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LPM2100 mg NB module hardware manual

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Shang Hai YUGE Information Technology co., LTD

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Chapter 1. Introduction

This document is a wireless solution product LPM2100 mg NB module hardware interface manual, which is designed to describe the hardware composition and functional features of the module, the definition and usage of the application interface, the electrical performance and mechanical properties. Combined with this document and other application documents, users can quickly use the module to design wireless products.

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Chapter 2. Review of modules

2.1 A brief introduction to the module

The LPM2100 mg module is a two band NB-IOT IOT wireless communication module, which supports Band3, Band5 and Band8. It is mainly applied to low power data transmission service. Meet the 3GPP Release 13 standard. The module has 44 pins in all. The ultra small size with 15.8mm*17.7mm*2.2mm can meet almost all M2M requirements. The LPM2100 mg module is a patch module. Using LCC package, the module can be embedded in the customer's application by the pin welding disk. It can provide a rich hardware interface between the module and the client's main board. LPM2100 mg NB module uses low-power technology, standby power consumption is less than 1mA, deep sleep can be as low as 5uA. The LPM2100 mg NB module can be applied to the following situations:

- ✧ Smart city (intelligent parking, water / gas meter, street lamp, smoke alarm, garbage bin, etc.)
- ✧ Consumption and medical care (wearable devices, VIP tracking, life support, remote clinical tracking, etc.)
- ✧ Industrial and agricultural intelligent monitoring (machine alarm, gas detection, irrigation, soil pH value, etc.)
- ✧ Agriculture and environment (agricultural application, environmental monitoring, etc.)
- ✧ Logistics support (industrial assets, container tracking, location and status updates, etc.)



NOTE

"*" indicates that it is being developed.

2.2 Main performance

Table 2-1 key features

Characteristic	Describe
Physical characteristics	15.8mm*17.7mm*2.2mm
Application processor	192MHz MIPS processor with 16KB I-Cache and 16KB D-Cache
Working voltage	3.4V - 4.2V Typical voltage 3.7V
Power saving	PSM mode power < 5uA
Standby	Dormancy mode current < 1mA
Application interface	Power interface Several general-purpose GPIO interfaces One standard SIM interface, support 3.0V/1.8V, support hot



	swap function * One Hardware reset interface Three UART serial port interface One SPI interface One Network state indicator interface One PSM_EINT# interface One ADC detection interface
Working band	Tri frequency: Band3, Band5, Band8 The module can automatically search frequency bands, and the band selection can be set by AT command. Need to correspond to a specific version
Network protocol characteristics	UDP/TCP/CoAP/LWM2M PPP/SSL/DTLS/FTP HTTP/MQTT/HTTPS
Data transmission characteristics	Single-tone:25.5kbps(DL),16.7kbps(UP) Multi-tone:25.5kbps(DL),62.5kbps(UP)
Antenna interface	50 Ω interface of the main antenna 50 Ω interface of Bluetooth antenna
Firmware update	Serial port upgrade
Temperature range	Normal working temperature - 20°C to +70°C Limit working temperature - 40°C to +85°C Storage temperature: -45°C to +90°C
AT command	Support standard AT command set (Hayes 3GPP TS 27.007 and 27.005)

2.3 Module function block diagram

The functional block diagram of the LPM2100 mg NB module mainly contains the following units:

- ✧ Baseband processing unit
- ✧ Power management unit
- ✧ RF transceiver unit
- ✧ RF front-end unit
- ✧ Peripheral interface

The functional block diagram of the LPM2100 mg NB module is shown as follows:

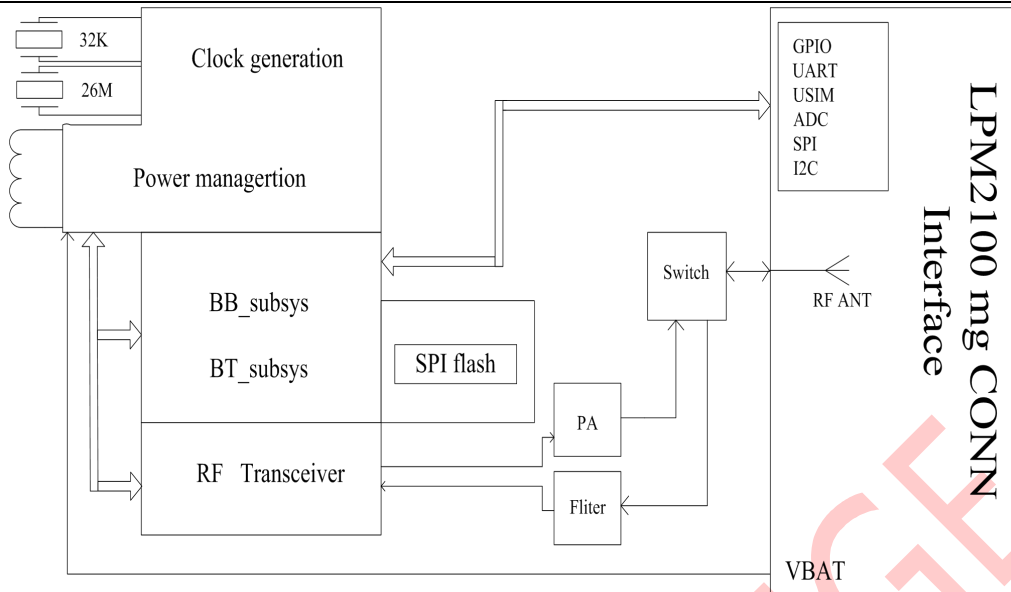


Figure 2-1 function block diagram of LPM2100 mg module

2.4 Module working mode

Table 2-2 work mode

Working mode	Describe
Turn off the machine	In the case of shutdown, the module can't work
Flight Mode	The module closes the module RF circuit, unable to interact with the network.
Dormancy	The module closes most functions, and it will synchronize with the network.
Free	Turn on the machine and register the network successfully, in the idle state
Data transmission	The module is in working state and has data interaction with the network.
PSM mode	After entering PSM mode, the module can achieve the minimum power consumption, each power supply inside the module is closed, the software except RTC stops running, and the serial port can not be used.



Chapter 3. Interface application description

3.1 A summary of this chapter

The LPM2100 mg NB module has 44 pins, including the following unit interface functions. The functions of each unit interface will be explained in detail in the following chapters.

- ✧ Power supply interface
- ✧ USIM interface
- ✧ UART interface
- ✧ Network status indicator interface
- ✧ SPI interface
- ✧ RF antenna interface
- ✧ I2C interface

3.2 Module interface

3.2.1 LPM2100 mg pins distribution diagram

LPM2100 mg pins are assigned as follows:

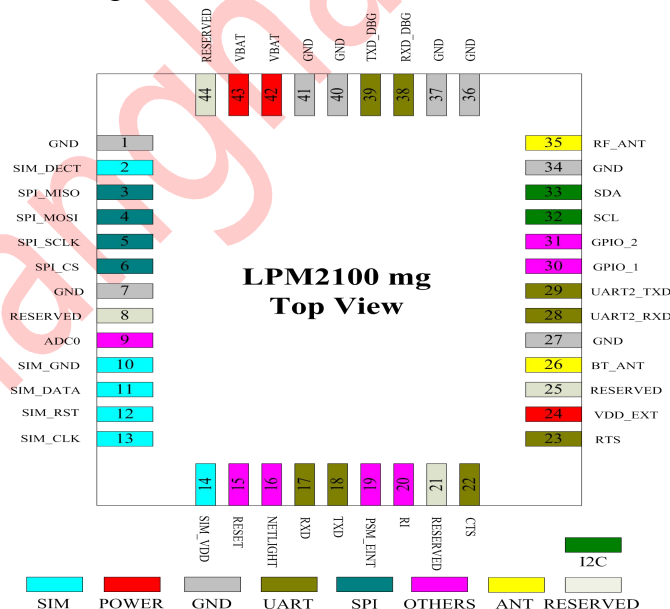


Figure 3-1 LPM2100 mg pins distribution diagram

NOTE

- ① The IO port electric level of the module is 2.8V (SIM card port electric level supports 1.8V and 3.0V).
- ② The module defines that the RESERVED pins are suspended and can not be used.



- ③ The voltage domain of the PSM_EINT tube is 1.1V.

3.2.2 Module pins description

The definition of the module interface pins is described as follows:

Table 3-1 pins parameter abbreviations

Sign indicator	Describe
IO	Input or output
PI	Power input
PO	Power output
AI	Analog input
AO	Analog output
DI	Digital input
DO	Digital output

Table 3-2 interface definition

Pins	Pins name	IO	Functional description	Remarks
Power supply				
42, 43	VBAT	PI	Module power supply	Input voltage 3.4~4.2V
24	VDD_EXT	PO	Internal steady voltage power output 2.8V	Hang out when you don't need it
1, 7, 27, 34, 36, 37, 40, 41	GND		Ground signal	
Control of system switchgear				
15	RESET	DI	Hardware reset control, low level effective	
SIM interface				
2	SIM_DECT	DI	SIM card hot plug detection	Internal level has been pulled up
10	SIM_GND		SIM card ground	
11	SIM_DATA	IO	SIM card bus data	Internal 10K pull-up resistance
12	SIM_RST	DO	SIM card reset output	Far away from the source of interference
13	SIM_CLK	DO	SIM card clock output	Far away from the source of interference



14	SIM_VDD	PO	Output power supply to SIM card	Far away from the source of interference
State indication				
16	NETLIGHT	DO	Network status indication	2.8V voltage domain
Main serial port interface				
17	RXD	DI	Master data reception	2.8V voltage domain
18	TXD	DO	Master data transmission	2.8V voltage domain
20	RI	DO	Ringing hints	2.8V voltage domain
22	CTS	DO	Scavenging sending	2.8V voltage domain
23	RTS	DI	Request to send	2.8V voltage domain
Debug serial port interface				
38	RXD_DBG	DI	Module debug data receiving	2.8V voltage domain
39	TXD_DBG	DO	Module debug data transmission	2.8V voltage domain
UART2 serial port				
28	UART2_RXD	DI	UART2 data reception	2.8V voltage domain
29	UART2_TXD	DO	UART2 data transmission	2.8V voltage domain
I2C interface				
32	SCL	OD	I2C bus clock output	2.8V voltage domain
33	SDA	IO	I2C bus data input and output	2.8V voltage domain
SPI interface				
3	SPI_MISO	DI	Host input and slave machine output	2.8V voltage domain
4	SPI_MOSI	DO	Host output slave machine input	2.8V voltage domain
5	SPI_SCLK	DO	Serial clock signal	2.8V voltage domain
6	SPI_CS	DO	Chip Select	2.8V voltage domain
Other functional feet				
19	PSM_EINT	DI	External interrupt pin	1.1V voltage domain
9	ADC0	AI	General analog digital converter interface	Range 0.1V~2.8V
Universal input-output interface				
30	GPIO_1	IO	General input / output port	
31	GPIO_2	IO	General input / output port	
Antenna interface				
26	BT_ANT	IO	Bluetooth antenna	50Ω characteristic



			interface	impedance
35	RF_ANT	IO	RF antenna interface	50Ω characteristic impedance
8,21,25, 44	RESERVED		NC	Hang out when you don't need it

3.3 Power interface

The LPM2100 mg NB module power interface consists of two parts:

- ✧ VBAT is the power supply for the module.
- ✧ The VDD_EXT is an internal LDO 2.8V output power for external use.

The voltage input range of the power supply VBAT is 3.4V~4.2V. The module supplies the internal RF and baseband circuits through the two pins of VBAT. On the premise of ensuring that the VBAT power supply is sufficient, one 100uF tantalum capacitors with low equivalent series resistance can be parallel in parallel to the power input, and then parallel connect 10pF, 33pF, 0.1uF, 1uF ceramic capacitors. The PCB line of VBAT is as short and coarse as possible.

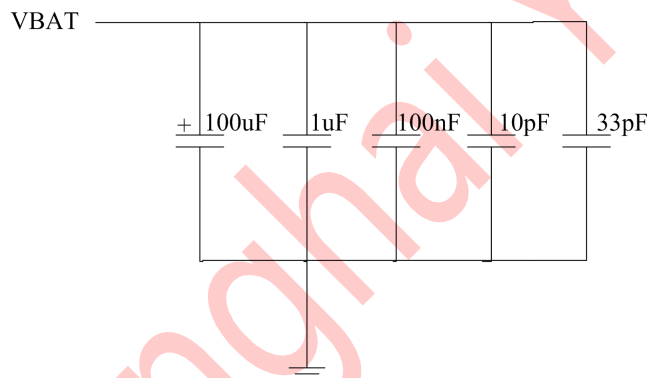


Figure 3-2 VBAT power supply power supply

NOTE

- ① In order to prevent the module from being damaged by surge and overvoltage, it is suggested that a 5.1V/500mW Zener diode be connected in parallel with the VBAT pin of the module.
- ② It is suggested that 3 ceramic capacitors (33pF, 10pF, 100nF) be added to the VBAT pin and placed near the VBAT pin.

3.4 VDD_EXT 2V8 voltage output

After the LPM2100 mg module is opened normally, the twenty-fourth pins will output voltage 2.8V, the current load is maximum 50mA, and the external master control can read the voltage of VDD_EXT to judge whether the module is on the machine. VDD_EXT can also be used as an external power supply, such as level conversion chips.

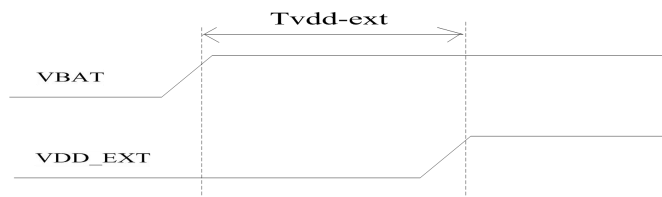


Figure 3-3 VDD_EXT power output sequence diagram.

3.5 Switchgear reset mode

3.5.1 Turn on the module

LPM 2100 mg NB module VBAT power on automatically boot, users can query the level of VDD_EXT pin to determine whether the module boot.

3.5.2 Starting time sequence

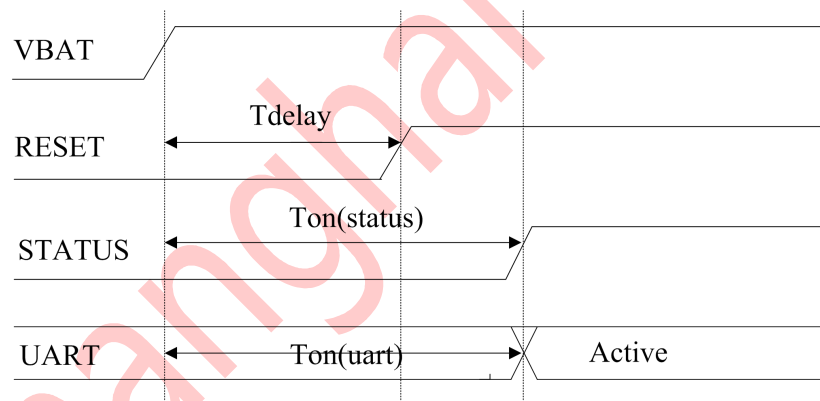


Figure 3-4 Starting time sequence diagram

Table 3-3 opening timing parameters

Symbol	Describe	Min	Typical	Max	Unit
Tdelay			TBD	-	ms
Ton(status)	Start time (according to status state)		TBD	-	s
Ton(uart)	Start time (according to UART state)		TBD	-	s



3.5.3 Module shutdown

The shutdown of the LPM2100 mg module can be powered off by the VBAT pin or shutdown by using the AT "at+cpof" command.

When the module is in the boot state, the VBAT pin stops the power supply, the module is to turn off.

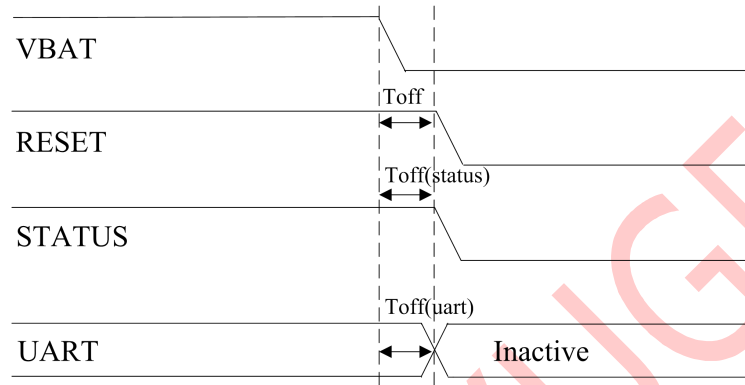


Figure 3-5 shutdown sequence diagram

Table 3-4 shutdown timing parameters

Symbol	Describe	Min	Typical	Max	Unit
Toff			TBD	-	s
Toff(status)	Shutdown time (according to status state)		TBD		
Toff(uart)	Shutdown time (according to UART state)		TBD	-	

3.5.4 Reset control

The LPM2100 mg module PIN15 signal is the RESET reset pin. The application terminal detects the module anomaly, and the software does not respond, the pin can be pulled down by 100-450ms to reset the module, and the external pull 10K resistance to VDD_EXT. RESET pins are sensitive to interference. A capacitor of 10 nF to 0.1 u F can be installed near the signal, which is used for signal filtering and away from the radio frequency interference signal when wiring.

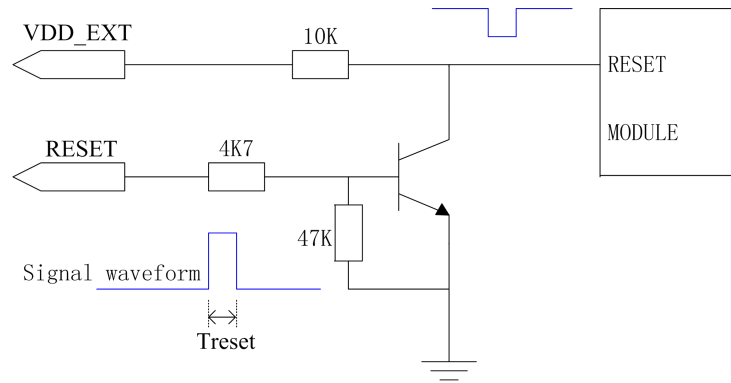


Figure 3-6 reset reference circuit

Table 3-5 RESET pin parameters

Symbol	Describe	Min	Typical	Max	Unit
Treset	Low level pulse width	100		600	ms
VIH	RESET input high level voltage	1.96	2.8	3	V
VIL	RESET input low level voltage	-0.3	0	0.84	V

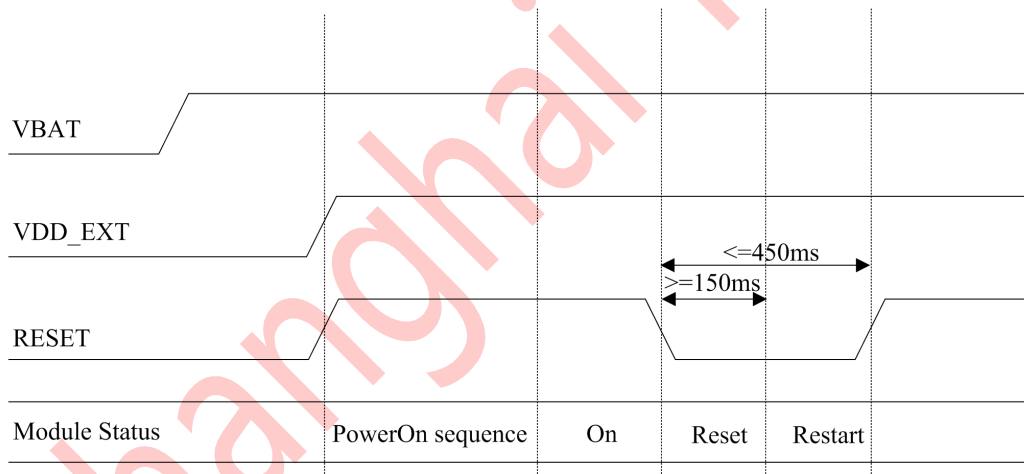


Figure 3-7 reset sequence diagram

The LPM2100 mg module supports AT command reset, and the AT command is AT+TRB to restart the module. Detailed command can view the LPM2100 mg AT command set manual.

3.6 UART interface

The LPM2100 mg module provides three sets of UART interfaces. The main serial port, debugging serial port and auxiliary serial port, serial port level is 2.8V. The module is the DCE (Data Communication Equipment) device

The main serial port can realize AT command interact and peripheral data interaction.



Debug serial port can upgrade firmware, check log information and so on.

Module serial port baud rate can be set 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600 BPS baud rate, the default is 57600 bps.

Table 3-6 definition of serial pin

Pin	Pin name	IO	Functional description	Remarks
18	TXD	DO	Master data transmission	2.8V voltage domain
20	RI	DO	Ringing hints	2.8V voltage domain
22	CTS	DO	Scavenging sending	2.8V voltage domain
23	RTS	DI	Request to send	2.8V voltage domain
28	UART2_RXD	DI	UART2 data reception	2.8V voltage domain
29	UART2_TXD	DO	UART2 data transmission	2.8V voltage domain
38	RXD_DBG	DI	Module debug data receiving	Debug UART
39	TXD_DBG	DO	Module debug data transmission	Debug UART

Table 3-7 serial port logic level

Parameter	Minimum	Maximum	Unit
VIL	0	$0.3 * V_{DD_EXT}$	V
VIH	$0.7 * V_{DD_EXT}$	V_{DD_EXT}	V
VOL	0	$0.3 * V_{DD_EXT}$	V
VOH	$0.7 * V_{DD_EXT}$	V_{DD_EXT}	V

3.6.1 Serial port application circuit

When users want to use the full function serial port, you can refer to the following connection mode.

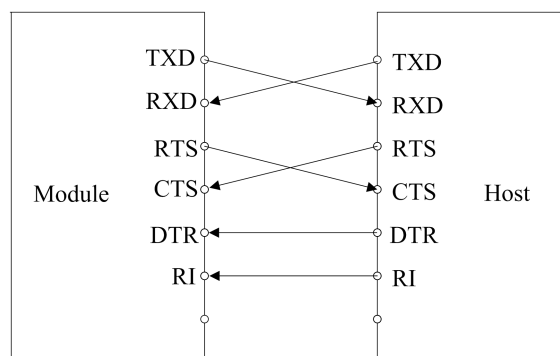


Figure 3-8 full function serial port design diagram



If you need to use the 2 wire serial port, you can refer to the following serial port design.

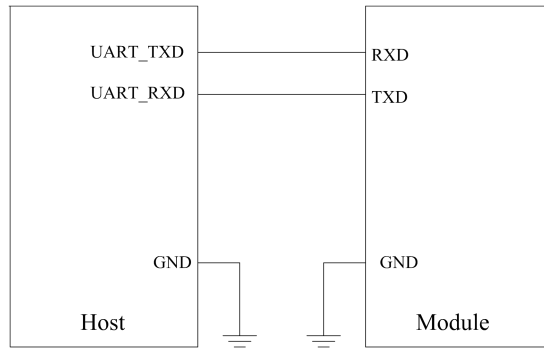


Figure 3-9 UART serial port design diagram

The module serial port is the TTL 2.8V electrical level. If the serial port needs to be connected with the MCU which have 3.3V electrical level, a level conversion chip needs to be added to realize the level matching. The chip connection mode can refer to the following circuit.

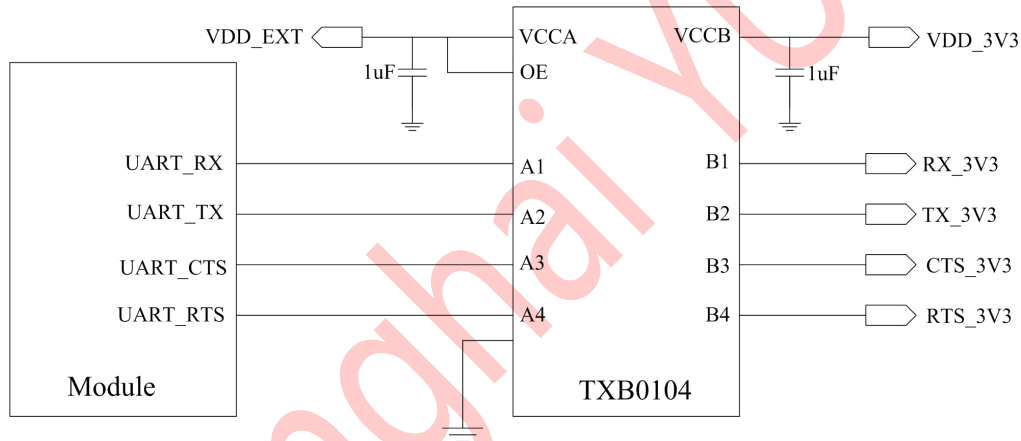


Figure 3-10 UART level conversion circuit

3.6.2 RI interface

LPM2100 mg module supports serial sleep hiving function, RI pin can be used as an interrupt to wake up the host.

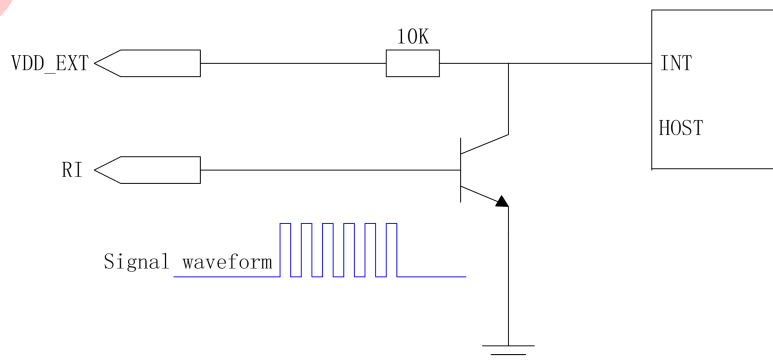


Figure 3-11 RI pin signal waveform



3.7 USIM interface

The LPM 2100 mg module provides a USIM card interface compatible with the ISO 7816-3 standard. The USIM card power supply is provided by the module internal power manager and supports 1.8V/3.0V voltage.

Table 3-8 USIM card signal definition

Pin	Pin name	IO	Functional description	Remarks
2	SIM_DECT	DI	SIM card hot plug detection	Internal level has been pulled up
10	SIM_GND		SIM card ground	2.8V voltage domain
11	SIM_DATA	IO	SIM card bus data	Internal 10K pull-up resistance
12	SIM_RST	DO	SIM card reset output	Far away from the source of interference
13	SIM_CLK	DO	SIM card clock output	Far away from the source of interference
14	SIM_VDD	PO	Output power supply to SIM card	Far away from the source of interference

3.7.1 USIM card reference circuit

The LPM2100 mg module does not own USIM card slot. When users are using it, they need to design USIM card slot on their own interface board.

The USIM card interface reference circuit is as follows:

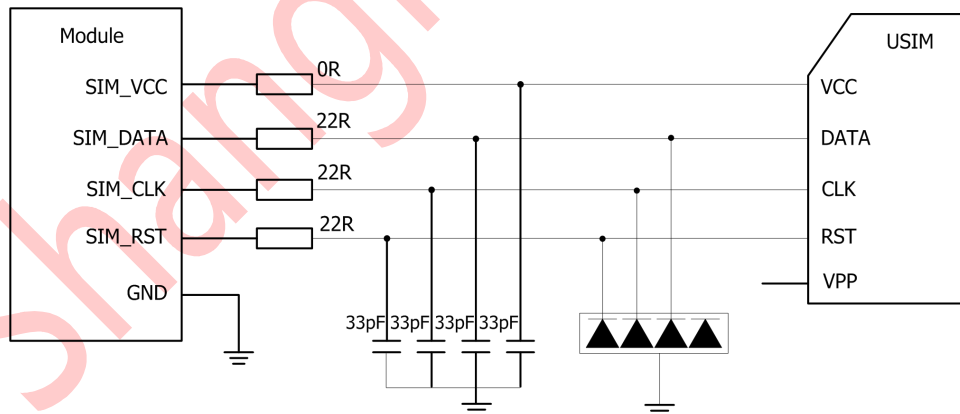


Figure 3-12 SIM circuit design diagram



NOTE

- ✧ The USIM interface line suggests choosing ONSEMI's SMF15C device to do ESD protection, and the peripheral circuit devices should be placed near the card holder. The SIM card seat is close to the module layout.
- ✧ USIM card circuit is easily caused by radio frequency interference to cause non recognition card or card loss, so the slot should be placed far away from the antenna



radiofrequency radiation, the card is far away from the radio frequency, power and high-speed signal line.

- ✧ The internal SIM_DATA has been pulled to VDD_EXT by 47K resistance, and no external pull resistance is required.
- ✧ SIM_DECT is a SIM card insertion or not insertion of the detection foot, the default is high level, hot-plug application can be through this PIN foot SIM card status detection.
- ✧ To avoid transient voltage overload, USIM interface needs to connect 22R resistor in series on signal path.
- ✧ The ground pin of USIM card should maintain good connectivity with the ground pin of module.

3.7.2 SIM_DECT hot plug reference design

The LPM2100 mg module supports the hot plug function of the USIM card.

The SIM_DECT pin is used as an input detection pin to determine whether the USIM card is inserted or not. The SIM_DECT pin is defaults to the high level. Hot plug can be turned on or off by AT + HOSCFG, which is turned off by default (see the LPM 2100 mg AT instruction set for details).

Table 3-9 SIM card hot plug detection foot definition

NO	PIN detection state	Functional description
1	high	SIM card is inserted, SIM_DECT is high
2	low	SIM card is pulled out, SIM_DECT is low

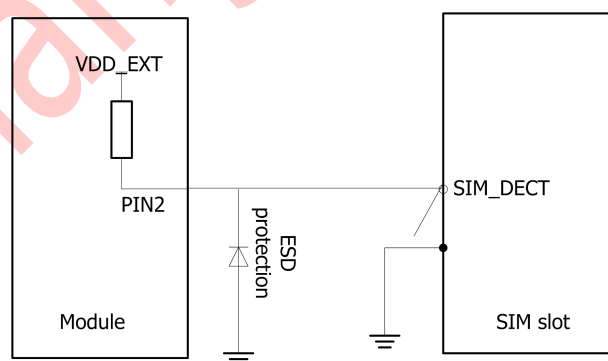


Figure 3-13 SIM card hot plug detection circuit *



NOTE

- ✧ It is suggested that a diode protection be added to the SIM_DECT pin side of the module side.



- ✧ Using the normally closed SIM card holder or the normally open SIM card holder, the detection function can be set through the AT instruction. When AT+HOSCFG=1,1, the SIM card is in a high state. When setting AT+HOSCFG=1,0, the SIM card is in a low state, and when setting AT+HOSCFG=0,0, the SIM card hot plug function is closed.
- ✧ "*" indicates that it is being developed.

3.8 ADC interface

LPM2100 mg module provides a 10-bit analog-to-digital conversion input interface, which can realize external temperature monitoring, and can read ADC pin voltage through AT command.

In order to improve the accuracy of ADC, ADC line should have a good reference.

Table 3-10 ADC signal definition

Pin	Pin name	IO	High level value	Remarks
9	ADC0	AI	General analog digital converter interface	

3.9 SPI interface

The LPM2100 mg module provides a set of SPI interfaces with an interface voltage of 2.8V.

Table 3-11 SPI signal definition

Pin	Pin name	IO	Functional description	Remarks
3	SPI_MISO	DI	Host input slave device output	2.8V voltage domain
4	SPI_MOSI	DO	Host output slave device input	
5	SPI_SCLK	DO	Serial clock signal	
6	SPI_CS	DO	Chip Select	

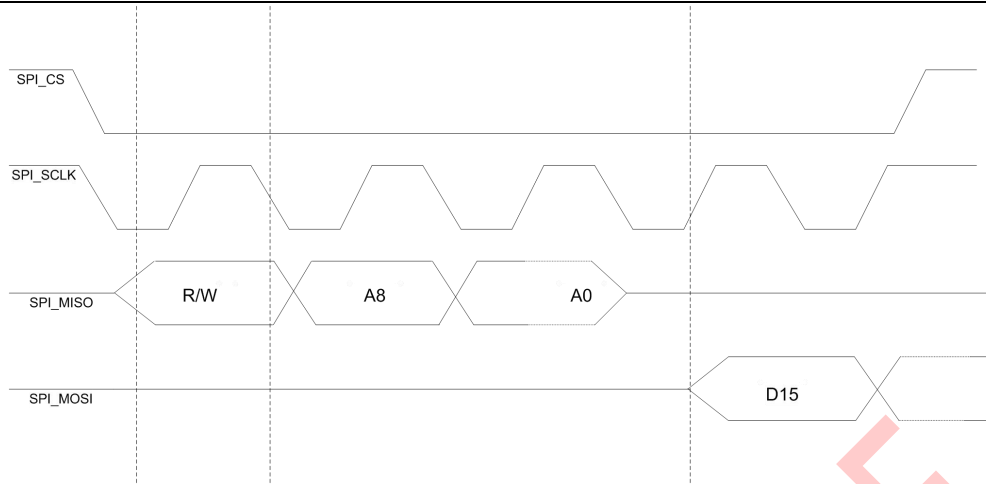


Figure 3-14 SPI reading sequence diagram

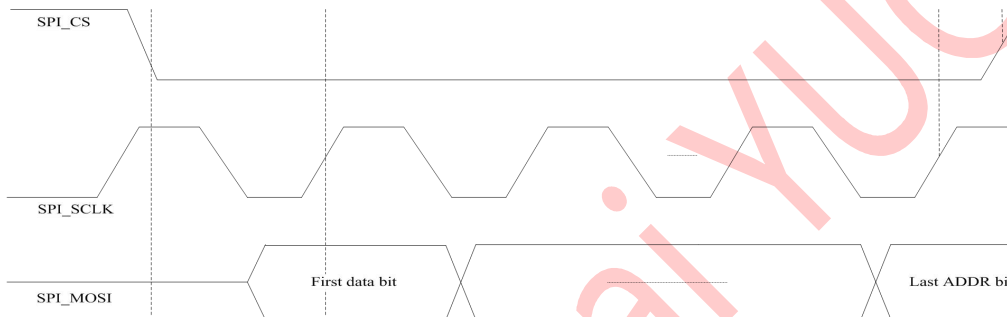


Figure 3-15 SPI writing sequence diagram

3.10 I2C bus

The LPM 2100 mg NB module provides a set of hardware 5.0 protocol bidirectional serial buses with a clock rate of 400 KHZ and an interface voltage of 2.8 V.

Table 3-12 I2C pin definition

Pin	Pin name	IO	Functional description	Remarks
32	SCL	OD	I2C bus clock output	Internal resistance pull up
33	SDA	IO	I2C bus data input and output	Internal resistance pull up

The I2C reference circuit is illustrated as follows:

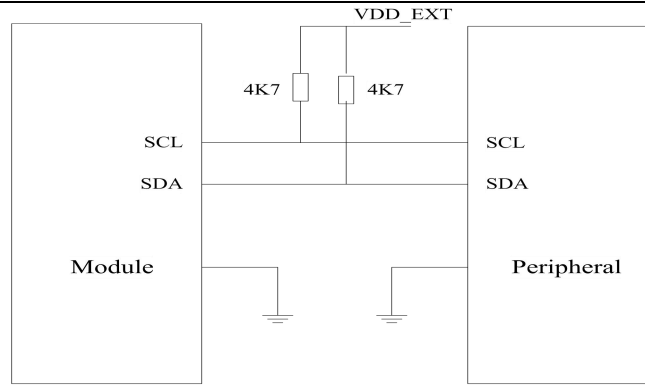


Figure 3-16 I2C interface reference circuit

NOTE

The internal pins of the I2C_SCL and I2C_SDA have been pulled up, so the pull-up resistors can be ignored externally.

3.11 Network indicator interface

The LPM2100 mg NB module provides a NENLIGHT pin to indicate the status of network communication, which can be used to drive LED lights indicating the network state.

Table 3-13 definition of network indicator lamp

Pin	Pin name	IO	Description
16	NETLIGHT	DO	Network status indication

Table 3-14 network indicator state

State	LED display status
Module is not run or module is not registered	Light out
Module successful registration network	Light light

LED network indicator light reference design chart is as follows:

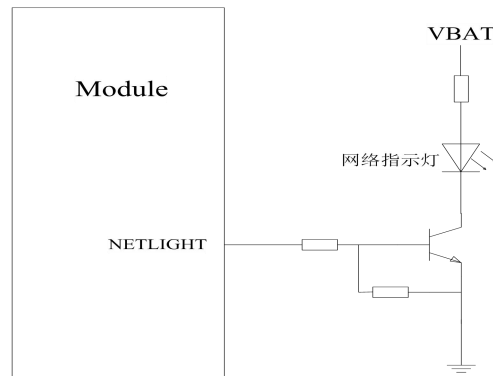


Figure 3-17 circuit diagram of network indicator

NOTE

The resistance value in the circuit diagram of the network indicator can be adjusted according to the LED lamp parameters.

3.12 General GPIO interface

The LPM2100 mg NB module provides two routes of GPIO. Some of these GPIO can be reused as a variety of functions. The specific usage can be consulted by the module provider.

Table 3-15 general GPIO pin definition

Pin	Pin name	IO	Functional description	Remarks
30	GPIO_1	IO	General input / output port	2.8V level
31	GPIO_2	IO	General input / output port	2.8V level



Chapter 4. RF overall technical index

4.1 Summary

LPM2100 mg NB module radio frequency overall technical indicators include the following parts:

- ✧ Frequency of work;
- ✧ Conductive radiofrequency measurement;
- ✧ It conducts receiving sensitivity and transmitting power.
- ✧ Antenna requirements
- ✧ Power characteristics of module

4.2 Main antenna and Bluetooth antenna

The LPM2100 mg NB module provides two antenna interfaces, one is the main antenna interface, the other is the Bluetooth antenna interface. In circuit design, the 50 ohmic impedance is required to connect the module to the antenna.

Antenna is a sensitive device which is easily influenced by external environment. For example, the size of the module, the position of the antenna, the size of the occupied space and the surrounding grounding may affect the performance of the antenna.

The modules of the module antenna are defined as follows:

Table 4-1 RF pin definition

Pin	Pin name	IO	Functional description	Remarks
26	BT_ANT	IO	Bluetooth antenna interface	50 ohm characteristic impedance
35	RF_ANT	IO	RF antenna interface	50 ohm characteristic impedance

The 35 pin of the LPM2100 mg NB module is the main antenna interface. In order to facilitate the antenna debugging, it is necessary to add the π matching circuit on the main board and take the 50 European impedance line. The recommended circuit is as follows:

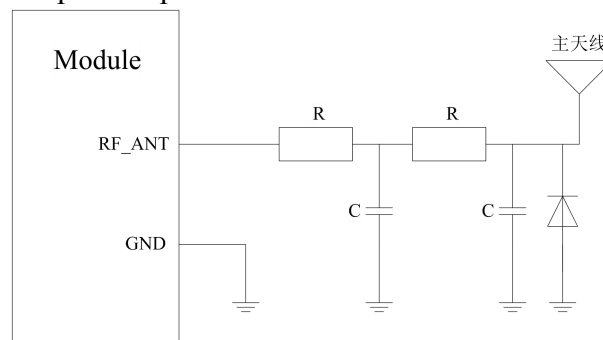


Figure 4-1 main antenna matching circuit diagram



The 26 pin of the LPM2100 mg NB module is the Bluetooth antenna interface. In order to facilitate the antenna debugging, it is necessary to add the π matching circuit on the main board and take the 50 European impedance line. The recommended circuit is as follows:

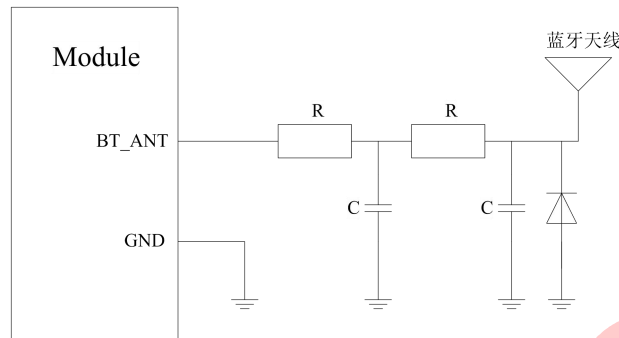


Figure 4-2 Bluetooth antenna matching circuit diagram



NOTE

The two antennas of the LPM2100 mg NB module are led by weld plate.

- ✧ The impedance line of antenna needs to be far away from the interference signal such as digital signal line, power supply and so on.
- ✧ The impedance line of the antenna needs to be ground in three dimensions, and more holes are added on both sides of the line.
- ✧ The loss of antenna line should be less than 0.3dB, so PCB line should be kept as short as possible.
- ✧ In the antenna matching, the parasitic capacitance of the TVS pin itself must be small to avoid interference of the signal. At the same time, taking into account the frequency bands used by the antenna and the minimum parasitic capacitance that can be accepted by different frequency bands, the parasitic capacitance of the ESD protection components usually used on the antenna must be less than 0.5pF or even lower.

4.3 Route guidance of radio frequency signal line

For users, the characteristic impedance of all RF signal lines should be controlled at 50 ohms. The impedance of the RF signal line is determined by the dielectric constant of the material, the widths (W), the ground clearance (S), and the height (H) of the reference ground plane. Please use the impedance simulation tool to calculate the RF line impedance value, PCB characteristic impedance control is usually use two ways of microstrip line and coplanar waveguide .

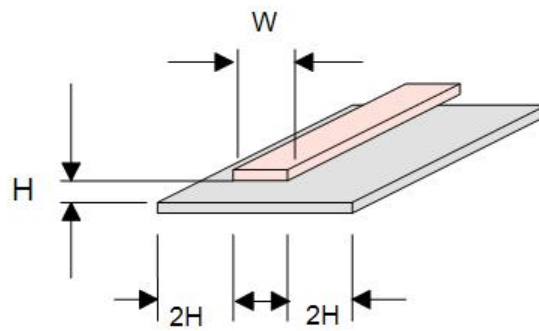


Figure 4-3 complete structure of microstrip line

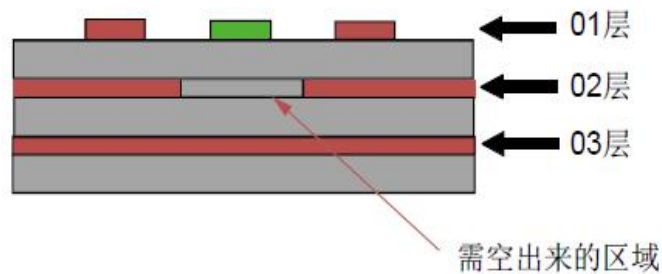


Figure 4-4 reference to the structure of the third layer microstrip transmission line

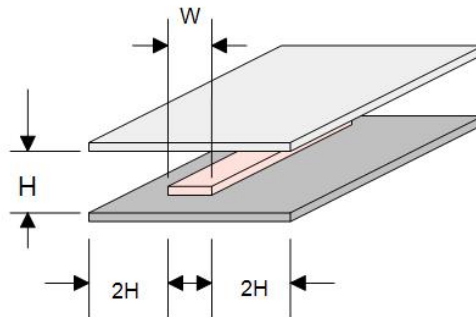


Figure 4-5 complete structure of strip line

4.4 Radiofrequency connector

In the design process, if the RF connector is required, the antenna connector must use a 50 ohm characteristic impedance coaxial connector, and the Hirose UF.L-R-SMT connector is recommended.

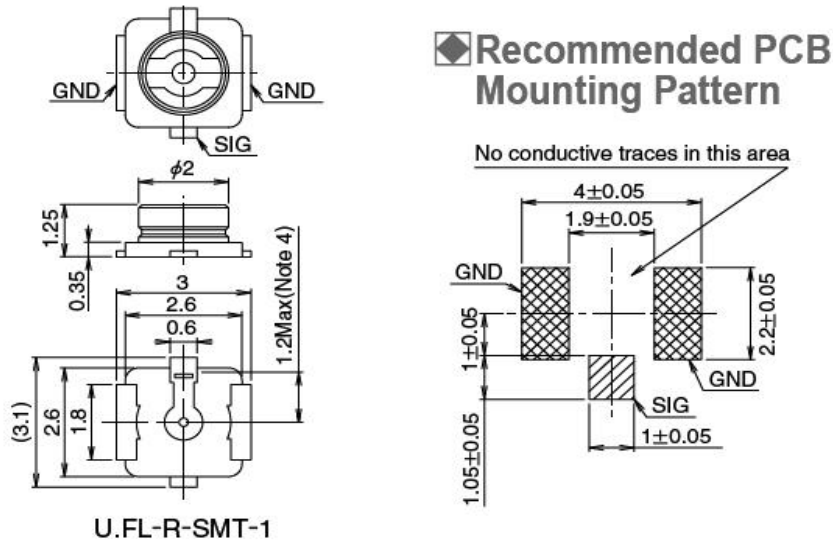


Figure 4-6 RF connector size diagram

The RF connector plug connected with this connector is U.FL-LP series of HRS company.

	U.FL-LP-040	U.FL-LP-066	U.FL-LP(V)-040	U.FL-LP-062	U.FL-LP-088
Part No.					
Mated Height	2.5mm Max. (2.4mm Nom.)	2.5mm Max. (2.4mm Nom.)	2.0mm Max. (1.9mm Nom.)	2.4mm Max. (2.3mm Nom.)	2.4mm Max. (2.3mm Nom.)
Applicable cable	Dia. 0.81mm Coaxial cable	Dia. 1.13mm and Dia. 1.32mm Coaxial cable	Dia. 0.81mm Coaxial cable	Dia. 1mm Coaxial cable	Dia. 1.37mm Coaxial cable
Weight (mg)	53.7	59.1	34.8	45.5	71.7
RoHS	YES				

Figure 4-7 antenna connector plug diagram

Table 4-2 RF connector main parameters

Rated condition		environment condition
frequency range	DC to 6GHZ	- 40° C to +85° C
characteristic impedance	50 Ω	- 40° C to +85° C

4.5 Working frequency

Table 4-3 radiofrequency frequency meter

Band	Uplink frequency	Downlink Frequency	Pattern
B3	1710MHz - 1785MHz	1805MHz - 1880MHz	Half duplex
B5	824MHz - 849MHz	869MHz - 894MHz	Half duplex
B8	880 MHz - 915 MHz	925 MHz - 960 MHz	Half duplex



4.6 RF conduction emission power and acceptance sensitivity

The RF output power of the LPM2100 mg NB module is as follows:

Table 4-4 LPM2100 mg RF output power

Directories	3GPP protocol requirements (dBm)	Minimum value
NB-IOT		
LTE B3	21 to 25	<-40dBm
LTE B5	21 to 25	<-40dBm
LTE B8	21 to 25	<-40dBm

Table 4-5 radiofrequency sensitivity index

Directories	3GPP protocol requirements (dBm)	Minimum	Typical	Maximum
NB-IOT				
LTE B3	-107.5	<-107.5	-113	
LTE B5	-107.5	<-107.5	-113	
LTE B8	-107.5	<-107.5	-113	

4.7 Power consumption characteristics

Table 4-6 NB-IOT power consumption

type	channel	power MAX	Call Current (mA)			
			Power	Avg Current	Min Current	Max Current
NB-IOT B3	TBD		Max power	TBD		
	TBD			TBD		
	TBD			TBD		
NB-IOT B5	TBD		Max power	TBD		
	TBD			TBD		
	TBD			TBD		
NB-IOT B8	TBD		Max power	TBD		
	TBD			TBD		
	TBD			TBD		



Chapter 5. Electrical characteristics of interface

5.1 Summary

- ✧ Extreme work
- ✧ IO level
- ✧ Power supply
- ✧ Electrostatic characteristics
- ✧ Reliability index

5.2 Extreme work

Table 5-1 LPM2100 mg module working storage temperature

Parameter	Minimum	Maximum
Normal working temperature	-20° C	70° C
Extreme working temperature	-40° C	85° C
Storage temperature	-45° C	90° C

Table 5-2 LPM2100 mg module limit operating voltage range

Parameter	Description	Minimum	Typical	Maximum
VBAT	Module power supply voltage	3.4V	3.7V	4.2V
	RMS average current			0.9V

5.3 Module IO level

The LPM2100 mg module port IO level is as follows:

Which corresponds to 1.8V USIM application, SIM_VDD is 1.8V, corresponds to 3V USIM application, SIM_VDD is 3V.

Other digital IO levels are unified to 2.8V.

Table 5-3 electrical characteristics of LPM2100 mg module

Parameter	Description	Minimum	Maximum
VIH	High level input voltage	0.7* VDD_EXT	VDD_EXT
VIL	Low level input voltage	-	0.3*VDD_EXT
VOH	High level output voltage	0.7*VDD_EXT	VDD_EXT
VOL	Low level output voltage	0	



5.4 Power Supply

The input power requirements of the LPM2100 mg NB module are as follows:

Table 5-4 LPM2100 mg module working voltage

Parameter	Minimum	Typical	Maximum	Unit
VBAT	3.4	3.7	4.2	V

The power on any interface of the module must not be earlier than the boot time of the module, otherwise it may cause the module to be abnormal or damaged.

5.5 Electrostatic characteristics

LPM2100 mg module without any overvoltage protection measures, the module needs to use static electricity protection, to ensure product quality.

ESD design recommendations:

- ✧ The module's USIM pin needs to be protected by adding TVS.
- ✧ Add TVS at the module input power supply.
- ✧ The PCB wiring of protective devices should take the "V" shape line as far as possible so as to avoid the "T" shape.
- ✧ Ensure the integrity of the module's surrounding ground plane and do not divide it.
- ✧ In the production, assembly and laboratory testing of modules, attention should be paid to the surrounding environment and ESD control of operators.

Table 5-5 LPM2100 mg ESD characteristics

Test port	Contact discharge	Air discharge	unit
USIM interface	±4	±8	KV
VBAT power supply	±4	±8	KV
RF_ANT	±4	±8	KV
BT_ANT	±4	±8	KV
Other PORT	±4	±8	KV

5.6 Reliability index

Table 5-6 reliability test

Test project	Test conditions	Reference standard	experimental result
Low temperature	Temperature: - 20 C Work mode: normal work	IEC60068 -2-1	Appearance check: normal Functional examination:



work	Test duration: 24 h		normal RF index check: normal
High temperature work	Temperature: 70 C Work mode: normal work Test duration: 24 h	JESD22-A108-C	Appearance check: normal Functional examination: normal RF index check: normal
Temperature cycle	High temperature temperature: 70 C Low temperature temperature: - 20 C Work mode: normal work Test duration: 30 Cycles; 1 h+1h /cycle	JESD22-A105-B	Appearance check: normal Functional examination: normal RF index check: normal
Drop Test	Height 0.8 m, 6 sides each time, fell to the level marble platform. Work mode: no package, no Power on and off	IEC60068-2-32	Appearance check: normal Functional examination: normal RF index check: normal



Chapter 6. Structure and mechanical properties

6.1 Summary

- ✧ Outward appearance
- ✧ Mechanical dimension of module

6.2 Appearance

The LPM2100 mg NB module is PCBA with a single layout. The module appearance is as follows:

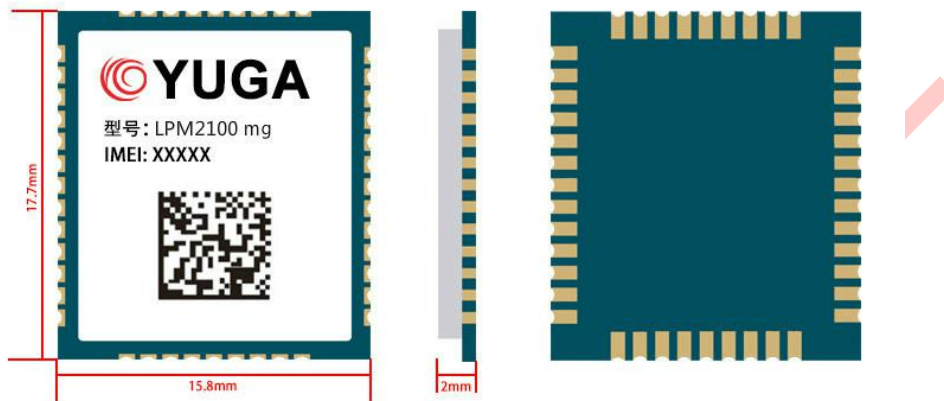


Figure 6-1 LPM2100 mg module appearance

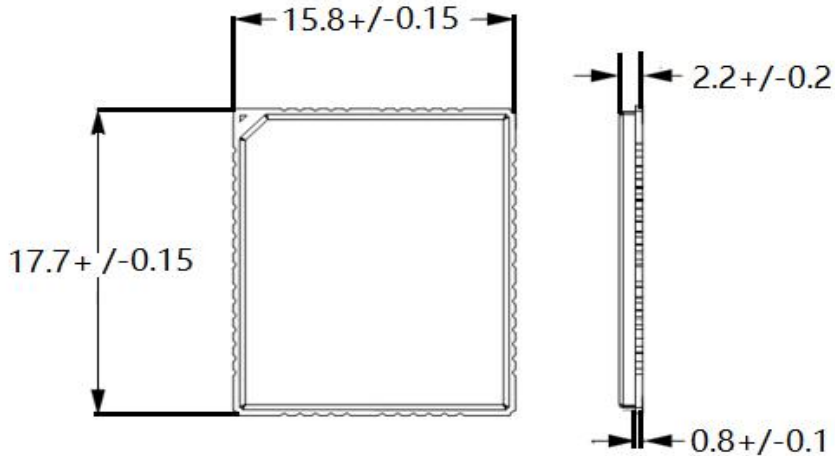


Figure 6-2 front view and side view of LPM2100 mg module (unit MM)

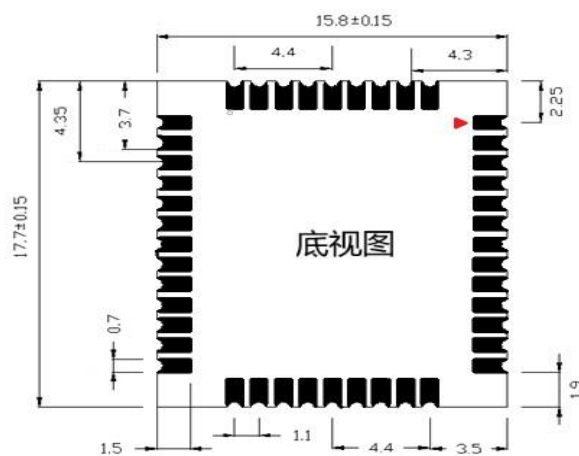


Figure 6-3 LPM2100 mg module bottom view (unit MM)



Chapter 7. Production and packaging

7.1 Summary

- ✧ Packaging and storage of module
- ✧ Production welding

7.2 Module packaging and storage

LPM 2100 mg NB module is packed in tray and packed in vacuum sealed bag. It is shipped in the form of vacuum sealed bag with 10PCS as a disk and 100PCS as a package.

The storage of LPM2100 mg NB module module should follow the following conditions:

- ✧ The humidity sensitive grade of the module is level 3.
- ✧ If the ambient temperature is greater 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.
- ✧ When the vacuum sealing bag is opened, if the temperature of the module is less than 30 degrees centigrade, the air humidity is less than 60%, the factory can finish the patch within 72 hours, and the module can be directly reflow welding or other high temperature flow.
- ✧ If the module is in other conditions, it needs baking before the patch.
- ✧ If the module needs to be baked, remove the package and bake at 125 degrees Celsius for 48 hours.

7.3 Production welding

LPM 2100 mg NB module is packed by antistatic tray, SMT production line should be equipped with Tray module, reflux furnace above 7 temperature zone is recommended.

- ✧ To ensure the quality of the printing paste, the thickness of the steel mesh corresponding to the pad of the LPM2100 mg NB module is recommended as 0.18mm.
- ✧ It is recommended that the temperature of reflow soldering is 235~245 C, not exceeding 260 C.
- ✧ When PCB double sided layout, LCC module layout must be processed on second sides. Avoid module reversal due to module gravity, resulting in module missing, welding and welding, and poor internal welding of modules.

The recommended temperature curve of the furnace is as shown in the following figure.

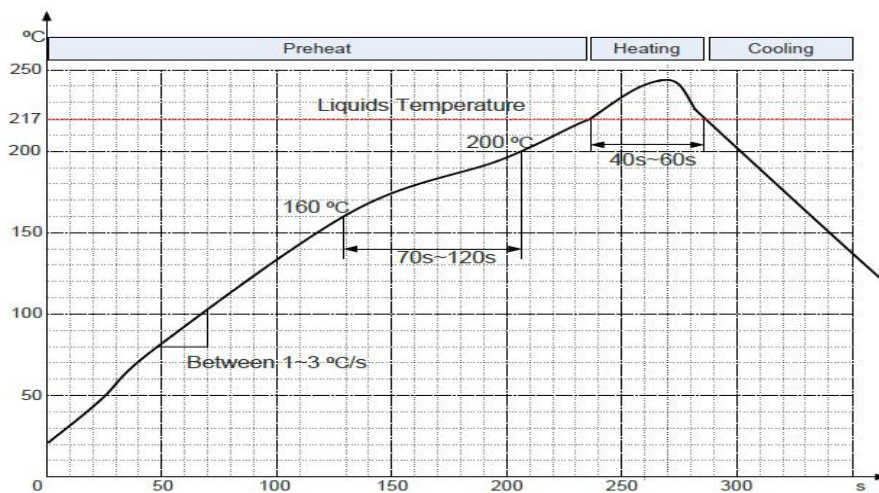


Figure 7-1 reflow soldering temperature curve

Table 7-1 recirculation process parameter table

Temperature zone	time	key parameter
Preheating zone (40S°C-165°C)		heating rate: 1°C/s-3°C/s
Isothermal zone (160°C-210°C)	(t1~t2): 70s-120s	
Reflux zone (> 217°C)	(t3~t4): 40s-60s	Peak temperature: 235°C-245°C
Cooling zone	cooling rate: 2°C/s ≤ Slope ≤ 5°C/s	



Chapter 8. Terminology abbreviation

Table 8-1 terminology abbreviations

Abbreviation	Full name
3GPP	Third Generation Partnership Project
AMR	Adaptive Multi-rate
CTS	Clear to Send
DTR	Data Terminal Ready
DL	Down Link
DTE	Data Terminal Equipment
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
LED	Light-Emitting Diode
NC	Not Connected
PCB	Printed Circuit Board
USIM	Universal Subscriber Identity Module
TVS	Transient Voltage Suppressor
TX	Transmitting Direction
UART	Universal Asynchronous Receiver-Transmitter
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency