



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

Hardware Design 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

## Document information

<b>Document ID</b>	JWAN0008
<b>Document Version</b>	V1.0/20230616
<b>Type of documentation</b>	0-Public

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## 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.

## 2. Hardware Block Diagram

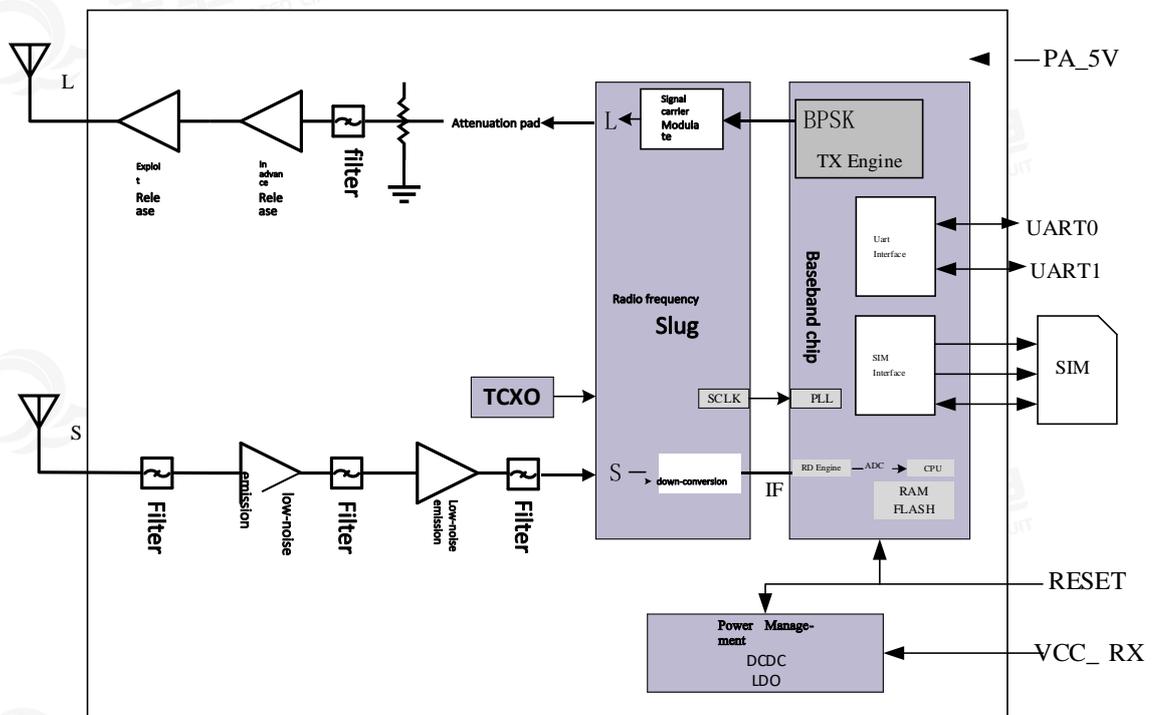


Figure 1 Hardware Function Block Diagram of DM222 Module

### (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, navigation message demodulation and decoding, the intermediate frequency AD conversion, the BPSK modulation signal encoding and output, the interface control, the timing output and other processing.

(3) external interface

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

### 3. Circuit Reference Design

#### 3.1. Peripheral Circuit Reference Design

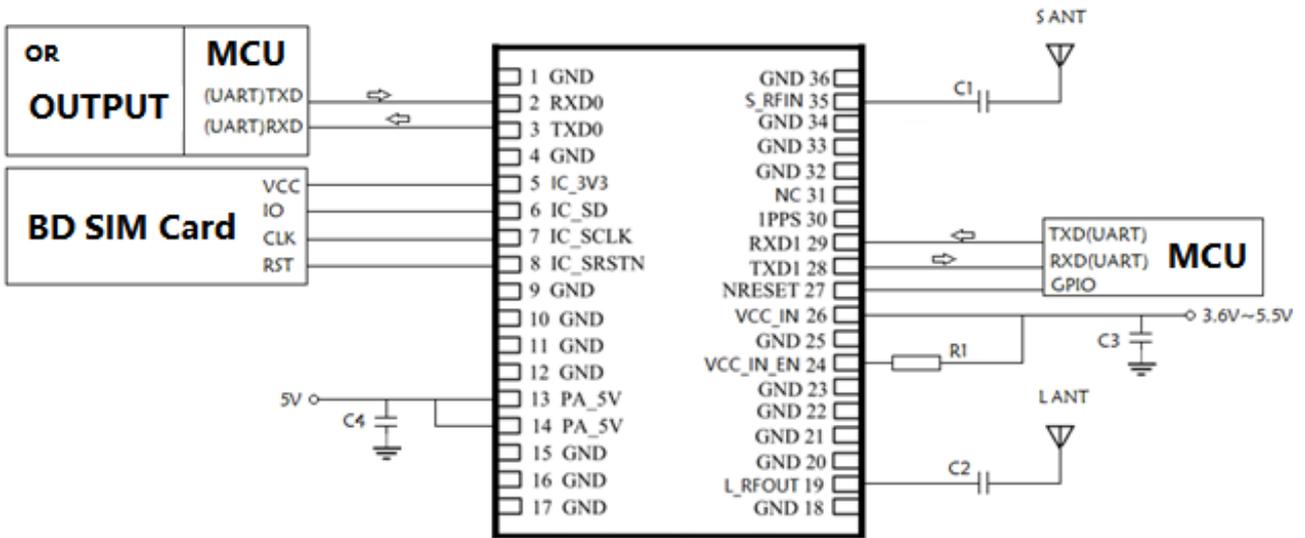


Figure 2 DM222 Reference Circuit

Table 1 Recommended Selection of Reference Circuit Devices for DM222

Order number	Device	Explain
1	R1	1k Ω
2	C1, C2	Capacitor, 100pF
3	C3	Capacitor, 2.2uF
4	C4	Capacitor, 100uF

3.2. Power Supply Reference Design

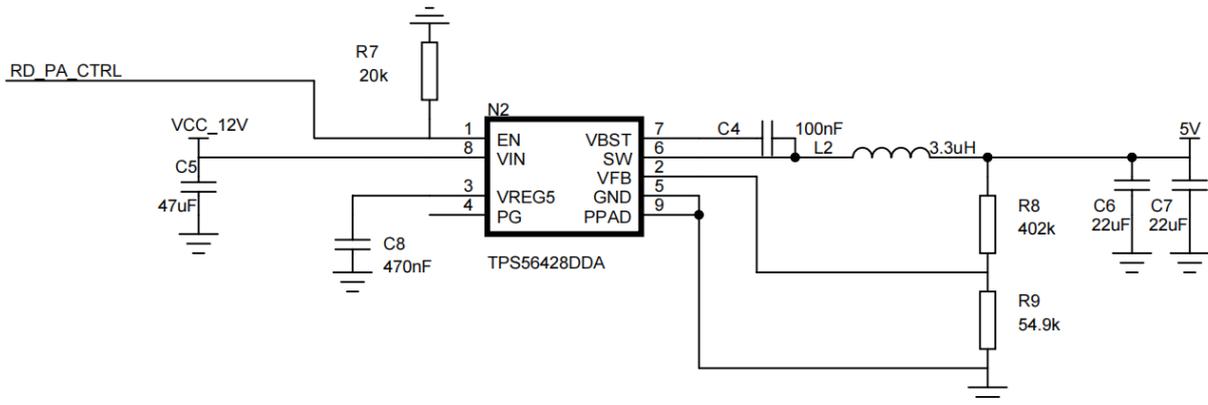


Figure 3: Reference Circuit for PA\_5V Power Supply in Power Amplifier

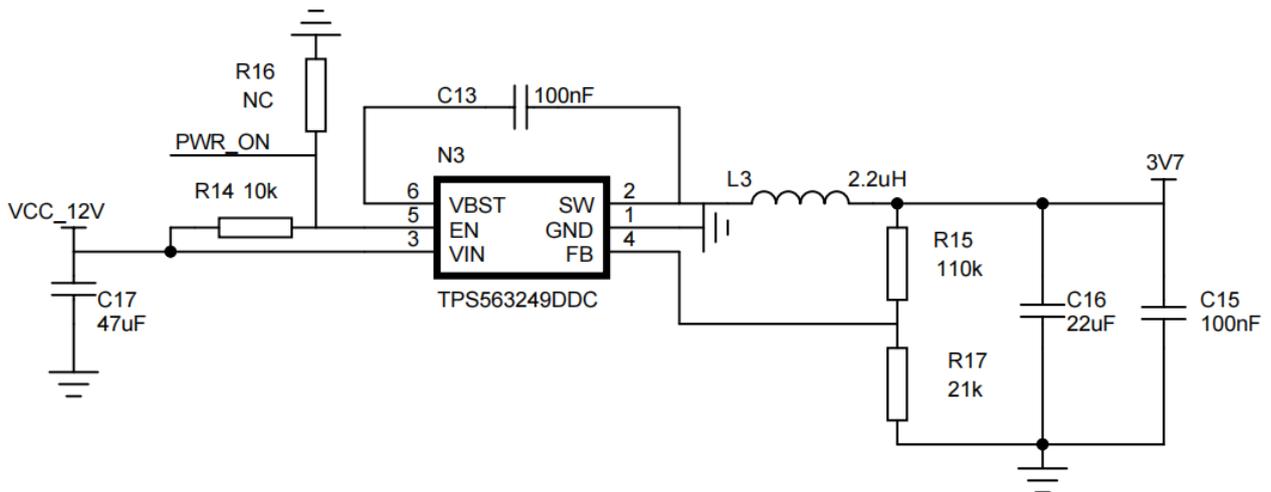


Figure 4 Reference Circuit for Receiving Power Supply VCC\_IN

As shown in Figure 3, the power supply is drawn from an external source, then stepped down to 5.0 V by a DC-DC converter chip, and supplied to the PA\_5V power amplifier of the DM222 module.

As shown in Figure 4, the power supply is drawn from an external source, then stepped down to 3.7V by a DC-DC converter chip, and supplied to the VCC\_IN pin of the DM222 module for power consumption.

matters need  
attention :

- The 5V supply for the power amplifier PA\_5V must deliver a minimum current of 3.5A. Therefore, the DC-DC converter should employ high-power components with a power supply ripple of no more than 50mVpp.
- The 3.7V supply provided to the receiving VCC\_IN must support a current capacity of at least 1A, with no power ripple allowed.

greater than 50 mVpp;

- c) The module's VCC\_IN power supply must not exceed 5.5V. Special attention should be paid to prevent voltage spikes caused by improper power design from surpassing this threshold. Therefore, it is recommended to install a TVS diode on the VCC\_IN input pin.
- d) While no specific power-up timing is required between VCC\_IN and PA\_5V, synchronization is recommended or VCC\_IN should be prioritized.
- e) The PA\_5V power amplifier operates within a 4.5V to 5.5V input range, while the VCC\_IN receiver operates within a 3.6V to 5V input range.

### 3.3. Peripheral Reference Design of Beidou Card

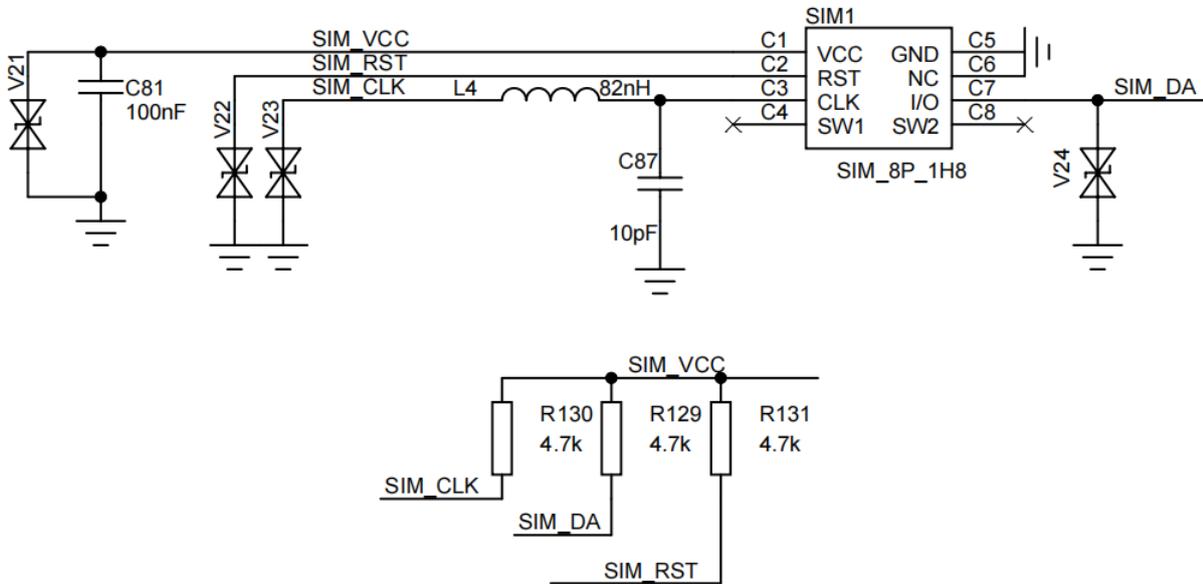


Figure 5 Reference Circuit of Beidou Card

As shown in Figure 5, this is a reference design for a Beidou card. It is recommended to install ESD protection devices on each signal line at the card slot. The signal traces of the Beidou card should be kept away from high-voltage and high-interference sensitive circuits. The SIM\_CLK signal from the module output should ideally pass through an LC filter circuit with an inductor of 82nH and a capacitor of 10pF.

### 3.4. UART Peripheral Reference Design

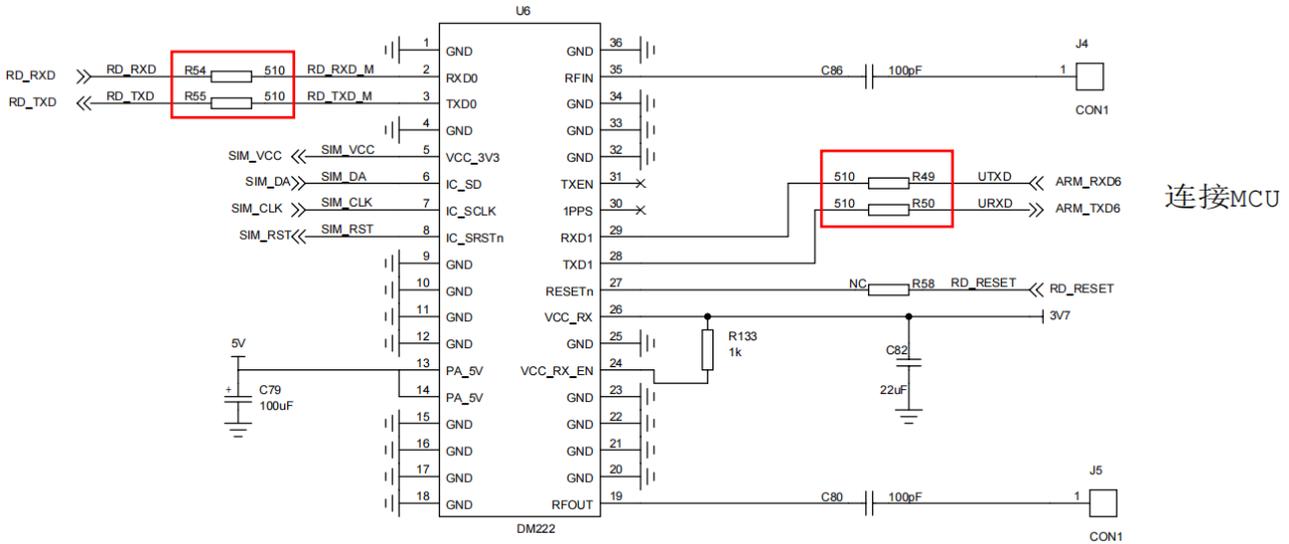


Figure 6 UART Connection Diagram

Since the UART operates at LVTTL level, a 500Ω to 1KΩ resistor should be connected in series at the RX port and a 33Ω or 510Ω resistor at the TX port to ensure connected IO ports remain high-impedance or low-level when the module is powered off, preventing series connection. Both Serial Ports 0 and 1 serve the same function and can connect to the MCU. For external connections to the MCU, Serial Port 0 is recommended for external use while Serial Port 1 connects to the MCU. Alternatively, if only the MCU needs to be connected, Serial Port 0 should be prioritized.

When using a serial port for external connections, remember to add an RS232 level converter chip to convert the module's LVTTL signal to RS232 output.

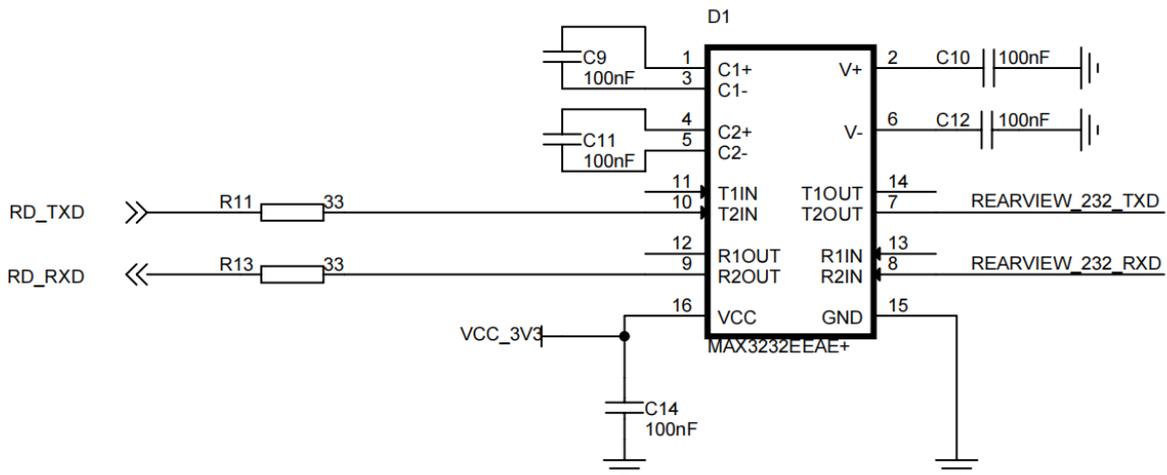


Figure 7 RS232 Level Conversion Circuit Reference Diagram

### 3.5. Design of Module Switching Control

24	VCC_IN_EN	I	模块接收电源使能，不能悬空，高电平开启 +2.5V~+3.3V，低电平关闭 0V~+0.8V
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VCC\_IN\_EN is the enable pin of the module, controlling its power on/off. A high level activates the module, while a low level deactivates it. It can be connected to the MCU to control the module's operation. If not needed, it can be directly connected to the input power supply.

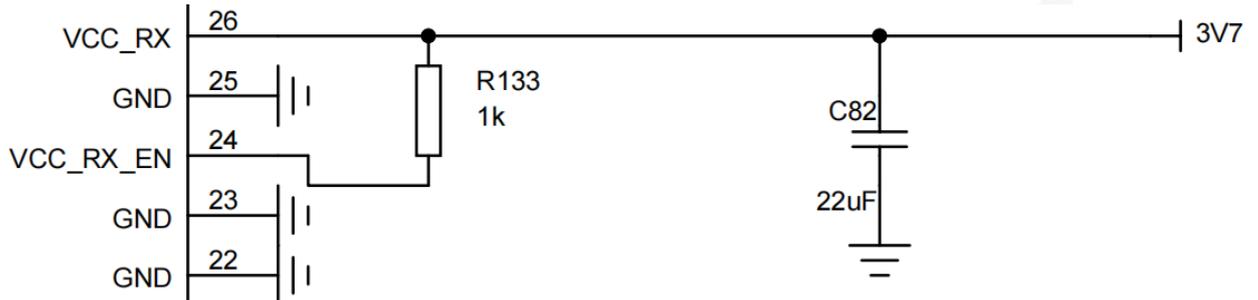


Figure 8 Module Enablement Design Reference

### 3.6. Antenna Selection and Design

The DM222 module uses a passive antenna, and the RF cable length should not exceed 15 cm. Recommended antenna parameters are as follows:

Table 2 Reference for Antenna Design and Selection

Parameter	Specifications	Numeric value	Remarks
S-band receiving antenna	Minimum gain at 30° elevation	0dBic	Shipboard equipment
	Minimum gain at 70° elevation	0dBic	Handheld devices
	Minimum gain at 90° elevation	3dBic	/
	Polarization mode	RHCP	Right-handed circular polarization
L-band receiving antenna	Minimum gain at 30° elevation	-2dBic	Shipboard equipment
	Minimum gain at 30° elevation	-5dBic	Handheld devices
	Minimum gain at 90° elevation	2dBic	/
	Polarization mode	LHCP	Left-hand circular polarization
Antenna isolation	Transceiver isolation	30dB	/
Output standing wave	$\leq 2$		/
Impedance	50 ohm		/

## 4. PCB Design

### 4.1. Encapsulation Size

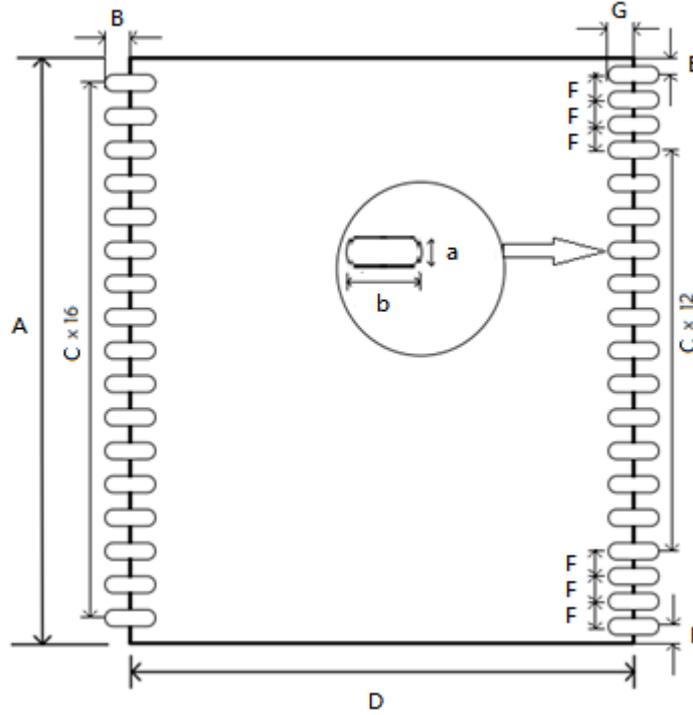


Figure 9 Packaging Dimensions

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

### 4.2. PCB Design Considerations

- (1) In the PCB design of the module, a good reference ground should be kept to provide the minimum current loop and as many ground holes as possible.

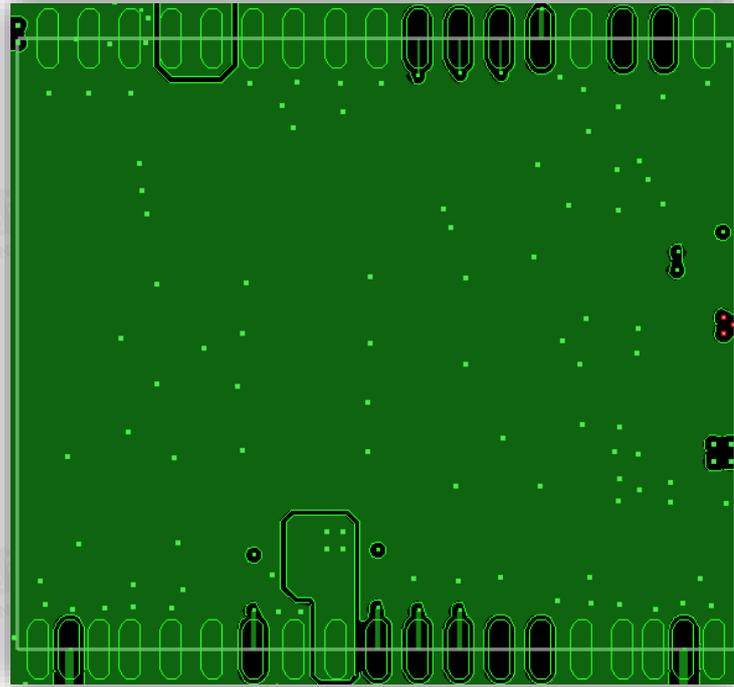


Figure 10: PCB Reference Design Diagram at the Bottom of the Module

- (2) To prevent interference and ensure signal integrity, the RF pins RX and TX must maintain 50ohm impedance, be kept as short as possible, and be properly grounded.

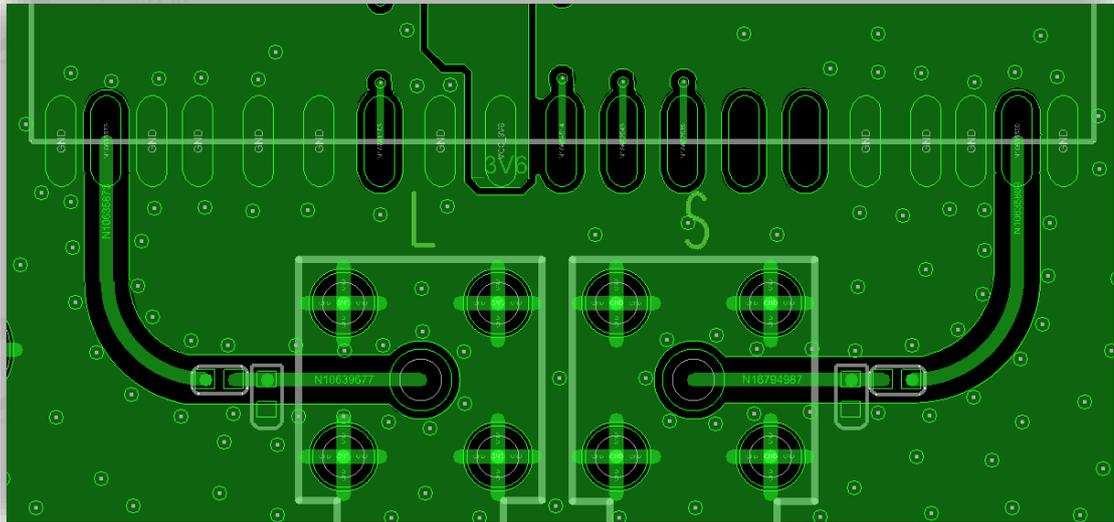


Figure 11 RF Trace Design Reference Diagram

- (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.

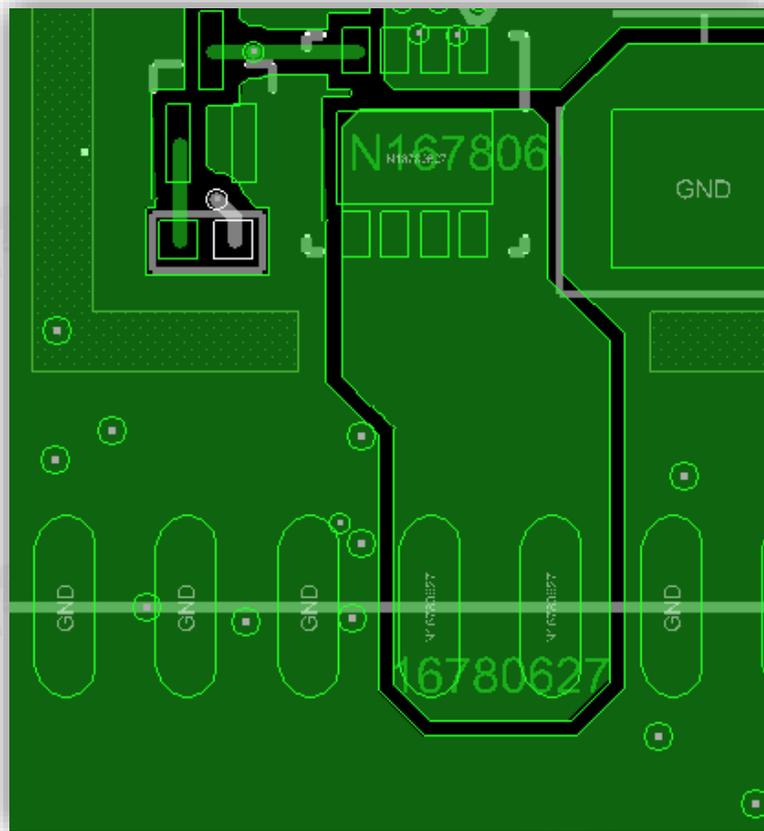


Figure 12 PA\_5V Reference Design

- (4) Avoid placing the module near interference sources such as Bluetooth, Wi-Fi, 4G,5G devices, crystal oscillators, large inductors, or high-frequency digital signal lines. It is recommended to fully ground the module's base.
- (5) When routing PCBs, avoid placing sensitive signals on the top layer directly beneath the module.
- (6) The layout and routing of BeiDou SIM cards should avoid strong interference signals, especially high-voltage signals.

## Revision History Record of Revision

Order number	Documentation Edition	Revision	Date of issue
1	V1.0	Found	2023.6

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