NM1 Module Hardware Design Manual

NB-IoT Series
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1 About This Document

1.1 Applicable Scope

This document describes hardware interface specifications, electrical features, mechanical specifications, and other related information about the NM1 module to help you design and develop NM1 module hardware.

1.2 Purpose

This document provides NM1 module design and development bases. Through this document, you can know the NM1 module and its technical parameters and develop related functional product or devices.
In addition to functional features and technical parameters, this document also describes the product reliability test, related test standards, service function implementation process, RF performance indicators, and circuit design.

1.3 Reference Documents

Table 1- 1 Reference documents

Document No.	Document Name
	NM1 Module Hardware Manual.pdf
	NM1 Module Software Manual.pdf
	NM1 Module TE-B User Manual.pdf

1.4 Acronyms and Abbreviations

Table 1- 2 Acronyms and abbreviations

Acronyms	Full Spelling
ESD	electrostatic discharge
USB	Universal Serial Bus
UART	universal asynchronous receiver/transmitter
SIM	subscriber identity module
SPI	serial peripheral interface
I^2C	inter-integrated circuit
I/O	Input/Output
GPIO	General Purpose Input/Output
TDB	To be determined
RTC	real-time clock
ADC	analog to digital converter

2 Product Overview

NM1 is a compact, high-performance, and low-power NB-IoT series module. It has the following features:

- Supports the B1, B3,B5,B8, B20 frequency bands.
- Provides the SIM card interface (1.8 V), USB 1.1 interface, UART interface, SPI, I²C interface, and GPIO interface.

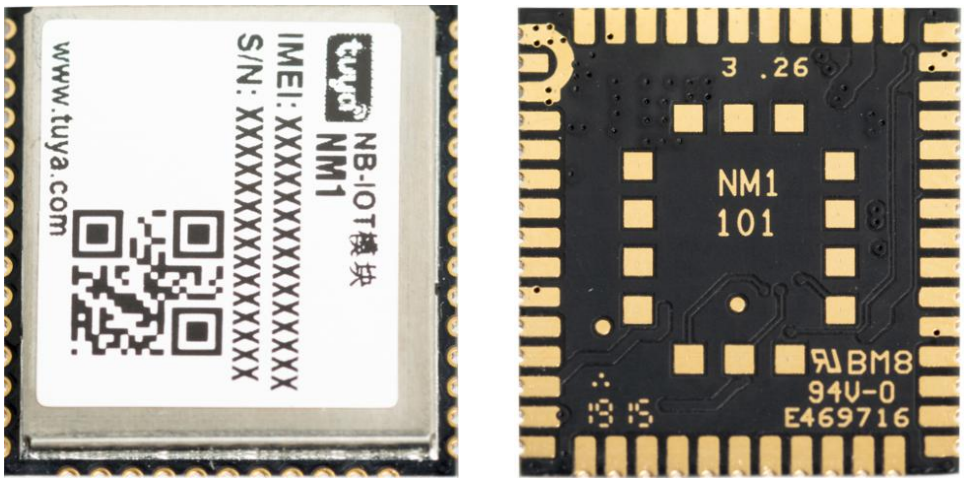


Figure 2- 1 Product appearance

2.1 Package Dimensions

The NM1 module has 66 pins. Its dimensions is 17.7 2.4 mm (H) x 17.7 mm (W) x 15.8 mm (D).

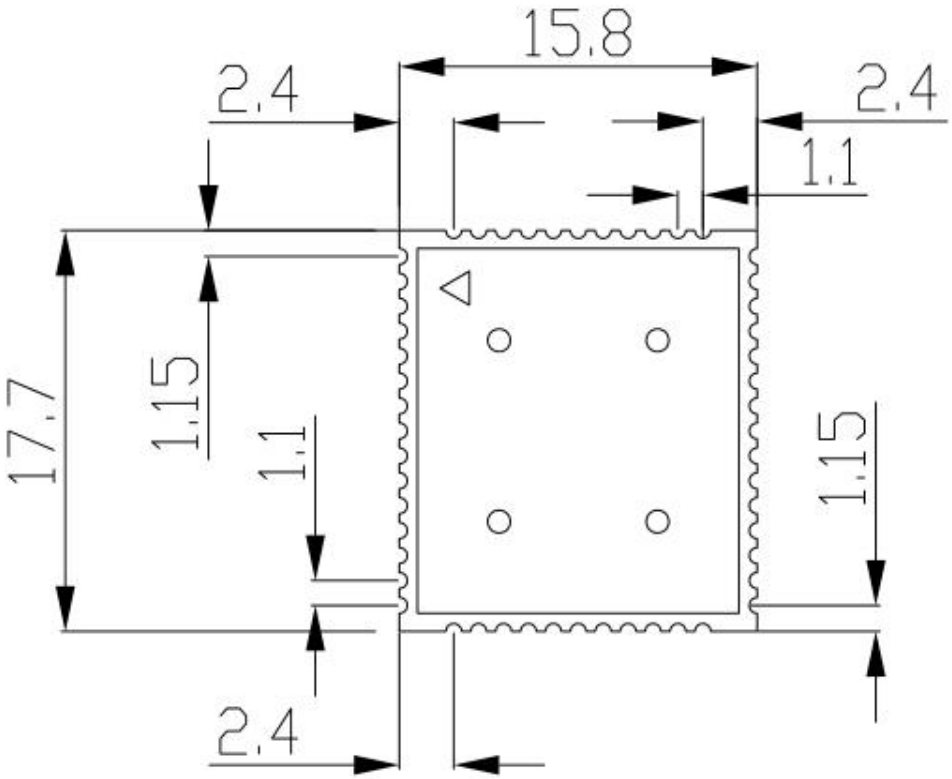


Figure 2- 2 Package dimensions diagram (unit: mm)

2.2 Technical Parameters

Table 2- 1 describes mechanical features, baseband features, RF features, technical standards, and environment features of the NM1 module.

Table 2- 1 Technical parameters of the NM1 module

Item	Parameter	Specifications
Mechanical features	Package size and type	17.7 mm x 15.8 mm x 2.6 mm Stamp hole (52 pins) and base pad (14 pins)
Module	Platform	MT2625
	Processor architecture	ARM Cortex-M4
	SIM card interface	1.8 V
	USB interface	USB 1.1
	Voltage	2.1 V to 3.63 V
	Working mode	Active: The NM1 module is active and can send and receive data. All functions are available. An active NM1 module can switch to the idle or PSM mode. Idle: The NM1 module is in idle state, connected to a network, and can receive paging messages. An idle NM1 module can switch to the active or PSM mode. PSM: Only RTC of the module works, and the module is disconnected from the network and cannot receive paging messages. The NM1 module is woken up from the PSM mode when the timer expires or the PWRKEY and PSM_EINT* pins are lowered.
	Power-saving	In PSM mode, the NM1 module consumes the minimum power of 5 μA. The PSM mode is provided to reduce power consumption and prolong the power supply duration of the battery.
	Serial port	Primary serial interface: transmits AT commands and data. The default baud rate is 115.2 kbit/s. It can also be used for firmware upgrade and the baud rate is 921.6 kbit/s. Debugging serial interface: exports log information for software commissioning. Auxiliary serial interface: transmits AT commands and data.
	Working current	TBD
	RTC	Supported
	ADC*	The NM1 module has a 10-bit analog-digit conversion input interface to measure the voltage. This interface works in both active and idle modes.
	RI signal*	When the NM1 module receives SMS messages or exports URC, it notifies the DTE over the RI pin.
	Network status indication*	The NETLIGHT signal indicates the module's network connection status.
RF	Frequency band	B1, B3, B5,B8, B20
	Maximum TX power	23±2 dBm
	Receiving sensitivity	TBD
	Main antenna interface	Supported
	Antenna interface	Characteristic impedance of 50 ohms. The antenna is provided by a third party, but not Tuya.
Technical standard	Data rate	Single-tone: downlink 25.5 kbit/s and uplink 16.7 kbit/s Multi-tone*: downlink 25.5 kbit/s and uplink 62.5 kbit/s
	Network protocol	UDP/TCP/CoAP/LWM2M/PPP*/SSL*/DTLS*/FTP*/HTTP*/MQTT*/HTTPS*
Environment feature	Temperature	Normal operating temperature: –35°C to +75°C[1] Extended operating temperature: –40°C to +85°C[2] Storage temperature: –40°C to +90°C
Application	SMS*	Text and packet data unit (PDU) modes
	Upgrade	Upgrade is performed over the primary serial interface.

Note:

1. When the NM1 module works at a temperature within the normal operating temperature range[1], its performance complies with 3GPP standards.
2. When the NM1 module works at a temperature within the extended operating temperature range[2], it works properly, has the SMS* and data transmission functions, and will not have unrecoverable faults. The RF spectrum and network are not affected. Several indicators, for example, the output power, may exceed the 3GPP limits. After the operating temperature is restored to the normal operating temperature, all NM1 module indicators can meet 3GPP standard requirements.
3. A feature with an asterisk (*) is being developed.

2.3 Product Functions

2.3.1 Baseband Functions

The NM1 module baseband includes the USB interface signal, SIM card interface signal, I²C interface signal, UART interface signal, working status indicator signal, module startup and reset signals, and multiplexing control signals, power supply, and grounding of multiple GPIO interfaces.

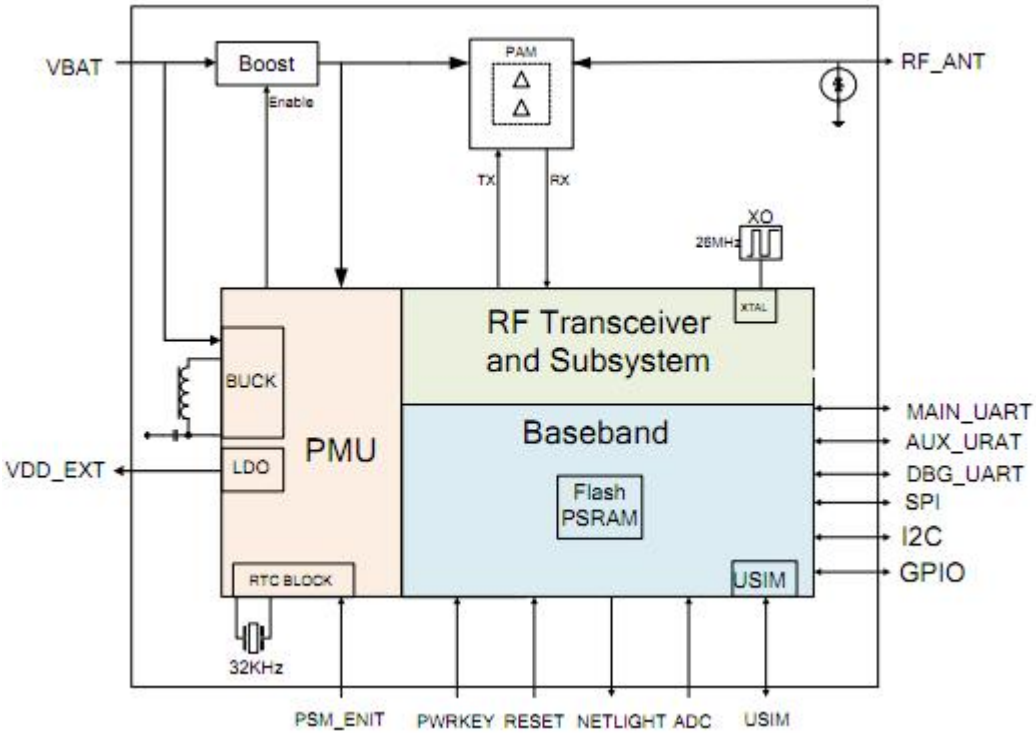


Figure 2- 3 System connection framework

2.3.2 RF Functions

Table 2- 2 Working frequency bands

Working Frequency Band	Uplink (MHz)	Downlink (MHz)
B1	1920–1980	2110–2170
B3	1710–1785	1805–1880
B5	824–849	869-894
B8	880–915	925–960
B20	832–862	791–821

Note: The NM1 module is being developed to support the frequency bands with an asterisk (*).

Table 2- 3 Line loss requirements

Frequency Band	Requirement
LTE B5, B8, B20	Line loss < 1 dB
LTE B1, B3	Line loss < 1.5 dB

Table 2- 4 Antenna requirements

Item	Requirement
Frequency band	LTE B1, B3, B5,B8, B20
Standing wave ratio (SWR)	≤ 2
Efficiency (%)	≥ 30
Maximum input power (W)	50
Input impedance (ohm)	50
Polarization type	Linear polarization

Note: The NM1 module is being developed to support the frequency bands with an asterisk (*).

Table 2- 5 Conducted RF transmit power

Frequency Band	Maximum Value (dBm)	Minimum Value (dBm)
B1	23±2 dBm	< –39
B3	23±2 dBm	< –39
B5	23±2 dBm	< –39
B8	23±2 dBm	< –39
B20	23±2 dBm	< –39

Note:
1. The designed conducted RF transmit power complies with the NB-IoT protocol in 3GPP Release 13 and Release 14.
2. The NM1 module is being developed to support the frequency bands with an asterisk (*).

3 Interfaces

3.1 Pin Definition

3.1.1 Pin Symbols

Table 3- 1 Pin symbols

Pin Symbol	Description
I	Input
O	Output
I/O	Input/Output

3.1.2 Pin Configuration Diagram

Figure 3- 1 shows the NM1 module's interface pins.

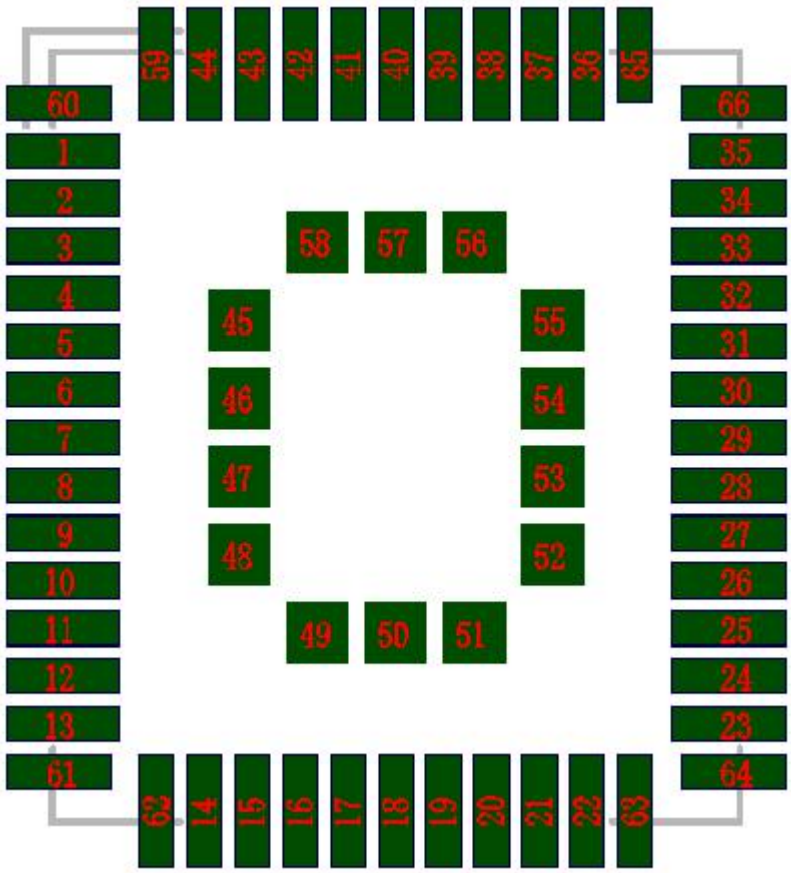


Figure 3- 1 Pin configuration diagram

3.1.3 Pins

Table 3- 2 Interface pin definition

Pin No.	Analog Signal Definition	Pin Attribute	Input/ Output	Pin Voltage (V)	Remarks
1	AGND	GND	N/A	N/A	N/A
2	GPIO0	GPIO0	N/A	1.8	N/A

Pin No.	Analog Signal Definition	Pin Attribute	Input/ Output	Pin Voltage (V)	Remarks
3	SPI_MISO	Primary device input and secondary device output signal	I	1.8	N/A
4	SPI_MOSI	Primary device output and secondary device input signal	O	1.8	N/A
5	SPI_SCLK	Serial clock signal	O	1.8	N/A
6	SPI_CS	Chip selection signal	O	1.8	N/A
7	PWRKEY	Lower PWRKEY to power on the NM1 module.	I	Maximum value of V_{IL}: 0.3 x VBAT Minimum value of V_{IH}: 0.7 x VBAT	N/A
8	GPIO22	GPIO22	N/A	N/A	N/A
9	ADC0	Common analog-digit conversion interface	I	0–1.4 V	N/A
10	SIM_GND	GND dedicated for the SIM card	N/A	N/A	N/A
11	SIM_DATA	SIM card data signal	I/O	Maximum value of V_{IL}: 0.25 x SIM_VDD Minimum value of V_{IH}: 0.75 x SIM_VDD Maximum value of V_{OL}: 0.15 x SIM_VDD Minimum value of V_{OH}: 0.85 x SIM_VDD	N/A
12	SIM_RST	SIM card reset signal	I/O	Maximum value of V_{OL}: 0.15 x SIM_VDD Minimum value of V_{OH}: 0.85 x SIM_VDD	N/A
13	SIM_CLK	SIM card clock signal	I/O	Maximum value of V_{OL}: 0.15 x SIM_VDD Minimum value of V_{OH}: 0.85 x SIM_VDD	N/A
14	SIM_VDD	SIM card power signal	O	1.8	N/A
15	RESET	Used to reset the NM1 module, which is active at low level	I	N/A	N/A
16	NETLIGHT	Network status indication	O	N/A	N/A
17	RXD	Primary serial interface that receives data	I	1.8	N/A
18	TXD	Primary serial interface that transmits data	O	1.8	N/A
19	PSM_EINT	External interrupt pin, which is used to wake up the NM1 module from the PSM mode	I	N/A	N/A
20	SRCLKENAI	NFC interface	N/A	1.8	N/A

Pin No.	Analog Signal Definition	Pin Attribute	Input/ Output	Pin Voltage (V)	Remarks
21	USB_DP	USB+ signal	N/A	N/A	N/A
22	USB_DM	USB– signal	N/A	N/A	N/A
23	USB_EINT	USB_EINT			N/A
24	VIO18_EXT	1.8 V output power (In PSM mode, no voltage is output.)	O	Vmin = 1.53 V Vnorm = 1.8 V	N/A
25	DVDD_IO	NC	NC	NC	N/A
26	NC	NC	N/A	N/A	N/A
27	GND	GND	N/A	N/A	N/A
28	UART1_RXD	Auxiliary serial interface that receives data	I	1.8	N/A
29	UART1_TXD	Auxiliary serial interface that transmits data	O	1.8	N/A
30	UART1_CTS	Determines whether data is received.	N/A	1.8	N/A
31	UART1_RTS	Determines whether data is transmitted.	N/A	1.8	N/A
32	I2C0_SDA	I^2C0 data	I/O	N/A	N/A
33	I2C0_SCL	I^2C0 clock	O	N/A	N/A
34	GND	GND	N/A	N/A	N/A
35	RF_ANT	RF antenna	Characteristic impedance of 50 ohms		
36	GND	GND	N/A	N/A	N/A
37	GND	GND	N/A	N/A	N/A
38	RXD_DBG	Debugging serial interface that receives data	I	1.8	N/A
39	TXD_DBG	Debugging serial interface that transmits data	O	1.8	N/A
40	GND	GND	N/A	N/A	N/A
41	GND	GND	N/A	N/A	N/A
42	VSYS_BB	Input power	I	Vmin = 2.1 V Vnorm = 3.3 V Vmax = 3.63 V	N/A
43	VBAT_BOOST	Input power	I	Vmin = 2.1 V Vnorm = 3.3 V Vmax = 3.63 V	N/A

Pin No.	Analog Signal Definition	Pin Attribute	Input/ Output	Pin Voltage (V)	Remarks
44	VSYS_PA	Output power	O	3.3	N/A
45	GPIO11	Reserved	N/A	1.8	N/A
46	GPIO10	Reserved	N/A	1.8	N/A
47	GPIO25	Reserved	N/A	1.8	N/A
48	MD_WAKEUP	N/A	N/A	N/A	N/A
49	GPIO28	Reserved	N/A	1.8	N/A
50	AP_READY	N/A	N/A	N/A	N/A
51	STATUS	N/A	N/A	N/A	N/A
52	GPIO24	Reserved	N/A	1.8	N/A
53	GPIO34	Reserved	N/A	1.8	N/A
54	GPIO33	Reserved	N/A	1.8	N/A
55	GPIO21	Reserved	N/A	1.8	N/A
56	GPIO20	Reserved	N/A	1.8	N/A
57	GPIO8	Reserved	N/A	1.8	N/A
58	GPIO1	Reserved	N/A	1.8	N/A
59	GPIO19	Reserved	N/A	1.8	N/A
60	RTC_GPIO0	N/A	N/A	N/A	N/A
61	SIM_DET	GPIO35	N/A	SIM card detection	N/A
62	GPIO32	Reserved	N/A	1.8	N/A
63	AVDD33_VUSB	N/A	I	N/A	N/A
64	FREF	Base frequency	I	N/A	N/A
65	GPIO31	GPIO31	N/A	1.8	N/A
66	GND	GND	N/A	N/A	N/A

3.2 Electrical Conditions

Table 3-3 Electrical conditions

Signal	Description	Minimum Value	Typical Value	Maximum Value	Unit
VBAT_BOOST	Input power	2.1	3.3	3.63	V
VSYS_BB	Input power	2.1	3.3	3.63	V
VSYS_PA	Output power	N/A	3.3	N/A	V

3.3 Power Interface

3.3.1 Power Pins and Grounding

The NM1 module can be powered by a battery or external power supply.

The GND signal pins indicate the power ground and signal ground of the NM1 module and need to be connected to the ground of the PCB. Improper connections of the GND signal pins may have adverse impact on the NM1 module performance.

3.3.2 Power Supply Requirements

The NM1 module's power design is important to its performance. The NM1 module can be powered by the low-dropout regulator (LDO) with low static current and output current (up to 0.5 A) or the Li-MnO2 battery. The input voltage range is from 2.1 V to 3.63 V. During data transmission, the power cannot be lower than the minimum working voltage 2.1 V. Otherwise, errors will occur.

To ensure better power supply performance, it is recommended that three 47 μF (0805) ceramic capacitors and 100 nF, 100 pF, and 22 pF (0402) filter capacitors be connected in parallel at the VBAT input end of the module. In addition, it is recommended that a TVS tube be connected to the VBAT input end to enhance the surge voltage bearing capability of the module. In principle, a longer VBAT cable leads to a larger trace width. Figure 3-2 shows the reference circuit.

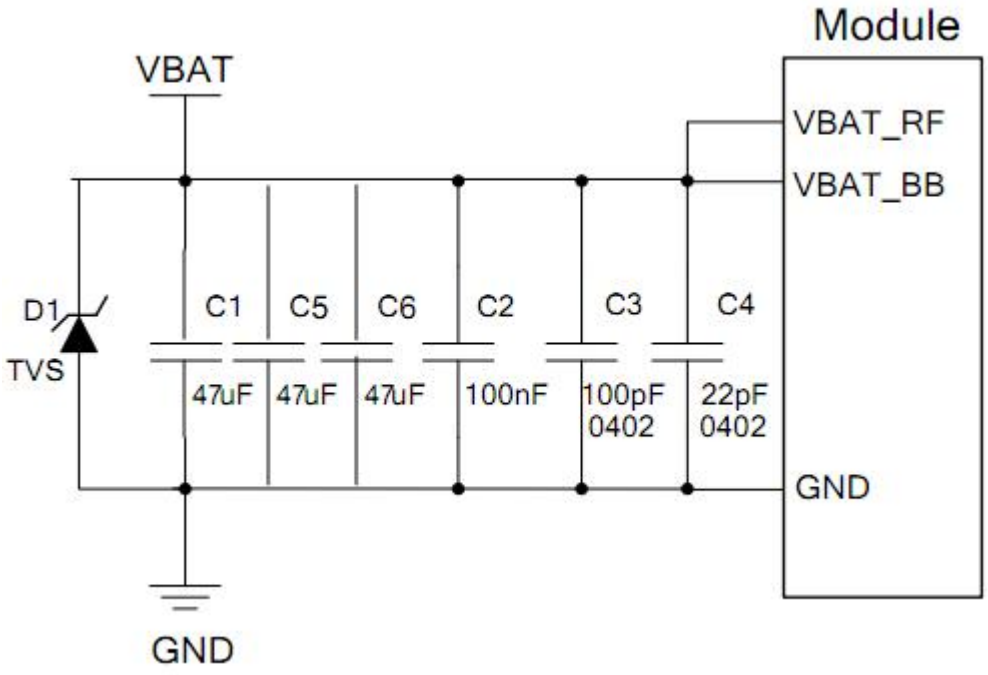


Figure 3-2 Power supply of the NM1 module

3.4 SIM Card Interface

3.4.1 Pins

Table 3-4 Definition and description of SIM card interface signals

Pin No.	Signal Name	Signal Definition	Remarks
11	SIM_DATA	SIM card data pin	Voltage precision: 1.8 V±5% Maximum current: about 60 mA
13	SIM_CLK	SIM card clock pin	
12	SIM_RST	SIM card reset pin	
14	SIM_VDD	SIM card power supply pin	

3.4.2 SIM Card Interface Application

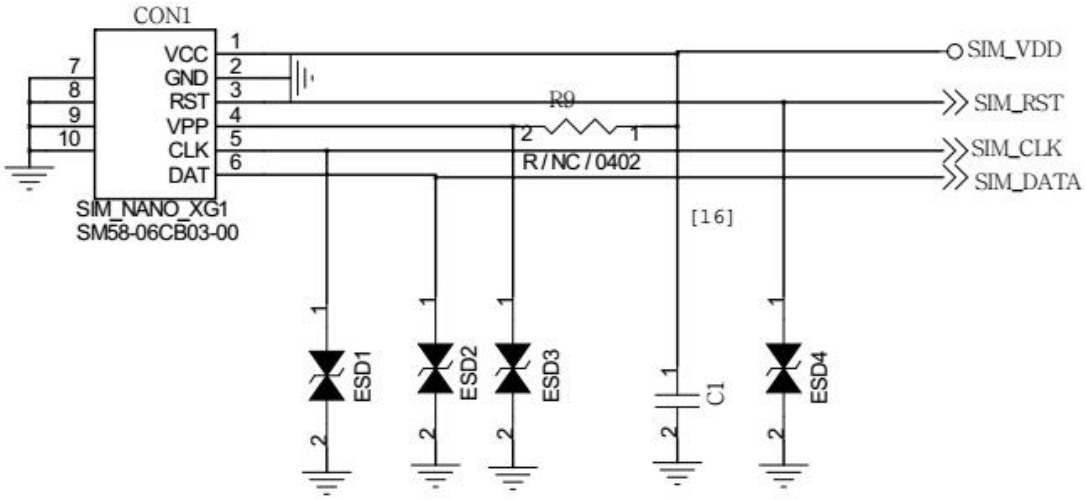


Figure 3-3 SIM card interface application

To ensure a better external SIM card performance and prevent the external SIM card being damaged, design the SIM card interface circuit in compliance with the following rules:

1. Place the external SIM card holder near the NM1 module. The external SIM card signal cable is 200 mm or shorter and is away from the RF cable and VBAT power cable.
2. The SIM_VDD decoupling capacitance does not exceed 1 μF, and the capacitor is near the external SIM card holder.
3. To prevent interference, keep the SIM_CLK and SIM_DATA signal cables at a certain distance from each other and use a ground cable to separate them.
4. Connect the SIM_RST signal cable to the ground.

To ensure a better ESD performance, you are advised to use TVS tubes to protect the pins of the external SIM card holder. The parasitic capacitance of the TVS tubes cannot be greater than 50 pF. Place ESD components near the external SIM card holder. Route the external SIM card signal cable from the external SIM card holder to the NM1 module through the ESD components.

3.5 SPIs

3.5.1 Pins

Table 3-7 defines the SPI signals. (SPIs support the slave mode.)

Table 3-5 SPI signal definition

Pin No.	Signal Name	Function Description
3	SPI_MISO	Master input and slave output
4	SPI_MOSI	Master output and slave input
5	SPI_ SCLK	SPI clock signal
6	SPI_CS	SPI selection signal

3.5.2 SPI Electrical Parameters and Application

The level of the SPI on the NM1 module is 1.8 V. If the host level is 3.3 V, add a level converter between the NM1 module and host. The level converter that supports the SPI data rate is recommended. Figure 3-4 shows the reference circuit.

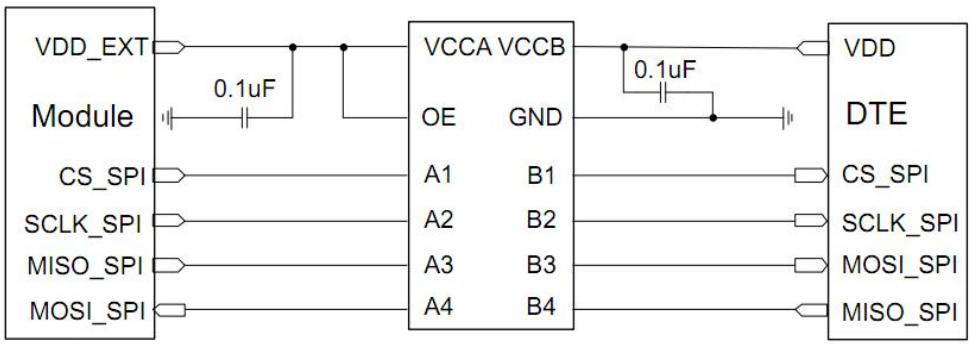


Figure 3-4 Reference circuit

3.6 I²C Interface

3.6.1 Pins

Table 3-6 I²C interface signal definition

Pin No.	Signal Name	Function Description
32	SDA	I²C serial data
33	SCL	I²C serial clock

I²C is a two-line bus for communication between ICs. It has a serial data cable (SDA) and a serial clock cable (SCL) to transmit information between connected devices. I²C identifies each device based on its unique address and can be used as both a transmitter and a receiver.

3.6.2 I²C Interface Electrical Parameters and Application

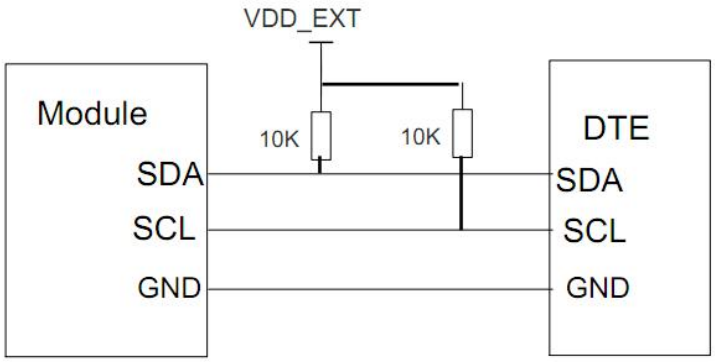


Figure 3- 5 Reference circuit

3.7 UART Interface

3.7.1 Pins

The NM1 module provides three UART interfaces. The primary serial interface can be used for firmware upgrade. The default baud rate is 115.2 kbit/s, and the downloading baud rate is 921.6 kbit/s. You can use a log viewing tool to view logs over the debugging serial interface to debug software.

Table 3- 7 UART interface signal definition

Pin No.	Signal Name	Function Description
17	RXD	Data receiving over the primary serial interface
18	TXD	Data transmission over the primary serial interface
28	UART1_RXD	Data receiving over the auxiliary serial interface
29	UART1_TXD	Data transmission over the auxiliary serial interface
38	RXD_DBG	Data receiving over the debugging serial interface
39	TXD_DBG	Data transmission over the debugging serial interface

3.7.2 UART Interface Electrical Parameters and Application

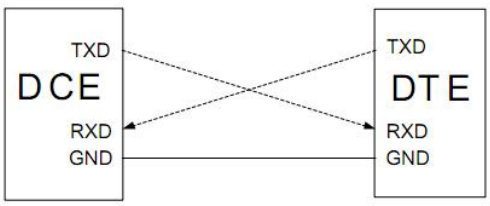


Figure 3- 6 Reference circuit

The level of the UART interfaces on the NM1 module is 1.8 V. If the application system level is 3.3 V, add a level converter to the connection between the NM1 module and application system over the serial interface. Figure 3- 7 shows the reference circuit with a level converter, UM3202.

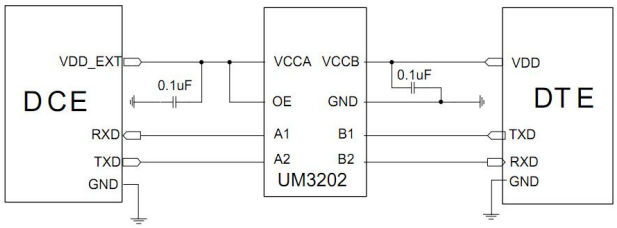


Figure 3- 7 Reference circuit with a level converter

A triode can also be used for level conversion.

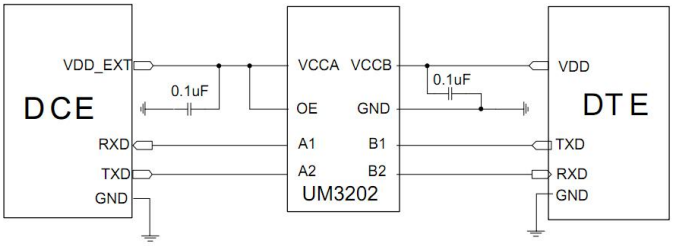


Figure 3- 8 Reference circuit with a triode for level conversion

Note: Connection methods of the debugging, auxiliary, and primary serial interfaces are similar.

3.8 USB Interface

3.8.1 Pins

The NM1 module has a USB 1.1 interface, which can only be used for module upgrade. If ESD design is required, the maximum capacitance of ESD components must be less than 0.5 pF. Otherwise, waveform distortion may occur, affecting bus communication. The differential impedance of differential data cables must be within 90 ohms.

Table 3- 8 USB interface signal definition

Pin No.	Signal Name	Function Description
17	RXD	Receiving over the serial interface
18	TXD	Transmission over the serial interface
21	USB_DP	USB+ signal
22	USB_DM	USB– signal
63	AVDD33_VUSB	Internal USB power supply

3.8.2 USB Interface Application

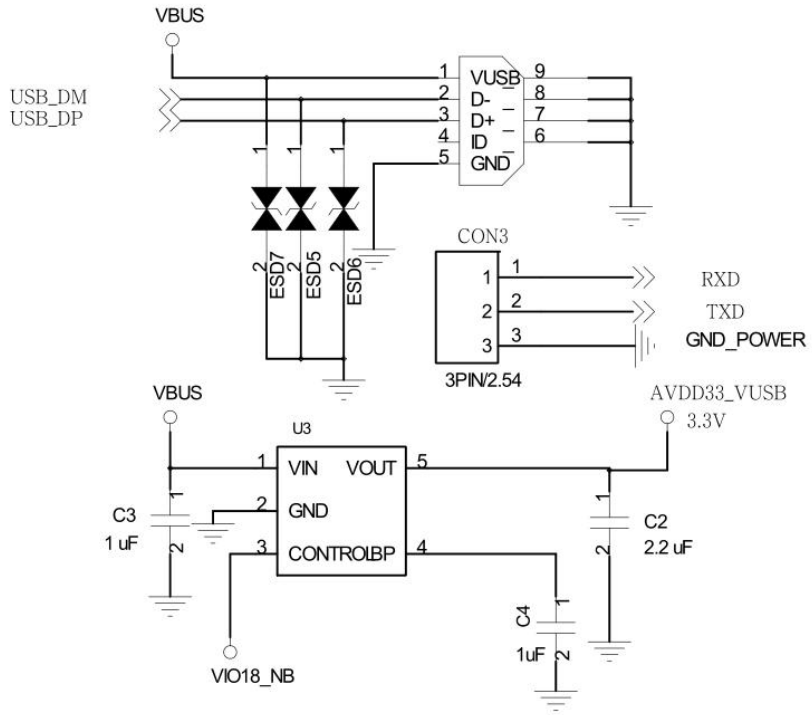


Figure 3- 9 Downloading interface application circuit

The nominated input power of the NM1 module is 3.3 V. When the USB interface is used for downloading, add an LDO circuit to keep the circuit voltage at 3.3 V.

3.9 Power-On/Power-Off and Reset Interface

3.9.1 PWRKEY Pin

Table 3- 9 PWRKEY signal definition

Pin No.	Signal Name	Function Description
7	PWRKEY	NM1 module power-on

3.9.2 Power-On/Power-Off Interface Application

To power on the NM1 module, lower the PWRKEY pin to a low level for a period of time and then disconnect it or raise it to a high level.

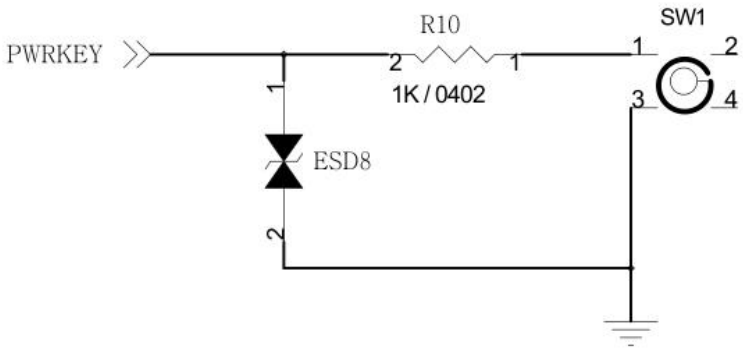


Figure 3- 10 PWRKEY interface application circuit

3.9.3 RESET Pin

Table 3- 10 RESET signal definition

Pin No.	Signal Name	Function Description
15	RESET	NM1 module resetting

To reset the NM1 module, lower the RESET pin to a low level for a period of time and then disconnect it or raise it to a high level.

3.9.4 RESET Interface Application

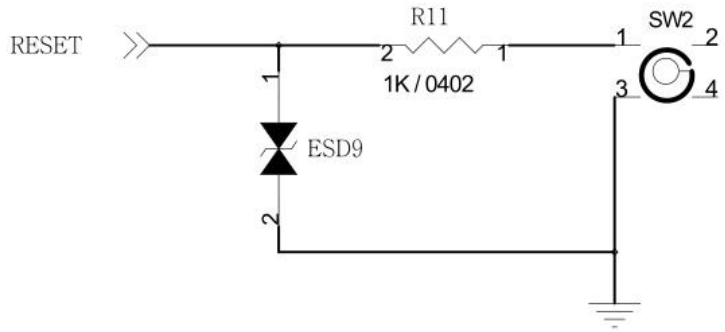


Figure 3- 11 RESET interface application circuit

4 Design Instructions

This chapter provides general design guidance about the NM1 module to ensure a better product performance.

4.1 General Design Rules and Requirements

During peripheral circuit design, ensure that the external power supply have sufficient power and the differential impedance of the USB 1.1 signal cable is within 90 ohms. Design general signal interfaces as required to match the interface signal level and prevent the NM1 module being damaged due to inconsistent levels. The NM1 module has good RF indicator performance. You need to design the antenna circuit on the PCB as required and control the impedance to prevent the RF indicators being affected.

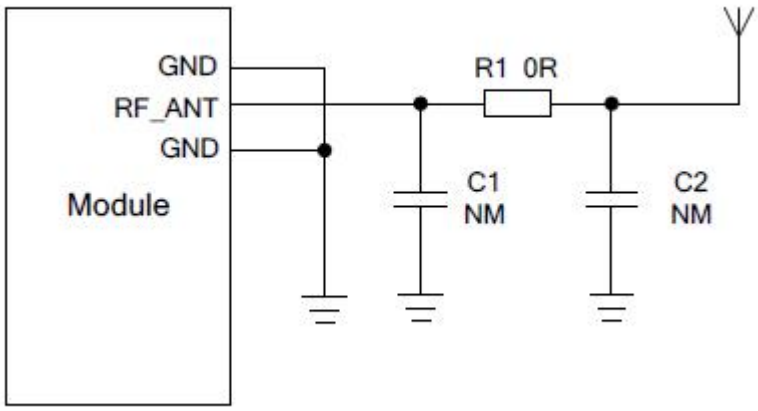
4.2 Power Supply Circuit Design

The power supply on the PCB should supply 0.5 A or higher power to meet peak current requirements of the NM1 module. The trace width on the PCB must be large enough and form good circulation with the ground. In addition, add a large capacitor with over 1000 μF to the power supply circuit to ensure transient power supply, and control the power ripple within 100 mV.

4.3 RF Circuit Design

34	GND	GND	N/A	N/A	N/A
35	RF_ANT	RF antenna	50 ohms characteristic impedance		
36	GND	GND	N/A	N/A	N/A
37	GND	GND	N/A	N/A	N/A

4.3.1 RF Antenna Circuit Design



It is recommended that a π-type matching circuit be reserved during RF antenna peripheral circuit design. Ensure that the matching circuit is near the antenna, and attach resistors based on actual debugging conditions. By default, no resistor is attached to C1 and C2, and a 0 ohms resistor is attached to R1.
The RF antenna peripheral circuit must have 50 ohms impedance.
In the recommended RF antenna peripheral circuit layout solution, the RF cable is routed at layer 1 and the reference cable at layer 2. Use the Shortcut to Si9000 software to calculate the PCB cable impedance of the RF antenna. Figure 4- 1 shows a model. During PCB cabling design, ensure that the RF reference point is complete.

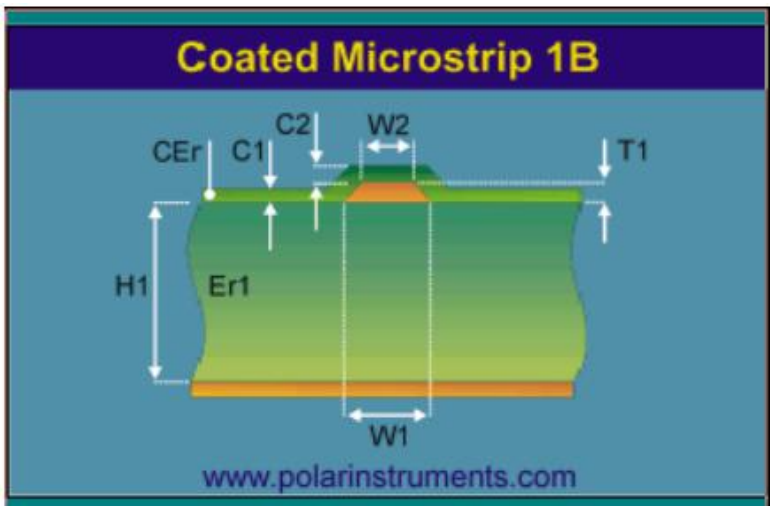


Figure 4- 1 Antenna impedance calculation model

During impedance calculation, specify parameters shown in Figure 4- 2 and change the RF trace width to obtain the required impedance value. For typical antennas, 50-ohm impedance is recommended.

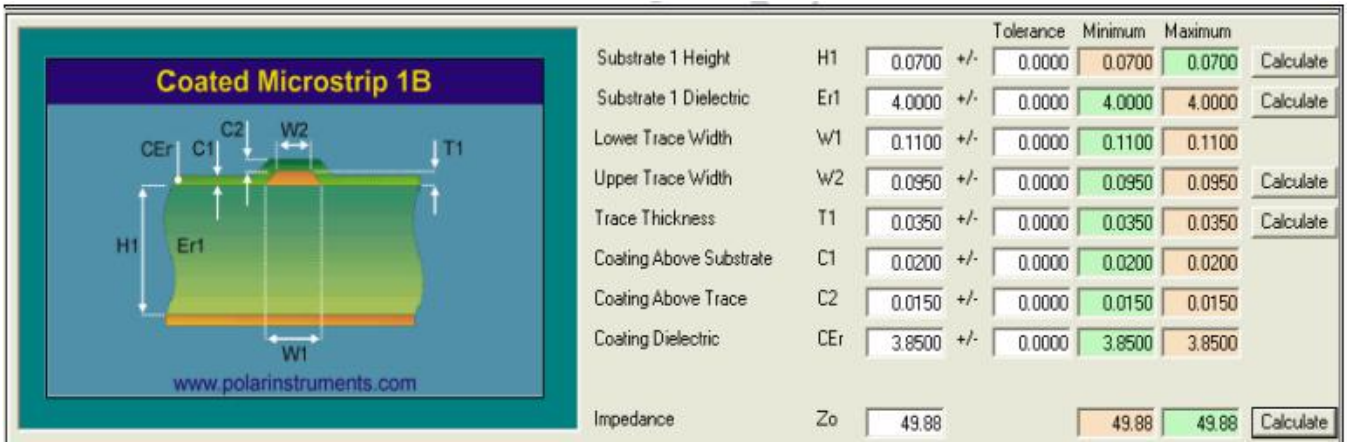


Figure 4- 2 Antenna PCB cabling impedance calculation data

4.3.2 Precautions for Initial Antenna Design

4.3.2.1 Pre-project Evaluation

Ensure that the antenna is horizontal with the base station for maximum efficiency. Do not place the antenna near the power cable, data cable, or chip that may generate electromagnetic interference. Do not reserve a place for hands on the antenna to prevent attenuation caused by the human body. Consider radiation reduction and structure implementation. In the initial design phase, the structure, ID, circuit, and antenna engineers evaluate the antenna layout together.

4.3.2.2 Antenna Matching Circuit

If a long cable exists between the RF and antenna interfaces on the NM1 module, design 50 ohms characteristics impedance for the microstrip or stripline between the RF pad and the antenna interface during PCB circuit design. In addition, reserve a matching circuit.

4.4 Suggestions on EMC and ESD Design

During overall design, consider EMC issues related to signal integrity and power integrity. During peripheral circuit cabling of the NM1 module, reserve doubled trace width between the power cable and signal cable to reduce signal coupling and ensure pure return current. During peripheral power circuit design, place the decoupling capacitor near the power pin on the NM1 module, keep high-frequency and high-speed circuits and sensitive circuits away from the PCB edges, and isolate the circuits from each other to reduce interference. Protect sensitive signals, and shield circuits or components on the PCB that may interfere the NM1 module.
Consider ESD protection during design. Place ESD components near the key input and output signal interfaces, for example, the SIM card signal interface, to protect them. On the PCB, reasonably design mechanical parts and PCB layout and ensure proper grounding of metal shielding covers to provide a smooth channel for static electricity discharging.

4.5 PCB Solder Pad Design

You are advised to design the middle 14 pads on the PCB based on the sizes in the structure diagram. Externally extend the 52 signal pads around the PCB to the NM1 module for over 0.3 mm, and externally extend other three sides of the pads for 0.05 mm. Use 50 ohms impedance cables for the main antenna and Wi-Fi antenna.

4.6 Thermal Design

The NM1 module generates heat when it works and may be affected by other high-temperature components. The NM1 module design ensures good heat dissipation. When connecting the NM1 module to the PCB, properly connect the thermal pad to the ground to ensure thermal conduction and balance and a better electrical performance.

Note:

1. Place the NM1 module away from the power supply and high-speed signal cables, and protect these cables.

2. Place the antenna and the coaxial cable that is used to connect the antenna and NIC away from these interference sources.
3. Place the NM1 module away from components that generate a large amount of heat such as the CPU to prevent the RF performance being affected by high temperature.

5 Production Instructions

5.1 Stencil Design

During stencil design, note the following:

(1) When making the stencil of the thermal pad at the bottom of the NM1 module, reduce the stencil opening by 25% to reduce short circuits between the thermal pad and functional pins around the NM1 module.

(2) To ensure better soldering, use step stencils.

(3) Use a diagonal opening for the stencil of the thermal pad. Figure 5- 1 shows recommended stencil strips.

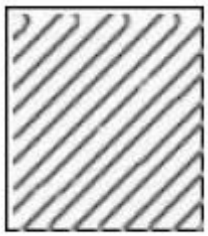


Figure 5- 1 Recommended stencil strips

5.2 Oven Temperature Curve

The oven temperature curve has great impact on the soldering quality and material status. When the temperature rises from the ambient temperature to 150°C, the rising speed is less than 3°C per second. A temperature higher than 217°C is allowed for a maximum of 70s, and 55s is recommended. Otherwise, some components may be invalid due to strong thermal attacks, resulting in a higher defect rate and more repair difficulty. The highest temperature cannot exceed 245°C. Some materials such as the crystal may have die cracks at a high temperature. As a result, the crystal does not work and the module functions are affected. Table 5- 1 describes the oven temperature curve parameter settings, and Figure 5- 2 shows the oven temperature curves.

Table 5- 1 Over temperature curve parameter settings

Lead-free Oven Temperature Curve		
Phase	**Temperature**	**Description**
Preheating	From the ambient temperature to 150°C	Rising speed: < 3°C per second
Heat preservation	150°C to 200°C	Duration: 40s to 110s
Soldering	> 217°C	Duration: 40s to 70s
	> 230°C	Duration: 15s to 45s
	Peak temperature	Maximum: 245°C
		Minimum: 230°C

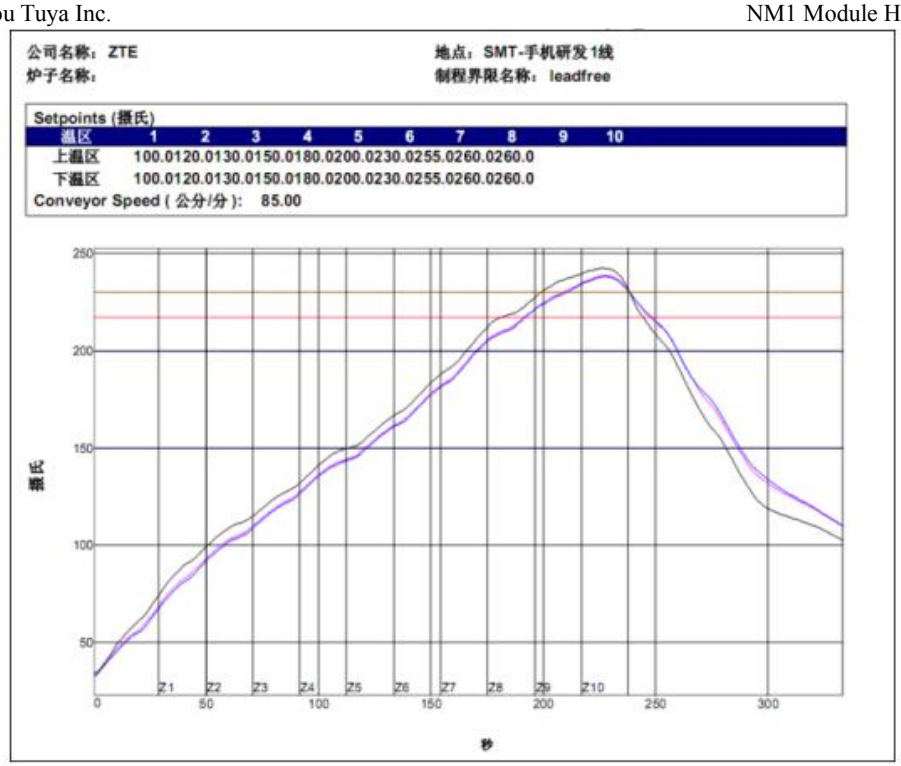


Figure 5- 2 Over temperature curve

To prevent the NM1 module being damaged due to overheating, you are advised to attach the module after reflow soldering of the PCB's first side.

6 Mechanical Dimensions

This chapter describes the mechanical dimensions of the NM1 module, in millimeters.

6.1 NM1 Module Mechanical Dimensions

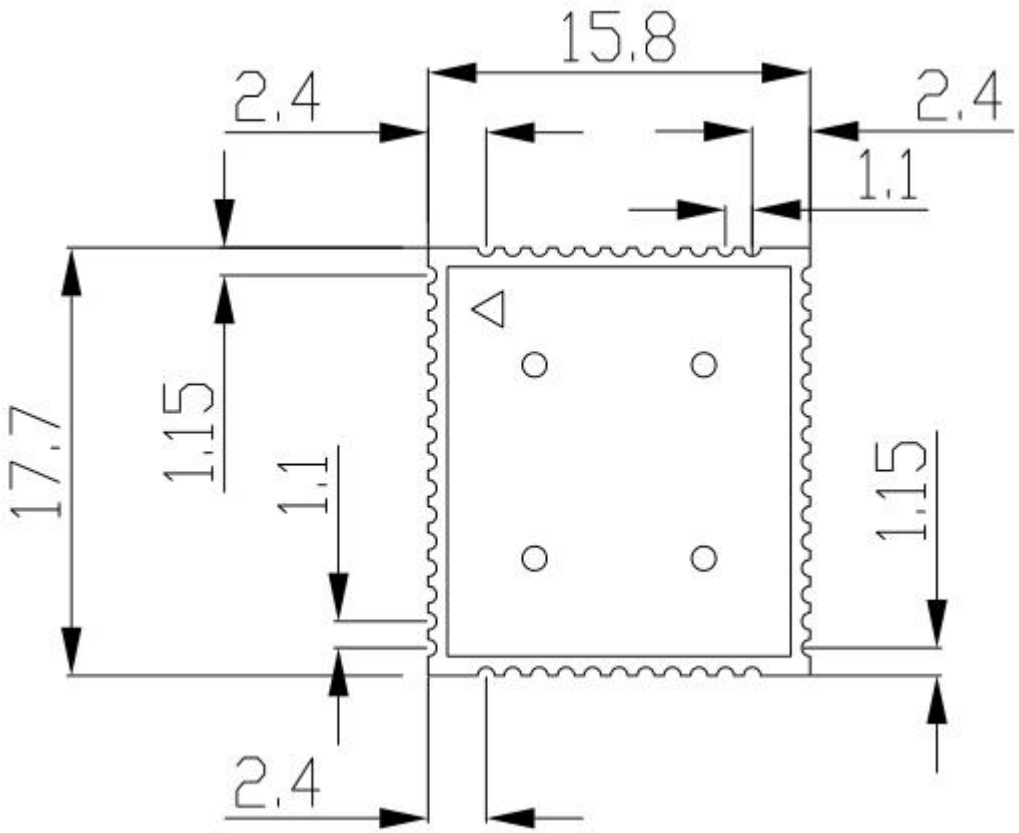


Figure 6- 1 Top view (unit: mm)

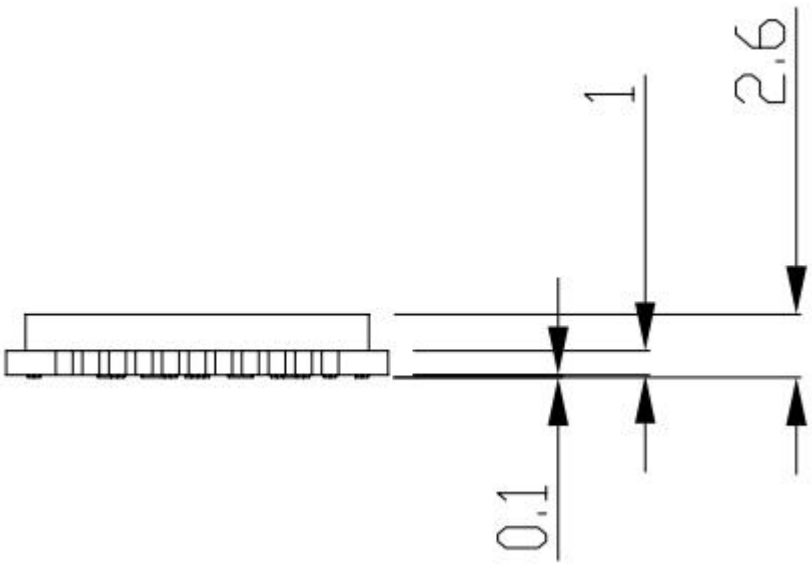


Figure 6- 2 Side view (unit: mm)

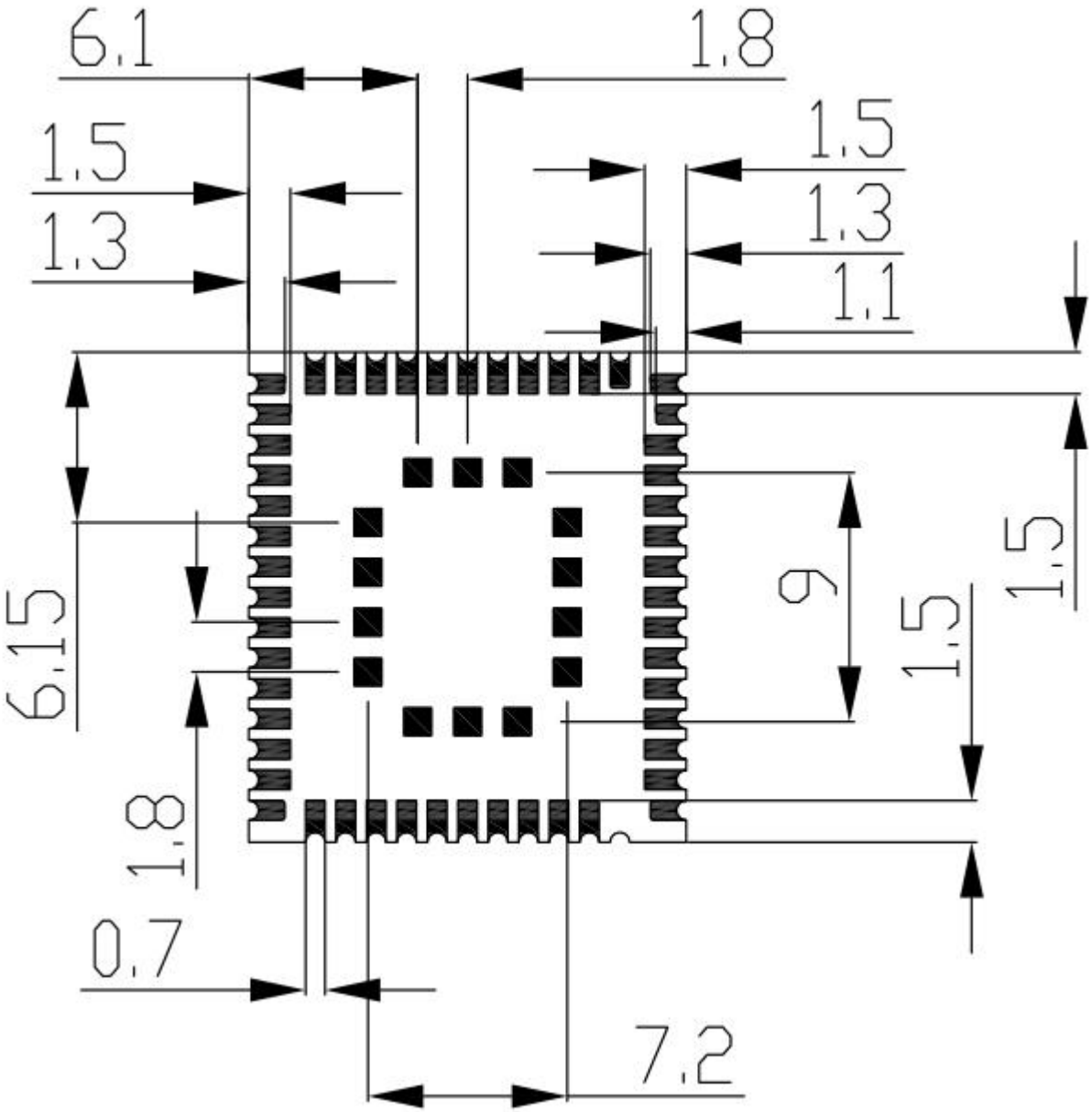


Figure 6- 3 Transparent view (unit: mm)

6.2 Recommended Package Dimensions

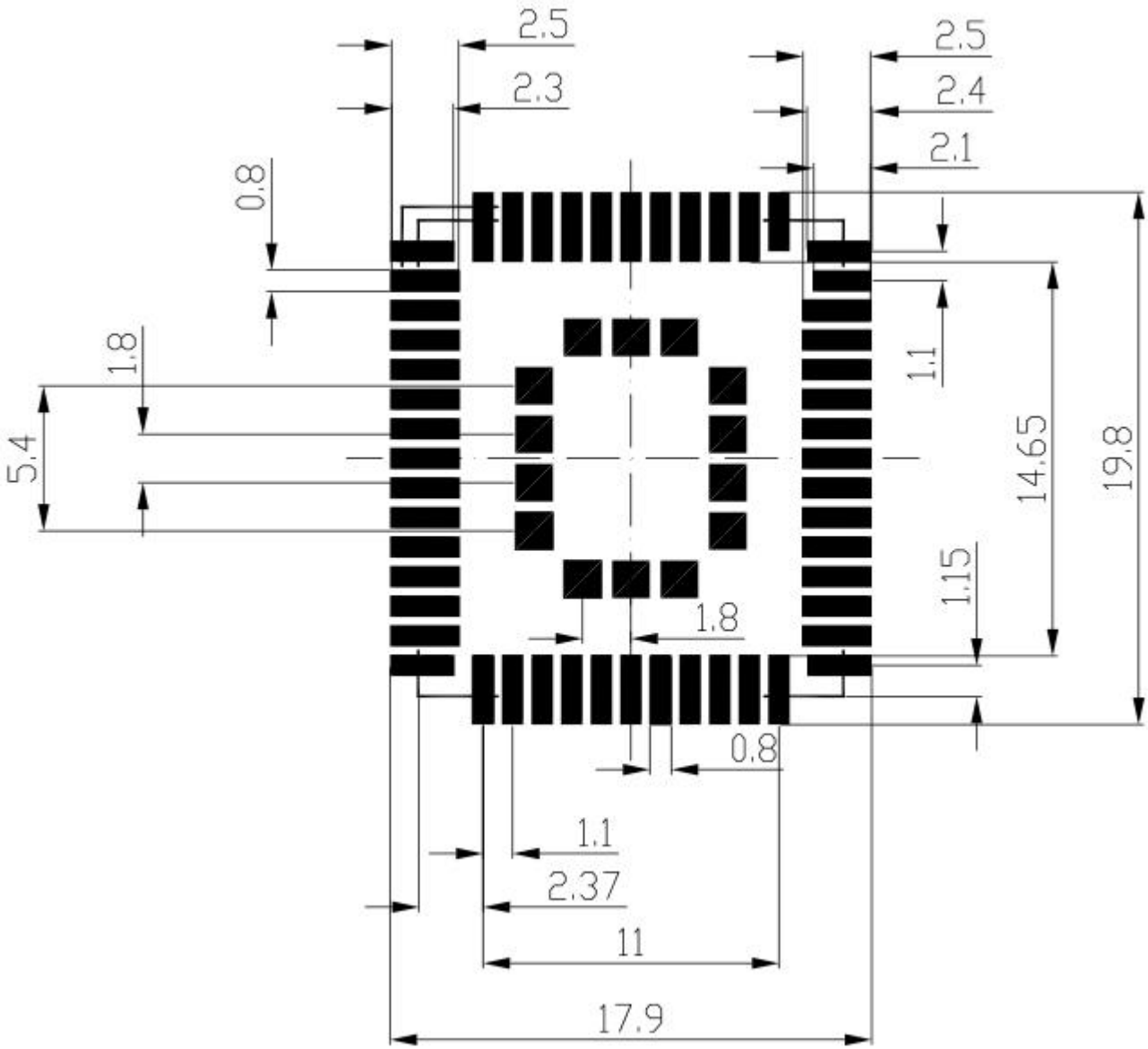


Figure 6-4 Recommended package dimensions (unit: mm)

7 Certification

FCC Statement

15.19

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference. (2) This device must accept any interference received, including interference that may cause undesired operation.

15.21

Note: The grantee is not responsible for any changes or modifications not expressly approved by the party responsible for compliance. Such modifications could void the user's authority to operate the equipment.

15.105(b)

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
• Reorient or relocate the receiving antenna.
• Increase the separation between the equipment and receiver.
• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
• Consult the dealer or an experienced radio/TV technician for help.

RF Exposure Statement
To satisfy FCC RF exposure requirements, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during device operation.
To ensure compliance, operations at closer than this distance is not recommended

Information for the OEM Integrators
This device is intended for OEM integrators only. Please see the full grant of equipment document for restrictions.

Label Information to the End User by the OEM Integrators
If this certified module is installed inside the host device, then the outside of the host must be labeled with “Contains FCC ID: 2ANDL-NM1”.