长沙金维集成电路股份有限公司
CHANGSHA JINWEI INTEGRATED CIRCUIT CO.,LTD.

DM222 Beidou-3 Short Message Communication Module

user's manual

致力于成为以自主芯片为核心竞争力的世界顶级导航定位企业

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Catalogue

1. Product Introduction

1.1. Product Introduction

The DM222 Beidou-3 Short Message Communication Module (hereinafter referred to as "DM222 Module ") is a Beidou-3 short message communication module developed based on the "Dolphin-3" baseband chip independently developed by Jinwei Jidian. It supports regional short message communication for Beidou-3 and is compatible with Beidou-2 RDSS communication functions. The module integrates an LNA, RDSS RF transceiver chip, 5W power amplifier, and dedicated Beidou-3 baseband circuit, with a compact 30mm×35mm size. It features simple application, high integration, small size, and low power consumption. The module is widely applicable to shipboard, vehicle-mounted, handheld, and life-saving terminal products, as well as in fields such as fisheries, forestry, and transportation.

1.2. Product Features

- The system utilizes the high-performance Dolphin III baseband chip independently developed by Jinwei Jidian.
- Capable of processing RDSS signals in China and surrounding areas;
- It features interference suppression for adjacent frequency signals including WIFI, Bluetooth, and 4G.
- Supports both BeiDou-2 short message and BeiDou-3 regional short message communication functions.
- Featuring a built-in LNA and 5W power amplifier, it can be directly connected to a passive antenna.
- The stamp packaging form of SMD.

1.3. Qualification

Table 1 Technical Specifications

Performance index		
RDSS funct-ion	Receiving frequency	Receive exit signals S1I and S2C, operating within the frequency range of 2491.75 MHz ± 8.16 MHz.
	Receiving sensitivity	S1I: Bit error rate ≤1×10^{-5} at signal power of-127.6dBm
		S2C:24kbps information frame, bit error rate: ≤1×10^{-5}(signal power-123.8dBm)
		S2C:16kbps information frame, bit error rate: ≤1×10^{-5}(signal power-127.5dBm)
		S2C:8kbps information frame, bit error rate: ≤1×10^{-5}(signal power-130dBm)
	Number of receiving beams	Beidou-2: 10; Beidou-3: 14
	Transmit frequency	Lf0 ： 1615.68 MHz±4.08MHz
		Lf1 ： 1614.26 MHz±4.08MHz
		Lf2 ： 1618.34 MHz±4.08MHz
	Transmitting power	6dBW to 8dBW (5W amplifier)
	Frequency accuracy of transmission	≤5×10^{-7}
	Modulation phase error of transmitting signal	≤3°
	Short message communication capacity	The maximum length of a single BeiDou-2 message is 120 Chinese characters.
		The maximum length of BeiDou-3 regional messages is 1000 Chinese characters.
	Anti narrowband interference	Dedicated segment 16kbps information frame, signal power-120dBm, and a dry signal-to-noise ratio (DSNR) of at least 60dBc
Power characteristics		Operating voltage: +3.6V to +5.5V, recommended 3.7V
		The amplifier operates at a voltage range of +4.5V to +5.5V.
Power dissipation		Operating power consumption: ≤160mA @+3.7V
		Power consumption: ≤3.5A@5V
Physical characteristics		
Structure size		30mm×35mm×3.7mm（±0.2mm）
Encapsulation form		SMD stamp port
Weight		≤8g
Environment pointer		
Working temperature		-40℃~+85℃
Storage temperature		-40℃~+85℃

1.4. Product Summary

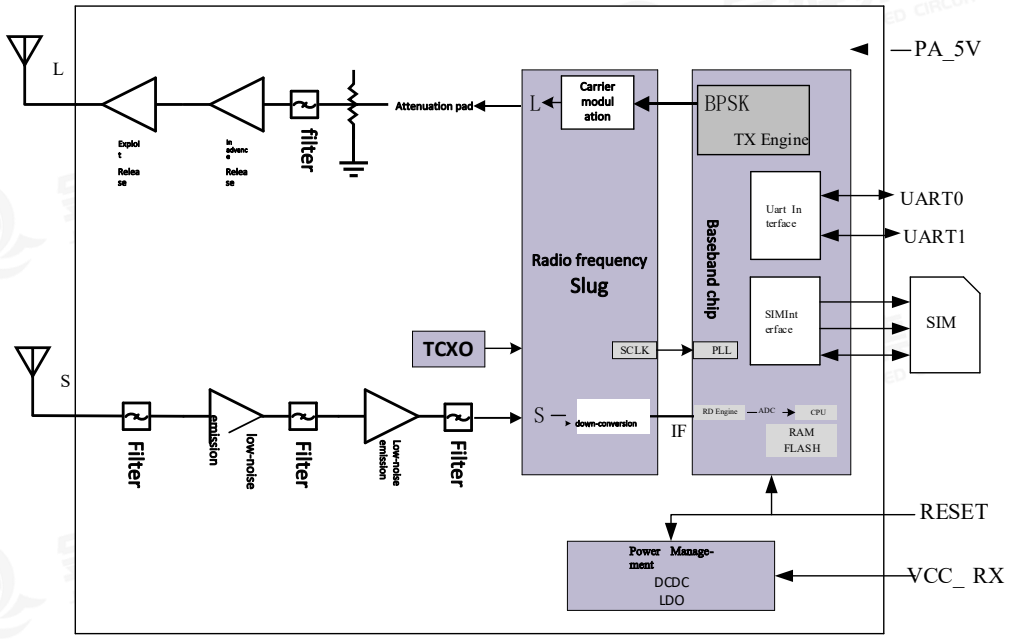


Figure 1 DM222 Block Diagram

(1) Radio Frequency Section

The passive antenna connects to the S and L antenna terminals of the module. After receiving the signal, it undergoes amplification and filtering, then down-conversion to intermediate frequency (IF) signals via the RF chip before being processed by the baseband chip. The transmitter modulates BPSK signals onto the carrier, generating output signals at the Beidou communication transmission frequency points LF0/LF1/LF2.

(2) baseband portion

The baseband part is mainly responsible for the capture, tracking and navigation of the satellite signal, the demodulation and decoding of the navigation message, the conversion of the intermediate frequency of the module, the encoding and output of the BPSK modulation signal, the interface control, the timing output and other processing.

(3) Interface part

The interface circuit includes the Beidou SIM card interface, UART interface, reset interface, antenna interface, etc.

2. Hardware Components

2.1. Structure Size

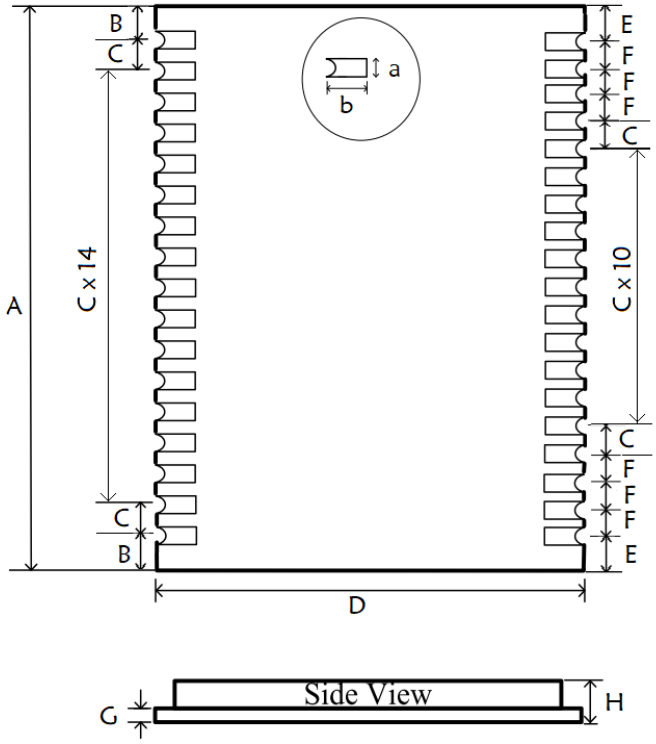


Figure 2 Structural Dimension Diagram

Table 2 Structural Dimensions Table

Parameter	Least value (mm)	Representative value (mm)	Crest value (mm)
a	0.7	0.8	0.9
b	1.4	1.5	1.6
A	34.5	35	35.5
B	1.45	1.5	1.55
C	1.95	2.0	2.05
D	29.5	30	30.5
E	0.9	1.0	1.1
F	1.45	1.5	1.55
G	0.95	1.0	1.05
H	3.5	3.7	3.9

2.2. PCB Package Reference

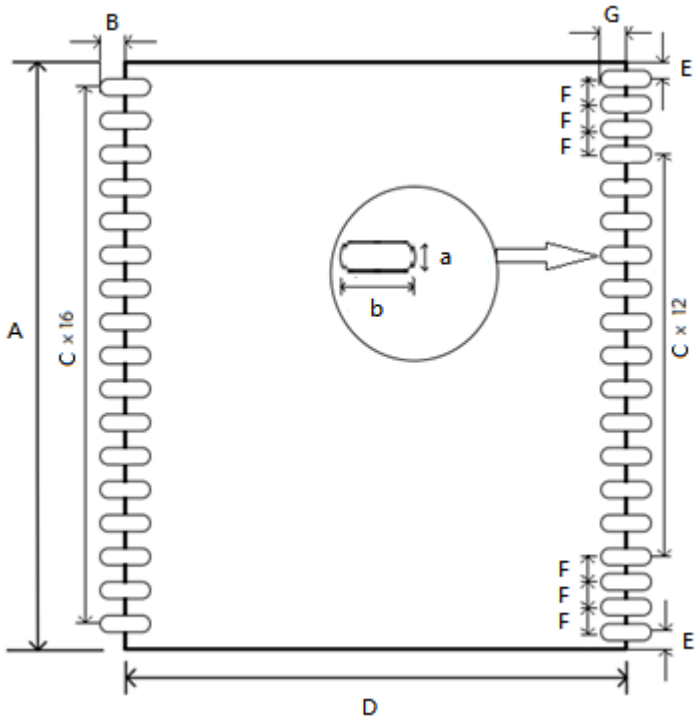


Figure 3 Packaging Dimensions

Table 3 Structural Dimension Table

Parameter	Least value (mm)	Representative value (mm)	Crest value (mm)
a	0.8	0.9	1.1
b	3.0	3.2	3.4
A	34.5	35	35.5
B	1.4	1.5	1.6
C	1.95	2.0	2.05
D	29.5	30	30.5
E	0.9	1.0	1.1
F	1.45	1.5	1.55
G	1.6	1.7	1.8

2.3. Pin Definition

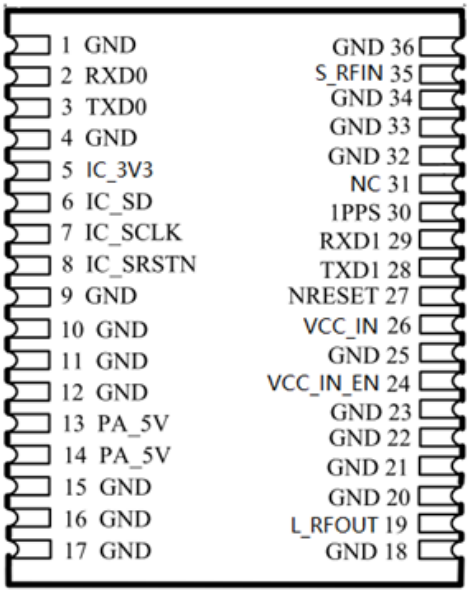


Figure 4 Pin Definition Diagram

Table 4 Pin Definition Table

Pin number	Name	Type	Explain	Remarks
1	GND	P	The earth	
2	RXD0	I	The RDSS serial communication interface operates at +3.3 V LVTTL voltage with a default baud rate of 115200bps. It supports upgrade, logging, and data protocol functions. We recommend reserving space for external upgrades.	
3	TXD0	O		
4	GND	P	The earth	
5	IC_3V3	O	The power output of the BeiDou SIM card is 3.3V.	
6	IC_SD	I	Beidou SIM card interface	
7	IC_SCLK	O		
8	IC_SRSTN	O		
9	GND	P	The earth	
10	GND	P	The earth	
11	GND	P	The earth	
12	GND	P	The earth	
13	PA_5V	P	Connect the power supply for PA transmission, operating at +4.5V to +5.5V (5W amplifier)	
14	PA_5V	P		
15	GND	P	The earth	
16	GND	P	The earth	
17	GND	P	The earth	
18	GND	P	The earth	
19	L_RFOUT	O	RDSS RF signal output port	
20	GND	P	The earth	

Pin number	Name	Type	Explain	Remarks
21	GND	P	The earth	
22	GND	P	The earth	
23	GND	P	The earth	
24	VCC_IN_EN	I	The module requires a power supply and cannot operate in a suspended state. It is powered on at high level (2.5V~+3.3V) and powered off at low level (0V~+0.8V).	
25	GND	P	The earth	
26	VCC_IN	P	The module receives an input power supply ranging from +3.6V to +5.5V (+3.7V).	
27	NRESET	I	Module reset input, low level active	
28	TXD1	O	The RDSS serial communication interface operates at +3.3V LVTTL voltage with a default baud rate of 115200bps. It supports data protocol functionality and is recommended for use with motherboard MCUs.	
29	RXD1	I		
30	NC	/	Hang in the air	
31	NC	/	Hang in the air	
32	GND	P	The earth	
33	GND	P	The earth	
34	GND	P	The earth	
35	S_RFIN	I	RDSS RF signal input port	
36	GND	P	The earth	

3. Electrical Character

3.1. Maximum Tolerated Value

Table 5 Maximum Tolerable Value Table

Parameter	Symbol	Least value	Crest value	Unit
Input voltage received	VCC_IN	3.6	5.5	V
Input voltage of power amplifier	PA_5V	4.5	5.5	V
Maximum input voltage for I/O pins	VImax	-0.5	3.6	V
Storage temperature	Tstorage	-40	85	°C
Working temperature	Toperate	-40	85	°C
Reflow soldering temperature	Tsolder	--	245	°C

3.2. Operation Requirement

Table 6 Operating Conditions Table

Parameter	Symbol	Least value	Representative value	Crest value	Unit	Condition
Input voltage received	VCC_IN	3.6	3.7	5.5	V	
Input voltage of power amplifier	PA_5V	4.5	5	5.5	V	
VCC_IN operating current	ICC	--	300	350	mA	VCC_IN=3.7V
PA_5V operating current	ICCpa	--	3.2	3.5	A	PA_5V=5V
RF input impedance	Rp	48	50	52	Ω	

3.3. IO Port Characteristics

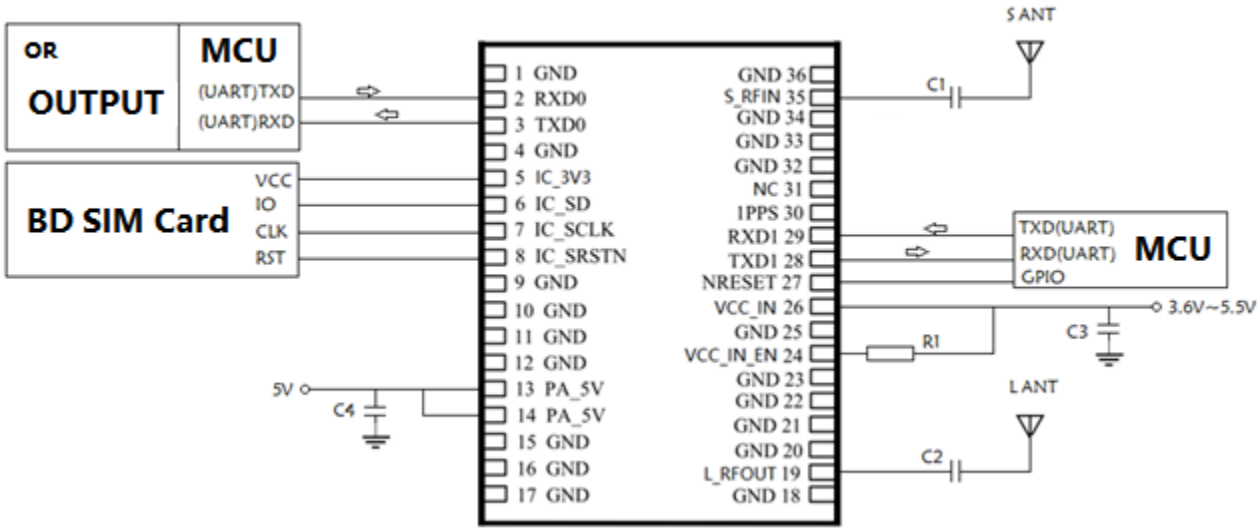
Table 7 IO Port Characteristics

Parameter	Symbol	Least value	Representative value	Crest value	Unit	Condition
Output high level voltage	V_{OH}	2.6	3.3	3.5	V	I_{OH}=5mA
Output low voltage	V_{OL}	-0.3	0	0.3	V	I_{OH}=5mA
Put high level voltage	V_{IH}	2.6	3.3	3.5	V	
Input low-level voltage	V_{IL}	-0.3	0	0.3	V	

4. Hardware Integration

4.1. Basic Reference Design

The diagram below shows the basic reference design of the DM222 module. The power input must comply with the 'Electrical Characteristics' requirements. For detailed reference circuits, please refer to the document 'JWAN0008_DM222 Beidou-3 Short Message Communication Module Hardware Design Manual'.



C1 and C2: recommended values 100pF; R1: recommended value 1kΩ; C3: recommended value 2.2uF; C4: recommended value 100uF.

Figure 5 Basic Reference Design

4.2. LAYOUT Design Notes

(1) In the PCB design of the module, a complete reference ground should be maintained to minimize the current loop.

(2) To prevent interference and ensure signal integrity, RF pins S_RFIN and L_RFOUT should maintain 50ohm impedance, be kept as short as possible, and be properly grounded during routing.

(3) Place decoupling capacitors near the power module pins. Ensure the VCC_IN power trace has a minimum width of 1mm, while the PA_5V power trace must support 4A current capacity, which can be achieved through copper plating.

(4) Do not place the module near interference sources such as communication antennas, crystal oscillators, large inductors, or high-frequency digital signal lines. It is recommended to fully fill the module base with floor filler.

(5) When routing PCB boards, avoid placing sensitive signals on the top layer directly beneath the module.

4.3. Other Design Considerations

(1) Avoid using the transmit function when the L_RFOUT port is not connected to a passive antenna (no load), as this may cause the module to burn out.

(2) Since the UART operates at LVTTL level, a 500Ω to 1KΩ resistor is connected in series at the RX port and a 33Ω or 510Ω resistor at the TX port to ensure the connected IO ports remain high-impedance or low-level when the module is not powered, thus preventing series connection.

(3) Select a reliable antenna, ensure its transmit/receive direction faces south, place it outdoors in an unobstructed location, and guarantee the environment is free from significant interference.

(4) The VCC_IN input voltage must not exceed 5.5V. Special attention should be paid to avoid surge spikes caused by improper power supply design.

The voltage is 5.5V, so it's advisable to add a TVS diode to the VCC_IN power input pin.

(5) The layout and routing of BeiDou SIM cards should avoid strong interference signals, especially high-voltage signals.

5. Software Configuration

5.1. Short Message Communication Flow

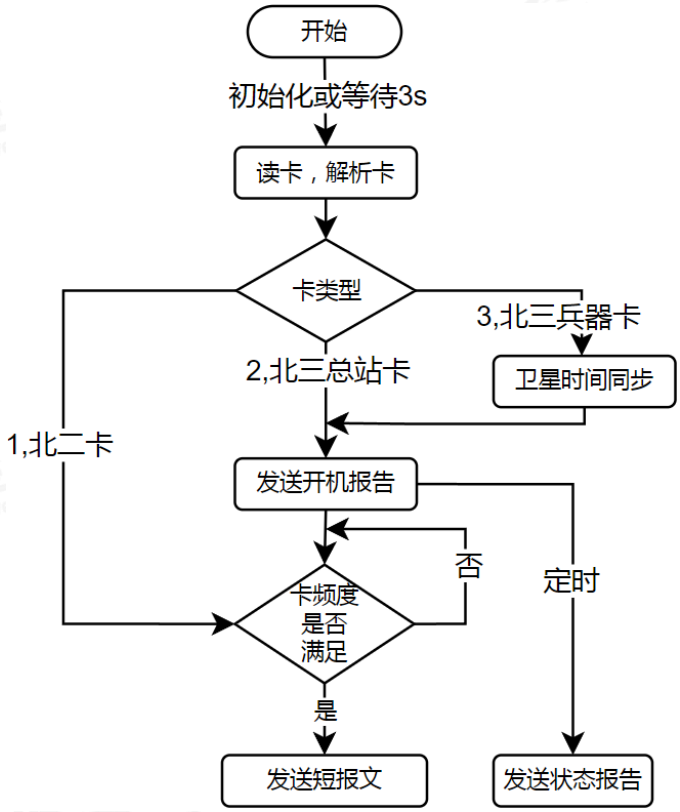


Figure 6 Short Message Communication Flow

The recommended procedure for short message communication is as follows:

Step 1: Power on the module.

Step 2: Wait for the Beidou card to complete initialization or wait for 3 seconds. Upon initialization, the card outputs the statement "$BDSTA, 1, x*HH" (where x indicates the card type: 0 = no card; 1 = Beidou-2 card; 2 = Beidou-3 master station card; 3 = Beidou-3 weapon card).

Step 3: Send a card reading request. Use the command "$CCSIM, 0, 0*57" (or "$CCICR, 0, 00*68").

Step4: Analyze the Beidou card information. Based on the BDSXX statement (or BDICP statement) output by the module, parse the Beidou card information. If the card number is 0, it indicates an abnormal card reading. First, check whether the Beidou card is installed correctly.

Step 5: Proceed with the steps based on the card type. If the card type is 1, proceed only to Step 8. If the card type is 2, execute Steps 6, 7, and 8 in sequence. If the card type is 3, wait until the module time synchronizes with the satellite and output the statement "$ BDSTA,5,x,yyyymmdd,hhmmss,sss*HH", then proceed to Steps 6, 7, and 8 in sequence.

Step 6: Transmit the startup report. Send the command "$CCOFQ, 1, 3*5A" without using transmission frequency. Step 7: Send status reports at scheduled intervals. Use the command "$ CCOFQ, 3, 3*5B" for status reports without frequency usage. Terminals requiring short messages should send status reports every 15 minutes, while non-receiving terminals may skip these reports.

Step 8: Transmit short message. Before transmission, check the card frequency countdown. Send the command "$CCTTC, 0*5F". Upon receiving the response command "$BDTTC, x*hh", where "x" equals 0 for regional or global short message transmission, and non-zero values require waiting for the frequency countdown to reset.

For detailed configuration instructions, please refer to the "JWAN0024 Beidou-3 Communication Module General Command Protocol Manual-V4.2" or later versions.

5.2. Common Commands

Table 1 Common Instruction Table

Order number	Instruct	Explain
1	$CCVER, 0, 0*41	Read version number
2	$CCPTL, 1*55	Set as trunk protocol
3	$CCPTL, 2*56	Set as an extended protocol
4	$CCDBG, freset*7E	Factory data reset
5	$CCSRF, 1, 1, 0, 0, 0*5B	Open the Beidou-2 S1I frequency band
6	$CCSRF, 1, 0, 1, 0, 0*5B	Open the Beidou-3 S2C frequency
8	$CCSRF, 1, 1, 1, 1, 0*5B	Enable all frequency points

5.3. Data Interface Protocol

Table 2 Data Interface Protocol

Order number	Joggle	Protocol name
1	NBI Data Interface Protocol	Beidou Navigation Satellite System User Terminal Common Data Interface V2.1
2	North Three Data Interface Protocol	Beidou-3 Civil Terminal General Data Interface Requirements V1.0
3	Extended interface protocol	Jinwei Collection-Bidou-3 Communication Module General Command Protocol V4.2

5.4. Serial Communication Format

Table 3 serial communication format

Joggle	Speed	Data format
UART output	115200	Data format: 1 start bit, 8 data bits, 1 stop bit, no parity bit
UART import	115200	Data format: 1 start bit, 8 data bits, 1 stop bit, no parity bit

5.5. Default Setting

Table 4 Default Configuration Output Table

Order number	Parameter	Explain	Output frequency	Remarks
1	PWI sentence	North Three Beams Information	1Hz	Enable S2C frequency
2	BSI sentence	Second wave beam information	1Hz	Open the S1I frequency

6. Firmware Upgrade

For detailed firmware upgrade procedures, please refer to the document "JWAN0029_Beidou Short Message Product Upgrade Tool User Manual".

7. Production Welding Requirements

7.1. Requirements for Fabrication of Steel Mesh

To ensure sufficient solder and reliable soldering during module encapsulation, the steel mesh requires localized step-up at the module position, with front-side (printed circuit board side) thickening. According to IPC 7525, the recommended steel mesh thickness for the module area is 0.15–0.25 mm. Adjustments can also be made based on the measured solder paste thickness and the actual conditions and empirical data of the SMT factory.

7.2. Sensitivity to Humidity

This module is a moisture-sensitive product. According to IPC-JEDEC standards, the MSL (Moisture Sensitivity Level) is defined as Level 3. Before use, verify that the packaging is intact. After opening the package, check the moisture-proof label card inside the vacuum bag. If the 5% indicator ring appears pink and the 10% indicator ring is not blue (as shown in the following image after moisture exposure), the module must be baked before use.

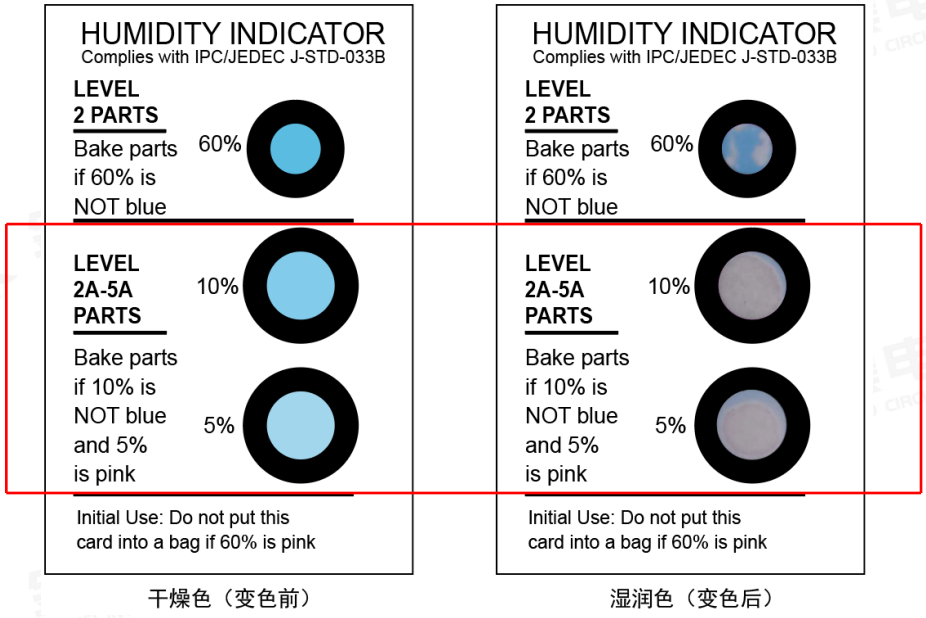


Figure 7 Moisture-Proof Identification Card (Three-Point Humidity Indicator Card)

7.3. Welding Temperature Curve

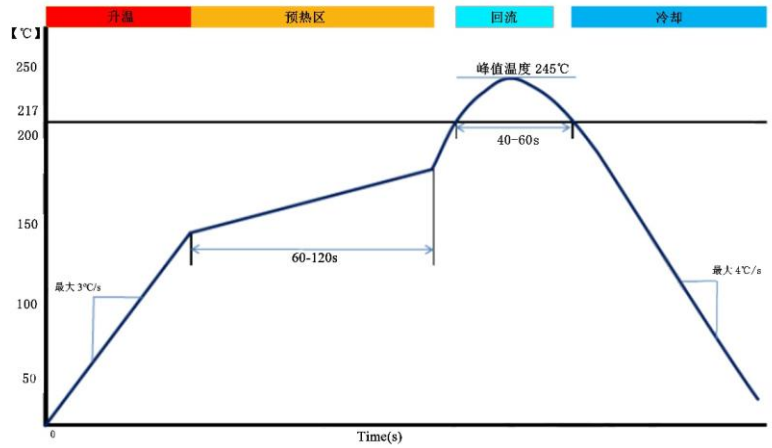


Figure 6 Welding Temperature Curve

Table 8 Welding Parameters Table

Order number	Stage	Temperature range	Explain
1	Temperature rise period	Temperature range for heating: 50℃-150℃	Rise rate: Maximum 3°C/s
2	Preheating stage	Preheating temperature range: 150℃ -180℃	Preheating time: 60s – 120s
3	Reflux stage	Maximum welding temperature: not exceeding 245℃	Time exceeding the melting point temperature: 40s – 60s
4	Cooling stage	/	Cooling rate: Maximum 4°C/s

7.4. Welding Precautions

(1) To prevent module detachment during welding, avoid welding the module on the back of the board (second mounting surface) and avoid two welding cycles.

(2) The welding temperature is determined by multiple factors in the manufacturing process, including the motherboard's properties, solder paste type, and thickness. Please also refer to relevant IPC standards and solder paste specifications.

(3) The module surface features laser-engraved one-step identification; ensure correct mounting orientation during surface mounting.

(4) The module employs a lead-free manufacturing process. When applying or repairing, ensure to select the appropriate process.

(5) The module should be baked before the patching, the baking requirement is 125℃,48h.

8. Pack

The DM222 module is pallet-mounted and vacuum-sealed in anti-static packaging, with a moisture-proof bag and identification card inside.

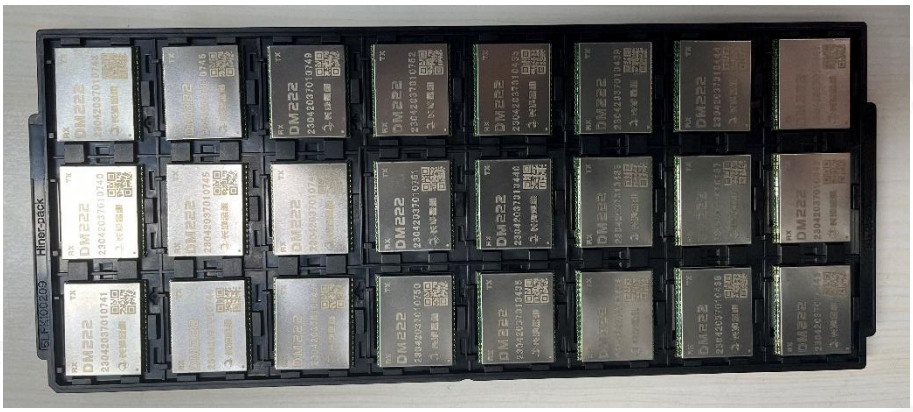


Figure 7 Schematic Diagram of DM222 Module Packaging

Table 12 DM222 Module Packaging Instructions

Order number	Project	Description
1	Module count	24 pieces/plate
2	Pallet size	13.5cm×32.2cm

Revision History Record of Revision

Order number	Documentation Edition	Revision	Date of issue
1	V3.6	Found	2023.6
2	V3.7	Modify the module thickness description and adjust the content of Section 5	2023.8
3	V3.8	Short Message Communication Software Operation Process	2025.7

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