L502-3 Series_Hardware Design

LTE CAT1 Module Series

Version： V1.0

Date： 2020-03-31

Shanghai Mobiletek Communication Ltd

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Version History

Date	Version	Modify records	Author
2020-03-31	V1.0	First Release	Rc.Dong

CONTENT

1. Introduction

L502-3 Series are a Cat1 module for LCC+LGA package, with stable and reliable performance. It can well meet customer's requirements for cost-effective, low-power applications. It suits to IoT areas, such as PoC, Mobile payment, security and alarm systems, on-board vehicle, DTU, asset tracking, sharing economy, etc.

1.1 Hardware Diagram

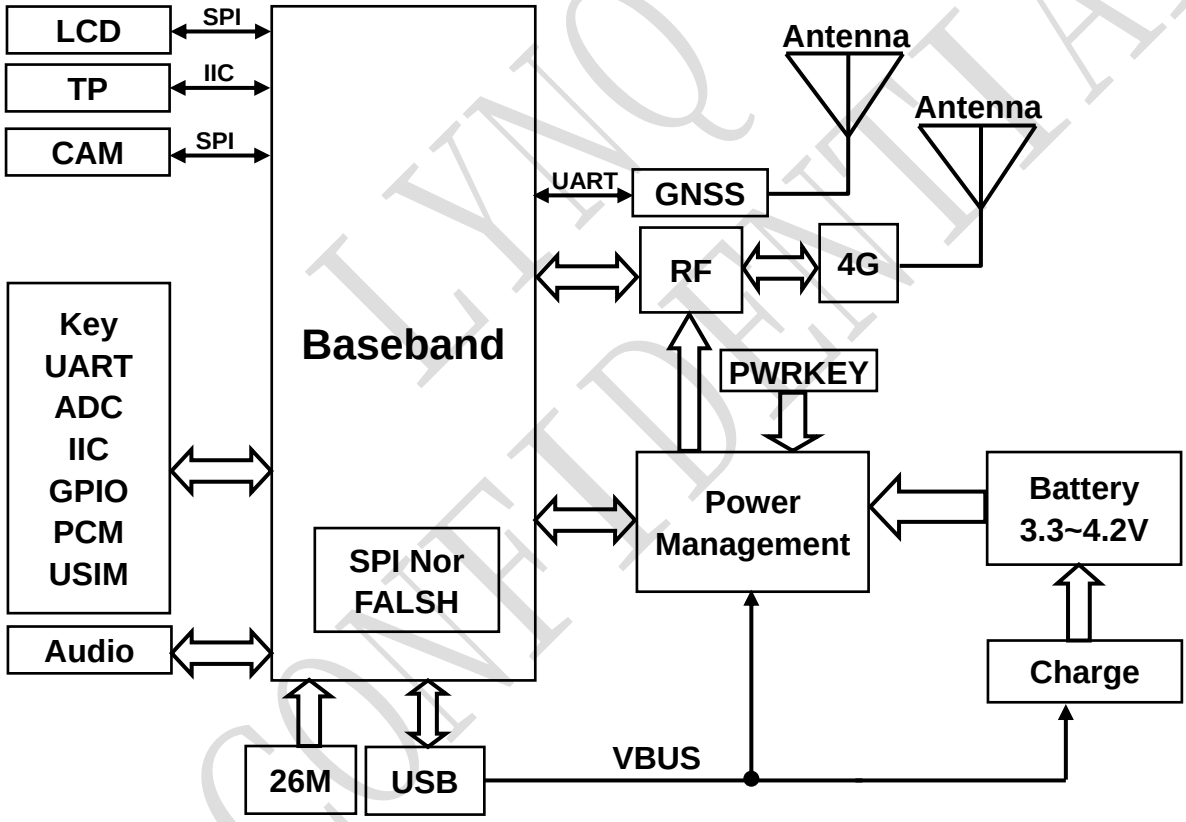


Figure 1.1-1 L502-3 Series Functional architecture

1.2 Main features

- **CPU**

ARM Cortex-R5@832MHz

- **Flash**

  SPI Nor Flash: 128Mb

- **Frequency bands**

  TDD-LTE: B34/B38/B39/B40/B41

  FDD-LTE: B1/B3/B5/B8

- **Output Power**

  LTE: 23dBm±2dB

- **Sensitivity**

  TBD

- **Data transmission**

  LTE Cat1 DL: 10Mbps

  UL: 5Mbps

- **Power consumption**

  Flight mode: 1mA @3.8V

  LTE Standby: TBD @3.8V

- **GNSS (L502CN-3E and L502MN-3E support GNSS)**

  Support GPS/BeiDou/QZSS

  Receive channel: 72 channels & DSP hardware accelerations

  Update rate: Max 20Hz

Tracking: -162dBm

Reacquisition: -159dBm

Hot starts: -158dBm

Cold starts: -148dBm

Cold starts TTFF: 28s

Hot starts TTFF: 1s

GNSS Accuracy: 2.5m CEP

Speed: 0.1m/s

1.3 Specifications

- Supply Voltage Range: 3.3～4.2V（typ3.8V）
- Dimensions: 27mm * 24mm * 2.5mm
- Package: 130-pin LCC+LGA
- Operation Temperature Range: -40℃～+85℃
- Storage Temperature Range: -45℃～+90℃
- Support WIFI SCAN
- Weight: Approx 4g

1.4 Interfaces

- IIC
- GPIO
- EINT
- USB2.0
- ADC
- SIM: Support 1.8V/3V
- UART
- SDIO
- SPI

- PCM
- Key
- Analog Audio
- Antenna

1.5 Peripherals Features

L502M(N)-3E:

- LCD: SPI Interface 240*320
- TP: Capacitive
- Camera: SPI Interface

2. Package Information

2.1 Pin Configuration

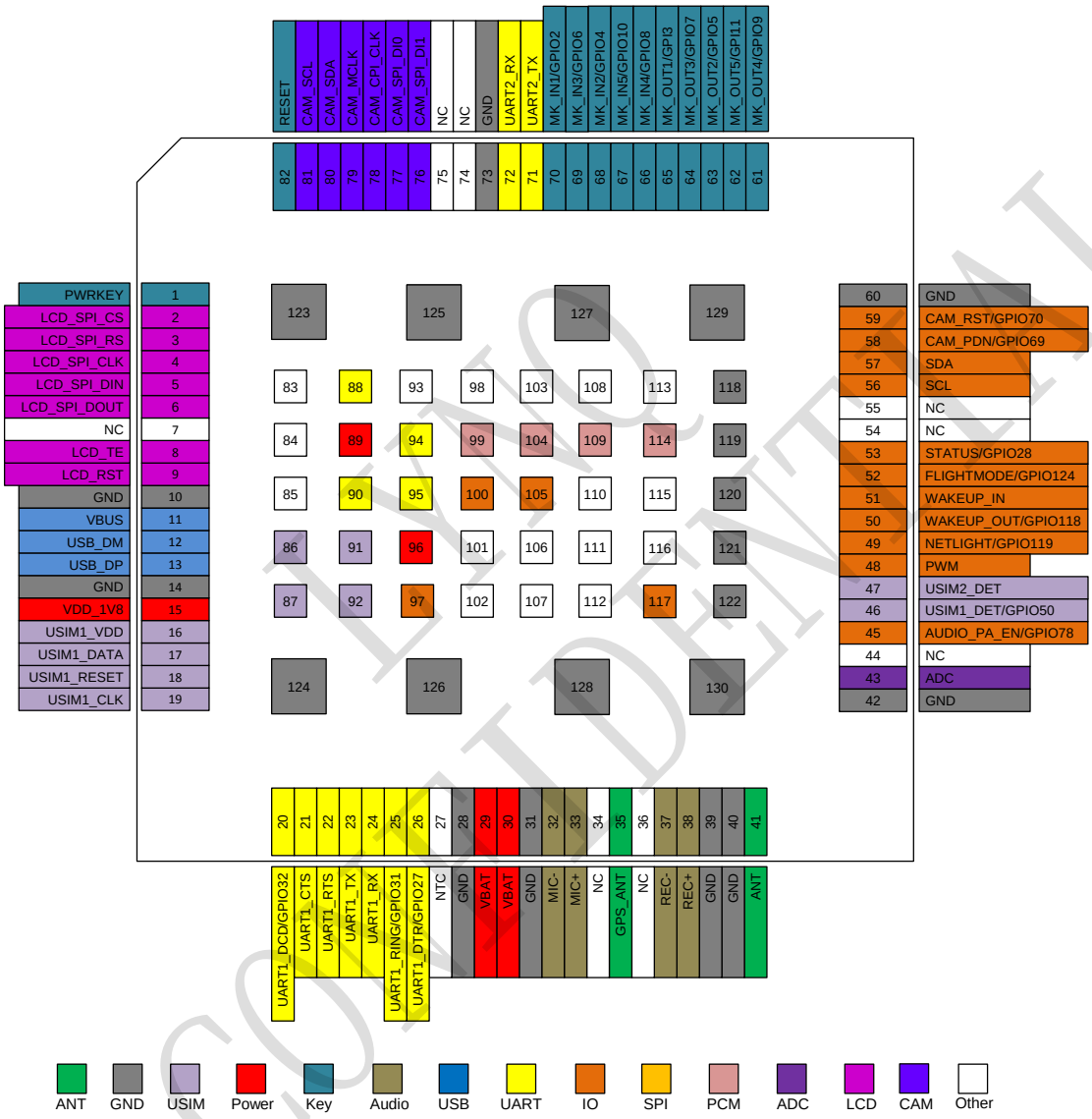


Figure 2.1-1 L502-3 Series Pin View

Notes: MK_OUT4 (PIN61) must not be pulled down low level before the module is successfully powered on.

2.2 Pin definition

The L502-3 Series have 130 pins, and the functions of the interface are as follows.

Table 2.2-1 L502C(N)-3 Series Pin description

Pin NO.	Pin name	Type	Function Description	Power domain	State(1)
1.	PWRKEY	I	Power key button	0～4.2V	Open
2.	LCD_SPI_CS	O	L502C(N)-3 Series do not support LCD function	1.8V	Open
3.	LCD_SPI_RS	O		1.8V	Open
4.	LCD_SPI_CLK	O		1.8V	Open
5.	LCD_SPI_DIN	I		1.8V	Open
6.	LCD_SPI_DOUT	O		1.8V	Open
7.	NC				
8.	LCD_TE	O		1.8V	Open
9.	LCD_RST	O		1.8V	Open
10.	GND	G	Ground		GND
11.	VBUS	PI	USB 5V voltage input	5V	Open
12.	USB_DM	DIO	USB port differential data line		Open
13.	USB_DP	DIO			Open
14.	GND	G	Ground		GND
15.	VDD_1V8	PO	1.8V output voltage, output current up to 50mA	1.8V	Open
16.	USIM1_VDD	PO	USIM1 output voltage	1.8/3.0V	Open
17.	USIM1_DATA	I/O	USIM1 data	1.8/3.0V	Open
18.	USIM1_RESET	O	USIM1 reset	1.8/3.0V	Open
19.	USIM1_CLK	O	USIM1 clock	1.8/3.0V	Open
20.	UART1_DCD	DO	UART1 data carrier detect	1.8V	Open

21.	UART1_CTS	DI	UART1 clear to send	1.8V	Open
22.	UART1_RTS	DO	UART1 request to send	1.8V	Open
23.	UART1_TX	DO	UART1 transmit output	1.8V	Open
24.	UART1_RX	DI	UART1 receive data input	1.8V	Open
25.	UART1_RING	DO	UART1 ring indicator	1.8V	Open
26.	UART1_DTR	DI	UART1 Data terminal ready(wake up module)	1.8V	Open
27.	NTC	I	Battery temperature monitoring pin	1.8V	Open
28.	GND	G	Ground		GND
29.	VBAT	PI	Power supply	3.3～4.2V	VBAT
30.	VBAT	PI			VBAT
31.	GND	G	Ground		GND
32.	MIC-	AI	Microphone Channel	0～1.8V	Open
33.	MIC+	AI	Microphone Channel	0～1.8V	Open
34.	RESERVED		Not connect		
35.	GPS_ANT	ANT	GPS Antenna		Open
36.	NC		NC		
37.	REC-	AO	Receiver Negative output	0～1.8V	Open
38.	REC+	AO	Receiver Positive output	0～1.8V	Open
39.	GND	G	Ground		GND
40.	GND	G	Ground		GND
41.	ANT	ANT	Antenna		Open
42.	GND	G	Ground		GND
43.	ADC	I	ADC external input channel	0.05～1.8V	Open
44.	RESERVED		Not connect		
45.	AUDIO_PA_EN	I/O	General Purpose Input Output 78 for Audio PA enable	1.8V	Open

46.	USIM1_DET	I	USIM1 detect pin	1.8V	Open
47.	USIM2_DET	I	USIM2 detect pin	1.8V	Open
48.	PWM	O	PWM Output	1.8V	Open
49.	NETLIGHT	O	Output PIN as LED control for network status	1.8V	Open
50.	WAKEUP_OUT	O	Output PIN can be used as wake signal to host from module	1.8V	Open
51.	WAKEUP_IN	I	Host to set the module into sleep or wake up the module from sleep	1.8V	Open
52.	FLIGHTMODE	I	Input PIN as RF operating control	1.8V	Open
53.	STATUS	O	Output PIN as operating status indicating of module	1.8V	Open
54.	NC		NC		
55.	NC		NC		
56.	SCL	I/O	IIC clock	1.8V	Open
57.	SDA	I/O	IIC data	1.8V	Open
58.	GPIO69	I/O	General Purpose Input Output 69	1.8V	Open
59.	GPIO70	I/O	General Purpose Input Output 70	1.8V	Open
60.	GND	G	Ground		GND
61.	MK_OUT4/GPIO9	O	Matrix keyboard out 4	1.8V	Open
62.	MK_OUT5/GPIO11	O	Matrix keyboard out 5	1.8V	Open
63.	MK_OUT2/GPIO5	O	Matrix keyboard out 2	1.8V	Open
64.	MK_OUT3/GPIO7	O	Matrix keyboard out 3	1.8V	Open
65.	MK_OUT1/GPIO3	O	Matrix keyboard out 1	1.8V	Open
66.	MK_IN4/GPIO8	I	Matrix keyboard in 4	1.8V	Open
67.	MK_IN5/GPIO10	I	Matrix keyboard in 5	1.8V	Open
68.	MK_IN2/GPIO4	I	Matrix keyboard in 2	1.8V	Open

69.	MK_IN3/GPIO6	I	Matrix keyboard in 3	1.8V	Open
70.	MK_IN1/GPIO2	I	Matrix keyboard in 1	1.8V	Open
71.	UART2_TX	DO	UART2 transmit output	1.8V	Open
72.	UART2_RX	DI	UART2 receive data input	1.8V	Open
73.	GND	G	Ground		GND
74.	NC		NC		
75.	NC		NC		
76.	CAM_SPI_DI1	I	L502C(N)-3 Series do not support CAM function	1.8V	Open
77.	CAM_SPI_DI0	I		1.8V	Open
78.	CAM_SPI_CLK	O		1.8V	Open
79.	CAM_MCLK	O		1.8V	Open
80.	CAM_SDA	I/O		1.8V	Open
81.	CAM_SCL	I/O		1.8V	Open
82.	RESET	I	System reset signal	1.8V	Open
83.	NC		NC		
84.	NC		NC		
85.	NC		NC		
86.	USIM2_DATA	I/O	USIM2 data	1.8/3.0V	Open
87.	USIM2_RESET	O	USIM2 reset	1.8/3.0V	Open
88.	GPS_UART_TXD	DO	GPS_UART transmit output	3.3V	Open
89.	GPS_ANT_VCC	PO	Power supply for active antenna or external LNA	3.3V	Open
90.	UART4_RX	DI	UART4 receive data input	1.8V	Open
91.	USIM2_CLK	O	USIM2 clock	1.8/3.0V	Open
92.	USIM2_VDD	PO	USIM2 output voltage	1.8/3.0V	Open
93.	RESERVED		Not connect		
94.	GPS_UART_RXD	DI	GPS_UART receive data input	3.3V	Open

95.	UART4_TX	DO	UART4 transmit output	1.8V	Open
96.	GPS_VBACKUP	PI	The backup battery input power supply for RTC	1.6V~3.6V Typical 3.3V	Open
97.	GPS_ANT_ON	O	3.3V power output supply for active antenna or external LNA control pin for power save	3.3V	Open
98.	NC		NC		
99.	PCM_OUT	O	PCM I/F data out	1.8V	Open
100.	GPS_FORCE_DL	I	GPS Force download	3.3V	Open
101.	NC		NC		
102.	NC		NC		
103.	GPIO122	I/O	General Purpose Input Output 122	1.8V	Open
104.	PCM_IN	I	PCM I/F data in	1.8V	Open
105.	GPIO	I/O	General Purpose Input Output	1.8V	Open
106.	NC		NC		
107.	NC		NC		
108.	VCXO_REQ	I	Clock Request	1.8V	Open
109.	PCM_CLK	O	PCM interface clock	1.8V	Open
110.	NC		NC		
111.	NC		NC		
112.	NC		NC		
113.	CLK_26M	O	26M out		Open
114.	PCM_SYNC	I/O	PCM interface sync	1.8V	Open
115.	NC		NC		
116.	NC		NC		
117.	GPIO	I/O	General Purpose Input Output	1.8V	Open
118.	GND	G	Ground		GND

119.	GND	G	Ground		GND
120.	GND	G	Ground		GND
121.	GND	G	Ground		GND
122.	GND	G	Ground		GND
123.	GND	G	Ground		GND
124.	GND	G	Ground		GND
125.	GND	G	Ground		GND
126.	GND	G	Ground		GND
127.	GND	G	Ground		GND
128.	GND	G	Ground		GND
129.	GND	G	Ground		GND
130.	GND	G	Ground		GND

Notes: (1) Suggested status when not in use.

Table 2.2-2 L502M(N)-3 Series Pin description

Pin NO.	Pin name	Type	Function Description	Power domain	State(1)
1.	PWRKEY	I	Power key button	0～4.2V	Open
2.	LCD_SPI_CS	O	LCD SPI chip-select	1.8V	Open
3.	LCD_SPI_RS	O	LCD SPI Data / command selection	1.8V	Open
4.	LCD_SPI_CLK	O	LCD SPI clock	1.8V	Open
5.	LCD_SPI_DIN	I	LCD SPI Data in	1.8V	Open
6.	LCD_SPI_DOUT	O	LCD SPI Data out	1.8V	Open
7.	NC		NC		
8.	LCD_TE	O	LCD tearing effect	1.8V	Open
9.	LCD_RST	O	LCD RESET signal	1.8V	Open

10.	GND	G	Ground		GND
11.	VBUS	PI	USB 5V voltage input	5V	Open
12.	USB_DM	DIO	USB port differential data line		Open
13.	USB_DP	DIO			Open
14.	GND	G	Ground		GND
15.	VDD_1V8	PO	1.8V output voltage, output current up to 50mA	1.8V	Open
16.	USIM1_VDD	PO	USIM1 output voltage	1.8/3.0V	Open
17.	USIM1_DATA	I/O	USIM1 data	1.8/3.0V	Open
18.	USIM1_RESET	O	USIM1 reset	1.8/3.0V	Open
19.	USIM1_CLK	O	USIM1 clock	1.8/3.0V	Open
20.	GPIO32	I/O	General Purpose Input Output 32（support interrupt）	1.8V	Open
21.	UART1_CTS	DI	UART1 clear to send	1.8V	Open
22.	UART1_RTS	DO	UART1 request to send	1.8V	Open
23.	UART1_TX	DO	UART1 transmit output	1.8V	Open
24.	UART1_RX	DI	UART1 receive data input	1.8V	Open
25.	GPIO31	I/O	General Purpose Input Output 31（support interrupt）	1.8V	Open
26.	GPIO27	I/O	General Purpose Input Output 27（support interrupt）	1.8V	Open
27.	NTC	I	Battery temperature monitoring pin	1.8V	Open
28.	GND	G	Ground		GND
29.	VBAT	PI	Power supply	3.3～4.2V	VBAT
30.	VBAT	PI			VBAT
31.	GND	G	Ground		GND
32.	MIC-	AI	Microphone Channel	0～1.8V	Open
33.	MIC+	AI	Microphone Channel	0～1.8V	Open
34.	RESERVED		Not connect		

35.	GPS_ANT	ANT	GPS Antenna		Open
36.	NC		NC		Open
37.	REC-	AO	Receiver Negative output	0～1.8V	Open
38.	REC+	AO	Receiver Positive output	0～1.8V	Open
39.	GND	G	Ground		GND
40.	GND	G	Ground		GND
41.	ANT	ANT	Antenna		Open
42.	GND	G	Ground		GND
43.	ADC	I	ADC external input channel	0.05～1.8V	Open
44.	RESERVED		Not connect		
45.	AUDIO_PA_EN	I/O	General Purpose Input Output 78 for Audio PA enable	1.8V	Open
46.	USIM1_DET	I	USIM1 detect pin	1.8V	Open
47.	USIM2_DET	I	USIM2 detect pin	1.8V	Open
48.	PWM	O	PWM Output	1.8V	Open
49.	GPIO119	I/O	General Purpose Input Output 119（support interrupt）	1.8V	Open
50.	GPIO118	I/O	General Purpose Input Output 118（support interrupt）	1.8V	Open
51.	GPIO	I/O	General Purpose Input Output	1.8V	Open
52.	GPIO124	I/O	General Purpose Input Output 124（support interrupt）	1.8V	Open
53.	GPIO28	I/O	General Purpose Input Output 28（support interrupt）	1.8V	Open
54.	NC		NC		
55.	NC		NC		
56.	SCL	I/O	IIC clock	1.8V	Open
57.	SDA	I/O	IIC data	1.8V	Open
58.	CAM_PDN/GPIO69	I/O	General Purpose Input Output 69 for camera power down	1.8V	Open

59.	CAM_RST/GPIO70	I/O	General Purpose Input Output 70 for camera reset	1.8V	Open
60.	GND	G	Ground		GND
61.	MK_OUT4/GPIO9	O	Matrix keyboard out 4	1.8V	Open
62.	MK_OUT5/GPIO11	O	Matrix keyboard out 5（It can be configured as GPIO or interrupt）	1.8V	Open
63.	MK_OUT2/GPIO5	O	Matrix keyboard out 2（It can be configured as GPIO or interrupt）	1.8V	Open
64.	MK_OUT3/GPIO7	O	Matrix keyboard out 3（It can be configured as GPIO or interrupt）	1.8V	Open
65.	MK_OUT1/GPIO3	O	Matrix keyboard out 1（It can be configured as GPIO or interrupt）	1.8V	Open
66.	MK_IN4/GPIO8	I	Matrix keyboard in 4（It can be configured as GPIO or interrupt）	1.8V	Open
67.	MK_IN5/GPIO10	I	Matrix keyboard in 5（It can be configured as GPIO or interrupt）	1.8V	Open
68.	MK_IN2/GPIO4	I	Matrix keyboard in 2（It can be configured as GPIO or interrupt）	1.8V	Open
69.	MK_IN3/GPIO6	I	Matrix keyboard in 3（It can be configured as GPIO or interrupt）	1.8V	Open
70.	MK_IN1/GPIO2	I	Matrix keyboard in 1（It can be configured as GPIO or interrupt）	1.8V	Open
71.	UART2_TX	DO	UART2 transmit output	1.8V	Open
72.	UART2_RX	DI	UART2 receive data input	1.8V	Open
73.	GND	G	Ground		GND
74.	NC		NC		
75.	NC		NC		
76.	CAM_SPI_DI1	I	Camera SPI Data in 1	1.8V	Open
77.	CAM_SPI_DI0	I	Camera SPI Data in 0	1.8V	Open
78.	CAM_SPI_CLK	O	Camera SPI Clock	1.8V	Open
79.	CAM_MCLK	O	Master clock to camera	1.8V	Open
80.	CAM_SDA	I/O	Camera IIC data	1.8V	Open
81.	CAM_SCL	I/O	Camera IIC clock	1.8V	Open

82.	RESET	I	System reset signal	1.8V	Open
83.	NC		NC		
84.	NC		NC		
85.	NC		NC		
86.	USIM2_DATA	I/O	USIM2 data	1.8/3.0V	Open
87.	USIM2_RESET	O	USIM2 reset	1.8/3.0V	Open
88.	GPS_UART_TXD	DO	GPS_UART transmit output	3.3V	Open
89.	GPS_ANT_VCC	PO	Power supply for active antenna or external LNA	3.3V	Open
90.	UART4_RX	DI	UART4 receive data input	1.8V	Open
91.	USIM2_CLK	O	USIM2 clock	1.8/3.0V	Open
92.	USIM2_VDD	PO	USIM2 output voltage	1.8/3.0V	Open
93.	RESERVED		Not connect		
94.	GPS_UART_RXD	DI	GPS_UART receive data input	3.3V	Open
95.	UART4_TX	DO	UART4 transmit output	1.8V	Open
96.	GPS_VBACKUP	PI	The backup battery input power supply for RTC	1.6V~3.6V Typical 3.3V	Open
97.	GPS_ANT_ON	O	3.3V power output supply for active antenna or external LNA control pin for power save	3.3V	Open
98.	NC		NC		
99.	PCM_OUT	O	PCM I/F data out	1.8V	Open
100.	GPS_FORCE_DL	I	GPS Force download	3.3V	Open
101.	NC		NC		
102.	NC		NC		
103.	GPIO122	I/O	General Purpose Input Output 122	1.8V	Open
104.	PCM_IN	I	PCM I/F data in	1.8V	Open
105.	GPIO79	I/O	General Purpose Input Output 79	1.8V	Open

106.	NC		NC		
107.	NC		NC		
108.	VCXO_REQ	I	Clock Request	1.8V	Open
109.	PCM_CLK	O	PCM interface clock	1.8V	Open
110.	NC		NC		
111.	NC		NC		
112.	NC		NC		
113.	CLK_26M	O	26M out		Open
114.	PCM_SYNC	I/O	PCM interface sync	1.8V	Open
115.	NC		NC		
116.	NC		NC		
117.	GPIO80	I/O	General Purpose Input Output 80	1.8V	Open
118.	GND	G	Ground		GND
119.	GND	G	Ground		GND
120.	GND	G	Ground		GND
121.	GND	G	Ground		GND
122.	GND	G	Ground		GND
123.	GND	G	Ground		GND
124.	GND	G	Ground		GND
125.	GND	G	Ground		GND
126.	GND	G	Ground		GND
127.	GND	G	Ground		GND
128.	GND	G	Ground		GND
129.	GND	G	Ground		GND
130.	GND	G	Ground		GND

Notes: (1) Suggested status when not in use.

Table 2.2-3 Pin type description

PI: POWER INPUT	PO: POWER OUTPUT
I: INPUT	DI: DIGITAL INPUT
O: OUTPUT	DO: DIGITAL OUTPUT
DIO: DIGITAL INPUT OUTPUT	AI: ANALOG INPUT
AO: ANALOG OUTPUT	I/O: INPUT or OUTPUT
ANT: ANTENNA	G: GROUND
NC: NOT CONNECT	

2.3 Package Information

2.3.1 Dimensions

The L502-3 Series mechanical dimensions are described as following figure (Top view, Back view, Side view).

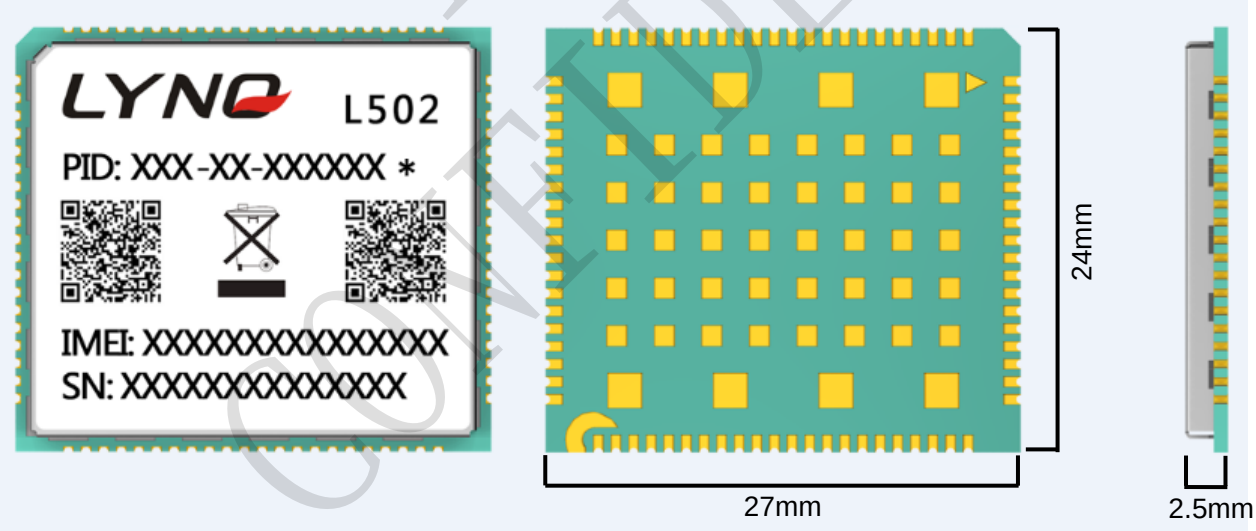


Figure 2.3.1-1 Mechanical Dimensions

2.3.2 Product labeling

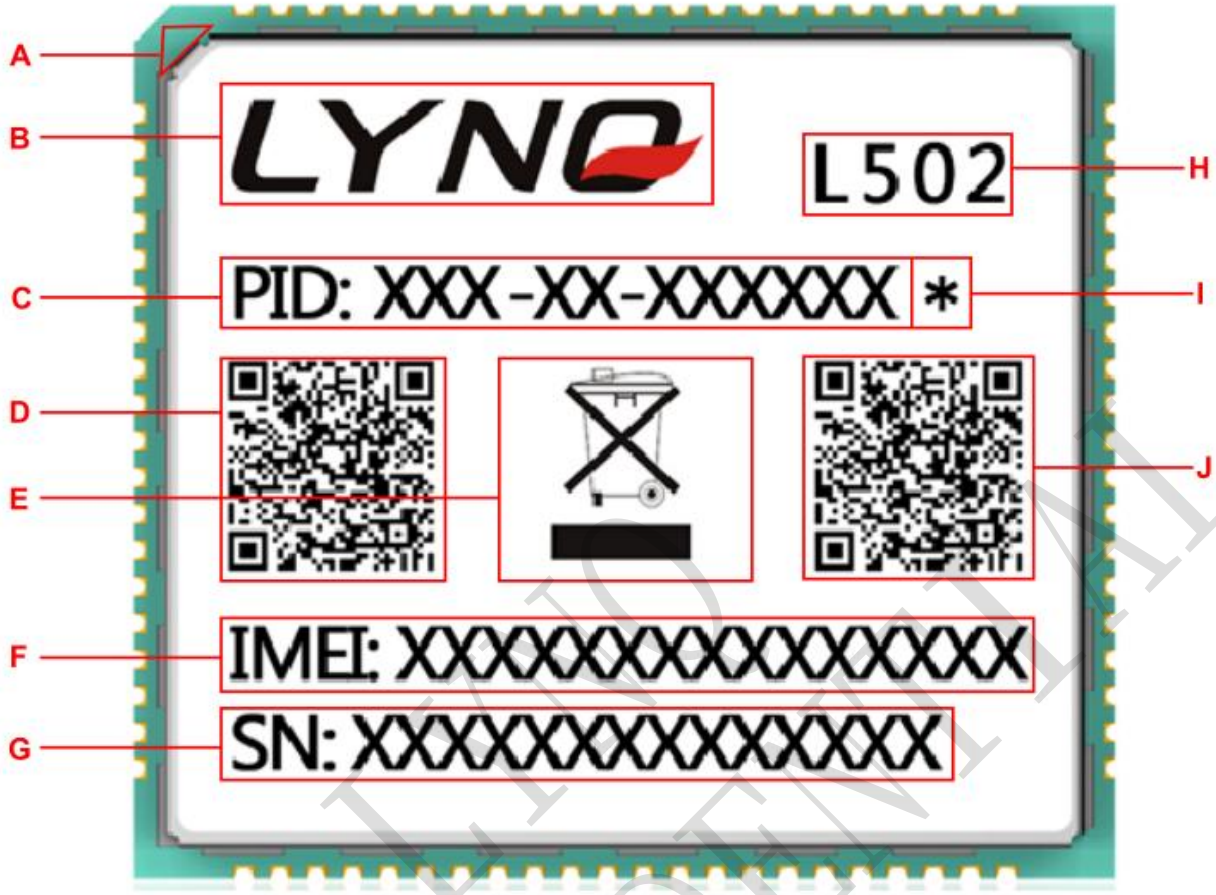


Figure 2.3.2-1 Label of L502-3 Series

Table 2.3.2-1 Description of label

Item	Description
A	Pin1 mark
B	Logo of company
C	PID number
D	QR code---include IMEI number
E	WEEE
F	IMEI number

G	SN number
H	Module name
I	Module configuration，* stands for C-3E or CN-3E or M-3E or MN-3E
J	QR code---include SN number

2.3.3 Module size

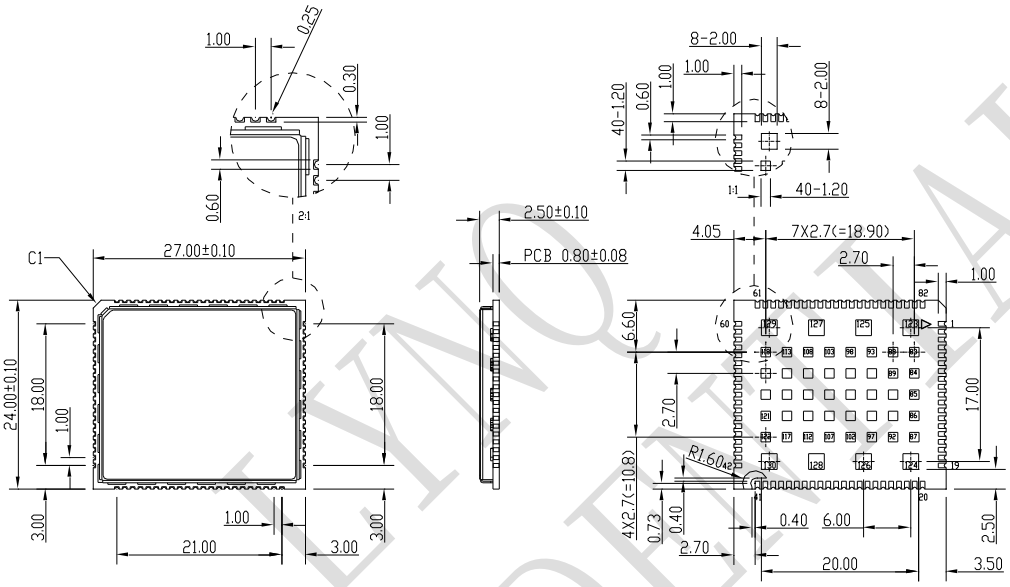


Figure 2.3.3-1 Module Size (Unit: mm)

2.3.4 Recommend Pad

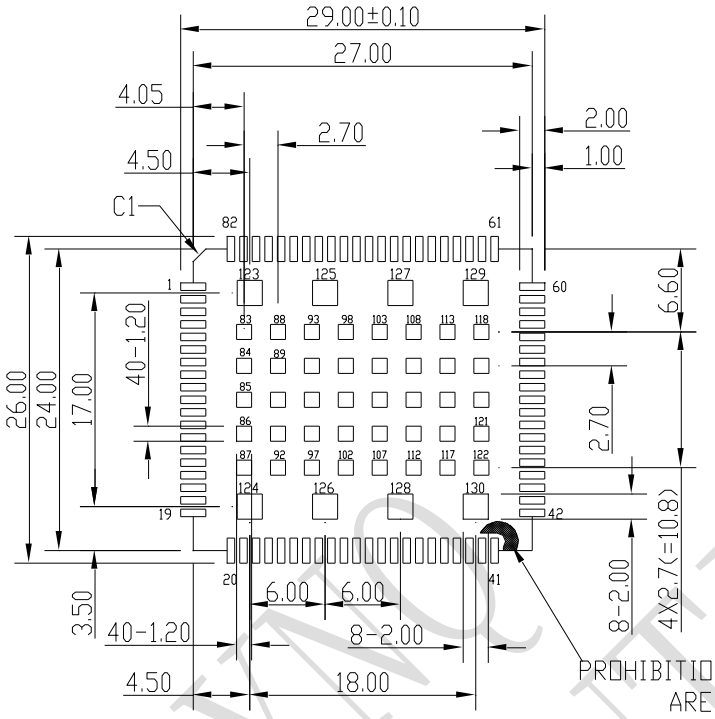


Figure 2.3.4-1 Recommend pad(Top view, Unit: mm)

3. Interface Circuit Design

3.1 Power Section

3.1.1 Power Supply

VBAT is the main power supply of the smart module, and the input voltage range is 3.3V to 4.2V. The recommended voltage is 3.8V. Because the module transmit burst may cause voltage to drop, the highest current peak will more than 1A (RF max current will be about 0.9A, and add the current of other parts of system working). A large capacitor is recommended to be used near VBAT pins, and the bigger of the capacitor's value is the better. In order to improve the continued flow of large current, it is recommended to use a low-impedance tantalum capacitor 100uF or larger. During layout, the capacitors are close to the VBAT pins.

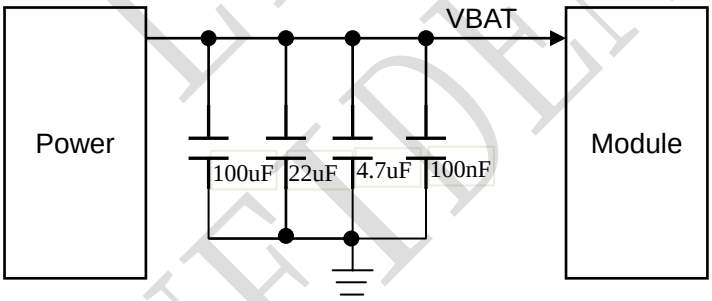


Figure 3.1.1-1 Power Supply Circuit

Notes: According to the environment, please select capacitor as large value as possible; and add 100pF, 33pF capacitors if requiring.

3.1.2 Hardware Power On

Module 1-pin is the power on key. Pulling down the PWRKEY at least 1s and then releasing, the module will boot. It is internally pull-up to VBAT, and does not need to pull up externally.

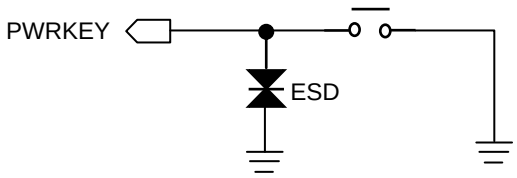


Figure 3.1.2-1 Turn on circuit

Notes: It is recommended to use the AT command AT+POWEROFF to shut down the module. The shutdown process takes about 3s to complete.

3.1.3 Hardware reset

Module 82-pin is the hardware reset input. The module will reset hardware when it receives a 1s low level signal. It is internally pull-up to VDD_1V8, and does not need to pull up externally.

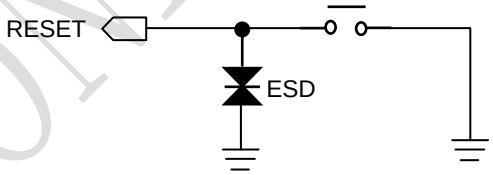


Figure 3.1.3-1 System Reset

3.2 (U)SIM Interface

3.2.1 Pin Description

L502-3 Series support and are able to automatically detect 3.0V and 1.8V SIM card. These support dual card function. SIM card interface signals are shown in table 3.2.1-1.

Table 3.2.1-1 (U)SIM Pin Description

Pin NO.	Pin Name	Signal definition	Function Description
16	VSIM1_VDD	VSIM1 output voltage	VSIM1 card power supply, output by the module
17	USIM1_DATA	SIM1 card data pin	SIM1 card DATA signal, I/O signal
18	USIM1_RESET	SIM1 card reset pin	SIM1 card reset signal, output by the module
19	USIM1_CLK	SIM1 card clock pin	SIM1 card clock signal, output by the module
46	USIM1_DET	SIM1 detect pin	SIM1 detect pin, input signal
86	USIM2_DATA	SIM2 card data pin	SIM2 card DATA signal, I/O signal
87	SIM2_RESET	SIM2 card reset pin	SIM2 card reset signal, output by the module
91	USIM2_CLK	SIM2 card clock pin	SIM2 card clock signal, output by the module
92	VSIM2_VDD	VSIM2 output voltage	VSIM2 card power supply, output by the module
47	USIM2_DET	SIM2 detect pin	SIM2 detect pin, input signal

3.2.2 (U)SIM application

Please note to increase the ESD components on SIM card signal group (PIN number: 16, 17, 18, 19 and 86, 87, 91, 92), near the SIM card seat.

In order to meet the requirements of 3GPP TS 27.005 protocol and EMC certification, the proposed SIM card is arranged near the module SIM card interface, and avoid to layout too long resulting in

serious waveform distortion, affecting the signal integrity. USIM_CLK and USIM_DATA signals are recommended to be protected. Paralleling a 1uF capacitor between GND and VSIM_VDD, it can filter out the interference of radio frequency signals. SIM circuit is as follow.

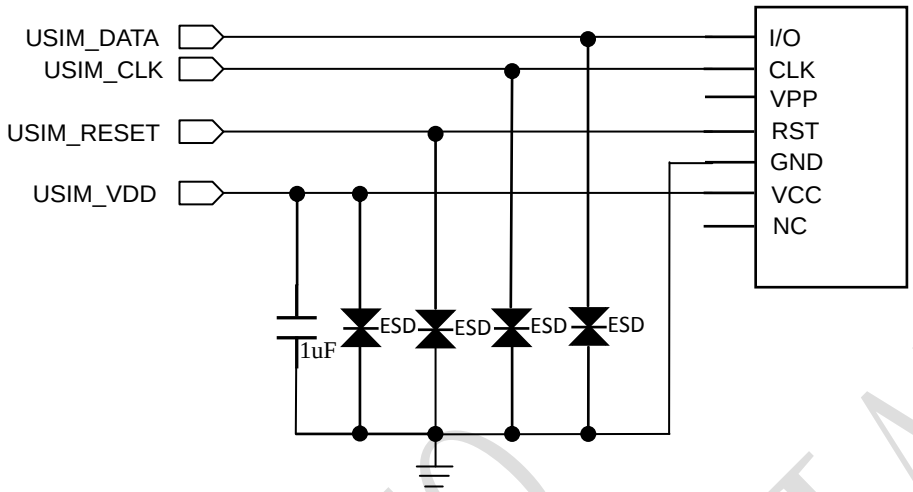


Figure 3.2.2-1 (U)SIM Circuit

Notes: The capacity value of ESD components should be under 22pF.

3.3 USB Interface

3.3.1 USB Application

The USB interface conforms to the USB2.0 specification and electrical characteristics. It supports low-speed, full-speed and high-speed modes. The data exchange between the main processor (AP) and the module is mainly completed through the USB interface. The USB interface of the L502-3 Series only support slave mode.

The USB is mainly used for data transmission, firmware update, module program testing and send AT command. The DM/DP differential impedance need to be controlled at 90ohm ±10%, and it should be protected up and down, and can't be crossed with other lines. USB circuit is as follow.

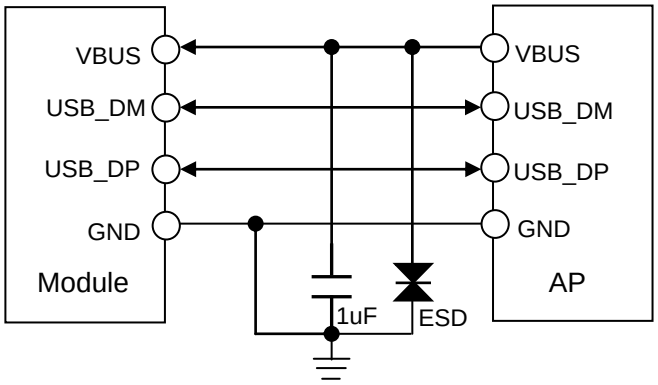


Figure 3.3.1-1 USB Circuit

Notes: If you use the serial port communication, the VBUS and DM/DP reserved test points respectively in order to firmware update. If DM/DP is used to communicate with the MCU, the position of the DM / DP signal near the module needs to reserve a test point and the DM/DP requires a series 0R resistor. The resistor is placed near the module and the test point is placed between module and resistor.

3.3.2 Firmware Update

The L502-3 Series require the module to enter the forced download mode when updating the firmware through the USB interface. When MK_OUT4 (PIN61) is detected to be low level during module startup, it enters USB download mode. The circuit of the force download interface is as follow.

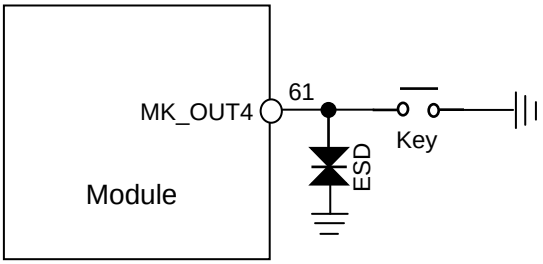


Figure 3.3.2-1 The Force Download Circuit

3.4 UART Interface

3.4.1 Pin Description

The L502-3 Series provide three UART serial communication interfaces: UART1 can be used as complete non-synchronous communication interface, supporting standard modem handshake signal control and in compliance with the RS-232 interface protocol, also supporting 4-wire serial bus interface or 2-wire serial bus interface mode. UART2 is used as a debug port of the L502-3 Series. UART4 can be used to connect peripherals. GPS_UART can be used to upgrade firmware of the built-in GNSS of the module.

The three groups of UART port support programmable data width, stop bits, and parity bits, with separate TX and RX FIFOs (512 bytes each). The UART1 supports 9600bps, 14400bps, 19200bps, 38400bps, 57600bps, 76800bps, 115200bps, 230400bps and 921600bps baud rates, and the default is 115200bps. This interface is used for AT command communication and data transmission (Only L502C-3 Series support AT command). The UART2 supports 115200bps baud rates for partial log output.

Table 3.4.1-1 UART Pin Description

Pin NO.	Pin Name	I/O	Function Description
20	UART1_DCD	DO	UART1 data carrier detect
21	UART1_CTS	DI	UART1 clear to send
22	UART1_RTS	DO	UART1 request to send
23	UART1_TX	DO	UART1 transmit data output
24	UART1_RX	DI	UART1 receive data input
25	UART1_RING	DO	UART1 ring indicator. It can be used as wake out signal to host from module

26	UART1_DTR	DI	UART1 Data terminal ready (wake up module)
71	UART2_TX	DO	UART2 transmit data output (debug)
72	UART2_RX	DI	UART2 receive data input (debug)
90	UART4_RX	DI	UART4 receive data input
95	UART4_TX	DO	UART4 transmit data output
88	GPS_UART_TXD	DO	GPS_UART transmit output
94	GPS_UART_RXD	DI	GPS_UART receive data input

3.4.2 UART Application

If customer used UART in communication between the module and application processor, and the level is 1.8V, the connection mode is shown in Figure 3.4.2-1 and Figure 3.4.2-2. You can use the complete RS232 mode, 4 wires or 2 wires mode connection. If the AP interface level is 3.3V, you must increase the level conversion circuit. We recommend using Texas Instruments TXS0108EPWR, as shown in Figure 3.4.2-3.

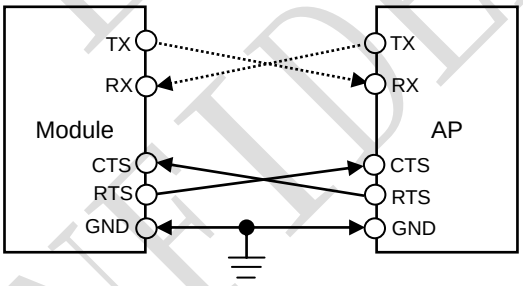


Figure 3.4.2-1 Connect to AP method (4lines)

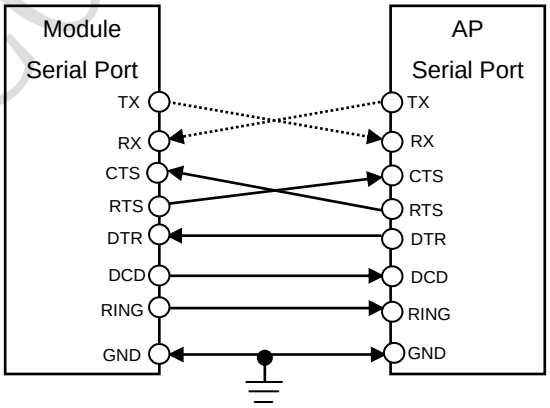


Figure 3.4.2-2 Connect to AP method

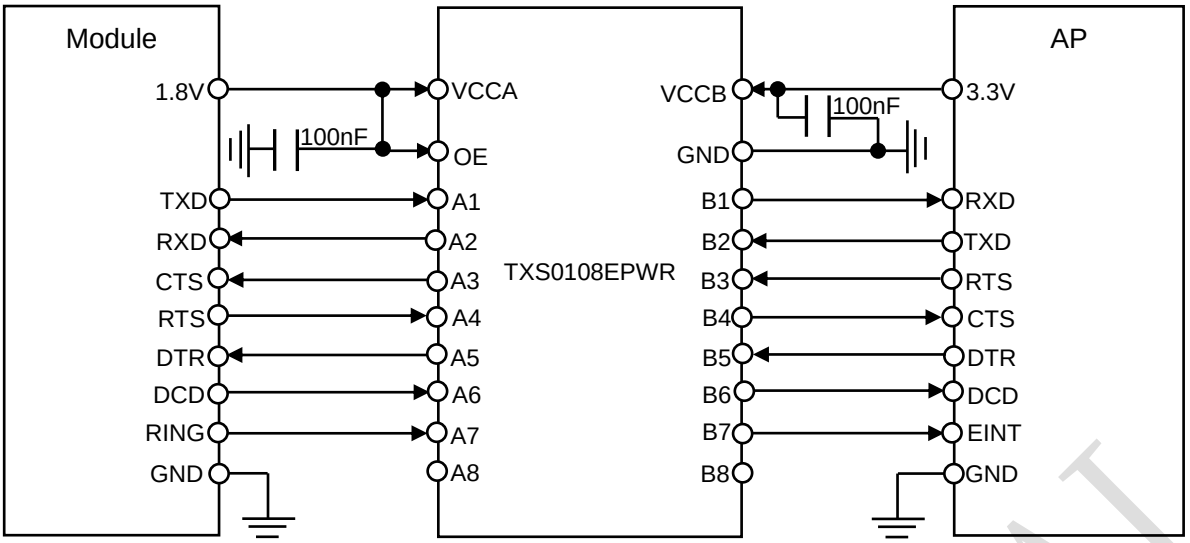


Figure 3.4.2-3 Level Conversion Circuit

3.5 Audio Interface

L502-3 Series support audio input and output, which can meet different audio demands. The audio must take the differential layout and must be protected by GND around it. The audio layout should be not parallel to other layout of power or high speed routes.

(1) The MIC input signal (MIC + / MIC-) provided by the module only supports Electret MIC (Electret MIC have only two pins). The reference circuit is shown in Figure 3.5-1.

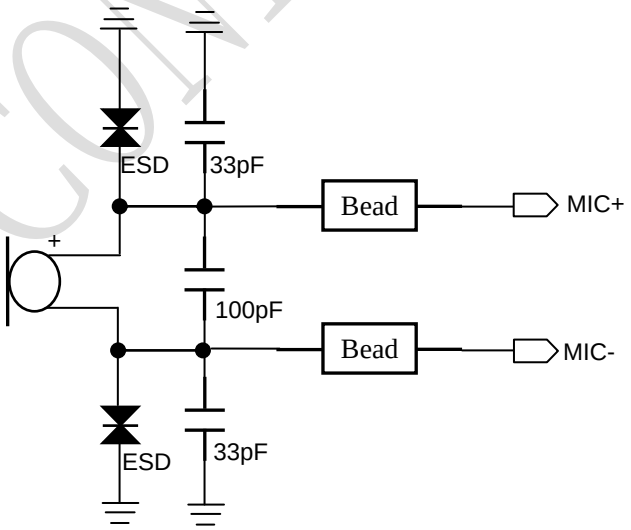


Figure 3.5-1 Electret MIC Circuit

(2) The module provides normal receiver output, and the receiver signals take the differential layout and connect directly to the device. The reference circuit is shown in Figure 3.5-2.

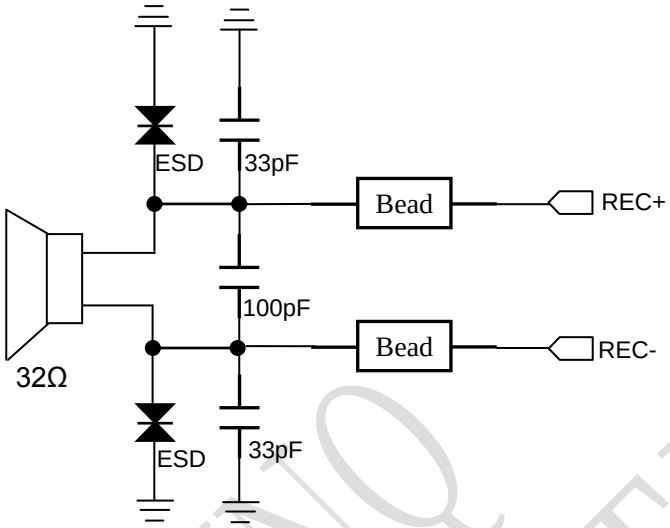


Figure 3.5-2 REC Circuit

(3) If you need the module to provide more power audio output, you can connect REC+/REC- to an external audio PA. The reference circuit is shown in Figure 3.5-3.

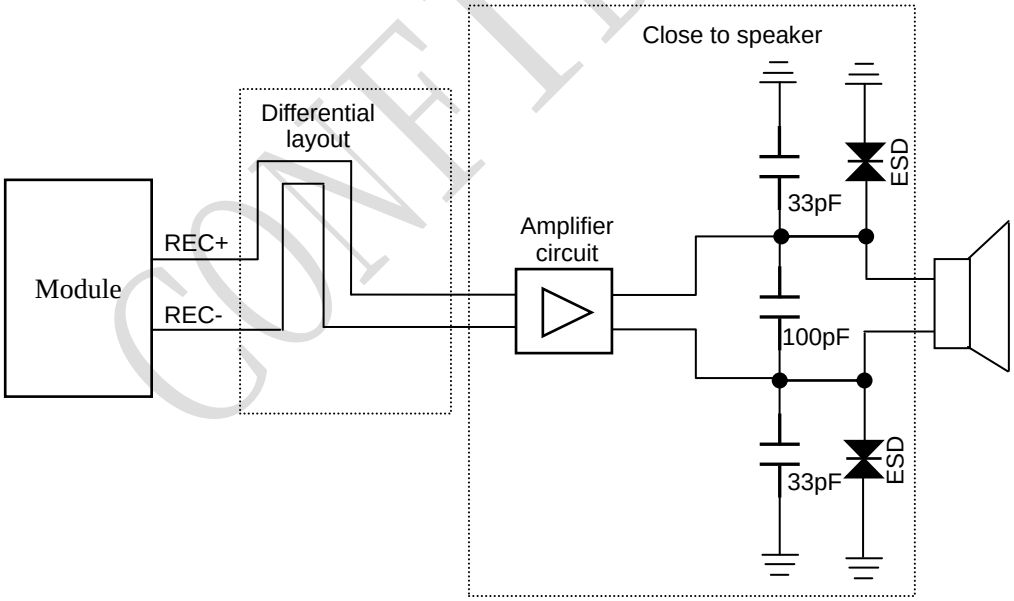


Figure 3.5-3 Speaker Amplify Circuit

3.6 IIC Interface

L502-3 Series provide two groups of IIC interfaces. One IIC can communicate with peripherals through the IIC interface. The CAM_IIC can only be used to connect the IIC interface of the camera. These need to add 4.7K resistor pulled up to VDD_1V8. These support standard mode (100KHz) and fast mode (400KHz).

3.7 NETLIGHT Interface

3.7.1 NETLIGHT LED Control circuit

NETLIGHT (PIN49) can be used to control the LED status of the network.

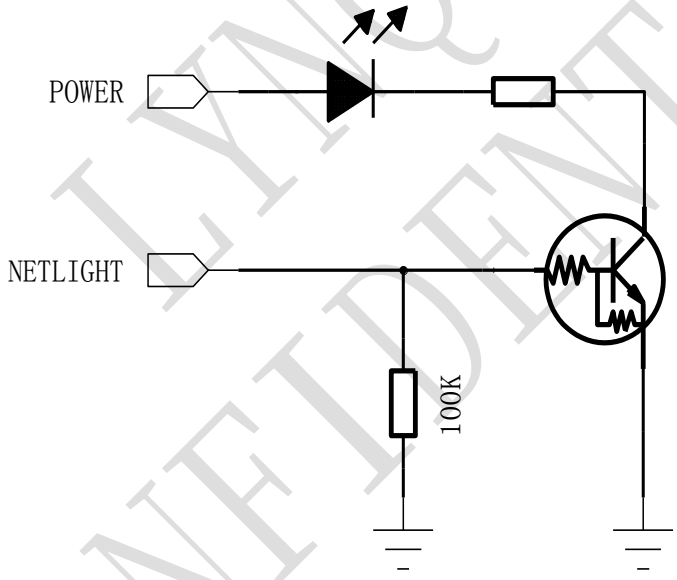


Figure 3.7.1-1 NETLIGHT LED Circuit

3.7.2 NETLIGHT LED Status description

NETLIGHT (PIN49) is used as the enable pin. Table 3.7.2-1 lists the LED status.

Table 3.7.2-1 NETLIGHT LED Status

LED Status	Module Status

OFF	Power off
64ms ON/800ms OFF	Shut down network
64ms ON/3000ms OFF	Registered network

3.8 Interactive Application Interface

3.8.1 Pin Description

L502-3 Series provide a variety of interfaces for interacting with the application processor, including WAKEUP (WAKEUP includes WAKEUP_IN and WAKEUP_OUT), STATUS and FLIGHTMODE.

Table 3.8.1-1 Interactive Application Interface

Pin NO.	Pin Name	I/O	Function Description
50	WAKEUP_OUT	O	Module wakes up AP
51	WAKEUP_IN	I	AP wakes up module
52	FLIGHTMODE	I	Flight mode
53	STATUS	O	AP query module status

3.8.2 Interface Application

The L502-3 Series provide a direct interactive signal to communicate with the AP.

STATUS: Module status query. Low level indicates power-off state or power-on initialization state, and high level indicates power-on state.

WAKEUP_IN: After the module enters sleep, the host can wake up the module by pulling down this signal. After the host pulls the signal high, the module is allowed to enter sleep.

WAKEUP_OUT: When the module has an event and needs to communicate with the AP, the module can wake up the AP by setting this pin to low level (Low level will last 120ms).

FLIGHTMODE: It can be used to control the module to enter or exit flight mode. The module enters flight mode by external input low level.

Notes: Sections 3.7 and 3.8 only apply to L502C(N)-3E.

3.9 LCD Interface

L502M(N)-3E support LCD function and only support SPI interface. It can provide 3-wire/4-wire SPI interface. The resolution supported by the screen can reach 320*240. LCD_SPI interfaces support serial interface I and serial interface II.

Table 3.9-1 LCD_SPI Interface Description

Mode		LCD_ SPI_CS	LCD_ SPI_CLK	LCD_ SPI_DOUT	LCD_ SPI_DIN	LCD_ SPI_RS
serial interface I	3-wire 9-bit	●	●	●		
	4-wire 8-bit	●	●	●		●
serial interface II	3-wire 9-bit	●	●	●	●	
	4-wire 8-bit	●	●	●	●	●

3.10 TP Interface

L502M(N)-3E support TP function and only support the capacitor TP of the IIC interface. The interface circuit is shown in figure 3.10-1.

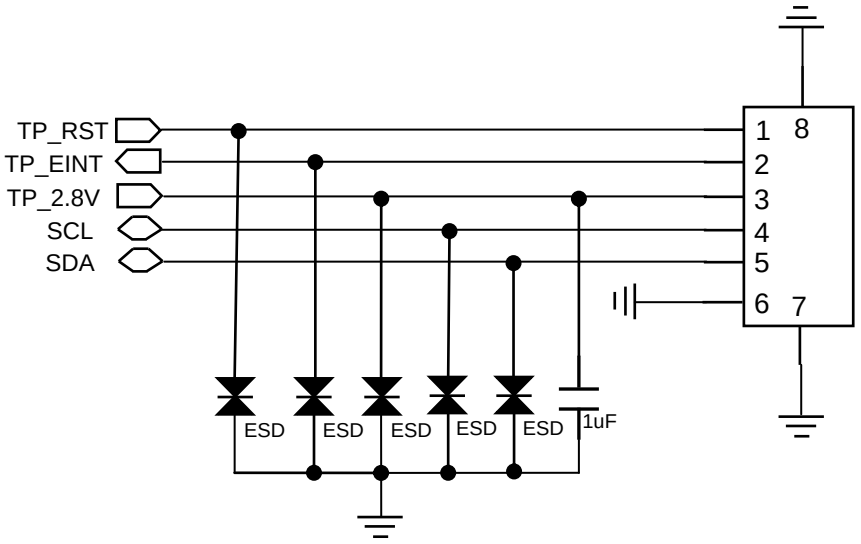


Figure 3.10-1 TP Connector

3.11 Camera Interface

L502M(N)-3E support camera function and up to 2bit SPI interface. Camera interfaces are shown in table 3.11-1.

Table 3.11-1 Camera Interface Description

Pin NO.	Pin Name	I/O	Function Description
76	CAM_SPI_DI1	I	Camera SPI Data in 1
77	CAM_SPI_DI0	I	Camera SPI Data in 0
78	CAM_SPI_CLK	O	Camera SPI Clock
79	CAM_MCLK	O	Master clock to camera
80	CAM_SDA	I/O	Camera IIC data
81	CAM_SCL	I/O	Camera IIC clock

Camera's power VCAMA, VCAMD and VCAMIO all need to use an external LDO. The voltage of VCAMIO only supports 1.8V. The power supply voltage of VCAMA and VCAMD needs to choose a suitable LDO according to the selected Camera module.

3.12 Key Interface

The module supports 5*5 keys.

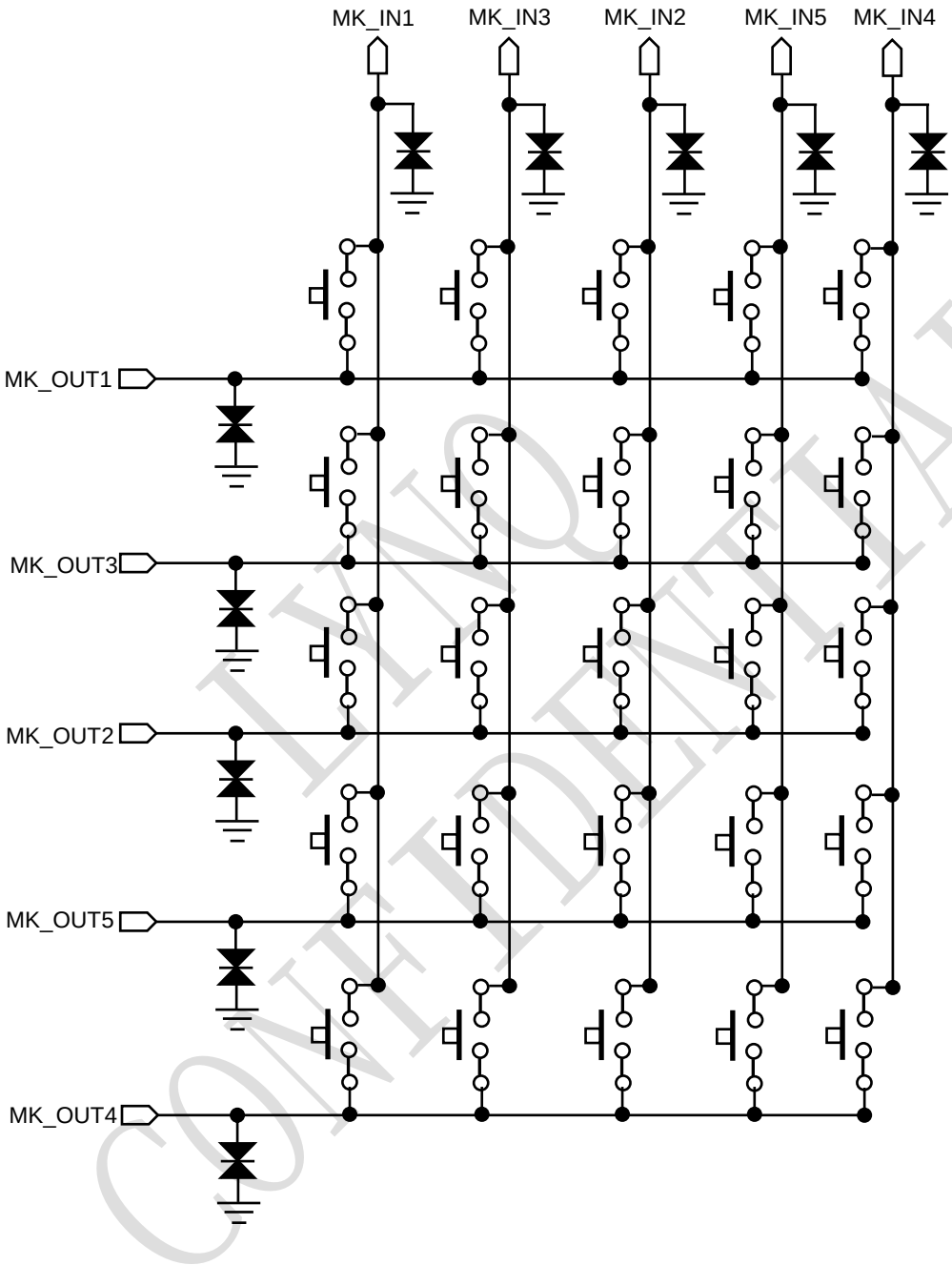


Figure 3.12-1 Keys

3.13 ADC

L502-3 Series provide an ADC for detecting light-sensitive resistors or other devices that require ADC

detection. The Max voltage of ADC is 1.8V with 10-bit accuracy.

Table 3.13-1 ADC value

Parameter	Min.	Typ.	Max.	Unit
Input range	0.05		1.8	V

3.14 GNSS Antenna

In order to obtain good GNSS reception performance, a good antenna needs to be selected. Proper choice of the antenna will ensure that satellites at all elevations can be seen, and therefore, accurate fix measurements are obtained.

There are two antenna options for the built-in GNSS of the module.

- Passive Antenna
- Active Antenna

Table 3.14-1 Antenna Specification

Antenna Type	Specification	
Passive Antenna	Frequency range	1558-1607MHz
	Polarization	RHCP & Linear
	Gain	>0dBi
Active Antenna	Frequency range	1558-1607MHz
	Polarization	RHCP & Linear
	Noise Figure	<1.5dB
	Gain	>10dBi

- Passive Antenna

Passive antenna is antenna that only component, such as the ceramic patch, the helical antenna and the patch antenna. Sometimes it also contains a passive matching network to match the electrical connection to 50 Ohm impedance.

The most commonly used in GNSS applications is the patch antenna. The patch antenna is a flat structure, inculding a ceramic body and a metal antenna body, and is mounted on a metal base plate.

The passive antanna design circuit of the L502C/MN-3 Series's GNSS antenna is shown in Figure 3.14-1.

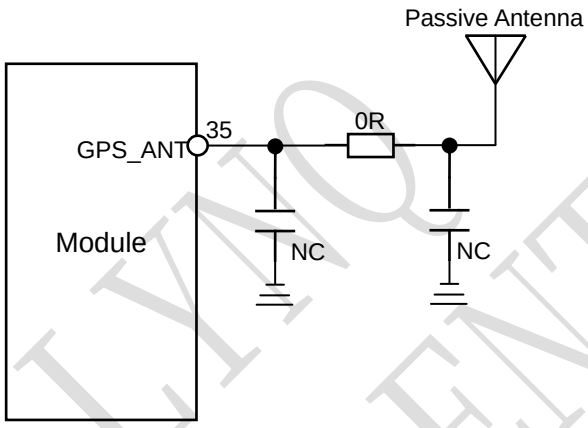


Figure 3.14-1 Passive Antenna of the GNSS

- Active Antenna

Active antenna has an integrated Low-Noise Amplifier (LNA). Active antenna need a power supply that will contribute to GNSS system power consumption.

Usually GPS_ANT_VCC(Pin89) is directly used for the active antenna power input, as shown in Figure 3.14-2. The voltage provided by PIN89 is 3.3V, and the maximum drive current can reach 50mA. If the GPS_ANT_VCC voltage does not meet the requirements for powering the active antenna, an external LDO should be used. The inductor L1 is used to prevent the RF signal from leaking into the GPS_ANT_VCC pin and route the bias supply to the active antenna, the recommended value of L1 is no less than 27nH. R1 can protect the whole circuit in case the active antenna is shorted to ground.

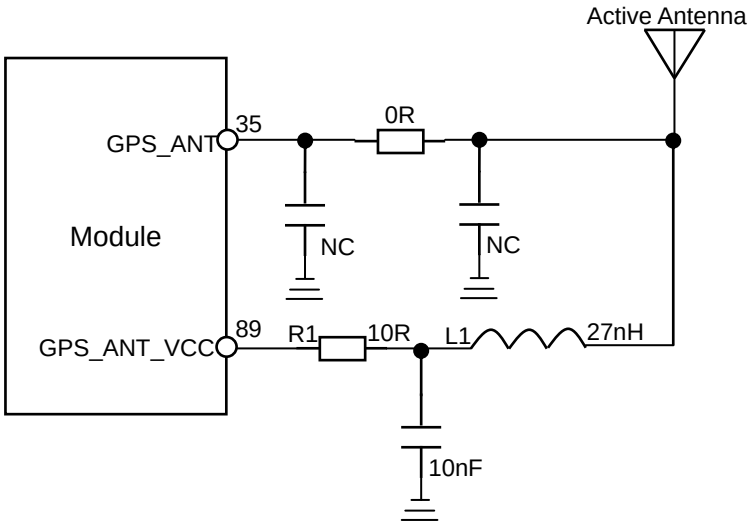


Figure 3.14-2 Active Antenna of the GNSS

4. Electrical characteristics

4.1 Electrical characteristic

Table 4.1-1 Electrical characteristic

Power	Min.	Nom.	Max	Unit
VBAT	3.3	3.8	4.2	V
Peak current	-0.3	-	1.0	A

Notes: The over-low voltage can't power on the module. Over-high voltage may be danger to damage the module.

4.2 Temperature characteristic

Table 4.2-1 Temperature characteristic

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

Notes: When the temperature is over the range, the RF performance may be dropped. It also may cause power down or restart problem. In the environment of -40℃～-30℃, the built-in GNSS function of the module can work, and the TTFF and sensitivity will be lost in the low temperature environment.

4.3 Absolute Maximum Power

Table 4.3-1 Absolute maximum power rating

PIN Name	Description	Min.	Typ.	Max.	Unit
VDD_1V8	Digital power for IO	-0.3		2	V
VBAT	Power supply	-0.3		6	V

4.4 Recommended operating conditions

Table 4.4-1 Recommended operating range

PIN Name	Description	Min.	Typ.	Max.	Unit
VDD_1V8	Digital power for IO	1.7	1.8	1.98	V
VBUS	USB detection and charging	4.5	5	5.5	V

Notes: All the GPIOs, UART and IIC of module are 1.8V.

4.5 Power consumption

Table 4.5-1 Power Consumption

Parameter	Conditions	Min.	Average	Max.	Unit
Power off mode	VBAT=3.8V	-	25		uA
Flight mode	VBAT=3.8V	-	1		mA
LTE Standby	VBAT=3.8V		TBD		mA
Peak current	VBAT=3.8V			1	A

Notes: The test value of power consumption is the value tested in laboratory condition.

4.6 Power Sequence

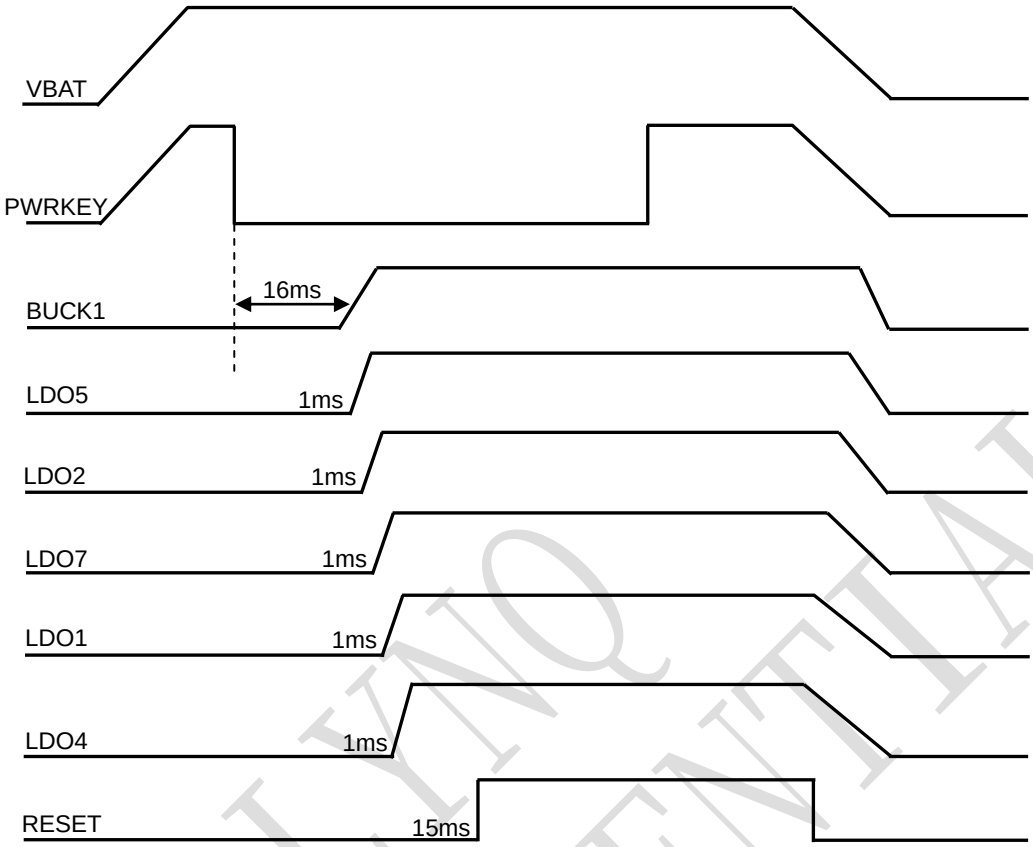


Figure 4.6-1 Power up time sequence diagram

4.7 Digital Interface Characteristics

Table 4.7-1 Digital IO Voltage

Parameter	Description	Min.	Typical	Max.	Unit
VIH	High level input voltage	0.7*VDD_1V8	1.8	1.98	V
VIL	Low level input voltage	0	-	0.3*VDD_1V8	V
VOH	High level output voltage	0.8*VDD_1V8	1.8	1.98	V
VOL	Low level output voltage	0	-	0.2*VDD_1V8	V

Notes: Suit to all GPIOs, IIC, UART interfaces.

4.8 ESD

The module contains high sensitive electronic and is an electrostatic Sensitive Device. More attentions should be paid to the procedure of handing and packaging. The ESD test results are shown in the following table.

ESD parameter（Tem: 25°C, humidity: 45%）

Table 4.8-1 ESD Performance

PIN Name	Contact discharge	Air discharge
VBAT	±4KV	±8KV
GND	±4KV	±8KV
ANT	±4KV	±8KV

Enhanced ESD performance method:

1、 If a converted board is added, it should have enough GND pins and be equally distributed. And the Layout of GND should be enough wide.

2、 Key (Power key, Matrix keyboard and Reset key) need to add ESD device. Reset key line can't be near the edge of the board.

3、 UART and other plug connector need to add ESD devices, and the other control lines from the outside of the machine also need to add ESD devices.

4、 SIM card should be added ESD protect.

5、 External antenna, please add ESD device, ESD C_{pf}<0.1pF.

Notes: For ESD protect, please add ESD methods according to upper ways.

ESD components include varistors and TVS. For better performance, please use TVS.

5. RF Features

5.1 RF Main Features

a) Support FDD/TDD LTE Rel-9 CAT1;

b) Support WIFI SCAN;

c) Support LTE bands include Band 1/3/5/8/34/38/39/40/41;

The operating frequency range of the product is shown in table 5.1-1.

Table 5.1-1 Frequency Band

Band	Uplink	Downlink	Note
Band1	1920 MHz ～ 1980 MHz	2110 MHz ～ 2170 MHz	
Band3	1710 MHz ～ 1785 MHz	1805 MHz ～ 1880 MHz	
Band5	824 MHz ～ 849 MHz	869 MHz ～ 894 MHz	
Band8	880 MHz ～ 915 MHz	925 MHz ～ 960 MHz	
Band34	2010 MHz ～ 2025 MHz	2010 MHz ～ 2025 MHz	
Band38	2570 MHz ～ 2620 MHz	2570 MHz ～ 2620 MHz	
Band39	1880 MHz ～ 1920 MHz	1880 MHz ～ 1920 MHz	
Band40	2300 MHz ～ 2400 MHz	2300 MHz ～ 2400 MHz	
Band41	2535 MHz ～ 2655 MHz	2535 MHz ～ 2655 MHz	Support 120MHz bandwidth

Table 5.1-2 Output power

Band	Max output power	Min output power
Band1	23dBm±2dB	< -40dBm
Band3	23dBm±2dB	< -40dBm

Band5	23dBm±2dB	< -40dBm
Band8	23dBm±2dB	< -40dBm
Band34	23dBm±2dB	< -40dBm
Band38	23dBm±2dB	< -40dBm
Band39	23dBm±2dB	< -40dBm
Band40	23dBm±2dB	< -40dBm
Band41	23dBm±2dB	< -40dBm

Table 5.1-3 Receive sensitivity

Band	REF SENS @10MHz (Total)
Band1	TBD
Band3	TBD
Band5	TBD
Band8	TBD
Band34	TBD
Band38	TBD
Band39	TBD
Band40	TBD
Band41	TBD

“TBD” Under development.

5.2 Data link

Table 5.2-1 Data link

Band	**Downlink**	**Uplink**
Band1	TBD	TBD
Band3	TBD	TBD

Band5	TBD	TBD
Band8	TBD	TBD
Band34	TBD	TBD
Band38	TBD	TBD
Band39	TBD	TBD
Band40	TBD	TBD
Band41	TBD	TBD

“TBD” Under development.

5.3 Antenna Circuit Design

The connecting part of the RF antenna supports the PAD form. The connection 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 Π matching network.

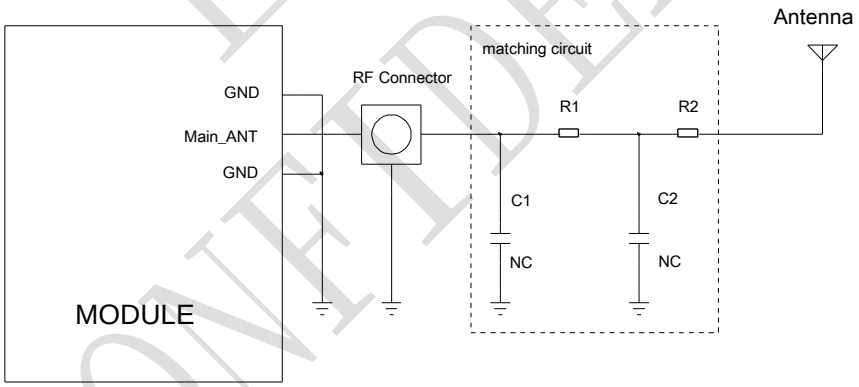


Figure 5.3-1 Main Antenna Design

Figure R1, C1, C2 and R2 composition of the antenna matching network for antenna debugging, the default R1, R2 paste 0 ohm resistor and C2, C1 empty paste.

RF Connector in the figure is used for testing and conducting test (for example, CE, FCC, etc.), which need to be placed as close as possible by the module, the RF path from the module to the antenna

feed point should be kept 50 ohm impedance control.

This product antenna peripheral circuit design, the proposed RF circuit Layout program: RF line trances top layer, a reference to the second layer. Users need to pay attention to the design of the PCB line: to ensure the RF has full reference GND layer.

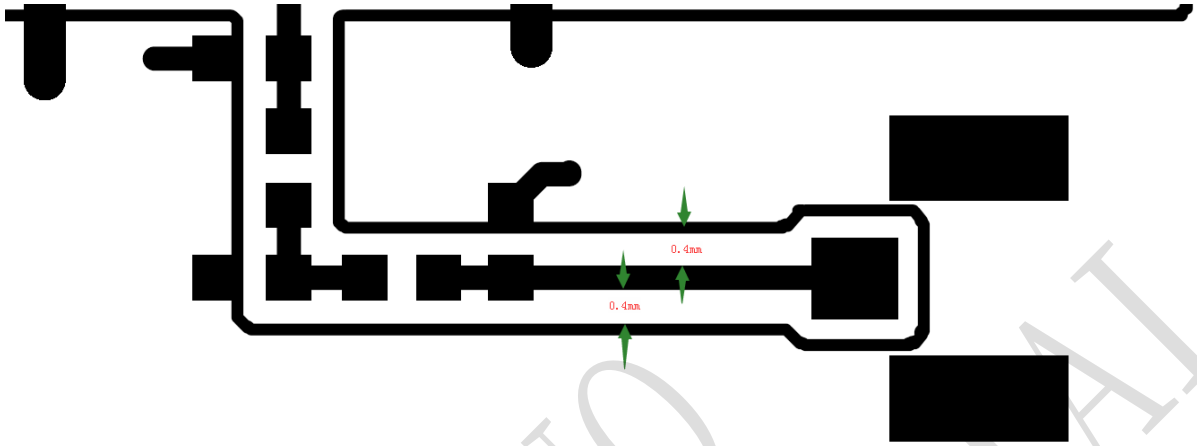


Figure 5.3-2 RF Trace Design

5.4 Antenna Design

PIFA or IFA antenna can be used for inner antenna; Whip antenna can be used for external antenna. The antenna gain must more than 3dBi. The recommend area of inner antenna: 100mm*10mm*6mm (L*W*H), the main board length no less than 90mm. The antenna should be as far as possible from the chip and memory, power interface, data cable interface, camera FPC, screen FPC, connector FPC, and other possible EMI modules and devices.

Table 5.4-1 Antenna Specifications

Parameter	Specification
Efficiency	>40%
S11/VSWR	<-10dB

Polarization		linear polarization
TRP	Low Band	>18dBm
	Middle Band	>18dBm
	High Band	>18dBm
TIS	Low Band	<-92dBm (@10MHz)
	Middle Band	<-92dBm (@10MHz)
	High Band	<-92dBm (@10MHz)
Low Band		Band 5/8
Middle Band		Band 1/3/34/39
High Band		Band 38/40/41

6. Storage, Production and Package

6.1 Storage

The rank of moisture proof of the module is level 3. There is an obvious sign on the table of the internal and the external packaging.

In the vacuum sealed bag, the module can be stored for 180 days when the temperature is below 40°C and the humidity is below 90% under good air circulation.

Humidity level is described detail as follows:

Table 6.1-1 Humidity level

Rank	Factory Environment ≦ +30°C /60%RH
1	No control < 30°C /85%RH
2	One year
2a	4 weeks
3	168 hours
4	72 hours
5	48 hours
5a	24 hours
6	Baking before using, SMT during the time table signs

Notes: Moving, storage, production of module must meet the demand of IPC/JEDEC J-STD-033.

6.2 Production

The module is a humidity sensitive device. If the device needs reflow soldering, disassembly and

maintenance, we must strictly comply with the requirements of humidity sensitive device. If module is damp, a reflow soldering or using a hot-air gun maintenance will lead to internal damage, because the water vapor has the rapid expansion of the burst, causing physical injury to the device, like PCB foaming and BGA component fail. So customers should refer to the following recommendations.

6.2.1 Module confirmation and moisture

The module in the production and packaging process should be strictly accordance with the humidity sensitive device operation. The factory packaging is vacuum bag, desiccant, and humidity indicator card. Please pay attention to the moisture control before SMT and the confirmation of the following aspects.

Demand of Baking confirmation

Smart module uses vacuum sealed bag, which can make it stored for 6 months under the condition of temp 40°C and humidity < 90%. The module should be baked before reflowing soldering if any of the conditions below happen.

1. Storage exceeds the time limit.

2. Package damages and vacuum bags have air leakage.

3. Humidity indicating card change the color at 10%.

4. Module is placed naked in the air over 168 hours.

5. Module is placed naked in the air under 168 hours but not temp 30°C and humidity < 60%.

Baking condition confirmation

The moisture proof level of the smart module is level 3. And the baking conditions are as follows.

Table 6.2.1-1 Baking conditions

Baking conditions	120°C / 5%RH	40°C / 5%RH
Baking time	4 hours	30 days
Description	not use the original tray	Can use the original tray

Notes: The original anti-ESD tray temperature does not exceed 50°C. 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.

During taking and placing, please take notes of ESD and cannot be placed as overlay.

Customer 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°C/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, which means the depth of the region of module is thicker than other areas. 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 outside. The GND pads use the net stencil.

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.

- For SMT quality, Please ensure the necessary condition according to actual condition of factory before SMT, like SMT pressure, speed (very important), stencil ways.

- 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 140-210°C, time: 60s-120s.

E. recirculation zone: PEAK temperature 220-245°C, time: 45s-75s.

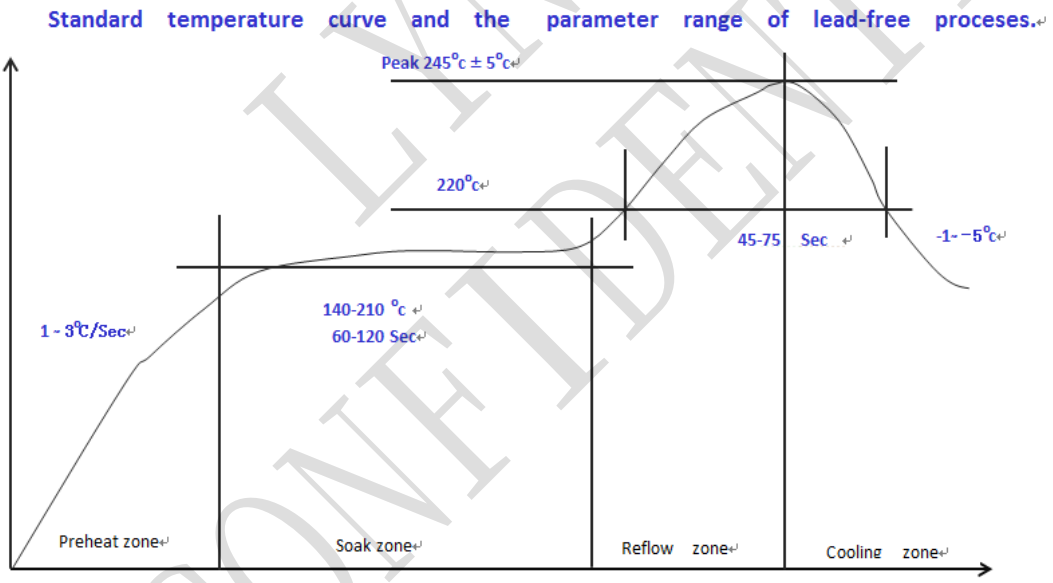


Figure 6.2.4-1 Temperature Curve

Notes: Customer's board deformation must be controlled well. By reducing the number of imposition or increasing patch clamp to reduce the deformation.

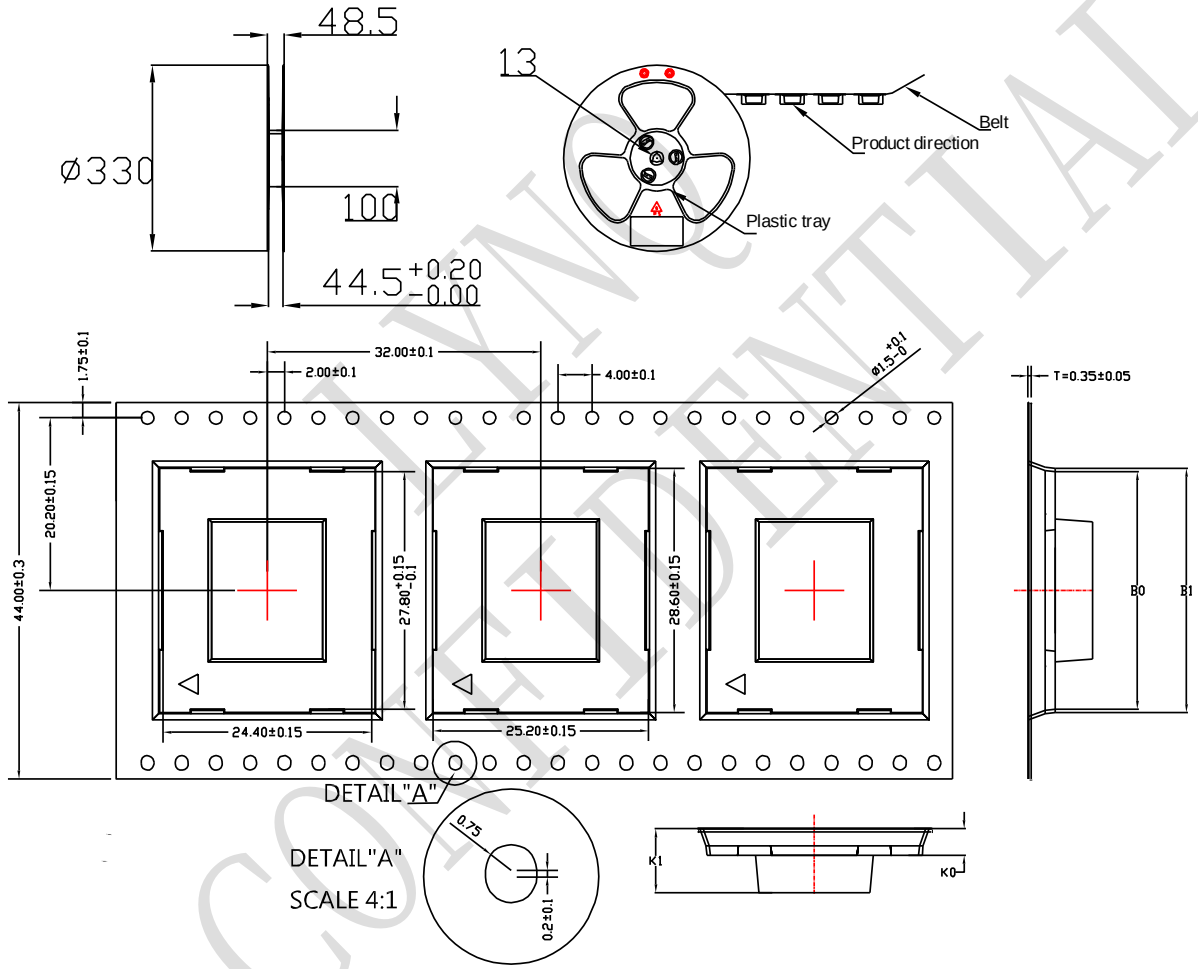
Module thickness of the stencil is recommended to be thickened, and the rest position can be maintained by 0.1mm.

6.3 Packaging Information

The L502-3 Series module are packaged with a roll of tape and sealed with a vacuum-sealed antistatic bag.

Coil tape

One coil can hold 280 modules, as shown in the figure.



ITEM	W	T	A0	A1	B0	B1	K0	K1	P	F	E	D	D1	P0	P2
DIM	44.0	0.35	24.4	25.2	27.8	28.6	3.1	7.5	32.0	20.2	1.75	1.5		4.0	2.0
TOLE	±0.3	±0.05	±0.15	±0.15	+0.15 −0.10	±0.15	±0.15	±0.15	±0.1	±0.15	±0.1	+0.10 −0.00	+0.10 −0.00	±0.1	±0.1

Figure 6.3-1 Coil tape information

7. 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.