E220-400MM22S

LLCC68 433/470MHz 160mW SPI LoRa Module SMD Type



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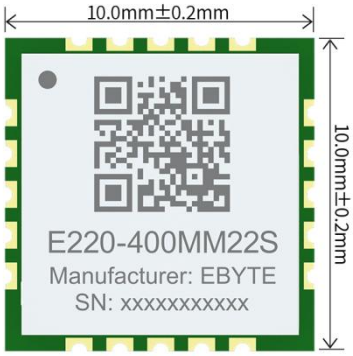
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1 Overview

1.1 Brief Introduction



E220-400MM22S is an ultra-small volume independently developed based on a new generation of LoRaTM RF chip LLCC68 produced by Semtech, and is suitable for 433MHz, 470MHz SMD LoRaTM wireless modules, using industrial grade 32MHz crystal oscillator.

Since it adopts the imported LLCC68 as the core of the module, compared with the previous generation LoRaTM transceiver, the anti-interference performance and communication distance have been further improved. Because it adopts the new LoRaTM modulation technology, its anti-interference performance and communication distance far exceed the current FSK and GFSK modulation products. This module is mainly aimed at smart home, wireless meter reading, scientific research and medical treatment, as well as medium and long distance wireless communication equipment. This product can cover the ultra-wide applicable frequency range of 410~493MHz.

Since this module is a pure RF transceiver module, it needs to use MCU driver or use a dedicated SPI debugging tool.

1.2 Features

- The measured distance can reach 6000m;
- Maximum transmit power 160mW, multi-level software adjustable;
- Support global license-free ISM 433/470MHz frequency band;
- Support data transmission rate of 1.76kbps~62.5kbps in LoRaTM mode;
- Supports data transfer rates up to 300kbps in FSK mode;
- Large FIFO capacity, support 256Byte data buffer;
- Support spreading factors SF5, SF6, SF7, SF8, SF9, SF10, SF11;
- Support 1.8V~3.7V power supply, more than 3.3V power supply can ensure the best performance;
- Industrial-grade standard design, support long-term use at -40 ~ 85°C;
- Ultra-small 10*10mm package, convenient for secondary development and integration.

1.3 Application

- Home security alarm and remote keyless entry;
- Smart home and industrial sensors, etc;
- Wireless alarm security system;
- Building automation solutions;
- Wireless industrial grade remote control;
- Healthcare products;

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- Advanced meter reading architecture (AMI);
- Automotive industry applications.

2 Specification and Parameter

2.1 RF Parameter

RF Parameter		Parameter Value	Remark
Operating frequency		410MHz～493MHz	Support ISM
Transmit power		21dBm～22dBm	The software is adjustable and needs to be developed and set by the user
Receiving sensitivity		-129dBm	BW_L=250kHz，SF = 10，LORA™
FIFO		256Byte	Maximum length of single transmission
Modulation mode		LoRa	LoRa modulation is recommended
Blocking power		10dBm	The probability of burning at close range is small
Air rate	LoRa（bps）	1.76k～62.5k	User programming control
Reference distance		6000m	Clear and open environment, antenna gain 5dBi, antenna height 2.5 meters, air rate 2.4kbps

2.2 Electrical Parameter

Main Parameter	Performance			Remark
	Min.	**Type**	Max.	
Operating voltage（V）	1.8	3.3	3.7	≥3.3V can guarantee the output power, more than 3.7V will permanently burn the module
Communication level（V）	-	3.3	-	Risk of burnout with 5V TTL

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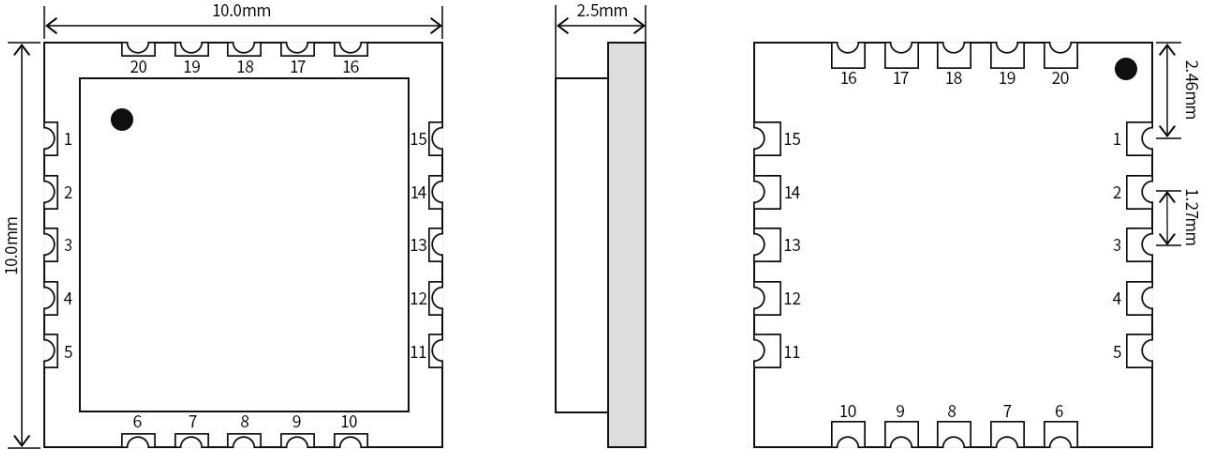
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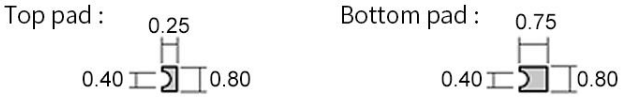
Operating temperature（℃）		-40	-	+85	Industrial grade design
Power consumption	TX current（mA）	-	100	-	Instantaneous power consumption
	RX current（mA）	-	10	-	-
	Sleep current（nA）	-	180	-	software shutdown

2.3 Hardware Parameter

Hardware Parameters	Parameter Value	Remark
Crystal oscillation frequency	32MHz	-
Package	SMD	-
Connector	stamp hole	Spacing 1.27mm
Communication interface	SPI	0-10Mbps
Size	10* 10*2.5 mm	With shield
Net weight	0.5g±0.02g	-
RF interface	stamp hole	-

3 Size and Pin Definition





Unit : mm
pad quantity : 20
Tolerance value : X.X±0.2mm
X.XX±0.05mm

Pin No.	Item	Direction	Description

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1	VCC	-	Power supply, range 1.8V~3.7V (recommended to add external ceramic filter capacitor)
2	GND	-	Ground wire, connected to the power reference ground
3	NRST	Input	Chip reset trigger input pin, active low
4	NC	-	-
5	NC	-	-
6	ANT	-	RF interface, stamp hole
7	GND	-	Ground wire, connected to the power reference ground
8	NC	-	-
9	TXEN	Input	RF switch launch control pin, connected to external microcontroller IO or DIO2, active high
10	RXEN	Input	RF switch receiving control pin, connected to external microcontroller IO, active high
11	BUSY	Output	Used for status indication (see LLCC68 manual for details)
12	MISO	Output	SPI data output pin
13	MOSI	Input	SPI data input pin
14	NSS	Input	Module chip select pin for starting an SPI communication
15	SCK	Input	SPI clock input pin
16	GND	-	Ground wire, connected to the power reference ground
17	NC	-	-
18	DIO3	Input/Output	Configurable general-purpose IO port (see LLCC68 manual for details)
19	DIO2	Input/Output	Configurable general-purpose IO port (see LLCC68 manual for details)
20	DIO1	Input/Output	Configurable general-purpose IO port (see LLCC68 manual for details)
For the pin definition, software driver and communication protocol of the module, please refer to the official LLCC68 Datasheet of SEMTECH			

4 Basic Operation

4.1 Hardware Design

- It is recommended to use a DC stabilized power supply. The power supply ripple factor is as small as possible and the module needs to be reliably grounded;
- Please pay attention to the correct connection of the positive and negative poles of the power supply, reverse connection may cause permanent damage to the module;
- Please check the power supply to ensure that between the recommended supply voltage, if exceeding the maximum, the module will be permanently damaged;
- Please check the stability of the power supply. Voltage can not fluctuate greatly and frequently;
- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the margin, so the whole machine is beneficial for long-term stable operation;
- The module should be as far away as possible from the power supply, transformers, high-frequency wiring and other parts with large electromagnetic interference;

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- Bottom Layer High-frequency digital routing, high-frequency analog routing, and power routing must be avoided under the module. If it is necessary to pass through the module, assume that the module is soldered to the Top Layer, and the copper is spread on the Top Layer of the module contact part(well grounded), it must be close to the digital part of the module and routed in the Bottom Layer;
- Assuming the module is soldered or placed over the Top Layer, it is wrong to randomly route over the Bottom Layer or other layers, which will affect the module's spurs and receiving sensitivity to varying degrees;
- It is assumed that there are devices with large electromagnetic interference around the module that will greatly affect the performance. It is recommended to keep them away from the module according to the strength of the interference. If necessary, appropriate isolation and shielding can be done;
- Assume that there are traces with large electromagnetic interference (high-frequency digital, high-frequency analog, power traces) around the module that will greatly affect the performance of the module. It is recommended to stay away from the module according to the strength of the interference.If necessary, appropriate isolation and shielding can be done;
- It is not recommended to use 5V level for communication lines, and there is a risk of damage. A level conversion circuit needs to be added;
- The antenna installation structure has a great influence on the performance of the module. Make sure that the antenna is exposed, preferably vertically upward. When the module is installed inside the case, a high-quality antenna extension cable can be used to extend the antenna to the outside of the case;
- The antenna must not be installed inside the metal shell, which will greatly weaken the transmission distance;
- It is recommended to add a 200R protection resistor to the RXD/TXD of the external MCU.

4.2 Software Design

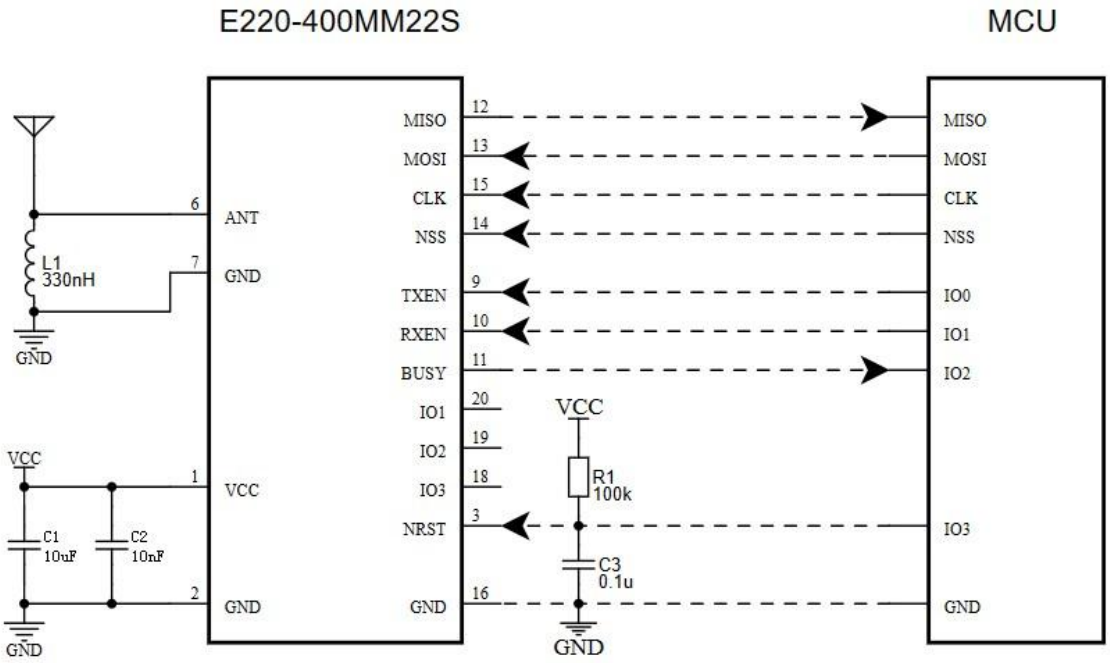
- This module is LLCC68+ peripheral circuit, users can operate according to LLCC68 chip book;
- DIO1, DIO2, and DIO3 are general-purpose IO ports, which can be configured with various functions; DIO2 can be connected with TXEN, not with the IO port of MCU, and is used to control the RF switch transmission, see LLCC68 manual for details, if not used, it can be left floating;
- Internal use of 32MHz passive crystal, no pin control, software program control;
- Difference between LLCC68 and SX1262/SX1268:
  1. SX1262/SX1268 support spreading factors SF5, SF6, SF7, SF8, SF9, SF10, SF11, SF12;
     LLCC68 supports spreading factors SF5, SF6, SF7, SF8, SF9, SF10, SF11.
  2. Spread spectrum factor and receiver bandwidth that can be set by LLCC68:
     LoRa® Rx/Tx, BW = 125 – 250 - 500 kHz,
     LoRa®，SF = 5 - 6 - 7 - 8 - 9 for BW = 125 kHz,
     LoRa®，SF = 5 - 6 - 7 - 8 - 9 - 10 for BW = 250 kHz,
     LoRa®，SF = 5 - 6 - 7 - 8 - 9 - 10 - 11 for BW = 500 kHz;

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5 Basic Application

5.1 Basic Circuit



Note: The L1 inductor is a protective device used to prevent the device from being damaged due to excessive input power of the antenna. The user should add this inductor when using the module.

6 FAQ

6.1 Communication Range Is Too Short

- The communication distance will be affected when obstacle exists;
- Data lose rate will be affected by temperature, humidity and co-channel interference;
- The ground will absorb and reflect wireless radio wave, so the performance will be poor when testing near ground;
- Sea water has great ability in absorbing wireless radio wave, so performance will be poor when testing near the sea;
- The signal will be affected when the antenna is near metal object or put in a metal case;
- Power register was set incorrectly, air data rate is set as too high (the higher the air data rate, the shorter the distance);
- At room temperature, the low voltage of the power supply is lower than the recommended value. The lower the voltage, the lower the output power;
- Due to antenna quality or poor matching between antenna and module.

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6.2 Module Is Easy To Damage

- Please check the power supply to ensure that it is between the recommended supply voltages, as exceeding the maximum value will cause permanent damage to the module;
- Please check the stability of power source, the voltage cannot fluctuate too much;
- Please make sure antistatic measure are taken when installing and using, high frequency devices have electrostatic susceptibility;
- Please ensure the humidity is within limited range, some parts are sensitive to humidity;
- Please avoid using modules under too high or too low temperature.

6.3 BER(Bit Error Rate) Is High

- There are co-channel signal interference nearby, please be away from interference sources or modify frequency and channel to avoid interference;
- The clock waveform on the SPI is not standard, check whether there is interference on the SPI line, and the SPI bus routing should not be too long;
- Poor power supply may cause messy code. Make sure that the power supply is reliable;
- The extension line and feeder quality are poor or too long, so the bit error rate is high.

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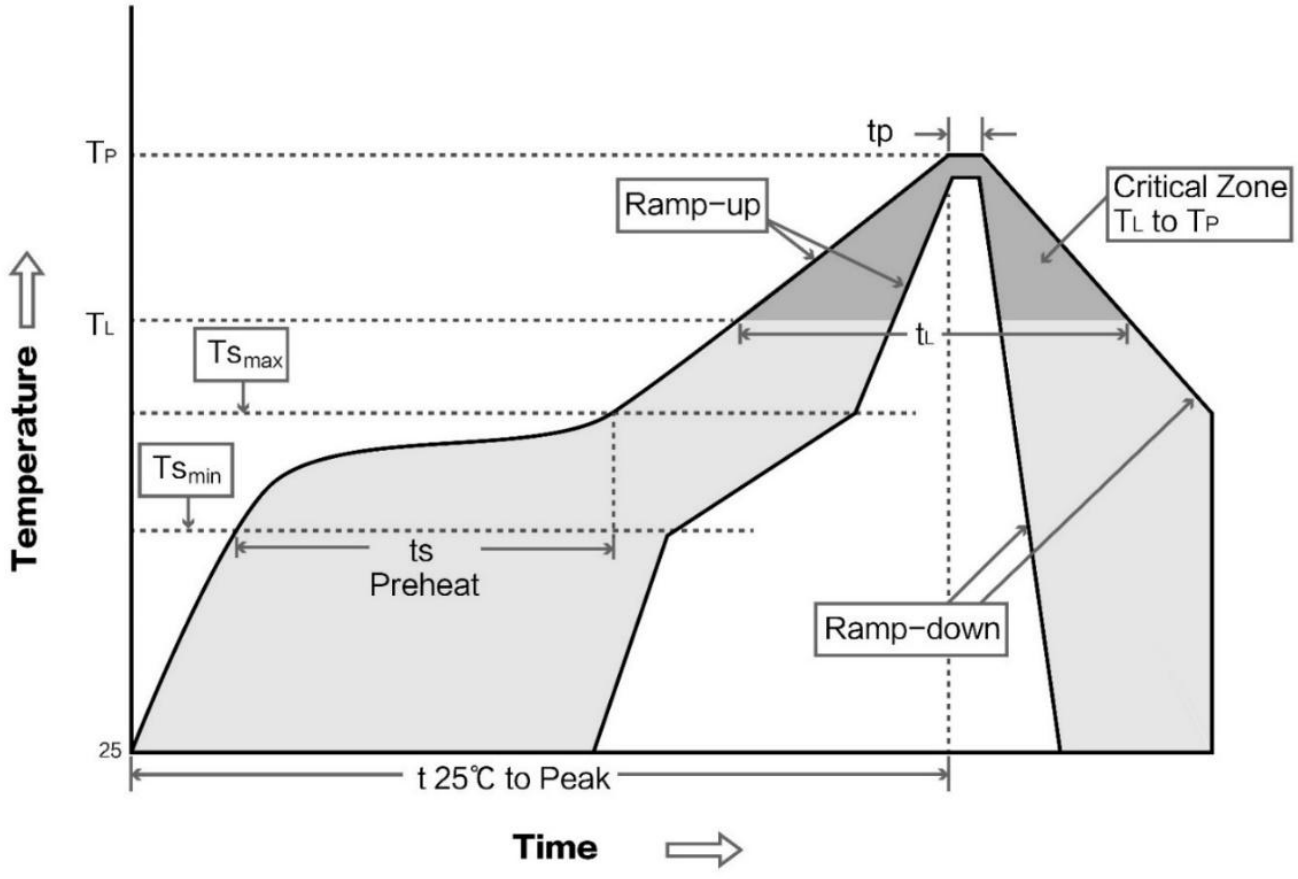
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7 Production Guidance

7.1 Reflow Soldering Temperature

Profile Feature	Curve characteristics	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Solder paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min （Tsmin）	Min preheating temp.	100℃	150℃
Preheat temperature max (Tsmax)	Max preheating temp.	150℃	200℃
Preheat Time (Tsmin to Tsmax)(ts)	Preheating time	60-120 sec	60-120 sec
Average ramp-up rate(Tsmax to Tp)	Average ramp-up rate	3℃/second max	3℃/second max
Liquidous Temperature (TL)	Liquid phase temp.	183℃	217℃
Time（tL）Maintained Above（TL）	Time below liquid phase line	60-90 sec	30-90 sec
Peak temperature（Tp）	Peak temp.	220-235℃	230-250℃
Average ramp-down rate（Tp to Tsmax）	Average ramp-down rate	6℃/second max	6℃/second max
Time 25℃ to peak temperature	Time to peak temperature for 25℃	6 minutes max	8 minutes max

7.2 Reflow Soldering Curve



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8 E220 Series

Model No.	Core IC	Frequency Hz	Tx power dBm	Distance km	Package	Size mm	Interface
E22-400M22S	SX1268	433M/470M	22	5.0	SMD	14*20	SPI
E22-900M22S	SX1262	868M/915M	22	5.5	SMD	14*20	SPI
E220-400M22S	LLCC68	433M/470M	22	5.5	SMD	14*20	SPI
E220-900M22S	LLCC68	868M/915M	22	5.5	SMD	14*20	SPI
E32-400M20S	SX1278	410M/493M	20	5.0	SMD	14*20	SPI
E32-900M20S	SX1276	850M/931M	20	5.0	SMD	17.6*25.2	SPI

9 Antenna Recommendation

9.1 Recommendation

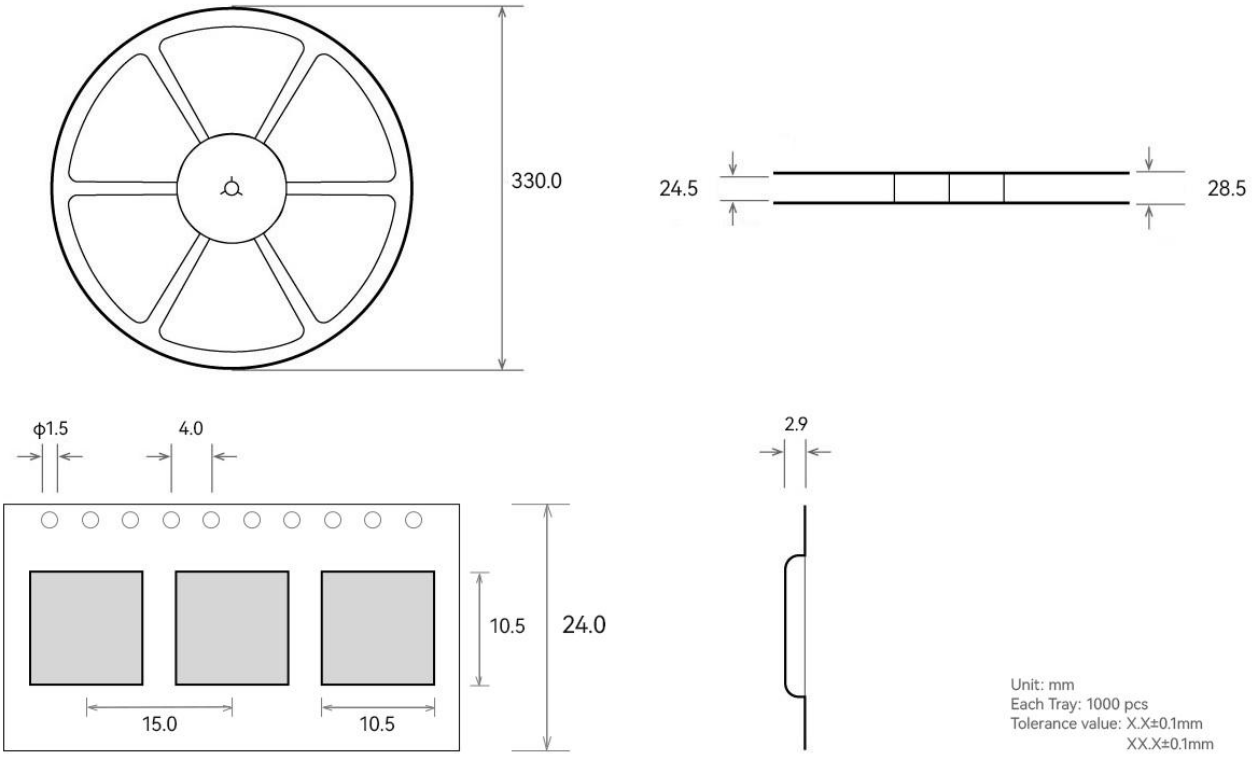
The antenna is an important role in the communication process. A good antenna can largely improve the communication system. Therefore, we recommend some antennas for wireless modules with excellent performance and reasonable price.

Model No.	Type	Frequency Hz	Interface	Gain dBi	Height	Cable	Function Feature
TX433-NP-4310	Flexible pcb antenna	433M	SMA-J	2	43.8*9.5mm	-	Built-in flexible, FPC soft antenna
TX433-JW-5	Rubber antenna	433M	SMA-J	2	50mm	-	Flexible &omnidirectional
TX433-JWG-7	Rubber antenna	433M	SMA-J	2.5	75mm	-	Flexible &omnidirectional
TX433-JK-20	Rubber antenna	433M	SMA-J	3	210mm	-	Flexible &omnidirectional
TX433-JK-11	Rubber antenna	433M	SMA-J	2.5	110mm	-	Flexible &omnidirectional
TX433-XP-200	Sucker antenna	433M	SMA-J	4	19cm	200cm	Sucker antenna, high gain
TX433-XP-100	Sucker antenna	433M	SMA-J	3.5	18.5cm	100cm	Sucker antenna, high gain
TX433-XPH-300	Sucker antenna	433M	SMA-J	6	96.5cm	300cm	Vehicle suction cup antenna, super high gain
TX433-JZG-6	Rubber antenna	433M	SMA-J	2.5	52mm	-	Short straight &omnidirectional
TX433-JZ-5	Rubber antenna	433M	SMA-J	2	52mm	-	Short straight &omnidirectional
TX490-XP-100	Sucker antenna	490M	SMA-J	50	12cm	100cm	Sucker antenna, high gain
TX490-JZ-5	Rubber antenna	490M	SMA-J	50	50mm	-	Short straight &omnidirectional

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10 Package For Batch Order



Revision History

Version	Date	Description	Issued By
1.0	2022-8-20	Initial version	Huang
1.1	2022-8-29	Content update	Hao
1.2	2023-5-12	Correct the recommended line diagram	Hao
1.3	2023-10-30	Content correction	Hao

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