

M1 Data Sheet

2.4 GHz ISM Band Transceiver Module

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Features

- Module design based on nRF24L01+ integrated circuit from Nordic Semiconductor
- 3-Wire Serial Peripheral Interface (SPI)
- Receive/Transmit interrupts
- Small Size: 0.64" x 1.135" (16.3 mm x 29.8 mm),
- Surface Mountable
- Integrated Crystal, internal Voltage Regulator, Matching Circuitry and Printed Circuit Board (PCB) Antenna
- Easy Integration into Final Product – Minimize Product Development, Quicker Time to Market
- Modular Device Approval for United States (FCC) and Canada (IC)
- Radio Regulation Certified for Europe (ETSI)

- Low Current Consumption:
 - Rx mode: 13.5mA at 2Mbps data rate
 - Tx mode: 11.3mA at 0dBm output power
 - Power down: 900nA
 - Standby-I: 25µA
- 5V tolerant inputs

RF/Analog Features

- 2.4 GHz ISM Band Operation: 2402MHz to 2481MHz
- 80 selectable channels: 2 through 81
- 250kbps, 1Mbps and 2Mbps on air data rates
- 1 to 32 bytes static/dynamic payload length
- Automatic CRC generation
- Automatic packet handling
- Auto packet transaction handling
 - Auto Acknowledgement with/without payload
 - Auto retransmit
- 3 to 5 byte RF Receiver Address

Operational

- Operating Voltage: 1.9V to 3.6V
- Temperature Range: -40°C to +85°C Industrial

Pin Diagram

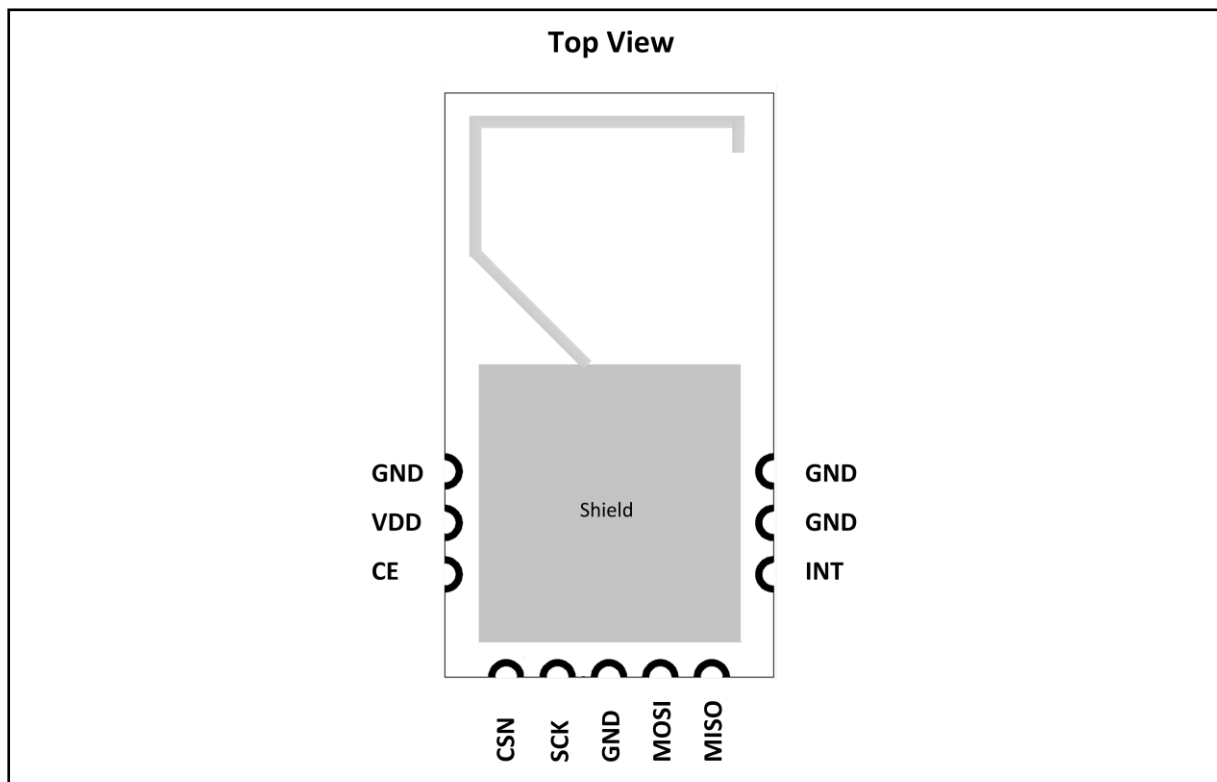


Table of Contents

1.0 DEVICE OVERVIEW.....	4
1.1 Interface Description.....	4
1.2 Mounting Details.....	5
1.3 OPERATION.....	6
1.3.1 RF Channel Frequency.....	6
2.0 CIRCUIT DESCRIPTION.....	7
3.0 REGULATORY APPROVAL.....	7
3.1 UNITED STATES.....	8
3.1.1 M1 Module Settings.....	8
3.1.1.1 RF Channel Frequency.....	8
3.1.2 Helpful Web Sites.....	8
3.2 CANADA	8
3.2.1 M1 Module Settings.....	9
3.2.1.1 RF Channel Frequency	9
3.2.2 Helpful Web Sites	9
3.3 EUROPE.....	9
3.3.1 M1 Module Settings.....	9
3.3.2 Helpful Web Sites.....	9

1.0 DEVICE OVERVIEW

The M1 module is a 2.4GHz ISM band surface mount transceiver module with integrated crystal, internal voltage regulator, matching circuitry and PCB antenna. The M1 module operates in the United States, Canada and Europe in the 2402 to 2481MHz ISM frequency band. The integrated module design frees the integrator from extensive RF and antenna design, and regulatory compliance testing, allowing quicker time to market.

In United States the M1 module has received Federal Communications Commission (FCC) CFR47 Telecommunications, Part 15 Subpart C “Intentional Radiators” 15.249 and modular approval in accordance with Part 15.212 Modular Transmitter approval.

The M1 module has been certified for use in Canada under Industry Canada (IC) Radio Standards Specification (RSS) RSS-210 and RSS-Gen. (IC).

Modular device approval removes the need for expensive RF and antenna design, and allows the user to place the M1 module inside a finished product and does not require regulatory testing for an intentional radiator (RF transmitter). To maintain conformance, refer to module settings in Section 3.1.1, M1 Module Settings

The M1 module has been tested for Europe and conforms to:

- ETSI EN 300 440-1 V1.6.1
- ETSI EN 300 440-2 V1.4.1
- ETSI EN 301 489-1 V1.9.2

- ETSI EN 301 489-3 V1.4.1
- European CISPR 22:2008-09 / EN55022:2010
- European CISPR 24:1997 + A1:2001 + A2:2002 / EN55024:1998 + A1:2001 + A2:2003

The module tests can be applied toward final product certification and Declaration of Conformity (DoC). To maintain conformance for Europe, refer to module settings in Section 3.1.1, M1 Module Settings. Additional testing may be required depending on the end application.

1.1 Interface Description

The simplified block diagram of the M1 module is shown in Figure 1-1. The module is based on the Nordic Semiconductor nRF24L01+ Single Chip Transceiver. The module interfaces to many popular microcontrollers through a 3-wire serial SPI interface, a chip enable (CE), an SPI chip select (CSN), one interrupt (IRQ), power and ground as shown in Figure 1-2. Table 1-1 provides the pin descriptions.

Data communication and module configuration are documented in the nRF24L01P Product Specification Data Sheet. For more information on specific serial interface protocol and general register definitions, refer to the “nRF24L01P Data Sheet” and see Section 1.3, Operation for specific register settings unique to the M1 module operation to maintain regulatory compliance.

Figure 1-1: M1 MODULE BLOCK DIAGRAM

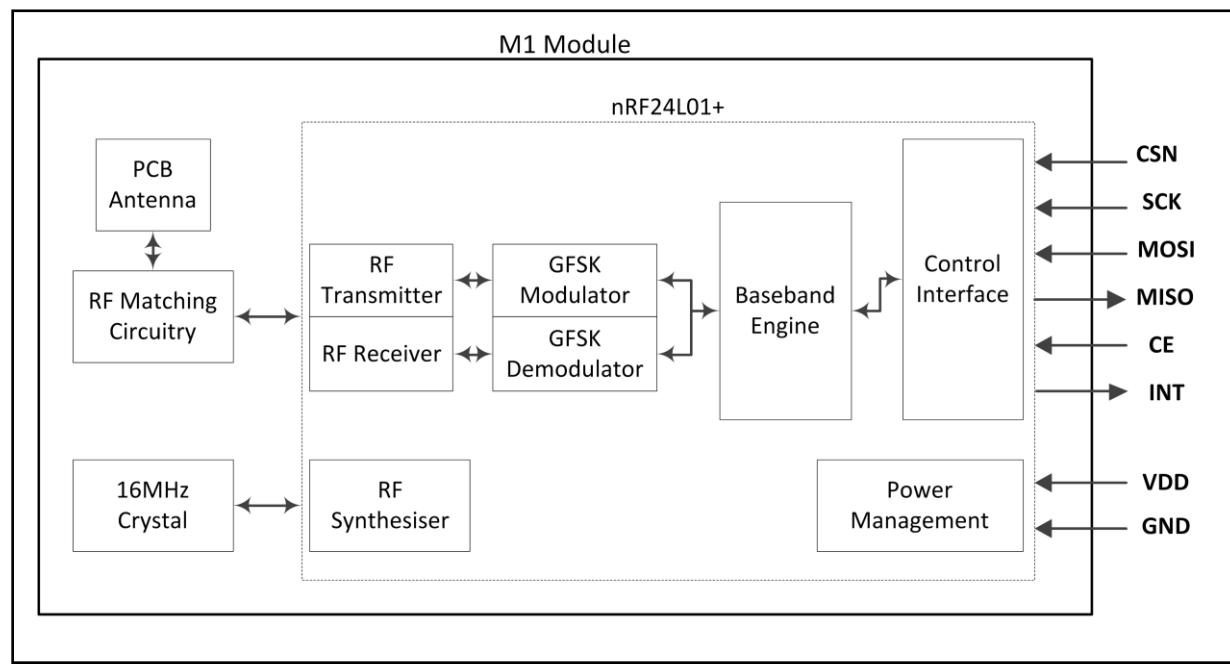


Table 1-1: PIN DESCRIPTION

Symbol	Type	Description
CSN	Digital Input	SPI Chip Select
SCK	Digital Input	SPI Clock
MOSI	Digital Input	SPI Slave Data Input
MISO	Digital Output	SPI Slave Data Output (with tri-state option)
CE	Digital Input	Chip Enable Activates RX or TX Mode
INT	Digital Output	Maskable Interrupt Pin (IRQ)
VDD	Power	Power Supply (+1.9V to +3.6V)
GND	Power	Ground (VSS)

1.2 Mounting Details

The M1 module is a surface mountable module. The dimensions of the module are shown in Figure 1-3. The module thickness is 0.168" measured over the shield and 0.067" measured over the antenna. The PCB has castellated mounting holes on the edge. Figure 1-4 is the recommended host PCB footprint for the M1.

The M1 module has an integrated PCB antenna. For best performance, it is recommended that the module be mounted on the edge of the host PCB, the immediate area around the antenna be kept clear of metal objects and the host PCB should have a ground plane around the M1 module that acts as a counterpoise to the PCB antenna.

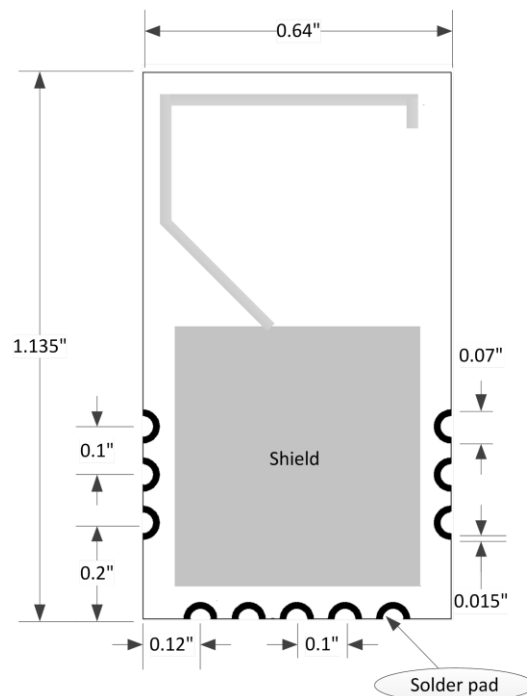
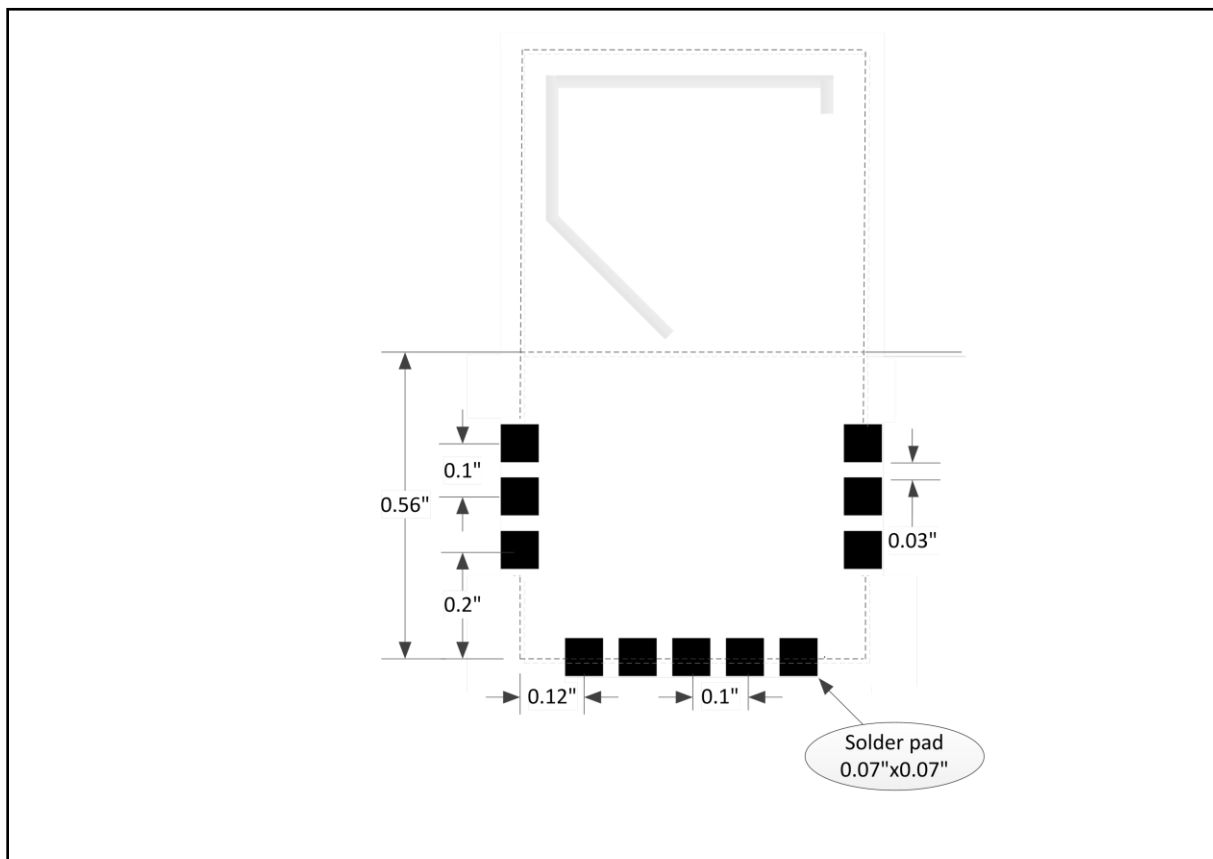
Figure 1-3: M1 MODULE DETAILS

Figure 1-4: RECOMMENDED PCB FOOTPRINT

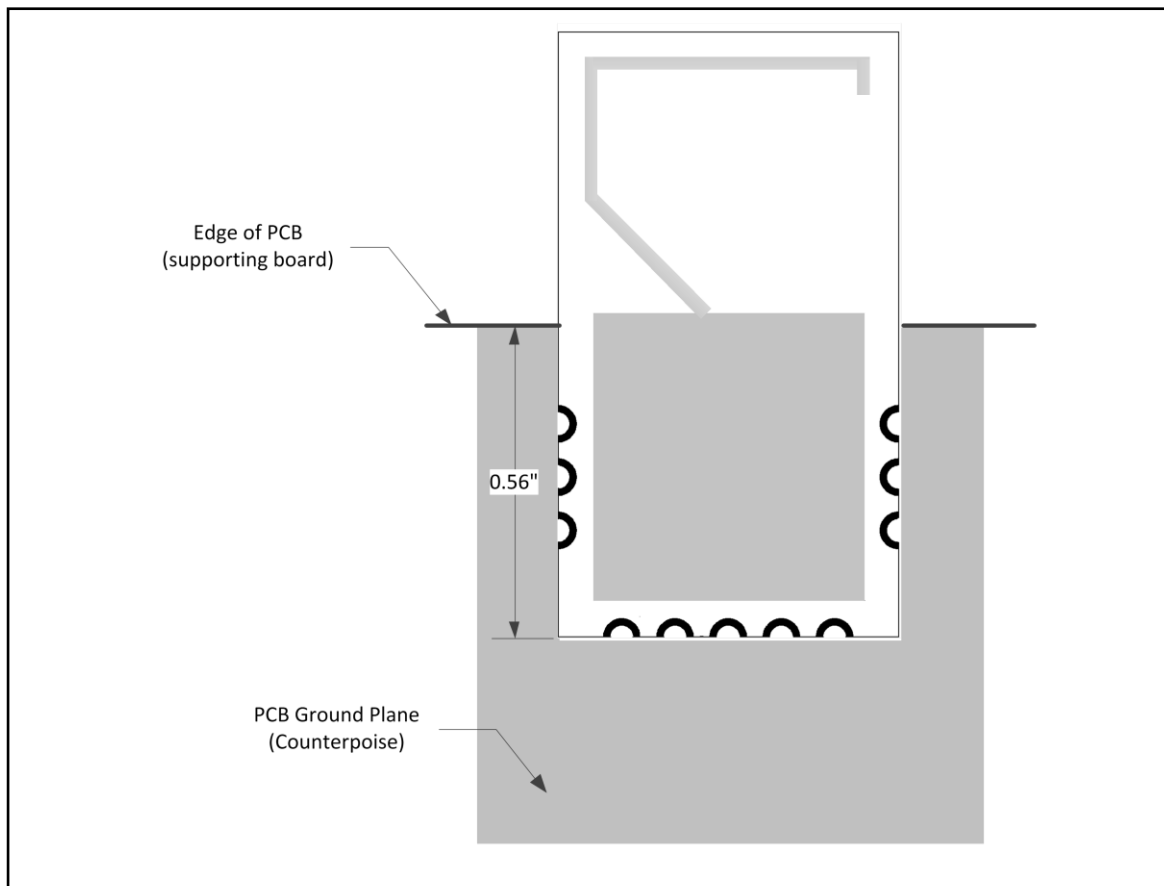
1.3 OPERATION

The M1 module is based on the Nordic Semiconductor nRF24L01+ Transceiver IC. Data communication and module configuration are documented in the nRF24L01P Product Specification Data Sheet.

This section emphasizes operational settings that are unique to the M1 module design that must be followed for proper operation.

1.3.1 RF Channel Frequency

Only channels 2 through 81 may be selected:
Register RF_CH<7:0> = 00000010 to 01010001.

Figure 1-5: MOUNTING DETAILS

2.0 CIRCUIT DESCRIPTION

The M1 module interfaces to microcontrollers through digital only connections (Figure 1-1).

3.0 REGULATORY APPROVAL

The M1 module has received regulatory approvals for modular devices in the United States and Canada. Modular device approval allows the end user to place the M1 module inside a finished product and not require regulatory testing for an intentional radiator (RF transmitter), provided that 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 M1 module has been tested for Europe and conforms to:

- ETSI EN 300 440-1 V1.6.1
- ETSI EN 300 440-2 V1.4.1

- ETSI EN 301 489-1 V1.9.2
- ETSI EN 301 489-3 V1.4.1
- European CISPR 22:2008-09 / EN55022:2010
- European CISPR 24:1997 + A1:2001 + A2:2002 / EN55024:1998 + A1:2001 + A2:2003

The module tests can be applied toward final product certification and Declaration of Conformity (DoC). Additional testing may be required depending on the end application.

The integrator is still responsible for testing the end product for any additional compliance requirements required with this module installed (digital device emission, PC peripheral requirements, etc.) in the specific country that the end device will be marketed. For more information on regulatory compliance, refer to the specific country radio regulations in the following sections.

3.1 UNITED STATES

The M1 module has received modular approval in accordance with Part 15.212 Modular Transmitter approval.

Notes for Final Integrator

CAUTION: Changes or modifications of the M1 module not expressly approved by PRS TECHWARE INC. could void the user's authority to operate the equipment.

The user's manual 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.

The M1 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 following:

Contains FCC ID: Z3FM1

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.

The integrator is still responsible for testing the end product for any additional compliance requirements required with this module installed (digital device emission, PC peripheral requirements, etc.).

For more information on regulatory compliance, refer to the specific country radio regulations in the following sections.

3.1.1 M1 Module Settings

To meet the FCC requirements, the following settings must be observed by the integrator:

3.1.1.1 RF Channel Frequency

Only channels 2 through 81 may be selected: Register RF_CH<7:0> = 00000010 to 01010001.

3.1.2 Helpful Web Sites

Federal Communications Commission (FCC)

<http://www.fcc.gov>

3.2 CANADA

The M1 module has been certified for use in Canada under Industry Canada (IC) Radio Standards Specification (RSS) RSS-210 and RSS-Gen.

Notes for Final Integrator

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 must 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.

Labeling Requirements for the Host Device (from Section 3.2.1, RSS-Gen, Issue 3, December 2010):

The host device must be 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 IC: 9924A-M1

The integrator is still responsible for testing the end product for any additional compliance requirements required with this module installed (digital device emission, PC peripheral requirements, etc.). For more information on regulatory compliance, refer to the specific country radio regulations in the following sections.

3.2.1 M1 Module Settings

To meet Industry Canada (IC) requirements, the following settings must be observed by the integrator:

3.2.1.1 RF Channel Frequency

Only channels 2 through 81 may be selected: Register RF_CH<7:0> = 00000010 to 01010001.

3.2.2 Helpful Web Sites

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

3.3 EUROPE

The M1 module has been tested and conforms to:

- ETSI EN 300 440-1 V1.6.1
- ETSI EN 300 440-2 V1.4.1
- ETSI EN 301 489-1 V1.9.2
- ETSI EN 301 489-3 V1.4.1
- European CISPR 22:2008-09 / EN55022:2010
- European CISPR 24:1997 + A1:2001 + A2:2002 / EN55024:1998 + A1:2001 + A2:2003

The module tests can be applied toward product certification and Declaration of Conformity (DoC).

NOTE: To maintain conformance tested ETSI standards, the module shall not be modified and settings in Section 1.3 "Operation" must be observed.

The European Standards do not provide a modular approval similar to the USA (FCC) and Canada (IC). However, the completed compliance testing can be used as part of the customer's application for product compliance approvals. The module test report data can be used as part of the customer's product test plan and can significantly lower customer's compliance burden..

Note for Final Integrator

The integrator is responsible for testing the end product for any additional compliance requirements that become necessary with this module installed (for example, digital device emission, PC peripheral requirements and so on).

3.3.1 M1 Module Settings

The RF Channel Frequency:

- Only channels 2 through 81 may be selected: Register RF_CH<7:0> = 00000010 to 01010001.

3.3.2 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): <http://www.ero.dk/>.

The other helpful websites are: Radio and Telecommunications Terminal Equipment (R&TTE): http://ec.europa.eu/enterprise/rte/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>