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A Global Leading IoT Terminals And Wireless Data Solutions Provider

SLM332L Hardware Design Manual

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Revision History

version Number	Time	Author	Revision Description
V1.00	2024-11	Hardware Department	Initial establishment
V1.01	2024-12	Hardware Department	PIN definition description modification
V1.02	2025-1	Hardware Department	Module serial number pin diagram modification
V1.03	2025-3	Hardware Department	Supplement module power consumption data
V1.04	2025-7	Hardware Department	Modify supported frequency band information

Content

1.Introduction

This document defines SLM332L and the air interface and hardware interface between module and customer application.

This document can help customers quickly understand the SLM332L module interface specifications, electrical characteristics, mechanical specifications and related product information. With the help of this document, combined with our application manual and user guide, customers can quickly apply the SLM332L module to wireless applications.

SLM332L wireless module is a broadband wireless terminal product suitable for TDD-LTE/FDD-LTE multiple network standards and multiple frequency bands.

Access rates supported by SLM332L:

- TDD-LTE:8Mbps/2Mbps;
- FDD-LTE:10Mbps/5Mbps;

SLM332L provides wireless data access and can be widely used in the M2M field, such as OTT, CPE, routers, data cards, tablets, security, and industrial grade PDAs.

1.1.Safety Instruction

You can ensure personal safety and help protect your product and work environment from potential damage by following the following safety principles:

	Driving safety first! When you are driving, do not use a handheld mobile terminal unless it has a hands-free function. Please stop and call again!
	Please turn off your mobile terminal device before boarding. The wireless function of the mobile terminal is prohibited to be turned on on the aircraft to prevent interference with the aircraft communication system. Ignoring this reminder may lead to flight safety or even breaking the law.
	In hospitals or health care facilities, pay attention to whether there are restrictions on the use of mobile terminal devices. RF interference can cause medical equipment to malfunction, so mobile terminal equipment may need to be turned off.
	The mobile terminal device cannot be effectively connected under any circumstances, there is no call charge or the SIM is invalid in the mobile device. When you encounter the above situation in an emergency, please remember to make an emergency call, and make sure your device is turned on and in an area with sufficient signal strength.
	Your mobile terminal device receives and transmits radio frequency signals when it is turned on. Radio frequency interference may occur when near televisions, radios, computers or other electronic equipment.
	Keep mobile devices away from flammable gases. When you are near gas stations, oil depots, chemical plants or explosive workplaces, please turn off the mobile terminal equipment. Operating electronic equipment in any potentially explosive location is a safety hazard.

1.2.Document Purpose

This article elaborates on the basic functions, main features, hardware interfaces, usage methods, structural characteristics, power consumption indicators, and electrical characteristics of the SLM332L wireless module, guiding users in the design of embedding the SLM332L module into various application terminals.

1.3.Content List

This article is divided into the following parts:

- Chapter 1, safety instructions, document purpose, revision records, etc;
- Chapter 2, basic functions and main features of the SLM332L wireless module;
- Chapter 3, functions, features, and usage methods of each hardware interface;
- Chapter 4, Related content and precautions of antenna interface;
- Chapter 5, electrical characteristics;
- Chapter 6, structural characteristics and precautions;
- Chapter 7, storage and production considerations;
- Chapter 8, Appendix A Reference Documents and Abbreviations of Terms.

2.Product Overview

2.1.Basic Description

SLM332L is a wireless communication module that supports TDD-LTE/FDD-LTE. Supports TDD-LTE and FDD-LTE network data connections, and can also provide customers with SMS and other functions. Supports WIFIScan (only supported in the Chinese version), GPS/BDS/GLONASS/Galileo/QZSS.

Table 2.1: SLM332L module supports frequency bands

network	SLM332L
TDD-LTE	B34/B38/B39/B40/B41
FDD-LTE	B1/B2/B3/B4/B5/B7/B8/B20/B28/B66

The SLM332L adopts an advanced highly integrated design scheme, integrating RF and baseband on one PCB to complete wireless reception, transmission, and baseband signal processing functions. It adopts a single-sided layout and the module structure size is 15.8 × 17.7 × 2.4mm.

2.2.Main Performance

The following table provides a detailed description of the performance of the SLM332L module.

Table 2.2: List of Main Characteristics of Modules

Feature	Description
power supply	● VBAT Supply voltage range:3.5V ~ 4.35V ● Typical power supply voltage:3.8V
Transmission power	● Class 3 (23dBm±2.7dB) for FDD-LTE bands ● Class 3 (23dBm±2.7dB) for TDD-LTE bands
LTE features	● Maximum support for CAT1 Bis ● Supports RF bandwidth of 1.4~20MHz ● FDD:Maximum upstream speed 5Mbps, maximum downstream speed 10Mbps ● TDD:Maximum upstream speed 2Mbps, maximum downstream speed 8Mbps
location	● Supports Wi Fi Scan positioning and shares the main antenna
Network protocol	● TCP/UDP/MQTT/FTP/FTPS/HTTP/HTTPS/LWM2M/Coap

characteristics	
USIM card interface	● Support USIM/SIM card: 1.8V/3V
PCM interface	● For audio use, an external CODEC chip is required ● Supports 16-bit linear encoding format ● Support short frame mode: the module is only the main device
LCD interface	● Support SPI_LCD ● 240*320
I2C interface	● Support 2 I2C interface
USB interface	● Support USB2.0 ● For AT commands, data transmission, software debugging and upgrades ● USB driver: Support Windows7，Windows 8/8.1，Windows10
Serial port	Main serial port: ● Used for AT commands and data transfer ● The baud rate defaults to 115200bps ● RTS and CTS hardware flow control are supported Debugging serial port: ● Debug use only, log output, non-generic UART
AT command	● Compliant with 3GPP TS 27.007, 27.005, with the addition of MeiG AT command
Network indications	● The NET _ STATUS pin indicates the network state
Antenna interface	● Main antenna interface （ANT_MAIN/WIFI SCAN antenna interface （ANT_MAIN/GNSS interface （ANT_GNSS）
Physical characteristics	● Size: 15.8×17.8×2.4mm
Temperature range	● Normal working temperature : -30℃ ~ +75℃ ● Storage temperature: -40℃ ~ +85℃
Software Upgrades	● USB interface
RoHS	● All devices are fully EU RoHS compliant
Ambient humidity	● 5%~95%
Functional interfaces	● Power interface ● USB2.0 High-Speed interface ● USIM/SIM card interface（support 3V/1.8V） ● Hardware reset interface ● Indicator light interface ● ADC interface

	• UART interface • PCM interface（Optional） • LCM interface • I2C interface • USB_BOOT interface

2.3.Module Function Block Diagram

The following figure lists the main functional parts of the module:

- BB
- RF
- PMU
- Peripheral interface

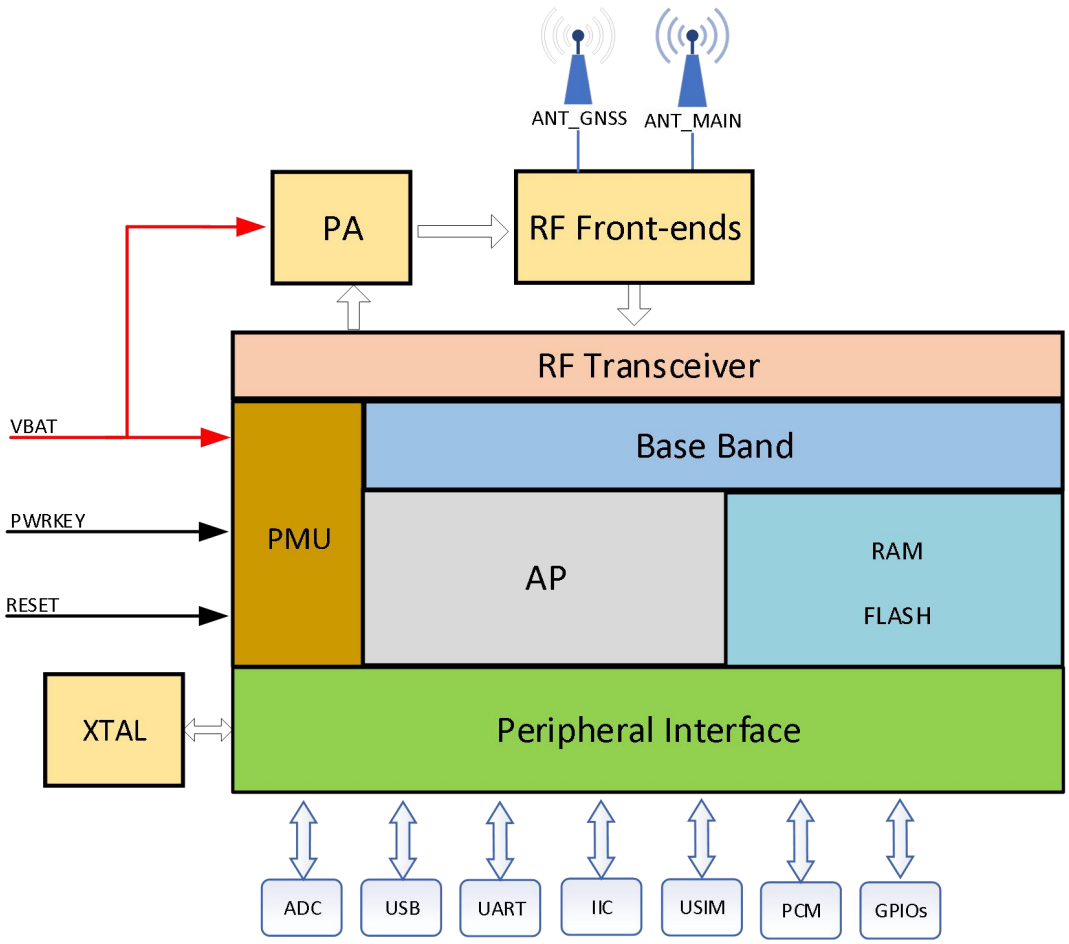


Fig2.1: Module function block diagram

2.4.Evaluation Board

To facilitate the testing and use of SLM332L modules, the company offers a set of evaluation boards. The EVB kit tools include USB cables, antennas, and other peripherals.

For details on how to use the EVB kit, please refer to the SLM332L_ZB User Operation Manual.

3.Application Interface

3.1.Basic Description

SLM332L uses 109 LGA pin interfaces, and provides the following functional interfaces:

- Power interface
- USB2.0 High-Speed interface
- USIM/SIM card interface（support 3V/ 1.8V）
- Hardware reset interface
- Indicator interface
- ADC interface
- UART interface
- PCM interface(Optional)
- I2C interface
- LCD interface
- USB_BOOT interface

3.2.Pin Distribution Diagram

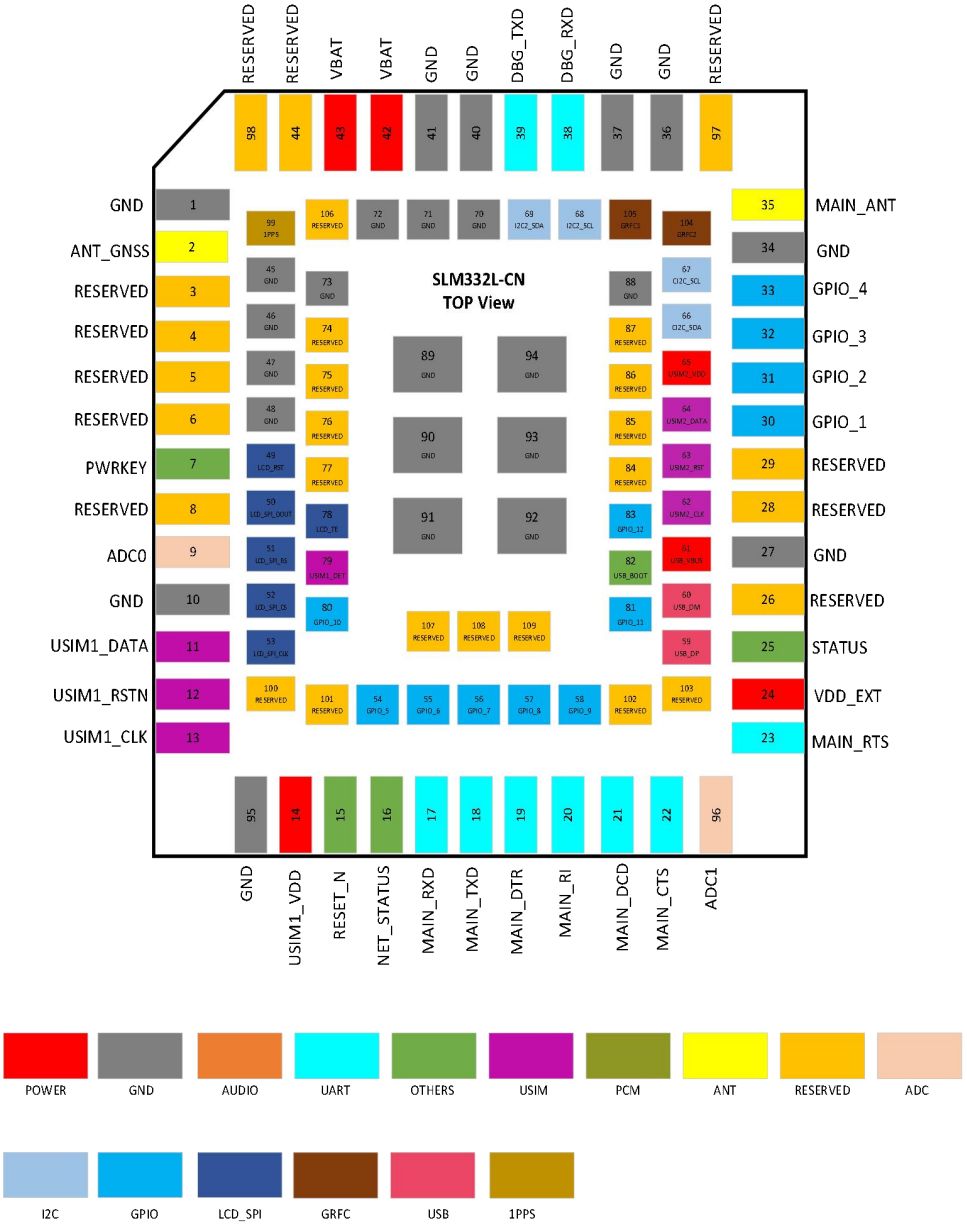


Figure 3.1: Module serial number pins (top view)

3.3.Pin Description

The table below shows the definitions of each pin of the SLM332L module.

Table 3.1: I/O parameter definitions

Type	Description
I/O	Input and output bidirectional signal
AI	Analog input signal
AO	Analog output signal

DI	Digital input signal
DO	Digital output signal
OD	Open-drain output signal
PI	power input
PO	power output

Table 3.2: Pin description

PIN number	PIN name	I/O	Level	Description	Remark
1	GND			GND	
2	ANT_GNSS	AI		GNSS antenna interface	
3	RESERVED				
4	RESERVED				
5	RESERVED				
6	RESERVED				
7	PWRKEY	DI	VILnom=0V VIHnom=VBat	Module power on/off signal valid low	The default high level is consistent with VBAT
8	RESERVED				
9	ADC0	AI	0~1.2V	Analog-to-digital conversion interface. When in use, 1k in series, and when not in use, it is suspended	The input voltage detection range is 0~1.2V
10	GND			GND	
11	USIM1_DATA	DI/O	1.8V/3.0V	SIM Card data signal line	
12	USIM1_RST	DO	1.8V/3.0V	SIM Card reset signal line	
13	USIM1_CLK	DO	1.8V/3.0V	SIM Card clock signal line	
14	USIM1_VDD	PO	1.8V/3.0V	SIM Card power supply	
15	RESET_N	DI	VILnom=0V VIHnom=1.8V	Module reset signal, active at low level	

16	NET_STATUS	DO	0V/1.8V	The network status light indicates, and if not in use, it will be suspended by 1.8V	
17	MAIN_RXD	DI	0V/1.8V	The module receives the data, and when it is not used, it is suspended	For AT commands
18	MAIN_TXD	DO	0V/1.8V	The module sends data, and when it is not used, it is suspended	For AT commands
19	MAIN_DTR	DI	0V/1.8V	DTE is ready, it is not used, it is suspended	
20	MAIN_RI	DO	0V/1.8V	Output ringing prompt,it is not used, it is suspended	
21	MAIN_DCD	DO	0V/1.8V	Module output carrier detection,it is not used, it is suspended	
22	MAIN_CTS	DO	0V/1.8V	DTE Clear sending	
23	MAIN_RTS	DI	0V/1.8V	DTE Request to send	
24	VDD_EXT	PO	1.8V	Module digital level, 1.8V output, 50mA load capacity, not in use, it is suspended	
25	STATUS	DO	0V/1.8V	Run status indicates the pin 1.8V	
26	RESERVED				
27	GND			GND	
28	RESERVED				
29	RESERVED				
30	GPIO_1/PCM_CLK	I/O	0V/1.8V	General GPIO; PCM clock signal	The default GPIO can be configured as a PCM

31	GPIO_2/PCM_SYNC	I/O	0V/1.8V	General GPIO; PCM frame synchronization	interface
32	GPIO_3/PCM_DIN	I/O	0V/1.8V	General GPIO; PCM data input	
33	GPIO_4/PCM_DOUT	I/O	0V/1.8V	General GPIO; PCM data output	
34	GND			GND	
35	ANT_MAIN	AIO		Main set antenna	Main antenna + Wi-Fi antenna
36,37	GND			GND	
38	DEBUG_RXD	DI	0V/1.8V	DEBUG Serial port reception	
39	DEBUG_TXD	DO	0V/1.8V	DEBUG Serial port sending	
40,41	GND			GND	
42	VBAT	PI	Vmax=4.35V Vmin=3.5V Vnorm=3.8V	Power input (3.5V-4.35V)	The external power supply needs to provide a current-carrying capacity of ≥2 A; It is recommended to add a TVS tube externally.
43	VBAT	PI	Vmax=4.35V Vmin=3.5V Vnorm=3.8V	Power input (3.5V-4.35V)	
44	NC				
45~48	GND			GND	
49	LCD_RST	DO	0V/1.8V	LCD reset signal	
50	LCD_SPI_DOUT	DO	0V/1.8V	LCD data output	
51	LCD_SPI_RS	DO	0V/1.8V	LCD Select Data/Commands	Select whether to send data or commands to the LCD
52	LCD_SPI_CS	DO	0V/1.8V	Select the LCD communication module	Select the LCD module you want to communicate with
53	LCD_SPI_CLK	DO	0V/1.8V	LCD clock	
54	GPIO_5	I/O	0V/1.8V	General GPIO	
55	GPIO_6	I/O	0V/1.8V	General GPIO	
56	GPIO_7	I/O	0V/1.8V	General GPIO	

57	GPIO_8	I/O	0V/1.8V	General GPIO	There will be a period of high output at the beginning of the power-up, so it is not recommended to use it as an external control circuit
58	GPIO_9	I/O	0V/1.8V	General GPIO	
59	USB_DP	I/O		USB DP signal	
60	USB_DM	I/O		USB DM signal	
61	USB_VBUS	AI	Vmin = 3.5 V Vnorm=5.0V	USB insert detection	
62	USIM2_CLK	DO	1.8V	SIM card clock signal line	SIM2 only supports 1.8V
63	USIM2_RST	DO	1.8V	SIM card reset signal line	
64	USIM2_DATA	DI/O	1.8V	SIM card data signal line	
65	USIM2_VDD	PO	1.8V	SIM card power supply	
66	CI2C_SDA	OD	0V/1.8V	CI21 Serial data signal	
67	CI2C_SCL	OD	0V/1.8V	CI21 Serial clock signal	
68	I2C2_SCL	OD	0V/1.8V	I2C2 Serial clock signal	
69	I2C2_SDA	OD	0V/1.8V	I2C2 Serial data signal	
70~73	GND			GND	
74	RESERVED				
75	RESERVED				
76	RESERVED				
77	RESERVED				
78	LCD_TE		0V/1.8V	LCD Frame synchronization signal	
79	USIM1_DET	DI	0V/1.8V	USIM1 Card hot-swap detection	

80	GPIO_10	I/O	0V/1.8V	General GPIO	
81	GPIO_11	I/O	0V/1.8V	General GPIO	
82	USB_BOOT	DI	0V/1.8V	Force into emergency download mode control	The low level is valid, please keep it in the floating state by default, and it is recommended to reserve the test point
83	GPIO_12	I/O	0V/1.8V	General GPIO	
84	RESERVED				
85	RESERVED				
86	RESERVED				
87	RESERVED				
88~95	GND			GND	
96	ADC1	AI	0~1.2V	The analog-to-digital conversion interface is connected in series with 1K when used, and is suspended when not in use	The input voltage detection range is 0~1.2V
97	RESERVED				
98	RESERVED				
99	1PPS	DO	0V/1.8V	GNSS pulse output per second	It is forbidden to pull the pin low
100	RESERVED				
101	RESERVED				
102	RESERVED				
103	RESERVED				
104	GRFC2	DO	0V/1.8V	Universal RF control	
105	GRFC1	DO	0V/1.8V	Universal RF control	
106	RESERVED				
107	RESERVED				
108	RESERVED				
109	RESERVED				

remark:

1. The above interface functions are not supported at the same time, and some pins are multiplexed functions, please pay attention when selecting!

3.4.Power Supply

Table 3.3: Description of the power interface of the SLM332L module

PIN name	I/O	PIN name	Description
VBAT	PI	42,43	Module power supply, 3.5~4.35V, nominal value 3.8V
VDD_EXT	PO	24	1.8V output, 50mA load capacity

3.4.1.Power Supply

SLM332L module needs to be powered by VBAT pins, as shown in Figure 3.2:

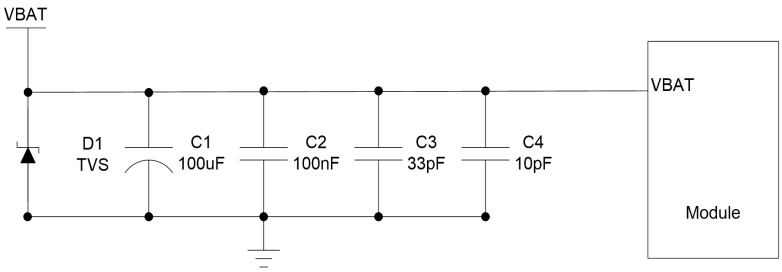


Figure 3.2: Module power supply circuit

To reduce voltage dips, a 100uF filter capacitor with low ESR is required. Chip multilayer ceramic capacitors (MLCCs) have the best ESR, and it is recommended to add 3 ceramic capacitors (100nF, 33pF, 10pF) to the VBAT pins, and the capacitors should be placed close to the VBAT pins. At the same time, in order to ensure better power supply performance, a TVS tube is added near the VBAT input of the module to improve the electrostatic resistance of the module, and the VBAT needs to be traced in a star shape when the external power supply is connected to the module. The width of the VBAT trace should not be less than 1.5mm. In principle, the longer the VBAT trace, the wider the line width.

3.4.2.Reduces Voltage Dips

The power supply range of the SLM332L is 3.5V~4.35V, and when data transmission or calling, the instantaneous high-power transmission will form a current peak of up to 1.5A, which will lead to a large ripple of VBAT, if the instantaneous voltage drop causes the VBAT power supply voltage to be too low, the module will restart or shut down. In order to ensure the normal operation of the module, the power supply must have sufficient power supply capacity, and the input voltage must not be less than 3.5V.

Figure 3.3 below shows the voltage dip during burst transmission under a 4G network.

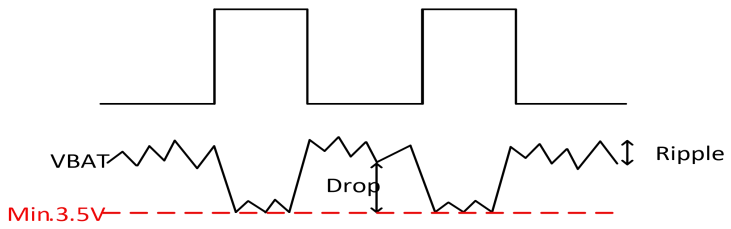


Figure 3.3:Burst transmission power requirements

3.4.3.Power Supply Reference Circuit

The design of the module power supply is very important, because a large part of the performance of the module depends on the power supply. SLM332L must choose a power supply capable of delivering at least 1.5A of current. If the voltage difference between the input voltage and the power supply voltage of the module is not large, we recommend that you select LDO as the power supply. If there is a large voltage difference between the input and output voltages, it is recommended to use DCDC as the power supply for the module.

The diagram below is a reference design for a +5V power supply circuit. The design is based on an LDO from Micrel, model MIC29302WU. It has a typical output voltage of 3.9V and a peak load current of 3A.

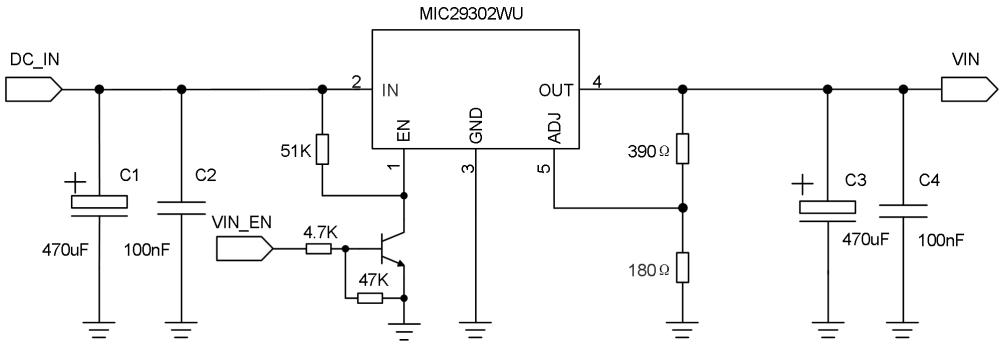


Figure 3.4:Power supply input reference design

3.4.4.VDD_EXT Voltage Output

When the SLM332L module is powered on normally, there is a voltage output on Pin24, the default output voltage is 1.8V, and the current load is 50mA. This output voltage can be used as an external pull-up source, such as a level reference, and it can also read the pin level status to determine whether the module is powered on.

3.5.Power On/Off

3.5.1.PWRKEY Power On

PIN name	I/O	PIN number	Description
PWRKEY	DI	7	Power on and off signal

After the system is powered off and detects that the PWRKEY is pulled down for more than 2 seconds, the chip is powered on and the boot process begins. The reference circuits are as follows:

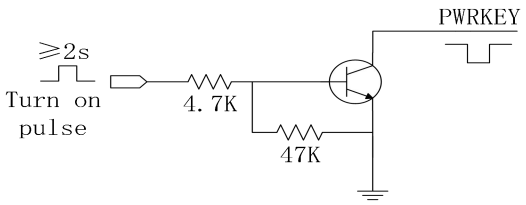


Figure 3.5:Drive the power-on reference circuit

Another way to control the PWRKEY pins is to switch directly through a pushbutton, and a TVS should be placed near the button for ESD protection, the reference circuit is as follows:

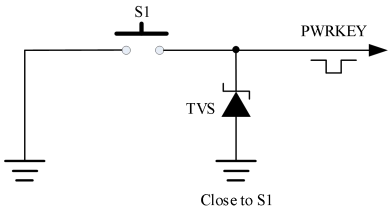


Figure 3.6: Button to power on reference circuit

The boot sequence is shown in the following figure:

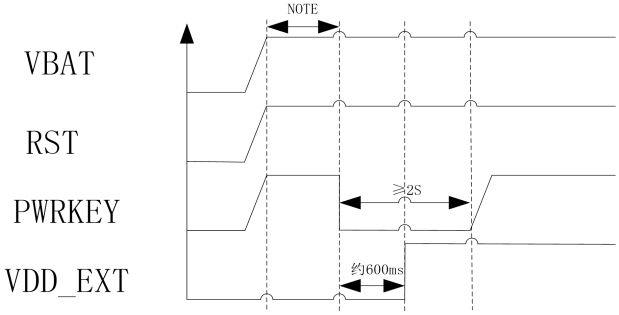


Figure 3.7:Boot sequence diagram

Remark:

Before pulling down the PWRKEY pin, the VBAT voltage needs to be stabilized.

3.5.2.PWRKEY Shutdown

Module shutdown:

Shutdown mode	Shutdown method	Applicable scenarios
Low voltage shutdown	When the VBAT voltage is too low or the power is off, the module will shut down	At this time, the module did not carry out the normal shutdown process, and did not go through the process of logging off from the base station
Hardware shutdown	Pull down PWRKEY (greater than 3s) and then release	Normal shutdown
AT shutdown	AT command	Software shutdown

Remark:

1. When the module is working normally, do not cut off the power of the module immediately to avoid damaging the Flash data inside the module. It is recommended to use the AT command to turn off the module before disconnecting the power supply.

2. When using the AT command to shut down, make sure that the PWRKEY is always in a high state after the shutdown command is executed, otherwise the module will automatically power on again after the shutdown is completed.

Shutdown timing:

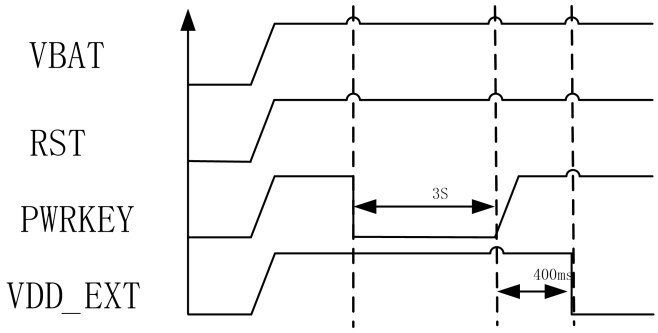


Figure 3.8:Shutdown timing diagram

3.6.Module Reset

PIN name	I/O	PIN number	Description
RESET_N	DI	15	Reset signal

There are two ways to SLM332L reset: hardware reset and AT command reset. When the module is working, the software mode is to use the AT command to reset, and the hardware reset mode is to pull down the RESET_N pin for at least 150ms and then release it to reset the module. RESET_N signal is sensitive to interference, so it is recommended that the traces on the module interface board should be as short as possible and need to be handled in a package manner.

The reference circuit is similar to the PWRKEY control circuit, and the customer can use the drive circuit or push button to control the pins RESET_N.

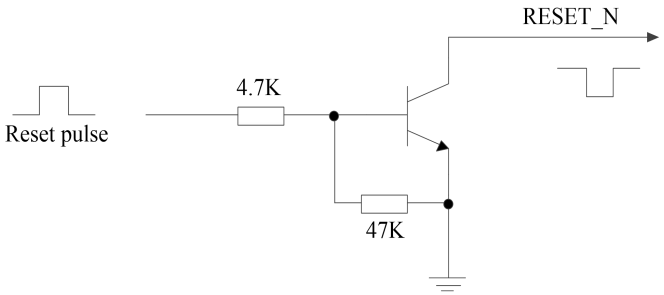


Figure 3.9:Drive the reset reference circuit

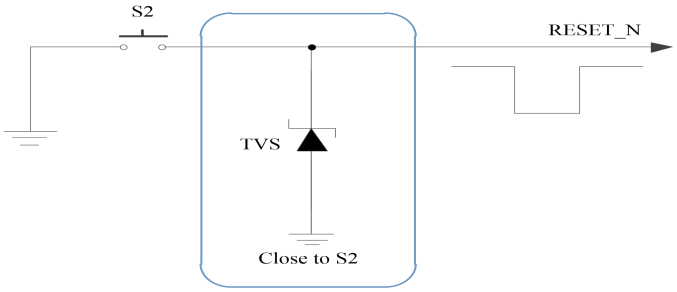


Figure 3.10:Key reset reference circui

The reset timing diagram is shown below:

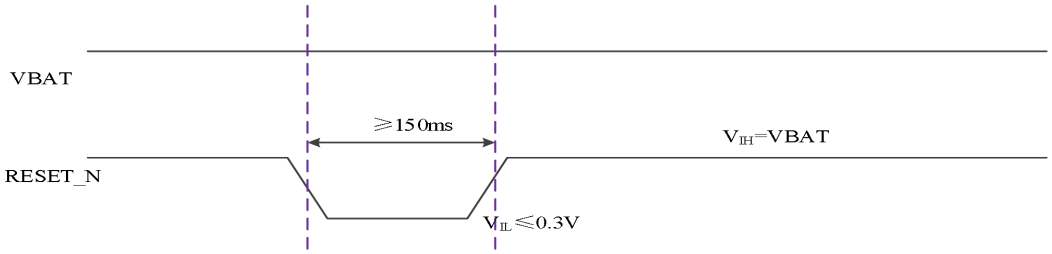


Figure 3.11:RESET_N reset timing diagram

3.7.USIM Interface

SLM332L supports 1.8V and 3.0V SIM cards.SIM1 supports 1.8V and 3.0V, and SIM2 can only support 1.8V.

Table 3.4: USIM interface description

PIN name	I/O	PIN number	Description
USIM1_DATA	DIO	11	SIM1 Card data signal line
USIM1_RST	DO	12	SIM1 Card reset signal line
USIM1_CLK	DO	13	SIM1 Card clock signal line
USIM1_VDD	PO	14	SIM1 Card power supply
USIM1_DET	DI	79	USIM1 card hot-swap detection
USIM2_CLK	DO	62	SIM2 card clock signal line
USIM2_RST	DO	63	SIM2 card reset signal line
USIM2_DATA	DIO	64	SIM2 card data signal line
USIM2_VDD	PO	65	SIM2 card power supply

The SLM332L module supports the USIM card hot-swap function through the USIM1_DET pin, and after the SIM card holder is inserted into the card, the SIM_DET pin is low, and when the SIM_DET pin level is high, no card is detected. Whether the SIM card hot-swap function is enabled can be configured by the AT command, which is enabled by default and recognizes the card at low level.

The circuit design of SIM card with hot-swappable function is as follows:

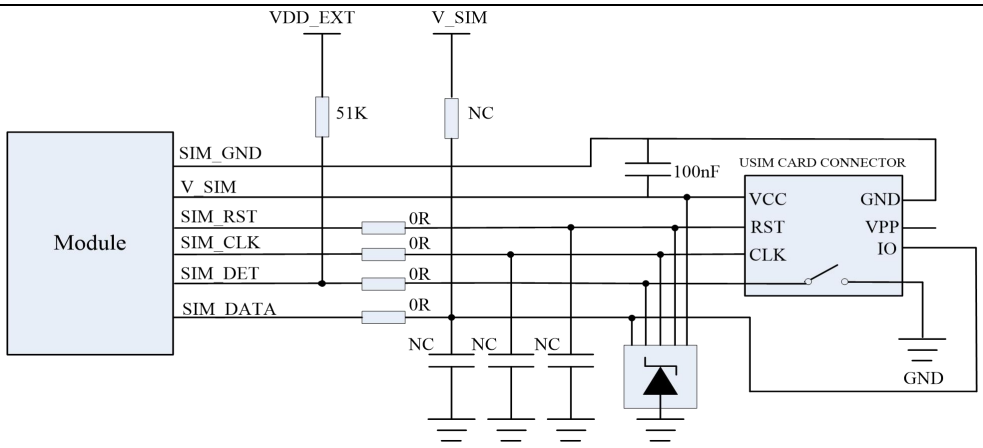


Figure 3.12:Reference design drawing of the card holder with hot-swappable function

If you don't need to use the SIM card hot-swap detection function, the USIM1_DET pins can be floated. The reference circuits are as follows:

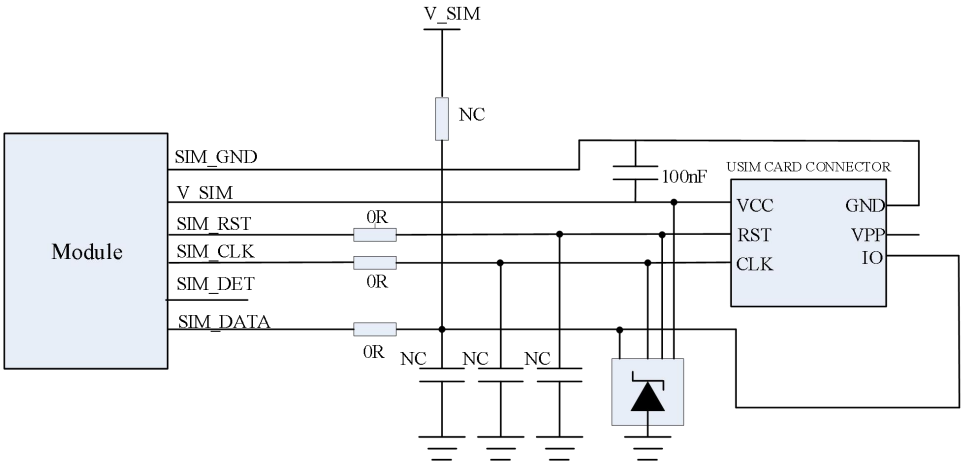


Figure 3.13:Reference design drawing of deck without hot-swappable function

In the circuit design of the USIM card interface, in order to ensure the good performance and reliability of the SIM card, the following design principles are recommended to be followed in the circuit design:

- A 0Ω resistor is reserved on the SIM_DATA, SIM_CLK and SIM_RST lines for easy debugging;
- In order to improve the antistatic ability, ESD protection devices with low parasitic capacitance are added to the SIM_VDD, SIM_DATA, SIM_CLK and SIM_RST lines;
- SIM card peripherals should be placed as close to the SIM card holder as possible;
- The SIM card holder is placed close to the module, and the wiring length of the SIM card signal cable should not exceed 100mm;
- The SIM card signal cable is routed away from the RF line and VBAT power line;
- In order to prevent crosstalk between the SIM_CLK signal and the SIM_DATA, the wiring of the two signals should not be too close to each other, and the ground shielding between the two traces should be increased.

3.8.USB Interface

SLM332L provides a USB interface that complies with the USB 2.0 specification. This interface is used for AT command interaction, data transmission, software debugging, and version upgrade.

3.8.1.USB PIN Description

SLM332L module provides a USB2.0 interface.

Table 3.5:USB interface description

PIN name	I/O	PIN number	Description
USB_DP	I/O	59	USB DP signal
USB_DM	I/O	60	USB DM signal
USB_VBUS	AI	61	USB insert detection

3.8.2.USB Reference Circuit

The USB interface application reference circuit of the SLM332L module is shown in the following figure.

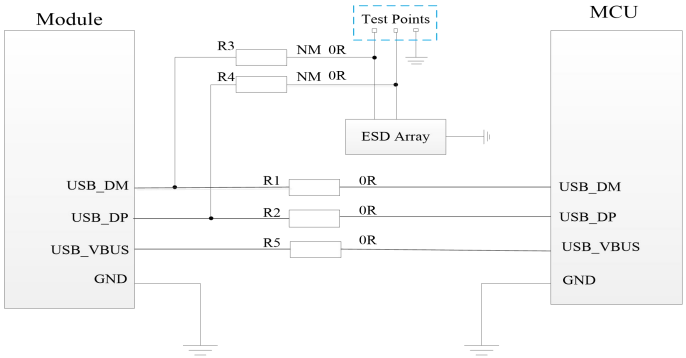


Figure 3.14:USB interface reference design

In order to meet the signal integrity requirements of the USB cable, resistors R1/R2/R3/R4 must be placed close to the module and close to each other. The leg connecting the test point must be as short as possible. In the design of USB interface circuits, in order to ensure USB performance, the following principles are recommended in the circuit design:

- Reduce the signal interference during USB high-speed data transmission, and connect R1 and R2 in series on the USB_DM and USB_DP interface circuits to improve the accuracy of data transmission, and 0Ω is recommended for both R1 and R2;
- In order to improve the antistatic performance of the USB interface, it is recommended to add ESD protection devices to the USB_DP and USB_DM interface circuits, and it is recommended to use ESD devices with junction capacitance less than 1pF. The ESD protection device for USB is placed as close to the USB interface as possible;
- In order to ensure the reliable operation of USB, more consideration should be given to the protection of USB in the design, such as the protection of USB during Layout, which needs to

control the impedance of USB_DP and USB_DM at 90Ω, and route the wires strictly according to the differential requirements to keep away from the interference signal as much as possible;

- Do not take the USB cable under the crystal oscillator, oscillator, magnetic device and RF signal, it is recommended to use the inner differential cable and wrap the ground up, down, left and right.

3.9.Serial Port

SLM332L module has 3 serial ports: the main serial port and the debug debug UART.The main features of the main and debug serial ports are described below.

- The default baud rate of the main serial port is 115200bps, which is used for download and AT commands.
- The debugging serial port is only used for debugging, and the log output is not a general UART.

Table 3.6:Description of the pins of the main serial port

PIN name	I/O	PIN number	Description
MAIN_CTS	DO	22	DTE Clear sending
MAIN_RTS	DI	23	DTE Request to send
MAIN_RXD	DI	17	The module receives the data, and when it is not used, it is suspended
MAIN_TXD	DO	18	The module sends data, and when it is not used, it is suspended
MAIN_DTR	DI	19	DTE is ready, it is not used, it is suspended
MAIN_RI	DO	20	Output ringing prompt,it is not used, it is suspended
MAIN_DCD	DO	21	Module output carrier detection,it is not used, it is suspended

Table 3.7:Description of the debugging serial port tube pin

PIN name	I/O	PIN number	Description
DEBUG_RXD	DI	38	DEBUG serial port reception
DEBUG_TXD	DO	39	DEBUG serial port sending

Table 3.8:Serial logic level

Parameter	Minimum	Maximal	Unit
V_{IL}	-0.3	0.6	V
V_{IH}	1.2	2.0	V
V_{OL}	0	0.45	V
V_{OH}	1.35	1.8	V

The serial port level of the SLM332L module is 1.8V. If the client host is 3.3V, a level shifter needs to be added to the serial application. The following diagram shows the reference design:

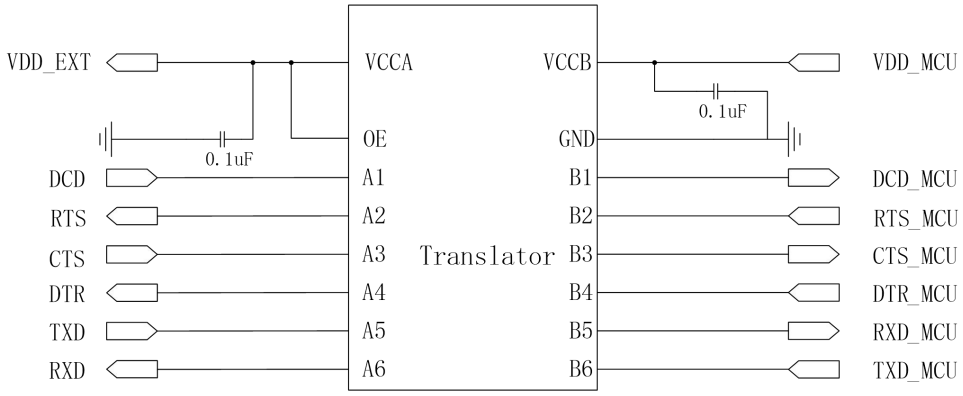


Figure 3.15: level translation chip reference circuit

Another level-shifting circuit is shown in the figure below. For the design of the input and output circuits of the dotted line section below, please refer to the solid line part, but pay attention to the connection direction. At the same time, this level-shifting circuit is not suitable for applications with baud rates greater than 460Kbps.

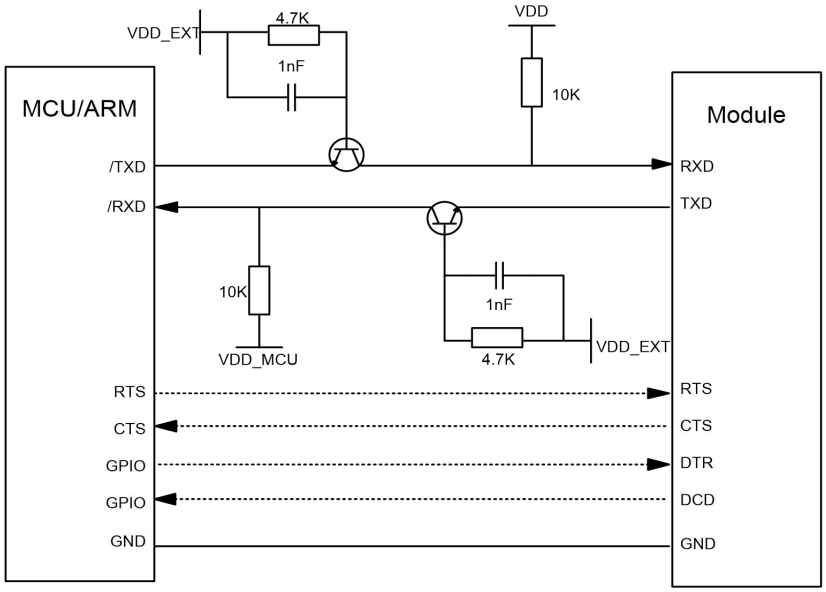


Figure 3.16:UART signal connection

3.10.Status Indication

The status indicator pin is mainly used to drive the network status indicator. SLM332L module has STATUS, which NET_STATUS two status indicator pins. The following two tables describe the pin definitions and logic level changes for different network states, respectively.

Table 3.9: Status indicates the pin description

PIN name	I/O	PIN number	Description
STATUS	DO	25	The module running status light indicates that the output level is high after the

			module is powered on
NET_STATUS	DO	16	Module network status light indication

Table 3.10: NET _ STATUS indicates the working state of the pin

PIN name	Pin working status	The indicated working status
NET_STATUS	Slow flash（200ms high/1800ms low）	Find the network status
	Slow flash（1800ms high/200ms low）	Standby state
	Quick flash（125ms high/125ms low）	Data transfer mode
	High level	On a call

NET_STATUS It is used to indicate the working status of the network of the module, and the reference circuit is shown in the following figure:

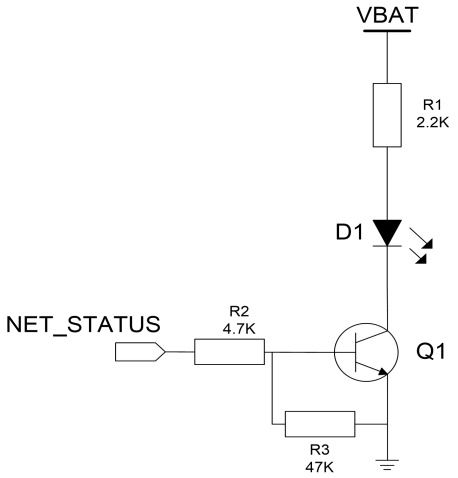


Figure 3.17:NET_STATUS reference circuit

STATUS is used to indicate the working status of the module, and the reference circuit is shown in the following figure:

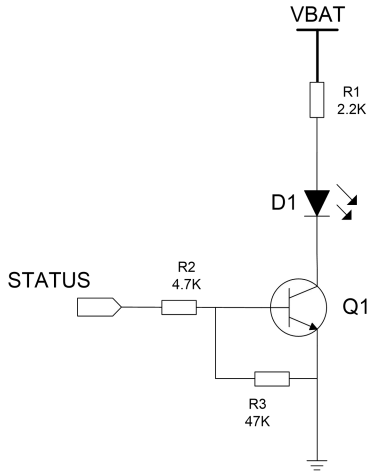


Figure 3.18:STATUS reference circuit

3.11.Low Power Mode

3.11.1.Airplane Mode

The module supports AT commands to enter airplane mode.

3.11.2.Ultra-low Power Mode

The module supports the use of AT commands to make the module enter the ultra-low-power mode.

3.12.ADC Function

SLM332L provides two 12-bit analog-to-digital conversion interfaces with an ADC voltage range of 0-1.2V.

Table 3.11: ADC pin description

PIN name	I/O	PIN number	Description
ADC0	AI	9	The analog-to-digital conversion interface is connected in series with 1K when used, and is suspended when not in use
ADC1	AI	96	The analog-to-digital conversion interface is connected in series with 1K when used, and is suspended when not in use

Remark:

1. When the module is not powered by VBAT, the ADC interface cannot be directly connected to any input voltage.

2. It is recommended that the ADC pins have a voltage-divider circuit input.

3. It is recommended that the ADC be ground wrapped when wiring, which can improve the accuracy of the ADC voltage measurement.

3.13.USB _ BOOT Interface

SLM332L supports USB_BOOT features. Customers can short the USB_BOOT to ground before the module is turned on and then turn it on, and the module will enter the forced download mode. In this mode, the module can be software upgraded via the USB interface.

Table 3.12: USB_BOOT pin definition

PIN name	I/O	PIN number	Description
USB_BOOT	DI	82	Forced download mode, the low level is effective

3.14.I2C Interface

Table 3.13: I2C pin definition

PIN name	I/O	PIN number	Description
CI2C_SCL	OD	67	CI2 1interface clock signal
CI2C_SDA	OD	66	CI21 interface data signal
I2C2_SCL	OD	68	I2C2 interface clock signal
I2C2_SDA	OD	69	I2C2 interface data signal

3.15.GPIO Interface

Table 3.14:GPIO pin definition

PIN name	I/O	PIN number	Description
GPIO_1/PCM_CLK	I/O	30	General GPIO; PCM clock signal
GPIO_2/PCM_SYNC	I/O	31	General GPIO; PCM frame synchronization
GPIO_3/PCM_DIN	I/O	32	General GPIO; PCM data input
GPIO_4/PCM_DOUT	I/O	33	General GPIO; PCM data output
GPIO_5	I/O	54	General GPIO
GPIO_6	I/O	55	General GPIO
GPIO_7	I/O	56	General GPIO
GPIO_8	I/O	57	General GPIO;There will be a period of high output at the beginning of the power-up, so it is not recommended to use it as an external control circuit
GPIO_9	I/O	58	General GPIO
GPIO_10	I/O	80	General GPIO
GPIO_11	I/O	81	General GPIO
GPIO_12	I/O	83	General GPIO

3.16.LCD Interface

Table 3.15:LCD pin definition

PIN name	I/O	PIN number	Description
LCD_RST	DO	49	LCD reset signal
LCD_SPI_DOUT	DO	50	LCD data output
LCD_SPI_RS	DO	51	LCD Select Data/Commands
LCD_SPI_CS	DO	52	LCD chip selection signal
LCD_SPI_CLK	DO	53	LCD clock
LCD_TE	DI	78	LCD tearing effect

4.Antenna Interface

The SLM332L module is designed with two antenna interfaces, and the antenna interface impedance is 50Ω.

Table 4.1: Antenna interface pin definition

PIN name	PIN number	Description	I/O	Comment
ANT_MAIN	35	Main antenna / WIFI SCAN antenna interface	IO	50Ω
ANT_GNSS	2	GNSS antenna interface	IO	50Ω

4.1.Antenna Interfaces

SLM332L provides two antenna pins: ANT_MAIN and ANT_GNSS.It is recommended that users use an antenna with a 50Ω impedance that matches the RF connector on the module side.

Remark:

In order to ensure the communication capability of all frequency bands

It is recommended that the application side carefully select the RF adapter cable. It is necessary to select an RF adapter cable with the lowest possible loss. RF adapter cables are recommended for the following RF loss requirements:

- TDD-LTE<1.2dB;
- FDD-LTE<1.2dB;

RF connector recommendation:

Product name		MHF®4L LK	MHF®4L	MHF®4L	MHF®4L	MHF®4
Appearance						
		MHF 4L with Mechanical lock	Best Insertion Loss and VSWR	Industry Standard for M.2	Industry Standard for M.2	low profile1.20 mm
Plug part number		-	20632-001R-37	20565-001R-13	20572-001R-08	20611-001R
Receptacle part number		20449-001E-**(MHF 4) 20579-001E(MHF 4L)				
Maximum height (mm)		2.0	1.7	1.4	1.2	1.2
Outside dimension of receptacle (mm)		2.0 x 2.0				
Coax O.D. (Center Conductor AWG)	2.00 mm (26)					
	1.80 mm (30)					
	1.37 mm (30)	●	●			
	1.32 mm (32)					
	1.13 mm (32)			●		
	0.95 mm (33)			●		
	0.81 mm (33)					
	0.81 mm (36)				●	●
	0.64 mm (36)				●	
	0.48 mm (38)					
Frequency		DC - 12 GHz				DC - 6 GHz
VSWR (L=100mm)	DC - 3 GHz	1.3 max.				
	3 GHz - 6 GHz	1.4 max.		1.45 max		1.5 max.
	6 GHz - 9 GHz	1.5 max.		1.6 max.		-
	9 GHz - 12 GHz	1.6 max.		1.9 max.		-
	12 GHz - 15 GHz	-				
Service temp. (Celsius)		-40 degree - 90 degree				
Characteristic impedance		50ohm				
Rated voltage		AC60V				
Contact resistance		20m ohm max.				
Withstand voltage		AC200V/min				
Insulation resistance		500M ohm min./DC100V				

Figure 4.1: RF connectors

4.2.RF Reference Circuit

4.2.1.Antenna Connection

The ANT_MAIN antenna connection reference design circuit is shown in the figure below. In order to obtain better RF performance, there are four things to keep in mind when designing schematics and PCB layouts:

1. Schematic design, close to the RF port of the module to reserve π matching circuit, capacitors are not pasted by default;

2. Schematic design, redundant RF connector between the RF port of the module and the antenna for certification testing, and the RF connector can not be pasted after mass production and delivery; (Reference: RF Connector C88P132-00001-H);

3. Schematic design, the π matching circuit is reserved near the antenna end, and the capacitor is not attached by default;

4. PCB layout, the trace between the RF port of the module and the antenna is as short as possible, and the board factory needs to do 50Ω impedance control for the RF trace.

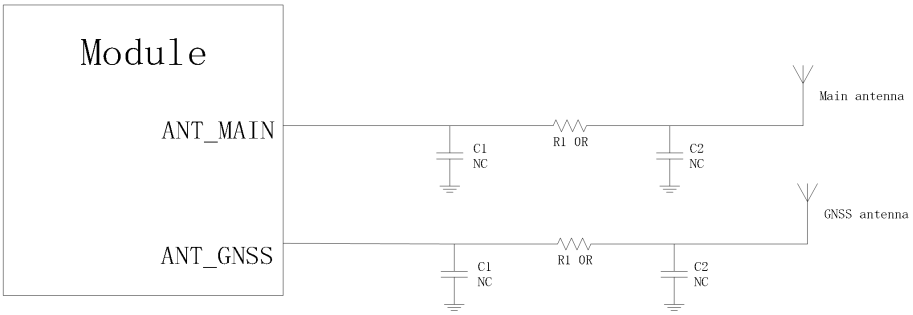


Figure 4.35V:RF reference circuits

4.2.2.RF Signal Line Wiring

For the user's PCB, the characteristic impedance of all RF signal lines should be controlled to 50 Ω. In general, the impedance of an RF signal line is determined by the dielectric constant of the material, the width of the trace (W), the clearance to ground (S), and the height of the reference ground plane (H). The characteristic impedance of the PCB is usually controlled in two ways: microstrip line and coplanar waveguide. To illustrate the design principles, the following diagrams illustrate the structural design of a microstrip line and a coplanar waveguide with an impedance line controlled at 50 Ω.

- Microstrip line complete structure

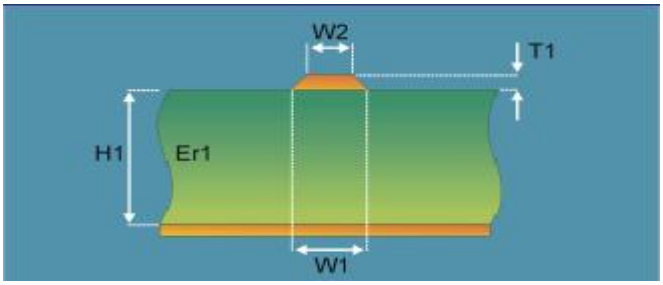


Figure 4.3: Two-layer PCB board microstrip line structure

- Coplanar waveguide complete structure

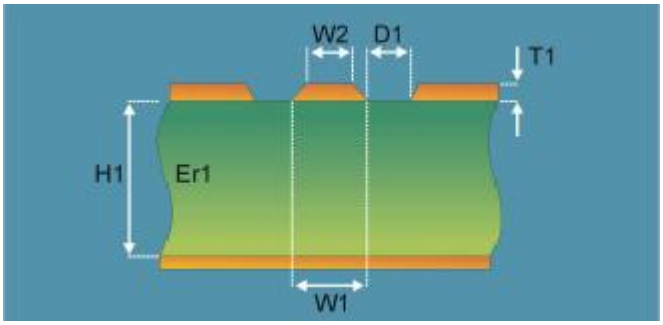


Figure 4.4: Two-layer PCB board coplanar waveguide structure

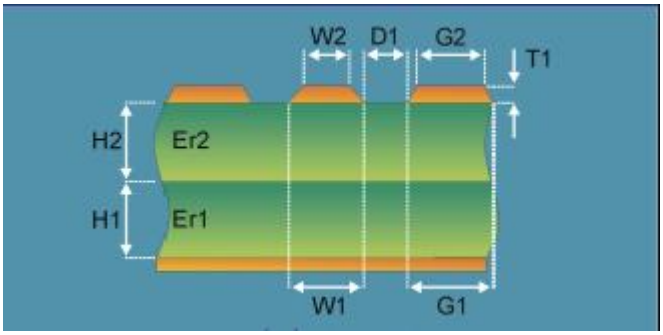


Figure 4.5:Multilayer PCB coplanar waveguide structure (reference ground is the third layer)

Remark:

W1: Maximum line width W2: Minimum line width T1:Copper thickness H1:Plate media thickness ERI:Plate dielectric constant

In the circuit design of RF antenna interface, the following design principles are recommended to ensure the good performance and reliability of RF signals:

- Impedance simulation calculation tools should be used to accurately control the 50Ω impedance of the RF signal line;
- The GND pin adjacent to the RF pin should not be a hot pad, but should be in full contact with the ground;
- The distance between the RF pins and the RF connector should be as short as possible; At the same time, right-angle wiring is avoided, and the recommended wiring angle is 135°;
- When the connection device package is established, it should be noted that the signal pin should be kept at a certain distance from the ground;
- The ground plane referenced by the RF signal line should be intact; Adding a certain amount of ground holes around the signal line and reference ground can help improve RF performance; The distance between the ground hole and the signal line should be at least 2 times the line width (2 × W);
- RF signal lines must be kept away from the source of interference and avoid crossing or parallel to any signal lines in adjacent layers.

4.3.Antenna Installation

4.3.1.Antenna Requirements

The requirements for the antenna receiving antenna are shown in the table below:

Table 4.35V: Antenna requirements

Type	requirement
TDD-LTE/FDD-LTE	VSWR: < 2
	Gain（dBi）： LTE Band2: 2.09 LTE Band4: 2.40 LTE Band5: 2.52 LTE Band7: 3.20 LTE Band66: 2.40
	Maximum input power（W）: 2W
	input impedence (ohm）: 50
	Polarization Type: Vertical
	Cable insertion loss: < 1.5dB (LTE B1/B3/B5/B8/B34/B39)
	Cable insertion loss: < 2dB (LTE B38/B40/B41)

4.3.2.RF Output Power

The RF output power of the SLM332L is shown in the table below.

Table 4.3:SLM332L RF emission power

Frequency	Maximum	Minimum
LTE-FDD B1	23dBm±2.7dB	<-39dBm
LTE-FDD B2	23dBm±2.7dB	<-39dBm
LTE-FDD B3	23dBm±2.7dB	<-39dBm
LTE-FDD B4	23dBm±2.7dB	<-39dBm
LTE-FDD B5	23dBm±2.7dB	<-39dBm
LTE-FDD B7	23dBm±2.7dB	<-39dBm
LTE-FDD B8	23dBm±2.7dB	<-39dBm
LTE-FDD B20	23dBm±2.7dB	<-39dBm
LTE-FDD B28	23dBm±2.7dB	<-39dBm

LTE-FDD B66	23dBm±2.7dB	<-39dBm
LTE-TDD B34	23dBm±2.7dB	<-39dBm
LTE-TDD B38	23dBm±2.7dB	<-39dBm
LTE-TDD B39	23dBm±2.7dB	<-39dBm
LTE-TDD B40	23dBm±2.7dB	<-39dBm
LTE-TDD B41	23dBm±2.7dB	<-39dBm

4.3.3.RF Receive Sensitivity

Table 4.4: SLM332L RF receiving sensitivity

Frequency	Receiving sensitivity （Typical BW）-10M			
	Main set	Episode	Main set + set	3GPP （ Main set + set）
LTE-FDD B1	-97dBm	NA	NA	-96.3dBm
LTE-FDD B2	-97dBm	NA	NA	-94.3dBm
LTE-FDD B3	-97dBm	NA	NA	-93.3dBm
LTE-FDD B4	-97dBm	NA	NA	-96.3dBm
LTE-FDD B5	-98dBm	NA	NA	-94.3dBm
LTE-FDD B7	-97dBm	NA	NA	-94.3dBm
LTE-FDD B8	-98dBm	NA	NA	-93.3dBm
LTE-FDD B20	-98dBm	NA	NA	-93.3dBm
LTE-FDD B28	-98dBm	NA	NA	-94.8dBm
LTE-FDD B66	-97dBm	NA	NA	-95.8dBm
LTE-TDD B34	-97.5dBm	NA	NA	-96.3dBm
LTE-TDD B38	-97.5dBm	NA	NA	-96.3dBm
LTE-TDD B39	-97.5dBm	NA	NA	-96.3dBm
LTE-TDD B40	-97.5dBm	NA	NA	-96.3dBm
LTE-TDD B41	-97.5dBm	NA	NA	-94.3dBm

Remark:

Other sub-models and frequency band information will be reflected in subsequent versions of the document.

4.3.4.Operating Frequency

Table 4.5:SLM332L operating frequency

3GPP frequency band	Transmit	Receive	Unit
LTE-FDD B1	1920~ 1980	2110~2170	MHz

LTE-FDD B2	1850~ 1910	1930~ 1990	MHz
LTE-FDD B3	1710~ 1785	1805~ 1880	MHz
LTE-FDD B4	1710~ 1755	2110~2155	MHz
LTE-FDD B5	824~849	869~894	MHz
LTE-FDD B7	2500~2570	2620~2690	MHz
LTE-FDD B8	880~915	925~960	MHz
LTE-FDD B20	832~862	791~821	MHz
LTE-FDD B28	703~748	758~803	MHz
LTE-FDD B66	1710~ 1780	2110~2180	MHz
LTE-TDD B34	2010~2025	2010~2025	MHz
LTE-TDD B38	2570~2620	2570~2620	MHz
LTE-TDD B39	1880~1920	1880~1920	MHz
LTE-TDD B40	2300~2400	2300~2400	MHz
LTE-TDD B41	2540~2650	2540~2650	MHz

4.3.5.OTA Antenna Requirements

Table 4.6:Antenna specification requirements

Network Mode	Band	VSWR	Gain		Effi.	SAR	TRP (dBm)	TIS (dBm)
			Peak	Avg.				
TDD-LTE	Band34	<2.5:1	>0dBi	>-4dBi	>40%	<1.6W/Kg	19	<-92
	Band38						19	<-92
	Band39						19	<-92
	Band40						19	<-92
	Band41						19	<-92
FDD-LTE	Band1						19	<-92
	Band2						19	<-92
	Band3						19	<-92
	Band4						19	<-92
	Band5						19	<-92
	Band7						19	<-92
	Band8						19	<-92
	Band20						19	<-92
	Band28						19	<-92

	Band66						19	<-92

5.Electrical Characteristics

5.1.Limit Voltage Range

The ultimate voltage range refers to the maximum voltage range that can be withstood by the module supply voltage and the digital and analog input/output interfaces. Working outside of this range may result in damage to this product.

The limiting voltage range for SLM332L is shown in the table below.

Table 5.1:Maximum operating voltage range of the module

Parameter	Description	Minimum	Typical	Maximum	Unit
VBAT	Power supply	-0.3	3.8	5.5	V
GPIO	The level supply voltage of the digital I/O	-0.3	1.8	2.0	V
VBUS	USB insert detection	-0.3	5.0	5.5	V

5.2.Environmental Temperature Range

SLM332L module is recommended to work in -35~+75°C environment. It is recommended that temperature control measures be considered at the application side under harsh environmental conditions. At the same time, it provides an extended operating temperature range of the module, which is used at the extended temperature and functions normally, and some RF indicators may deteriorate. At the same time, it is recommended that the module application terminal be stored under a certain temperature condition. Outside of this range, the module may not work properly or may be damaged.

Table 5.2:Module temperature range

Parameter	Minimum	Typical	Maximum	Unit
Working temperature	-35	+25	+75	℃
Storage temperature	-40		+85	℃

5.3.Electrical Characteristics of the Interface Working State

V_L: Logic low level; V_H: logic high level

Table 5.3:The logical level of the normal digital IO signal

Signal	V_L		V_H		Unit
	Minimum	Maximum	Minimum	Maximum	
Digital input	-0.3	0.36	1.26	2.0	V

Digital input		0.45	1.35		V

Table 5.4: Electrical characteristics of the power supply operating state

Parameter	I/O	Minimum	Typical	Maximum	Unit
VBAT	PI	3.5	3.8	4.35V	V
USIM_VDD	PO	1.62/2.7	1.8/3.0	1.9/3.3	V
VBUS	AI	4.5	5.0	5.5	V

5.4.Module Power Consumption Range

Table 5.5:Power consumption

Module state	Test item	Test case		Result
Shut down	Shut down leakage current	Maintain normal voltage (3.8 V) in case of power off		5uA
Dormancy	Flight hibernation mode	Use the AT command to turn on airplane mode, and hibernate to record the average current for 10 minutes		1.01mA
	PSM	Refer to the PSM test documentation		TBD
	Solid net dormancy	Plug in the mobile card for actual network standby, use the AT command to turn on the sleep mode, and record the average current for 5 minutes.		2.9 mA
		Plug in the China Unicom card for actual network standby, use the AT command to turn on the sleep mode, and record the average current for 5 minutes.		2.5 mA
		Plug in the telecom card for actual network standby, use the AT command to turn on the sleep mode, and record the average current for 5 minutes.		2.3 mA
		Plug in the mobile card and sleep after receiving the SMS under the actual network, and record the average current for		2.6 mA
		Maintain the data connection, send a 256-byte packet every 5 minutes, and the server returns a 256-byte packet.		18.3 mA
	FDD	When the module is powered on, the idle DRX listening period on the registered network is 1.28s; 1) The module under test is powered on and successfully registered on	Band1 CH18300	1.7mA
			Band3 CH19575	1.8mA
			Band5 CH20525	1.9mA
			Band8 CH21625	1.9mA
	TDD		Band34 CH36275	1.8mA
			Band38 CH38000	1.8mA

		the data network; 2) Set the module to sleep via AT command (USB is dangling); 3)The module under test is kept in the state of no data transmission for 10 minutes, and the average current for 10 minutes is recorded.	Band39 CH38450	1.8mA
			Band40 CH39150	1.8mA
			Band41 CH40620	1.8mA
Standby	FDD	The module is powered on, and the idle state DRX monitoring period is 1.28 seconds on the registered network, and the USB is active when there is no data transmission.	Band1 CH18300	21.99
			Band3 CH19575	21.88 mA
			Band5 CH20600	21.98 mA
			Band8 CH21750	21.85 mA
	TDD	The module under test is kept in the state of no data transmission for 10 minutes, and the average current is recorded for 10 minutes.	Band34 CH36275	22.09 mA
			Band38 CH38000	22.03 mA
			Band39 CH38450	21.58 mA
			Band40 CH39150	21.95 mA
			Band41 CH40620	22.08 mA
Datatransmission	FDD	1) Indoor room temperature state; 2) The DC power supply is used to supply the module, and the voltage is set to 3.8V. The module under test transmits data and holds it for 5 minutes, recording the average current for 5 minutes.	Band1 0dBm	179.7 mA
			Band1 10dBm	249.3mA
			Band1 23dBm Low channel	595.5 mA
			Band1 23dBm Middle channel	556.1 mA
			Band1 23dBm High channel	571.5 mA
			Band3 0dBm	177.3 mA
			Band3 10dBm	257.9 mA
			Band3 23dBm Low channel	544.6 mA
			Band3 23dBm Middle channel	524.5 mA
			Band3 23dBm High channel	545.9 mA
			Band5 0dBm	171.3 mA
			Band5 10dBm	245.1 mA
			Band5 23dBm Low channel	559.4 mA

			Band5 23dBm Middle channel	544.5 mA
			Band5 23dBm High channel	535.2 mA
			Band8 0dBm	167.5 mA
			Band8 10dBm	242.8 mA
			Band8 23dBm Low channel	501.9 mA
			Band8 23dBm Middle channel	484.9 mA
			Band8 23dBm High channel	475.1 mA
	TDD		Band34 0dBm	97.1 mA
			Band34 10dBm	129.6 mA
			Band34 23dBm Low channel	271.6 mA
			Band34 23dBm Middle channel	272.2 mA
			Band34 23dBm High channel	274.6 mA
			Band38 0dBm	99.8 mA
			Band38 10dBm	134.3 mA
			Band38 23dBm Low channel	306.9 mA
			Band38 23dBm Middle channel	304.9 mA
			Band38 23dBm High channel	302.4 mA
			Band39 0dBm	96.2 mA
			Band39 10dBm	122.9 mA
			Band39 23dBm Low channel	251.3 mA
			Band39 23dBm Middle channel	247.1 mA
			Band39 23dBm High channel	244.35V mA
			Band40 0dBm	93.4 mA
			Band40 10dBm	124.5 mA
			Band40 23dBm Low channel	263.2 mA
			Band40 23dBm Middle channel	255.1 mA
			Band40 23dBm High channel	254.7 mA
			Band41 0dBm	98.3 mA
			Band41 10dBm	132.5 mA
			Band41 23dBm Low channel	296.1 mA
			Band41 23dBm Middle channel	303.2 mA

			Band41 23dBm High channel	300.8 mA

5.5.ESD Characteristics

The module is not specifically protected against electrostatic discharge. Therefore, users must pay attention to ESD protection when producing, assembling and operating modules.

6.Mechanical Dimension

This section describes the mechanical dimensions of the module, all dimensions in millimeters, and all dimensions without tolerances are ±0.05mm.

6.1.Mechanical Dimensions

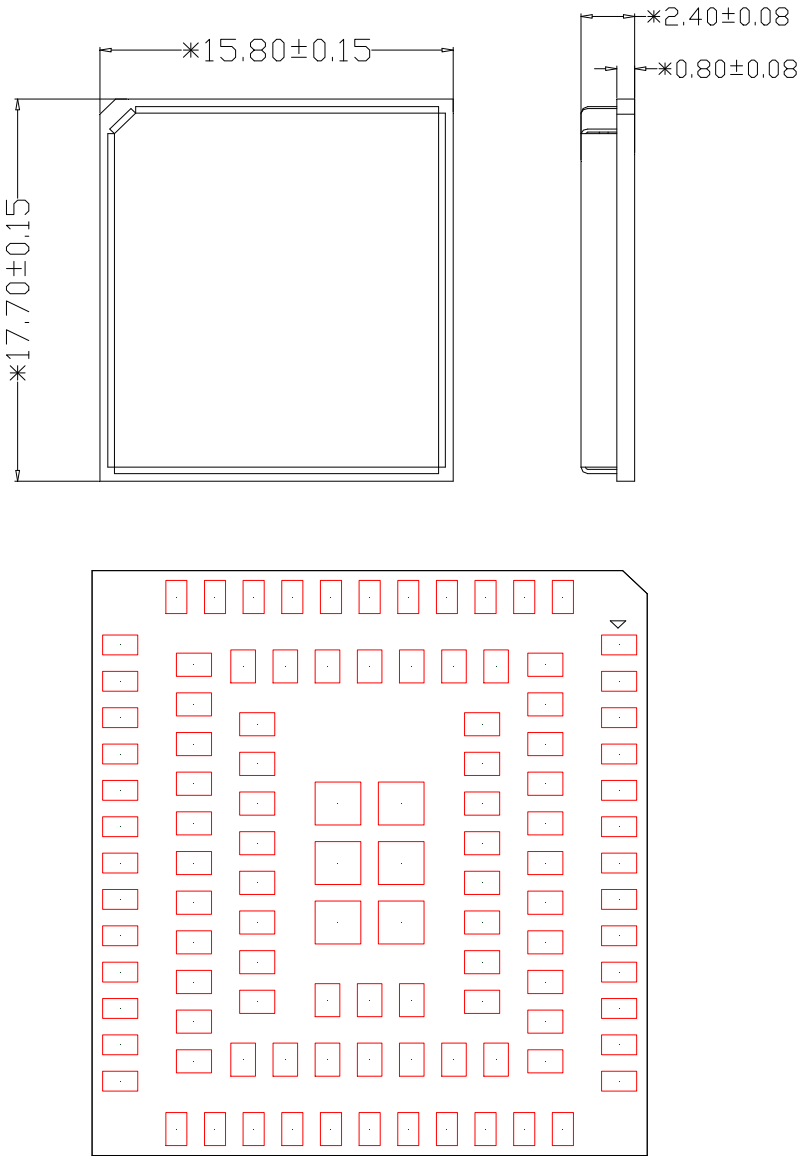


Figure 6.1:Top view and bottom view

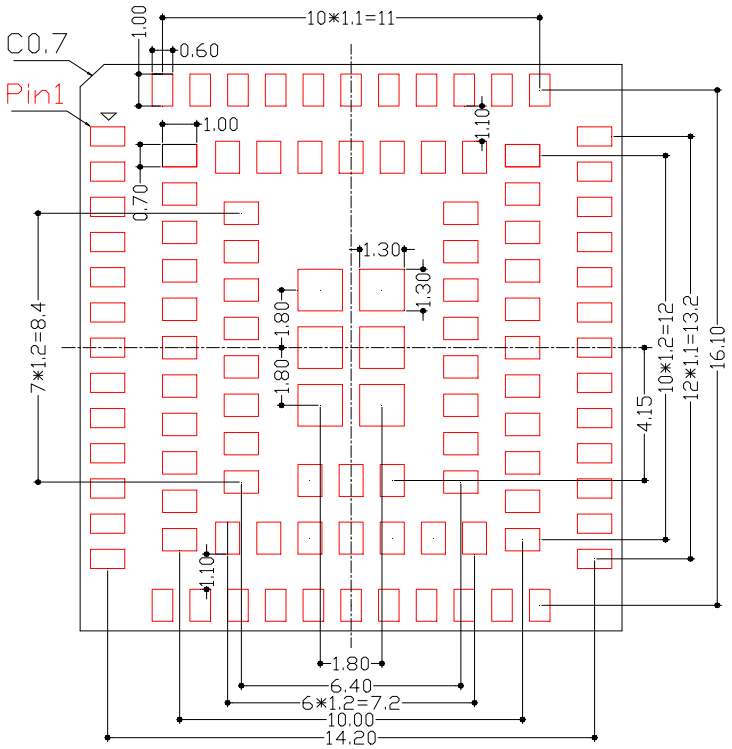


Figure 6.2:Packages are recommended（unit: mm）

6.2.Top View

Figure 6.3:Top view of the module

6.3.Bottom View

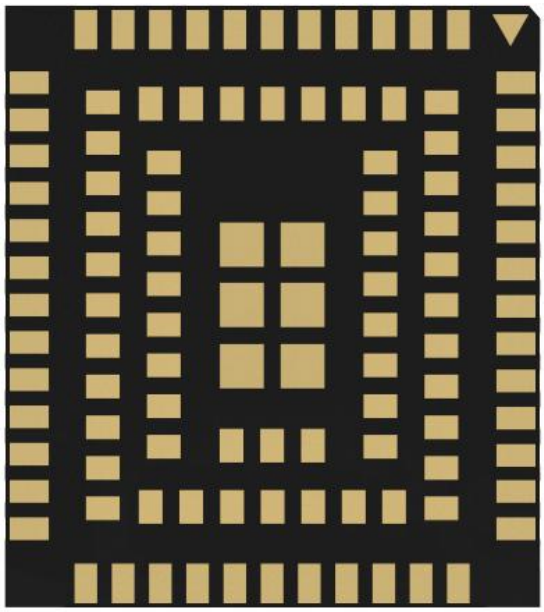


Figure 6.4:Bottom view of the module

7.Storage and Package

7.1.Storage

SLM332L ships in vacuum-sealed bags. The storage of modules must comply with the following conditions:

1. When the ambient temperature is lower than 40 degrees Celsius and the air humidity is less than 90%, the module can be stored in a vacuum sealed bag for 12 months;

2. When the vacuum-sealed bag is opened, the module can be directly reflowed or other high-temperature processes if the following conditions are met:

- The humidity of the air stored in the module is less than 10%;
- The ambient temperature of the module is lower than 30 degrees Celsius, the air humidity is less than 60%, and the factory completes the placement within 72 hours.

3. If the module is under the following conditions, it needs to be baked before mounting:

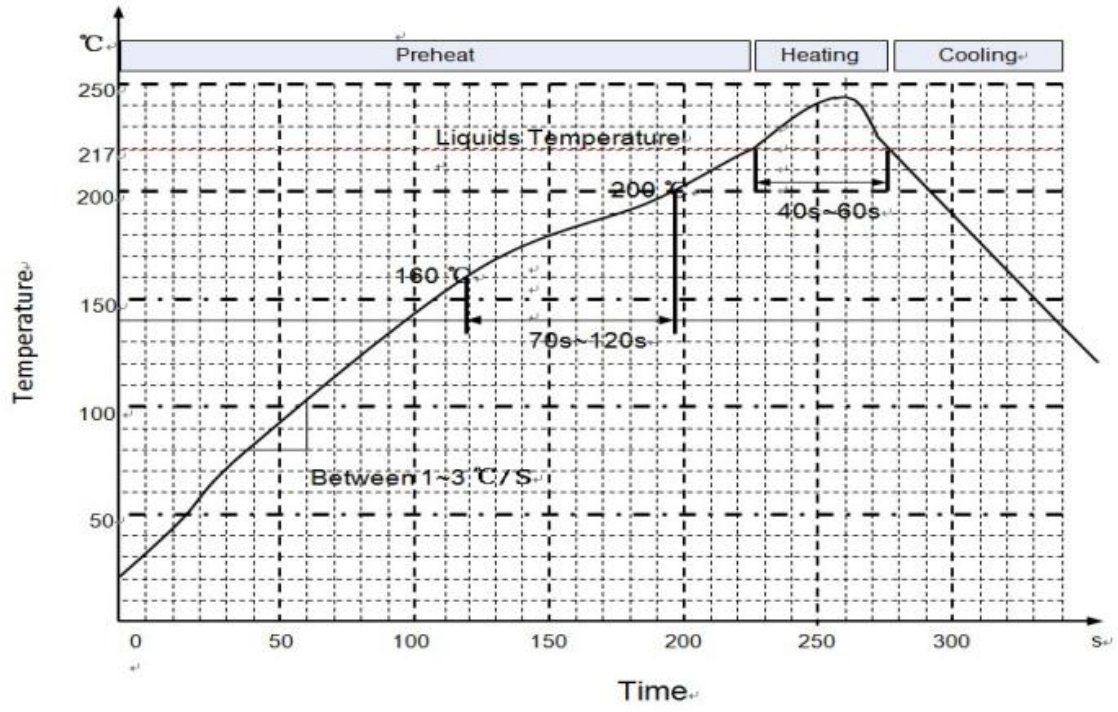
- When the ambient temperature is 23 degrees Celsius (5 degrees Celsius up and down is allowed), the humidity displayed on the humidity indicator card is greater than 10%;
- When the vacuum-sealed bag was opened, the ambient temperature of the module was lower than 30 degrees Celsius and the air humidity was less than 60%, but the factory failed to complete the placement within 168 hours;
- When the vacuum-sealed bag is opened, the humidity of the air stored in the module is greater than 10%.

4. If the module needs to be baked, bake for 8 hours at 125 degrees Celsius (allowing for fluctuations of 5 degrees Celsius up and down).

Remark:

The packaging of the module cannot withstand such high temperatures, please remove the packaging of the module before the module bakes.

7.2.Production Welding



	参数	参考值
无铅回流温度曲线参考	预热温升要求（<160℃）	≤2℃/s
	均温区要求（165℃到217℃）	60~100s
	峰值温升速率	1~3℃/s
	最低回流峰值温度	230℃
	最高回流峰值温度	250℃
	液态线（217℃）以上时间	35~90s
	230℃以上时间	25~50s
	冷却阶段的降温斜率（T=217~120℃）	-2~-5℃/s
	冷却阶段的最大斜率	-6℃/s
	从50度到217℃时间	150~240s
	回流炉温区数量	≥7
	备注：最大温度斜率的计算应该是最少间隔10s，太短的时间间隔会得出错误、太大的斜率值，尤其是上表面的器件和热容量比较小的器件的测量位置 以上参数均针对焊点温度，单板上的焊点最热点和最冷点均需要满足要求。	

Figure 7.1:Furnace temperature curve and lead-free reflux temperature curve reference parameters

Remark:

The above furnace temperature curve is for reference only, and customers can optimize it according to the actual product characteristics.

7.3.Package

SLM332L is packaged on tape and reel.

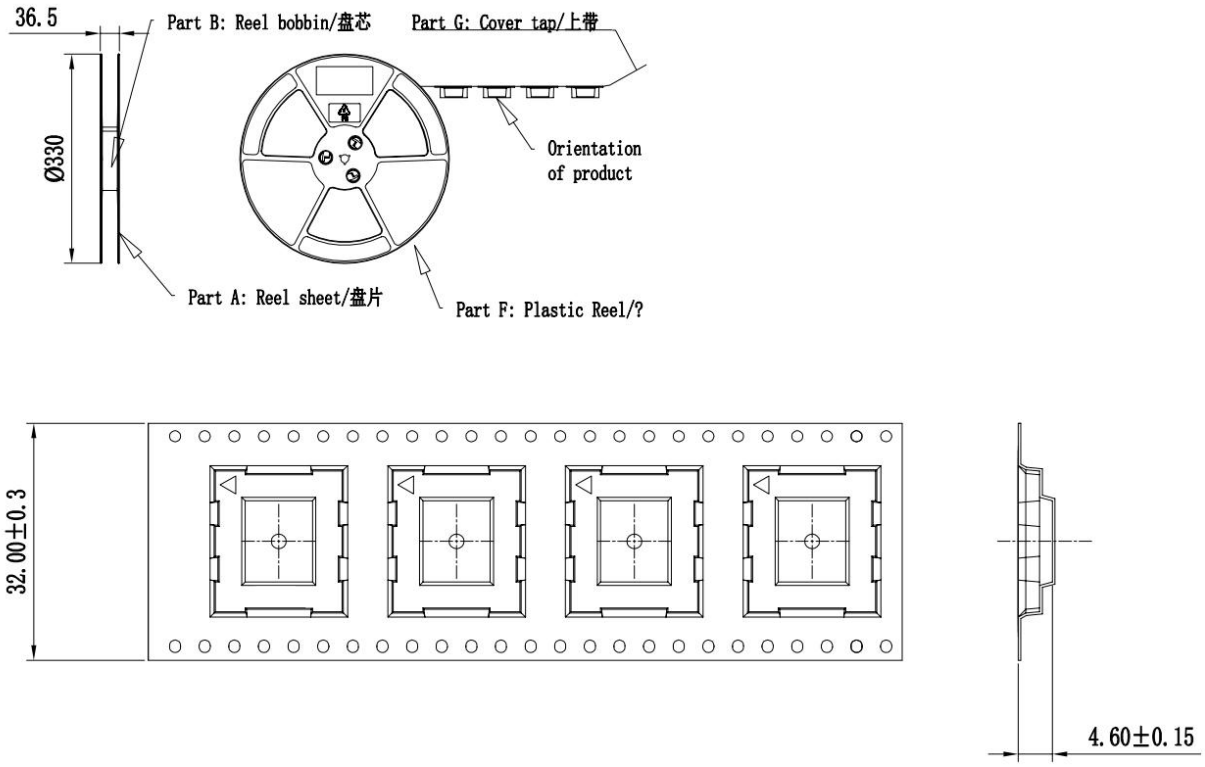


Figure 7.2:Tape and reel packaging

8. Appendix A: Reference documents and abbreviations of terminology

8.1. Reference

- SLM332L module specifications;
- SLM332L AT instruction set;
- SLM332L reference design circuits;
- SLM332L apply business process manuals.

8.2. Term Abbreviation

Table 8.1:Terms abbreviations

Term	English description	Chinese description
AMR	Adaptive Multi-rate	自适应多速率
BER	Bit Error Rate	误码率
BTS	Base Transceiver Station	基站收发信台
PCI	Peripheral Component Interconnect	外设部件互连
CS	Circuit Switched (CS) domain	电路域
CSD	Circuit Switched Data	电路交换数据
DCE	Data communication equipment	数据电路终端设备
DTE	Data terminal equipment	数据终端设备
DTR	Data Terminal Ready	数据终端就绪
EDGE	Enhanced Data rates for GSM Evolution	增强型GPRS
EFR	Enhanced Full Rate	增强型全速率
EGSM	Enhanced GSM	增强型GSM
EMC	Electromagnetic Compatibility	电磁兼容性
ESD	Electrostatic Discharge	静电释放
FR	Frame Relay	帧中继
GMSK	Gaussian Minimum Shift Keying	高斯最小移频键控
GPIO	General Purpose Input Output	通用输入/输出
GPRS	General Packet Radio Service	通用分组无线系统
GSM	Global Standard for Mobile Communications	全球标准移动通信系统

HR	Half Rate	半速
HSDPA	High Speed Downlink Packet Access	高速下行分组接入
HSUPA	High Speed Uplink Packet Access	高速上行分组接入
HSPA	HSPA High-Speed Packet Access	高速分组接入
HSPA+	HSPA High-Speed Packet Access+	增强型高速分组接入
IEC	International Electro-technical Commission	国际电工技术委员会
IMEI	International Mobile Equipment Identity	国际移动设备标识
MEID	Mobile Equipment Identifier	CDMA终端的身份识别码
I/O	Input/Output	输入/输出
ISO	International Standards Organization	国际标准化组织
ITU	International Telecommunications Union	国际电信联盟
bps	bits per second	比特每秒
LED	Light Emitting Diode	发光二极管
M2M	Machine to machine	机器到机器
MO	Mobile Originated	移动台发起的
MT	Mobile Terminated	移动台终止的
NTC	Negative Temperature Coefficient	负温度系数
PC	Personal Computer	个人计算机
PCB	Printed Circuit Board	印制电路板
PCS	Personal Cellular System	个人蜂窝系统
SPI_FLASH	Pulse Code Modulation	脉冲编码调制
PCS	Personal Communication System	GSM1900
PDU	Packet Data Unit	分组数据单元
PPP	Point-to-point protocol	点到点协议
PS	Packet Switched	分组交换
QPSK	Quadrate Phase Shift Keying	正交相位移频键控
SIM	Subscriber Identity Module	用户识别模组
TCP/IP	Transmission Control Protocol/ Internet Protocol	传输控制协议/互联网协议
UART	Universal asynchronous receiver-transmitter	通用异步收/发器（机）
SIM	Universal Subscriber Identity Module	通用用户识别模组
UMTS	Universal Mobile Telecommunications System	通用移动通信系统
USB	Universal Serial Bus	通用串行总线
WCDMA	Wideband Code Division Multiple Access	宽带码分多址

TD-SCDMA	Time Division-Synchronous Code Division Multiple Access	时分同步码分多址
TDD-LTE	Time Division Long Term Evolution	时分长期演进
FDD-LTE	Frequency Division Duplexing Long Term Evolution	频分长期演进
Vmax	Maximum Voltage Value	最大电压值
Vnorm	Normal Voltage Value	典型电压值
Vmin	Minimum Voltage Value	最小电压值
V_{IH}max	Maximum Input High Level Voltage Value	输入高电平的最大电压
V_{IH}min	Minimum Input High Level Voltage Value	输入高电平的最小电压
V_{IL}max	Maximum Input Low Level Voltage Value	输入低电平的最大电压
V_{IL}min	Minimum Input Low Level Voltage Value	输入低电平的最小电压
V_{OH}max	Maximum Output High Level Voltage Value	输出高电平的最大电压
V_{OH}min	Minimum Output High Level Voltage Value	输出高电平的最小电压
V_{OL}max	Maximum Output Low Level Voltage Value	输出低电平的最大电压
V_{OL}min	Minimum Output Low Level Voltage Value	输出低电平的最小电压

9. Appendix B: Warning language

9.1. FCC Warning Language

According to the definition of mobile and fixed device is described in Part 2.1091(b), this device is a mobile device.

And the following conditions must be met:

1. This Modular Approval is limited to OEM installation for mobile and fixed applications only. The antenna installation and operating configurations of this transmitter, including any applicable source-based time-averaging duty factor, antenna gain and cable loss must satisfy MPE categorical Exclusion Requirements of 2.1091.

2. The EUT is a mobile device; maintain at least a 20 cm separation between the EUT and the user's body and must not transmit simultaneously with any other antenna or transmitter.

3. A label with the following statements must be attached to the host end product: This device contains FCC ID:. 2APJ4-SLM332L

4.To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, maximum antenna gain (including cable loss) must not exceed:

Band1(Tx: 1920MHz~1980MHz): <4dBi

Band2(Tx: 1850MHz~1910MHz): <4dBi

5. This module must not transmit simultaneously with any other antenna or transmitter

6. The host end product must include a user manual that clearly defines operating requirements and conditions that must be observed to ensure compliance with current FCC RF exposure guidelines.

For portable devices, in addition to the conditions 3 through 6 described above, a separate approval is required to satisfy the SAR requirements of FCC Part 2.1093

If the device is used for other equipment that separate approval is required for all other operating configurations, including portable configurations with respect to 2.1093 and different antenna configurations.

For this device, OEM integrators must be provided with labeling instructions of finished products. Please refer to KDB784748 D01 v07, section 8. Page 6/7 last two paragraphs:

A certified modular has the option to use a permanently affixed label, or an electronic label. For a permanently affixed label, the module must be labeled with an FCC ID - Section 2.926 (see 2.2 Certification

(labeling requirements) above). The OEM manual must provide clear instructions explaining to the OEM the labeling requirements, options and OEM user manual instructions that are required (see next paragraph).

For a host using a certified modular with a standard fixed label, if (1) the module's FCC ID is not visible when installed in the host, or (2) if the host is marketed so that end users do not have straightforward commonly used methods for access to remove the module so that the FCC ID of the module is visible; then an additional permanent label referring to the enclosed module:"Contains Transmitter Module FCC ID: 2APJ4-SLM332L" or "Contains FCC ID: 2APJ4-SLM332L" must be used. The host OEM user manual must also contain clear instructions on how end users can find and/or access the module and the FCC ID.

The final host / module combination may also need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.

The user's manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. In cases where the manual is provided only in a form other than paper, such as on a computer disk or over the Internet, the information required by this section may be included in the manual in that alternative form, provided the user can reasonably be expected to have the capability to access information in that form.

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, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

To ensure compliance with all non-transmitter functions the host manufacturer is responsible for ensuring compliance with the module(s) installed and fully operational. For example, if a host was previously authorized as an unintentional radiator under the Declaration of Conformity procedure without a transmitter certified module and a module is added, the host manufacturer is responsible for ensuring that the after the module is installed and operational the host continues to be compliant with the Part 15B unintentional radiator requirements.

9.2.IC Warning Language

Canada Regulations:

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:

(1) This device may not cause interference; and

(2) This device must accept any interference, including interference that may cause undesired operation of the

device.

Le présentappareilestconforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitationestautorisée aux deux conditions suivantes :

(1) l'appareil ne doit pas produire de brouillage;

(2) l'utilisateur de l'appareildoit accepter tout brouillageradioélectriquesubi, mêmesi le brouillageest susceptible d'encompromettre le fonctionnement.

Caution:

This transmitter must not be co-located or operating in conjunction with any other antenna or transmit-ter. This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body.

Cet émetteur ne doit pas être Co-placé ou ne fonctionnant en même temps qu'aucune autre antenne ou émetteur. Cet équipement devrait être installé et actionné avec une distance minimum de 20 centimètres entre le radiateur et votre corps.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmit- ter. This equipment should be installed and operated with a minimum distance of20centimeters between the radiator and your body.
Cet émetteur ne doit pas être Co-placé ou ne fonctionnant en même temps qu'aucune autre antenne ou émetteur. Cet équipement devrait être installé et actionné avec une distance minimum de 20 centimètres entre le radiateur et votre corps.

The host product shall be properly labelled to identify the modules within the host product.

The Innovation, Science and Economic Development Canada certification label of a module shall be clearly visible at all times when installed in the host product; otherwise, the host product must be labelled to display the Innovation, Science and Economic Development Canada certification number for the module, preceded by the word "Contains" or similar wording expressing the same meaning, as follows:

"Contains IC: 23860-SLM332L" or "where: 23860-SLM332L is the module's certification number".

Le produit hôte doit être correctement étiqueté pour identifier les modules dans le produit hôte.

L'étiquette de certification d'Innovation, Sciences et Développement économique Canada d'un module doit être clairement visible en tout temps lorsqu'il est installé dans le produit hôte; sinon, le produit hôte doit porter une étiquette indiquant le numéro de certification d'Innovation, Sciences et Développement économique Canada pour le module, précédé du mot «Contient» ou d'un libellé semblable exprimant la même signification, comme suit:

"Contient IC: 23860-SLM332L" ou "où: 23860-SLM332L est le numéro de certification du module".

A label with the following statements must be attached to the host end product: This device contains IC: 23860-SLM332L.

SLM332L The manual provides guidance to the host manufacturer will be included in the documentation that will be provided to the OEM.

SLM332L The module is limited to installation in mobile or fixed applications.

SLM332L The separate approval is required for all other operating configurations, including portable configurations and different antenna configurations.

SLM332L The OEM integrators are responsible for ensuring that the end-user has no manual or instructions to remove or install module.

SLM332L The module is limited to OEM installation ONLY.

Une étiquette avec les instructions suivantes doit être attachée au produit final hôte:

Cet appareil contient IC:

Le manuel fournit des conseils au fabricant hôte sera inclus dans la documentation qui sera fournie à l'OEM.

Le module est limité à l'installation dans des applications mobiles ou fixes.

L'approbation distincte est requise pour toutes les autres configurations de fonctionnement, y compris les configurations portables et différentes configurations d'antenne.

Les intégrateurs OEM sont responsables de s'assurer que l'utilisateur n'a pas de manuel ou d'instructions pour retirer ou installer le module.

Le module est limité à l'installation OEM SEULEMENT.

9.3.CE Warning Language

The frequency band information supported by the device is as follows:

Operating Mode	Operating Frequency Range(MHz)		Transmitted Power (dBm)
	Tx	Rx	
LTE-FDD B1	1920 ~ 1980	2110 ~ 2170	25.14
LTE-FDD B3	1710 ~ 1785	1805 ~ 1880	24.19
LTE-FDD B5	824 ~ 849	869-894	23.99
LTE-FDD B7	2500-2570	2620-2690	25.49
LTE-FDD B8	880-915	925-960	24.35
LTE-FDD B20	832-862	791-821	23.63
LTE-FDD B28 (A)	703-733	758-788	23.25
LTE-FDD B28 (B)	718-748	773-803	23.50

RF Exposure

This equipment complies with CE radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20cm between the radiator and your body.

RED Declaration of Conformity

Hereby, MeiG Smart Technology Co., Ltd, declares that this device is in compliance with the essential requirements and other relevant provisions of Directive 2014 / 53 / EU. The full text of the EU declaration of conformity is available at the following internet address: https://www.meigsmart.com.