

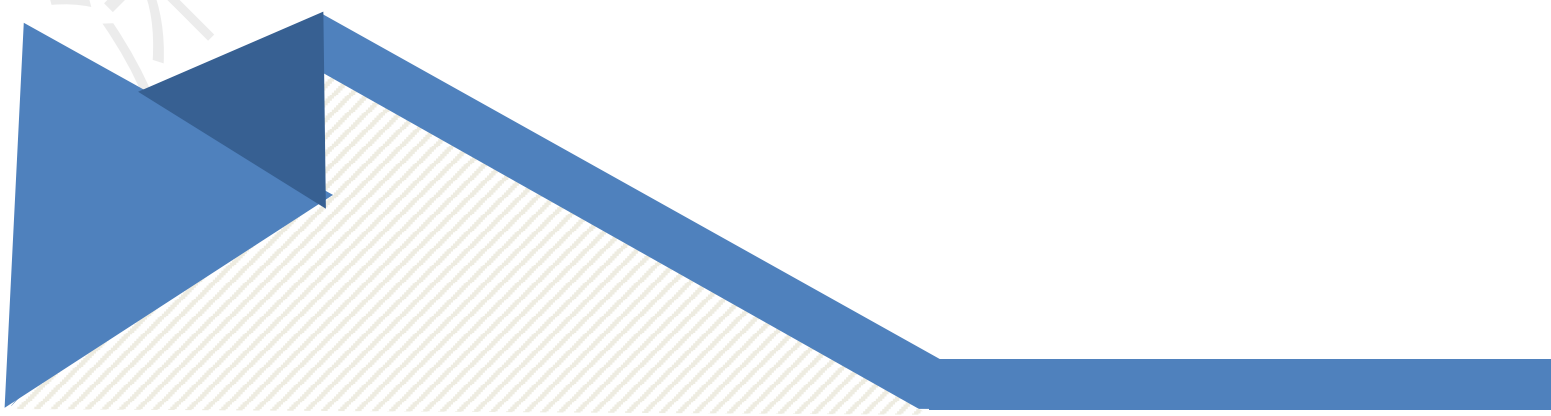


# **DX-LR20-900M22S**

## **Module technical manual**

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## Updated records

Version	Date	Instructions	Author
V1.0	2024/10/18	Initial version	SML
V2.0	2024/11/20	Optimizing RF parameters	SML

## Contact Us

**SHEN ZHEN DX-SMART TECHNOLOGY CO.,LTD,**

Email: [manager@szdx-smart.com](mailto:manager@szdx-smart.com)

Tel: 0755-2997 8125

Whatsapp: +86 15798463070

Website: [en.szdx-smart.com](http://en.szdx-smart.com)

Address: 601, A1 Block, Huafengzhigu, Hang Kong Road, Hang Cheng Street, Baoan District, Shenzhen

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# 1. Module Introduction

## 1.1. Overview

DX-LR20-900M22S is a low-power ultra-long distance LoRa pure RF hardware module, which is built by SHEN ZHEN DX-SMART TECHNOLOGY CO.,LTD,for intelligent wireless data transmission. It is suitable for 868MHz and 915MHz patch LoRa wireless module, and uses industrial-grade 32MHz crystal oscillator. Using LLCC68 chip, anti-interference performance and communication distance are further improved, with the advantages of low power consumption, high performance and long distance.

Since this module is pure RF hardware, it is necessary to use MCU drivers or use specialized SPI debugging tools.

## 1.2. Features

Features:

- Output power: +22dBm
- Maximum receiving sensitivity: -124dBm
- The open visible distance can reach 8km (for reference only, the actual distance is subject to the actual measurement)

Module parameters:

- Working voltage: 1.8V~3.7V (typical value: 3.3V)
- Support working frequency range: 850-930MHz
- External antenna
- Operating temperature: -40~+85 ° C

Note: The current module uses a non-temperature compensated crystal oscillator. When the bandwidth is below 125K, it may cause excessive frequency offset. If the bandwidth is below 125K, please contact our business personnel for customization.

## 1.3. Basic parameters

**Table 1: Table of basic parameters1**

Parameter names	Description	Remarks
Reference distance	8km	Clear open environment, antenna height 3 m, air rate 244bit/s
FIFO	256Byte	Maximum length for a single send
Crystal frequency	32MHz	-
Modulation	LoRa	LoRa modulation is recommended
Encapsulation method	Patch type	-
Interface method	Stamp hole	-
Communication interface	SPI	0~10Mbps
Dimensions	20.0(L) x 14.0 (W) x 2.3(H) mm	Shield hood included
Rf interface	Stamp hole /IPEX	-

## 1.4. Working parameters

**Table 2: Work Parameter Sheet2**

Parameter names	Details			Notes
	Minimum	Typical value	Maximum value	
Operating voltage (V)	1.8	3.3	3.7	≥3.3V ensures output power
Communication level (V)	-	3.3	-	Use a 5V TTL with a risk of burning

Operating temperature (C)	-40	-	85	Industrial grade design
Operating frequency band (MHz)	850	868/915	930	Supports ISM
Power consumption	Transmit current (mA)	-	100	Instantaneous power consumption
	Received current (mA)	-	6.5	-
	Standby current (nA)	-	180	Software turn-off
transmit power (dBm)	0	-	22	-
Receiver sensitivity (dBm)	-	-124	-	BW=125 and SF=7
Air rate LoRa(bps)	-	-	-	User programmed control

## 1.5. Fixed configuration

**Table 3: Fixed Configuration Table 3**

BW (bandwidth)	SF (spread spectrum factor)
BW=125kHz	5-6-7-8-9
BW=250kHz	5-6-7-8-9-10
BW=500kHz	5-6-7-8-9-10-11

### Notes

For example: SF can only be 5-6-7-8-9 when BW is 125KHZ

## 2. Application interface

### 2.1. Module pin definition

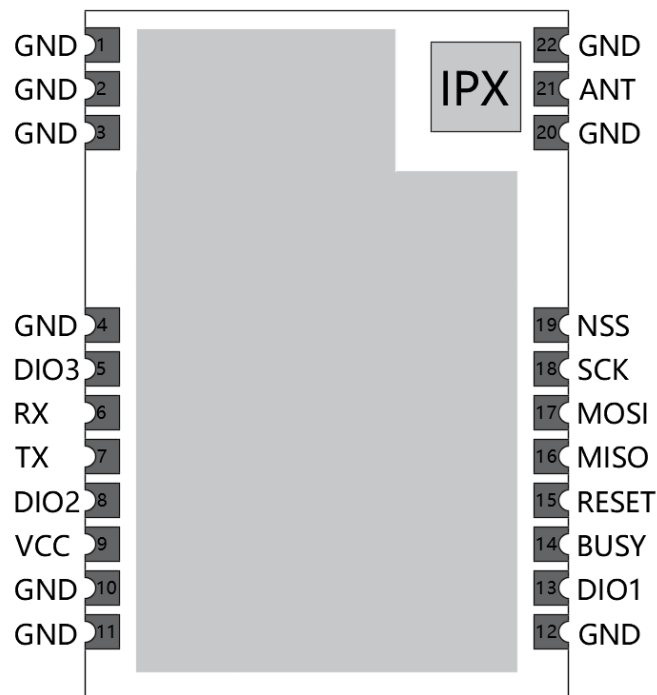


Figure 1: Module pin definition1

### 2.2. Description of the module pin definition

Table 4: Module Pin Definition Description Table 4

Pin serial number	Pin name	Pin function	Instructions
1,2,3,4,10,11,12,20,22	GND	Power ground	-
5	DIO3	Multi-function digital input/output - External TCXO power supply voltage	Input/output
6	RX	Antenna toggle switch	To switch the



			reception
7	TX	Antenna toggle switch	Used to switch transmissions
8	DIO2	Multipurpose digital input/output/RF band switching control	Input/Output
9	VCC	Power input pin	3.3V(typical value)
13	DIO1	Multipurpose digital input/output	Input/output
14	BUSY	Used for status indication	-
15	RESET	Reset foot	-
16	MISO	SPI data output pin	-
17	MOSI	SPI data input pin	-
18	SCK	SPI clock input pin	-
19	NSS	Module pieces select pins for starting an SPI communication	-
21	ANT	Rf interface	-

### 2.3. Reference Basic circuit

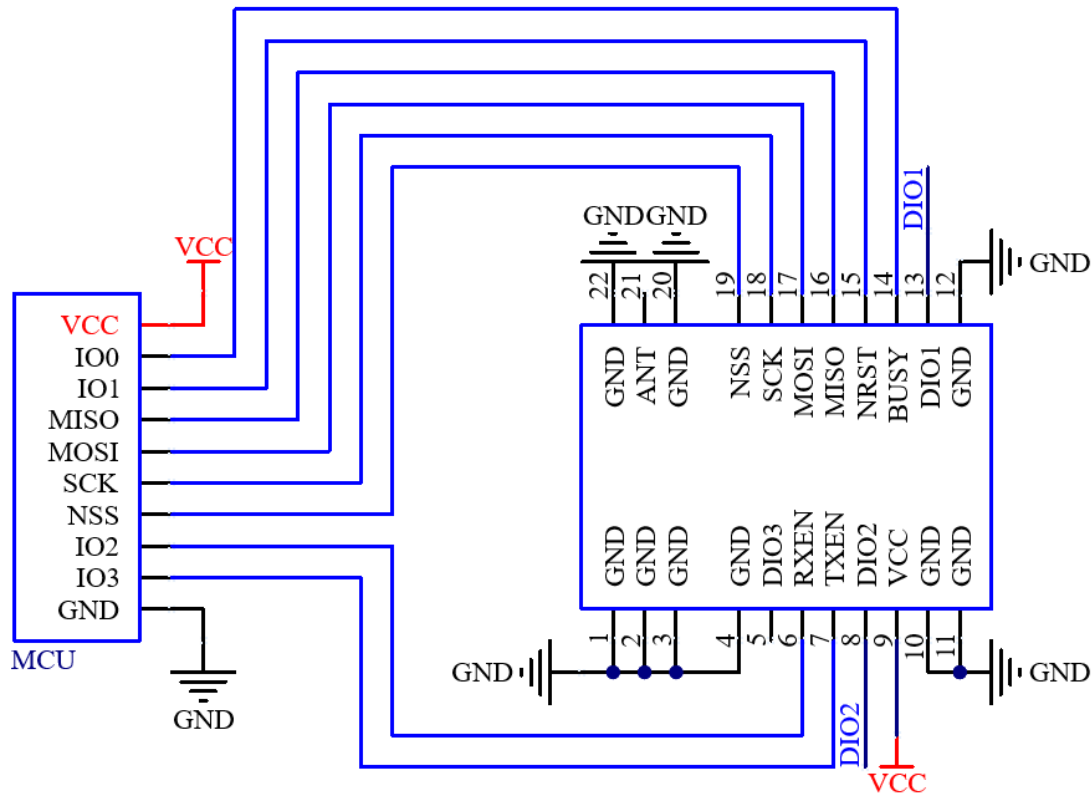


Figure 2: Basic circuit2

## 3. Electrical characteristics, RF characteristics, and reliability

### 3.1. Maximum rating

Pressure in excess of the absolute maximum rating may cause permanent damage to the equipment. These are stress ratings only and therefore do not imply functional operation of the equipment under these or any other conditions beyond those indicated in the operating section of the instruction manual. Prolonged exposure to absolute maximum rating conditions may affect the reliability of the equipment.

**Table 5: Absolute Maximum Rating Table5**

Parameters	Minimum	Maximum	Units
VCC	-0.5	3.7	V
Storage temperature range	-55	+125	°C

**Table 6: Recommended conditions of use6**

Parameters	Minimum	Typical value	Maximum value	Units
VCC	1.8	3.3	3.7	V
Operating temperature range (TA)	-40	-	+85	°C

### 3.2. Static protection

In the application of modules, due to the static electricity generated by human body static electricity and charged friction between microelectronics, it may cause some damage to the module through various ways, so ESD protection should be paid attention to. ESD protection measures should be taken in the process of research and development, production, assembly and testing, especially in product design. For example, at the interface of the circuit design and the point susceptible to electrostatic discharge damage or influence, anti-static protection should be increased, and anti-static gloves should be worn in production.

**Table 7: Table of ESD tolerant voltage of module pins7**

Symbol	Description	Max	Units
ESD_HBM	American National Institute for Standardization/Electronic Systems Design Association/Associated Electronic Equipment Manufacturing Chamber of Commerce Standard JS-001-2014 (mannequins) Category 2	+2	kV
ESD_CDM	ESD charging device model, JEDEC standard JESD22-C101D, three levels	+1	kV

## 4. Basic operations

### 4.1. Hardware design

- It is recommended to use DC regulated power supply to power the module, and the power ripple coefficient should be as small as possible, and the module should be reliably grounded.
- Please pay attention to the correct connection of the positive and negative poles of the power supply, such as reverse connection may lead to permanent damage to the module;
- Please check the power supply to ensure that between the recommended supply voltage, such as more than the maximum value will cause permanent damage to the module;
- Please check the stability of the power supply, the 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, which is conducive to the long-term stable work of the whole machine;
- The module should try to stay away from the power supply, transformer, high-frequency line and other parts of the large electromagnetic interference;
- High-frequency digital wiring, high-frequency analog wiring, power supply wiring must avoid below the module, if it is really necessary to pass below the module, assuming that the module is welded in the Top Layer, the Top Layer of the module contact part of the floor copper (all copper and good grounding), must be close to the digital part of the module and wiring in the Bottom Layer;
- Assuming that the module is solder or placed in the Top Layer, in the Bottom Layer or other layers of random wiring is also wrong, will affect the spurious and receiving sensitivity of the module in different degrees;
- It is assumed that there are large electromagnetic interference devices around the module will also greatly affect the performance of the module, according to the strength of the interference, it is recommended to stay away from the module, if the situation permits, appropriate isolation and shielding can be done;
- It is assumed that there is a large electromagnetic interference around the module (high-frequency digital, high-frequency analog, power supply line) will also greatly affect



the performance of the module, according to the strength of the interference, it is recommended to stay away from the module, if the situation permits, appropriate isolation and shielding can be done;

- If the communication line uses 5V level, it must be connected in series with 1k-5.1k resistance (not recommended, there is still a risk of damage);
- Try to stay away from TTL protocols that have a physical layer of 2.4GHz, such as USB3.0;
- Antenna installation structure has a great impact on the performance of the module, be sure to ensure that the antenna is exposed, preferably vertical. When the module is installed inside the shell, high-quality antenna extension cable can be used to extend the antenna to the outside of the shell;
- The antenna must not be installed inside the metal shell, which will greatly weaken the transmission distance;
- It is recommended to increase the protection resistance of 200R in the RXD/TXD of the external MCU.

## 4.2. Software writing

- This module is LLCC68+ peripheral circuit, users can operate in accordance with LLCC68 chip book;
- DIO1, DIO2, DIO3 are general IO ports, which can be configured into a variety of functions; DIO2 can be connected with TXEN, not with MCU IO port connection, used to control RF switch emission, see LLCC68 manual, if not used can be suspended;
- The differences 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, LLCC68 can set the spreading factor and receiving bandwidth:
    - 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.



## 5. Mechanical dimensions and layout suggestions

This section describes the mechanical dimensions of the module, all dimensions are in millimeters; All dimensions not marked with tolerances with tolerances of  $\pm 0.3$  mm.

### 5.1. Modular mechanical ruler

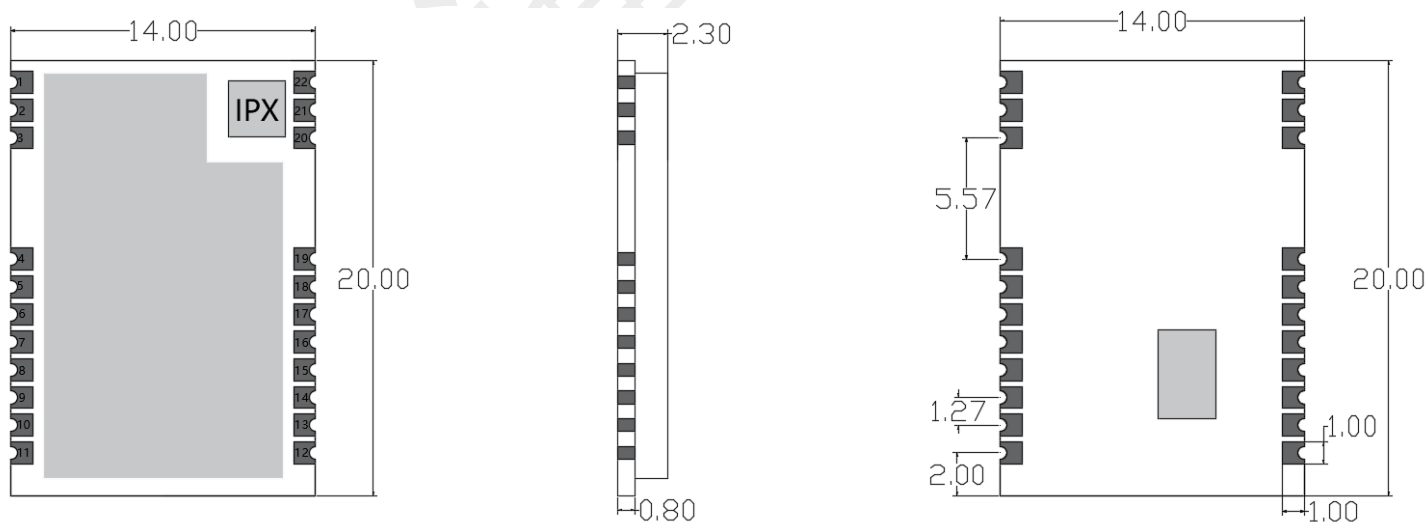
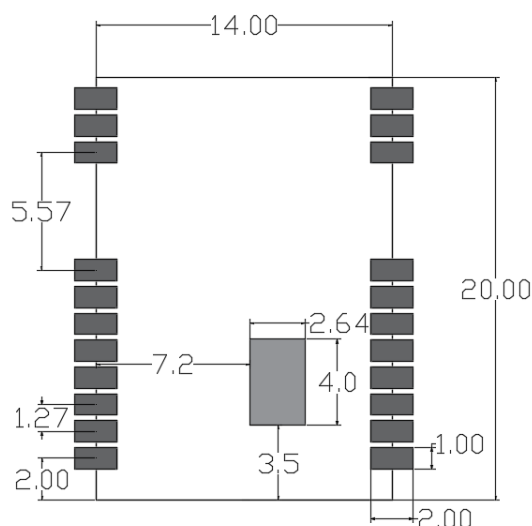


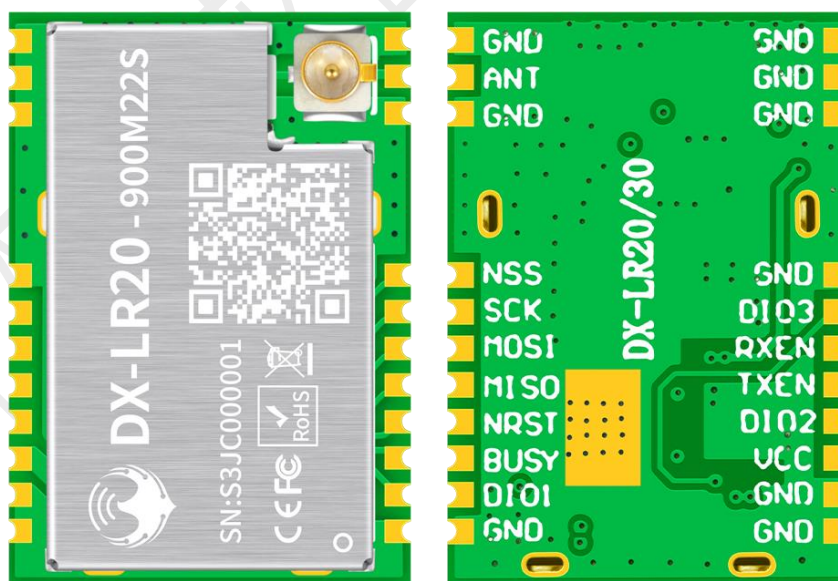
Figure 3: Module size chart for top view, side view and bottom view3

## 5.2. Recommended packaging



**Figure 4: Bottom view of recommended package size**

### 5.3. Module top view/bottom view



**Figure 5: Module top view and bottom view**



## Notes

The above picture is for reference only, please refer to the actual product appearance and label information of the module.

## 5.4. Hardware design layout suggestions

The DX-LR20-900M22S module works in the 850M-930M frequency band and uses an external antenna. The standing Wave ratio (VSWR) and efficiency of the antenna depend on the position of the patch. The influence of various factors on the wireless receiving and transmitting signal should be avoided as much as possible.

1, surrounding the LR20-900M22S product shell to avoid the use of metal, when using part of the metal shell, should try to let the module antenna part away from the metal part. Product internal metal connection wire or metal screws, should be as far away from the module antenna part.

2. The module antenna part should be placed on the edge of the carrier board PCB or directly exposed to the carrier board, try not to be placed in the middle of the board.

3. It is recommended to use insulating materials to isolate the module mounting position on the substrate, such as putting a whole screen print (TopOverLay) at the position.

# 6. Q&A

## 6.1. Transmission distance is not ideal

- When there is a linear communication barrier, the communication distance will attenuate accordingly;
- Temperature, humidity, the same frequency interference, will lead to increased communication packet loss rate;





- The ground absorbs and reflects radio waves, and the test effect is poor near the ground.
- Seawater has a strong ability to absorb radio waves, so the seaside test effect is poor.
- There are metal objects near the antenna, or placed in a metal shell, the signal attenuation will be very serious;
- The power register is set incorrectly, the air rate is set too high (the higher the air rate, the closer the distance);
- The power supply voltage at room temperature is lower than the recommended value, the lower the voltage is, the smaller the transmission power is.
- Poor matching degree between the antenna and the module or the quality of the antenna itself.

## **6.2. Modules are easily damaged**

- Please check the power supply to ensure that between the recommended supply voltage, if exceed the maximum value will cause permanent damage to the module;
- Please check the stability of the power supply, the voltage can not fluctuate greatly and frequently;
- Please ensure the anti-static operation during installation and use, and the electrostatic sensitivity of high-frequency devices;
- Please ensure that the humidity should not be too high during installation and use, some components are humidity sensitive devices;
- If there is no special demand, it is not recommended to use at too high or too low temperature.

## **6.3. Bit error rate is too high**

- Nearby with the same frequency signal interference, away from interference sources or modify the frequency, channel to avoid interference;
- SPI clock waveform is not standard, check whether there is interference on the SPI line, SPI bus line should not be too long;
- Power supply is not ideal may also cause garbled code, be sure to ensure the reliability of the power supply;
- Extension line, feeder quality is poor or too long, will also cause a high error rate.

## 7. Storage, production and packaging

### 7.1. Storage conditions

Modules are shipped in vacuum-sealed bags. The module has a humidity sensitivity class of 3 (MSL 3), and its storage is subject to the following conditions:

1. Recommended storage conditions: temperature  $23\pm 5^{\circ}\text{C}$  and relative humidity of 35~60%.
2. Under the recommended storage conditions, the module can be stored in a vacuum sealed bag for 12 months.
3. The unsealed workshop life of the module is 168 hours under workshop conditions of  $23\pm 5^{\circ}\text{C}$  and relative humidity below 60%. Under these conditions, the module can be directly used for reflux production or other high temperature operation. Otherwise, it is necessary to store the module in an environment with relative humidity less than 10% (for example, a moistureproof cabinet) to keep the module dry.
4. If the module is under the following conditions, it is necessary to pre-bake the module to prevent the PCB foaming, cracking and delamination after the module is wet and damp and then welded at high temperature:
  - Storage temperature and humidity do not meet the recommended storage conditions
  - The module fails to complete production or storage according to Clause 3 above after unpacking
  - Vacuum packaging leakage, materials in bulk
  - Before module repair

### 7.2. Module baking treatment

- It needs to be baked at  $120\pm 5^{\circ}\text{C}$  for 8 hours at high temperature

- The second baked module must be welded within 24 hours after baking, otherwise it still needs to be stored in the drying oven

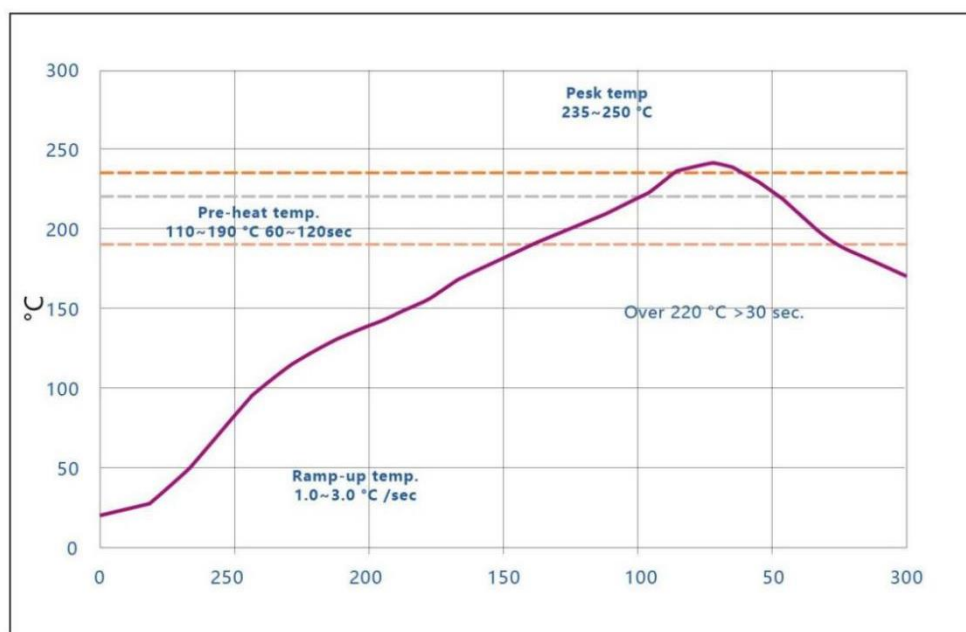
#### Notes

1. In order to prevent and reduce the occurrence of bad welding such as foaming and delimitation caused by moisture, the module should be strictly controlled. It is not recommended to be exposed to the air for a long time after opening the vacuum package.
2. Before baking, it is necessary to remove the module from the package and place the bare module on the high temperature resistant appliance to avoid high temperature damage to the plastic tray or reel; The second baking module must be completed within 24 hours after baking welding, otherwise it needs to be stored in the drying oven. Please pay attention to ESD protection when unpacking and placing the module, for example, wear anti-static gloves.

### 7.3. Reflow soldering

Use a printing scraper to print solder paste on the screen plate, so that the solder paste is leaked to the PCB through the opening of the screen plate, and the printing scraper strength needs to be adjusted appropriately. In order to ensure the quality of the module paste, the thickness of the steel mesh corresponding to the module pad part is recommended to be 0.1~0.15mm.

The recommended reflow soldering temperature is 235~250 °C, and the maximum temperature should not exceed 250 °C. To avoid damage to the module due to repeated heat exposure, it is highly recommended that customers do not attach the module until the first side of the PCB has been reflow soldered. The recommended furnace temperature curve (lead-free SMT reflow soldering) and related parameters are shown in the following chart:



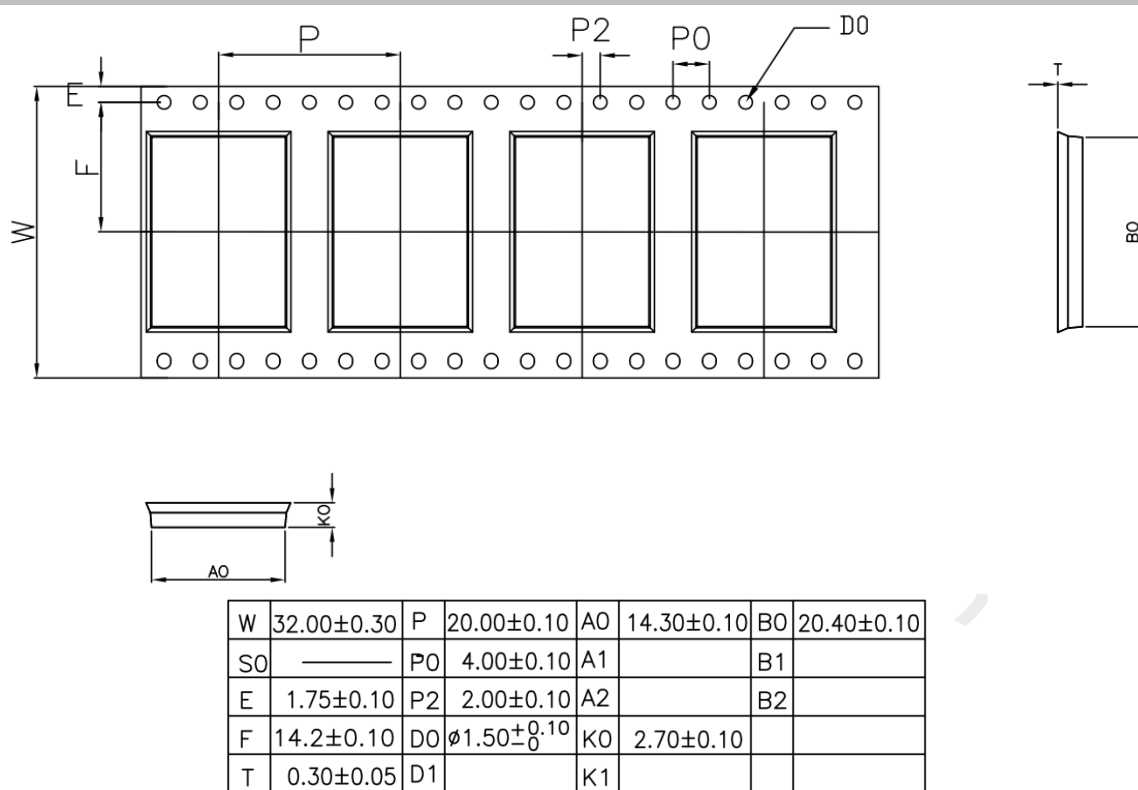
**Figure 6: Recommended reflow soldering temperature curve 6**

**Table 8: Recommended reflow soldering temperature8**

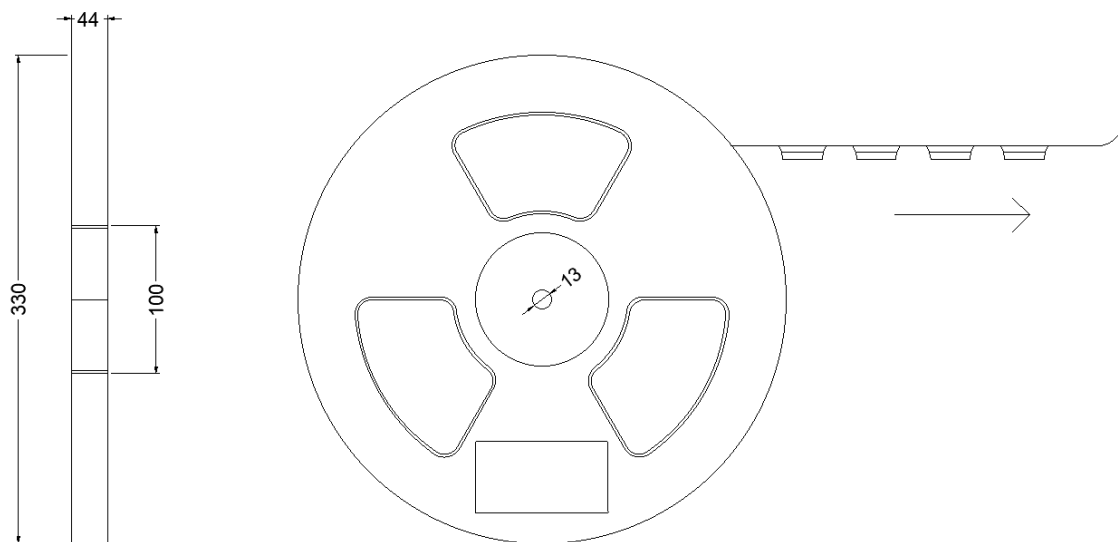
Statistical name	Lower limit	Upper limit	Units
Slope 1 (target =2.0) is between 30.0 and 70.0	1	3	Degrees/SEC
Slope 2 (target =2.0) is between 70.0 and 150.0	1	3	Degrees/SEC
Slope 3 (target =-2.8) is between 220.0 and 150.0	-5	-0.5	Degrees/SEC
Constant temperature time 110-190 ° C	60	120	seconds
@220C reflux time	30	65	seconds
Peak temperature	235	250	Celsius
@235 ° C total time	10	30	seconds

## 7.4. Packing specifications

The DX-LR20-900M22S module is packaged in roll tape and enclosed in a vacuum sealed bag with desiccants and humidity cards. Each carrier is 20.4 meters long, contains 1200 modules, and the reel is 330 mm in diameter. The specifications are as follows:



**Figure 7: Strap size (unit: mm)7**



**Figure 8: Reel size (unit: mm)8**

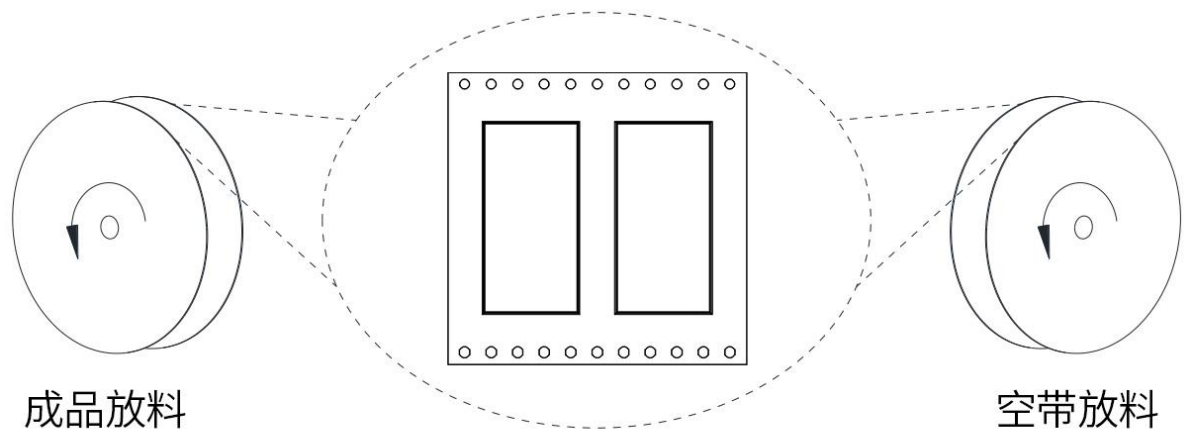


Figure 9: Reel orientation9