BM2502-6x-1
Sub-1GHz FSK RX Module

Revision: V1.00 Date: May 26, 2023

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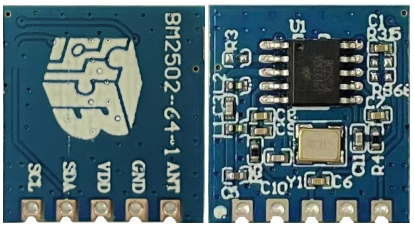
Features



- Operating voltage range: 2.4V~5.5V
- Frequency range: 315MHz~915MHz
- Modulation: FSK
- Symbol rate: 1ksps~50ksps
- Standby current: 0.5μA(Typ.) @ 5V, Deep Sleep mode
- Operating current
  - 4.7mA(Typ.) @ 5V, RX mode, 315MHz
  - 4.5mA(Typ.) @ 5V, RX mode, 433.92MHz
  - 5.8mA(Typ.) @ 5V, RX mode, 868.35MHz
  - 5.8mA(Typ.) @ 5V, RX mode, 915MHz
- Receiver sensitivity
  - -108dBm @ 10ksps, 315MHz
  - -108dBm @ 10ksps, 433.92MHz
  - -104dBm @ 10ksps, 868.35MHz
  - -104dBm @ 10ksps, 915MHz
- Interface: 5-pin stamp hole&straight hole
- Size: 15.0mm(L)×16.0mm(W)×2.5mm(H)

General Description

The BM2502-6x-1 is an ultra-low power consumption, high-performance and low-cost Sub-1GHz Low-IF FSK receiving module whose design is based on the BC2502A/B devices. The module supports wireless applications in the 315MHz, 433MHz, 868MHz and 915MHz frequency bands and can be easily accessed using a two-wire interface like the I²C interface. The symbol rate is in a range of 1ksps to 50ksps. The receiver sensitivity can be up to -108dBm at 433.92MHz.

Applications

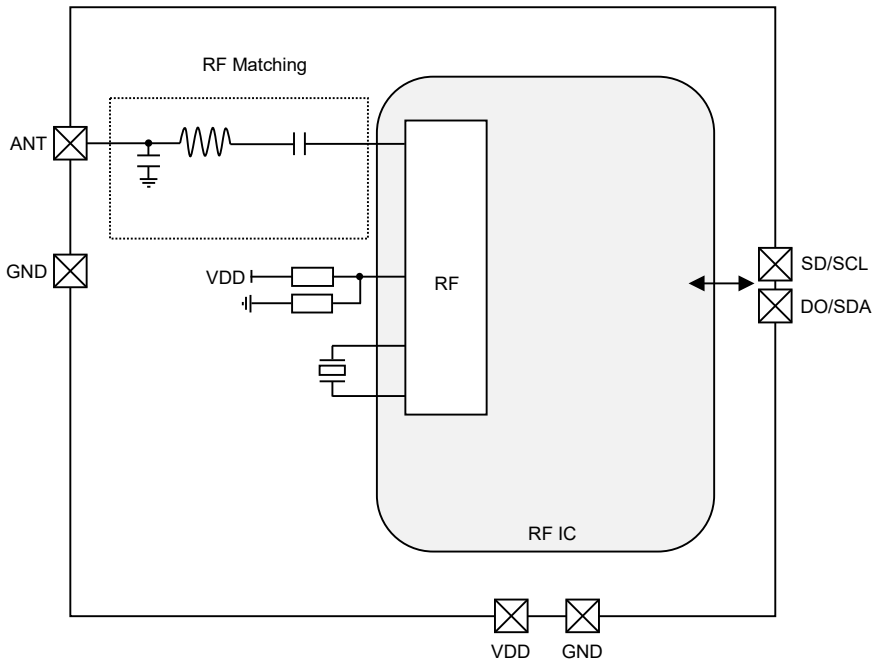
- Ceiling lamps
- Wireless switches
- Drying racks
- Wireless doorbells
- Integrated ceilings

Selection Table

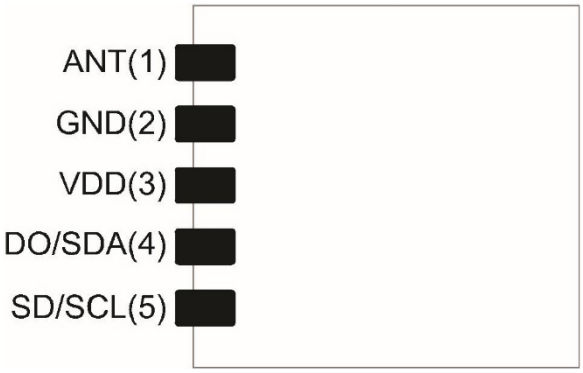
Part No.	Frequency Band	Optimal Operating Frequency	*Supported Frequency Range
BM2502-63-1	315MHz	315MHZ	290MHz~349MHZ
BM2502-64-1	433MHz	433.92MHz	396.92MHz~471.92MHZ
BM2502-68-1	868MHz	868.35MHz	805.35MHz~918.35MHZ
BM2502-69-1	915MHz	915MHz	856MHZ~966MHz

*Module features cannot be ensured under the supported frequency range, so the above optimal operating frequencies are recommended.
*Products are available from Best Modules.

Block Diagram



Pin Assignment



Pin Description

Pin	Function	Type	Description
1	ANT	AI/O	Antenna interface
2	GND	PWR	Negative power supply, GND
3	VDD	PWR	Positive power supply
4	DO/SDA	O	DO: Demodulated data output in RX mode
		I/O	SDA: I^2C data line in configuration mode
5	SD/SCL	I	SD: RX mode shut-down control, this pin should be pulled low in RX mode
		I	SCL: I^2C clock line in configuration mode

Legend: PWR: Power; I: Digital input; O: Digital output;
I/O: Digital input/output; AI/O: Analog input/output

Technical Specifications

Absolute Maximum Ratings

Supply Voltage ..... V_{SS}-0.3V~V_{SS}+5.5V

Input Digital Voltage ..... V_{SS}-0.3V~V_{DD}+0.3V

Storage Temperature..... -60°C~150°C

Operating(Ambient) Temperature ..... -40°C~85°C

ESD HBM ..... ±2kV

Note: Devices being ESD sensitive. HBM(Human Body Mode) is based on MIL-STD-883.

D.C. Electrical Characteristics

Ta=25°C, V_{DD}=5.0V, f_{XTAL}=16MHz, FSK demodulation with matching circuit, unless otherwise specified

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
T_{OP}	Operating Temperature	—	-40	—	85	°C
V_{DD}	Operating Voltage	—	2.4	5.0	5.5	V
Current Consumption						
I_{SLP}	Current Consumption, Deep Sleep Mode	—	—	0.5	—	μA
I_{RX}	Current Consumption, RX Mode	@ 315MHz	—	4.7	—	mA
		@ 433MHz	—	4.5	—	mA
		@ 868MHz	—	5.8	—	mA
		@ 915MHz	—	5.8	—	mA

RF Electrical Characteristics

Ta=25°C, V_{DD}=5.0V, f_{XTAL}=16MHz, FSK demodulation with matching circuit, unless otherwise specified

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Receiver Characteristics						
SR	Symbol Rate	—	1	—	50	ksps
f_{DEV}	Frequency Deviation	—	4	—	25	kHz
P_{SENS}(Note)	RX Sensitivity – 315MHz (Instrument: Keysight E4438C)	SR=1ksps, BER=0.1%	—	-105	—	dBm
		SR=10ksps, BER=0.1%	—	-108	—	
	RX Sensitivity – 433.92MHz (Instrument: Keysight E4438C)	SR=1ksps, BER=0.1%	—	-106	—	
		SR=10ksps, BER=0.1%	—	-108	—	
	RX Sensitivity – 868.35MHz (Instrument: Keysight E4438C)	SR=1ksps, BER=0.1%	—	-104	—	
		SR=10ksps, BER=0.1%	—	-104	—	
	RX Sensitivity – 915MHz (Instrument: Keysight E4438C)	SR=1ksps, BER=0.1%	—	-104	—	
		SR=10ksps, BER=0.1%	—	-104	—	
Cof_{ST}	Configuration Mode Settling Time (Deep Sleep Mode to Configuration Mode)	—	—	2.5	—	ms
RX_{ST}	RX Mode Settling Time (Deep Sleep Mode to RX Mode Data Output)	—	—	2.5	—	ms

Note: 315/433MHz Bands Digital Filter BW=93.6kHz.
868/915MHz Bands Digital Filter BW=187.2kHz.

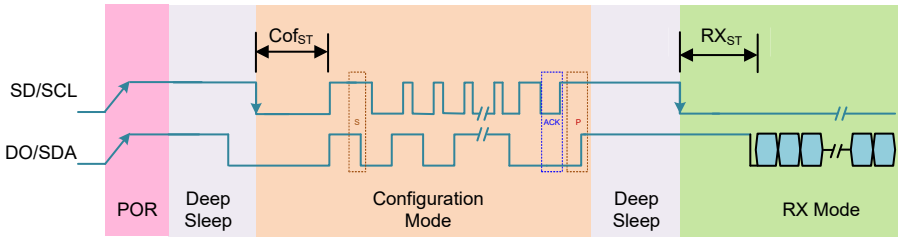
Functional Description

The BM2502-6x-1 is a Sub-1GHz FSK receiving module, which provides three operation modes, Deep Sleep mode, configuration mode and RX mode.

In the Deep Sleep mode, there is a less than 1μA of sleep current with register data retention.

When the SDA is low and a SCL falling edge occurs, the module enters the configuration mode after a 2.5ms delay time. In the configuration mode, the BM2502-6x-1 is as the I²C slave, users can implement the required RF function by configuring the internal register using the SDA and SCL. Besides, users can set the CFOMSD bit high, which is the bit0 of the register at address 40h, in order to leave the configuration mode and return to the Deep Sleep mode.

In the Deep Sleep mode, if the SCL is pulled low, the BM2502-6x-1will enter the RX mode. In this mode, the module can receive the RF signal and output the demodulated data into the DO/SDA pin. Users can pull high the SCL to make the module exit the RX mode and return to the Deep Sleep mode.



I²C Communication Format

This I²C communication interface is composed of the BM2502-6x-1 SDA and SCL. It can be used to configure and read the module register data in the configuration mode. The series of modules support the I²C formats for byte write, page write, byte read and page read formats. Every byte placed onto the SDA line must be 8-bit long. The device address of the module is fixed at 0x25. Refer to the BC2502A/B Datasheet for more information.

Byte Write

S	DADDR[6:0]	W	A	RADDR[7:0]	A	DATA	A	P

Page Write

S	DADDR[6:0]	W	A	RADDR[7:0]	A	DATA	A	DATA(n+1)	A	DATA(n+x)	A	P

Byte Read

S	DADDR[6:0]	W	A	RADDR[7:0]	A	RS	DADDR[6:0]	R	A	DATA	NA	P

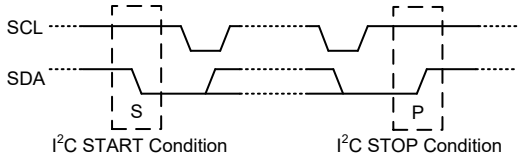
Page Read

S	DADDR[6:0]	W	A	RADDR[7:0]	A	RS	DADDR[6:0]	R	A	DATA(n)	A	DATA(n+1)	A	DATA(n+x)	NA	P

Bus Direction: : Host to device; : Device to host

Symbol Definitions: S: Start; RS: Repeated Start; P: Stop;
DADDR[6:0]: Device address, 25h; R: Read(1); W: Write(0);
RADDR[7:0]: Register address; A: ACK(0): NA: NAK(1)

I²C START and STOP Conditions:



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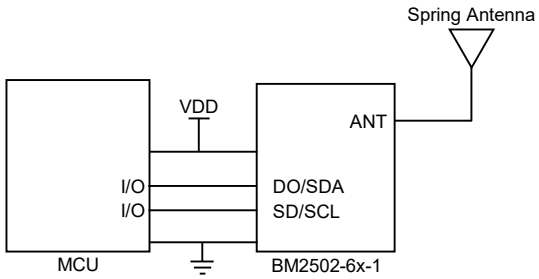
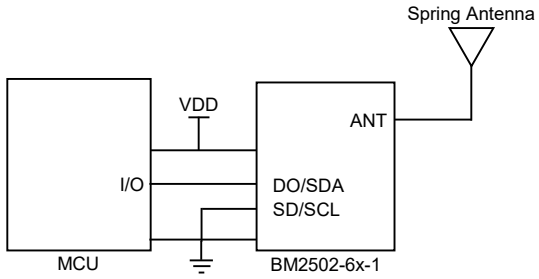
Application Circuits

I²C Mode

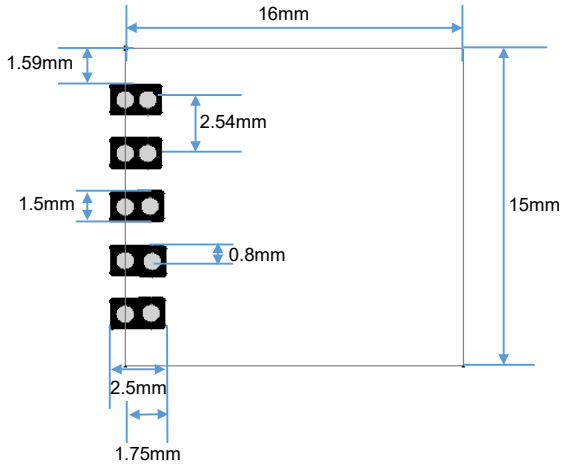


AUTO Mode



Layout Description

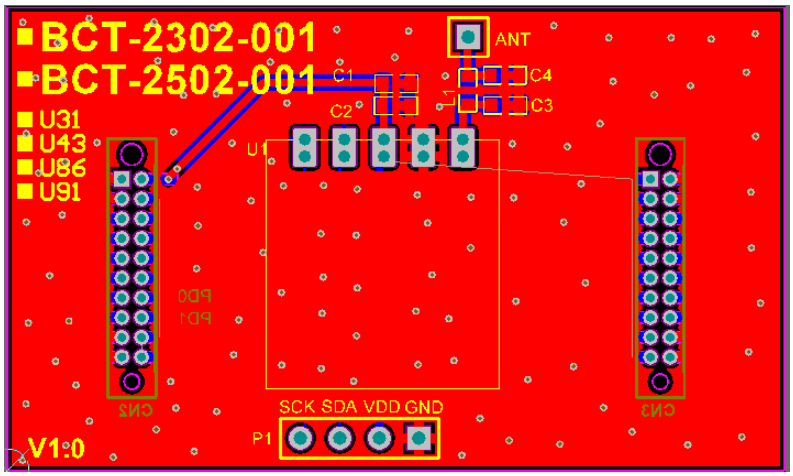
PCB Footprint



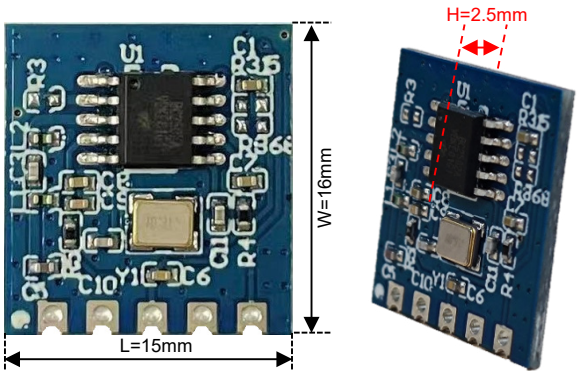
Layout Guidelines

1. Provide a stable power supply and add appropriate filter capacitors.
2. Keep away from the DC-DC circuit as much as possible.
3. Reserve a π matching circuit for the antenna.

Layout Example



Dimensions



Reference Information

Modification History

Date	Author	Issue	Modification Information
2023.04.21	Zahi	V1.00	First Version

Relevant Document

BC2502 Example Program Description Document

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