DL-A6601PA-B High-power SOC Wireless LoRa Module

Model No.: DL-A6601PA-B

Version: V1.0

433/470MHz
(With Metal Shield)

Before using this module, please pay attention to the following important matters:

This module is an electrostatic sensitive product. Please operate it on an anti-static workbench during installation and testing.

This DL-A6601PA-B module uses an external antenna (with IPEX socket) by default, which is intended to be embedded in your product or application, and does include a metal casing when producing. The antenna can be a wire antenna or a standard UHF antenna. You can choose a specific antenna according to the actual situation.

Metal objects and wires should be kept away from the antenna as much as possible. If the product uses a metal shell, be sure to install the antenna outside the metal shell. Otherwise, the RF signal will be seriously attenuated, which will affect the effective distance.

Disclaimer:

This specification is just for your information, all the charts and pictures used in this specification are for reference only. The actual test shall prevail for details. We do not assume any responsibility for personal injury or property loss caused by user's improper operation.

This specification is subject to change due to the continuous improvement and upgrading of the product version, and the latest version specification shall prevail. DREAMLNK reserves the right of final interpretation and modification of all contents in this specification.

Date	Version	Formulation / Revision of Contents	Approved by
2024-1-17	V1.0	DL-A6601PA-B Standard RF Module	Fagan Xu

1. Module Introduction

1.1 Brief Introduction

This DL-A6601PA-B wireless transceiver module is a high-power RF module based on the ASR6601 chip solution with LoRa modulation, which integrates a 48MHz main frequency Cortex-M4 low-power core. While this ASR6601 SOC chip is an MCU with RF encapsulated, with higher integration than the SPI+MCU solution, but smaller size.

The DL-A6601PA-B module integrates a Power Amplifier internally, with a maximum TX power of 30dbm, which can effectively improve link budget, thereby improving communication quality and distance. This LoRa module is also equipped with temperature compensation crystals, which solve the problem of frequency deviation between communication parties caused by the instantaneous heat generated by PA, or the large temperature difference between high and low environments. At the same time, it can also achieve narrower bandwidth at room temperature, with higher sensitivity and stable communication.

As for the RF characteristic, compared to traditional modulation methods, its LORA modulation can greatly improve the RF performance in all aspects. The RX current is 7mA, and the highest sensitivity can reach up to -148dBm.

This LoRa module fully utilizes the ASR6601 chip’s anti-interference ability, its high sensitivity and low power consumption make this RF module excellent in long-range communication, which can be widely used in various wireless communication fields of the IoT industry, especially battery powered application, and long-distance communication projects.

Moreover, this LoRa module has 24 GPIOs, and the RF circuit of this LoRa module has been matched and optimized by professional equipment, which will guarantee its good performance under high power in such compact size. You can easily develop wireless products with stable performance and high reliability base on this RF module, without having a deep understanding of RF circuit design.

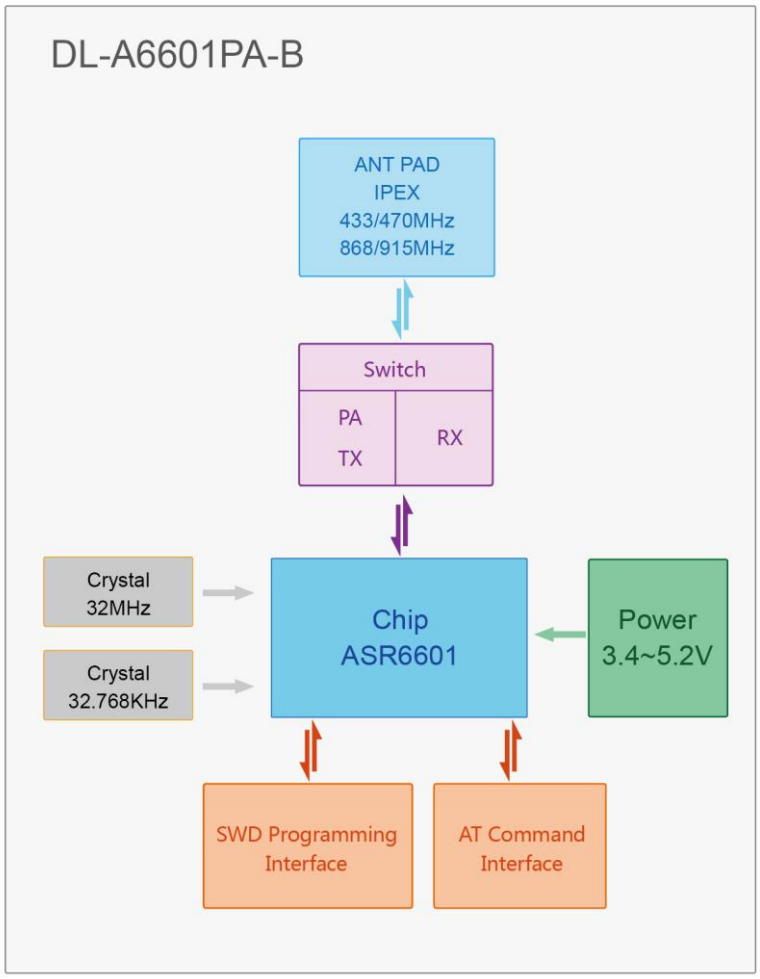
1.2 Secondary Development

Resource	ASR6601CB SRAM 16KB Flash 128 KB Cortex-M4 32bit 48MHz
Peripheral	See Chip datasheet ASR6601_Datasheet_V1.4.0.pdf
Development Environment	GNU toolchains and kits will be used; Keil can be used to compile and download simulations through SWD and serial ports

1.3 Features

- Working Voltage: 3.5~5.3V;
- Frequency Range supported by the Chip: 150~960MHz;
- Operating Frequency Band: 433Mhz/470Mhz (ready to use);
  868MHz/915MHz (need to be customized);
- Highest Sensitivity supported by the Chip: -148dBm;
- Actual Max. Sensitivity of the RF Module: -145dBm;
- Maximum TX Power: +29.5dBm;
- Receiving Current: 7mA (Radio + MCU);
- Sleep Current: 3uA;
- Supported Modulation: LoRa, (G)FSK, programmable control;
- Fast transmission or receiving supported;
- Fast frequency hopping supported;
- Communication Rate of the Chip:
  LoRa: up to 62.5 Kbps
  (G)FSK: up to 300 Kbps
- Bandwidth Range
  LORA: 7.81Khz-500Khz
  (G) FSK: 4.8Khz-467Khz;
- Blocking Suppression: 90db@LORA, BW=125Khz; SF12, F(n)=±2MHz
- Operating temperature: -40~85 C

1.4 Circuit Schematic Diagram



Circuit Schematic Diagram (DL-A6601PA-B)

1.5 Typical Application

- ISM frequency band data communication
- Wireless Automatic Meter Reading (water meter, electric meter, gas meter)
- Smart Home System
- Intelligent Security Monitoring
- Smart Building
- Wireless Remote Control
- Wireless Sensor Network
- Intelligent Parking System
- RKE (Remote Keyless Entry)
- Thermal Energy Collection, Meter Measurement

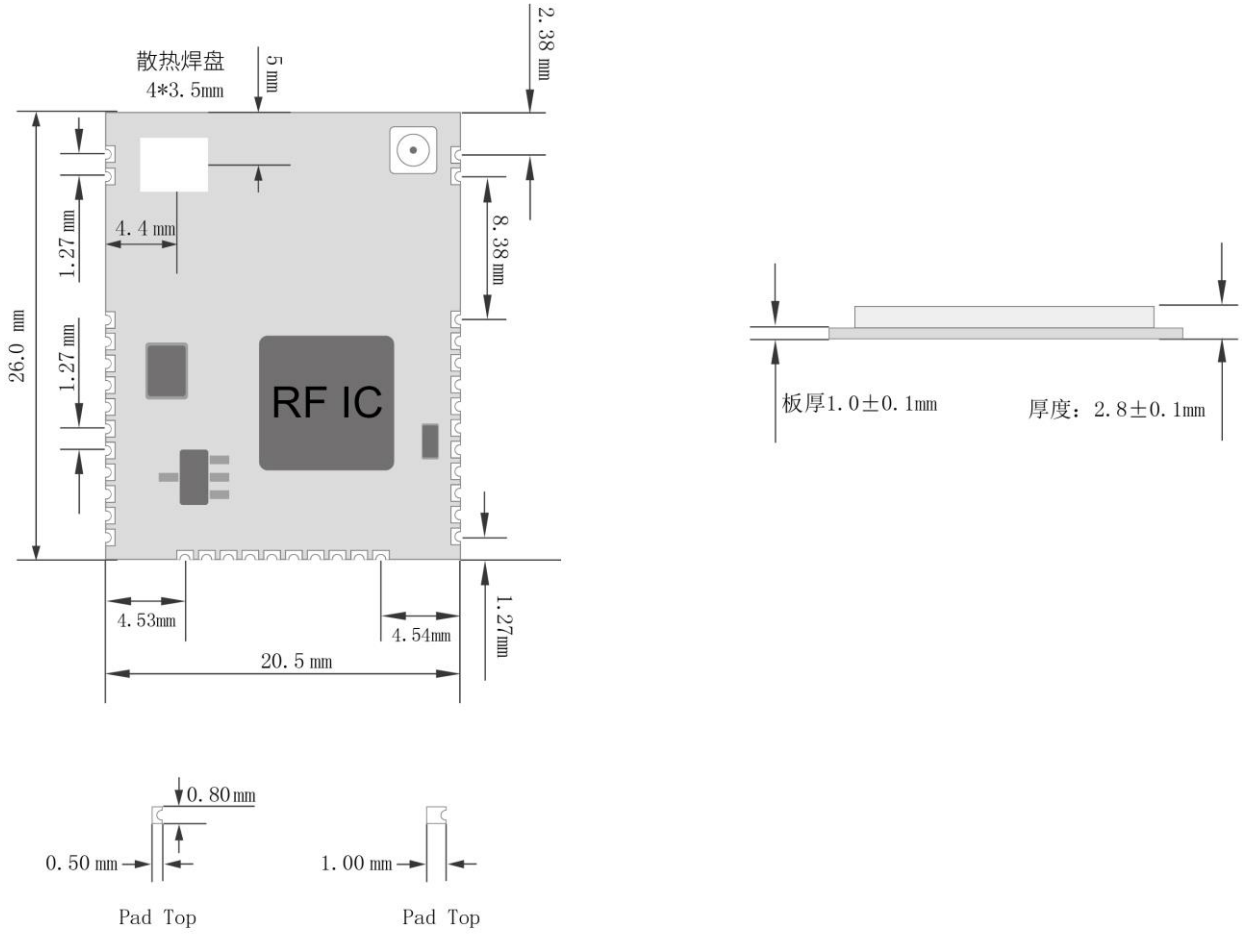
2. Technical Parameter

Parameter	Min.	Typical	Max.	Unit	Remarks
Operating Conditions					
Working Voltage (VDD)	3.4	3.7	5.4	V	The voltage cannot exceed 5.4V, Otherwise, it may burn out the module
Communication Level Range	-0.3	3.3	3.6	V	Exceeding this range will damage the chip
Working Temperature Range	-40	25	85	℃	The larger the temperature difference, the greater the bandwidth required for communication (temperature compensation crystal was equipped)
Current Consumption					
Receiving Current	6	6.6	8	mA	@MCU+Radio DCDC Software adopts WOR working mode, which can effectively reduce the overall working current
Transmission Current	510	578 200	800	mA	@433MHz @DCDC @ANT 50-ohm impedance; TX +29.5dbm @ANT 50-ohm impedance; TX +20dbm
	525	600 230	829	mA	@868MHz @915MHz @DCDC @ANT 50-ohm impedance; TX +29dbm @ANT 50-ohm impedance; TX +20dbm
Max. Current	-	1.2A	-	A	RF transmission is related to many factors, such as power and antenna matching. What we provided are the requirements that need to be met when designing power supplies
Sleep Current	3	3.5	5	uA	Save via register
RF Parameters					
Recommended Frequency (For best performance)	400	433/470	510	MHz	@433MHz/470Mhz RF module
	820	868/915	960	MHz	@868MHz/915Mhz RF module
Transmit Power Range	-10	20	20	dBm	Software configurable
LORA Receiving sensitivity		-143		dBm	@DR= 0.067Kbps, BW_L = 15.6kHz, SF = 11
		-130		dBm	@DR= 1.758Kbps, BW_L= 125KHz, SF=9
		-120		dBm	@DR= 10.94Kbps, BW_L = 250kHz, SF = 7

FSK Receiving sensitivity		-123		dBm	@DR=1.2Kbps, FDA = 0.8 kHz, BW_F= 4 kHz
		-109		dBm	@DR=38.4Kbps, FDA = 40 kHz, BW_F=160kHz
		-104		dBm	@DR=250Kbps, FDA =125 kHz, BW_F=500 kHz
LoRa Payload Rate	0.018	-	62.5	Kb/s	For application with low transmission rate
FSK Rate Range	0.6	-	300	Kb/s	For application with high transmission rate

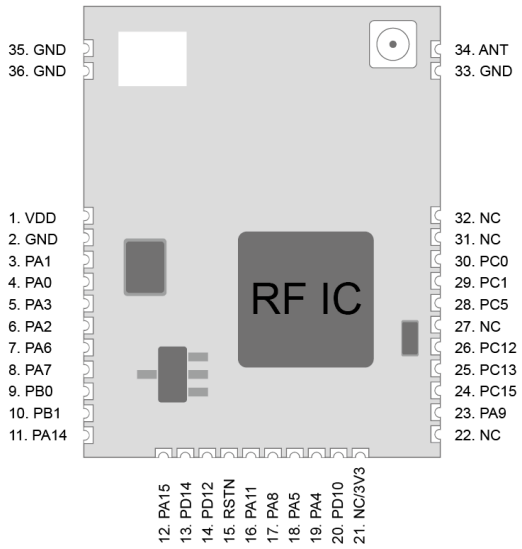
Table 1: Technical Parameter

3. Module Size

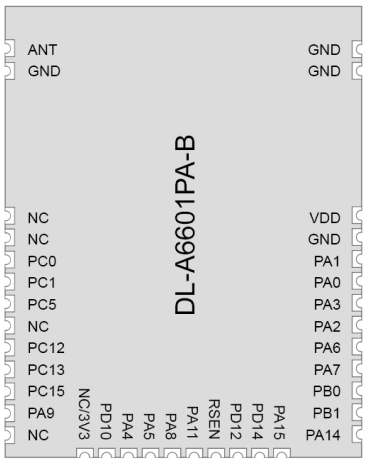


DL-A6601PA-B Dimensions

4. Pin Diagram



Front Side



Back Side

No	Definitions	Type	Description
1	VDD	PWR	Powered by 5.5V-3.4V, and passes through a 3.3V LDO internally
2	GND	PWR	Reliable grounding
3	PA1	IO	Universal GPIO / Serial Port Download; TXD
4	PA0	IO	Universal GPIO / Serial Port Download; RXD
5	PA3	IO	Universal GPIO port
6	PA2	IO	Universal GPIO / Enter serial port for download PA2, power on and pull high to enter download mode
7	PA6	IO	Universal GPIO / SWDAT download and debugging port
8	PA7	IO	Universal GPIO / SWDCLK download and debugging port
9	PB0	IO	Universal GPIO / UART0_RXD
10	PB1	IO	Universal GPIO / UART0_TXD
11	PA14	IO	Universal GPIO port
12	PA15	IO	Universal GPIO port
13	PD14	IO	Universal GPIO port

14	PD12	IO	Universal GPIO port
15	RSTN	I	Reset pin, effective at low level
16	PA11	IO	Universal GPIO port
17	PA8	IO	Universal GPIO port
18	PA5	IO	Universal GPIO port
19	PA4	IO	Universal GPIO port
20	PD10	IO	Universal GPIO port
21	NC/3V3	NC	Internal LDO, 3.3V, normally can be “floating”
22	NC	NC	No connection
23	PA9	IO	Universal GPIO port
24	PC15	IO	Universal GPIO port
25	PC13	IO	Universal GPIO port
26	PC12	IO	Universal GPIO port
27	NC	NC	No connection
28	PC5	IO	Universal GPIO port
29	PC1	IO	Universal GPIO port
30	PC0	IO	Universal GPIO port
31	NC	NC	No connection
32	NC	NC	No connection
33	GND	PWR	Reliable grounding
34	ANT	AI/IO	RF signal input/output port, π-matching circuit must be reserved; Adopt 50Ω impedance matching for RF routing, route the ground and add via holes around it
35	GND	PWR	Reliable grounding
36	GND	PWR	Reliable grounding

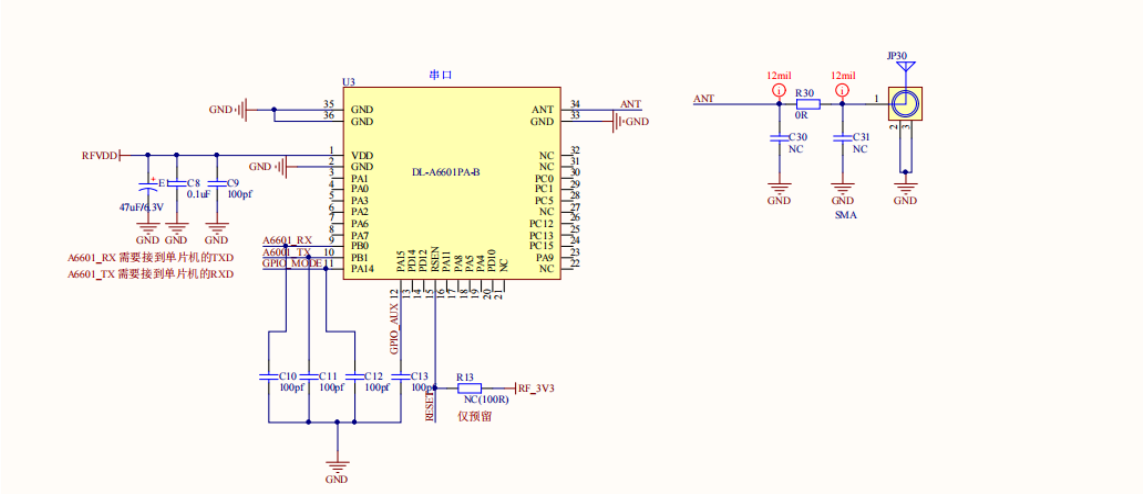
Table 2: Pin Definitions

* Pin reuse can be found in chip data: Not all pin positions support interrupts

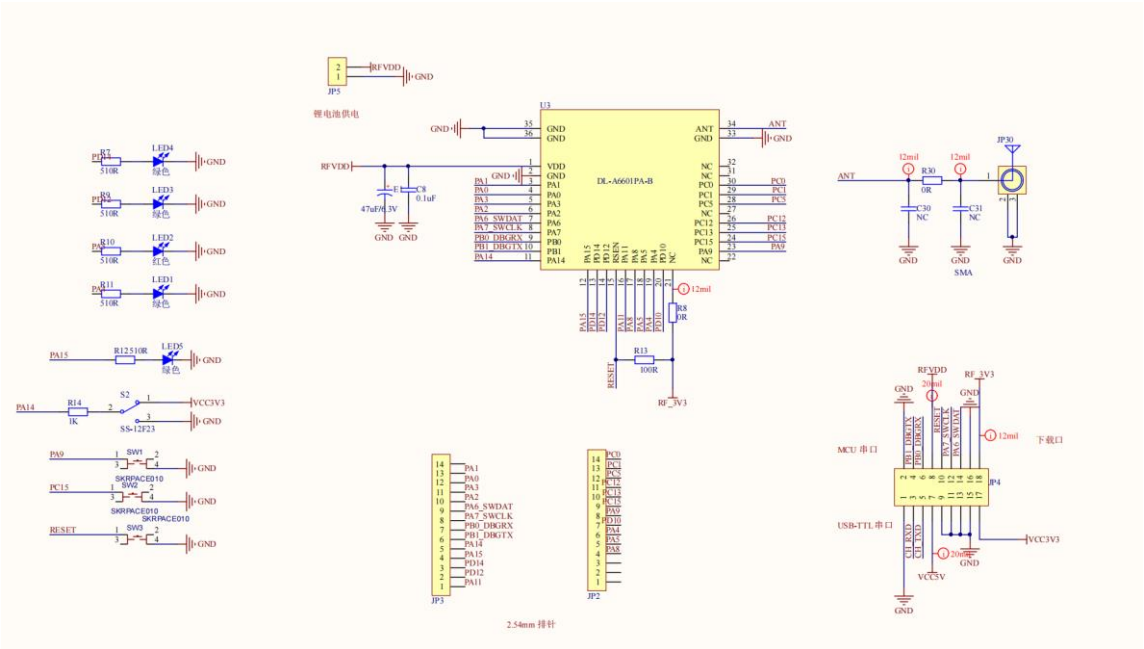
5. Application Connection Diagram

RFVDD is used internally to supply power to PA, while passing through a low-power LDO to supply power to the internal chips of the module. Three capacitors are necessary to decouple and filter out wireless interference, and try to be as close to the module as possible.

Basic Circuit for Serial Port Development



Secondary development circuit (development board)



1). Download Port: SWD Download port (PA6 PA7)

2). Serial Port recommended: PB0_RXD, PB1_TXD

3). When PA2 is turned on as a BOOT, it is at high level and enters serial port download mode

4). Serial port download using PA0-RXD, PA1-TXD

6. Circuit Design

6.1 Power Supply Design

● Please pay attention to the power supply voltage of the device, exceeding the recommended voltage range may cause function abnormally and permanently damage;

● Try to use a DC stabilized power supply, and the power ripple coefficient should be as small as possible; the power load when transmitting the maximum power needs to be also considered;

● The module needs to be reliably grounded, with proper grounding and reduced loops. Especially, the circuits for ANT PIN and GND should be as short as possible to achieve better performance output and reduce the impact of RF on other sensitive devices.

6.2 RF Routing Design

● The module should be far away from RF interference sources, such as high-frequency circuit transformer, and please do not directly route at the lower layer of the RF module. Otherwise, the receiving sensitivity may be affected;

● When using the on-board antenna, the antenna needs to be clear on both sides, and the ground should not be too close to the antenna at the same time, otherwise it will absorb the radiated energy;

● Route 50Ω impedance line, lay the ground and add more via holes around it

● If there is enough space on your PCBA, please reserve a π-type matching circuit, and it needs to be placed as close to the chip end as possible, please make it grounded and add via holes around it. Do remember to connect it through a 0R resistor, otherwise the antenna will open circuit; SMA ANT circular through-hole requires clearance treatment

6.3 Antenna Design

● There are many types of antennas, please choose the appropriate antenna according to your needs;

● Choose a suitable position to place the antenna, according to the antenna polarity. And it is recommended to be vertically upward;

● There should be no metal objects in the antenna radiation path, otherwise the transmission distance will be affected (such as a closed metal casing).

6.4 Wireless interference

For high-power wireless transmission, wireless interference may occur, which may affect the functions of some sensitive circuits, such as amplifiers, ADCs, RESETs, and data pins with low driving force. This situation has a significant impact on high-power transmission at 20dbm and above. The interference mainly comes from the antenna power being amplified and coupled to longer lines or devices through conduction or radiation. Therefore, when making the hardware

design, the signal routing should be as short as possible; when using high power, try to use external antennas as much as possible, stay away from PCB sensitive devices, and add 100pF ground capacitance in sensitive device circuits to filter out high-frequency interference in low-speed signals to reduce wireless interference in other circuits.

7. Development Method

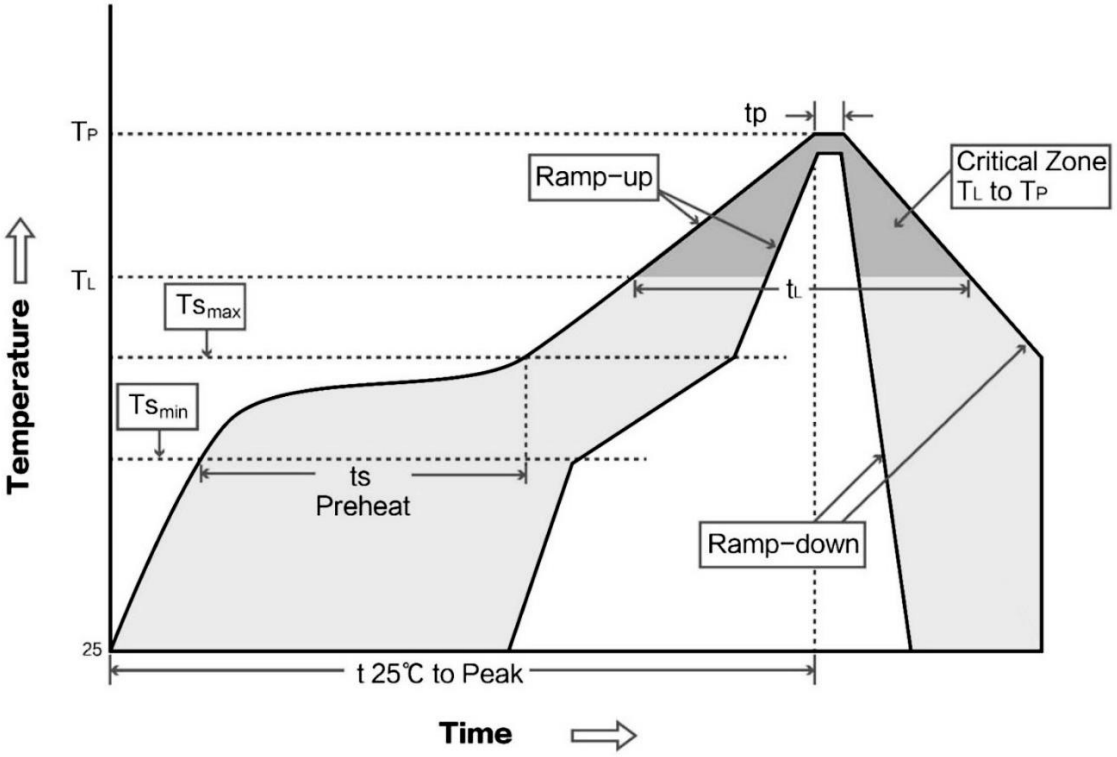
Using private self-organizing network protocols

Developing base on LoRaWAN protocol

Secondary development is supported (please contact us for more secondary development materials)

8. Welding Operation Guidance

8.1 Reflow Soldering Curve Chart



8.2 Reflow Soldering Temperature

IPC/JEDEC J-STD-020B the condition for lead-free reflow soldering	Big size components (thickness ≥ 2.5 mm）
The ramp-up rate (Tl to Tp)	**3℃/s (max.)**
Preheat Temperature	
- Temperature Minimum (Tsmin)	150℃
- Temperature Maximum (Tsmax)	200℃
- Preheat Time (ts)	60~180s
Average ramp-up rate (Tsmax to Tp)	**3℃/s (Max.)**
- Liquidous temperature (TL)	217℃
- Time at liquidous(tL)	60~150 second
Peak Temperature (Tp)	**245+/-5℃**

9. Notice for module application

(1) This module is an electrostatic sensitive product. Please operate on an anti-static workbench during installation and testing;
(2) When installing the module, make sure that nearby objects keep a sufficient safe distance from the module to prevent short-circuit damage;
(3) Liquid substance is not allowed to come into contact with this module, and this module should be used in a dry environment;
(4) Please use an independent voltage stabilizing circuit to supply power to this module, and avoid sharing with other circuits. The tolerance of the power supply should not be less than 5%.
(5) The indicators of this module are accord to commonly used international standard. If special certifications needed, we can adjust certain indicators according to your needs.

10. Contact us

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★ Data collection, Smart home, Internet of Things applications, Wireless remote control technology, Remote active RFID, Antennas ★

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