LLCC68SXXXX0M1 wireless module

Hardware Specifications

V1.0

Content

1. Overview

LLCC68SXXXX0M1 series wireless modules, based on SEMTECH's LLCC68 high-performance wireless transceiver chip design, are ultra-long-distance two-way wireless transceiver modules with built-in power amplifier (PA) and low noise amplifier (LNA) .

The LLCC68 sub - GHz wireless transceiver is ideal for long-range wireless applications. This module adds a power amplifier (PA) and a low noise amplifier (LNA) on the basis of the original , so that the maximum transmit power reaches 1W and the receiving sensitivity is further improved. The overall communication distance and stability are compared with ordinary power modules . raised dramatically. The module can support LoRa modulation for LPWAN use cases and (G)FSK modulation for traditional use cases, and has highly configurable parameters to meet different application requirements in the industrial market. The wireless transceiver supports continuous frequency coverage from 150 MHz to 960 MHz, allowing support for all major sub - GHz ISM bands worldwide.

The module integrates all RF-related functions and devices. Users can use this module to easily develop wireless solutions and wireless IoT devices with stable performance and high reliability without having an in-depth understanding of RF circuit design.

Features:

- Supports LoRa and FSK modems
- Built-in power amplifier (PA), maximum 1W transmit power
- Built-in low noise amplifier (LNA), high receiving sensitivity
- LORA mode is programmable from 1.76 kbps to 62.5 kbps
- Highly integrated and easy to use

Application:

- Supply Chain and Logistics
- building automation
- Smart City
- Industrial remote control
- street light
- medical insurance
- Remote control application

2. Electrical Characteristics

Parameter	Description	Remark
Power Supply	4.5 to 5.5 V	Typically 5.0 V
Frequency Bands	433MHz / 868MHz / 915MHz	The applicable frequency band is determined by the specific hardware module
Output Power	30dBm (1W)	RF chip power output configuration is 12dBm
Crystal frequency	32MHz _	Passive crystal oscillator
Data Rate	0.6kbps ~300Kbps@FSK 1.76kbps ~62.5kbps@LoRa _	Programmable configuration
RF Modulation	LORA, (G) FSK	Recommend LORA
Receive sensitivity	-1 34dBm _	LORA modulation , BW=250K, SF=10
receive bandwidth	4.8kHz~467kHz/FSK 125kHz , 250kHz , 500kHz / LoRa ____	Programmable configuration
TX Current	600mA	Transmit power 1W
RX Current	18 mA	
sleep Current	< 5 uA	
driver interface	SPI	Standard 4-wire SPI, SPI clock: <=10MHz CPOL = 0, CPHA = 0
Antenna impedance	50Ω	
Antenna connection method	Stamp Hole / IPEX Holder	Generation IPEX seat
storage temperature	-55 ℃~ + 125 ℃	
Operating temperature	-40℃~ + 85℃	Industrial grade
Size	29.9 x 20.5mm _	

3. Pin Diagram

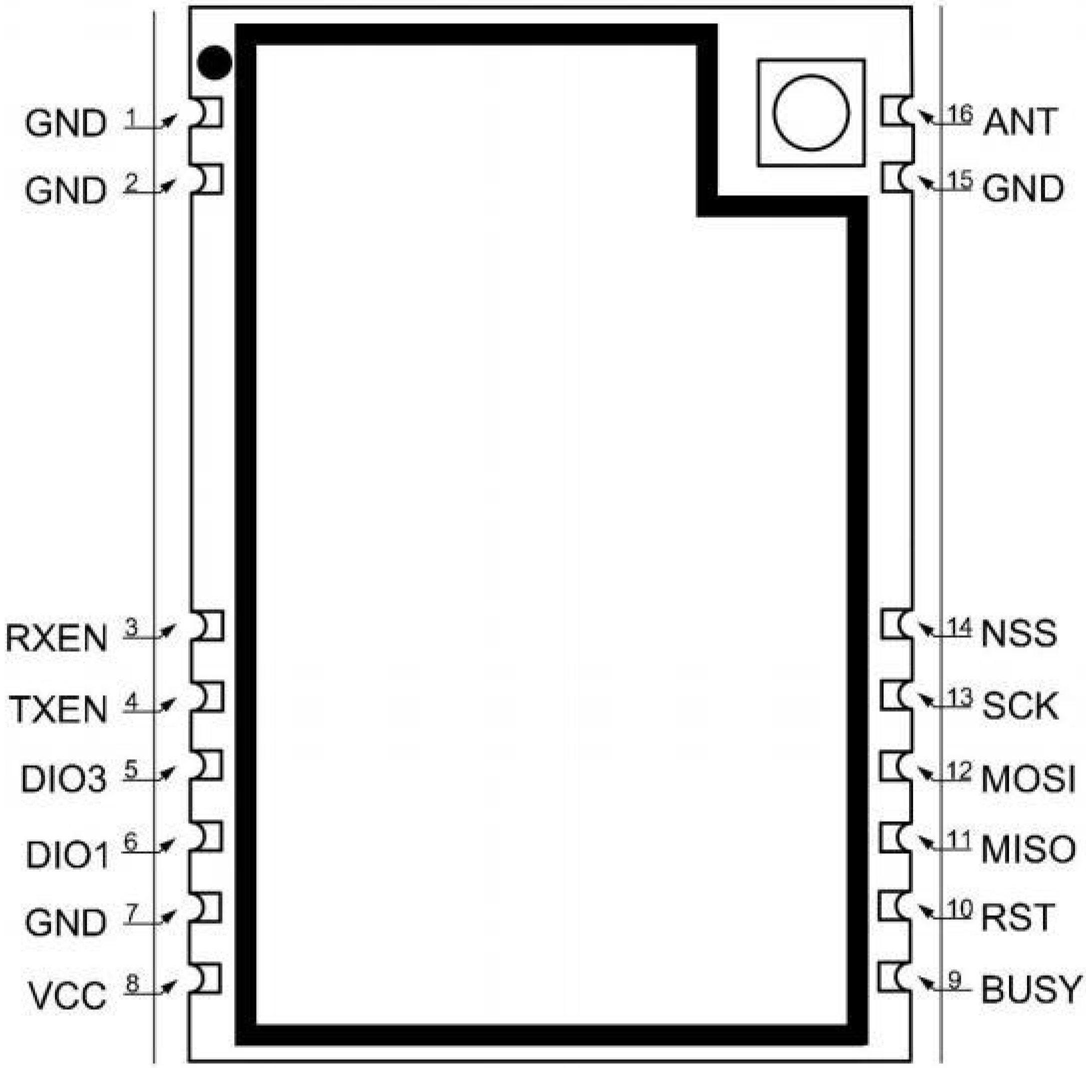


Figure 1-1 Top view

4. Pin Description

number	Name	Type	Description
1	GND	power supply	land
2	GND	power supply	land
3	RXEN	I	Module LNA amplifier work control pin, the level control logic is RXEN =1, TXEN =0 when receiving; RXEN =0, TXEN =0 during sleep
4	TXEN	I	Module PA amplifier work control pin, the level control logic is TXEN =1, RXEN =0; TXEN =0, RXEN =0 during sleep
5	DIO3	I /O	Directly connected to the chip DIO3 digital I/O pin, software configurable function
6	DIO1	I /O	Directly connected to the chip DIO1 digital I/O pin, software configurable function
7	GND	power supply	land
8	VCC	power supply	Positive power supply
9	BUSY	O	Chip working status indication, busy status indication
10	RST	I	Reset signal, active low
11	MISO	O	SPI interface MISO data output
12	MOSI	I	SPI interface MOSI data input
13	SCK	I	SPI interface clock input
14	NSS	I	SPI interface SPI chip select
15	GND	power supply	land
16	ANT	I/O	RF signal input/output, connect to 50Ω antenna, you can choose to use IPEX socket for external antenna or stamp hole for external connection

5. Hardware design guide

5.1. Application circuit

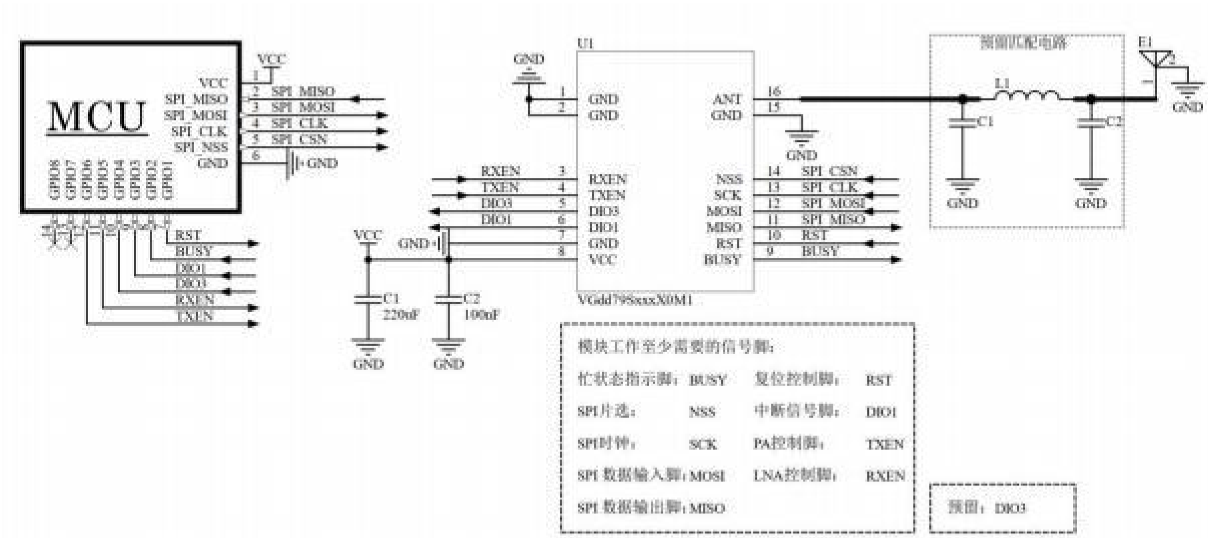


Figure 5-1 Programming development hardware connection

5.2. Power supply design

1. Please pay attention to the correct connection of the positive and negative poles of the power supply, and ensure that the power supply voltage is within the recommended power supply voltage range. If it exceeds the maximum allowable power supply range of the module, the module will be permanently damaged; the decoupling capacitor of the module power supply pin should be as close as possible to the module power supply pin . .

2. In the power supply system of the module, the excessive ripple may be coupled to the line that is easily interfered by the wire or the ground plane, such as the sensitive signal line such as the antenna, feeder, clock line, etc., which may easily cause the radio frequency performance of the module to deteriorate, so We recommend using an LDO or linear regulator as the power supply for the wireless module.

3. When choosing LDO or linear voltage regulator chip, it is necessary to pay attention to the heat dissipation of the power supply and the driving ability of the stable output current of the power supply; considering the long-term stable operation of the whole machine, it is recommended to reserve more than 50% of the current output margin.

4. It is best to use a single LDO or linear voltage regulator for power supply to the module; if a DC-DC power supply chip is used, an LDO or linear voltage regulator can be added later as the isolation of the module power supply to prevent the noise of the switching power supply chip from interfering with the radio frequency. work performance.

5. If the communication line between the MCU and the module uses a 5V level, a 1K-5.1K resistor must be connected in series (not recommended, there is still a risk of damage) .

6. The RF module should be kept away from high-voltage devices as far as possible, because the electromagnetic waves of high-voltage devices will also have a certain impact on the RF signal.

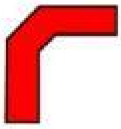
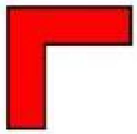
7. High-frequency digital wiring, high-frequency analog wiring, and high-current power supply wiring should be avoided under the module as much as possible. If it is necessary to pass under the module, the wiring should be placed on another layer of the PCB bottom plate where the module is placed, and ensure that the module is under the module. The copper is well grounded.

8. This module is a high-power radio frequency power device, and the current consumption is relatively large during the maximum power transmission. In order to ensure its high-power transmission drive performance, it is necessary to ensure the stability of the power supply voltage of the module power pins and the current flow of the power traces of the PCB backplane In addition, when the module transmits, the antenna will generate a strong electromagnetic field. In order to reduce the electromagnetic interference to the sensitive devices such as the MCU on the baseboard, the RF module and the antenna should be kept away from the sensitive devices on the baseboard as far as possible.

5.3 . Antenna design and guidance

5.3.1 Guidelies for bends in RF lines and RF trace

the RF output interface of the module is selected in the form of a stamp hole , a 50ohm characteristic impedance trace is used to connect the antenna on the backplane PCB during design. Considering the attenuation of high-frequency signals, it should be noted that the length of the RF traces on the backplane PCB should be as short as possible. It is recommended that the longest trace length should not exceed 20 mm , and the trace width should be kept continuous. When turning, try not to take acute or right angles. , it is recommended to take a circular arc.

The first recommended way of turning the RF traces	
Second, the recommended way of turning the RF traces	
Bad way of turning RF traces , not recommended	

In order to ensure that the RF trace impedance of the backplane is 50 ohms, the following parameters can be adjusted according to different board thicknesses. The following simulation values are for reference only.

RF traces use 20mil line width	thickness is 1.0mm , the spacing between ground copper and traces is 5.3mil
	thickness is 1.2mm , the spacing between ground copper and traces is 5.1mil
	the board thickness is 1.6mm , the distance between ground copper and trace is 5mil
RF traces use 25mil line width	thickness is 1.0mm , the distance between ground copper and trace is 6.3mil
	the board thickness is 1.2mm , the distance between ground copper and trace is 6mil
	thickness is 1.6mm , the distance between ground copper and trace is 5.7mil
RF traces use 30mil line width	thickness is 1.0mm , the distance between ground copper and trace is 7.6mil
	thickness is 1.2mm , the distance between ground copper and trace is 7.1mil

	thickness is 1.6mm , the distance between ground copper and trace is 6.6mil

5.3.2 Internal Antenna

The built-in antenna refers to the antenna soldered on the PCB bottom plate and placed inside the product shell, including chip ceramic antenna, spring antenna, etc. When using the built-in antenna, the structure of the product and the installation position of the antenna have a great influence on the RF performance. On the premise that the structure space of the product shell is sufficient, the spring antenna should be placed vertically upward as much as possible; Or the circuit board below the antenna can be hollowed out, because the metal has a very strong ability to absorb and shield RF signals, which will seriously affect the communication distance. In addition, the antenna should be placed on the edge of the bottom plate as much as possible.

5.3.3 External Antenna

External antenna refers to the antenna that the module is installed on the outside of the product casing through IPEX extension cable, SMA and other standard RF interfaces, including rod antenna, suction cup antenna, fiberglass antenna, etc. The external antenna is basically a standard product. In order to better choose an antenna suitable for the module, in the process of antenna selection, the parameters of the antenna should be selected as follows:

1. The working frequency of the antenna should be consistent with the working frequency of the corresponding module.

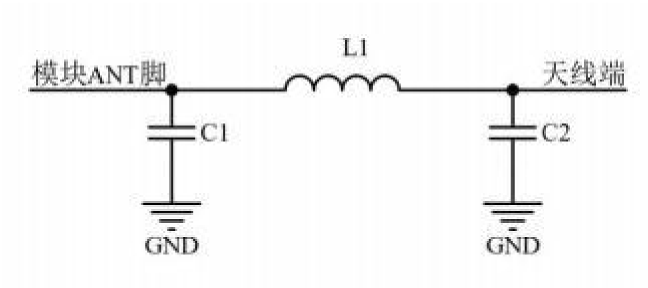
2. The input characteristic impedance of the antenna should be 50ohm.

3. The interface size of the antenna should match the size of the antenna interface of the module.

4. The standing wave ratio (VSWR) of the antenna is recommended to be less than 2, and the antenna should have a suitable frequency bandwidth (covering the frequency points used in the actual application of specific products) .

5.3.4 Antenna matching

The antenna is critical to the transmission distance of the RF module. In practical applications, in order to facilitate the user's later antenna matching adjustment. It is recommended that users reserve a simple π-type matching circuit between the antenna and the ANT pin output of the module when designing the schematic diagram. If the antenna is already a standard 50Ω, the component L1 is attached with a 0R resistor, and the components C1 and C2 do not need to be soldered. Otherwise, you need to use a network analyzer to measure the actual impedance of the antenna and perform matching to determine the values of C1, L1, and C2. The trace from the ANT pin of the module to the antenna end should be as short as possible. It is recommended that the longest trace length should not exceed 20 mm .



5-2 π-type matching circuit

6. Programming development

1) The DIO2 pin of the RF chip has been used for the RF signal switch control driver inside the module. When programming the driver software, it is necessary to set the working state of DIO2, just call the function SetDio2AsRfSwitchCtrl (...). During normal operation, the radio frequency chip will automatically switch the output signal of DIO2 according to the wireless working mode.

```
void SX126xInit( DioIrqHandler dioIrq )
{
    SX126xReset( );
    SX126xWakeup( );
    SX126xSetStandby( STDBY_RC );

#ifdef USE_TCXO
    CalibrationParams_t calibParam;

    SX126xSetDio3AsTcxoCtrl( TCXO_CTRL_1_7V, RADIO_TCXO_SETUP_TIME << 6 );
    calibParam.Value = 0x7F;
    SX126xCalibrate( calibParam );

#endif

    SX126xSetDio2AsRfSwitchCtrl( true );
    OperatingMode = MODE_STDBY_RC;
}
```

2)LLCC68SXXXX0M1 series modules are made based on LLCC 68 chips, and its driver software package is compatible with SX1262\SX1268 series. Attention should be paid to the use range of the receiving bandwidth and the spreading factor of L o Ra modulation. The bandwidth BW and spreading factor SF supported by LLCC68 are listed as follows:

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

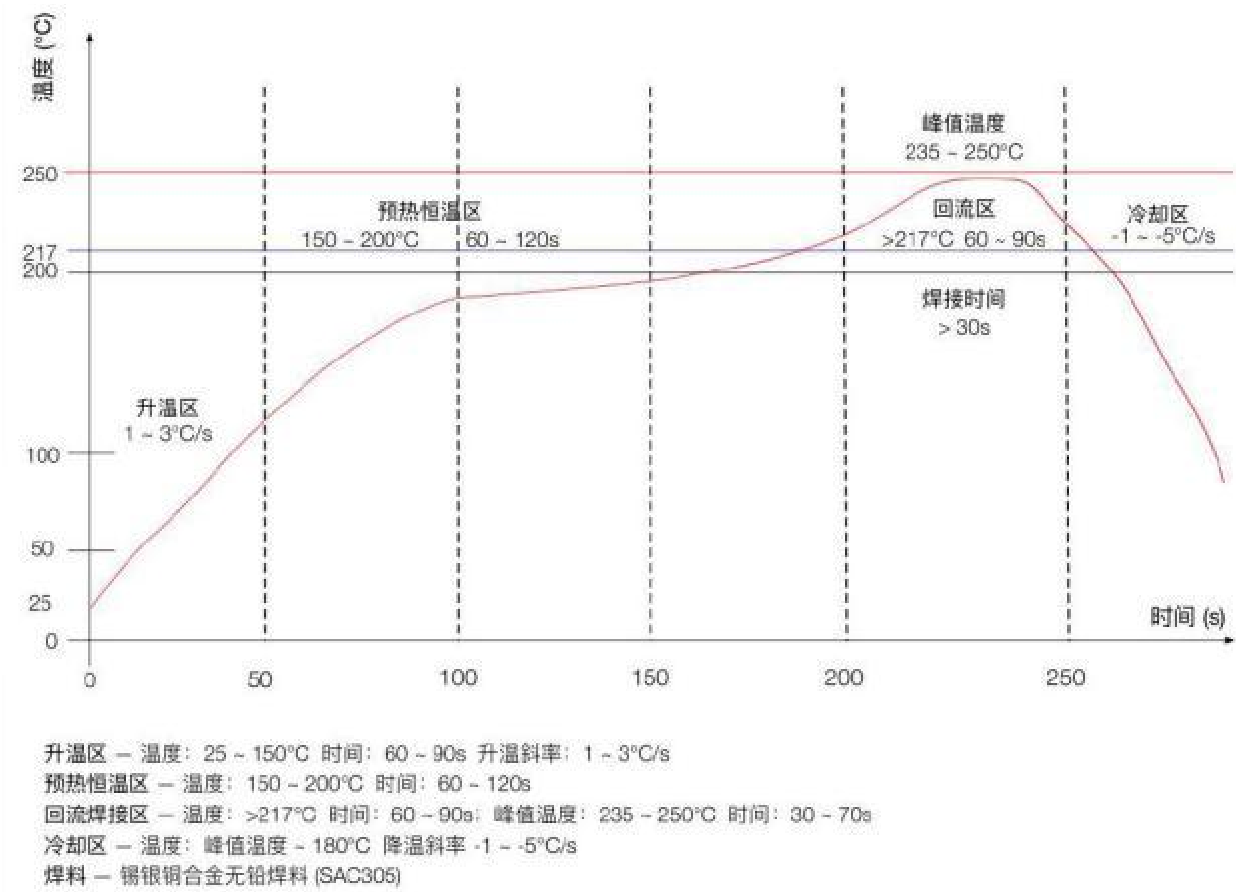
3) Since the PA amplifier is added outside the chip, it is recommended to set the output power of the pre-stage LLCC68 chip to a maximum of 12 dBm to achieve the PA saturation output power of 30 dBm. After the PA reaches the saturation power, its power output will no longer increase with the pre-stage power. If it increases, it will increase the power consumption of the module.

4) Generally speaking, the receiving sensitivity of the RF chip is relatively poor at the integral multiple of the operating frequency of its crystal oscillator . It is recommended that users avoid the mirror frequency of the module crystal oscillator when selecting the operating frequency, that is, the frequency of the crystal oscillator . Integer frequency point, the crystal frequency of this module is 32MHz .

5) The TXEN pin and RXEN pin of the module are the logic control pins of the PA&LNA device inside the control module. Please pay attention to the control level of the TXEN and RXEN pins of the module when using it. Its control logic is listed as follows:

model	TXEN	RXEN
emission	1	0
take over	0	1
hibernate	0	0

7 . Reflow Profile



8. ESD Notice

The RF module is a high-voltage electrostatic sensitive device, in order to prevent damage to the module by static electricity

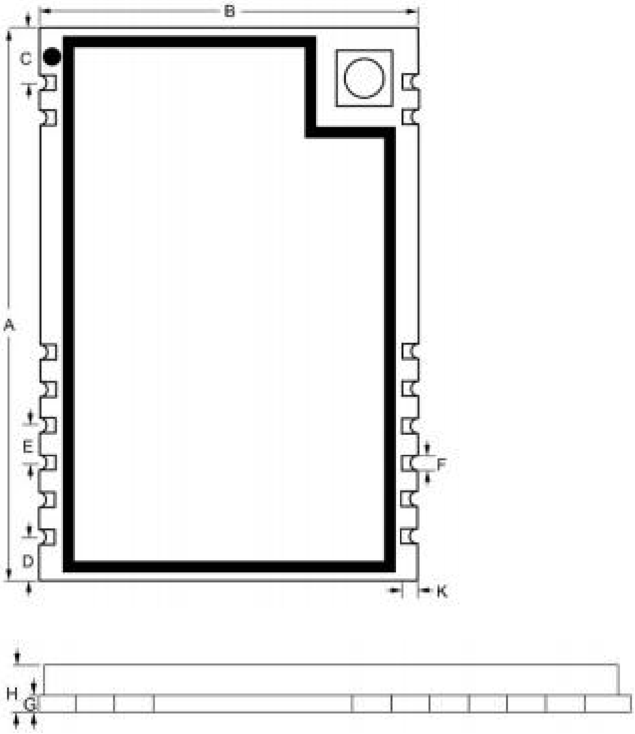
1、 Strictly follow anti-static measures, and do not touch the module with bare hands during production.

2、 Modules should be placed in a placement area that can prevent static electricity.

3、 The anti-static protection circuit at the high voltage input should be considered in product design.

9. Packaging information

Mechanical size（unit:mm）



Numbering	Dimensions (mm)	Error(mm)
A	29.9	±0.5
B	20.5 _	± 0.1
C	3.0	± 0.1
D	2.3	± 0.1
E	2.0 _	± 0.1
F	1.2	± 0.1
K	0.8	± 0.1
G	1.0	± 0.1
H	2.8 _	± 0.2

10. Revision History

Revision	Comment	Date
V1.0 _	Initial release version	December 3, 2021

11. Ordering Information

Index	Part Number	Description
1	LLCC68S433X0M1	433 MHz Band, Tape Packing\Pallet Packing
2	LLCC68S868X0M1	868 MHz Band, Tape Packing\Tray Packing
3	LLCC68S915X0M1	915 MHz Band, Tape Packing\Pallet Packing

12. Statement

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