

RF02 User Manual

2.4 GHz RF wireless module

Applications

2412.75-2464.25 MHz ISM/SRD band systems

Consumer electronics

Wireless game controllers

Wireless audio

Wireless keyboard and mouse

RF enabled remote controls

Product Description

The RF02 is a low-cost 2.4 GHz RF wireless module. The circuit is intended for the 2412.75-2464.25 MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band. The RF transceiver is integrated with a highly configurable baseband modem. The modem supports various modulation formats and has a configurable data rate up to 500 kBaud.

RF02 provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, link quality indication, and wake-on-radio. The main operating parameters and the 64- byte transmit/receive FIFOs of RF02 can be controlled via an SPI interface. In a typical system, the RF02 will be used together with a microcontroller and a few additional passive components.

Key Features

RF Performance

High sensitivity (−104 dBm at 2.4 kBaud, 1% packet error rate) Low current consumption (13.3 mA in RX, 250 kBaud, input well above sensitivity limit) Programmable output power up to +1 dBm Excellent receiver selectivity and blocking performance Programmable data rate from 1.2 to 500 kBaud Frequency range: 2412.75-2464.25 MHz

Analog Features

GFSK Suitable for frequency hopping and multichannel systems due to a fast settling frequency synthesizer with 90 us settling time Automatic Frequency Compensation (AFC) can be used to align the frequency synthesizer to the received centre frequency Integrated analog temperature sensor

Digital Features

Flexible support for packet oriented systems: On-chip support for sync word detection, address check, flexible packet length, and automatic CRC handling
Efficient SPI interface: All registers can be programmed with one “burst” transfer
Digital RSSI output
Programmable channel filter bandwidth
Programmable Carrier Sense (CS) indicator
Programmable Preamble Quality Indicator (PQI) for improved protection against false sync word detection in random noise
Support for automatic Clear Channel Assessment (CCA) before transmitting (for listen-before-talk systems)
Support for per-package Link Quality Indication (LQI)
Optional automatic whitening and de whitening of data

Low-Power Features

400 nA SLEEP mode current consumption
Fast startup time: 240 us from SLEEP to RX or TX mode (measured on EM design)
Wake-on-radio functionality for automatic low-power RX polling
Separate 64-byte RX and TX data FIFOs (enables burst mode data transmission)

General

Few external components: Complete onchip frequency synthesizer, no external filters or RF switch needed
Green package: RoHS compliant and no antimony or bromine
Small size (QLP 4x4 mm package, 20 pins)
Suited for systems compliant with CE, FCC ID, ISED and TELEC
Support for asynchronous and synchronous serial receive/transmit mode for backwards compatibility with existing radio communication protocols

Operating Conditions

The **RF02** operating conditions are listed in Table 2 below

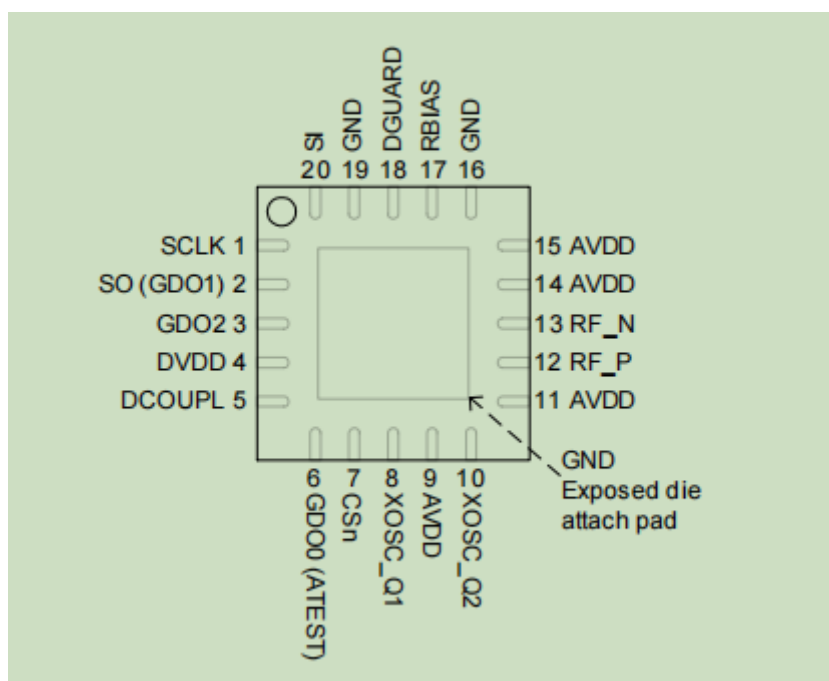
Parameter	Min	Max	Unit	Condition/Note
Operating temperature	−40	85	°C	
Operating supply voltage	1.8	3.6	V	All supply pins must have the same voltage

General Characteristics

Parameter	Min	Max	Unit	Condition/Note
Frequency range	2412.75	2464.25	MHz	There will be spurious signals at $n/2 \cdot \text{crystal oscillator frequency}$ (n is an integer number). RF frequencies at $n/2 \cdot \text{crystal oscillator frequency}$ should

				therefore be avoided (e.g. 2405, 2418, 2431, 2444, 2457, 2470 and 2483 MHz when using a 26 MHz crystal).
Data rate	1.2 1.2 26	500 250 500	kBaud kBaud kBaud	GFSK Optional Manchester encoding (the data rate in kbps will be half the baud rate).

Pin Configuration

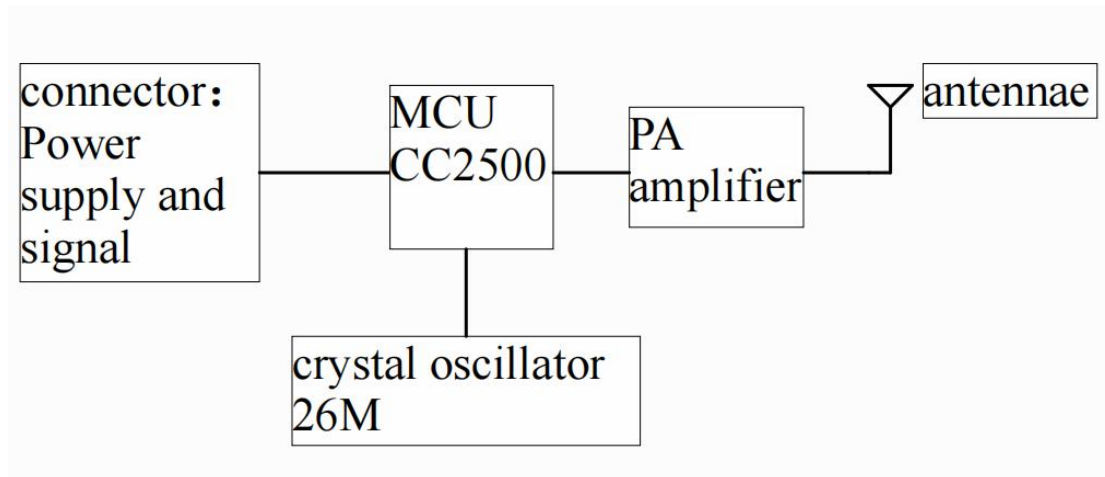


Note: The exposed die attach pad **must** be connected to a solid ground plane as this is the main ground connection for the chip

Pin #	Pin Name	Pin Type	Description
1	SCLK	Digital Input	Serial configuration interface, clock input
2	SO (GDO1)	Digital Output	Serial configuration interface, data output. Optional general output pin when CSn is high
3	GDO2	Digital Output	Digital output pin for general use: - Test signals - FIFO status signals - Clear Channel Indicator

			• Clock output, down-divided from XOSC • Serial output RX data
4	DVDD	Power (Digital)	1.8 - 3.6 V digital power supply for digital I/O's and for the digital core voltage regulator
5	DCOUP	Power (Digital)	1.6 - 2.0 V digital power supply output for decoupling. NOTE: This pin is intended for use with the CC2500 only. It can not be used to provide supply voltage to other devices.
6	GDO0 (ATEST)	Digital I/O	Digital output pin for general use: • Test signals • FIFO status signals • Clear Channel Indicator • Clock output, down-divided from XOSC • Serial output RX data • Serial input TX data Also used as analog test I/O for prototype/production testing
7	CSn	Digital Input	Serial configuration interface, chip select
8	XOSC_Q1	Analog I/O	Crystal oscillator pin 1, or external clock input
9	AVDD	Power (Analog)	1.8 - 3.6 V analog power supply connection
10	XOSC_Q2	Analog I/O	Crystal oscillator pin 2
11	AVDD	Power (Analog)	1.8 - 3.6 V analog power supply connection
12	RF_P	RF I/O	Positive RF input signal to LNA in receive mode Positive RF output signal from PA in transmit mode
13	RF_N	RF I/O	Negative RF input signal to LNA in receive mode Negative RF output signal from PA in transmit mode
14	AVDD	Power (Analog)	1.8 - 3.6 V analog power supply connection
15	AVDD	Power (Analog)	1.8 - 3.6 V analog power supply connection
16	GND	Ground (Analog)	Analog ground connection
17	RBIAS	Analog I/O	External bias resistor for reference current
18	DGUARD	Power (Digital)	Power supply connection for digital noise isolation
19	GND	Ground (Digital)	Ground connection for digital noise isolation
20	SI	Digital Input	Serial configuration interface, data input

Block diagram



Description of working principle

Power the MCU and PA amplifier through the socket. The signal received by the antenna is converted by the MCU and then sent to the main control of other products through the socket. Note: The MCU here is CC2500.

Selectivity

Figure 22 to Figure 26 show the typical selectivity performance (adjacent and alternate rejection).

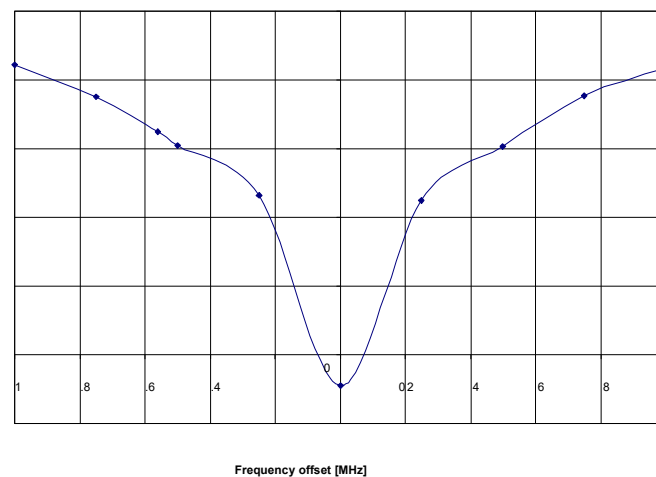


Figure 22: Typical Selectivity at 2.4 kBaud. IF Frequency is 273.9 kHz.

MDMCFG2.DEM_DCFILT_OFF=1

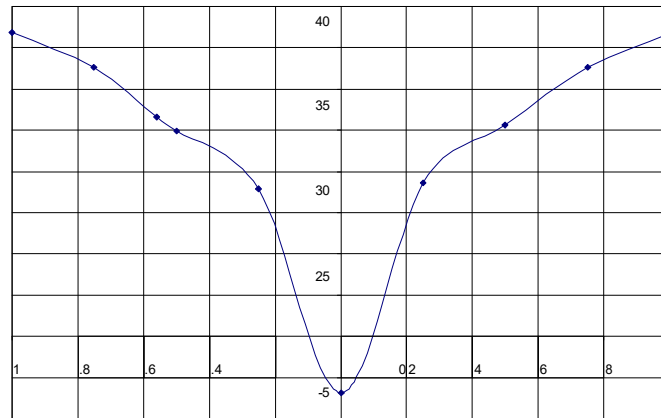


Figure 23: Typical Selectivity at 10 kBaud. IF Frequency is 273.9 kHz.

MDMCFG2.DEM_DCFILT_OFF=1

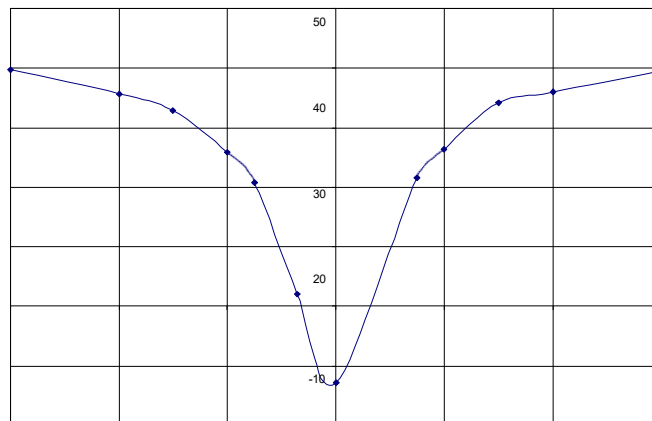


Figure 24: Typical Selectivity at 250 kBaud. IF Frequency is 177.7 kHz.

MDMCFG2.DEM_DCFILT_OFF=0

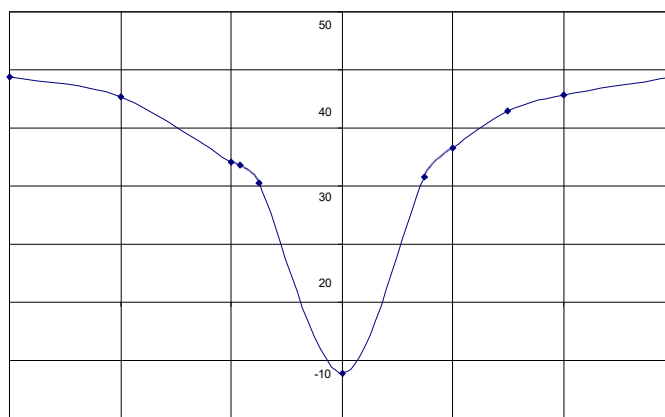


Figure 25: Typical Selectivity at 250 kBaud. IF Frequency is 457 kHz.
MDMCFG2.DEM_DCFILT_OFF=1

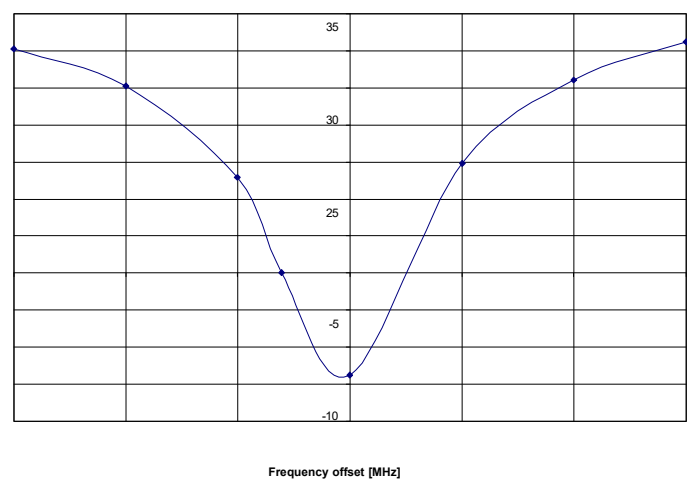
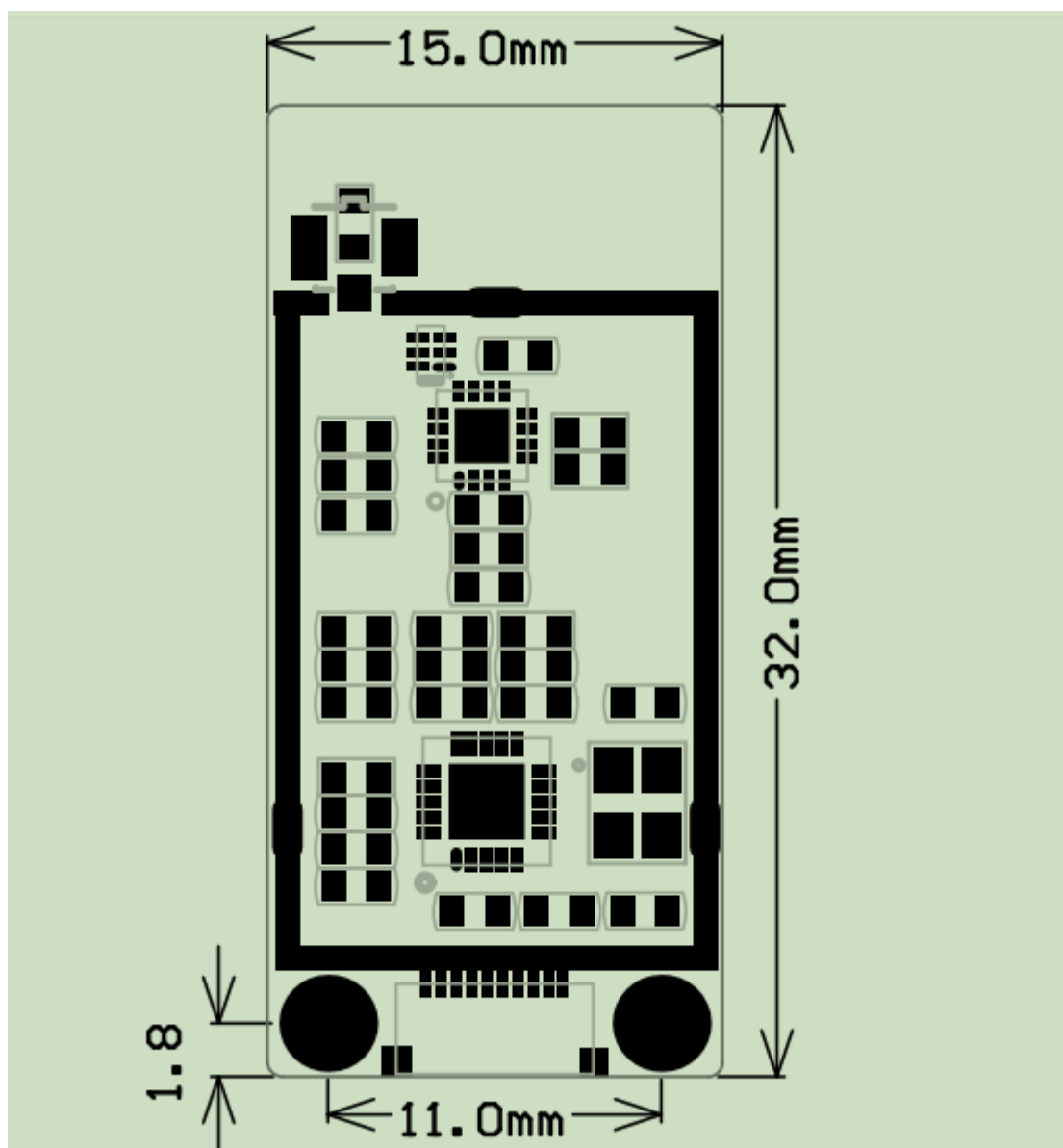


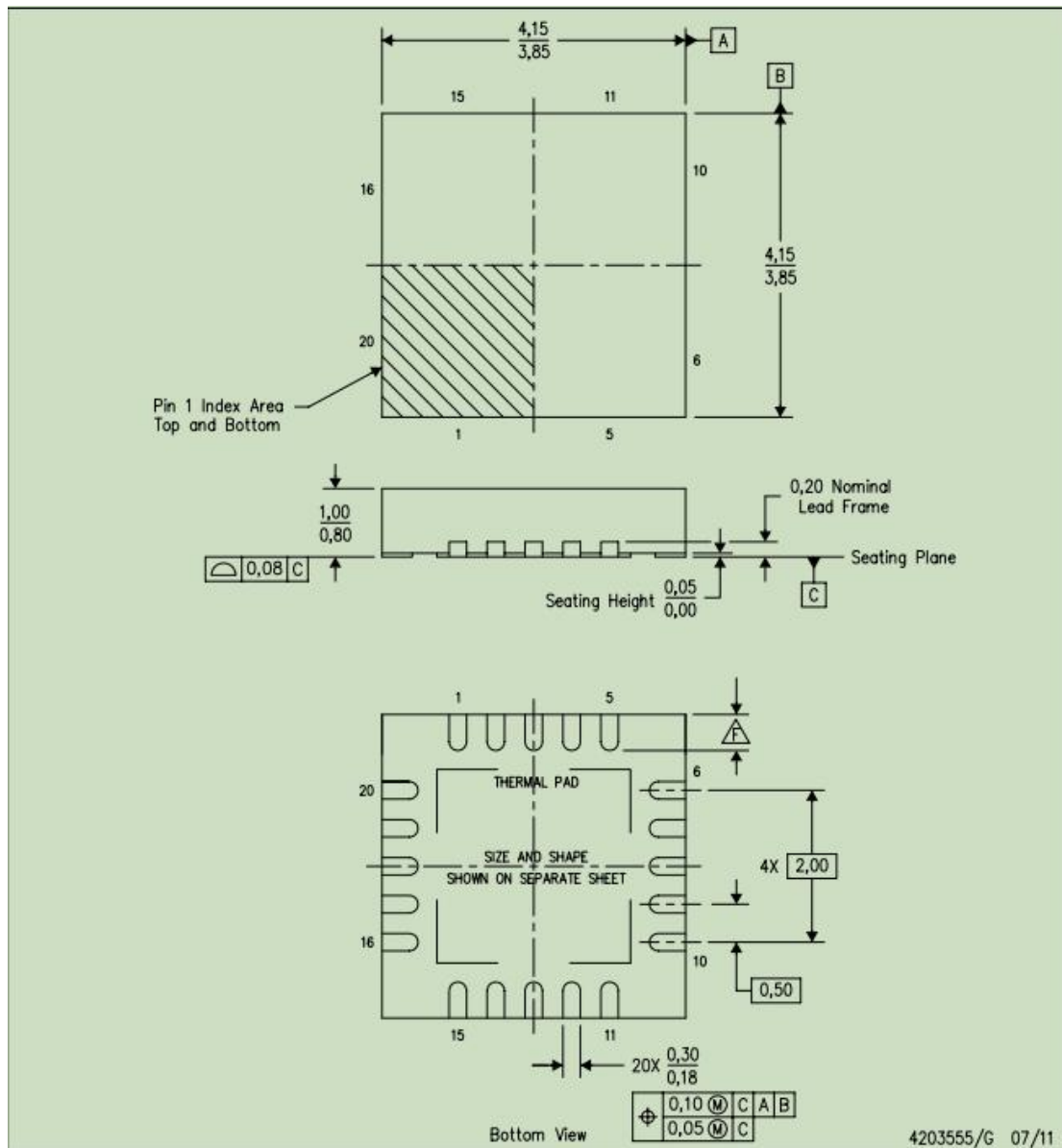
Figure 26: Typical Selectivity at 500 kBaud. IF Frequency is 304.7 kHz.
MDMCFG2.DEM_DCFILT_OFF=0

Mechanical Specifications

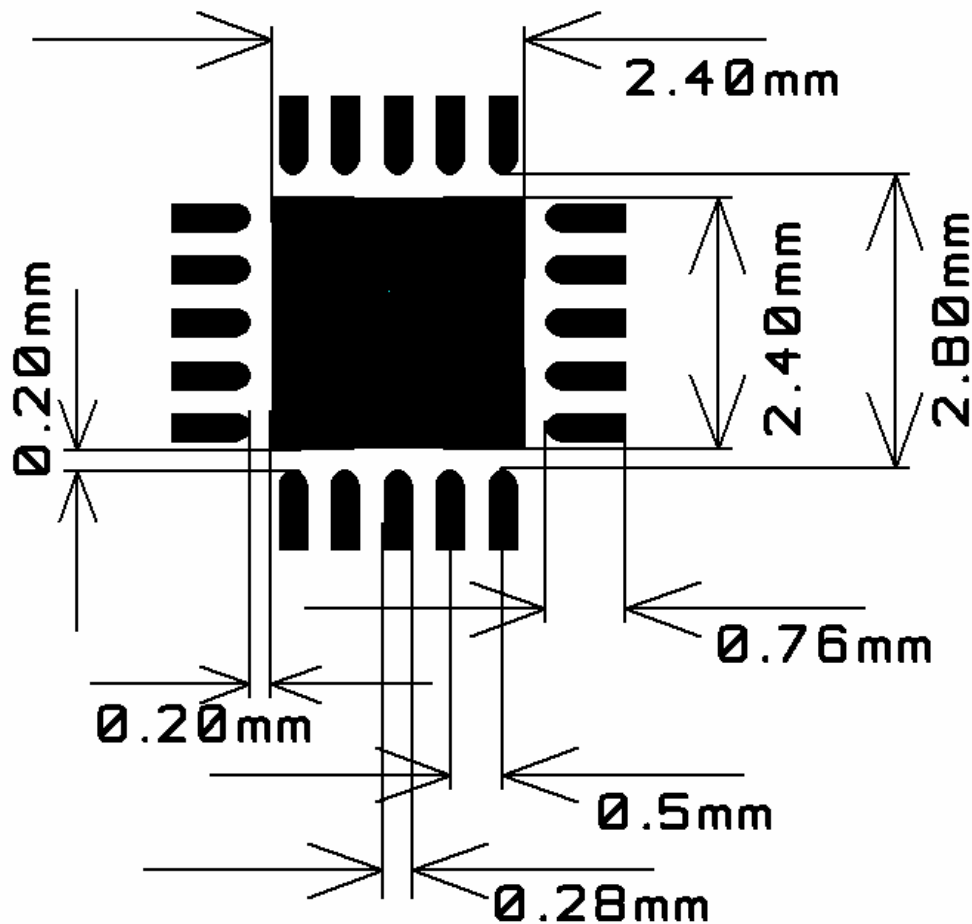
Dimensions



Chip size diagram



PCB Footprint



FCC Statement

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.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: 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 important announcement
- Important Note:

Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

Integration instructions for host product manufacturers according to KDB 996369

D03 OEM Manual v01r01

2.2 List of applicable FCC rules

CFR 47 FCC PART 15 SUBPART C has been investigated. It is applicable to the modular transmitter

2.3 Specific operational use conditions

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.

2.4 Limited module procedures

Not applicable

2.5 Trace antenna designs

Not applicable

2.6 RF exposure considerations

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

2.7 Antennas

This radio transmitter **FCC ID: 2ANIV-RF02** has been approved by Federal Communications Commission to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Antenna No.	Model No. of antenna:	Type of antenna:	Gain of the antenna (Max.)	Frequency range:
DBTQ6-WIFI-V3	/	FPC Antenna	-0.19	2400-2500MHz

2.8 Label and compliance information

The final end product must be labeled in a visible area with the following" Contains **FCC ID:2ANIV-RF02**".

2.9 Information on test modes and additional testing requirements

Host manufacturer is strongly recommended to confirm compliance with FCC requirements for the transmitter when the module is installed in the host.

2.10 Additional testing, Part 15 Subpart B disclaimer

Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15 B.

2.11 Note EMI Considerations

Host manufacture is recommended to use RF02 Module Integration Guide recommending as "best practice" RF design engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties.

2.12 How to make changes

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system. According to the KDB 996369 D02 Q&A Q12, that a host manufacture only needs to do an evaluation (i.e., no C2PC required when no emission exceeds the limit of any individual device (including unintentional radiators) as a composite. The host manufacturer must fix any failure.

ISED Statement

English: This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

- (1) This device may not cause interference.
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

French: Cet appareil contient des émetteurs/récepteurs exempts de licence qui sont conformes aux RSS exemptés de licence d'Innovation, Sciences et Développement économique Canada.

L'exploitation est soumise aux deux conditions suivantes :

- (1) Cet appareil ne doit pas provoquer d'interférences.
- (2) Cet appareil doit accepter toute interférence, y compris les interférences susceptibles de provoquer un fonctionnement indésirable de l'appareil.

This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Cet équipement doit être installé et utilisé à une distance minimale de 20 cm entre le radiateur et votre corps.

ISED Modular Usage Statement

NOTE 1: When the ISED certification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use the wording "Contains transmitter module IC: 22889-RF02" or "Contains IC: 22889-RF02".

NOTE 1: Lorsque le numéro de certification ISED n'est pas visible lorsque le module est installé dans un autre appareil, l'extérieur de l'appareil dans lequel le module est installé doit également afficher une étiquette faisant référence au module inclus. Cette étiquette extérieure peut être libellée Contient le module émetteur IC: 22889-RF02 ou Contient IC: 22889-RF02.

Contact

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