High Performance RF Module for MIOTY 868 MHz

ADVANCE INFORMATION
This document contains information on a new product. Specifications and information herein are subject to change without notice.

Product Description

The RC1882CEF-MIOTY module is a compact surface-mounted product that measures only 12.7 x 25.4 x 3.7 mm. The module contains a communication controller with embedded MIOTY protocol software and is pre-certified for operation under the European and US/FCC regulations. Custom variants can be offered with customized functionalities. How to use the embedded MIOTY protocol is described in the MIOTY User Manual.

Applications

- Large scale massive LPWAN
- Smart Metering
- Smart City
- Long range sensor applications
- Industry 4.0

Features

- MIOTY compliant
- ETSI technical specification TS 103 357 Low Throughput Network (LTN)
- Massive IoT deployment, > 1M messages/day
- Long range, high reliability
- Ultra narrowband, high-performance radio
- High sensitivity and high selectivity
- High blocking properties
- Completely shielded module
- Pin compatible with other products from Radiocrafts
- 12.7 x 25.4 x 3.7 mm compact module for SMD mounting
- 1.8 – 3.8 V supply voltage
- Ultra low power modes for extended battery operation
- Conforms with EU RED directive (EN 300 220, EN 301 489, EN)

Part Name Overview

Part name	RF Frequency band	Max output power	VCC
RC1882CEF-MIOTY1	868 MHz	14 dBm	+3.3V
RC1882CEF-MIOTY2	868 MHz/915 MHz	14 dBm	+3.3V
RC1892HPCF-MIOTY2	868 MHz/915 MHz	27 dBm	+3.3V

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Quick Reference Data (typical at 3.6V, 868 MHz, 400 b/s)

Parameter	RC1882CEF-MIOTYx		RC1892HPCF-MIOTY2	Unit
Frequency band	862-870	902-928	902-928	MHz
Max output power	14	14	27 (TBC)	dBm
Sensitivity (PER 10 %) @ 400b/s	-129	-129	-130	dBm
Supply voltage	1.8- 3.8	1.8- 3.8	1.8 - 3.8	V
Current consumption, RX/TX	6.0 / 25	6.0 / 25	8/250	mA
Current consumption, Shutdown	1	1	1	uA
Flash memory Total User Application	 352 128 (TBC)	 352 128 (TBC)	 352 128 (TBC)	 kB *(MIOTY2)*
RAM Total User Application	 80 32 (TBC)	 80 32 (TBC)	 80 32 (TBC)	 kB *(MIOTY2)*
Internal EEPROM (optional)	4	4	4	kB
Internal SPI Flash (optional)	1024	1024	1024	kB
Operating Temperature	-30 to +85	-30 to +85	-30 to +85	°C

Functional behaviour

The module is offered in two different feature sets, MIOTY1 and MIOTY2

MIOTY1

Module operate as a radio modem with serial UART interface and AT command set

UART setup:
UART-TXD = pin 5
UART-RXD = pin 6
Default baud rate 115200 baud/s
Data bits: 8
Stop bit: 1
Parity: none

Support mode EU0 as transmit only.

Example:
AT-U command to send a unicast packet
AT-U=5 46726F6465
5 is length byte and 46726F6465 are the 5 byte sent.

Complete AT command interface will be available upon release

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MIOTY2

Autonomous module including application

A customer specific application run inside the module reading sensors, processing data and transmitting and receiving data via RF.

The MIOTY2 module program memory is divided in 3 different segments.

- The bootloader
- The platform image
- Application code space

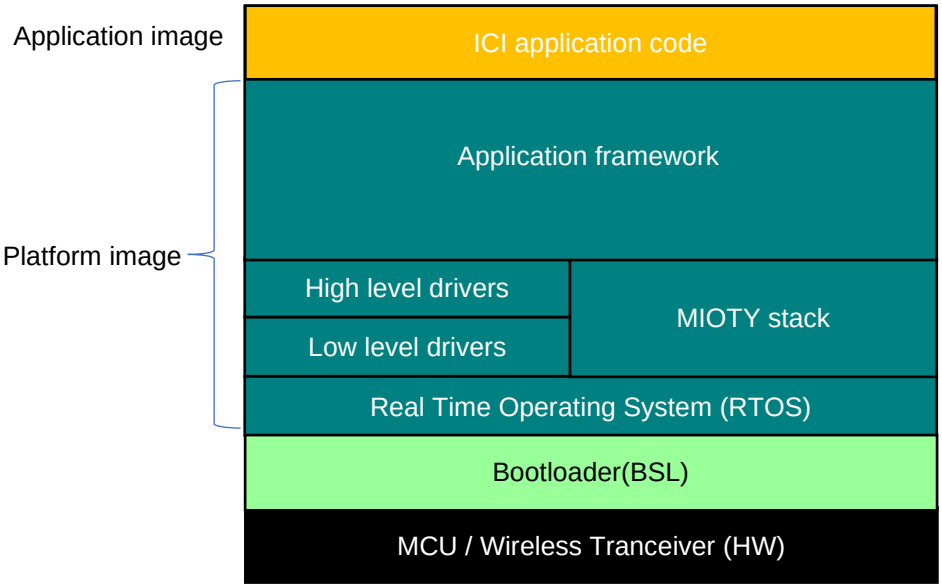

Figure 1. System overview

The platform image is the main firmware part and includes an operating system, MIOTY stack, drivers and application framework. This firmware image is preloaded from Radiocrafts and newer revisions will be made available from Radiocrafts as an encrypted image. When downloading a new platform image through the bootloader, the image will be decrypted internally in the module.

The application code space has available 128 kB of flash space and 32 kB of static variables.

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Intelligent C-programmable I/O (ICI) for MIOTY2

The ICI programming concept is described in detail in MIOTY SDK documentation. Below is shown an example application that read a temperature sensor every 10 seconds and send data to the concentrator. This is a very small example with only 39 code lines to build a complete sensor device.

Example : i:zi code

```
#include "MIOTY_app.h"

/********* Constants ***********/
#define SHT35_I2C_ADDRESS 0x44
#define SENSOR_ID_SHT35 0x01

/********* Private Variables ***************/
static TimerId readSensorTimer;
static uint16_t temperature;
static uint16_t humidity;
static uint8_t temperature_l,temperature_h, humidity_l, humidity_h;

/********* Private Function Declarations ***************/
static void readSensor(void);

/********* Public Functions ***************/

/**
* Setup() is called by the framework on startup
*/
void Setup()
{
    Network.setFreqBand(EU0);
    Network.connectToGateway(true);
    I2C.init(I2C_400KHZ);
    readSensorTimer = Timer.create(PERIODIC, 10*SECOND, readSensor);
    Timer.start(readSensorTimer);
}

/********* Private Functions ***************/
static void readSensor(void)
{
    uint8_t writeBuffer[2] = {0x2C, 0x06};
    uint8_t readBuffer[6];

    SPR_Status status = I2C.transfer(SHT35_I2C_ADDRESS, writeBuffer, sizeof(writeBuffer),readBuffer,
sizeof(readBuffer));
    if (SPR_OK == status)
    {
        // unpacks the data from the byte buffer into 16-bit integer variables
        uint16_t temperature_raw = Util.unpack_uint16_msb(readBuffer, 0);
        uint16_t humidity_raw = Util.unpack_uint16_msb(readBuffer, 3);

        temperature = (uint16_t)((uint32_t)temperature_raw*17500/0xFFFF - 4500);
        humidity = (uint16_t)((uint32_t)humidity_raw*10000/0xFFFF);
    }
    temperature_l=(uint8_t)(temperature&&0x00FF);
    temperature_h=(uint8_t)(temperature>>8);

    humidity_l=(uint8_t)(humidity&&0x00FF);
    humidity_h=(uint8_t)(humidity>>8);

    uint8_t message[] = {SENSOR_ID_SHT35, temperature_l, temperature_h,humidity_l, humidity_h);
    Network.send(sizeof(message), message);
}
```


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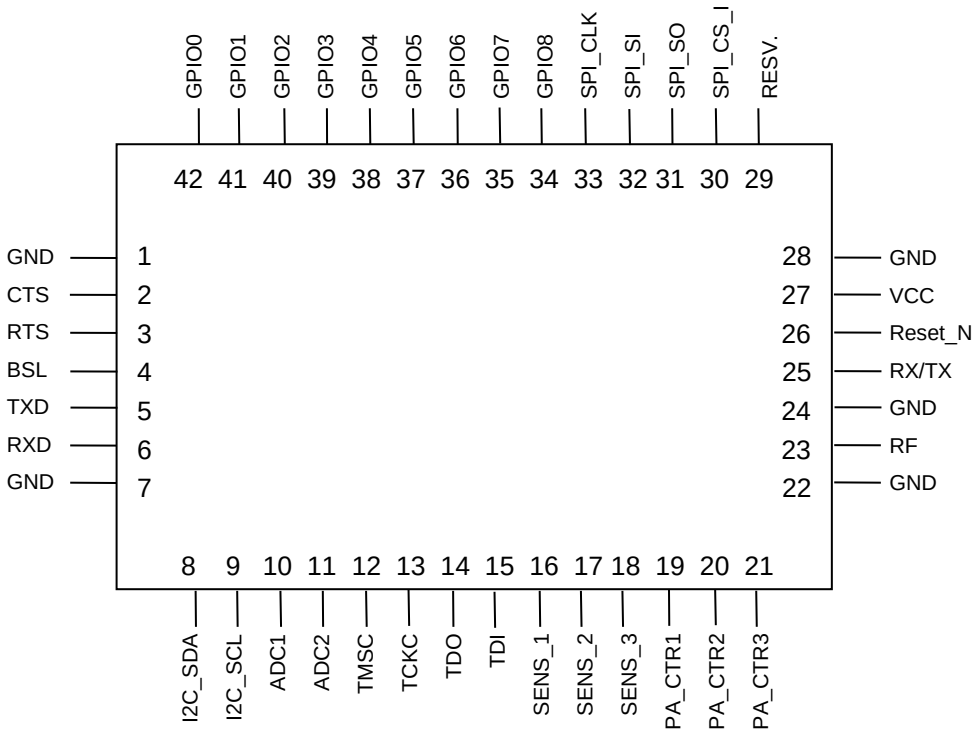
Bootloader

Both MIOTY1 and MIOTY2 modules are supplied with the same bootloader.
The bootloader is preloaded from Radiocrafts. It allows user to upload new platform image or unique application image[1] generated by each customer.
The bootloader also allows user to program unique encryption keys into the device. These keys are not possible to read out. The bootloader uses the standard UART port and operate at 115 200 Baud.

Pin Assignment



[1] MIOTY2 only

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Pin Description

Pin no	Pin name	Description
1	GND	System ground
2	CTS	UART flow control
3	RTS	UART flow control
4	BSL	Enable boot strap loader
5	TXD	Configurable I/O pin
6	RXD	Configurable I/O pin
7	GND	System ground
8	I2C SDA	I2C SDA, internal 4.7k pullup
9	I2C SCL	I2C SCL, internal 4.7k pullup
10	ADC1	Analog input
11	ADC2	Analog input
12	TMSC	JTAG interface
13	TCKC	JTAG interface
14	TDO	JTAG interface
15	TDI	JTAG interface
16	SENS_1	Reserved for future use
17	SENS_2	Reserved for future use
18	SENS_3	Reserved for future use
19	PA_CTR1	Power Amplifier Control – High when radio is active. Low when idle.
20	PA_CTR2	
21	PA_CTR3	Power Amplifier Control – High when radio is active and transmitting. Low when receiving.
22	GND	System ground
23	RF	RF I/O connection to antenna
24	GND	System ground
25	RX/TX	Not connected
26	RESET_N	Reset (Active low)
27	VCC	Supply voltage
28	GND	System ground
29	RESV.	Reserved for future use
30	SPI_CS_I	SPI CS for internal flash - DO NOT CONNECT
31	SPI_SO	SPI bus
32	SPI_SI	SPI bus
33	SPI_CLK	SPI bus
34	GPIO_8	General purpose I/O pin. Pin is tristated by module during bootloading. Add pull-up if used as SPI chip select(CS) for external SPI devices.
35	GPIO_7	
36	GPIO_6	
37	GPIO_5	
38	GPIO_4	
39	GPIO_3	
40	GPIO_2	
41	GPIO_1	
42	GPIO_0	

Note 1: Pins 8 and 9 are suggested as I2C interface. They can be configured otherwise, but are connected to an optional internal EEPROM with I2C address = 000. It is recommended to leave these pins as I2C. Sensors and actuators or any other I2C device can be connected to these pins and accessed from the module.

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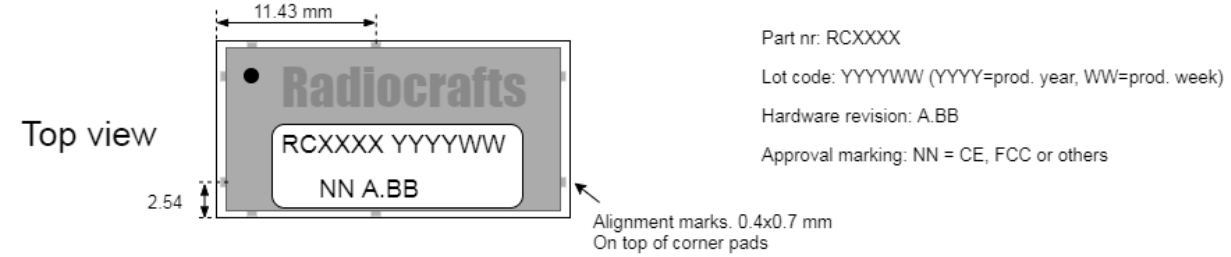
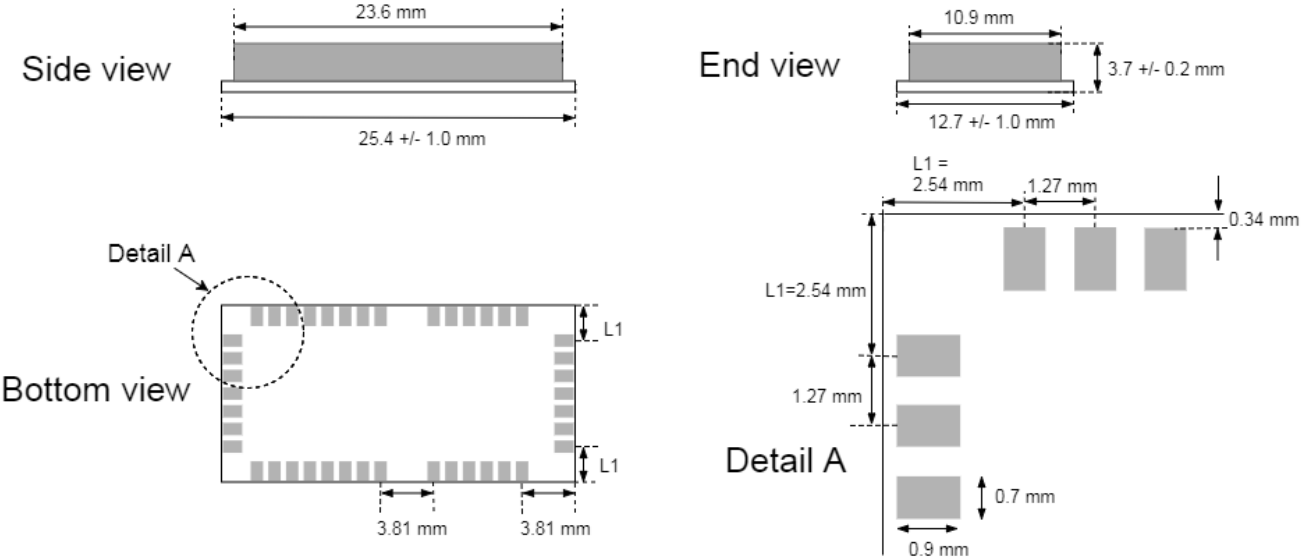
Mechanical Drawing





Mechanical Dimensions

The module size is 12.7 x 25.4 x 3.7 mm

Carrier Tape and Reel Specification

Carrier tape and reel is in accordance with EIA Specification 481.

Tape width	*Component pitch*	*Hole pitch*	*Reel diameter*	*Units per reel*
44 mm	16 mm	4 mm	13”	Max 1000

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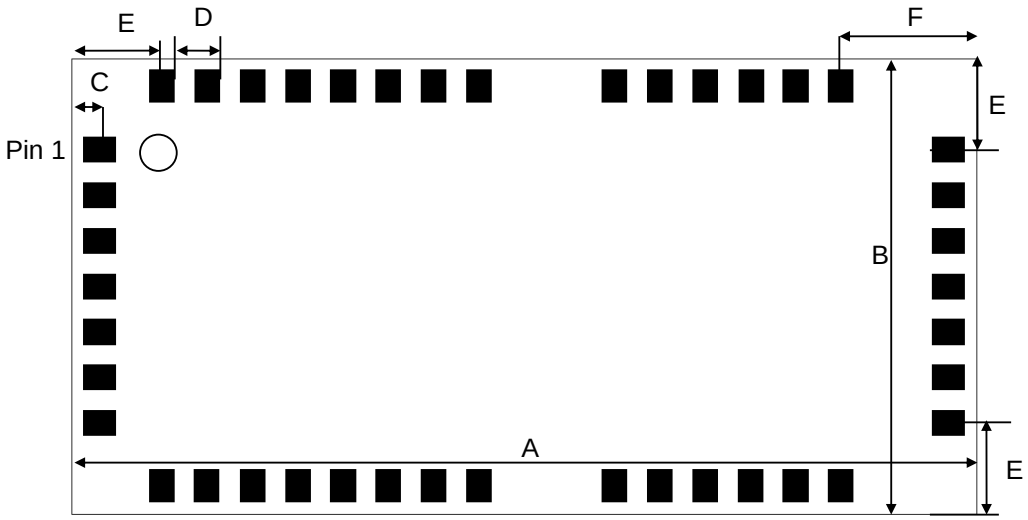
PCB Layout Recommendations

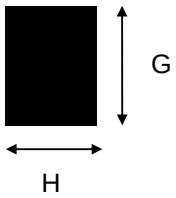
The recommended layout pads for the module are shown in the figure below.

The circle in upper left corner is an orientation mark only, and should not be a part of the copper pattern.



Dimention	*Length [mm] (mil)*	*Comment*
A	25.4 (1000)	Length of module
B	12.7 (500)	Width of module
C	0.79 (31)	Module edge vs centre of pad (Valid for all pads)
D	1.27 (50)	Pad to pad distance
E	2.54 (100)	Modul edge to pad (centre)
F	3.81 (150)	Modul edge to pad (centre)
G	0.9 (35.4)	Length of pad/recommend footprint pad
H	0.7 (27.6)	Width of pad/recommend footprint pad

Recommended pad design is shown below.



The recommended footprint for solder paste stencil is a one-to-one mapping between the LGA pad on module and the footprint.

For prototype build a solder hot plate is recommended. If the prototype is soldered manually by soldering iron, it is recommend to extend the pads of the footprint out from the module to make is accessible for a soldering iron.

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A PCB with two or more layers and with a solid ground plane in one of the inner- or bottom layer(s) is recommended. All GND-pins of the module shall be connected to this ground plane with vias with shortest possible routing, one via per GND-pin.

Routing or vias under the module is not recommended as per IPC-recommendation. If any routing or vias is required under the module, the routing and vias must be covered with solder resist to prevent short circuiting of the test pads. It is recommended that vias are tented.

Reserved pins should be soldered to the pads, but the pads must be left floating electrically (no connection).

Note that Radiocrafts technical support team is available for free-of-charge schematic- and layout review of your design.

Soldering Profile Recommendation

JEDEC standard IPC/JEDEC J-STD-020D.1 (page 7 and 8), Pb-Free Assembly is recommended.

The standard requires that the heat dissipated in the "surroundings" on the PCB is taken into account. The peak temperature should be adjusted so that it is within the window specified in the standard for the actual motherboard.

Aperture for paste stencil is normally areal-reduced by 20-35%, please consult your production facility for best experience aperture reduction. Nominal stencil thickness of 0.1-0.12 mm recommended.

Absolute Maximum Ratings

Parameter	*Min*	*Max*	*Unit*
Supply voltage, VCC	-0.3	4.1	V
Voltage on any pin	-0.3	VCC + 0.3 (max 4.1)	V
Input RF level		10	dBm
Storage temperature	-40	150	°C
Operating temperature	-30	85	°C

Caution ! ESD sensitive device. Precaution should be used when handling the device in order to prevent permanent damage.

Under no circumstances the absolute maximum ratings given above should be violated. Stress exceeding one or more of the limiting values may cause permanent damage to the device.

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Contact Information

Web site: http://www.radiocrafts.com

Address:
Radiocrafts AS
Sandakerveien 64
NO-0484 OSLO
NORWAY

Tel: +47 4000 5195
Fax: +47 22 71 29 15
E-mail: sales@radiocrafts.com

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