

L206H(L) Hardware Design

GSM/GPRS Module Series

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Version History

Date	Version	Description of change	Author
2016-06-17	V1.0	Initial version	
2017-04-06	V1.1	1.modified Picture	x.ren
2017-04-09	V1.1.1	1.Update document	robin
2017-09-13	V1.2	Added L206H	
2018-11-10	V1.3	Update product baking instructions	Jacky.ren
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2019-08-28	V1.6	1, Added L206L-1 model	

Summary

This document is intended for products: L206H(L)module.

This document describes the hardware interface of the L206H(L)module,can help user to quickly understand L206H(L) interface specifications, electrical and mechanical details,with the help of this document users can use L206L module to design and set-up various types wireless terminals.

Intended audience

This document applicable to:

- Systems Design Engineer
- Structural Engineer
- Hardware Engineer
- Software Engineer
- Test Engineer

Introduction

This document contains contents as below:

Chapter	Content
1 Overview	Introduce L206H(L) module basic technical SPEC. and reference standard.
2 Pin definitions	Introduce L206H(L) module pin names and functions.
3 Hardware interface	IntroduceL206H(L) module hardware interface.
4 Module Dimensions	IntroduceL206H(L)module packaging size.
5 Electrical, reliability and RF	IntroduceL206H(L)module electrical, reliability and RF.
6 Manufacturing	Introduce L206H(L) module notice of production.
7 Related documents	List L206 H(L)module related documents.

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1. INTRODUCTION

L206L is a quad-band GSM/GPRS module, working frequency: GSM/GPRS 850/900/1800/1900 MHz.

With a tiny package of 15.8mm x 17.8mm x 2.3mm, L206L fits all the applications, such as M2M, smart phone, PDA, etc.

It is a 88-pin SMT pad module, which provides rich hardware interfaces. It supports voice, SMS and data transmission with low power consumption.

Key Features

Table 1 Main Feature

<ul style="list-style-type: none"> ● GSM quad-band 850/900/1800/1900 MHz ● GSM 2/2+ standard <ul style="list-style-type: none"> – Class 4 (2 W @ 850/900 MHz) – Class 1 (1 W @ 1800/1900 MHz) ● AT command (GSM 07.07, 07.05 and Enhanced AT command set) ● Power supply: 3.4 ~ 4.2V (Recommended 3.8V) ● Operating temperature: -40 ~ +85°C ● Storage temperature: -45 ~ +90°C ● weight: 1g
--

Key Parameters:

Data Transmission	● Coding schemes CS 1, 2, 3, 4
	● PPP-stack
SMS	● Point to Point MO and MT
	● SMS status report
	● Text and PDU
Voice	● Half Rate (HR)
	● Full Rate (FR)
	● Text and PDU mode
	● Enhanced Full Rate (EFR)
	● Adaptive-negotiation Multi-code Rate (AMR)

Interface	● 88 SMT pads (LGA)
	● Two analog audio
	● PCM Digital Audio
	● One serial interfaces
	● I2C interface
	● One SIM card interface (3V/ 1.8V)
	● One ADC interface

	<ul style="list-style-type: none"> ● GPIO interface ● 5*5 Keypad ● GSM antenna pad ● BT antenna pad ● FM antenna pad
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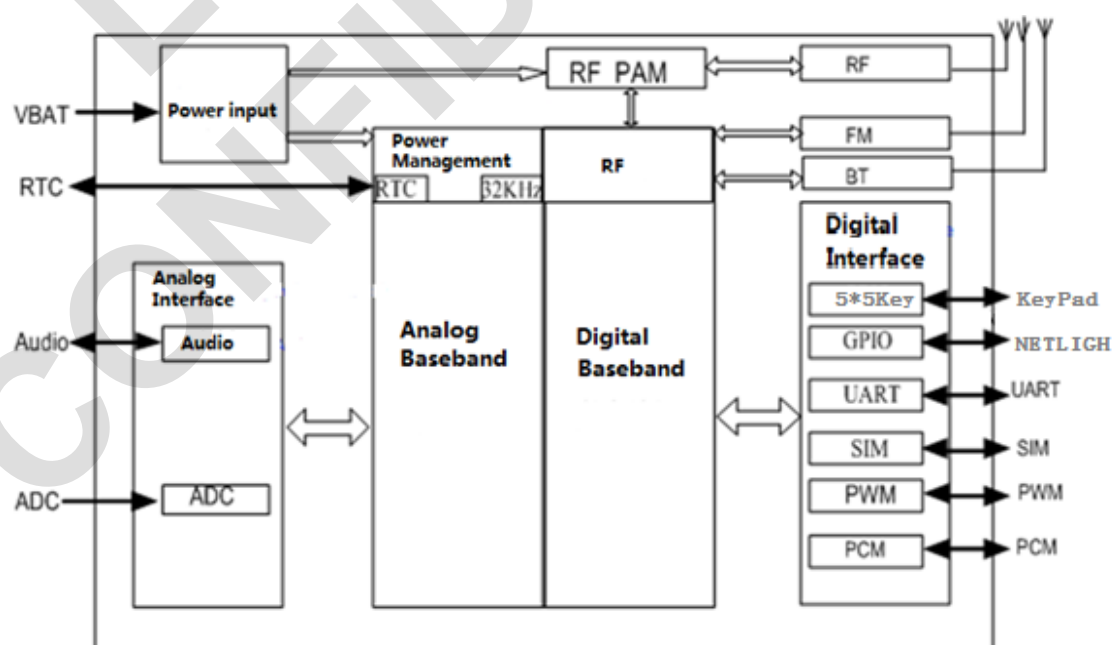
Table 1-2: Hardware config

Config	L206L	L206H	L206L-1	Remarks
BT	TBD	Support (3.0)	TBD	Reference software version
Temperature detection	Not Support	Not Support	Support	Reference AT Command AT+MMTE
RAM	32M bit	32M bit	32M bit	
ROM	24M bit	32M bit	24M bit	

Module system diagram

Following figure: List main function of module

- GSM Baseband and RF
- Power Management
- Antenna Interface
- Other interfaces

**Figure1: Module function diagram**

2. APPLICATION INTERFACE

2.1 PIN Assignment

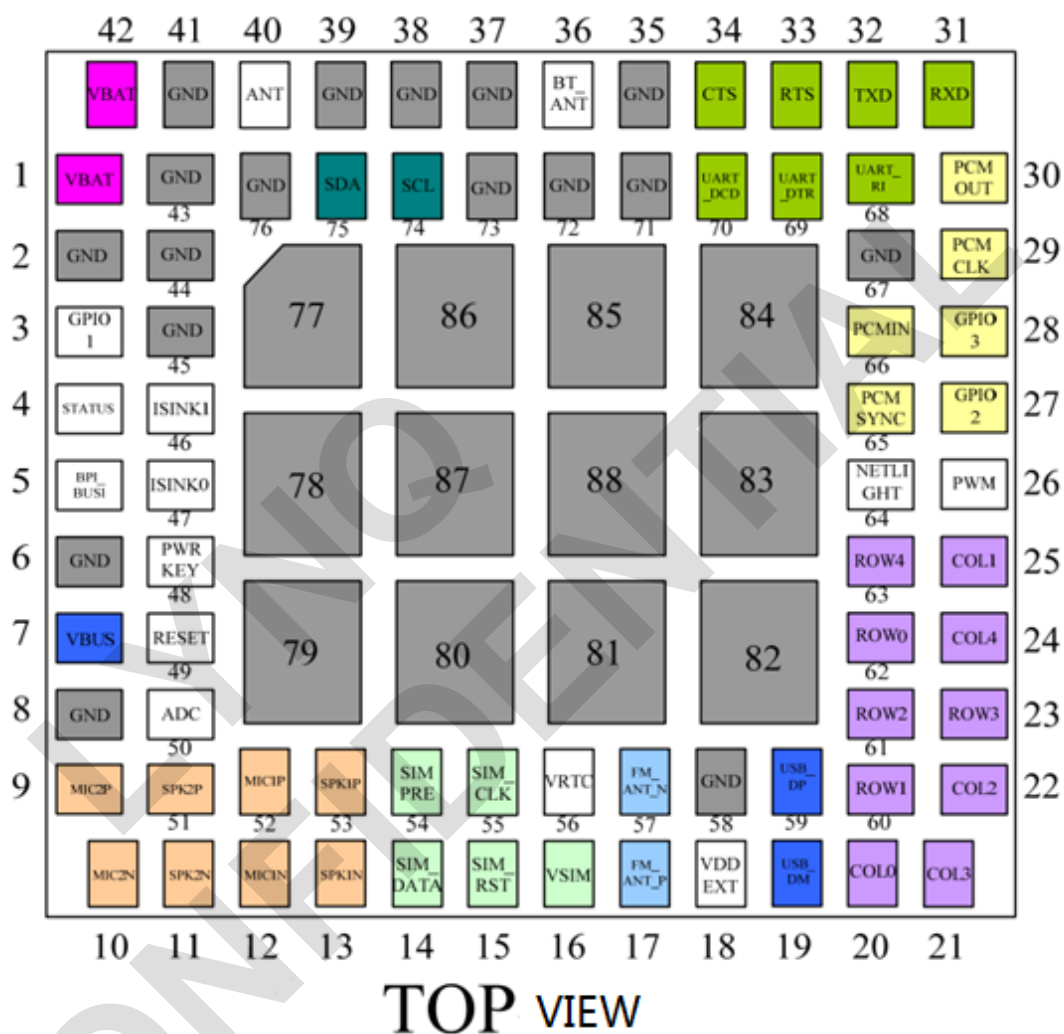


Figure2:L206L Pin out diagram (TOP View)

Interfaces as below:

- Analog voice: Two MIC inputs, one for speaker output, another for earphone right channel output.
- Digital voice: PCM voice.
- SIM card: support 1.8V and 3V.
- Reset: Support RESETB pin to reset the module.
- I2C: Pulled up to VIO28 in the module.

- GPIO: PIN 3,27,28 for normal general purpose in/out, and some other pins can be configured as GPIO pin(detail information in the following table).
- Serial port: Contain one full functional serial interface and one 2-wire serial interface. CTS and RTS etc. can be NC when not used.
- RF: GSM, BT, FM.

2.2 PIN Description

L206L PIN description as below:

Table 3:PIN description

PIN NO.	PIN name	Type*	Reset	Function Description
1	VBAT	POWER	/	Power supply. The power supply range is from 3.4V to 4.2V. Recommended voltage is 3.8V.
2	GND	GND	/	GND
3	GPIO1	I/O	/	General purpose input/output 1
4	STATUS	O	/	Running status indicator
5	BPI_BUSI	O	/	Radio frequency synchronization signal
6	GND	GND	/	GND
7	VBUS	I	/	USB power, detect USB
8	GND	GND	/	GND
9	MIC2P	AI	/	MIC 2 difference positive input
10	MIC2N	AI	/	MIC 2 difference negative input
11	SPK2N	O	/	Speak 2 minus end output
12	MIC1N	AI	/	MIC 1 difference negative input
13	SPK1N	I/O	/	Speak 1 minus end output
14	SIM_DATA	I/O	PD	SIM card Data
15	SIM_RST	O	PD	SIM card reset
16	VSIM	O	/	SIM card power supply
17	FM_ANT_P	I	/	FM Antenna
18	VIO28	O	/	VDDIO 2.8V output, max current is 20mA
19	USB_DM	I/O	/	USB Differential data D-
20	COL0	I	/	COL0 of KEY
21	COL3	I	/	COL3 of KEY
22	COL2	I	/	COL2 of KEY

23	ROW3	O	/	ROW1 of KEY
24	COL4	I	/	COL4 of KEY
25	COL1	I	/	COL1 of KEY
26	PWM	O	PD	PWM output
27	GPIO2	I/O	/	General purpose input/output 2
28	GPIO3	I/O	/	General purpose input/output 3
29	PCM_CLK	O	PU	PCM interface clock
30	PCM_OUT	O	PD	PCM interface data output
31	RXD	I	PU	Receive data, For AT command, firmware upgrades and data transmission.
32	TXD	O	PU	Request to Send, For AT command, firmware upgrades and data transmission.
33	RTS	O	PU	Request to Send
34	CTS	I	PU	Clear to send
35	GND	GND	/	GND
36	BT_ANT	I/O	/	Bluetooth antenna
37	GND	GND	/	GND
38	GND	GND	/	GND
39	GND	GND	/	GND
40	ANT	I/O	/	GSM Antenna
41	GND	GND	/	GND
42	VBAT	POWER	/	Power supply. The power supply range is from 3.4V to 4.2V. Recommended voltage is 3.8V.
43	GND	GND	/	GND
44	GND	GND	/	GND
45	GND	GND	/	GND
46	ISINK1	I	/	Driver button light,the maximum current is 60mA
47	ISINK0	I	/	Driver LCD Backlight,the maximum current is 60mA
48	PWRKEY	AI	/	PWRKEY should be pulled low at least 1 second and then released to power on/down the module
49	RESET	I	/	Reset signal, internal pulled up to 1.8V.
50	ADC	AI	/	Analog-digital conversion port, 2.8V is the maximum power input
51	SPK2P	O	/	Speak 2 plus end output
52	MIC1P	AI	/	MIC 1 difference positive input

53	SPK1P	O	/	Speak 1 plus end output
54	SIMPRE	I/O	PD	SIM card hotplug detection signal (SIM booth support hot plug function)
55	SIM_CLK	I/O	PD	SIM card clock
56	VRTC	POWER	/	RTC voltage, input 2.8V, maximum current of 2mA. External button battery or a large capacitor, If no use can be set NC.
57	FM_ANT_N	I	/	FM Antenna-GND
58	GND	GND	/	GND
59	USB_DP	I/O	/	USB Differential data D+
60	ROW1	O	/	ROW1 of KEY
61	ROW2	O	/	ROW2 of KEY
62	ROW0	O	/	ROW0 of KEY
63	ROW4	O	/	ROW4 of KEY
64	NETLIGHT	I/O	PD	Net status indication
65	PCMSYNC	O	PD	PCM interface synchronization signal
66	PCMIN	I	PU	PCM interface data input
67	GND	GND	/	GND
68	UART_RING	O	PD	Ring indicator
69	UART_DTR	I	PD	Data terminal ready(Control module wake or sleep)
70	UART_DCD	O	PD	Data carrier detect
71	GND	GND	/	GND
72	GND	GND	/	GND
73	GND	GND	/	GND
74	SCL	SCL	PD	I2C interface(pull up 4.7K to 2.8V)
75	SDA	SDA	PD	
76	GND	GND	/	GND
77	GND	GND	/	GND
78	GND	GND	/	GND
79	GND	GND	/	GND
80	GND	GND	/	GND
81	GND	GND	/	GND
82	GND	GND	/	GND
83	GND	GND	/	GND
84	GND	GND	/	GND
85	GND	GND	/	GND
86	GND	GND	/	GND

87	GND	GND	/	GND
88	GND	GND	/	GND

* Type **I,O,I/O** can be configured as general GPIO, its status is PU or PD when reset.

* The high level of the digital signal is 2.8V(min:2.6V,max3.0V)

2.3 Functional Diagram

Main function of module listed as below

- SIM card interface
- Audio interface
- Antenna interface
- Other interfaces

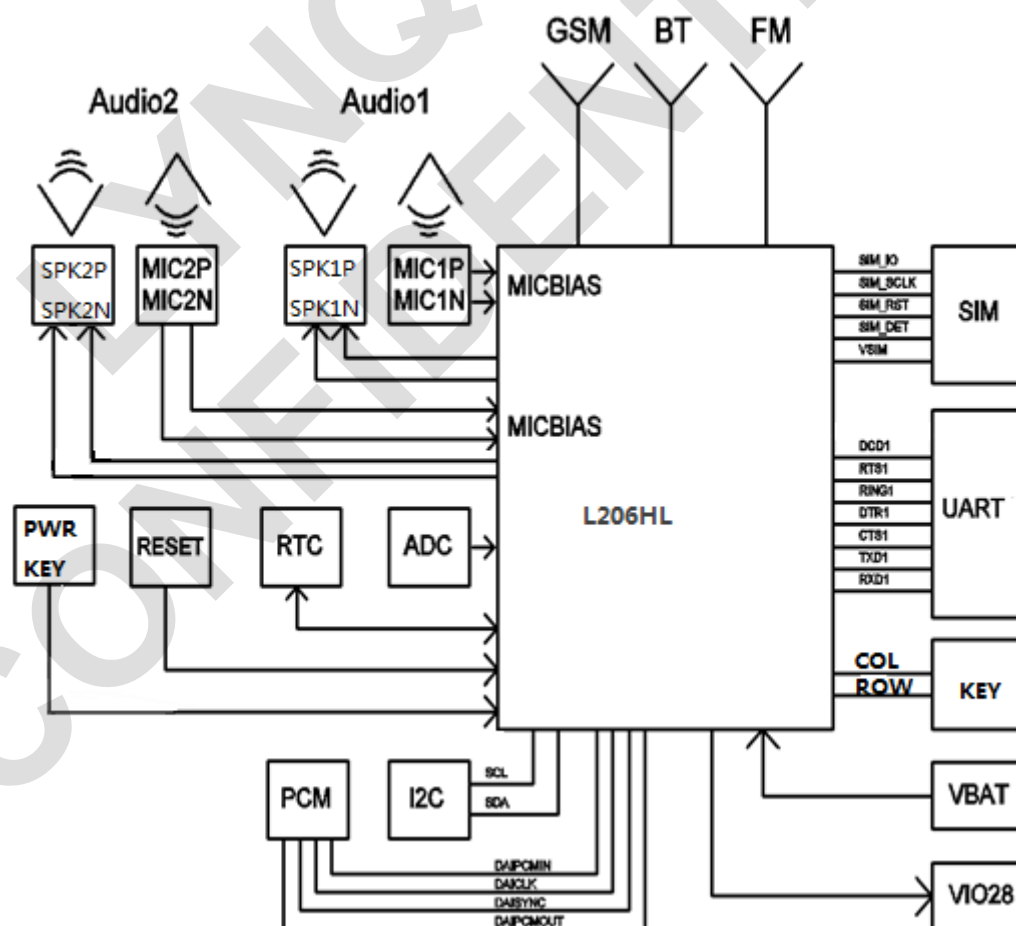


Figure 3: Function diagram

3. INTERFACE CIRCUIT REFERENCE DESIGN

3.1 Power

3.1.1 Power supply

VBAT is the main power source of L206L module., from 3.4V to 4.2V, and 3.8V is the recommended voltage. In GSM system, RF signal works in burst transmit, a continuous 577us(1/8 of a TDMA period) burst will be found at intervals of 4.615ms. In burst period, peak current is necessary to make sure operating voltage won't drop to the base one. Because when module is working under the base voltage, the burst will cause VBAT has instantaneous large current, which the peak value could reach 2A or above and lead to the Vdrop about 350mV.

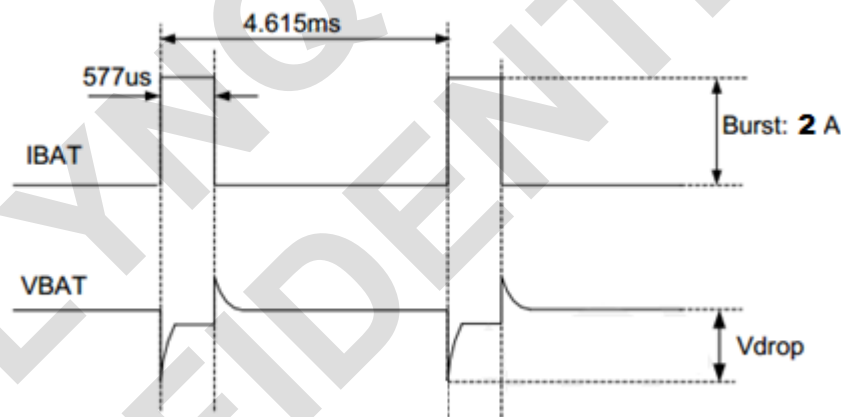


Figure4: Module burst current and voltage waveforms

It is recommended to use a large capacitor close to VBAT PIN. The capacitor is the bigger the better to improve power stability. 470uF or more low-ESR aluminum electrolytic capacitors is recommended for CA. If the lithium battery directly connected, 220uF or 100uF tantalum capacitor (low ESR) is recommended for CB. The capacitors of 33pF and 10pF in parallel can effectively remove high-frequency interference. The capacitors should close to the VBAT pin of module.

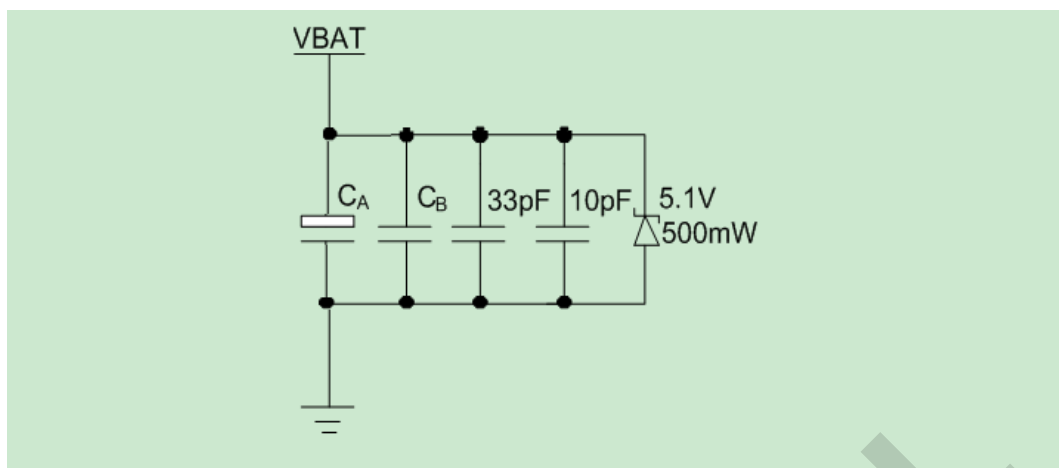


Figure5: VBAT input (Reference circuit)

It is strongly recommended to add a 5.1V / 500mW Zener diode to VBAT pin in parallel, Zener diode should close to the VBAT pin. Recommended parts list as below:

Table6: Recommended Zener diode

Vendor	Factory Model	Power	Encapsulation
On semi	MMSZ5231BT1G	500mW	SOD123
JCST	MMSZ5231B	500mW	SOD123
Prisemi	PZ5D4V2H	500mW	SOD523
ROHM	HDZMV4Z015.1B	500mW	UMD2
SIG	SIG1Z5T1G	500mW	SOD323
Vishay	MMSZ4689-V	500mW	SOD123
Crownpo	CDZ55C5V1SM	500mW	0805

NOTE:

If the power supply is over 4.2V, voltage conversion is required, LDO or Buck chipset can do that function.

1、 As the LDO efficiency is closely related to the input/output dropout voltage value, the greater the voltage difference, the lower the efficiency, and at the same time, the problem of heat radiation will be detected, there is a demand of the small dropout voltage between DC input and LDO output. For instance, the voltage difference between 5V input and 4.1V output is acceptable.

The reference power supply circuit design with LDO is shown as figure below:

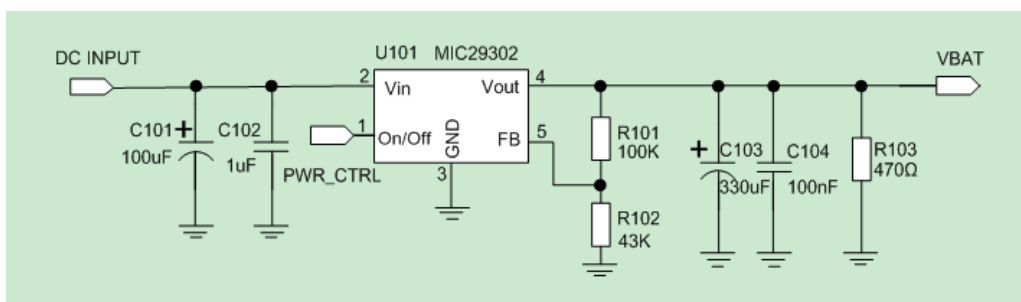


Figure7: LDO(Reference circuit)

2、Buck circuit can enhance the conversion rate if the differential value is great. But meanwhile, the EMI issue caused by DCDC will be concerned.

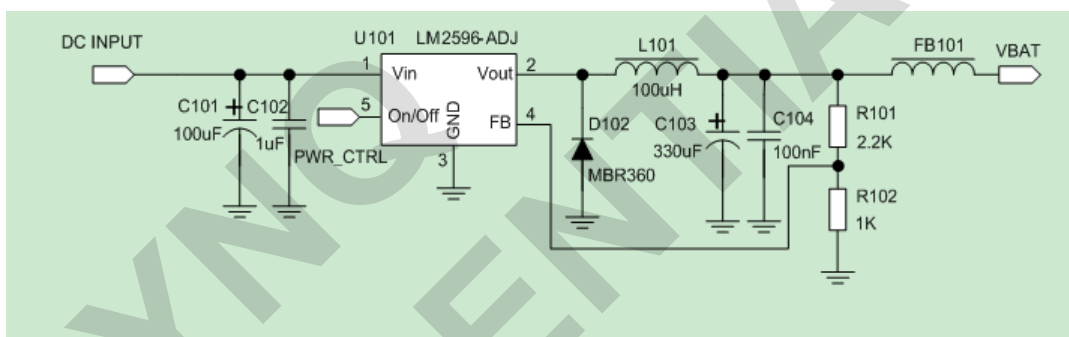


Figure8: DC-DC (Reference circuit)

3、PMOS control circuit for power switch.

If want to control VBAT under the circumstance that there is no need of power conversion, for example, lithium-ion battery is the direct power supply, PMOS control circuit can be the choice.

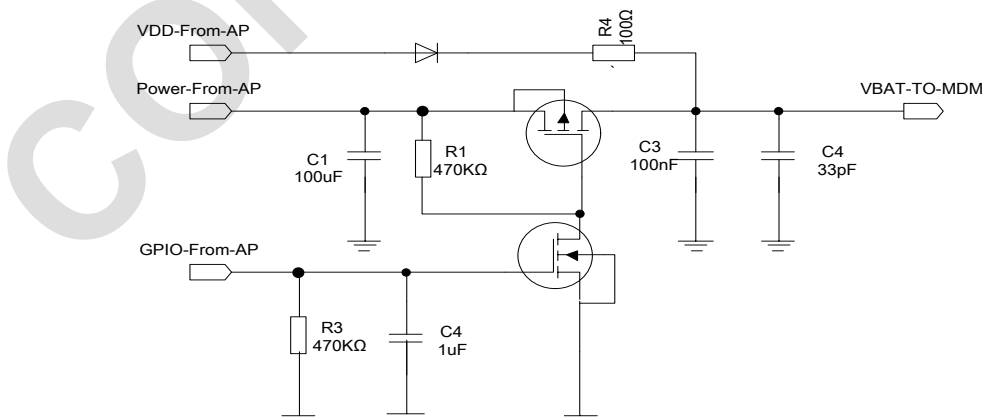


Figure 9: PMOS (Reference circuit)

3.1.2 Power monitor

To monitor the power supply voltage, you can use "AT + EADC = 1" command. For details, you can refer to AT command manual.

3.1.3 Power on

Module to normal boot mode is through the lower PWRKEY pin through lower PWRKEY pin at least 1 second. After successful boot PWRKEY pin can be released. NETLIGHT signal can be used to determine whether module boot. When NETLIGHT start according to certain frequency output pulse signal, if connect lights, lights flashing, suggests that successful boot module. If no output pulse signal, has been as low level, no boot module.

Recommend the following boot circuit (PWRKEY came on the module VBAT). The reference circuit is as follows:

1、With triode control boot

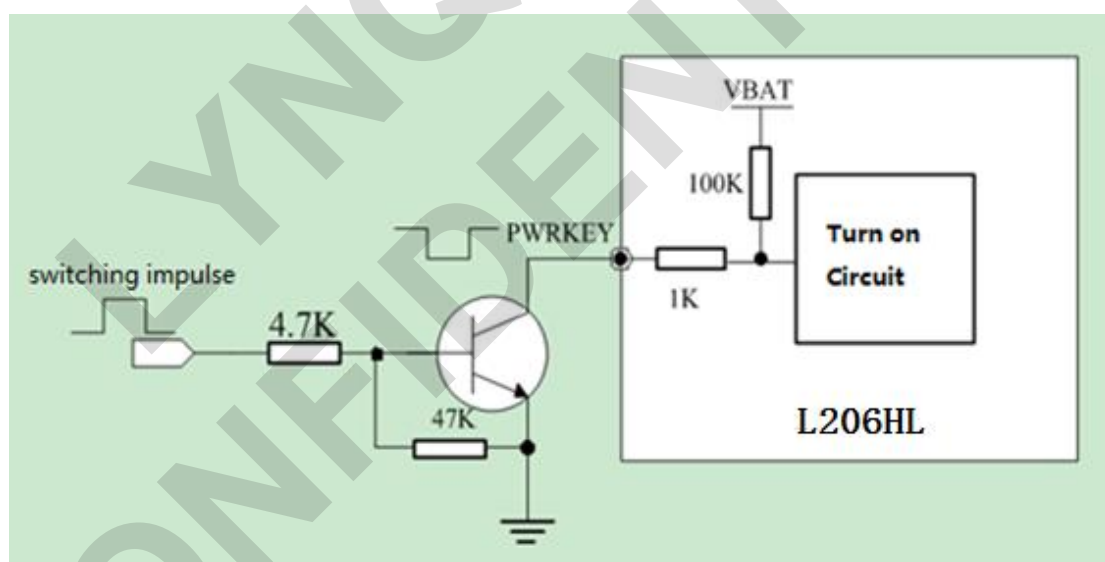


Figure 10: Use triode control boot

2、Use key boot

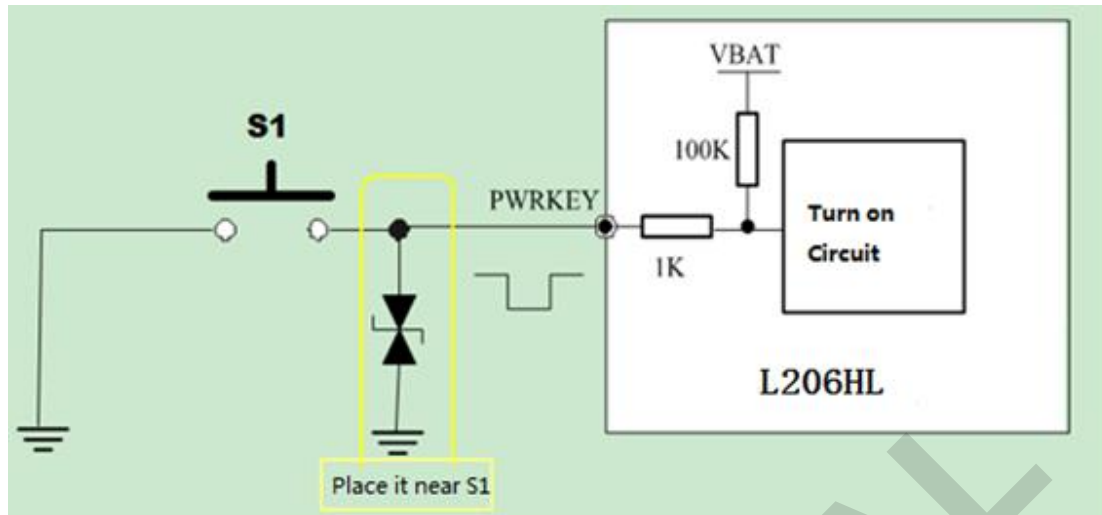


Figure 11:Use keytooboot

Module on the mains electricity cannot be earlier than the external MCU with electricity, prevent module on the electric moment, external MCU serial port is in unstable condition, cause the module into the mode of the error. To ensure stable operation of external MCU, then control module is powered on.

Boot sequence diagram below:

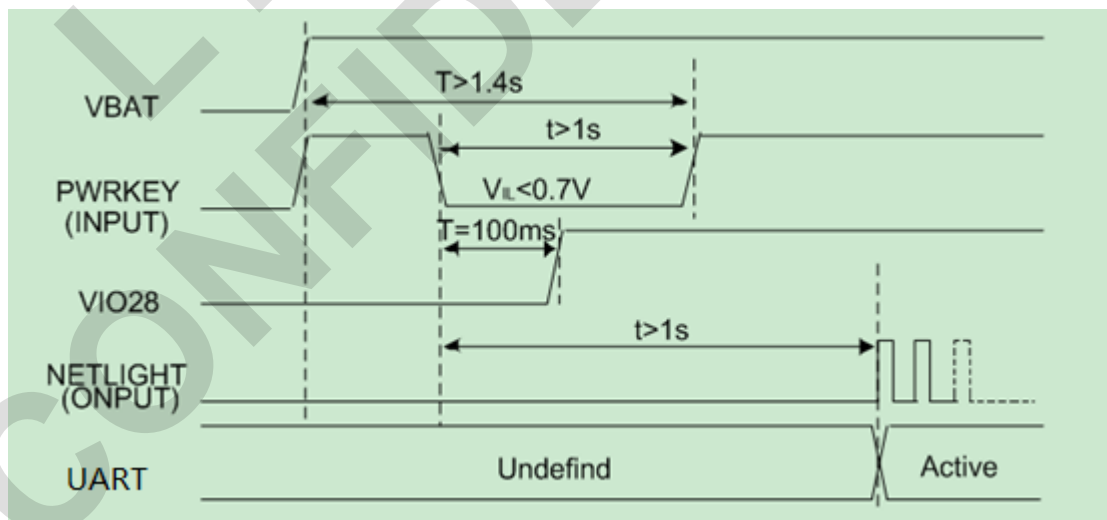


Figure 12:Boot sequence

Also pay attention to the external MCU and module connection interface level anomaly, especially the main UART port, could affect the module of the boot sequence, when switched on. For example, external MCU IO mouth is in a state of output, the module of UART0 mouth RTS signal (output pin) forced to lower or higher, the module may not be able to normal boot.

3.1.4 Power off

It is a safe way to turn off the module by driving the PWRKEY to a low level voltage for a certain time. The power down scenario is illustrated below.

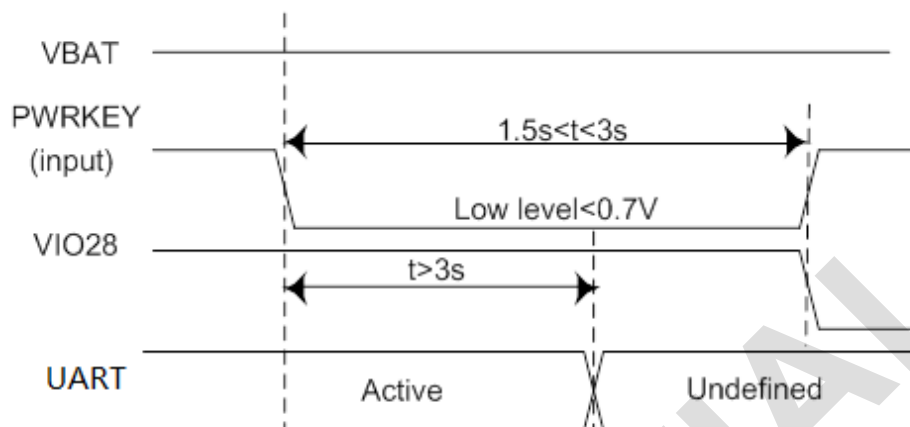
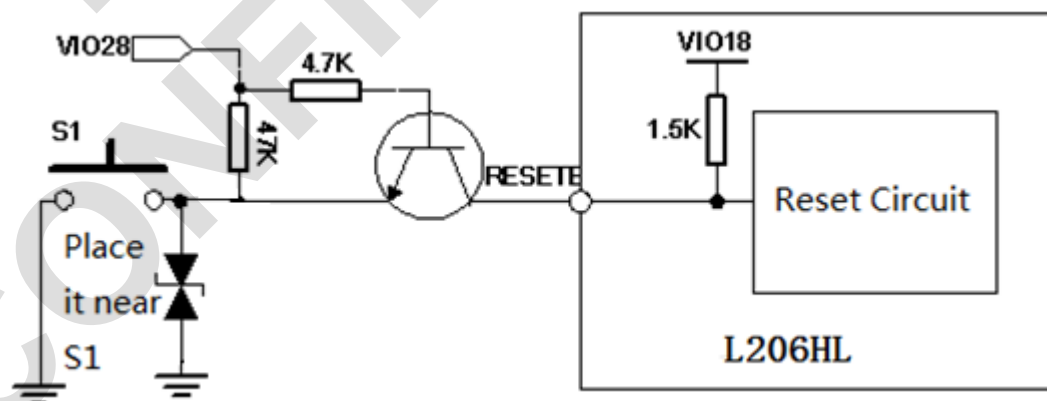


Figure 13:Shutdown sequence

Note: As logout network time is related to the local mobile network, it is recommended to delay about 3seconds before disconnecting the power supply or restarting the module.

3.1.5 Reset

The hardware reset reference design as below (Key reset and MCU reset L206L Module):



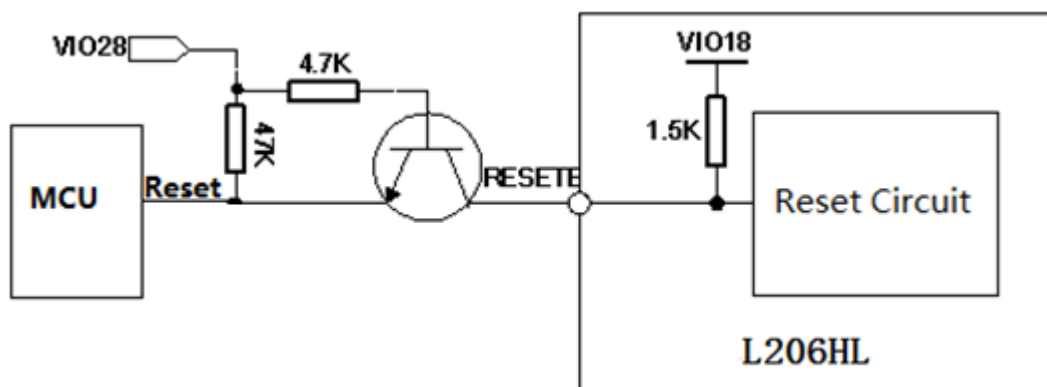


Figure 14:Recommend the reset circuit:Key reset and MCU reset L206L Module

Note:

- 1, Only use under emergency, such as no AT response, PWRKEY failure.
- 2, Don't connect RESET PIN to MCU directly.

Table 15: Electronic characteristic of the RESET pin

PIN name	Symbol	Min	Typ	Max	Unit
RESET	V_{IH}	2.4	--	--	V
	V_{IL}	--	--	0.6	V
	Low power time	105	--	--	ms

RESETB Reset timing sequence:

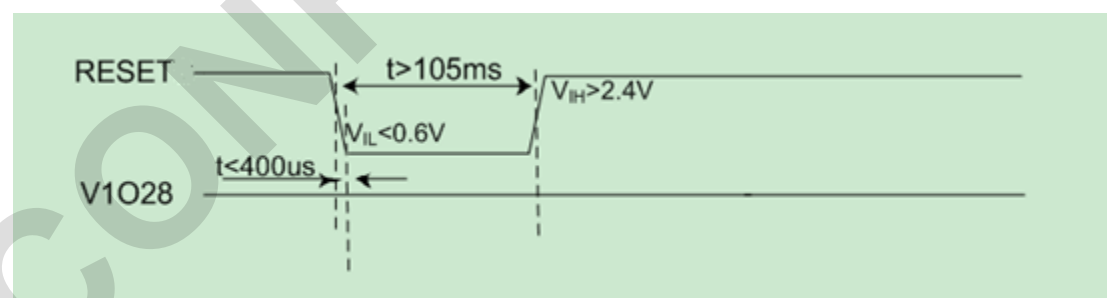


Figure 16:Reset timing sequence

3.1.6 Power saving mode

The module has a variety of ways to sleep wake up:

1, Sleep

AT Sleep:

(1) When the module in the idle state can make through the AT + ESLP = 1 module into

sleep mode.

- (2) When the module in a busy state (e.g., GPRS data transfer, send and receive SMS, external interrupt events, etc.) when sending the AT + ESLP = 1 instruction, module after in dealing with the current task will enter the sleep mode.

DTR way dormancy:

In order to set up AT + CSCLK = 1, can be introduced into dormancy by DTR pin control module:

- (1) When the module in the idle state by raising DTR pin led module into sleep mode.
- (2) When the module in a busy state (e.g., GPRS data transfer, send and receive SMS, external interrupt events, etc.) when raising DTR pin, module after in dealing with the current task will enter the sleep mode.

2, Wake up

When the module into sleep mode after a serial port will not be available. Modules can be wake up by the following ways:

- (1) After receive the voice or data call, module out of sleep mode, and through the RING foot give instructions.
- (2) After receiving the short message (SMS), module out of sleep mode, and through the RING foot give instructions.
- (3) In has been set AT + CSCLK = 1 condition, will DTR1 feet down, out of hibernation, wake up the module.

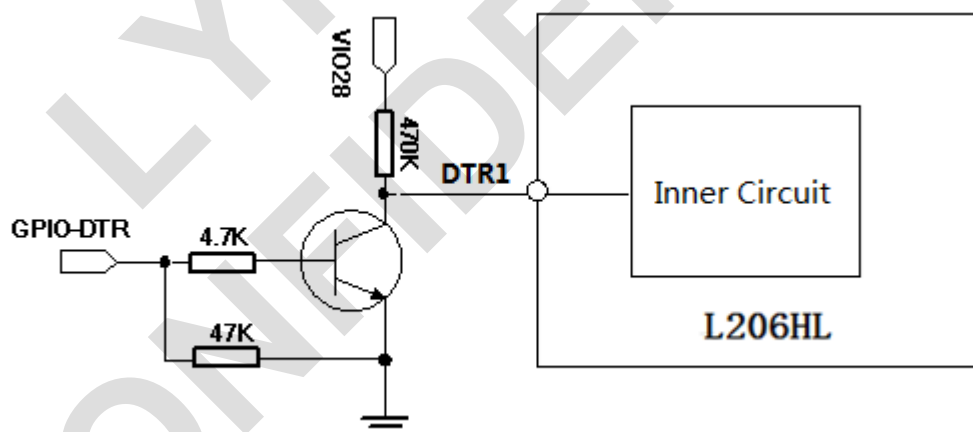


Figure 17: DTR circuit

3.1.7 RTC power

When VBAT disconnect, users need to save the real time clock, the VRTC pin can't hung up. It need an external large capacitance or batteries. When external large capacitance, the recommended value of 100uF, to keep the real time clock for 1 minute. RTC power using external large capacitance or battery to RTC power supply inside the module. Modules contain a 1.5 K current-limiting resistance. Button cell or super capacitor can be used to give the RTC power supply. Notes: In order to accurate clock, VBAT power supply. Below are several to RTC power supply circuit of reference:

- External capacitance of power supply

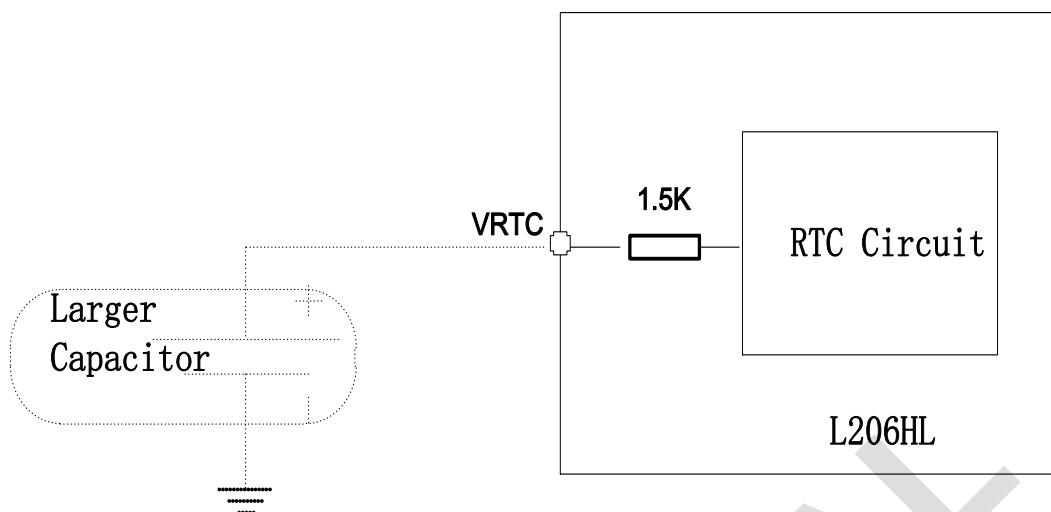


Figure 18: External capacitance to the RTC power supply

- Non-chargeable Backup battery

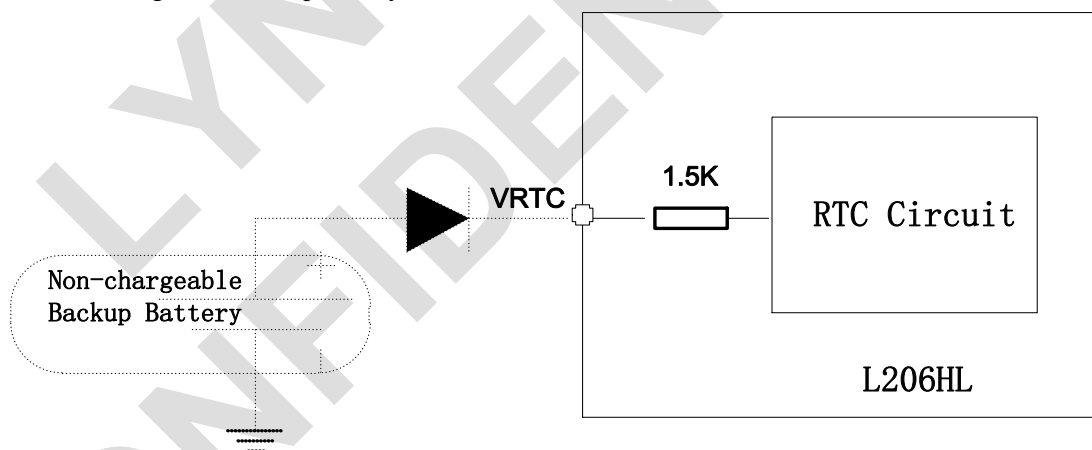


Figure 2: Non-rechargeable battery

- Rechargeable battery

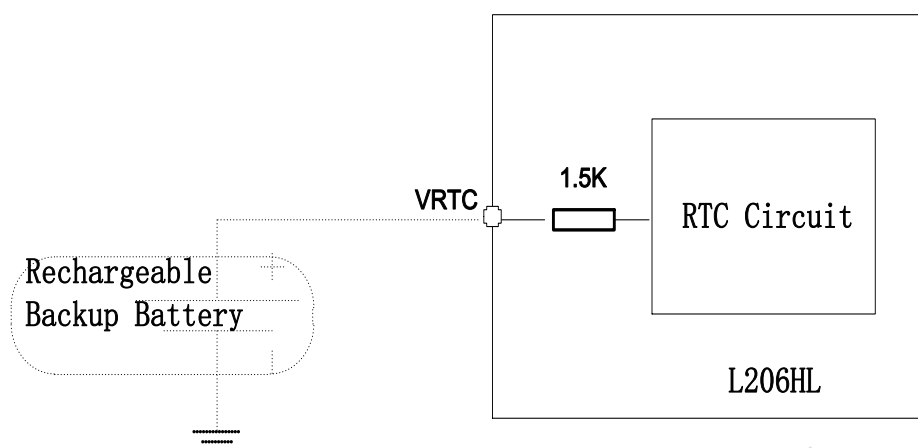


Figure 3: Rechargeable battery

The VRTC power typical value of 2.8 V, consumption flow about 3 uA when VBAT disconnect.

3.2 Audio

Table 19: Audio interface pin definition

NO.	PIN name	PIN NO.	Description
1	MIC2N	10	Audio differential input 2negative
2	MIC2P	9	Audio differential input 2 positive
3	MIC1N	12	Audio differential input 1 negative
4	MIC1P	52	Audio differential input 1 positive
5	SPK2N	11	Audio differential output 2 negative
6	SPK2P	51	Audio differential output2 positive
7	SPK1N	13	Audio differential output 1 negative
8	SPK1P	53	Audio differential output 1 positive

3.2.1 Audio channel 1

1、 The difference signal SPK1N,SPK1P of audio, directly connected to the receiver device (note: is the receiver, not the Speaker).

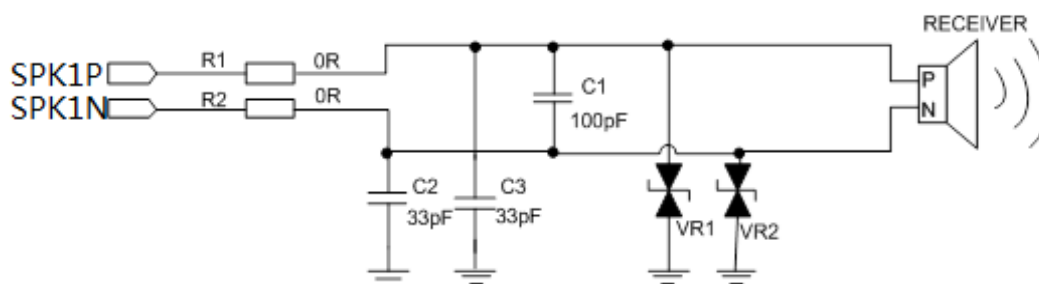


Figure 20:receiver circuit

2、MIC1 has internal MICBIAS power, external microphone can be directly connected MIC1P and MIC1N.

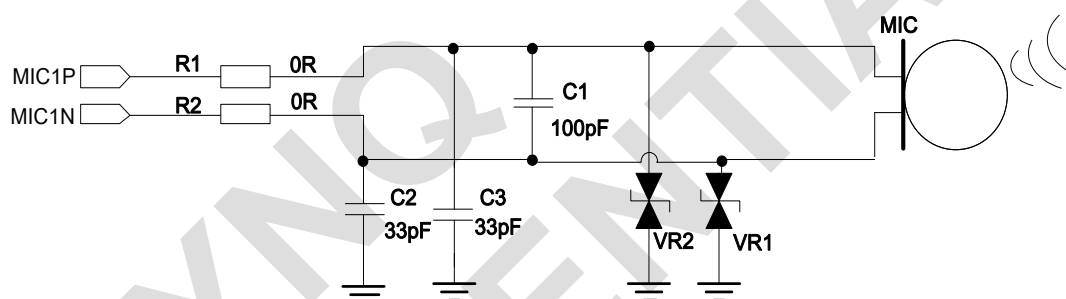


Figure 21:MIC1(Reference circuit)

3.2.2 Audio channel2

SPK2P/SPK2N can directly drive the Speaker. MIC2 has internal MICBIAS power, external microphone can be directly connected MIC2P and MIC2N.

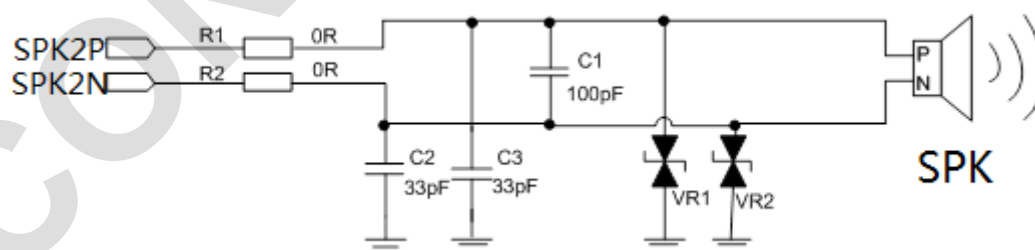


Figure 22: SPK(Reference circuit)

3.2.3 TDD noise

Electret microphone (with embedded double frequency filtering capacitance, 10pF and 47pF) is suggested to use on hand handle or hand free microphone to stop RF interference and TDD noise from the beginning. If double frequency filtering capacitance is not selected, TDD noise

may be heard during conversation. Please consult to capacitance provider to choose the most suitable capacitance value to filter high-frequency noise out in GSM850/GSM900/DCS1800/PCS1900MHz.

The order of noise severity in GSM band depends on application design. For instance, TDD noise is relatively serious in GSM900 or DCS1800 in different conditions. Users choose their desired filter capacitor according to their situation. The place of nearing audio element or interface is better for filter capacitor, wire layout must be shortest as it could be, through filter capacitor first. The place far away from audio element or layout is better for antenna to avoid disturbing. Power layout and audio layout cannot be paralalled, and keep them in distance.

TDD noise can be affected by GND. If GND layout is not suitable, noise will disturb MIC and speaker.

Add some large capacitances or series magnetic beads during schematic diagram designing to avoid conductive interference.

Differential audio layout must abide the rules of differential signal layout.

3.2.4 Digital audio channel

Module supports PCM interface, it can be also configured to normal GPIO. It can be used as the master or slave mode with 8K sampling rate, 8/16bit data.

Table23: PCM interface pin definition

NO.	PIN name	PIN NO.	Description
1	DAIPCMOUT	30	PCM Data output
2	DAISYNC	65	PCM Sync signal
3	DAICLK	29	PCM clock signal
4	DAIPCMIN	66	PCM Data input

Support three operating modes:

- Short sync
- Long sync
- Complex model

Example, Digital audio channel is connected to the BT device chip, convenient for debugging, the customer can place zero ohm resistance.

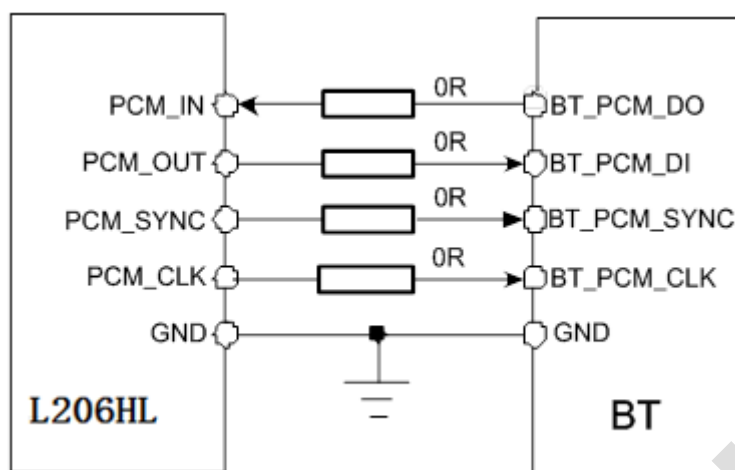


Figure 24: PCM(Reference circuit)

3.2.5 PCM multiplexing function

PCM interface have multiple function, can be configured to SPI, please refer to the table below:

Table 25: PCM interface multiplex

No.	PIN name	PIN NO.	Default function	Reuse function 1	Reuse function 2
1	DAIPCMOUT	30	DAIPCMOUT	SPI_MOSI	GPIO28
2	DAISYNC	65	DAISYNC	SPI_MISO	GPIO29
3	DAICLK	29	DAICLK	SPI_CK	GPIO26
4	DAIPCMIN	66	DAIPCMIN	SPI_SCK	GPIO27

3.3 UART Communication

1、Serial pin definition

Modules provide 1 group of UART serial port, including UART1 support full serial port function, main effect for the AT communications, data services, software upgrades, etc. Module called a DCE device (Data Communication Equipment), according to the traditional DCE - DTE (Data Terminal Equipment) connection. Adaptive baud rate support range 4800 bps to 115200 bps.

Table 26: Serial pin definition:

Interface	PIN name	PIN NO.	Description
Main serial port	ART_DCD	70	Data carrier detect
	RTS	33	DTE request data
	UART_RI	68	Ringring indicating
	UART_DTR	69	DTE is ready
	CTS	34	Clear to send

	TXD	32	Data sent
	RXD	31	Data reception

2、Serial port characteristics

Main serial port:

- 7 signal lines. Including cable TXD and RXD, hardware flow control line RTS and CTS, and other line of DTR, DCD and RI.
- 8 data bits, No parity, One stop bit.
- Hardware flow control off by default, if use hardware flow control, use the "AT + ICF = 0" open flow control function.
- AT command transfer, GPRS data transmission.
- Support a fixed baud rate is as follows:
2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600, 115200.
- The default configuration module for adaptive baud rate. Adaptive support the following baud rate: 4800、9600、19200、38400、57600、115200bps.

The baud rate is fixed or adaptive baud rate synchronization settings. And send a command string "A-T" when serial ready after module will reply "OK".

The host controller by sending "AT" command to the module, the module will automatically detect and identify the host controller's current baud rate. Adaptive baud rate function can make the host controller don't need to know the current baud rate and the module of communication will be finished. Adaptive baud rate function open by default.

Adaptive baud rate operating configuration:

- Serial interface is configured to 8 bits of data bits, parity bits, one stop bit (the factory configuration).
- Adaptive baud rate mode, if there is no first synchronization module boot, such as "RDY", "+ CFUN: 1" and "+ CPIN: READY" URC information will not be reported.
- DTE in switching to a new baud rate, will first through the "AT" set up the new baud rate, before module detection and synchronous new baud rate, the module will use previous messages URC baud rate. DTE when switch to the new baud rate, the equipment is likely to receive unrecognized characters.
- Baud rates, is not recommended in a fixed mode switch to the adaptive baud rate model

Note: the default module is adaptive baud rate (AT + IPR = 0), in the baud rate adaptive mode, after power on the URC information "RDY" will not back to the master machine. In the module

boot after 2 ~ 3 seconds, can send the module AT commands. Master need to first send the "AT" the baud rate of character to the module to detect a master, and continue to send 1 ~ 5 "AT" string until module returns "OK". Then send a "AT + IPR = x & W" command to the module set the baud rate of a fixed, and save the configuration, after completed the configuration, each module after boot, will return to a URC information via a serial port "RDY". To further understand, please refer to the document [AT_DOCUMENT] "AT + IPR" in the chapter.

3、Serial port connection

The main serial port connection mode is more flexible, as follows are three common ways of connection.

1、Full-featured serial connection as shown in the figure below, this way is mainly used in the modem mode dial (PPP)

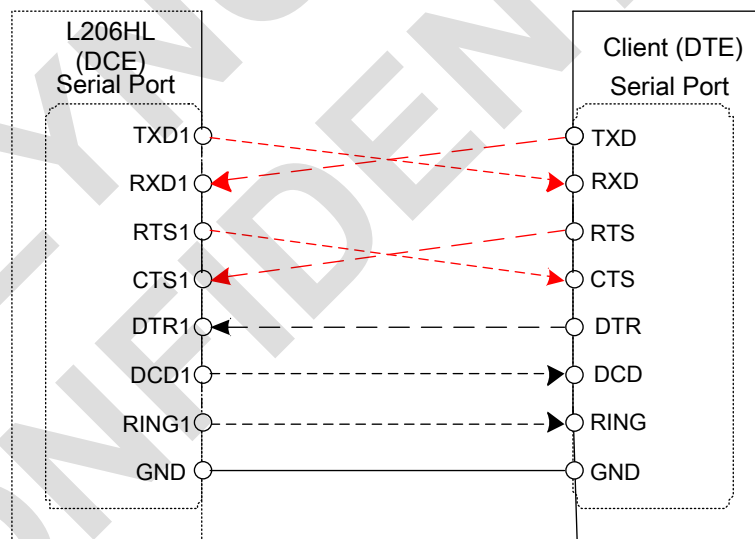


Figure 27:Full-featured serial connection

2、Three wire system without hardware flow control of the serial port is as follows

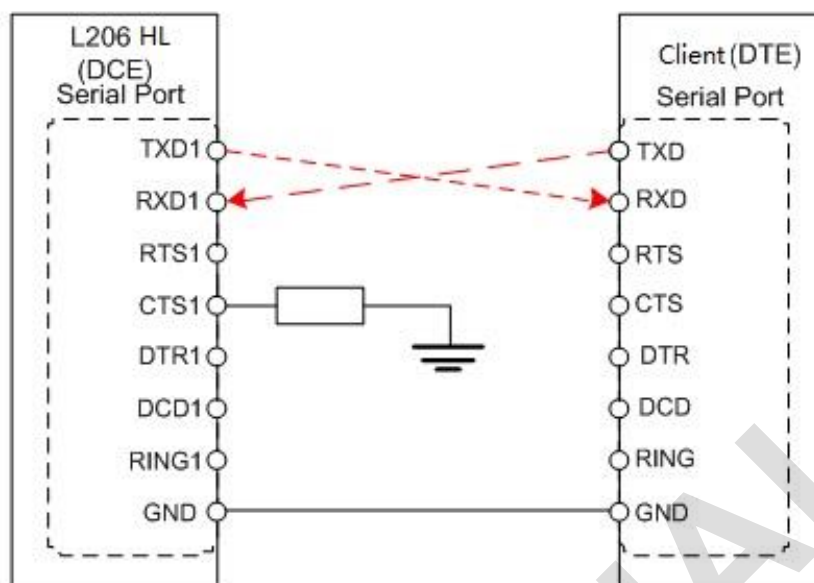


Figure 284: Serial port three lines connection

3、Three wire system with hardware flow control of the serial port is as follows:

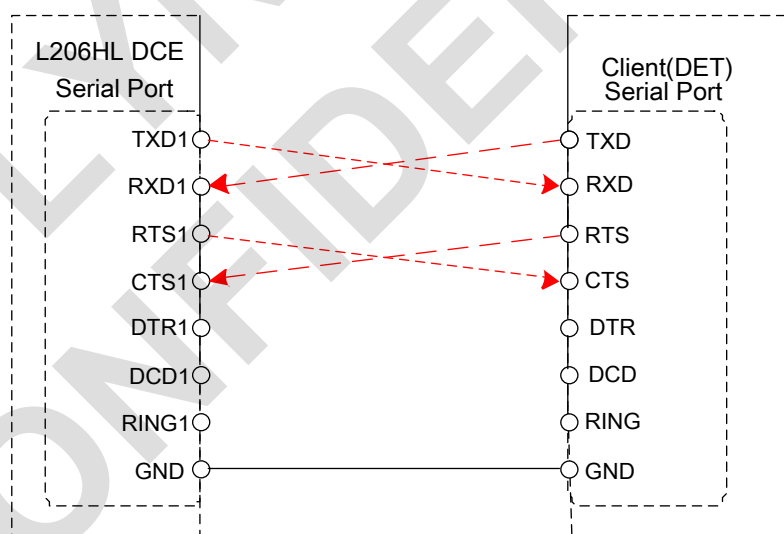


Figure 29:Serial flow control connection

4、Serial level matching

Module serial port is COMS VIO28 level signal, connected to the external MCU, it should pay attention to the matching of IO level. Normal job requirements input level lower than 3.0V, the default rate is 115200 bps.

When external MCU serial level of 3.3 V, it is recommended to use the following reference

circuit. If the external MCU level is 3.0 V, please change the resistance of 5.6 K to 14 K.

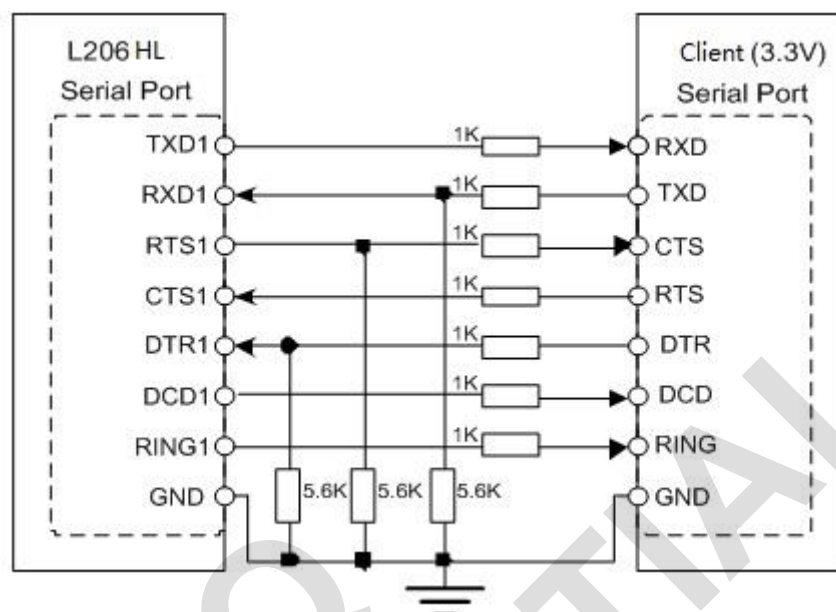


Figure 30: Resistor level matching (Reference circuit)

If the external host MCU serial level is 5 v, can use the transistor voltage conversion circuit or use special voltage conversion circuit, the reference is as follows:

- 1、 Use triode to do level transformation

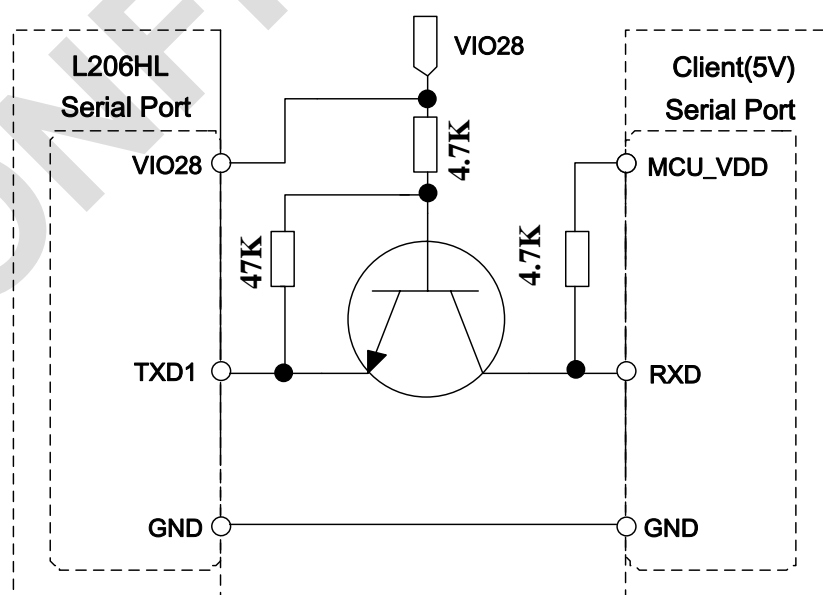


Figure 31: 5V TXD level matching (Reference circuit)

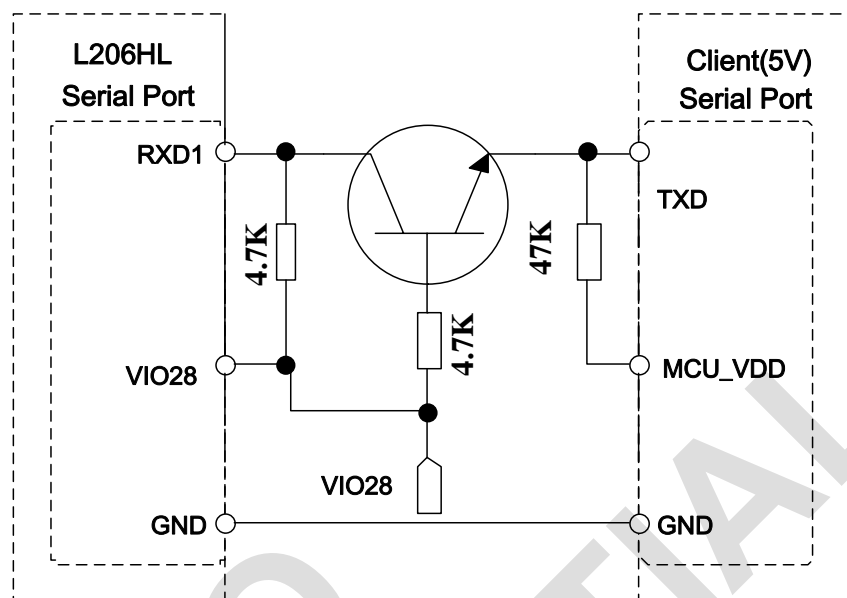


Figure 32: 5V RXD level matching (Reference circuit)

2、Use FAIRCHILD to convert the chip NC7WZ07:

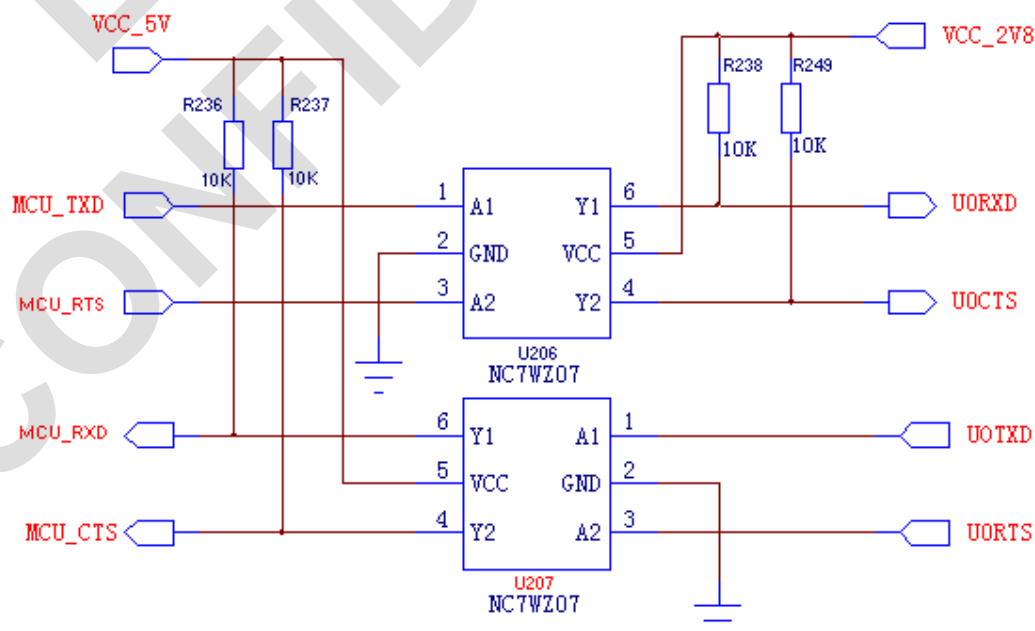


Figure 33: Chip level matching (Reference circuit)

3.4 SIM card interface

SIM card interface support GSM Phase1 specification function, also support the function of the GSM Phase 2 + specification and FAST 64 kbps SIM CARDS (for SIM application toolkit).

SIM card supports 1.8V and 3.0V power supply through the internal power supply of the module.

3.4.1. SIM Interface

Table 34: SIMcard interface pin definition:

NO.	PIN name	PIN NO.	Description
1	SIM_IO	14	SIM card data I/O
2	SIM_SCLK	55	SIM card clock
3	SIM_RST	15	SIM card reset
4	SIM_DET	54	SIM card insert detection pin
5	VSIM	16	SIM power supply, according to the type of SIM card automatically select the output voltage, 3.0V 10% or 1.8V 10%, the output current of about 10mA.

Below is a SIM card interface reference circuit, using 8 pin SIM gets stuck. SIM_DET pins for Molex SIM booth detection. When card is inserted into the booth, SIM_DET into a low level. At this time whether or not a SIM card inside the card, SIM_DET level from high to low make initialization module produces a SIM card. By default, the SIM card detection is off, you can use the "AT + ESIMS = 1" to open or "AT + ESIMS = 0" to close the function. Learn more about the content of the AT command, please refer to the document [AT_DOCUMENT].

When sending the "AT + QSIMDET = 1" the order, if not SIM card into the booth, can appear the URC information below:

+CPIN: NOT READY

If the SIM card has been done into the booth, SIM initialized, the URC information will appear as below:

Call Ready

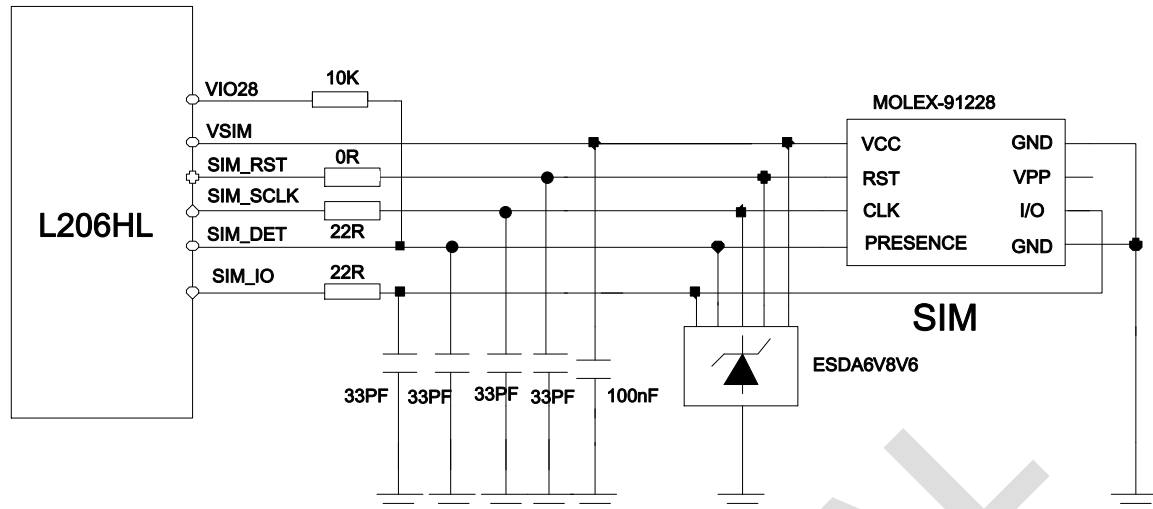


Figure 35: 8-pin SIM card(Reference circuit)

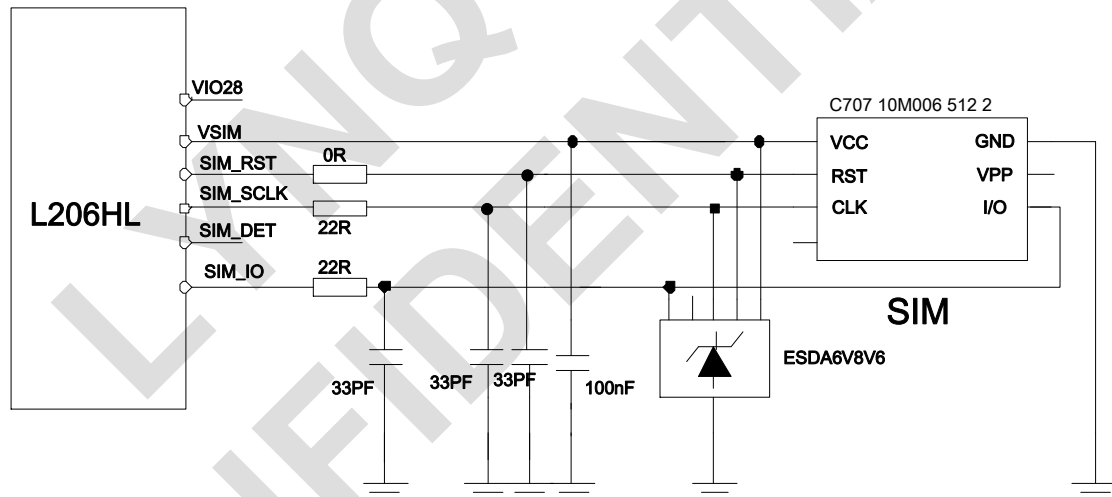


Figure 36: 6-pin SIM card(Reference circuit)

SIM card each signal need to increase the ESD protection devices used for ESD protection. In circuit design, in order to ensure the good performance of SIM card and is not damaged, in circuit design advice follow the following principles:

1. SIM gets stuck close to the module put, keep SIM card signal wiring less than 100 mm.
2. SIM card signal cable wiring away from the RF line and VBAT power line.
3. SIM gets-stuck and module of SIM_GND wiring to short and thick. SIM_VDD and SIM_GND wiring width ensure that not less than 0.5 mm, and between SIM_VDD and GND bypass capacitor does not exceed 1uf, and close to put SIM gets-stuck.
4. In order to prevent and SIM_DATA SIM_CLK signal crosstalk mutually, both wiring can't stand too close to, and between two linear increase shielding. In addition, SIM_RST signal also

need to protect.

5. In order to ensure good ESD performance, it is recommended that the SIM card pin increase TVS diode. Choose the TVS diode parasitic capacitance is not more than 50 pf, for example: WILL ESDA6V8AV6 (<http://www.willsemi.com>). Series between the module and SIM card need to 22 ohm resistance to suppress stray EMI and ESD protection. SIM card of peripheral devices should be placed near the SIM holder.

6. Suggest SIM_DATA, SIM_RST, SIM_CLK and SIM_VDD online parallel 33 pf capacitor is used to filter out radio frequency interference, and close to put SIM gets-stuck.

3.4.2. SIM gets stuck (Reference Figure)

SIM card connector 8 pin recommended Molex 91228. Please visit the <http://www.molex.com> website for more information!

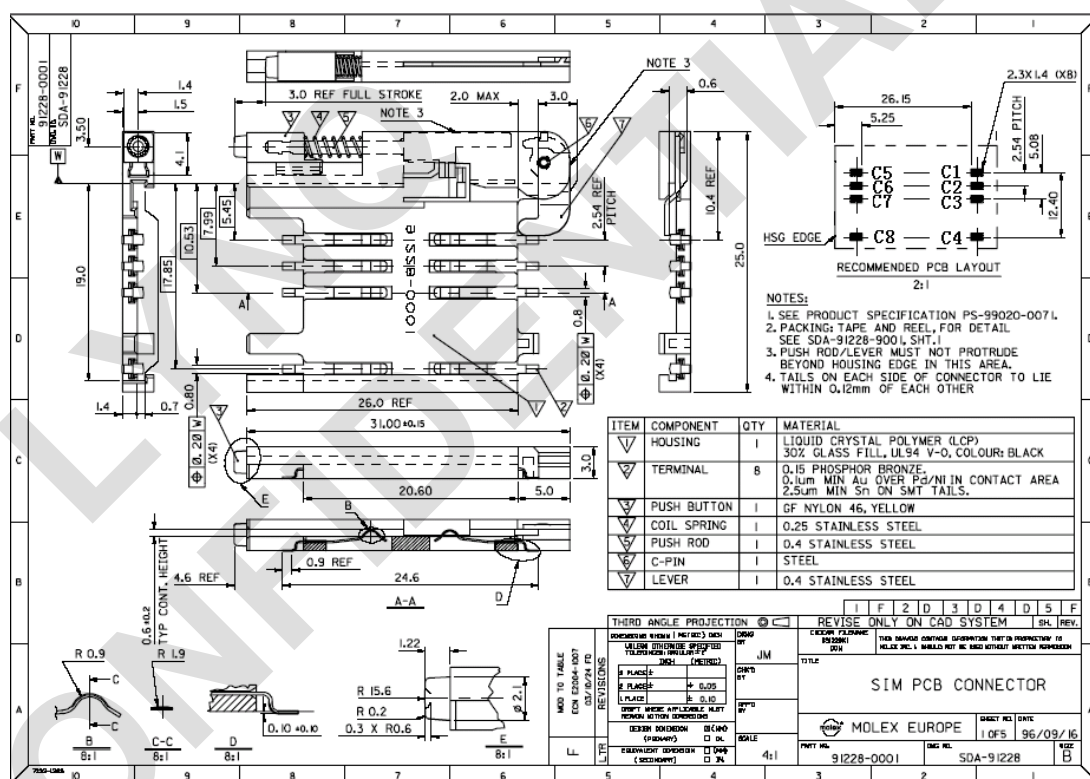


Figure 4: Molex 91228 SIM gets stuck

Table 37: PIN description (Molex SIM gets stuck)

PIN name	Signal	Description
C1	SIM_VDD	SIM card power supply pin
C2	SIM_RST	SIM card reset
C3	SIM_CLK	SIM card clock
C4	SIM_PRESENCE	SIM card detect pin
C5	GND	GND
C6	VPP	Not connected
C7	SIM_DATA	SIM card data input/output

C8	SIM_DETECT	Card SIM in position detection, the pin is directly connected to the ground, with the use of SIM_PRESENCE. When the SIM card tray is inserted, C4 and C8 are shortcircuit.
----	------------	--

6 pins SIM booth is recommended to use Amphenol company C707 10M006 5122. Please visit <http://www.amphenol.com> for more information!

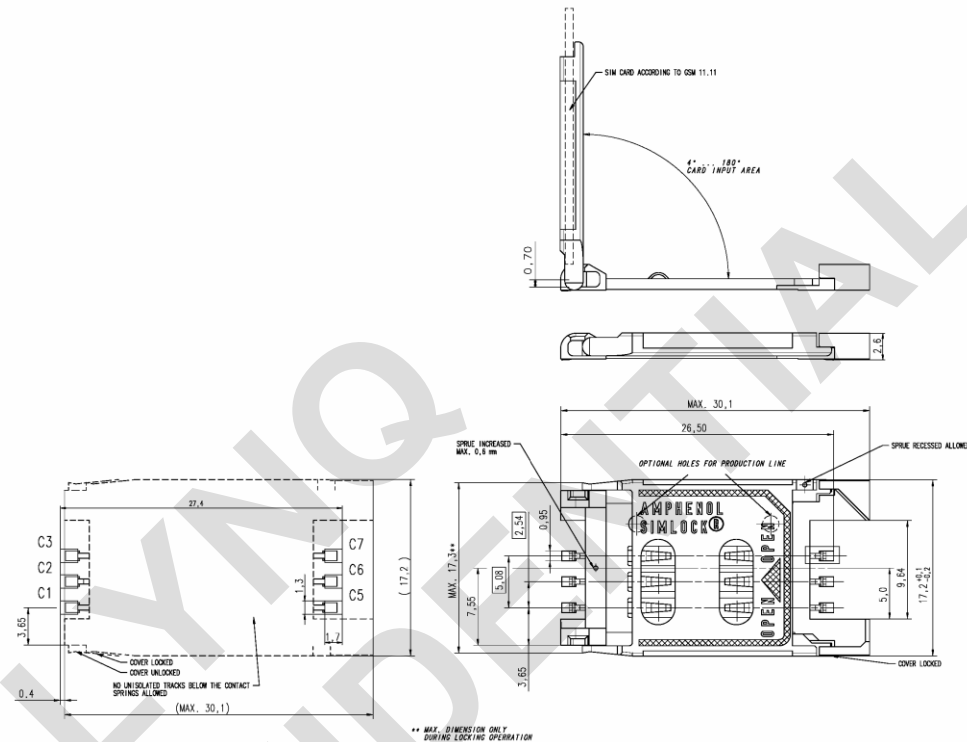


Figure 38: Amphenol C707 10M006 5122 SIM gets stuck

Table 39: PIN description(Amphenol SIM gets stuck)

PIN name	Signal	Description
C1	SIM_VDD	SIM card power supply pin
C2	SIM_RST	SIM card reset
C3	SIM_CLK	SIM card clock
C5	GND	GND
C6	VPP	Not connected
C7	SIM_DATA	SIM card data input/output

3.5 PWM interface

Table40: PWM Pin definition

PIN NO.	PIN name	Description
---------	----------	-------------

26	PWM	PWM signal
----	-----	------------

PWM can provide the frequency range of 0~2KHz, the user can set the output frequency, duty cycle through the AT+SPWM command, please refer to the AT document.

PWM pin can be used to drive buzzer.

NOTE: Make sure the PWM pin keep low level when module in the boot process.

Buzzer volume can be set by "AT + CRSL".

The reference circuit as follows:

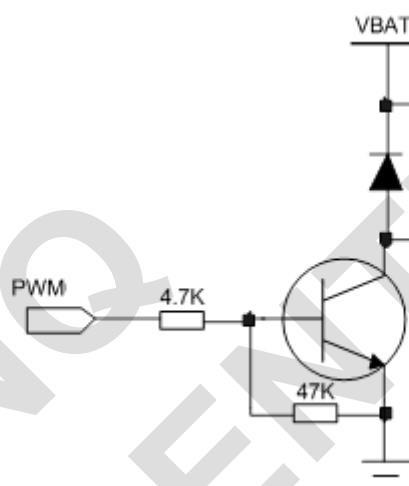


Figure 5: PWM(Reference circuit)

Table 41: Buzzer Output characteristic

Item	Min	Typ.	Max	Units
Working voltage	2.5	2.8	2.9	V
Working current		4	16	mA

Table 42: PWM multiplexing function

PIN name	PIN NO.	Default function	Multiplex function	
PWM	26	PWM	GPIO2	

3.6 NETWORK status indicator

Table43: NETLIGHT pin definition

PIN NO.	PIN name	Description
---------	----------	-------------

64	NETLIGHT	Network status indicator
----	----------	--------------------------

The NETLIGHT signal can be used to drive network status LED, the working state of this pin in the following table:

Table44: working state of NETLIGHT

Light status	Work status
off	Power off
64ms on/ 800ms off	No Network
64ms on/ 3000ms off	Register to network
64ms on/ 300ms off	GPRS Data Communication

Reference circuit:

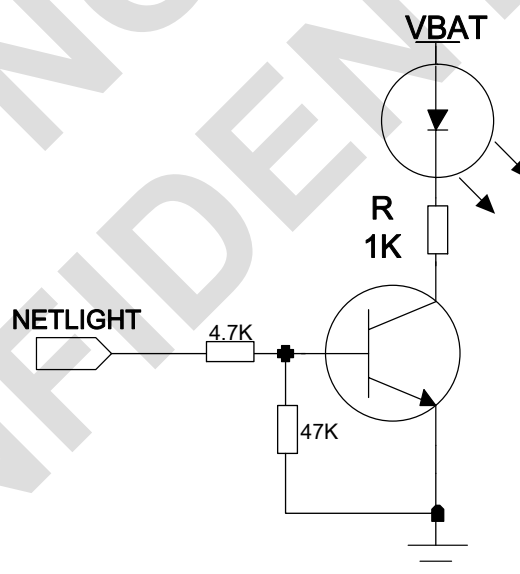


Figure 6: NETLIGHT(Reference circuit)

3.7 ADC interface

L206L provides an ADC channel, the user can use the AT command "AT + CADC" to read voltage value on ADC pin. Note: the ADC sampling the voltage cannot be more than 2.8 V, otherwise easy to cause damage to the ADC. About the AT commands related information please refer to the document [AT_DOCUMENT_R1. 04]. In order to improve the accuracy of ADC, the layout of ADC should be surrounded by ground.

Table45: ADC interface pin definition

PIN NO.	PIN name	Description
50	ADC	Analog sampling

Table46: ADC Parameter

Item	Min	Typ.	Max	Units
Input voltage range	0	-	2.8	V
ADC resolution	-	10	-	bits
ADC sampling rate	-	-	1.0833	MHz
ADC precision		10	30	mV

3.8 Antenna interface

L206L provides three antenna interfaces, pin definition as below:

Table 47: Antenna interface pin definition

PIN NO.	PIN name	Description
36	BT_ANT	BT antenna interface
40	RF_ANT	RF antenna interface
17	FM-ANT-P	FM antenna interface

The GSM antenna and BT antenna need to select the input impedance of 50 ohm and the standing wave coefficient is less than 2.

Two kinds of antennas try not to put too close.

The isolation of each port antenna and other port antennas is greater than 30db.

1、RF reference circuit

For the peripheral circuit design of the antenna interface, in order to better adjust the RF performance, the proposed reservation matching circuit. Antenna connection reference circuit as shown below. Where C101, C102 default is not posted, only 0 ohm R101 resistance, the line needs to be controlled by 50 ohm.

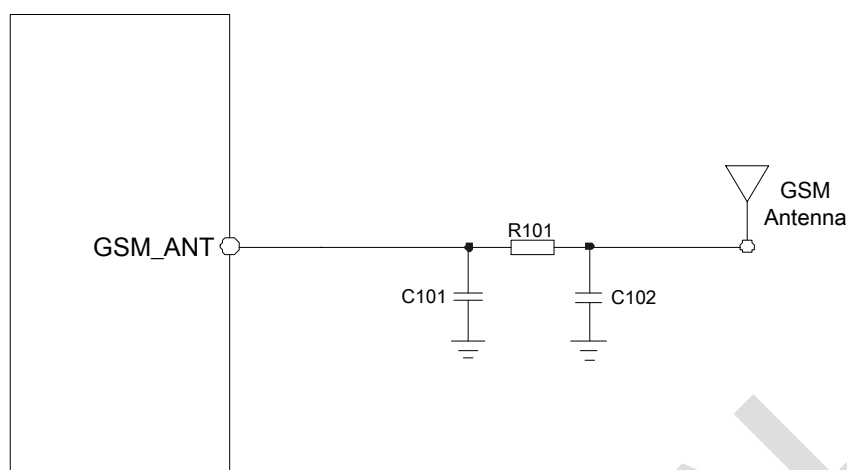


Figure 48:RF (Reference circuit)

Component placement and RF routing takes note:

- Matching circuit must be placed near the antenna
- RF ANT foot to the antenna RF cable must be 50 ohm impedance control
- RF_ANT PIN to antenna RF line must be far away from the high speed signal lines and strong interference sources, to avoid any signal lines cross or parallel and adjacent layer

2、Bluetooth Function

L206L supports Bluetooth interface. Bluetooth is a wireless technology that allows devices to communicate, or transmit data or voice, wirelessly over a short distance. It is described as a short-range communication technology intended to replace the cables connecting portable and/or fixed devices while maintaining high level of security. Bluetooth is standardized as IEEE802.15 and operates in the 2.4 GHz range using RF technology. Its data rates of up to 3Mbps.

L206L is fully compliant with Bluetooth specification 3.0.

L206L supports profile including SPP and OPP.

L206L provides a Bluetooth antenna pad named BT_ANT.

Refer to the documentation for the AT command on the Bluetooth operation

[L206L_AT_DOCUMENT].

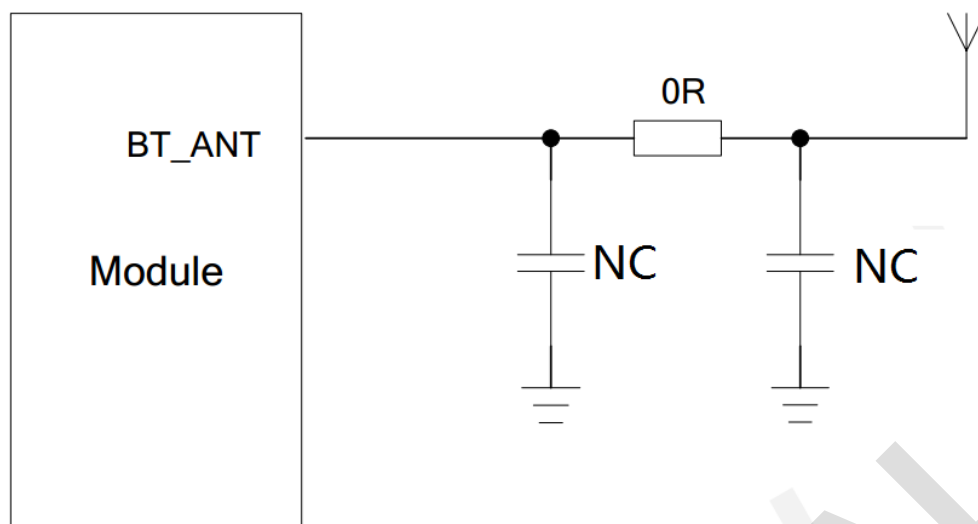


Figure 497:BT(Reference circuit)

3.9 Key interface

L206L keyboard interface module contains five rows keyboard output, and five columns of the keyboard input. The user can use at most 5 * 5 * 2 keys array.

Table 50: Key pin definition

NO.	PIN name	PIN NO.	Description	Reuse function
1	COL0	20	column0	GPIO16
2	COL1	25	column 1	GPIO9
3	COL2	22	column 2	GPIO8
4	COL3	21	column 3	GPIO7
5	COL4	24	column 4	GPIO6
6	ROW0	62	row0	GPIO21
7	ROW1	60	row 1	GPIO1
8	ROW2	61	row 2	GPIO19
9	ROW3	23	row 3	GPIO0
10	ROW4	63	row 4	GPIO17

Note: different functions require different software configuration. Please contact us if you need to use reuse function.

There are two kinds of connection module keys. Traditional way of connection can support 5 * 5 keys, connection mode is as follows:

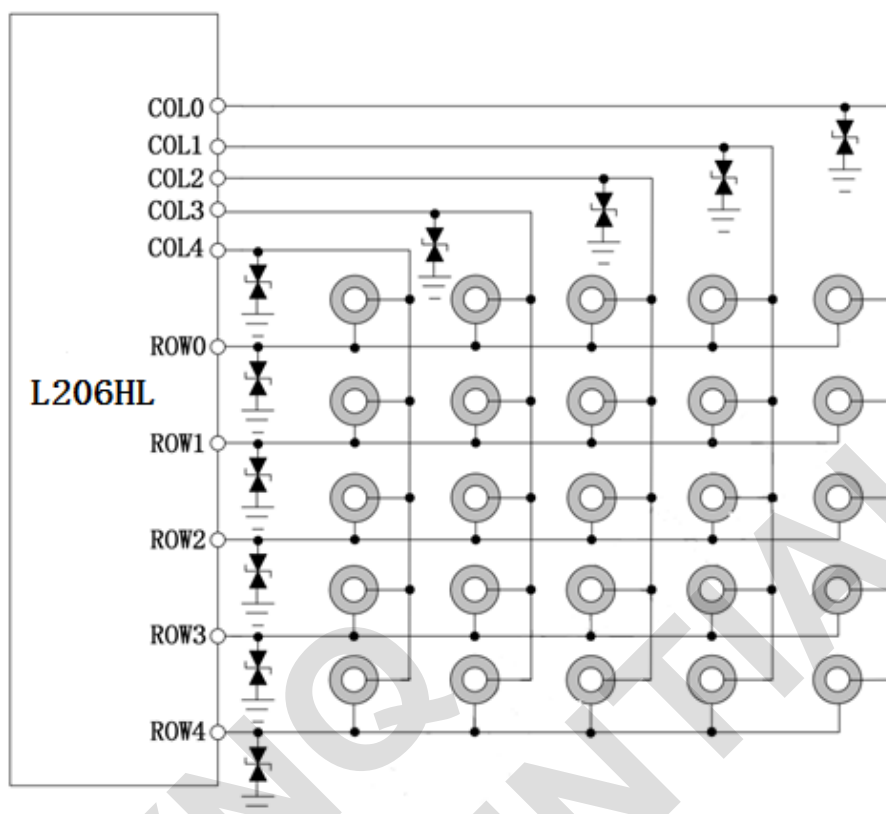


Figure 518:Key pad(Reference circuit1)

Note: according to the traditional 5 * 5 to design the keys, when have spare COL or ROW, the user can through the AT command, define it as GPIO use, detailed the AT command, please see the relevant manuals.

Connection module supports a new button connection, can support 5 * 5 * 2 buttons, meet the demand of full keyboard,as follows:

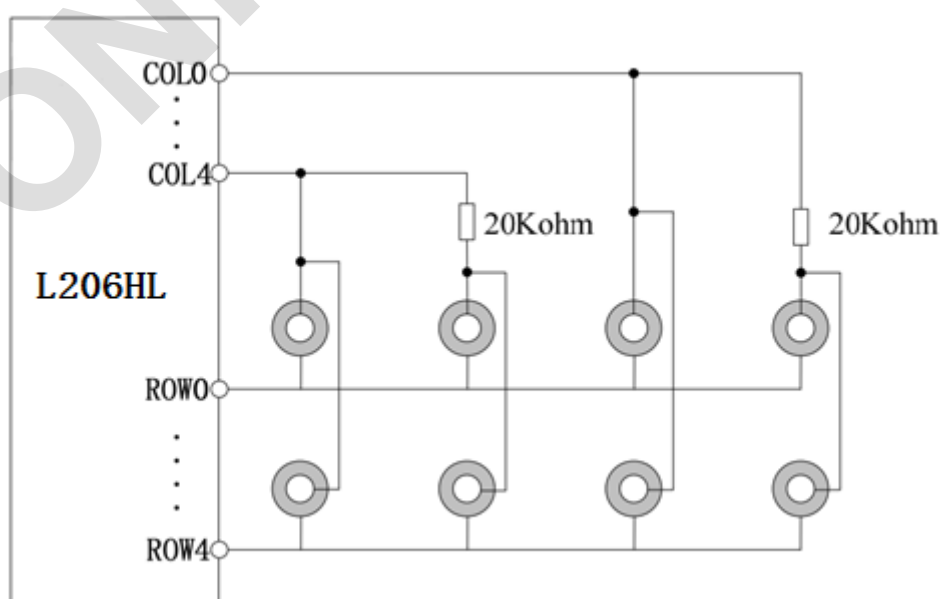


Figure 529:Key pad(Reference circuit2)

To improve the ESD performance, the user can in series with the COL by one less than 1 k resistor, as follows:

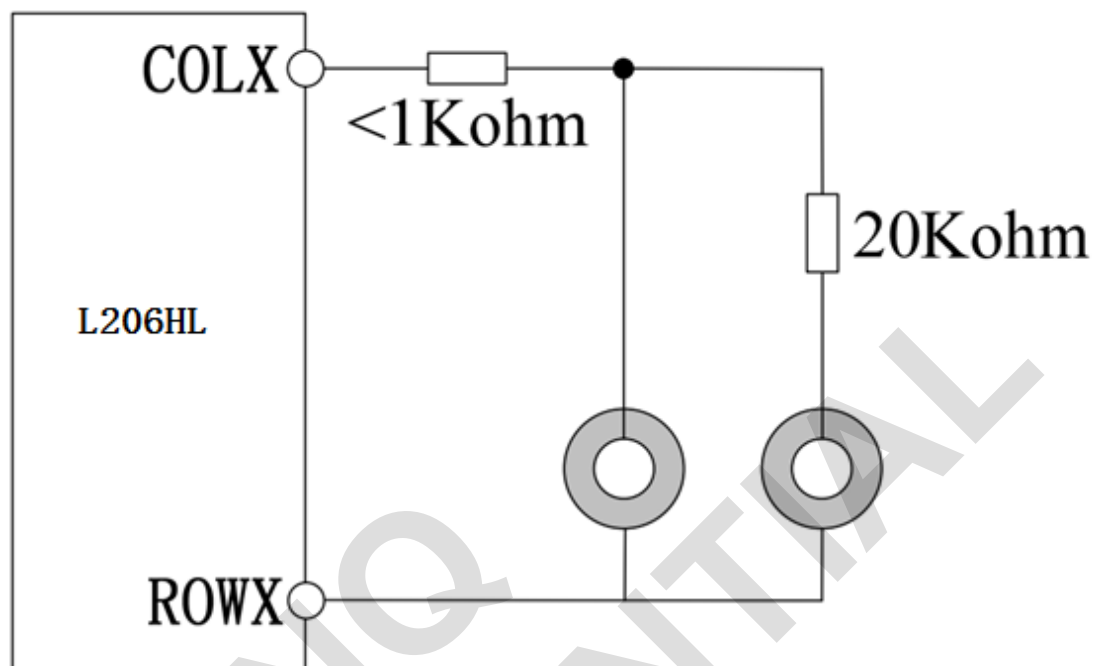


Figure 40:Key pad(Reference circuit3)

No matter use 5 * 5 key array or 5 * 5 * 2 array, the module can be detected at the same time press the two buttons, but when using 5 * 5 * 2 keys, in the same row, column can't meet at the same time press the two buttons, as follows:

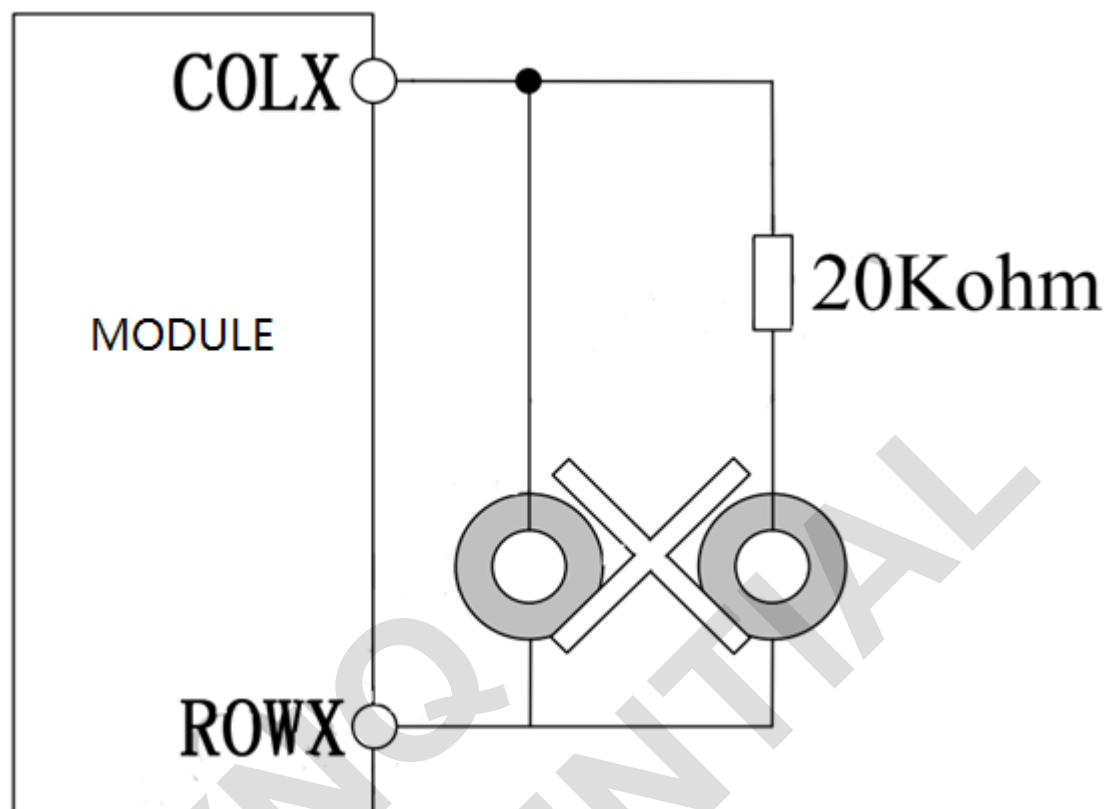


Figure 41:Key pad(Reference circuit4)

3.10USB interface

L206L has a high speed USB1.1 interface, support full - speed mode, a main processor (AP) and mainly through the USB interface for data transmission between modules.

Table 21: USB pin definition

NO.	PIN name	PIN NO.	Description
1	VBUS	7	USBPower
2	USB_DM	19	USB Differential data D-
3	USB_DP	59	USB Differential data D+

USB bus is mainly used for data transmission, software upgrades, detection module program. Work under the mode of high - speed USB line, if you need to ESD design, must satisfy the junction capacitance value of ESD protection devices < 5 pf, or larger junction capacitance will cause waveform distortion, affect the bus communication. Differential difference of the data line impedance should be controlled in $90\ \text{ohm} \pm 10\%$.

4. Mechanical Dimensions

Mechanical dimensions of Module:

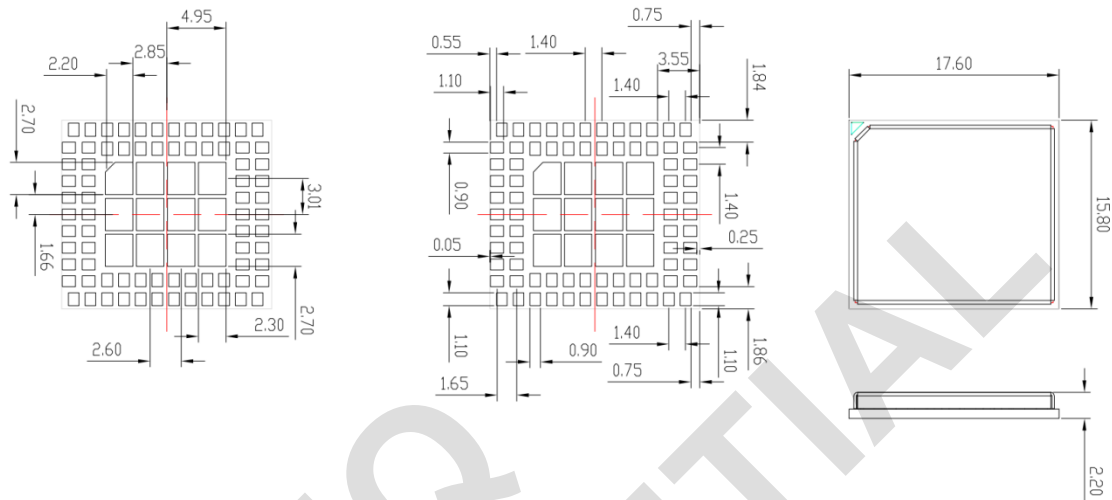


Figure 42:L206L top view and side view (mm)

5. ELECTRICAL CHARACTERISTICS

5.1 Absolute Maximum Ratings

The following table shows the absolute maximum state in abnormal situation, more than the limit value will likely result in permanent damage to the module.

Table 22: Absolute Maximum Ratings

Parameter	Min	Typ.	Max	Unit
V _{BAT}	3.3	3.8	4.4	V
Peak current	-0.3	-	3	A
Digital signal input voltage	-0.3	-	3.1	V
Analog input voltage	-0.3	-	3.1	V
Working temperature	-40	25	+85	°C
Storage temperature	-45	25	+90	°C

5.2 Digital Interface Characteristics

Table 533: Digital Interface Characteristics

Parameter	Description	Min	Typ.	Max	Unit
V _{IH}	Input high level	2.1	-	3.1	V
V _{IL}	Input high level	0	-	0.7	V
V _{OH}	Input high level	2.5	-	3.1	V
V _{OL}	Input high level	0	-	0.3	V
V _{IH}	Input high level	2.1	-	3.1	V

* Apply to the GPIO, I2C, UART, PCM digital interface, etc.

5.3 VSIM Characteristics

Table 544: SIM card interface characteristics

Parameter	Description	Min	Typ.	Max	Unit
V _O	Output voltage	1.65	1.8	1.95	V

		2.8	3.0	3.2	V
IO	Output current	-	-	60	mA

5.4 Current Consumption

Table 555: Current consumption

Parameter	Conditions	Min	Typ.	Max	Unit
Bottom current	Shutdown mode	--	0.16	--	mA
Working current	Sleep mode	--	1	--	mA
	Standby mode	--	10.6	--	mA
	Voice (maximum power)	--	280	--	mA
	Data transfer mode GPRS(1Rx,4Tx)	--	493	--	mA
Peak current	Data transfer mode GPRS(3Rx,2Tx)	--	386	--	mA
	Maximum power burst current	--	--	2.0	A
	Data transfer mode GPRS(3Rx,2Tx)	--	413	--	mA

5.5 ESD

In the use of the module, due to the human body static electricity, electric charge and friction between the two kinds of static electricity generated by various means of discharge to the module, may cause some damage, so ESD protection must pay attention, whether in the development, production assembly, testing process, especially in product design, should be taken to prevent ESD protection measures. Such as circuit design in the interface or vulnerable to the ESD point to increase the ESD protection, the production of anti-static gloves, etc.. Because the module is not specifically designed for electrostatic discharge protection, so in the production, assembly and operation module must pay attention to the electrostatic protection. The performance of the module test parameters in the following table:

ESD performance parameters (temperature: 25, humidity: 45%)

Table 566: ESD performance parameters

PIN	Contact discharge	Air discharge
VBAT	±5KV	±10KV
GND	±5KV	±10KV
RXD,TXD	±1KV	±6KV

RF_ANT	$\pm 5\text{KV}$	$\pm 10\text{KV}$
MIC_P/N	$\pm 2\text{KV}$	$\pm 6\text{KV}$
RCV_P/N		
PWRKEY	$\pm 3\text{KV}$	$\pm 6\text{KV}$
RESET_N		

5.6 RF performance

● RF output power

Following table lists the conducted output power of modules, compliant with 3GPP TS 05.05 SPEC.

Table 577: EGSM900 and GSM850 conducted output power

PCL	Output power(dBm)	Tolerance (dB) for conditions	
		Normal	Extreme
--	Nominal		
5	32.5	± 0.4	± 2
6	30.8	± 1	± 2
7	29	± 1	± 2
8	27	± 1	± 2
9	25	± 1	± 2
10	23	± 1	± 2
11	21	± 1	± 2
12	19	± 1	± 2
13	17	± 1	± 2
14	15	± 1	± 2
15	13	± 1.5	± 2
16	11	± 1.5	± 2
17	9	± 1.5	± 2
18	7	± 1.5	± 5

Table 588: DCS1800 and PCS1900 conducted output power

PCL	Output power(dBm)	Tolerance (dB) for conditions	
		Normal	Extreme
--	Nominal		
0	29.5	± 0.4	± 2
1	27.5	± 1	± 2
2	26	± 1	± 2
3	24	± 1	± 2
4	22	± 1	± 2

5	20	± 1	± 2
6	18	± 1	± 2
7	16	± 1	± 2
8	14	± 1	± 2
9	12	± 1.5	± 2
10	10	± 1.5	± 2
11	8	± 1.5	± 2
12	6	± 1.5	± 2
13	4	± 1.5	± 2
14	2	± 1.5	± 5
15	0	± 2	± 5

- Module conduction receiver sensitivity

The following table lists the module's conduction reception sensitivity and is tested under static conditions.

Table 599:Conduction sensitivity

Band	Receiving sensitivity (Typ.)
GSM850	$\cong -108\text{dBm}$
EGSM900	$\cong -108\text{dBm}$
DCS1800	$\cong -108\text{dBm}$
PCS1900	$\cong -108\text{dBm}$

- Module frequency band

The following table lists the module's working frequency bands, compliant with the TS 3GPP 5.05 specification.

Table 30:Module frequency band

Band	Receiving sensitivity (Typ)	Receiving sensitivity (Max))
GSM850	869 ~ 894MHz	824 ~ 849MHz
EGSM900	925 ~ 960MHz	880 ~ 915MHz
DCS1800	1805 ~ 1880MHz	1710 ~ 1785MHz
PCS1800	1930 ~ 1990MHz	1850 ~ 1910MHz

6. MANUFACTURING

6.1.L206L top and bottom view

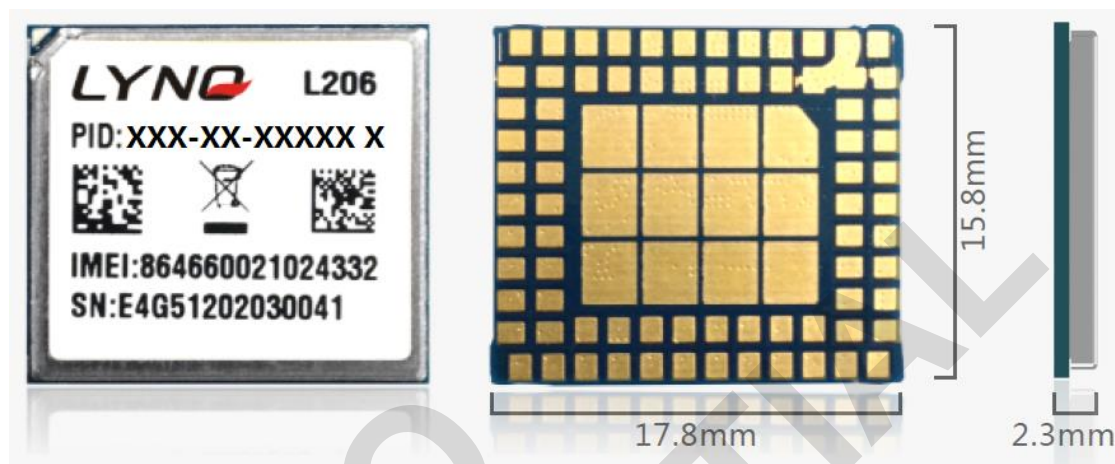


Figure 43:L206L top and bottom view

6.2.Soldering

In order to ensure soldering quality, special attention should be paid to the control of temperature curve pipes. The soldering profile shown below is only a general recommendation and should be adjusted according to the specific application and manufacturing.

Standard temperature curve and the parameter range of lead-free processes.

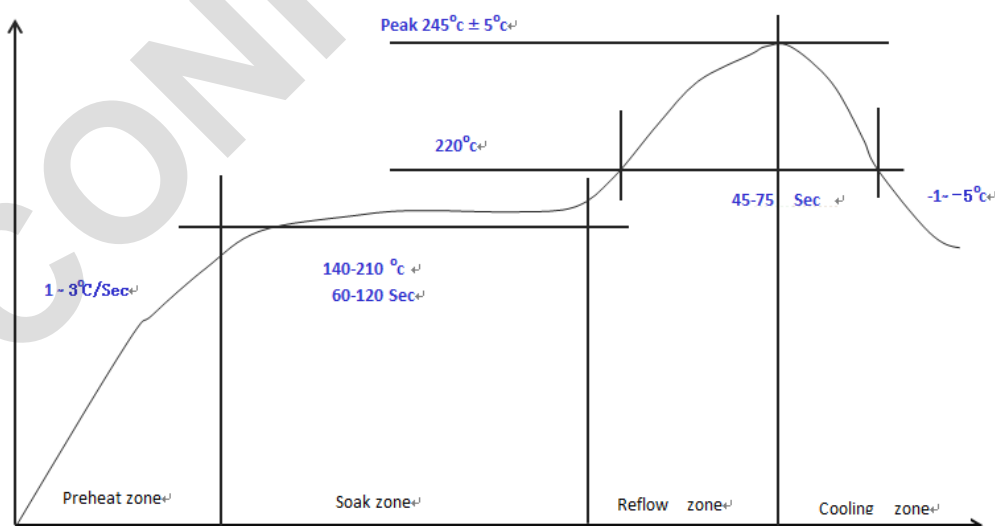


Figure 6-2 The reference temperature curve

6.3.The Moisture Sensitivity Level (MSL)

L206L module complies with the humidity level 3. At a temperature of <30 degrees and relative humidity of <60% of the environmental conditions, dry pack to perform J-STD-020C specification according to IPC / JEDEC standard. At a temperature of <40 degrees and a relative humidity of <90% of the environmental conditions, in the case of unopened shelf life of at least six months. After unpacking, Table29 shows the module shelf life at different times corresponding to the level of humidity.

Table 31: Moisture sensitivity level and floor life

TheMoistureSensitivityLevel (MSL)	Floor Life(out of bag) at factory ambient $\leq +30$ /60%RH
1 RH °C condition	Unlimited at $\leq +30$ /85%
2	1 Year
2a	4 weeks
3	168 hours
4	72 hours
5	48 hours
5a	24 hours
6	Mandatory bake before use. After bake,it must be reflowed within the time limit specified on the label.

After unpacking,<30 degrees in temperature and relative humidity <60% environmental conditions, 168 hours in the SMT patch. If not meet the above conditions need to be baked.

NOTES: For product handling, storage, processing, IPC / JEDEC J-STD-020C must be followed

6.4.Baking Requirements

Due to the humidity sensitive characteristics of the L206L module, the L206L is a vacuum packaging, which can be stored for 6 months without damage to the package, and the ambient temperature is less than 40 C and the relative humidity is less than 90%. To meet one of the

following conditions, the process of reflow soldering should be performed before the full bake, or the module may cause permanent damage to the process.

- 1、 Vacuum packing damage or leakage
- 2、 The module is exposed in the air for 168 hours or more
- 3、 The module is exposed in air for 168 hours, not meet the temperature <30 degrees and relative humidity of the environment conditions <60%

Table32:Baking requirements

Baking temperature	Humidity	Baking time
120° C±5° C	<5%	4 Hours

Note: The original packaging of the module cannot bear the high temperature of baking. The packaging needs to be removed before baking, otherwise the packaging will be damaged.

7. RELATED DOCUMENTS

Table 603: Related documents

NO.	Documents	Note
[1]	AT_DOCUMENT_R1.04	
[2]	ITU-T Draft new recommendation V.25ter:	Serial asynchronous automatic dialing and control
[3]	GSM 07.07:	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[4]	GSM 07.10:	Support GSM 07.10 multiplexing protocol
[5]	GSM 07.05:	Digital cellular telecommunications (Phase 2+); Use of Data Terminal Equipment – Data Circuit terminating Equipment (DTE – DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
[6]	GSM 11.14:	Digital cellular telecommunications system (Phase 2+); Specification of the SIM Application Toolkit for the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[7]	GSM 11.11:	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface

8. SAFETY INFORMATION

For the reasonable usage of the module, please comply with all these safety notices of this page. The product manufacturers should send followed safety information to user, operator or product's spec.



The devices using the module may disturb some electronic equipment. Put the module away from the phone, TV, radio and automation equipment to avoid the module and the equipment to interfere with each other.



Shut down the mobile device or change to flying mode before boarding. The Using of wireless appliances in an aircraft is forbidden to avoid the interference, or else cause to unsafe flying, even violate the law.



In hospital or health care center, switch off the mobile devices. RF interference may damage the medical devices, like hearing-aid, cochlear implant and heart pacemaker etc.



Mobile devices can't guarantee to connect in all conditions, like no fee or with an invalid SIM card. When you need emergent help, please remember using emergency calls and make sure your device power on in an area with well signal.



Put the module away from inflammable gases. Switch off the mobile device when close to gas station, oil depot, chemical plant etc.



The module is not water proof. Please don't use the module in the area with high humidity like bathroom, which will decelerate the physical performance, insulation resistance and mechanical strength.



Non-professionals can't teardown the module which will damage it. Refer to the specification or communicate the related staffs to repair and maintain it.



Please switch on the module before cleaning. The staffs should be equipped with anti-ESD clothing and gloves.

The users and product manufacturers should abide by the national law of wireless modules and devices. If not, Mobiletek will not respond the related damages.