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 RN1723 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, RN1723 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 RN1723 module test reports can be used as part of the product certification and compliance folder. All test reports are available on the RN1723 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-of-licence/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 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.

NOTES:

5.0 ELECTRICAL CHARACTERISTICS

TABLE 5-1: ENVIRONMENTAL CONDITIONS

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

TABLE 5-2: ELECTRICAL CHARACTERISTICS

Characteristic	Minimum	Typical	Maximum	Units
Supply Voltage				
VBATT	1.8	3.3	3.7	V _{DC}
VDD_3V3	-0.3	—	3.7	V _{DC}
VDD	3.0	—	3.7	V
Digital Input				
Input Logic High V _{IH}	2.3	—	—	V _{DC}
Input Logic Low V _{IL}	—	—	1.0	V _{DC}
Digital Output Drive				
GPIO 4, 5, 6, 7, 8	—	24	—	mA
GPIO 9, 10, 11, 12, 13	—	8	—	mA
Power Consumption				
Sleep	—	4	—	μA
Stand-by (Doze)	—	15	—	mA
Connected (Idle, RX)	—	40	—	mA
Connected (TX) 0 dBm	—	120	—	mA
Connected (TX) 12 dBm	—	190	—	mA

TABLE 5-3: ABSOLUTE MAXIMUM RATINGS

Parameter	Minimum	Typical	Maximum	Units	Comments
VBATT	1.8	—	3.7	V	—
Input Voltage for Pin Types: VDD, DI, DIO, DO	-0.3	—	See Comments	V	The voltage should never exceed 3.7V and should be no greater than 0.3V + VDD. Refer to Section 2.9 “Power Management” for further discussion.
Input Voltage for Analog Pin Types: Analog 1V2, SENSOR7:SENSOR0	—	—	1.2	V	—
Input Voltage for Analog Pin Types: Analog RF	0	—	0	V	This pad is an RF output. Do not apply any voltage to the antenna output.
Input Voltage on Pins: FORCE_WAKE RESET	-0.3	—	3.7	V	The voltage should never exceed 3.7V and should be no greater than 0.3V + VDD. Refer to Section 2.9 “Power Management” for further discussion.

WARNING

A given RN1723 module pin can operate from three different voltages: VBATT, 1.2V, or 3.3V. If a pin is driven outside its absolute maximum ratings, the module may not work, may work inconsistently, or may be permanently damaged. Please adhere to the Electrical Characteristics in [Table 5-2](#) to avoid damage, and the Absolute Maximum Ratings in [Table 5-3](#) as appropriate for the proper operation.

TABLE 5-4: MODULE DIMENSIONS

Parameters	Dimensions	Units
Size	26.67 x 17.78 x 3.18	mm

TABLE 5-5: ANALOG SENSOR INPUTS

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

TABLE 5-6: RADIO CHARACTERISTICS

Parameters	Specification
Frequency	2.412 to 2.462 GHz

TABLE 5-6: RADIO CHARACTERISTICS

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 5-7: 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.

NOTES:

APPENDIX A: REVISION HISTORY

Revision A (May 2015)

This is the initial released version of the document.

NOTES:

THE MICROCHIP WEB SITE

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:

- **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 web site 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 web site at: <http://microchip.com/support>

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.

<u>PART NO.</u>	<u>I</u>	<u>RM</u>	<u>XXX</u>
Device	Temp Range	Radio Module	Firmware Revision Number
Device	RN1723; VDD range 3.0V to 3.7V		
Temperature Range	I = -40°C to +85°C (Industrial Temperature)		

Examples:

a) RN1723-I/RM = Industrial Temp

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.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "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 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. 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 ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. 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.

Trademarks

The Microchip name and logo, the Microchip logo, dsPIC, FlashFlex, flexPWR, JukeBlox, KEELoQ, KEELoQ logo, Klear, LANCheck, MediaLB, MOST, MOST logo, MPLAB, OptoLyzer, PIC, PICSTART, PIC³² logo, RightTouch, SpyNIC, SST, SST Logo, SuperFlash and UNI/O are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

The Embedded Control Solutions Company and mTouch are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Analog-for-the-Digital Age, BodyCom, chipKIT, chipKIT logo, CodeGuard, dsPICDEM, dsPICDEM.net, ECAN, In-Circuit Serial Programming, ICSP, Inter-Chip Connectivity, KlearNet, KlearNet logo, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, RightTouch logo, REAL ICE, SQI, Serial Quad I/O, Total Endurance, TSHARC, USBCheck, VariSense, ViewSpan, WiperLock, Wireless DNA, 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.

Silicon Storage Technology is a registered trademark of Microchip Technology Inc. in other countries.

GestIC is a registered trademarks 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, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

ISBN: 978-1-63277-360-9

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
== ISO/TS 16949 ==

Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELoQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.



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

Cleveland
Independence, OH
Tel: 216-447-0464
Fax: 216-447-0643

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

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

New York, NY
Tel: 631-435-6000

San Jose, CA
Tel: 408-735-9110

Canada - Toronto
Tel: 905-673-0699
Fax: 905-673-6509

ASIA/PACIFIC

Asia Pacific Office
Suites 3707-14, 37th Floor
Tower 6, The Gateway
Harbour City, Kowloon
Hong Kong
Tel: 852-2943-5100
Fax: 852-2401-3431

Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing
Tel: 86-10-8569-7000
Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8665-5511
Fax: 86-28-8665-7889

China - Chongqing
Tel: 86-23-8980-9588
Fax: 86-23-8980-9500

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

China - Hangzhou
Tel: 86-571-8792-8115
Fax: 86-571-8792-8116

China - Hong Kong SAR
Tel: 852-2943-5100
Fax: 852-2401-3431

China - Nanjing
Tel: 86-25-8473-2460
Fax: 86-25-8473-2470

China - Qingdao
Tel: 86-532-8502-7355
Fax: 86-532-8502-7205

China - Shanghai
Tel: 86-21-5407-5533
Fax: 86-21-5407-5066

China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

China - Shenzhen
Tel: 86-755-8864-2200
Fax: 86-755-8203-1760

China - Wuhan
Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

China - Xian
Tel: 86-29-8833-7252
Fax: 86-29-8833-7256

ASIA/PACIFIC

China - Xiamen
Tel: 86-592-2388138
Fax: 86-592-2388130

China - Zhuhai
Tel: 86-756-3210040
Fax: 86-756-3210049

India - Bangalore
Tel: 91-80-3090-4444
Fax: 91-80-3090-4123

India - New Delhi
Tel: 91-11-4160-8631
Fax: 91-11-4160-8632

India - Pune
Tel: 91-20-3019-1500

Japan - Osaka
Tel: 81-6-6152-7160
Fax: 81-6-6152-9310

Japan - Tokyo
Tel: 81-3-6880-3770
Fax: 81-3-6880-3771

Korea - Daegu
Tel: 82-53-744-4301
Fax: 82-53-744-4302

Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

Malaysia - Kuala Lumpur
Tel: 60-3-6201-9857
Fax: 60-3-6201-9859

Malaysia - Penang
Tel: 60-4-227-8870
Fax: 60-4-227-4068

Philippines - Manila
Tel: 63-2-634-9065
Fax: 63-2-634-9069

Singapore
Tel: 65-6334-8870
Fax: 65-6334-8850

Taiwan - Hsin Chu
Tel: 886-3-5778-366
Fax: 886-3-5770-955

Taiwan - Kaohsiung
Tel: 886-7-213-7828

Taiwan - Taipei
Tel: 886-2-2508-8600
Fax: 886-2-2508-0102

Thailand - Bangkok
Tel: 66-2-694-1351
Fax: 66-2-694-1350

EUROPE

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

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

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

Germany - Dusseldorf
Tel: 49-2129-3766400

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

Germany - Pforzheim
Tel: 49-7231-424750

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

Italy - Venice
Tel: 39-049-7625286

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

Poland - Warsaw
Tel: 48-22-3325737

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

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

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

01/27/15