L306 Hardware Design Manual

GSM/GPRS/WCDMA Module Series

Version： V1.0

Date： 2016-09-18

FCC Statement

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

---Reorient or relocate the receiving antenna.

---Increase the separation between the equipment and receiver.

---Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

---Consult the dealer or an experienced radio/TV technician for help.

FCC Caution:

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

IMPORTANT NOTE:

This module is intended for OEM integrator. The OEM integrator is still responsible for the FCC compliance requirement of the end product, which integrates this module. 20cm minimum distance has to be able to be maintained between the antenna and the users for the host this module is integrated into. Under such configuration, the FCC radiation exposure limits set forth for an population/uncontrolled environment can be satisfied.

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

FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body as well as kept minimum 20cm from radio antenna depending on the Mobile status of this module usage. This module should NOT be installed and operating simultaneously with other radio. The manual of the host system, which uses L306, must include RF exposure warning statement to advice user should keep minimum 20cm from the radio antenna of L306module depending on the Mobile

status. Note: If a portable device (such as PDA) uses L306module, the device needs to do permissive change and SAR testing.

LABEL OF THE END PRODUCT:

The final end product must be labelled in a visible area with the following "Contains FCC ID: 2AHSAL306". If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual: 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.

USERS MANUAL OF THE END PRODUCT:

In the users manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user’s authority to operate this equipment. If the size of the end product is smaller than 8x10cm, the additional FCC part 15.19 statement is required to be available in the users manual: This device complies with Part 15 of 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.

EU Regulatory Conformance

Hereby, we (Shanghai Insislink Technology Co., Ltd.) declared that this device is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

CE 0681

Revision History

Date	Version	Modify records	Author
2016-09-18	V1.0	First Release	

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1.Introduction

L306 is a small UMTS/HSPA+ module for LCC package, with stable and reliable performance. It supports UMTS/HSDPA/HSUPA900(850)/2100(1900)and can be completely compatible with existing EDGE and GSM/GPRS networks

1.1 Hardware Diagram

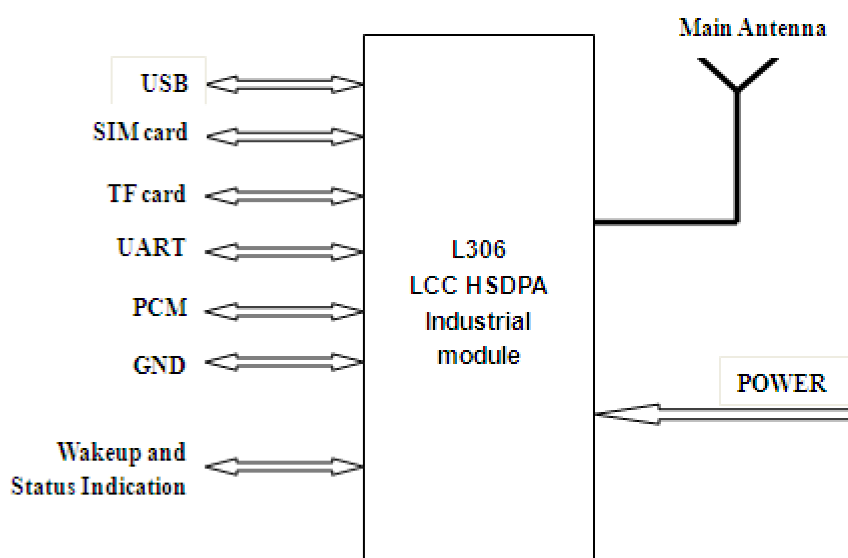


Figure 1-1: L306 functional architecture

1.2 Main features

- **CPU**

  ARM Cortex-R4
  481Hz

- **Flash**
  RAM: 512Mb LPDDR1, 200 MHZ
  Flash: 1Gb NAND

- **L306 series frequency bands**

Standard	Frequency	L306	L306A	L306M	L306MA	L306H	L306HA
GSM	GSM850 MHZ	●	●	●	●	●	●
	EGSM900 MHZ	●	●	●	●	●	●
	DCS1800 MHZ	●	●	●	●	●	●
	PCS1900 MHZ	●	●	●	●	●	●
WCDMA	UMTS850 MHZ		●		●		●
	UMTS900 MHZ	●		●		●	
	UMTS1900 MHZ		●		●		●
	UMTS2100 MHZ	●		●		●	
HSPA	HSDPA(1)	●	●	●	●	●	●
	HSUPA(1)	●	●	●	●	●	●

（1） L306/L306M/L306H support different Version of HSPA ,Please Reference Table 5-4 Datalink

1.3 Product specifications

- Supply Voltage Range：3.3～4.2V （type3.8V）
- Dimensions：30mm * 30mm * 2.5mm
- Package :82-pin LCC
- Support FOTA
- Operation Temperature Range：-40℃～+85℃
- Storage Temperature Range：-45℃～+90℃
- Antenna：Main Antenna、Diversity Antenna
- Weight : Approx 5g

1.4 Interfaces

- SDIO : ×1

- SPI : ×1
- IIC : ×1
- PCM : Digital audio interface
- SIM : ×1,support 1.8V/3V
- UART : ×2,High speed UART
- USB 2.0 :High Speed ,480Mbps

2. Package Information

2.1 Pin Configuration

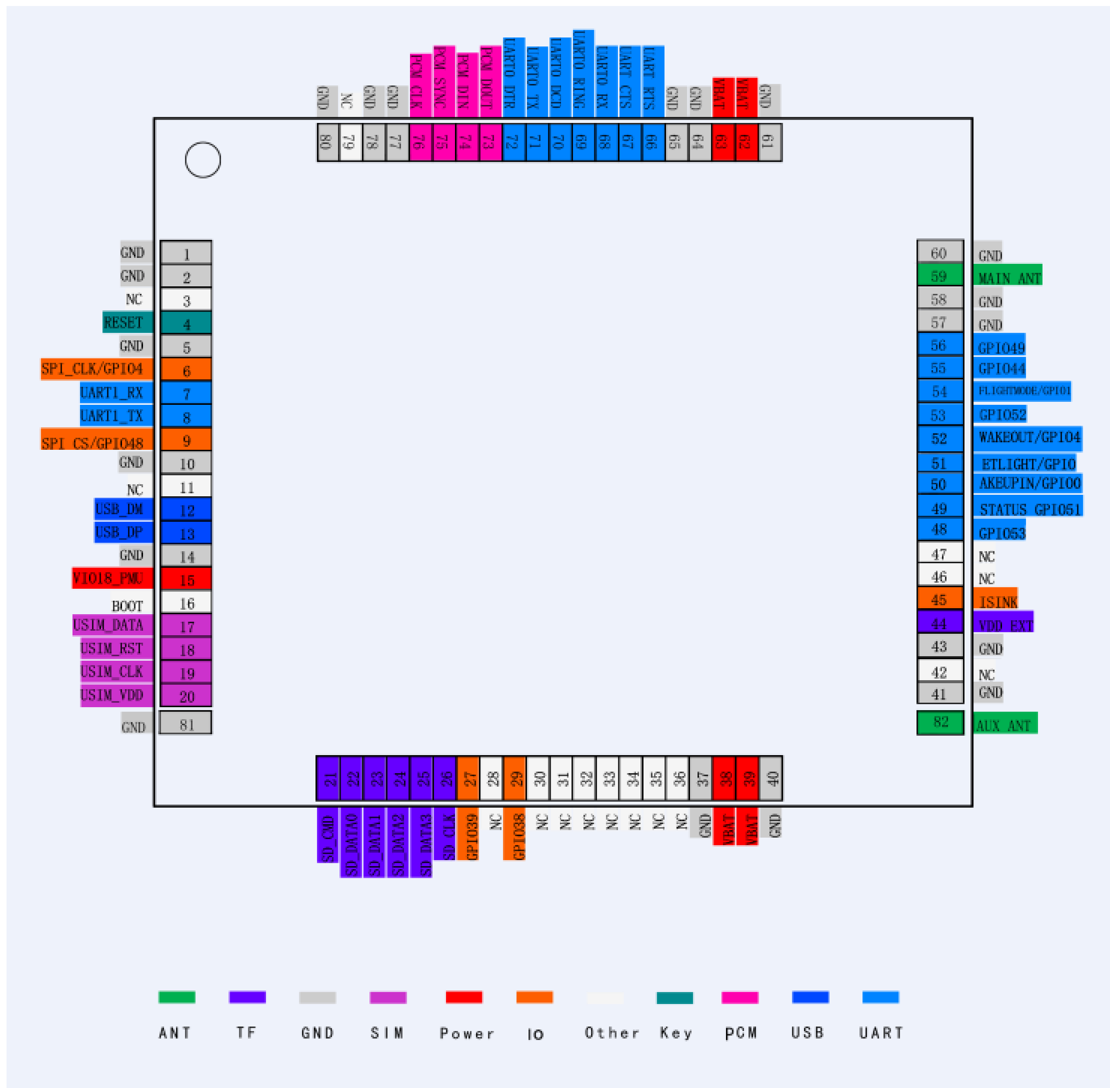


Figure 2-1: L306 PIN View

2.2 Pin definition

Table 2-1：Pin description

Pin NO.	Pin name	Type	Function Description	Power domain	State when not used
1.	GND	G	Ground		GND
2.	GND	G	Ground		GND
3.	NC		NC		
4.	SYSRSTB	I	System reset signal	DVDD18	Open
5.	GND	G	Ground		GND
6.	GPIO47	I/O	General input/output PIN. It can be used as SPI clock	DVDD18	Open
7.	URXD1	I/O	UART1 RX	DVDD18	Open
8.	UTXD1	I/O	UART1 TX	DVDD18	Open
9.	GPIO48	I/O	General input/output PIN. It can be used as SPI chip-select	DVDD18	Open
10.	GND	G	Ground		GND
11.	NC		NC		
12.	USB_DM	DIO	USB port differential data line		Open
13.	USB_DP	DIO			Open
14.	GND	G	Ground		GND
15.	VIO18	P	1.8V output voltage	1.8V	Open
16.	LPRDB	I/O	USB download key (Reserve)	DVDD18	Open
17.	USIM_DATA	I/O	USIM data	DVDD18	Open
18.	USIM_RESET	I/O	USIM reset	DVDD18	Open
19.	USIM_CLK	I/O	USIM clock	DVDD18	Open
20.	USIM_VCC	P	SIM output voltage	1.8/3.0	Open
21.	SD_CMD	I/O	SD card command pin	DVDD28	Open
22.	SD_DAT0	I/O	SD card data pin	DVDD28	Open
23.	SD_DAT1	I/O		DVDD28	Open
24.	SD_DAT2	I/O		DVDD28	Open
25.	SD_DAT3	I/O		DVDD28	Open
26.	SD_CLK	I/O	SD card clock output	DVDD28	Open
27.	GPIO39	I/O	General input/output PIN	DVDD18	Open
28.	NC		NC		
29.	GPIO38	I/O	General input/output PIN	DVDD18	Open
30.	NC		NC		
31.	NC		NC		

32.	NC		NC		
33.	NC		NC		
34.	NC		NC		
35.	NC		NC		
36.	NC		NC		
37.	GND	G	Ground		GND
38.	VBAT	P	Power supply	3.3～4.2V	VBAT
39.	VBAT				VBAT
40.	GND	G	Ground		GND
41.	GND	G	Ground		GND
42.	NC		NC		
43.	GND	G	Ground		GND
44.	VMC_PMU	P	VMC_PMU output voltage for SD	2.8/3.0/3.1/3.3V	Open
45.	GPIO17	I/O	General input/output PIN. It can be used as LED control	DVDD18	Open
46.	NC		NC		
47.	NC		NC		
48.	GPIO53	I/O	General input/output PIN	DVDD18	Open
49.	STATUS/GPIO51	I/O	Output PIN as operating status indicating of module	DVDD18	Open
50.	WAKEUP IN/GPIO0	I/O	Host to set the module into sleep or wake up the module from sleep,internal pullup by VIO18	DVDD18	Open
51.	NETLIGHT/GPIO54	I/O	Output PIN as LED control for network status	DVDD18	Open
52.	WAKEOUT/GPIO46	I/O	General input/output PIN. It can be used as wake signal to host from module	DVDD18	Open
53.	GPIO52	I/O	General input/output PIN	DVDD18	Open
54.	FLIGHTMODE/ GPIO1	I/O	Input PIN as RF operating control, internal pullup by VIO18	DVDD18	Open
55.	GPIO44	I/O	General input/output PIN. It can be used as I2C clock	DVDD18	Open
56.	GPIO49	I/O	General input/output PIN. It can be used as I2C data	DVDD18	Open
57.	GND	G	Ground		GND
58.	GND	G	Ground		GND
59.	MAIN_ANT	ANT	RF Main Antenna		Open
60.	GND	G	Ground		GND
61.	GND	G	Ground		GND

62.	VBAT	P	Power supply	3.3～4.2V	VBAT
63.	VBAT				VBAT
64.	GND	G	Ground		GND
65.	GND	G	Ground		GND
66.	UART0_RTS	I/O	UART0 ready to receive	DVDD18	Open
67.	UART0_CTS	I/O	UART0 clear to send	DVDD18	Open
68.	UART0_RX	I/O	UART0 receive data input	DVDD18	Open
69.	UART0_RING	I/O	UART0 ring indicator	DVDD18	Open
70.	UART0_DCD	I/O	UART0 data carrier detect	DVDD18	Open
71.	UART0_TX	I/O	UART0 transmit output	DVDD18	Open
72.	UART0_DTR	I/O	UART0 Data terminal ready	DVDD18	Open
73.	PCM_DOUT	I/O	PCM I/F data out	DVDD18	Open
74.	PCM_DIN	I/O	PCM I/F data in	DVDD18	Open
75.	PCM_SYNC	I/O	PCM interface sync	DVDD18	Open
76.	PCM_CLK	I/O	PCM interface clock	DVDD18	Open
77.	GND	G	Ground		GND
78.	GND	G	Ground		GND
79.	NC		NC		
80.	GND	G	Ground		GND
81.	GND	G	Ground		GND
82.	AUX_ANT		MIMO Antenna		Open

Table 2-2: Pin type description

P:POWER	NC:NOT CONNECT
G:GROUND	AI:ANALOGY INPUT
I:INPUT	I/O:INPUT or OUTPUT
O:OUTPUT	AO:ANALOGY OUTPUT
ANT:ANTENNA	AIO:ANALOGY INPUT OUTPUT
DIO:DIGITAL INPUT OUTPUT	

2.3 Package Dimensions

2.3.1 Module Size

Module TOP View and Side View：

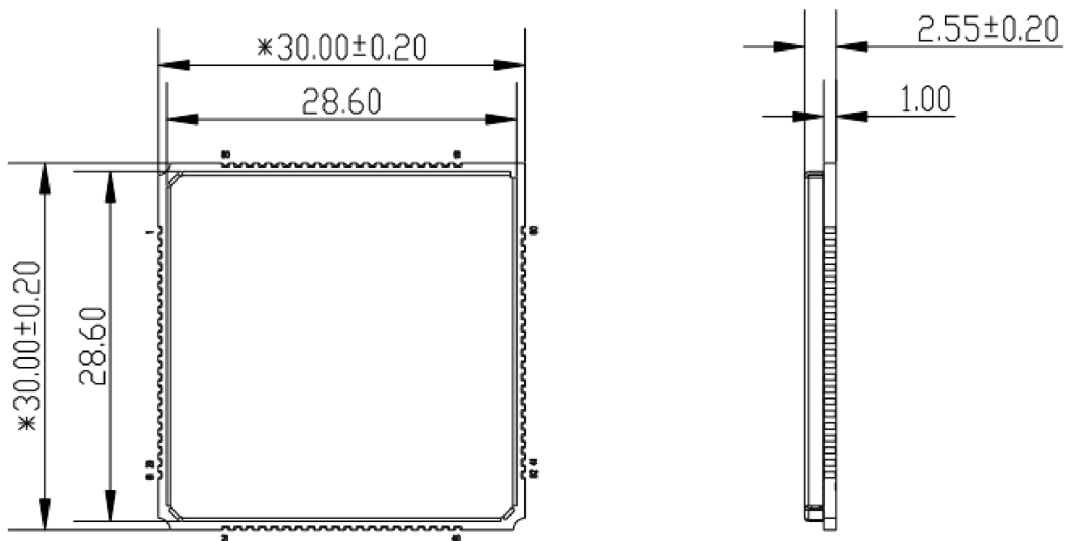
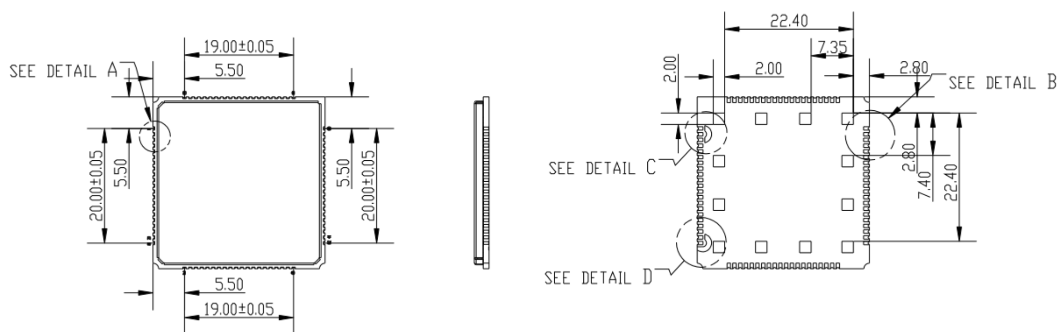


Figure 2-2 Module SIZE

2.3.2 Package Size



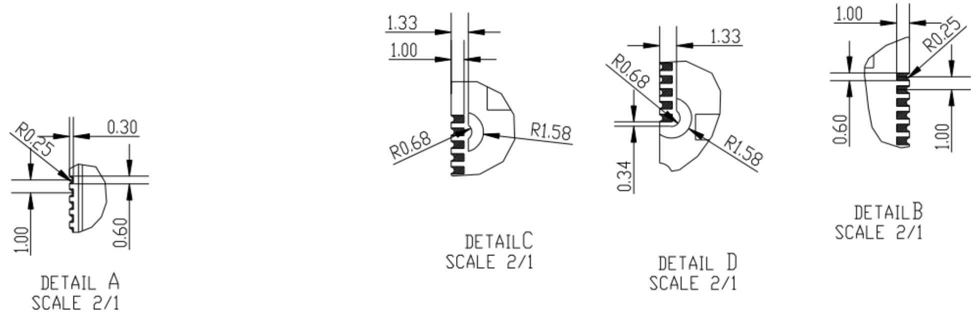
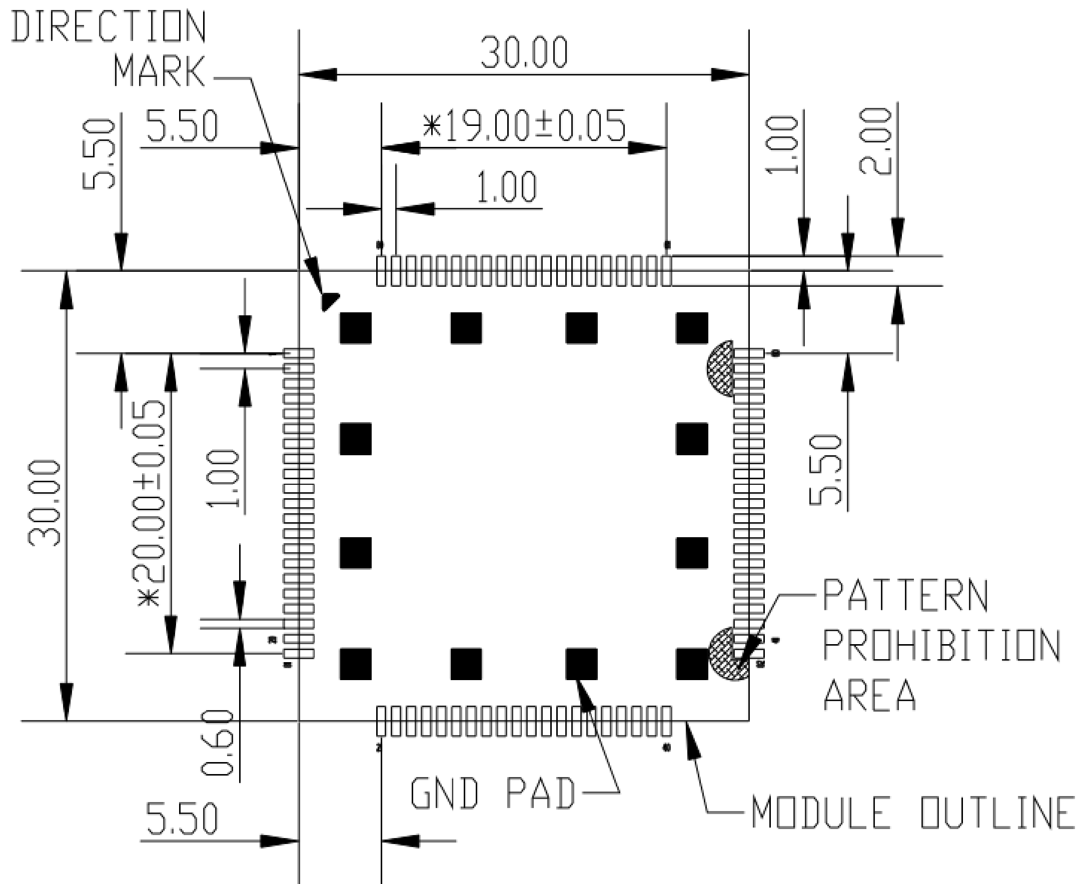


Figure 2-3 Package SIZE

2.3.3 Recommend Pad



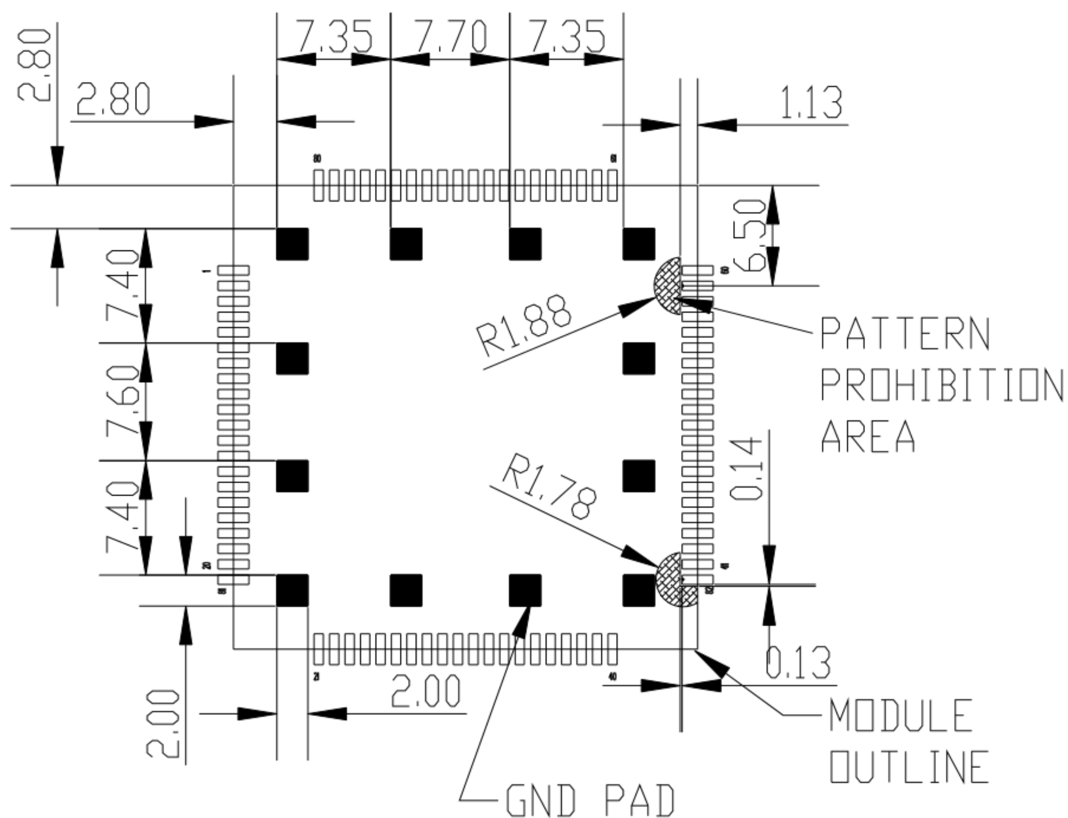


Figure 2-4 Recommend pad

3.Interface Circuit Design

3.1 POWER

3.1.1 Power Supply

VBAT is the main power supply of the module, and the input voltage range is 3.5V to 4.35V. The recommended voltage is 4.0V. Because the module transmit burst may cause voltage drops, the highest peak will reach 3A（RF max current will be about 2A, and add the current of LCM and Speaker）.A large capacitor voltage is recommended to use near VBAT pins, and the capacitor's value is the bigger the better. In order to improve the continued flow of large current, it is recommended to use a low-impedance tantalum 470uF or larger. During layout, the capacitors are close to the VBAT pins.

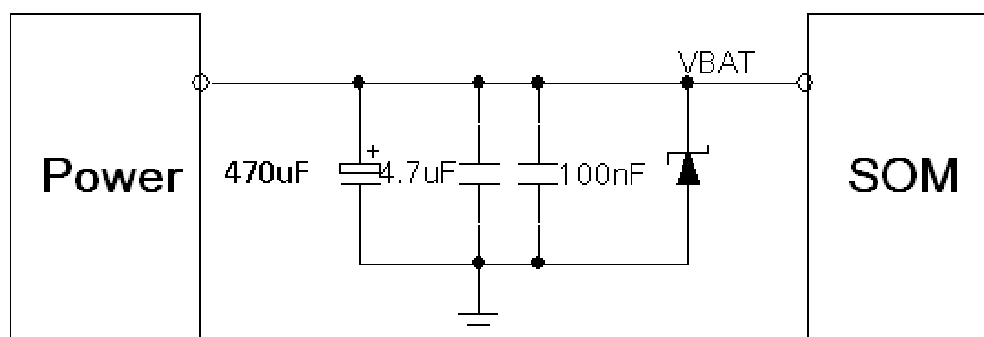


Figure 3-1：Power Supply circuit

Notes: According to the environment, please select capacitor as large value as possible; and add 100pF, 33pF capacitors if requiring.
Add Ziner close to our SOM. The ziner should be 5.1V/500mW, Ir<100uA @Vr=4.2V.

3.1.2 Power pin description

Pin number	Pin name	Description
38/39/62/63	VBAT	positive signal
1/2/5/10/14/37/40/41/43/57/58/60/64/65 77/78/80/81	GND	GND
83/84/85/86/87/88/89/90/91/92/93/94	Fix	Fix and Temperature

The power supply and the signal ground of the product need to be connected to the ground plane of the system board. GND signal connection is not complete will have an impact on the performance of the product. In addition, there are a total of 12 83~94 heat sink and fixed pad.

3.1.3 Hardware switch machine

L306 module does not have a separate boot key, using the power on the boot form。

3.1.4 Hardware reset

Module fourth pin for the hardware reset input, when the pin input to the input of a sustained low level 20ms trigger reset, the module will power off reset. The system has an internal pull, the typical value is 1.8V, do not need to pull.

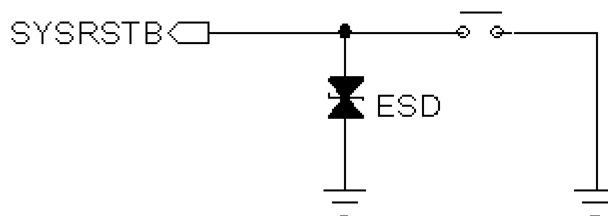


Figure 3-2：System Reset

3.2 USIM

3.2.1 Pin Description

L303 module baseband processor integrated with 7816-2 USIM standard ISO card interface, support and be able to automatically detect 3.0V and USIM 1.8V card, USIM card interface signal as shown in table 3-1.

Table 3-1 (U)SIM Pin Description

Pin number	Name	Signal definition	Function Description
20	USIM_VCC	USIM card power supply pin	USIM card power supply, output by the module
17	USIM_DATA	USIM card data pin	USIM card DATA signal, I/O signal
19	USIM_CLK	USIM card clock pin	USIM card clock signal, output by the module
18	USIM_Reset	USIM card reset pin	USIM card reset signal, output by the module

3.2.2 USIM application

USIM card signal group (PIN number: 17, 18, 19, 20), in close proximity to the USIM card seat on the line, design, please note that the need to increase the ESD protection device.

In order to meet the requirements of 3GPP TS 51.010-1 protocol and EMC certification, the proposed USIM card is arranged in close proximity to the position module USIM card interface, avoid due to go line is too long, resulting in serious waveform distortion, affecting the signal integrity of. USIM_CLK and USIM_DATA signal to walk the line to recommend the package to protect. Between GND and USIM_VCC in parallel with a 1uF and 33pF capacitors, filter out the interference of radio frequency signals.

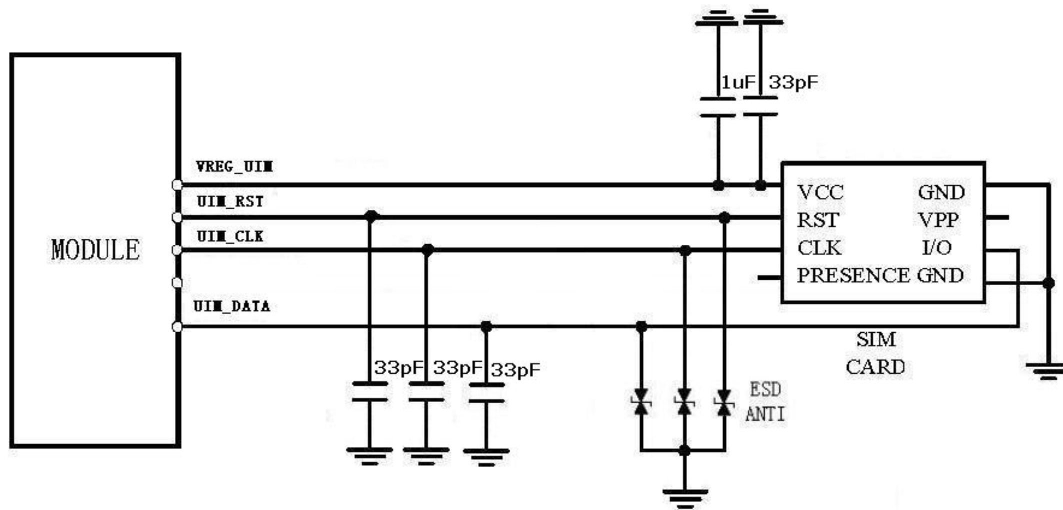


Figure 3-3 (U)SIM Circuit

3.3 TF

Module supports 4 bit data interface SD card, support SDIO2.0 protocol。

The ESD device is used to protect TF signal, the ESD device placed near the device. SD_CLK signal PCB on both sides of the package to protect.

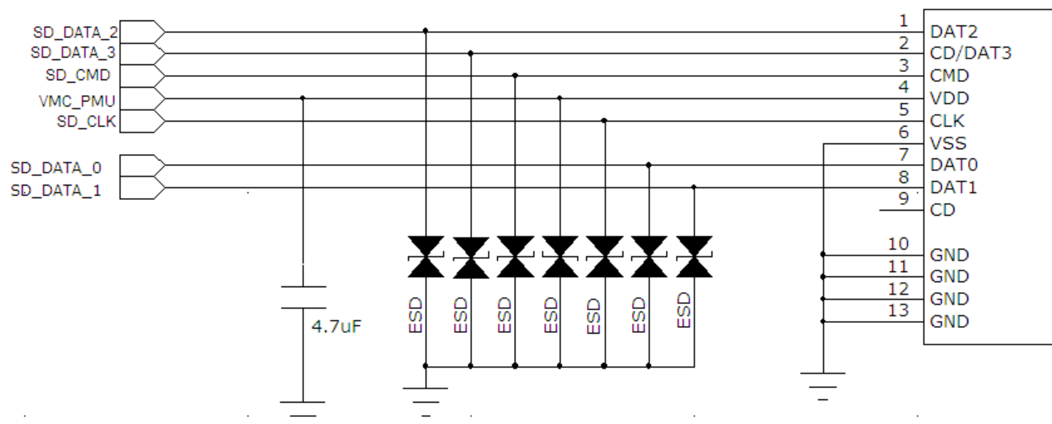


Figure 3-4 TF Circuit

Note：ESD Cpf<10pF

3.4 USB

3.4.1 USB application

The USB interface of the module conforms to the USB2.0 specification and electrical characteristics. Support for low-speed, full-speed and high-speed three modes of operation. The data exchange between the main processor (AP) and the module is mainly completed through the USB interface.

USB bus is mainly used for data transmission, software upgrade, module program testing. Working in the USB mode of the high-speed line, if you need ESD design, ESD protection devices must meet the junction capacitance value of <3pf, otherwise the larger junction capacitance will cause waveform distortion, affect the bus communication. Differential data line of the differential impedance to be controlled at 90ohm + 10%, up and down around the package, and can not be crossed with other lines. USB connection circuit as follows:

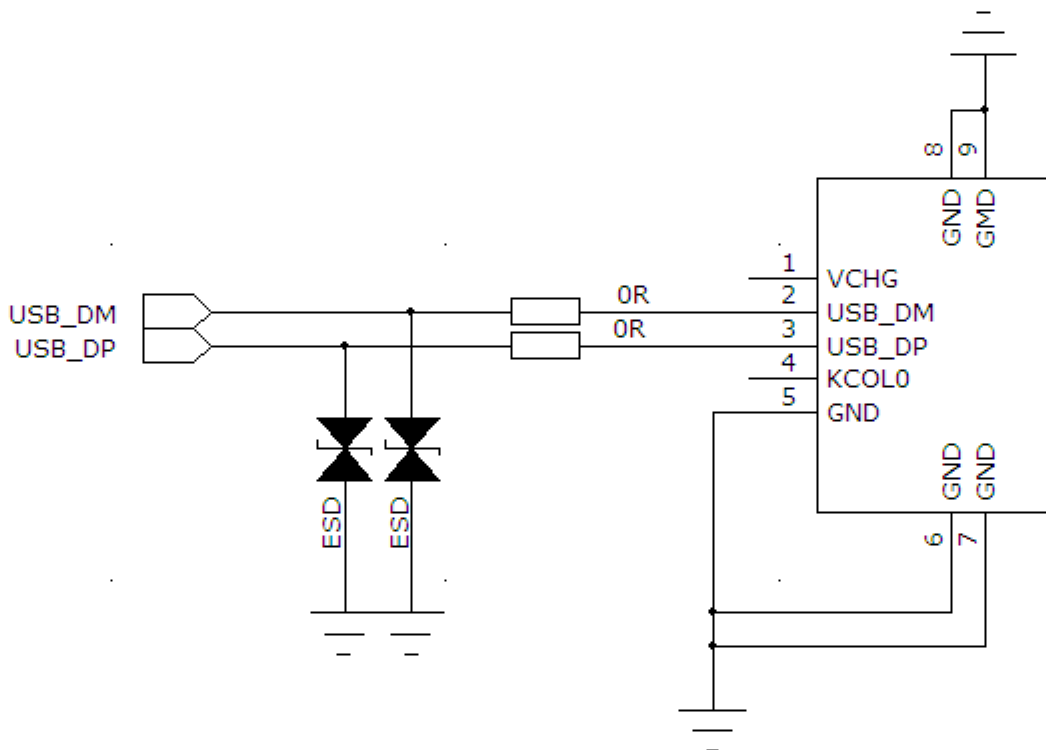


Figure 3-5 USB Circuit

3.5 PCM

3.5.1 PCM application

Digital audio interface (PCM) module L306 can as PCM main equipment digital transmission of voice signal, in use process, module L306 only act as a master device, PCM sync, PCM CLK are as output pins and PCM sync output 8kHz synchronization signals, the PCM data support 8-bit or 16 bit data format. And the codec connection from the device is shown in figure 3-6:

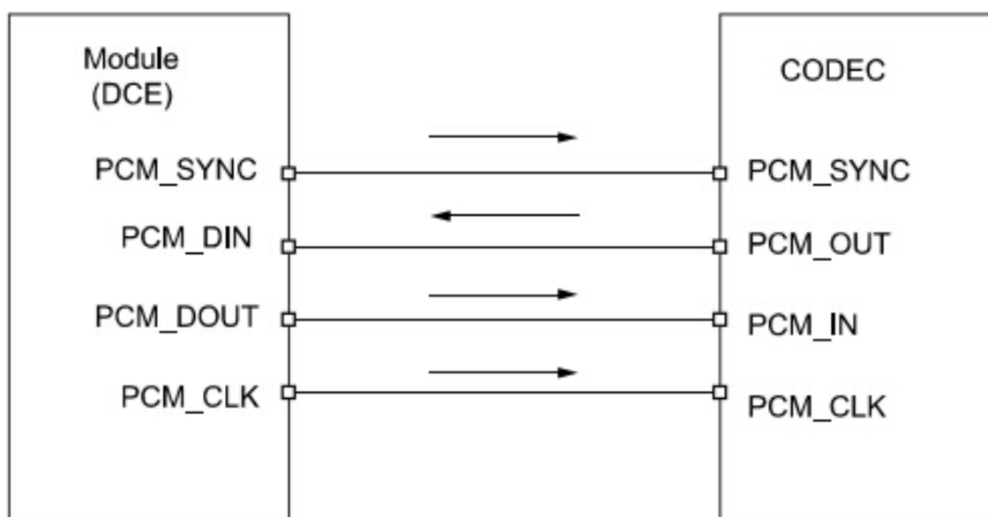


Figure 3-6 PCM Circuit（L306 as Main）

3.6 IIC

L306 module does not have a dedicated IIC interface, if you need to use the IIC interface for communication, you need to use the GPIO port to simulate the IIC interface, and the need to pull the resistance of VIO18 to 4.7K .

3.7 SPI

Module does not have a dedicated SPI interface, if you need to use the SPI interface for communication, the need to use the GPIO port analog SPI interface, only support the main device model.

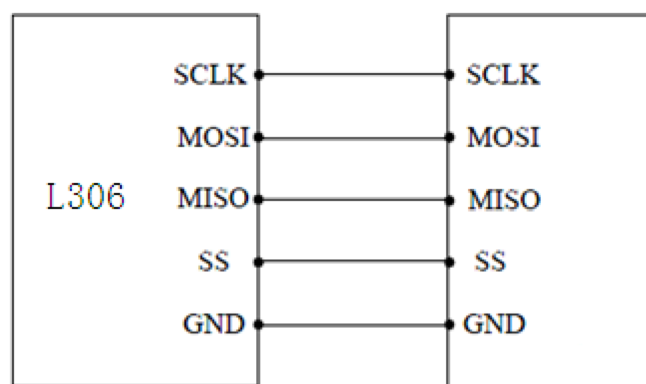


Figure 3-7 SPI

Note：SPI and IIC interface，the average power is 1.8V，if the external level standards are not the same，you need to do level conversion . Proposed using IC level conversion .

3.8 UART

3.8.1 Pin Description

Provide two UART serial communication interface module L306: the uart1 as the end of the L306 with the AP module debug port, 2-wire UART interface; UART0 both can debug port as the end of the L306 modem module also can be as complete non synchronous communication interface, support standard modem handshake signal control and in compliance with the RS-232 interface protocol, also support 4-wire serial bus interface or 2-wire serial bus interface mode, the module can be serial communication and at commands are input through the UART interface with the outside world .

The two groups of UART port support can be programmed data width, stop bits data programming, programming of the parity bit, with separate TX and Rx FIFOs (512 bytes each), for the largest baud rate for normal application of UART (non-Bluetooth) to 115200bps. The default baud rate to 115200bps.

Table 3-2 UART Pin Description

PIN number	Name	I/O	Description
8	UART1_TX	DO	UART1 transmit output only for debugging
7	UART1_RX	DI	UART1 receive data input only for debugging
71	UART0_TX	DO	UART0 transmit data output
68	UART0_RX	DI	UART0 receive data input

69	UART0_RING	DO	UART0 Ring Indicator
66	UART0_RTS	DO	UART0 Ready to receive
72	UART0_DTR	DI	Data Terminal Ready
67	UART0_CTS	DI	UART0 Clear to Send
70	UART0_DCD	DO	UART0 Data Carrier Detect

3.8.2 UART application

UART0 and UART1 in order to have a log in the software debugging process, we suggest that the user design to retain this interface and set aside the test point.

UART0 if used in the module and application processor communication, and the level of 1.8V matching, the connection mode as shown in Figure 3-8 and figure 3-9, you can use the complete RS232 mode, 4 wire or 2 wire mode connection. Module interface level is 1.8V, if the AP interface level does not match, you must increase the level conversion circuit.

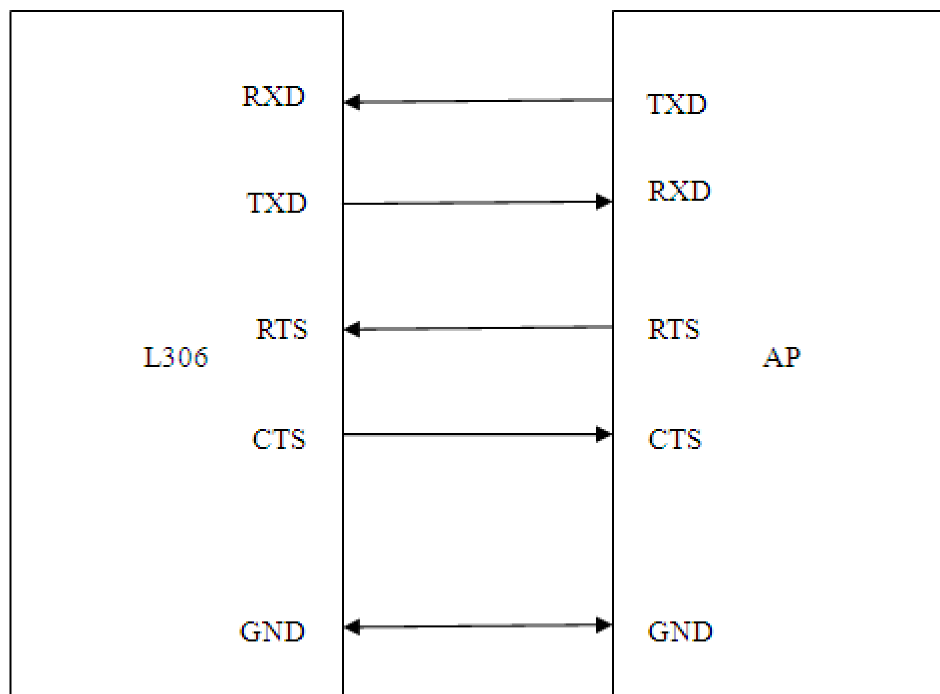


Figure 3-8 Connect to AP method(4lines)

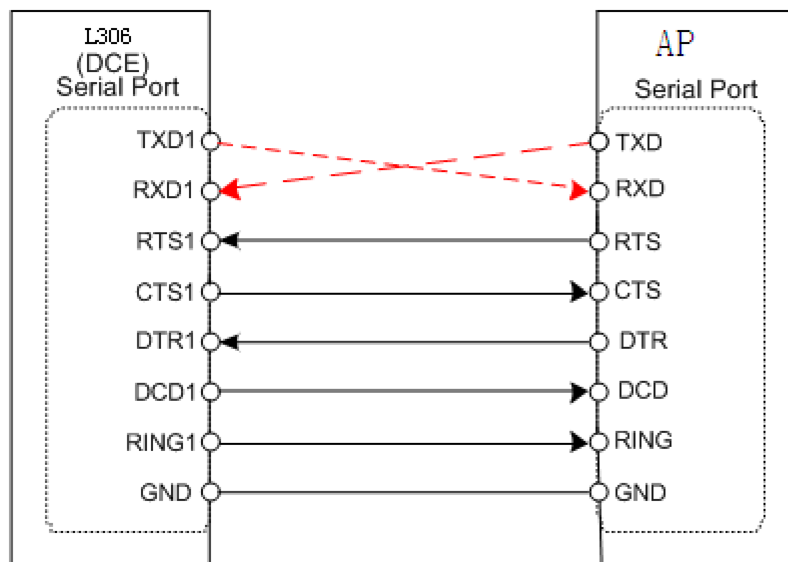


Figure 3-9 Connect to AP method

3.9 Interactive application interface

3.9.1 Pin Description

Table 3-3 Interactive application interface

Pin MO.	Pin name	I/O	Function
51	NETLIGHT/GPIO54	0	Output PIN as LED control for network status. If it is unused, left open.
54	FLIGHT MODE/GPIO1	I	Input PIN as RF operating control. H: Normal ModeL:Flight Mode. If it is unused, left open.
49	STATUS/GPIO51	O	Output PIN as operating status indicating of module. H: Power on L: Power off. If it is unused, left open.
52	WAKEOUT/GPIO46	I/O	General input/output PIN. It can be used as wake/interrupt signal to host from module If it is unused, left open.
50	WAKEUP IN/GPIO0	I/O	General Purpose Input/Output Port. It can be used as wake/interrupt signal to module from host. If it is unused, left open.

Note: If you need to use more GPIO port, you can refer to table 2-1; user can read and write through the AT GPIO port state

3.10 LED

3.10.1 LED Control circuit

GPIO54 (PIN51) can be used to control the network status of the lamp so that the foot; GPIO17 (PIN45) can be used as an indicator of the power supply connection and disconnection of the indicator light.

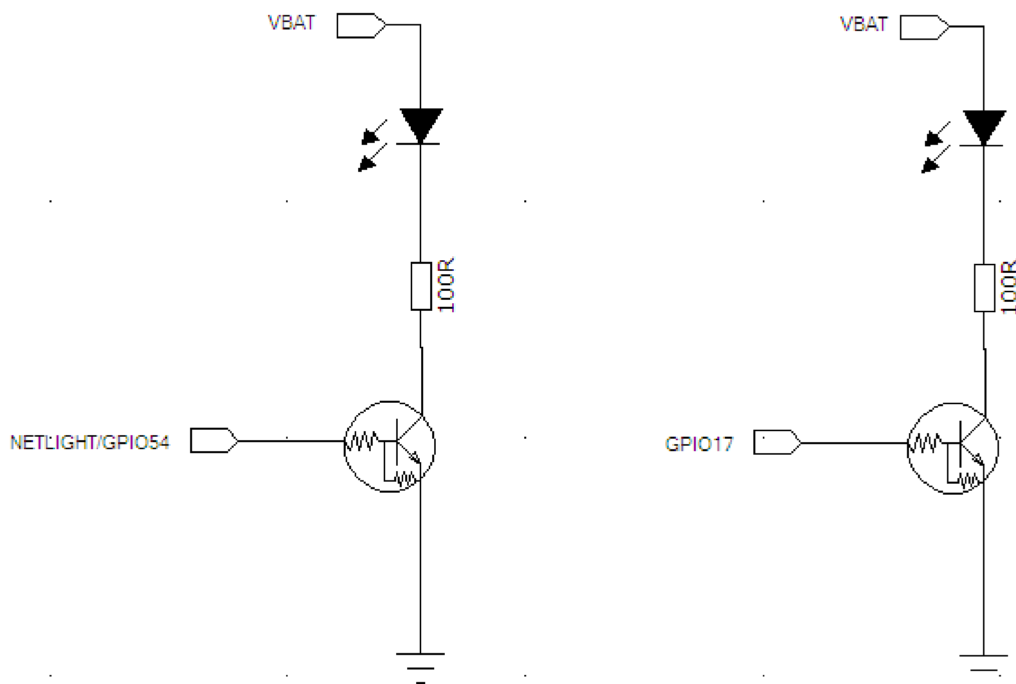


Figure 3-10 LED Circuit

3.10.2 LED State description

GPIO17 as the enable pin:

Table 3-4 LED State

LED Status	Module Status
Always On	Power on
OFF	Power off

GPIO54 as the enable pin：

Table 3-5 LED State

LED Status	Module Status
Always On	Searching Network/Call Connect
200ms ON, 200ms OFF	Data Transmit
800ms ON, 800ms OFF	Registered network
OFF	Power off / Sleep

4. Electrical characteristics and reliability

4.1 Electrical characteristics

Table 4-1 Electrical characteristics

Power	Min.	Nom.	Max.	Unit
VBAT	3.3	3.8	4.2	V
MAX	-0.3	-	2.0	A

Note: The voltage is too low can cause the module don't normally boot; the voltage is too high or the boot impulse may also cause permanent damage to the module. Using the DCDC supply, please ensure the capacity of DCDC over 2.0A.

4.2 Temperature characteristic

Table 4-2Temperature characteristic

State	Min.	Nom.	Max	Unit
Operation	-40	25	85	℃
Storage	-45		90	℃

Notes: When the temperament is over the range, the RF performance may be dropped. It also may cause power down or restart problem.

4.3 Absolute Maximum Power

Table 4-3Absolute maximum power rating

PIN Name	Description	Min.	Typ.	Max.	Unit
DVDD18	Digital power input for IO	1.7	1.8	1.9	V
DVDD28	Digital power input for IO	2.65	2.8	3.5	V

4.4 Recommended operating conditions

Table 4-4Recommended operating range

PIN Name	Description	Min.	Typ.	Max.	Unit
DVDD18	Digital power input for IO	1.7	1.8	1.9	V
DVDD28	Digital power input for IO	2.65	2.8	3.5	V

Note： All the GPIO ports provided by the core board are 1.8V

4.5 Power Sequence

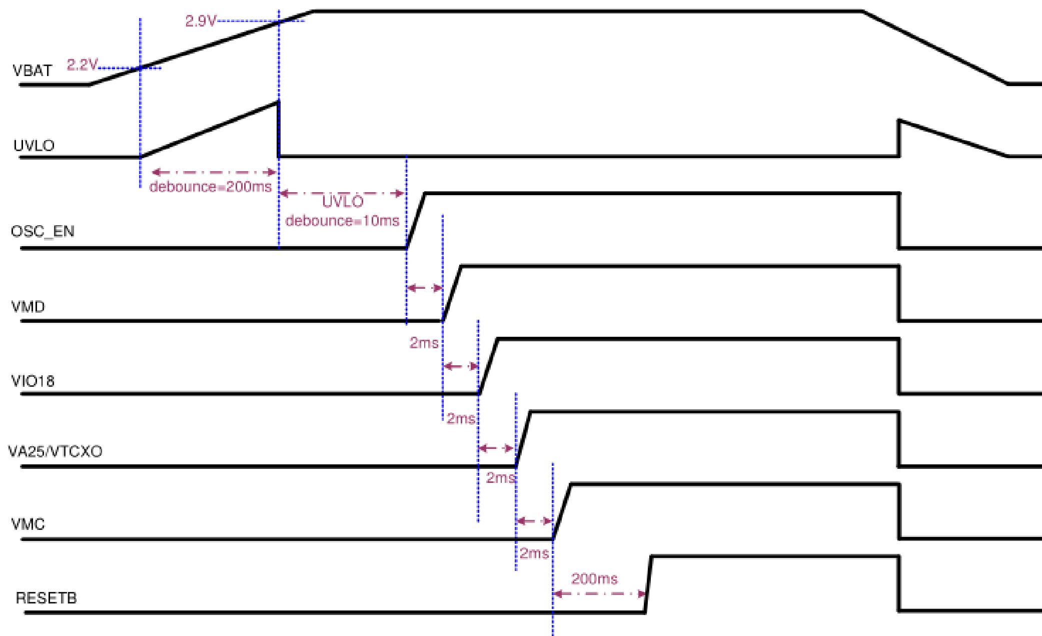


Figure 4-1: Power up time sequence diagram

4.6 Digital Interface Characteristics

Table 4-5 Digital interface characteristics

Parameter	Description	Min.	Typ.	Max.	Unit
VIH	Input high level	1.62	1.8	1.98	V
VIL	Input low level	0	-	0.7	V
VOH	Output high level	1.62	1.8	1.98	V
VOL	Output low level	0	-	0.3	V

Note：Suitable for GPIO，I2C，UART，SPI and other digital interface

4.7 ESD

Because there is no special protection against electrostatic discharge in the module, it is necessary to pay attention to the protection of electrostatic protection in the production, assembly and operation module. The performance parameters of the module test are as follows:

ESD parameter（Tem：25℃，humidity：45%）

Table 4-7 ESD

Pin Name	Contact	Air
VBAT	±4KV	±8KV
GND	±4KV	±8KV
RF_ANT	±4KV	±8KV

Enhanced ESD performance method:

1、 The metal frame of the screen needs a good grounding; the screen of the FPC needs to brush the film, the film needs a good grounding.；

2、 If the customer to the adapter plate, the adapter plate anchor as much as possible, and the

uniform distribution of conduction path width；

3、The suspension plate (key board or light board, etc.) need to be well grounded, for grounding copper exposure；

4、Key (reset key) need to add ESD device; reset key to walk the line do not rely on the edge of the board；

5、USB, UART and other plug connection need to add ESD devices, the other from the outside of the machine out of the control line also need to add ESD devices;

6、SIM card, users will get inserted t-card touch the place also need to add ESD device；

7、External antenna, please add ESD device；

Note：In order to ensure the performance of ESD, please follow these steps to enhance the performance of ESD;
High speed line (such as USB, memory, SIM card) ESD performance values have specific requirements, refer to the corresponding document;
ESD devices can be used for pressure sensitive resistance and TVS tube, if the performance requirements are more, please use TVS tube;

5. RF Specifications

5.1 Frequency Band

L306 support GSM Band 2/3/5/8 and WCDMA Band1(2)/Band8(5);

Table 5-1 Frequency Bands

Frequency	Uplink	Downlink
GSM850	824 MHz — 849 MHz	869 MHz — 894 MHz
E-GSM900	880 MHz — 915 MHz	925 MHz — 960 MHz
DCS1800	1710 MHz — 1785 MHz	1805 MHz — 1880 MHz
PCS1900	1850 MHz — 1910 MHz	1930 MHz — 1990 MHz
UMTS2100	1920 MHz — 1980 MHz	2110 MHz — 2170 MHz
UMTS1900	1850 MHz — 1910 MHz	1930 MHz — 1990 MHz
UMTS850	824 MHz — 849MHz	869 MHz — 894 MHz
UMTS900	880 MHz — 915 MHz	925 MHz — 960 MHz

Table 5-2 Output power

Frequency	Max output power	Min output power
GSM850	33dBm ±2dB	5dBm ±5dB
E-GSM900	33dBm ±2dB	5dBm ±5dB
DCS1800	30dBm ±2dB	0dBm ±5dB
PCS1900	30dBm ±2dB	0dBm ±5dB
GSM850(8-PSK)	27dBm ±3dB	5dBm ±5dB
E-GSM900(8-PSK)	27dBm ±3dB	5dBm ±5dB
DCS1800(8-PSK)	26dBm +3/-4dB	0dBm ±5dB
PCS1900(8-PSK)	26dBm +3/-4dB	0dBm ±5dB
UMTS2100	24dBm +1/-3dB	-56dBm ±5dB
UMTS1900	24dBm +1/-3dB	-56dBm ±5dB
UMTS850	24dBm +1/-3dB	-56dBm ±5dB
UMTS900	24dBm +1/-3dB	-56dBm ±5dB

Table 5-3 Receive sensitivity

Frequency	Receive sensitivity
GSM850	<-109dBm
E-GSM900	<-109dBm
DCS1800	<-109dBm
PCS1900	<-109dBm
UMTS2100	<-109dBm
UMTS1900	<-109dBm
UMTS850	<-109dBm
UMTS900	<-109dBm

5.2 Data link

L306 support GPRS/EDGE CLASS12,and HSDPA/HSDPA R8, The actual use depends on the local network operator support.

Table 5-4 DataLink

Version	Function	Max supported	Theoretical max peak rate
L306/L306M/H	GPRS	CS4	85.6kbps
L306/L306M/H	EDGE	MCS9	236.8kbps
L306	HSDPA	Cat10	14.4Mbps
L306M	HSDPA	Cat14	21Mbps
L306H	HSDPA	Cat24	42Mbps
L306	HSUPA	Cat6	5.76Mbps
L306M	HSUPA	Cat7	11Mbps
L306H	HSUPA	Cat7	11Mbps

5.3 Antenna Design

The access part of the RF antenna of this product supports the PAD pad form. The module of the radio frequency main antenna between the module and the main board antenna interface is required to be welded and connected through a microstrip line or a strip line. The microstrip line or strip line is designed according to the characteristic impedance of 50 ohm, and the length of the wire is less than 10mm. Reserved PI matching network

Antenna efficiency

Antenna efficiency is the ratio of the input power and radiant power. Because of the return loss, material loss and coupling loss of the antenna ,the radiant power is always lower than the input power. The ratio is recommended to be controlled over 40%(-4dB).

S11 or VSWR

S11 indicates the matching level of the 50 Ohm impedance for the antenna. It affects the antenna efficiency in a certain extent. The VSWR testing method could be used for measuring purpose. The recommended value for S11 is less than -10dB.

Polarization

Polarization refers to the rotation direction of electric field while the antenna is in the direction of maximum radiation. Linear polarization is recommended. It is recommended to use the diversity antenna which has the different polarization direction from the main antenna.

Radiation pattern

The radiation pattern refers to the intensity of the electromagnetic field while the antenna is in every direction of the far field. Dipole antenna is perfect as the terminal antenna. For built-in antenna, it is recommended to use PIFA , IFA and Dipole antennas.

Antenna dimension:6mm*10mm*100mm(H*W*L).
Antenna radiation direction: omnidirectional.

Gain and directivity

Antenna directivity refers to the intensity of the electromagnetic field while the electromagnetic wave is in all directions. Gain is the collection of the efficiency and directivity of the antenna. It is recommended that antenna gain is less than or equal to 3dBi.

Interference

In addition to antenna performance, some other interference from the PCB will also affect the module performance. To ensure the high performance of the module, the interference must be under control. Suggestions: keep speaker, LCD, CPU, FPC wire routing, audio circuits, and power supply away from the antenna, and add appropriate filtering and shielding protection, or adding filtering devices on the traces.

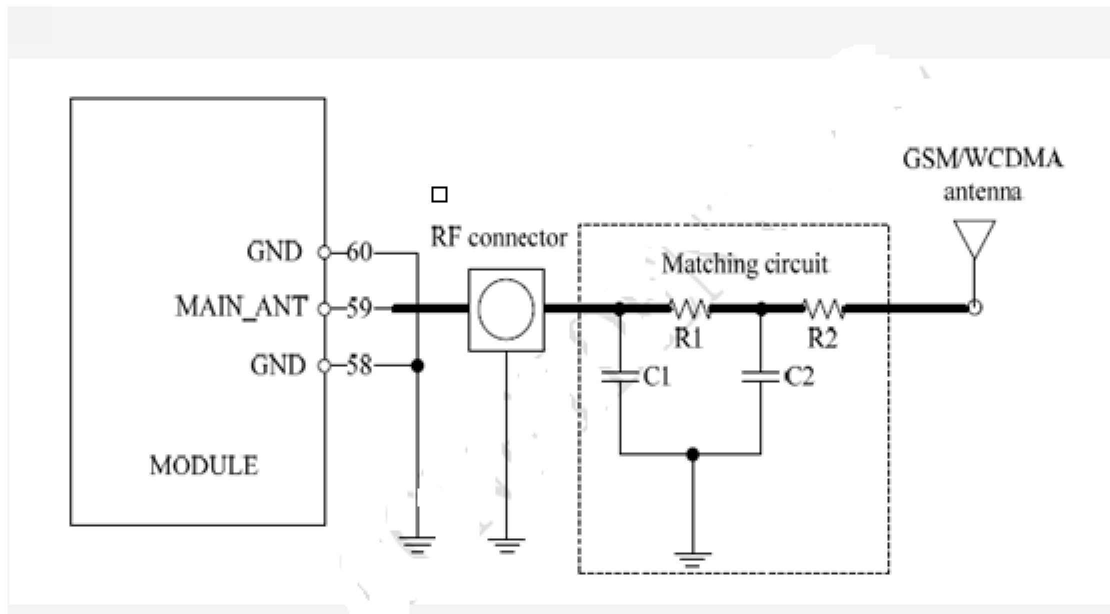


Figure 5-1 Main Antenna Design

Figure R1, C1, C2 and R2 composition of the antenna matching network for antenna debugging, the default R1, R2 paste 0 ohm resistor C2, C1 empty paste, to be antenna factory after the antenna to determine the value of the antenna.
Connector RF in the figure is used for testing and conducting test (for example, CE, FCC, etc.), which need to be placed as far as possible by the module, the RF path from the module to the antenna feed point should be kept 50 ohm impedance control.

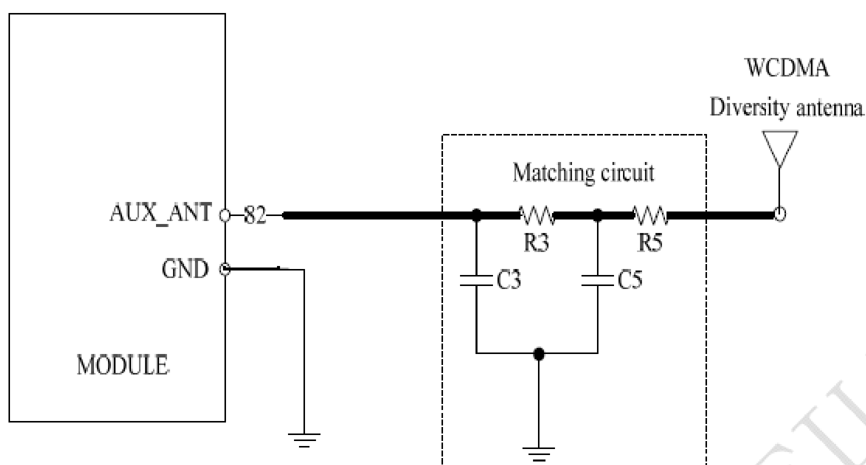


Figure 5-2 Div Antenna Design

Figure R3, C3, C5 and R5 composition of the antenna matching network for antenna debugging,

the default R3, R5 paste 0 ohm resistor C5, C3 empty paste, to be antenna factory after the antenna to determine the value of the antenna.

6. Guide for Production

6.1 Storage

Module moisture level is three, in the finished product outside the packing box and inside the label stickers, there are obvious humidity sensitive information.

Original vacuum packaging complete case (no damage, leakage), the storage period of 120 days, the storage environment for the temperature between 18 degrees to 28 degrees, the humidity is lower than 40~65%.

6.2 SMT

The patch module is humidity sensitive device, if we want to carry on the production of reflow soldering, subsequent disassembly and maintenance, in the finished product storage, production and maintenance process, we must strictly comply with the requirements of wet. If module damp after a reflow soldering or using a hot-air gun maintenance and can lead to internal module or IC module PCB, due to the water vapor that the rapid expansion of the burst, causing physical injury to the device is bad, typical fault is PCB board foaming and BGA devices, RF module burst failure and other undesirable. So, customers in the use of modules, please refer to the following recommendations.。

6.2.1 Incoming and moisture

Intelligent module in the production and packaging process in strict accordance with the humidity sensitive device flow operation, the factory packaging for vacuum bag + desiccant + humidity indicator card packaging, strict control of humidity. Please pay attention to the customer before the patch moisture control, and to the following aspects of the confirmation of each link.

6.2.1.1 Product packaging confirmation

In order to ensure customer patch quality, intelligent module using vacuum packaging and shipment, to avoid product moisture in the air leading to the customer in the placement process appeared a series of patch, and keeping the patch over through the furnace products will not function. Therefore, the requirements of the customers to confirm for the packaging of products in the product line before the, look at the packaging is damaged, vacuum packing leaks, and if there is any breakage and leakage, in front of the patch to bake, to avoid products PCB foaming, BGA

chip and RF PA chip damage failure phenomenon of the furnace.

6.2.1.2 Product production cycle

The customer needs to confirm the production cycle of the product when receiving the product, if more than the storage period or suspect that the product has been affected with damp, the product must be baked. If the storage time not extended, and after opening the packaging, humidity indicator card at 10% without discoloration, suggesting that good packaging can be normal use。

6.2.1.3 Humidity indicator card

Customers need to patch a furnace in the production of SMD module, have according to the moisture level 3 processing, internal packaging have been placed humidity indicator cards, so customers in the use of smart SMD module, in front of the patch on the humidity indicator card for confirmation, if the humidity indicator card has changed and has more than 10%, need to carry on to the material baking rear can on-line furnace.

6.2.1.4 Baking condition

Table 6-1 Baking condition

Baking conditions	90°/ 5%RH	60°/5%RH （Recommend）	40°/ 5%RH
Baking time	48 hours	72 hours	30days
Description	not use the original tray	not use the original tray	Can use the original tray

Customers can also choose baking conditions according to their own conditions. But please refer to Level 3 and device thickness 1.4 ~ 2.0mm standard.

Note: The original anti-ESD tray temperature does not exceed 50 degree. Otherwise the tray will be deformed.
The anti-ESD tray of the original packaging is only used for packaging, and can't be used as a SMT tray.

6.2.1.5Factory life confirmation

Module SMT with good humidity control should be completed in 48 hours after opening the package. The unused Module should be vacuum packaging, and placed in a drying box. If exposure to air for more than 48 hours, the module need to be baked. Due to the larger size of the module, damp needs to bake for a long time, and the price is high, so please try to run out after opening the package.

6.2.1.6Customer product maintenance

If maintenance module after SMT, it is easy for damp module to damage when removing, so the module disassembly and other related maintenance operations should complete within 48 hours after SMT, or need to bake and then maintenance the module.

Because the module return from the field work can’t ensure the dry state, it must be baked in accordance with the conditions of baking, then for disassembly and maintenance. If it has been exposed to the humid environment for a long time, please properly extend the baking time, such as 125 degrees /36 hours.

6.2.2 SMT reflow attentions

The module has the BGA chips, chip resistances and capacitances internally, which will melt at high temperature. If module melt completely encountered a large shock, such as excessive vibration of reflux conveyor belt or hit the board, internal components will easily shift or be false welding. So, using intelligent modules over the furnace need to pay attention to:

- Modules can't be vibrate larger, namely customer requirements as far as possible in orbit (chain) furnace, furnace, avoid on the barbed wire furnace, in order to ensure smooth furnace.

- The highest temperature can't too high. In the condition that meet the welding quality of customer motherboard and module, the lower furnace temperature and the shorter maximum temperature time, the better.

Some customer's temperature curve in the line is not suitable, high temperature is too high, and customer motherboard melt good, but non-performing rate is on the high side. Through the analysis of the causes, it found that melt again of BGA components lead device offset and short circuit. After adjusting the temperature curve, it can ensure that the customer's motherboard the welding quality, and also improve the pass through rate. Non-performing rate is controlled below the 2/10000.

6.2.3 SMT stencil design and the problem of less tin soldering

Part of customers found false welding or circuit short when reflowing. The main reason is module tin less, PCB distortion or tins too large. Suggestions are as follows:

- Suggest use ladder stencil 0.10-0.18mm, which means the region of module is proposed to 0.18mm stencil thickness. Please adjust validation according to the measured thickness of solder paste, the actual company conditions and experience value. The products need to strictly test.

- Stencil: Reference module package, and the user can adjust according to their company experience;

Outside of the module, the stencil extends to 0.3mm outside.

The GND pads use the net stencil.

In the production process, if you cannot judge the opening or process conditions, you can also contact our sales or after-sales service. We will give specific recommendations according to the actual situation.

6.2.4 SMT attentions

If customer motherboard is thin and slender with a furnace deformation, warping risks, you will be suggested to create "a furnace vehicle" to ensure the welding quality. Other production proposals are as follows:

- The solder pastes use brands like Alfa;
- The module must use the SMT machine mount (important), and do not recommend manually placed or manual welding.
- Please strictly control the pressure and speed in SMT (very important);
- We must use the reflow oven more than 8 temperature zones, and strictly control the furnace temperature curve.

Recommended temperature:

B. constant temperature zone: temperature 160-190°C, time: 60s-100s

E. recirculation zone: PEAK temperature 235-245°C, time over 220°C: 30s-60s

Note: customer's board deformation must be controlled within 0.15mm. By reducing the number of imposition or increasing patch clamp to reduce the deformation.

SOM thickness of the stencil is recommended to be thickened to 0.18mm, and the rest position can be maintained by 0.1mm;