Radiocrafts
Embedded Wireless Solutions

RC2300/01/02/04

ZigBee™- Ready RF Transceiver Modules

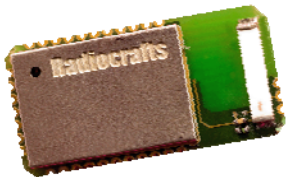
Product Description

The RC2300/2301/2302/2304 RF Transceiver Modules are a series of compact surface-mounted modules specially designed for the ZigBee™ protocol stack for wireless star and mesh networks based on IEEE 802.15.4 compliant PHY and MAC layers providing 16 channels in the 2.45 GHz world-wide license-free ISM band.

The complete shielded module is only 12.7 x 25.4 x 2.5 mm, optionally available with integrated antenna or RF available at module pin. 128 kB flash memory, 19 digital and analogue I/Os, an 8 channel 14 bit ADC, timers, UART and SPI interfaces make it possible to embed the complete application in this tiny module. Location engine, 64k, 32k flash memory options will be available.

Applications

- Home control and industrial automation
- Building automation
- OEM equipment
- Fleet and inventory management



Features

- Complete ZigBee-ready module with integrated antenna
- 12.7 x 25.4 x 2.5 mm compact shielded module for SMD mounting
- IEEE 802.15.4 compliant PHY
- Single-cycle high performance 8051 microcontroller core
- 128 kB Flash memory, 8 kB SRAM, 4 kB EEPROM
- 19 digital and analogue I/Os, 8 channel 14 bit ADC
- UART, SPI and debug interfaces
- On-board 32.768 kHz real time clock (RTC), 4 timers
- High performance direct sequence spread spectrum (DSSS) RF transceiver
- 16 channels in the 2.45 GHz ISM band
- 2.0 – 3.6 V supply voltage, ultra low power modes
- Conforms with EN 300 440 and EN 300 328 (Europe), FCC CFR 47 part 15 (US), ARIB STD-T66 (Japan)

Quick Reference Data

Parameter	RC2300	RC2301	RC2302	RC2304	Unit
Frequency band	2.400-2.4835				GHz
Number of channels	16				
Data rate	250				kbit/s
Max output power	0				dBm
Sensitivity (PER 1%)	-92				dBm
Adjacent Channel Rejection	29				dB
Alternate Channel Rejection	53				dB
Supply voltage	2.0 – 3.6				Volt
Current consumption, RX/TX	27				mA
Current consumption, PD	0.9				uA
Flash memory	128	128	32	64	kB
RAM	8				kB
EEPROM	4				kB
Location Engine	No	Yes	No	No	
Operating Temperature	-40 to +85				°C

Quick Product Introduction

The RC230x series of modules are specially designed to meet the IEEE 802.15.4 standard used by ZigBee and a variety of proprietary network protocols. Using the module together with the TI/Chipcon / Figure 8 Wireless Z-stack or any other ZigBee network implementation makes it a powerful platform to build any ZigBee profile and application. The module contains qualified RF hardware and enough processor power to run the complete ZigBee mesh network protocol for a full function device including the application.

Using a pre-qualified module is the fastest way to make a ZigBee product and shortest time to market. Because it contains all the RF HW and MCU resources you need in a 100% RF tested and pre-qualified module shorten the qualification and approval process. No RF design or expertise is required to add powerful wireless networking to the product. As an option you can even get the module with integrated antenna. In the simplest case like a home light remote control you only need an external battery and a pushbutton.

You may find more general information on how to build a ZigBee application Radiocrafts application note AN003.

Typical application circuit

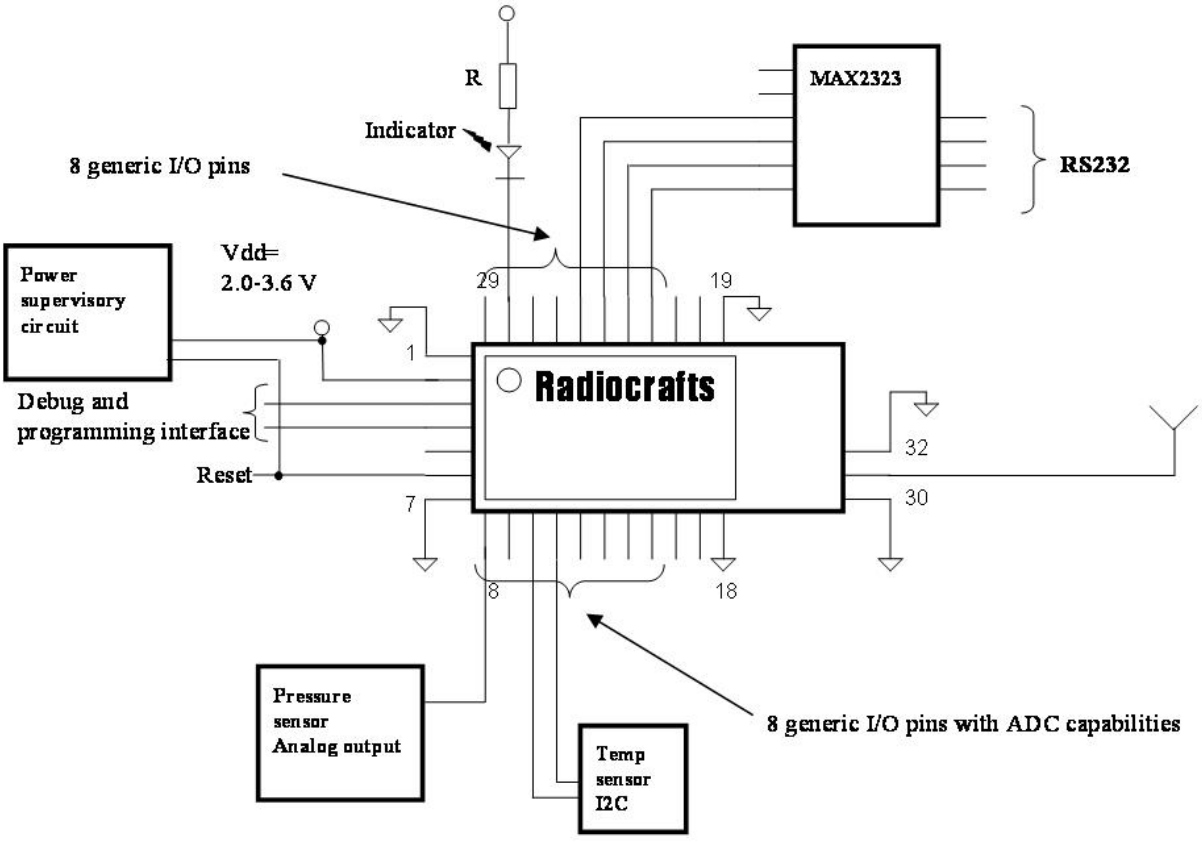


Figure 1 Example of application circuit

For more details on I/O possibilities, see page 4 and page 6 regarding pin description and I/O resources.

Frequently Asked Questions

What is IEEE 802.15.4?
It is a standard for low data rate wireless Personal Area Networks (PAN) focusing on low power, low cost and robustness. It defines a Physical layer (PHY) and a Medium Access Control layer (MAC) and is the basis for the open ZigBee protocol or proprietary protocols.

What is ZigBee?
ZigBee is an open global standard aimed for wireless network communication between devices in home control, industrial and building automation applications. It provides star, cluster tree and mesh topologies (see illustration). The multi-hop and ad-hoc routing properties is ideal for non-static networks covering a house or building.

How do I implement my application?
Your application can be implemented on top of the ZigBee stack sharing the resources in the embedded microcontroller. An extensive number of digital and analogue I/Os can be used to directly interface sensors, switches and actuators. Timing applications can use the on-board 32 kHz real-time clock. Ultra low power modes are ideal for battery operation.

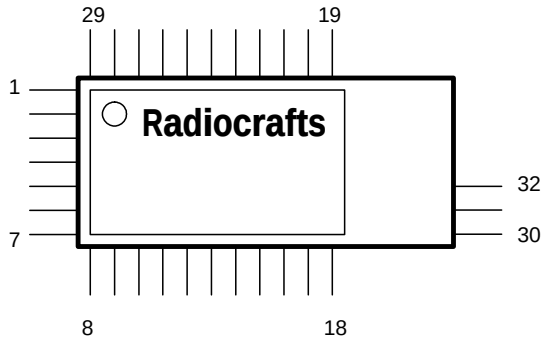
What about the ZigBee stack?
In principle any third-party ZigBee stack implementation can be used with the module. But in particular the module is intended for use with the TI/Chipcon / Figure 8 Wireless Z-stack and MAC. The Z-stack license and software development tools are available from TI/Chipcon.

What development tools do I need?
The following development tools for the embedded MCU (8051) are recommended:

- IAR Embedded workbench

Smart-RF EB RF04 from TI/Chipcon can be used to download the program into the embedded controller.

Pin Assignment

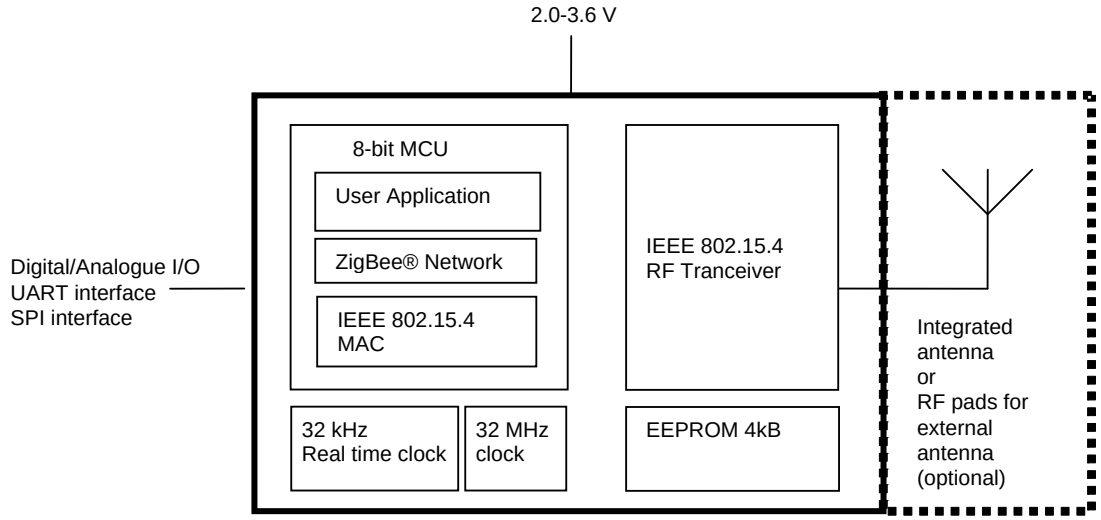


Pin Description

Pin no	Pin name	Description and internal MCU connection
1	GND	System ground
2	VCC	Supply voltage input
3	P2_2	Debug Clock, P2.2. Debug interface is used for programming.
4	P2_1	Debug Data, P2.1. Debug interface is used for programming.
5	P2_0	Digital I/O, P2.1
6	RESET_N	Reset. Active low with internal pull-up.
7	GND	System ground
8	P0_0	Digital or analogue I/O, P0.0
9	P0_1	Digital or analogue I/O, P0.1
10	P0_2	Digital or analogue I/O, P0.2, I2C SDA
11	P0_3	Digital or analogue I/O, P0.3, I2C SCL
12	P0_4	Digital or analogue I/O, P0.4
13	P0_5	Digital or analogue I/O, P0.5
14	P0_6	Digital or analogue I/O, P0.6
15	P0_7	Digital or analogue I/O, P0.7
16	RXTX	Digital output, RX/TX control signal.
17	NC	Not connected. Reserved for future use.
18	GND	System ground
19	GND	System ground
20	32kHz_Q2	Internal 32 kHz oscillator. Do not connect. (P2.4)
21	32kHz_Q1	Internal 32 kHz oscillator. Do not connect. (P2.3)
22	P1_7	Digital I/O, P1.7
23	P1_6	Digital I/O, P1.6
24	P1_5	Digital I/O, P1.5
25	P1_4	Digital I/O, P1.4
26	P1_3	Digital I/O, P1.3
27	P1_2	Digital I/O, P1.2
28	P1_1	Digital I/O, P1.1, 20 mA sink/source capability
29	P1_0	Digital I/O, P1.0, 20 mA sink/source capability
30	GND	System ground
31	RF	RF I/O connection to antenna, 50 Ohm. Do not connect for integrated antenna variant (AT).
32	GND	System ground

Note 1: For I/O peripheral mapping, please refer to I/O resources at page 5 or TI/Chipcon CC2430 data sheet
Note 2: Suggested UART interface: Pin 23 TXD1, pin 22 RXD1, pin 25 CTS1, pin 24 RTS1. Other options are available; see I/O resources at page 5 or TI/Chipcon CC2430 data sheet
Note 3: Pins 10 and 11 are suggested as I2C interface. They can be configured otherwise, but are connected to an 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.

Block Diagram



* Firmware not included in the basic module

Embedded resources

MCU: Enhanced single-cycle 8051
PHY/MAC: TI/Chipcon CC2430 (CC2431 for location engine option)
ZigBee stack: Not included, but any stack implementation can be used (TI/Figure8 Wireless, Airbee Wireless etc.)

Circuit Description

The module contains an IEEE 802.15.4 compliant SoC RF transceiver, external EEPROM, high speed oscillator and an RTC 32 kHz oscillator. The module is intended for running the ZigBee network protocol.

The application software together with the ZigBee protocol software stack can be programmed in Flash memory through a proprietary serial debugging interface. The easiest way to do this is by using an evaluation board from TI and an IAR Embedded workbench.

The module includes two USART that are configurable as either SPI or UART. Totally 19 I/O pins are available to the user. 8 pins can be used for the internal 8-14 bit A/D converter. All of the pins have interrupt features.

The MCU provides several low power modes with can be utilized to reduce the current consumption in battery operated applications. An internal 32 kHz crystal oscillator can be used for real-time clock and timer applications.

The module has an internal POR circuit and a brown out detector, but it is still highly recommended to add an external power supervisory circuit to ensure a proper reset when a power fault has occurred.

For further details on the SoC transceiver (TI/Chipcon CC2430 and CC2431), please consult the respective data sheet.

I/O resources

The module has 19 digital I/O pins. They are shown in the table below together with the additional I/O feature associated with them

PIN	3	4	5	8	9	10	11	12	13	14	15	22	23	24	25	26	27	28	29
Port/ Function	P2_2	P2_1	P2_0	P0_0	P0_1	P0_2	P0_3	P0_4	P0_5	P0_6	P0_7	P1_7	P1_6	P1_5	P1_4	P1_3	P1_2	P1_1	P1_0
ADC				X	X	X	X	X	X	X	X								
SPI0 Alt2						MI	MO	SS	C										
UART0 Alt2						RX	TX	CT	RT										
SPI1 Alt2						C	SS	MO	MI										
UART1 Alt2						RT	CT	TX	RX										
Timer1 Alt2						0	1	2									0		2
Timer3 Alt2																0			
Timer4 Alt2																		1	0
DEBUG	DC	DD																	
I2C						C	D												

IEEE 802.15.4

The IEEE 802.15.4 standard, approved in May 2003, provides a worldwide standard for Personal Area Networks or short distance wireless networks for low data rate solutions with long battery life and very low complexity. It defines a Physical layer (PHY) and a Medium Access Control layer (MAC) and is the basis for the open ZigBee protocol or proprietary protocols. The typical applications are home and building automation, industrial control and monitoring systems, wireless sensor networks, remote controls and consumer electronics.

The module complies with the IEEE 802.15.4 standard operating in the 2.45 GHz band. It uses direct sequence spread spectrum (DSSS) with 2 Mc/s chip rate giving a raw data rate of 250 kbit/s 16 channels are available in the 2.45 GHz band, channel 11 – 26 (channels 0-10 are reserved for use in the 868 and 915 MHz bands).

For more information on the standard, please consult www.ieee802.org/15/pub/TG4.html

Reference:
IEEE std 802.15.4 -2003: Wireless Medium Access Control (MAC) and Physical layer (PHY) specifications for Low Rate Wireless Personal Area Networks (LR-WPANs)
http://standards.ieee.org/getieee802/download/802.15.4-2003.pdf

The ZigBee Protocol

The ZigBee Alliance is an association of companies working together to enable reliable, cost-effective, low-power, wirelessly networked, monitoring and control products based on an open global standard. The ZigBee Alliance is a rapidly growing, non-profit industry consortium of leading semiconductor manufacturers, technology providers, OEMs and end-users worldwide. Membership is open to all. The ZigBee Alliance, in collaboration with the IEEE, is defining the network, security, and application layers above the IEEE 802.15.4 PHY and MAC layers. This cooperation has resulted in an easy-to-use, standards-based wireless network platform optimised for wireless monitoring and control applications. For more information about the ZigBee Alliance and the ZigBee standard, please consult www.zigbee.org

The module is intended for using the ZigBee protocol. However, other proprietary network protocols can also be implemented using the module.

The ZigBee stack implementation from TI/Chipcon/Figure 8 Wireless is recommended as it provides seamless integration with the module. However, third party stack implementations can also be used provided they support the TI/Chipcon MAC firmware.

Location engine

The Location Engine (RC2301) implements a distributed calculation algorithm used to estimate the position of nodes in an ad-hoc wireless network. Reference nodes are placed with known coordinates, typically being part of an installed infrastructure. Other blind nodes, whose coordinates need to be estimated are often mobile and attached to assets that need to be tracked. See datasheet CC2431 for details.

Debugging interface

The module has a two-wire proprietary debug interface. This interface can also be used for in-circuit programming of the device.

For debugging the device programmer sends commando <DEBUGGING_INSTR> to the microcontroller. The instructions succeeding the debugging commando are executed by the CPU without updating the program counter.

For in circuit programming the same debugging commando is used, only the instruction preformed is flash programming with through the flash controller. See datasheet for TI/Chipcon CC2430 for details.

Supply and ground must also be connected during programming or debugging.

The debug pins are:

Signal	Pin #
Debug Clock(DC)	3
Debug Data(DD)	4

Pin 3 and 4 can be used as normal digital I/O pins when the module is not in debugging mode.

Power Management

The ZigBee protocol allows End Devices to be powered down, while Routers must be powered all the time in order to handle packet routing. Battery operated devices should be End Devices in order to reduce the power consumption to a minimum.

The module can be set in several sleep modes using the features of the MCU and turning off the RF transceiver. Sleep modes enable the application to shut down unused segments in the MCU, thereby saving power. The MCU provides various sleep modes allowing the user to tailor the power consumption to the application's requirements.

To enter any of the 3 sleep modes (power modes 1-3) available in the RC2300, the appropriate registers in CC2430 must be set. See datasheet for CC2430 for details.

The different power modes available are:
Power mode 0 - Normal operation
Power mode 1 – Power mode 0 + high frequency oscillator turned off
Power mode 2 – Power mode 1 + internal voltage regulator turned off
Power mode 3 – Power mode 2 + low frequency oscillator turned off

The devices can be awoken from power mode 1 & 2 to power mode 0 from a reset, external interrupt or sleep timer. From power mode 3, an external interrupt or reset is required.

In applications like switch remote controls, the switch buttons should be connected to one of the interrupt pins. PIR sensors (for occupancy detection) and light sensors should also be using pin interrupts to awake the device from power down mode (PD). During PD the pin interrupts are still active.

Temperature sensors, humidity sensors and similar could be polled at regular intervals using the 32 kHz low frequency oscillator timer to awake the device. In this case using the power mode 1 or 2 is recommended. The choice between power mode 1 and 2 are a trade-off between response time and power consumption during power down.

RF Frequency, Output Power Levels and Data Rates

The following table shows the RF channels as defined by the IEEE 802.15.4 standard.

RF channel	Frequency
11	2405 MHz
12	2410 MHz
13	2415 MHz
14	2420 MHz
15	2425 MHz
16	2430 MHz
17	2435 MHz
18	2440 MHz
19	2445 MHz
20	2450 MHz
21	2455 MHz
22	2460 MHz
23	2465 MHz
24	2470 MHz
25	2475 MHz
26	2480 MHz

For proprietary solutions (non-IEEE 802.15.4), the RF transceiver can be programmed in steps of 1 MHz.

The output power level can be configured from the firmware in the range -25 to 0 dBm.

The RF transceiver uses direct sequence spread spectrum (DSSS) with 2 Mchip/s chip rate, giving a raw data rate of 250 kbit/s. The modulation format is Offset – Quadrature Phase Shift Keying (O-QPSK). The DSSS makes the communication link robust in noisy environments when sharing the same frequency band with other applications.

The use of RF frequencies and maximum allowed RF power is limited by national regulations. The RC2300 series is complying with the applicable regulations for the world wide 2.45 GHz ISM band.

Specifically it complies with the European Union R&TTE directive meeting EN 300 328 and EN300 440 class 2. It also meets the FCC CFR47 Part15 regulations for use in the US and the ARIB T-66 for use in Japan.

Antenna and Range Considerations

As an option the module is delivered with an integrated antenna (RC230xAT). This is highly recommended for most applications, as this gives a very compact solution containing all the critical RF parts within the module. However, a somewhat better range can be achieved using an external antenna.

Range testing using the integrated antenna shows these typical distances:

- 105 meter outdoor line-of-sight (LOS)
- 10-30 meters indoors depending on building material and construction
- 10-15 meters when passing through floors
- 25-30 meters in the same floor

The variation between different orientations of the antenna measured outdoors line-of-sight is typically within +/- 20%.

With more efficient antennas the range can be extended. LOS distances can typically be:

- 250 meters with ¼ wave monopole antenna on ground plane
- 350 meters with 5/8 wave dipole antenna

The integrated antenna is a compact ceramic antenna working as a quarter-wave resonant antenna. Due to the dielectric ceramic material the antenna is shorter than a normal quarter wave antenna (in air), still providing high radiation efficiency (typical 1 dBi). The antenna is matched for use in the 2.45 GHz band. The radiating part of the antenna is the white ceramic component located outside the shield can. The radiation pattern from the antenna is similar to the donut-shaped radiation from a quarter wave antenna. That is, the maximum radiation is in the plane normal to the length axis of the antenna. For best possible omni-directional radiation the module should be oriented so that the antenna is vertical. To achieve the very best range the transmitting and receiving antenna should be oriented the same way, ensuring the same polarity at both devices. However, indoors reflections of the radio waves in metallic structures tend to spread the polarisation, so even if same orientation is not possible, communication will still take place, but the range is somewhat shorter, typically by 20%.

The antenna should be kept away (> 10mm) from metallic or other conductive and dielectric materials, and should never be used inside a metallic enclosure.

Compared to lower frequencies, operation at 2.45 GHz is more limited to LOS. Reflections from walls and other objects may give multi-path fading resulting in dead-zones. The ZigBee mesh network topology is used to overcome this fading as it allows for alternative routing paths. The mesh network is therefore highly recommended for increased reliability and extended coverage throughout buildings.

In applications where the module must be placed in a metallic enclosure, an external antenna must be used. The RF available at a module pin must be fed to external antenna. The RF input/output is matched to 50 Ohm. If the antenna or antenna connector is placed away from the module at the motherboard, the track between the RF pin and the connector should be a 50 Ohm transmission line.

Using an external antenna, the VSWR of the antenna should be less than 2:1. The VSWR is normally specified in the antenna datasheet and most commercial available antennas fulfil this requirement. If you design a PCB antenna this is an important input requirement for such a design. Using a VSWR higher than 2:1, will result in much reflected power into the module and reducing both the module performance and radiated power. This will in turn reduce the range. Using a VSWR higher than 4:1 is not recommended.

On a two layer board made of FR4 the width of a microstrip transmission line should be 1.8 times the thickness of the board, assuming a dielectric constant of 4.8. The line should be run at the top of the board, and the bottom side should be a ground plane.

Example: For a 1.6 mm thick FR4 board, the width of the trace on the top side should be 1.8 x 1.6 mm = 2.88 mm.

The simplest antenna to use is the quarter wave whip antenna. A quarter wave whip antenna above a ground plane yields 37 Ohm impedance and a matching circuit for 50 Ohm are usually not required.

A PCB antenna can be made as a copper track where the ground plane is removed on the back side. The rest of the PCB board should have a ground plane as large as possible, preferably as large (in one dimension) as the antenna itself, to make it act as a counterweight to the antenna. A quarter wavelength antenna on a PCB must be shorter than the wire antenna due to the influence of the dielectric material of the PCB. The length reduction depends on the PCB thickness and material, as well as how close to the edge of the board the antenna is placed. Typical reduction is to 75-90 % but must be found empirically.

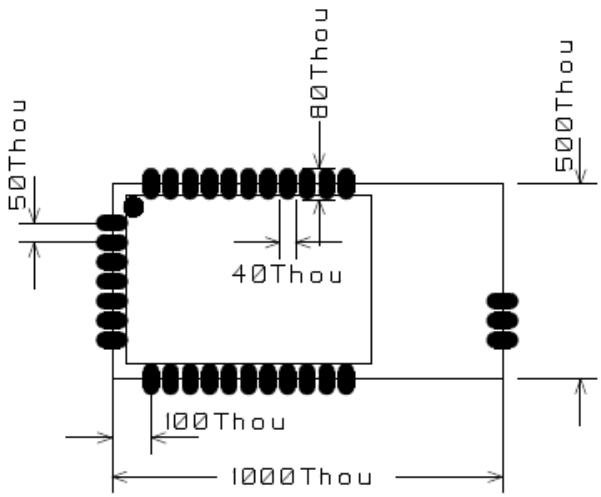
The length of a quarter-wave antenna is given in the table below.

Frequency [MHz]	Length of whip antenna [cm]	Length of PCB track [cm]
2450	2.9	2.25 – 2.7

If, for space reasons, the track is made even shorter than the resonating quarter of a wavelength, the antenna should be matched to 50 ohms using a series inductor and a shunt capacitor.

PCB Layout Recommendations

The recommended layout pads for the module are shown in the figure below. All dimensions are in thousands of an inch (mil). The circle in upper left corner is an orientation mark only, and should not be a part of the copper pattern.



The area underneath the module should be covered with solder resist in order to prevent short circuiting the test pads on the back side of the module. A solid ground plane is preferred. Unconnected pins should be soldered to the pads, and the pads should be left

floating. For the module version with integrated antenna, the RF pad can be soldered, but the pad should not be connected further. The two ground pads (pin 30 and 32 should be grounded for all variants.

When using the onboard chip antenna ("AT" version), careful attention is required to the layout of the PCB where the module is mounted. In Figure 2 the area were no ground plane or other conductive parts must be present, is shown as shaded. This means that there should be no metal on any layer in this region. If possible, the area should stretch infinitely along the two axes. The rest of the PCB should have a solid ground plane.

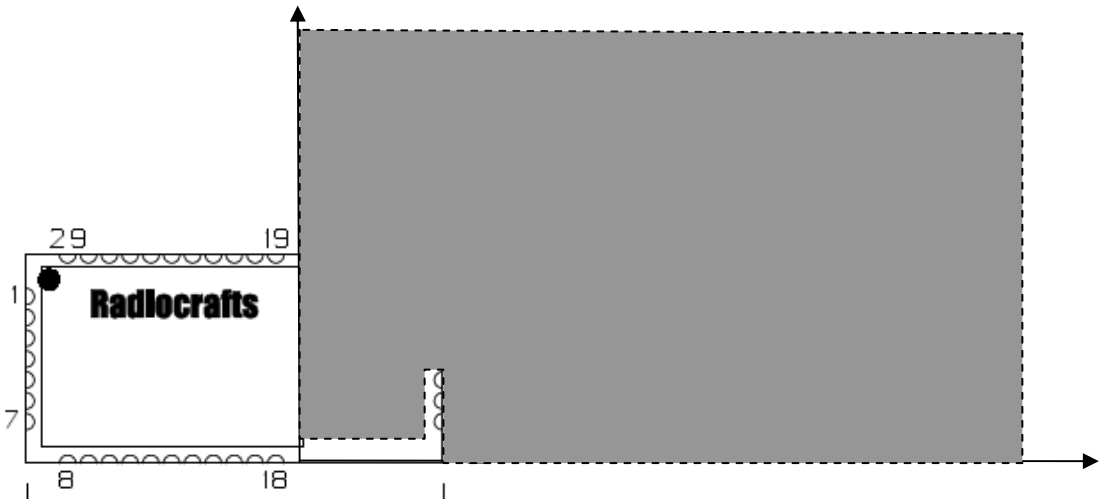
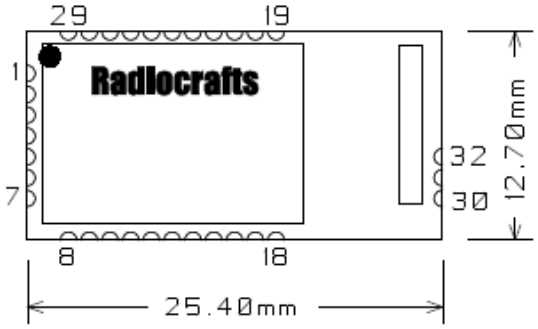


Figure 2. Area without ground plane

In Figure 3 a motherboard is shown with a recommended placement of the module. The recommended PCB type is FR4 with 1.6 mm thickness.

Figure 3. Recommended placement of the module on a motherboard (shaded area is ground plane on the motherboard)

Mechanical Drawing



Mechanical Dimensions

The module size is 0.5” x 1.0” x 0.1” (12.7 x 25.4 x 2.5 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 800

Absolute Maximum Ratings

Parameter	Min	Max	Unit
Supply voltage, VCC	-0.3	3.6	V
Voltage on any pin	-0.3	VCC+0.5	V
Input RF level		10	dBm
Storage temperature	-50	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.

Electrical Specifications

T=25°C, VCC = 3.0V if nothing else stated.

Parameter	Min	Typ.	Max	Unit	Condition / Note
Operating frequency	2400		2483	MHz	Programmable in 1 MHz steps, 5 MHz steps for IEEE 802.15.4 compliance
Number of channels		16			For IEEE 802.15.4 compliance
Channel spacing		5		MHz	For IEEE 802.15.4 compliance
Input/output impedance		50		Ohm	
Data rate		250		kbit/s	
DSSS chip rate		2		Mc/s	
Frequency stability			+/-40	ppm	
Transmit power	-25		0	dBm	Programmable from firmware
Harmonics 2nd harmonic 3rd harmonic		 -55 -57			
Spurious emission, TX 30 – 1000 MHz 1-12.75 GHz 1.8-1.9 GHz 5.15-5.3 GHz			 -58 -48 -58 -56	dBm	Complies with EN 300 328, EN 300 440, FCC CRF47 Part 15 and ARIB STD-T66
Sensitivity		-92		dBm	PER = 1%
Adjacent channel rejection +/- 5 MHz		41/29		dB	At -82 dBm, PER = 1%. 0 dB for IEEE 802.15.4 compliance
Alternate channel selectivity +/- 10 MHz		54/53		dB	At -82 dBm, PER = 1%. 30 dB for IEEE 802.15.4 compliance
Blocking / Interferer rejection / desensitization +/- 5 MHz +/- 10 MHz +/- 20 MHz +/- 50 MHz		 -29 -25 -19 -17		dBm	Wanted signal 3 dB above sensitivity level, CW interferer, PER = 1%. Minimum numbers corresponds to class 2 receiver requirements in EN 300 440.
Saturation	0	10		dBm	
Spurious emission, RX 30 -1000 MHz 1-12.75 GHz			 -57 -47	dBm	Complies with EN 300 328, EN 300 440, FCC CRF47 Part 15 and ARIB STD-T66

Parameter	Min	Typ.	Max	Unit	Condition / Note
Supply voltage	2.0		3.6	V	
Current consumption, RX		27		mA	MCU in Idle mode using the 32 MHz oscillator.
Current consumption, TX		27		mA	At 0 dBm output power. MCU in Idle mode using the 32 MHz oscillator.
Current consumption, Power mode 1		300		µA	MCU in Idle mode using the 32 kHz oscillator. Wake-up time to power mode 0 is 2 uS
Current consumption, Power down 2		0.9		µA	Wake-up time to power mode 0 is 54 uS
Current consumption, Power down 3		0.6		µA	Wake-up time to power mode 0 is 54 uS
Flash memory RC2300 RC2301 RC2302 RC2304		 128 128 32 64		kB	
RAM memory		8		kB	
EEPROM memory		4		kB	
MCU clock frequency		32		MHz	
MCU low frequency crystal		32.768		kHz	
Antenna VSWR		<2:1	4:1		

Ordering Information

Ordering Part Number	Description
RC2300	ZigBee-ready RF module, 128 kB Flash
RC2300AT	ZigBee-ready RF module, 128 kB Flash, integrated antenna
RC2301	ZigBee-ready RF module, 128 kB Flash, Location Engine
RC2301AT	ZigBee-ready RF module, 128 kB Flash, Location Engine, integrated antenna
RC2302	ZigBee-ready RF module, 32 kB Flash
RC2302AT	ZigBee-ready RF module, 32 kB Flash, integrated antenna
RC2304	ZigBee-ready RF module, 64 kB Flash
RC2304AT	ZigBee-ready RF module, 64 kB Flash, integrated antenna

Document Revision History

Document Revision	Changes
1.0	First release
1.1	Added information on power supervisory circuit
1.2	Added info in recommended VSWR, update a figure for recommended ground plane. Changed product status to Full Production. Updated Electrical specification. Elaborated Block diagram.

Product Status and Definitions

Current Status	Data Sheet Identification	Product Status	Definition
	Advance Information	Planned or under development	This data sheet contains the design specifications for product development. Specifications may change in any manner without notice.
	Preliminary	Engineering Samples and First Production	This data sheet contains preliminary data, and supplementary data will be published at a later date. Radiocrafts reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
X	**No Identification Noted**	**Full Production**	**This data sheet contains final specifications. Radiocrafts reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.**
	Obsolete	Not in Production	This data sheet contains specifications on a product that has been discontinued by Radiocrafts. The data sheet is printed for reference information only.

Disclaimer

Radiocrafts AS believes the information contained herein is correct and accurate at the time of this printing. However, Radiocrafts AS reserves the right to make changes to this product without notice. Radiocrafts AS does not assume any responsibility for the use of the described product; neither does it convey any license under its patent rights, or the rights of others. The latest updates are available at the Radiocrafts website or by contacting Radiocrafts directly.

As far as possible, major changes of product specifications and functionality, will be stated in product specific Errata Notes published at the Radiocrafts website. Customers are encouraged to check regularly for the most recent updates on products and support tools.

Trademarks

RC232™ is a trademark of Radiocrafts AS. The RC232™ Embedded RF Protocol is used in a range of products from Radiocrafts. The protocol handles host communication, data buffering, error check, addressing and broadcasting. It supports point-to-point, point-to-multipoint and peer-to-peer network topologies.

All other trademarks, registered trademarks and product names are the sole property of their respective owners.

Life Support Policy

This Radiocrafts product is not designed for use in life support appliances, devices, or other systems where malfunction can reasonably be expected to result in significant personal injury to the user, or as a critical component in any life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness. Radiocrafts AS customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Radiocrafts AS for any damages resulting from any improper use or sale.

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