Sub-1GHz FSK&OOK RX Module

BM2502-6x-2

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Features

- Operating voltage range: 2.4V~5.5V
- Frequency range: 315MHz~915MHz
- Modulation mode: FSK&OOK
- Symbol rate (OOK): 0.5Ksps~40Ksps
- Data rate (FSK): 1Kbps~50Kbps
- 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:
  - -109dBm @ 10Kbps(FSK), 315MHz
  - -111dBm @ 10Ksps(OOK), 315MHz
  - -108dBm @ 10Kbps(FSK), 433.92MHz
  - -110dBm @ 10Ksps(OOK), 433.92MHz
  - -104dBm @ 10Kbps(FSK), 868.35MHz
  - -108dBm @ 10Ksps(OOK), 868.35MHz
  - -102dBm @ 10Kbps(FSK), 915MHz
  - -108dBm @ 10Ksps(OOK), 915MHz
- Interface: 5-pin stamp hole & straight hole
- Size: 16.0mm(L)×15.0mm(W)×2.5mm(H)

General Description

The BM2502-6x-2 is a Sub-1GHz low-IF FSK&OOK receiver module designed based on the BC2502C/D device, which has ultra-low power, high performance and low-cost. The module supports wireless applications in the 315MHz, 433MHz, 470MHz, 868MHz and 915MHz frequency bands and can be easily accessed using a 2-wire interface similar to the I^2C interface. The symbol rate ranges from 0.5Ksps to 40Ksps, and the data rate ranges from 1Kbps to 50Kbps. When the frequency band is 433.92MHz, the receiving sensitivity can reach -108dBm if the modulation mode is FSK, and -110dBm if the modulation method is OOK.

Applications

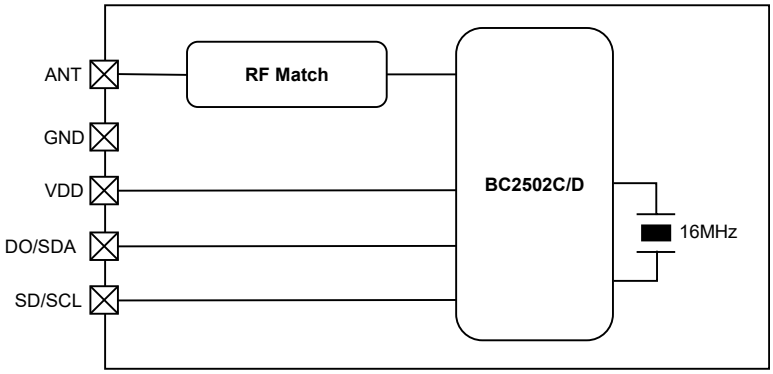
- Ceiling lamps
- Wireless switches
- Drying racks
- Wireless doorbells
- Integrated ceilings

Selection Table

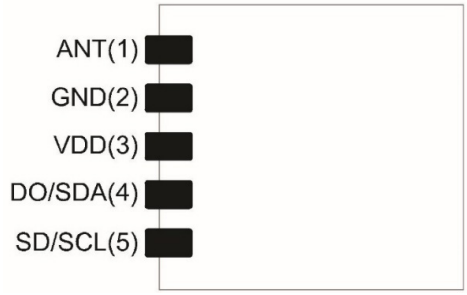
Part No.	Frequency Band	Optimal Operating Frequency Point	Supported Frequency Range
BM2502-63-2	315MHz	315MHZ	290MHz~349MHZ
BM2502-64-2	433MHz	433.92MHz	396.92MHz~471.92MHZ
BM2502-68-2	868MHz	868.35MHz	805.35MHz~918.35MHZ
BM2502-69-2	915MHz	915MHz	856MHZ~966MHz

*The module feature cannot be fully guaranteed within the supported frequency range. It is recommended to use the optimal operating frequency point.

Block Diagram



Pin Assignment



Pin Description

Pin	Function	Type	Description
1	ANT	AI/O	Antenna interface
2	GND	PWR	Negative power supply, GND
3	VCC	PWR	Positive power supply
4	DO/SDA	O	DO: Demodulated data output in RX Mode
		I/O	SDA: I²C data line in Configuration Mode
5	SD/SCL	I	SD: RX mode shut-down control, should be pulled low in RX Mode
		I	SCL: I²C clock input line in Configuration Mode

Legend: PWR: Power; I: Digital input;
O: Digital output; I/O: Digital 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℃~150℃

Operating (Ambient) Temperature ..... -40℃~85℃

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, OOK/FSK modulation with matching circuit, unless otherwise specified

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
T_{OP}	Operating Temperature	—	-40	—	85	℃
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, OOK/FSK modulation with matching circuit, unless otherwise specified

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Receiver Characteristics						
SR	Symbol Rate	—	0.5	—	40	Ksps
DR	Data Rate	—	1	—	50	Kbps
f_{DEV}	Frequency Deviation	—	4	—	25	kHz
P_{SENS}	RX Sensitivity – 315MHz (Instrument: Keysight E4438C)	DR=10kbps, BER=0.1% (@f_{DEV}=20kHz)	—	-109	—	dBm
		SR=10Ksps, BER=0.1%	—	-111	—	
	RX Sensitivity – 433.92MHz (Instrument: Keysight E4438C)	DR=10kbps, BER=0.1% (@f_{DEV}=20kHz)	—	-108	—	
		SR=10Ksps, BER=0.1%	—	-110	—	
	RX Sensitivity – 868.35MHz (Instrument: Keysight E4438C)	DR=10kbps, BER=0.1% (@f_{DEV}=20kHz)	—	-104	—	
		SR=10Ksps ,BER=0.1%	—	-108	—	
	RX Sensitivity – 915MHz (Instrument: Keysight E4438C)	DR=10kbps, BER=0.1% (@f_{DEV}=20kHz)	—	-102	—	
		SR=10Ksps, BER=0.1%	—	-108	—	
Cof_{ST}	Configure Mode Settling Time (Deep Sleep to Configure Mode)	SMD3225 XO	—	2.5	—	ms
RX_{ST}	RX Mode Settling Time (Deep Sleep Mode to RX Mode Data Out)	SMD3225 XO	—	2.5	—	ms

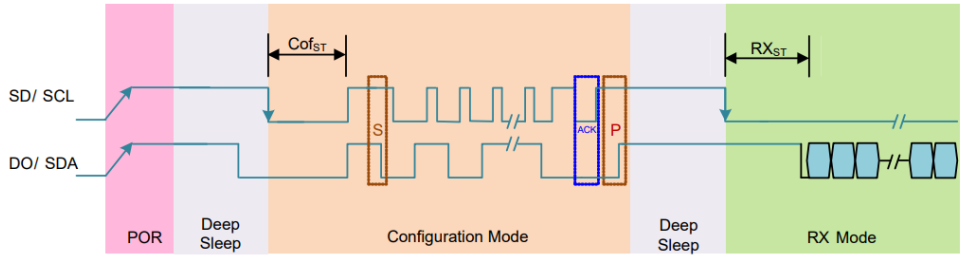
Functional Description

The BM2502-6x-2 is a Sub-1GHz FSK&OOK receiver module, it has three operation modes: deep sleep mode, configuration mode and RX mode.

In the deep sleep mode, there is less than 1μA of sleep current with internal register data retention.

For the BM2502-6x-2 when the SDA is low and a SCL falling edge occurs, the moduele will enter the configuration mode after a 2ms delay time. In the configuration mode, the BM2502-6x-2 will serve as an I²C slave, users can configure its internal registers using the SDA and SCL to implement RF function. The module will exit the configuration mode and return to the deep sleep mode by setting the CFOMSD bit (bit0) high of the register at 40h.

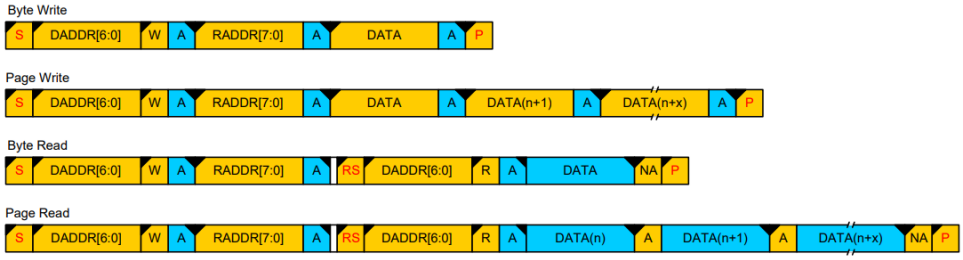
In the deep sleep, if the SCL is pulled low, the BM2502-6x-2 will enter the RX mode. In the RX mode, the module will receive RF signal and demodulate it, then output the data to the DO/SDA pin. The users can pull the SCL high to exit the RX mode and return to the deep sleep mode.



Interface

I²C Communication Format

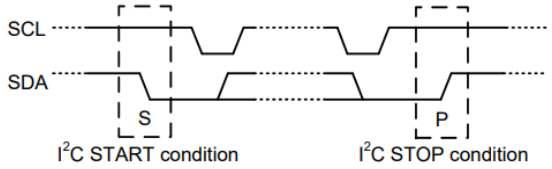
The BM2502-6x-2 includes an I²C communication interface, which is composed of SDA and SCL lines. This interface can be used to configure and read module internal register data in configuration mode. The series of modules support the I²C format for byte write, page write, byte read and page read formats. Each data byte length on the SDA line is 8 bits, and the device address of the module is fixed at 0x25. Refer to the BC2502C/D datasheet for details.



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

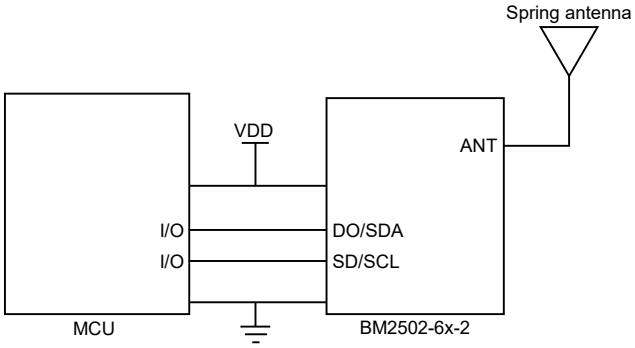
Symbol Definitions: S: Start; RS: Repeated Start; P: Stop;
DADDR[6:0]: Device Address, 25h;
R:Read(1); W: Write(0);
RADDR[7:0]: register address;
A: ACK(0); NA: NAK(1)

I²C START and STOP Conditions:

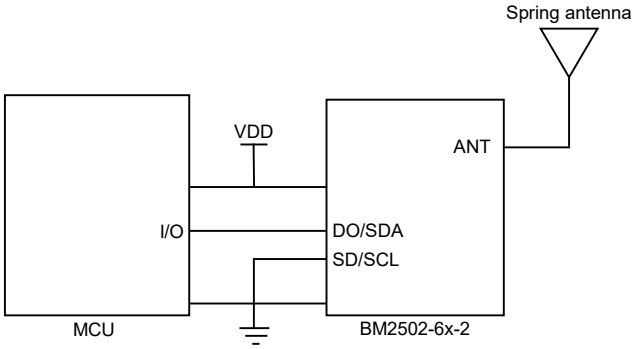


Application Circuits

I²C Mode



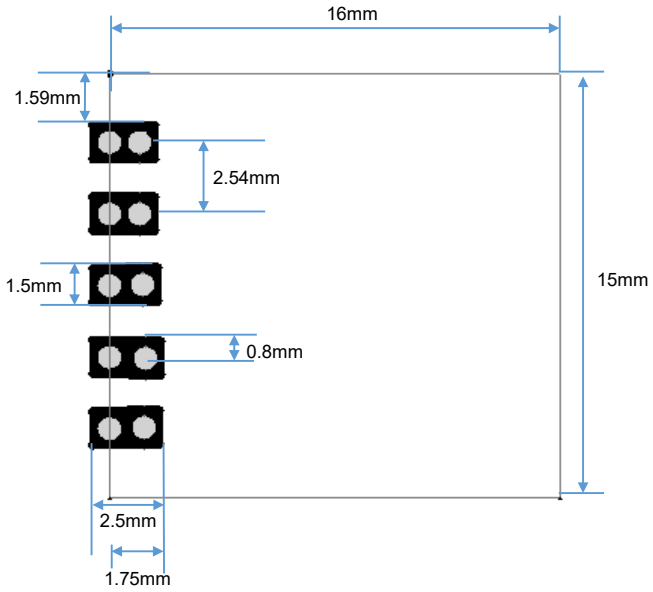
AUTO Mode



Note: In the AUTO mode, the module default modulation mode is FSK; to switch the modulation mode to OOK, a 1k resistor requires to be soldered in R3.

Layout Description

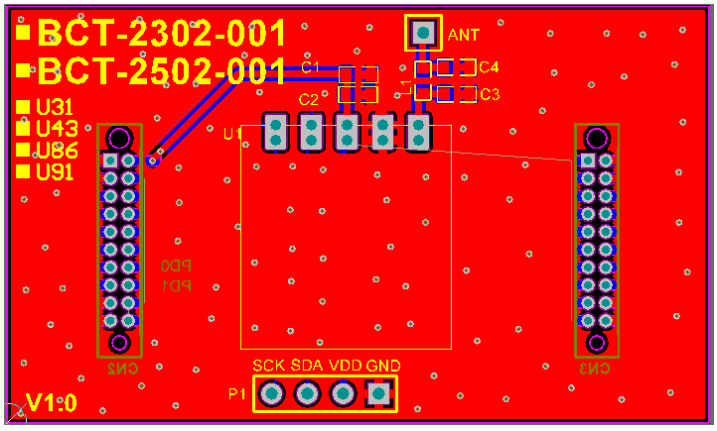
PCB Footprint



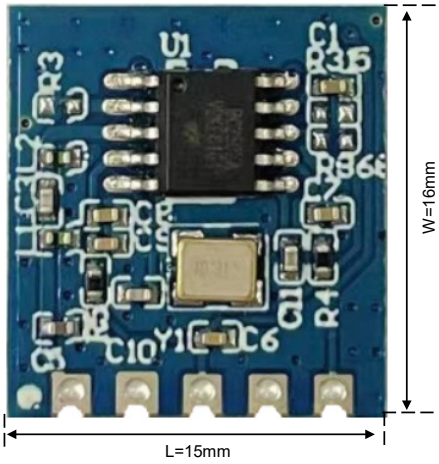
Layout Guidelines

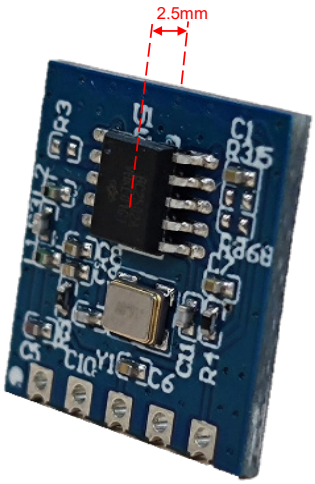
1. Provide a stable power supply and add appropriate filter capacitors;
2. Stay away from the DC-DC circuits as much as possible;
3. Reserve a π type matching circuit for the antenna.

Layout Example



Dimensions





Reference Information

Modification History

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

Relevant Document

BC2502 Example Program Description Document

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