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CLM920_TE3 LTE Module Hardware User's Guide

V2.0



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Contents

Chapter 1. Introduction.....	- 9 -
Chapter 2. Module Overview.....	- 10 -
2.1 Module introduction.....	- 10 -
2.2 Module characteristics.....	- 10 -
2.3 Module function.....	- 14 -
Chapter 3. Interface application description.....	- 16 -
3.1 Chapter overview.....	- 16 -
3.2 Module interface.....	- 17 -
3.2.1 144-pin LCC interface.....	- 17 -
3.2.2 Interface definition.....	- 17 -
3.3 Power interface.....	- 24 -
3.3.1 Power supply design.....	- 25 -
3.3.2 Power reference circuit.....	- 26 -
3.3.3 VDD_SDIO 1.8V/2.85V voltage output.....	- 27 -
3.3.4 VDD_EXT 1V8 voltage output.....	- 27 -
3.4 Switching machine reset mode.....	- 28 -
3.4.1 Boot.....	- 28 -
3.4.2 Boot timing.....	- 28 -
3.4.3 Power down.....	- 29 -
3.4.4 Reset control.....	- 29 -
3.5 USB interface.....	- 30 -
3.6 UART interface.....	- 32 -
3.6.1 Main serial port.....	- 32 -
3.6.2 Debug serial port.....	- 34 -
3.6.3 RI and DTR interface.....	- 34 -
3.7 USIM interface.....	- 35 -
3.7.1 USIM card reference circuit.....	- 36 -
3.7.2 UIM_DET Hot Swap Reference Design.....	- 37 -
3.8 General purpose GPIO interface.....	- 38 -
3.9 Network status indication interface.....	- 39 -
3.10 Module status indication.....	- 40 -
3.11 PCM digital voice interface.....	- 41 -
3.12 I2C bus.....	- 42 -



3.13 SDIO interface.....	- 43 -
3.14 SPI interface / multiplexed I2S interface.....	- 47 -
3.15 MCLK interface.....	- 49 -
3.16 ADC interface.....	- 49 -
3.17 RF interface.....	- 50 -
3.17.1 Main set antenna interface.....	- 50 -
3.17.2 Diversity antenna interface.....	- 51 -
3.17.3 GNSS interface.....	- 51 -
3.17.4 RF trace reference.....	- 53 -
3.17.5 RF connector size.....	- 54 -
Chapter 4. Overall technical indicators.....	- 57 -
4.2 GNSS reception performance.....	- 57 -
4.3 working frequency.....	- 58 -
4.4 Conducted radio frequency measurement.....	- 58 -
4.4.2 standard test.....	- 59 -
4.5 Conducted receiving sensitivity and transmit power.....	- 59 -
4.6 Antenna requirements.....	- 60 -
4.7 Power consumption characteristics.....	- 62 -
Chapter 5. Interface electrical characteristics.....	- 65 -
5.1 Chapter overview.....	- 65 -
5.2 Working storage temperature.....	- 65 -
5.3 Module IO level.....	- 65 -
5.4 power supply.....	- 65 -
5.5 Electrostatic property.....	- 66 -
5.6 Reliability index.....	- 66 -
Chapter6. Structural and mechanical properties.....	- 69 -
6.1 Chapter overview.....	- 69 -
6.2 Exterior.....	- 69 -
6.3 CLM920 TE3 module mechanical size.....	- 69 -
Chapter7. Packaging and production.....	- 71 -
7.1 Chapter overview.....	- 71 -
7.2 Module packaging and storage.....	- 71 -
7.3 Production welding.....	- 71 -
Chapter 8. Appendix.....	- 73 -



8.1 Chapter overview.....	- 73 -
8.2 Abbreviations.....	- 73 -
8.3 Encoding.....	- 74 -
8.4 Safety and precautions.....	- 77 -

Figures Contents

Figure 2-1 Functional block diagram of the CLM920 TE3 LCC module.....	- 15 -
Figure 3-1 LCC module interface definition.....	- 17 -
Figure 3-2 Burst current supply voltage drop for GSM TDMA network.....	- 25 -
Figure 3-4 LDO linear power reference circuit.....	- 26 -
Figure 3-5 DC switching power supply reference circuit.....	- 26 -
Figure 3-6 PMOS tube control power switch reference circuit.....	- 27 -
Figure 3-7 Startup timing diagram.....	- 28 -
Figure 3-8 Power-on reference circuit.....	- 29 -
Figure 3-9 Reset reference circuit.....	- 30 -
Figure 3-10 Reset timing diagram.....	- 30 -
Figure 3-11 USB connection design circuit diagram.....	- 31 -
Figure 3-12 Full-featured serial port design.....	- 33 -
Figure 3-13 UART serial port design.....	- 33 -
Figure 3-14 Level conversion chip circuit.....	- 34 -
Figure 3-15 RI pin signal waveform.....	- 35 -
Figure 3-16 USIM design circuit diagram.....	- 36 -
Figure 3-17 Hot swap detection of the USIM card.....	- 38 -
Figure 3-18 Network indicator circuit diagram.....	- 40 -
Figure 3-19 STATUS Pin Reference Circuit.....	- 40 -
Figure 3-20 PCM short frame mode timing diagram.....	- 41 -
Figure 3-21 PCM to analog voice map.....	- 42 -
Figure 3-22 I2C interface reference circuit diagram.....	- 43 -
Figure 3-23 SD card interface reference circuit diagram.....	- 46 -
Figure 3-24 I2S to analog voice map.....	- 49 -
Figure 3-25 Main antenna matching circuit.....	- 51 -
Figure 3-26 Diversity Antenna Matching Circuit.....	- 51 -
Figure 3-27 GNSS passive antenna reference circuit.....	- 52 -
Figure 3-28 GNSS active antenna reference circuit.....	- 52 -



Figure 3- 29 The complete structure of the two-layer PCB microstrip line.....	- 53 -
Figure 3-30 The complete structure of the multilayer PCB strip line.....	- 54 -
Figure 3-31 Reference ground is the third layer PCB microstrip transmission line structure.....	- 54 -
Figure 3-32 RF connector size chart.....	- 55 -
Figure 3-33 Antenna connector matching plug diagram.....	- 55 -
Figure 3-34 Matching coaxial RF line size.....	- 56 -
Figure 6-1 Appearance of the CLM920 TE3.....	- 69 -
Figure 6-2 Front view and side view of the module (unit: mm).....	- 69 -
Figure 6-3 Bottom view of the module (unit: mm).....	- 70 -
Figure 6-4 Recommended module package (unit: mm).....	- 70 -
Figure 7-1 Reflow soldering temperature graph.....	- 72 -

Tables Contents

Table 2-1 Module band list.....	- 10 -
Table 2-2 Key Features.....	- 11 -
Table 3-1 Pin definitions.....	- 18 -
Table 3-2 IO parameter definition.....	- 20 -
Table 3-3 Pin description.....	- 20 -
Table 3-4 Power pin definitions.....	- 25 -
Table 3-5 Switch pin definition.....	- 28 -
Table 3-6 Boot timing parameters.....	- 28 -
Table 3-7 Reset foot definition.....	- 29 -
Table 3-8 RESET pin parameters.....	- 30 -
Table 3-9 USB interface pin definition.....	- 31 -
Table 3-10 UART serial port signal definition.....	- 32 -
Table 3-10 Debug serial port pin definition.....	- 34 -
Table 3-11 SIM card signal definition.....	- 35 -
Table 3-12 SIM card hot swap detection pin definition.....	- 37 -
Table 3-13 General GPIO Pin Definitions.....	- 38 -
Table 3-14 Network indicator pin definition.....	- 39 -
Table 3-15 Network indication status.....	- 39 -
Table 3-16 PCM pin definition.....	- 41 -
Table 3-17 PCM specific parameters.....	- 41 -
Table 3-18 I2C pin definition.....	- 42 -
Table 3-19 SD card pin definition.....	- 43 -



Table 3-20 SPI Pin Definitions.....	- 47 -
Table 3-21 I2S pin definition.....	- 48 -
Table 3-22 CLK Pin Definition.....	- 49 -
Table 3-23 ADC Pin Definitions.....	- 50 -
Table 3-24 Antenna interface pin definition.....	- 50 -
Table 3-25 Main parameters of the RF connector.....	- 55 -
Table 4-1 Main parameters of GNSS.....	- 57 -
Table 4-2 RF frequency table.....	- 58 -
Table 4-3 Test instruments.....	- 58 -
Table 4-4 2G3G RF indicators.....	- 59 -
Table 4-5 4G RF sensitivity indicators.....	- 59 -
Table 4-6 4G RF transmit power indicators.....	- 60 -
Table 4-7 Main set antenna indicator requirements.....	- 60 -
Table 4-8 GNSS antenna indicator requirements.....	- 61 -
Table 4-9 Three major operators' live network sleep and idle power consumption (GNSS off).....	- 62 -
Table 4-10 Call Power Consumption (GNSS Off).....	- 62 -
Table 4-11 GPRS data transmission power consumption (GNSS off).....	- 63 -
Table 4-12 EDGE Data Transmission Power Consumption (GNSS Off).....	- 63 -
Table 4-13 HSDPA data transmission power consumption (GNSS off).....	- 63 -
Table 4-14 TD-SCDMA Data Transmission Power Consumption (GNSS Off).....	- 63 -
Table 4-15 EVDO data transmission power consumption (GNSS off).....	- 63 -
Table 4-16 LTE data transmission power consumption (GNSS off).....	- 63 -
Table 5-1 CLM920 TE3 module working storage temperature.....	- 65 -
Table 5-2 Electrical Characteristics of CLM920 TE3 Module.....	- 65 -
Table 5-3 CLM920 TE3 Module Operating Voltage.....	- 65 -
Table 5-4 CLM920 TE3 ESD Features.....	- 66 -
Table 5-5 CLM920 TE3 Reliability Test.....	- 66 -
Table 7-1 Reflow process parameter table.....	- 72 -
Table 8-1 Abbreviations.....	- 73 -
Table 8-2 Time slot allocation table for different levels of GPRS/EDGE.....	- 74 -
Table 8-3 Maximum GPRS rate.....	- 75 -
Table 8-4 Maximum EDGE Rate.....	- 75 -
Table 8-5 Maximum HSDPA rate.....	- 75 -
Table 8-6 Maximum HSUPA rate.....	- 76 -



Table 8-7 LTE-FDD DL maximum rate.....	- 76 -
Table 8-8 LTE-FDD UL Maximum Rate.....	- 77 -



Chapter 1. Introduction

This document is a wireless solution product CLM920_NC3, CLM920_TB3, CLM920_TE3 module hardware interface manual, designed to describe the hardware components and functional characteristics of the module solution, application interface definition and use instructions, electrical performance and mechanical characteristics. Combined with this and other application documents, users can quickly use this module to design wireless products.



Chapter 2. Module Overview

2.1 Module introduction

The CLM920 TE3 module is an LCC package module. It is a wireless terminal product that integrates various network standards and GPS positioning services such as FDD-LTE/TDD-LTE/TD-SCDMA/WCDMA/EVDO/CDMA/EDGE/GSM. The module is based on Qualcomm MDM9X07 chip development, supports Cat4, uplink and downlink speeds up to 50Mbps/150Mbps, and fully supports VOLTE and SRLTE, and supports embedded operating systems such as Windows 7/Windows 8/Windows 10/Android/Linux.

The CLM920 TE3 module can be used in the following applications:

- ✧ Car equipment
- ✧ Wireless POS machine
- ✧ Wireless advertising, multimedia
- ✧ Remote monitoring
- ✧ Smart meter reading
- ✧ Mobile broadband
- ✧ Industrial automation
- ✧ Other wireless terminals, etc.

2.2 Module characteristics

Table 2-1 Module band list

Network Type	Frequency band	Module series		
		CLM920 NC3	CLM920 TB3	CLM920 TE3
GSM	GSM850	√	√	√
	GSM900	√	√	√
	GSM1800	√	√	√
LTE(FDD)	LTE FDD B1	√	√	√
	LTE FDD B3	√	√	√
	LTE FDD B5	√	√	√
	LTE FDD B7			√
	LTE FDD B8	√	√	√
	LTE FDD B20			√
LTE(TDD)	LTE TDD B38	√	√	√
	LTE TDD B39	√	√	√



	LTE TDD B40	√	√	√
	LTE TDD B41	√	√	√
TD-SCDMA	TD-SCDMA B34	√	√	√
	TD-SCDMA B39	√	√	√
WCDMA	BAND 1	√	√	√
	BAND 5	√	√	√
	BAND 8	√	√	√
CDMA2000/EVDO	BC0	√		
GNSS	GLONASS	√	√	√
	GPS	√	√	√
	BeiDou/Compass	√	√	√

NOTE

- ✧ Module does not support diversity, GPS, voice function by default
- ✧ GNSS function optional
- ✧ Diversity function optional
- ✧ Voice function (digital voice)
- ✧ CLM920 TB3 supports CAT1 standard modules for customer specific applications, Mbps for uplink CAT1 and 10Mbps for CAT1
- ✧ Module supports Category 4 by default. When you need to support the Category 1 module, the CLM920 TB3 cat1 is printed on the module label. CAT1 does not support diversity.

Table 2-2 Key Features

characteristic	description
Physical characteristics	32mm x 29mm x 2.4mm
fixed way	LCC package, patch mount
Application processor	Single core ARM Cortex-A7 processor, clocked at 1.2GHZ, 256kB level 2 cache
Operating Voltage	3.3V - 4.2V Typical Voltage 3.7V
Energy saving current	Standby current < 5mA



Applicati on interface	✧	Standard interface	SIM	Support 3.0V/1.8V, support hot swap functionUSB2.0 (High-Speed)(only supports slave mode), data transfer rate up to 480Mbps For AT commands, data transfer, GNSS NMEA output, software debugging and software upgrades
	✧	USB2.0		USB driver: Support Windows XP, Windows Vista, Windows 7, Windows 10, Windows CE 5.0/6.0/7.0 Linux 2.6 or higher Android 2.3/4.0/4.2/4.4/5.0 /6.0/7.1, etc.
	✧	Hardware interface	reset	Used to reset the module, low effective
	✧	UART interface	serial	Main serial port (8 lines): For AT commands and data transfer The baud rate is up to 921600bps and the default is 115200bps. Support RTS and CTS hardware flow control Debug serial port (2 lines): Used to print module logs
	✧	PCM interface		For audio, requires an external codec chip Supports 8-bit u-law and 16-bit linear encoding formatsSupport short frame mode Support main mode
	✧	SPI interface		Maximum clock rate up to 26MHz SPI can only be used as the master, the interface voltage domain is 1.8V Reusable I2S interface for external CODEC
	✧	SD card interface		4-bit SD/MMC interface Clock frequency up to 50MHz Maximum capacity supports 32GB Interface voltage domain is 1.8/2.95V, two voltages are adjustable
	✧	Power interface		Support 3.3V-4.2V DC power supply Used to indicate the status of the module, the speed of the light is on, indicating the status of the module that is



	✧ Network status indication ✧ General purpose GPIO interface	not available. WAKEUP_IN sleep mode control, low wake-up module AP_READY sleep state detection W_DISABLE# flight mode control
Transmit power		LTE: Class 3 (23dBm $\pm$ 2dB) UMTS: Class 3 (24dBm+1/-3dB) TD-SCDMA: Class 2 (24dBm+1/-3dB) CDMA2000: Class 3 (24dBm+3/-1dB) GSM/GPRS: Class 4 (33dBm $\pm$ 2dB) GSM850/GSM900 Class 1 (30dBm $\pm$ 2dB) DCS1800/PCS1900
Data service		GSM/EDGE: GPRS: DL 85.6 kbps/UL 85.6 kbps EDGE: DL 236.8 kbps/UL 236.8 kbps WCDMA: UMTS R99: DL 384 kbps/UL 384 kbps DC-HSPA+: DL 42 Mbps/UL 5.76 Mbps TD-SCDMA: TD-HSDPA/HSUPA: 2.2Mbps (UL) /2.8Mbps (DL) EV-DOr0/DOrA CDMA 1xEVDOOr0: DL 2.4Mbps/UL 153kbps CDMA 1xEVDOOrA: DL 3.1Mbps/UL 1.8Mbps LTE: LTE FDD:DL 150Mbps/UL 50Mbps@20M BW cat4 LTE TDD:DL 130Mbps/UL 35Mbps@20M BW cat4 LTE FDD:DL 10Mbps/UL 5Mbps@20M BW cat1 LTE TDD:DL 10Mbps/UL 5Mbps@20M BW cat1
Satellite positioning		GPS/BEIDOU/GLONASS Protocol: NMEA



Diversity antenna	Support LTE diversity antenna
AT command	Support for standard AT instruction sets (Hayes 3GPP TS 27.007 and 27.005) Specific AT query CLM920 TE3 AT instruction set
SMS business	Support Text and PDU mode Support point-to-point MO and MT SMS storage: USIM card / ME (default)
Virtual network card	Support USB virtual network card
temperature range	Normal operating temperature -30 ° C to +75 ° C Extreme operating temperature -40° C to +85° C
storage temperature	-40° C to +85° C
humidity	RH5%~RH95%
Module function distinction	On the label paper, M stands for the main set, D takes the table diversity, and G stands for GPS.

NOTE

When the temperature is in the range of -40°C to -30°C or +75°C to +85°C, some RF specifications of the CLM920 TE3 module may not meet the 3GPP standards.

2.3 Module function

The CLM920 TE3 LCC module mainly contains the following circuit units:

- ✧ Baseband processing unit
- ✧ Power Management Unit
- ✧ memory unit
- ✧ RF transceiver unit
- ✧ RF front-end unit
- ✧ GPS RF receiving unit

The functional block diagram of the CLM920 TE3 LCC module is as follows:

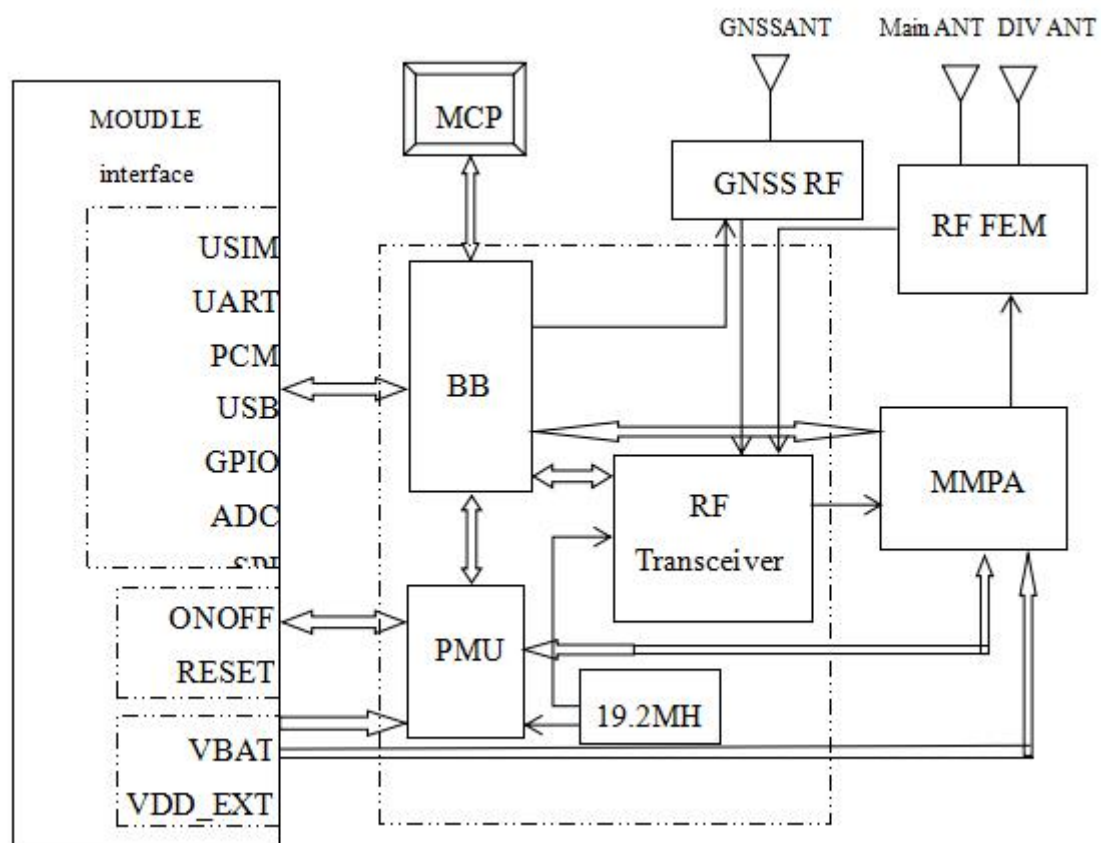


Figure 2-1 Functional block diagram of the CLM920 TE3 LCC module



Chapter 3. Interface application description

3.1 Chapter overview

This chapter mainly describes the interface definition and application of this module. Contains the following sections:

- ✧ 144 pin pin definition map
- ✧ Interface definition
- ✧ Power interface
- ✧ USB interface
- ✧ USIM interface
- ✧ UART interface
- ✧ Control interface
- ✧ PCM/I2S voice interface
- ✧ RF antenna interface
- ✧ GPIO interface
- ✧ Reserved
- ✧ NC interface
- ✧ SPI interface
- ✧ SDIO interface



3.2 Module interface

3.2.1 144-pin LCC interface

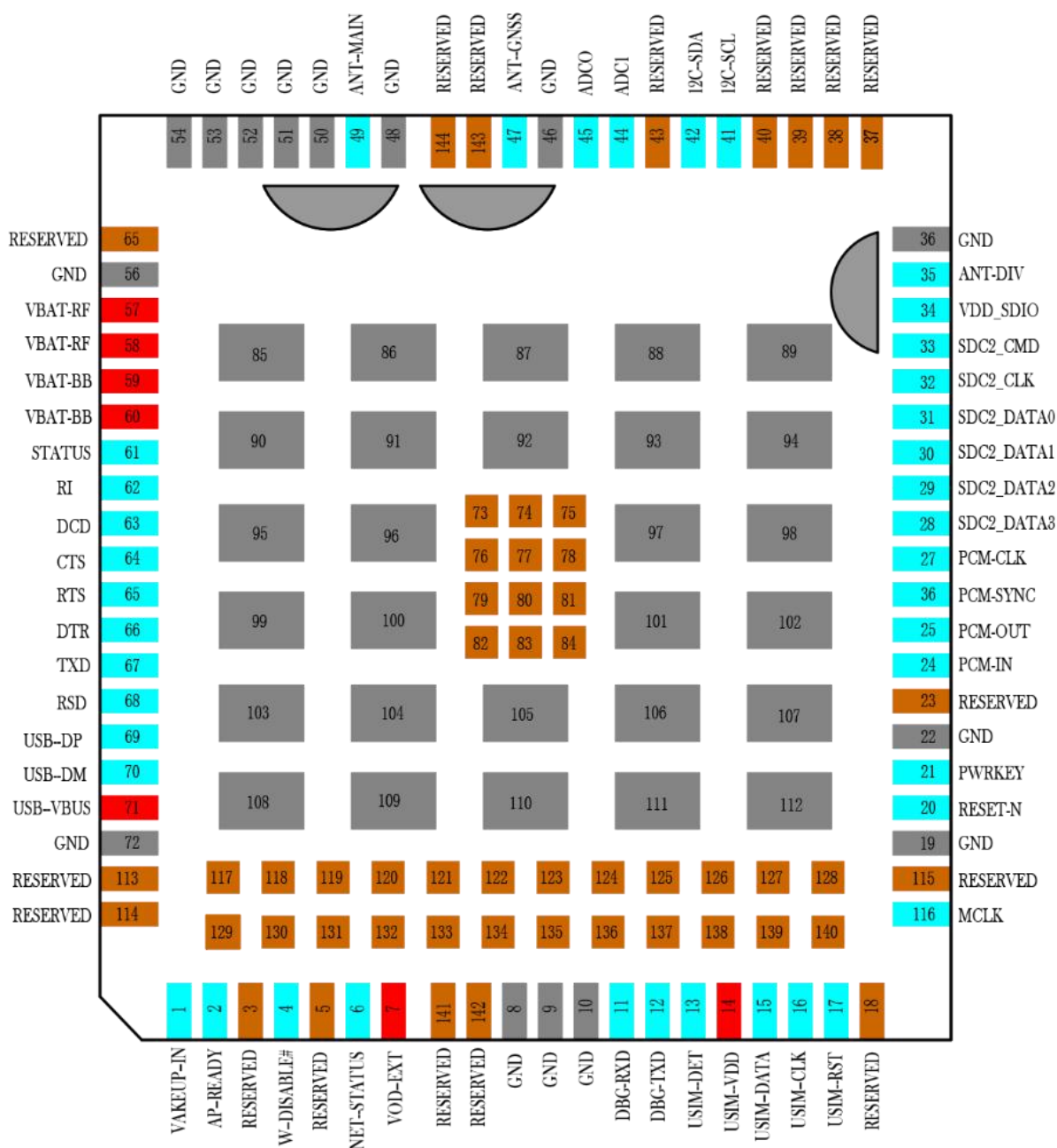




Table 3-1 Pin definitions

Pin number	Pin name	Pin number	Pin name
1	WAKEUP_IN	2	AP_READY
3	GPIO_1	4	W_DISABLE#
5	GPIO_2	6	NET_STATUS
7	VDD_EXT	8	GND
9	GND	10	GND
11	DBG_RXD	12	DBG_TXD
13	USIM_DET	14	USIM_VDD
15	USIM_DATA	16	USIM_CLK
17	USIM_RST	18	RESERVED
19	GND	20	RESET_N
21	PWRKEY	22	GND
23	RESERVED	24	PCM_IN
25	PCM_OUT	26	PCM_SYNC
27	PCM_CLK	28	SDC2_DATA3
29	SDC2_DATA2	30	SDC2_DATA1
31	SDC2_DATA0	32	SDC2_CLK
33	SDC2_CMD	34	VDD_SDIO
35	ANT_DIV	36	GND
37	SPI_CS_N (I2S_D1)	38	SPI_MOSI (I2S_WS)
39	SPI_MISO (I2S_D0)	40	SPI_CLK (I2S_SCLK)
41	I2C_SCL	42	I2C_SDA
43	RESERVED	44	ADC1
45	ADC0	46	GND
47	ANT_GNSS	48	GND
49	ANT_MAIN	50	GND
51	GND	52	GND
53	GND	54	GND
55	RESERVED	56	GND
57	VBAT	58	VBAT
59	VBAT	60	VBAT
61	STATUS	62	RI



63	DCD	64	CTS
65	RTS	66	DTR
67	TXD	68	RXD
69	USB_DP	70	USB_DM
71	USB_VBUS	72	GND
73	RESERVED	74	RESERVED
75	RESERVED	76	RESERVED
77	RESERVED	78	RESERVED
79	RESERVED	80	RESERVED
81	RESERVED	82	RESERVED
83	RESERVED	84	RESERVED
85	GND	86	GND
87	GND	88	GND
89	GND	90	GND
91	GND	92	GND
93	GND	94	GND
95	GND	96	GND
97	GND	98	GND
99	GND	100	GND
101	GND	102	GND
103	GND	104	GND
105	GND	106	GND
107	GND	108	GND
109	GND	110	GND
111	GND	112	GND
113	RESERVE	114	RESERVE
115	RESERVE	116	MCLK
117	RESERVE	118	RESERVE
119	RESERVE	120	RESERVE
121	RESERVE	122	RESERVE
123	RESERVE	124	RESERVE
125	RESERVE	126	RESERVE
127	RESERVE	128	RESERVE
129	RESERVE	130	RESERVE



131	RESERVE	132	RESERVE
133	RESERVE	134	RESERVE
135	RESERVE	136	RESERVE
137	RESERVE	138	RESERVE
139	RESERVE	140	RESERVE
141	RESERVE	142	RESERVE
143	RESERVE	144	RESERVE

Table 3-2 IO parameter definition

Symbol sign	Description
IO	Two-way input and output
PI	power input
PO	Power Output
AI	Analog input
AO	Analog output
DI	Digital input
DO	Digital output
OD	Leaky open circuit

Table 3-3 Pin description

power supply				
NO.	Definition	IO	Description	Remarks
57	VBAT	PI	Module power input	Power supply needs to guarantee 2A current
58	VBAT	PI	Module power input	
59	VBAT	PI	Module power input	
60	VBAT	PI	Module power input	
7	VDD_EXT	PO	1.8v output	Can provide pull-up for external GPIO (maximum 50MA), please keep left floating
8,9,10,19,22,36,46,48,50,51,52,53,54,56,72	GND		Ground	
85~112	GND		Heat sink pad	



Module switch machine and reset				
NO.	Definition	IO	Functional description	Remarks
21	PWRKEY	DI	Switching machine pin	Active low
20	RESET	DI	Module reset pin	Low level reset module

USB interface				
NO.	Definition	IO	Functional description	Remarks
71	USB_VBUS	PI	USB Detection	
69	USB_D+	IO	USB bus differential positive signal	90Ω differential impedance
70	USB_D-	IO	USB bus differential negative signal	90Ω differential impedance

UART interface (main serial port)				
NO.	Definition	IO	Functional description	Remarks
62	RI	DO	Ringing prompt	Wake up the host, please keep it empty when not in use
63	DCD	DO	Carrier detection	please keep it empty when not in use
64	CTS	DO	Clear send	please keep it empty when not in use
65	RTS	DI	Request to send	please keep it empty when not in use
66	DTR	DI	Module sleep mode control	please keep it empty when not in use
67	TXD	DO	Serial data transmission	please keep it empty when not in use
68	RXD	DI	Serial data reception	please keep it empty when not in use
Debug serial port				
11	DBG_RXD	DI	Serial data reception	please keep it empty when not in use
12	DBG_TXD	DO	Serial data transmission	please keep it empty when not in use

USIM interface				
NO.	Definition	IO	Functional description	Remarks
13	USIM_DET	DI	USIM card detection	please keep it empty when not in use
14	USIM_VDD	PO	USIM card power supply	Module automatically recognizes 1.8V or 3V USIM card



15	USIM_DATA	IO	USIM card data	
16	USIM_CLK	DO	USIM card clock	
17	USIM_RST	DO	USIM card reset	

GPIO pin				
NO.	Definition	IO	Functional description	Remarks
1	WAKEUP_IN	DI	Sleep mode control	
2	AP_READY	DI	Sleep state detection	This pin function is under development (please keep it floating when not in use)
3	GPIO_1	IO	This pin function has not been defined	RESERVE, please keep floating
4	W_DISABLE#	DI	Flight mode control	This pin function is under development (please keep it floating when not in use)
5	GPIO_2	PI	This pin function has not been defined	RESERVE, please keep floating

Module status indication interface				
NO.	Definition	IO	Functional description	Remarks
6	NET_STATUS	OD	Module work network status light indication	please keep it floating when not in use
61	STATUS	DO	Module running status indication	please keep it floating when not in use

PCM interface				
NO.	Definition	IO	Functional description	Remarks
24	PCM_IN	DI	PCM receiving data	please keep it floating when not in use
25	PCM_OUT	DO	PCM sends data	please keep it floating when not in use
26	PCM_SYNC	IO	PCM frame sync signal	please keep it floating when not in use
27	PCM_CLK	IO	PCM clock pulse	please keep it floating when not in use

I2C interface				
NO.	Definition	IO	Functional description	Remarks



41	SCL	DO	I2C bus clock	please keep it floating when not in use
42	SDA	I/O	I2C bus data	please keep it floating when not in use

SDIO interface				
NO.	Definition	IO	Functional description	Remarks
23	SD_CARD_DET	DI	SD card insertion detection	please keep it floating when not in use
28	SDC2_D3	IO	SDIO bus DATA3	please keep it floating when not in use
29	SDC2_D2	IO	SDIO bus DATA2	please keep it floating when not in use
30	SDC2_D1	IO	SDIO bus DATA1	please keep it floating when not in use
31	SDC2_D0	IO	SDIO bus DATA0	please keep it floating when not in use
32	SDC2_CLK	DO	SDIO bus clock output	please keep it floating when not in use
33	SDC2_CMD	DI	SDIO bus command output	please keep it floating when not in use
34	VDD_SDIO	PO	SDIO bus pull-up power supply	Output is configurable, please keep it floating when not in use

SPI interface				
NO.	Definition	IO	Functional description	Remarks
37	SPI_CS_N	DO	SPI chip selection	Reuse I2S_D1 (keep it floating when not in use)
38	SPI_MOSI	DO	SPI data output	Reuse I2S_D1 (keep it floating when not in use)
39	SPI_MISO	DI	SPI data input	Multiplexing I2S_DO (keep it floating when not in use)
40	SPI_CLK	DO	SPI clock	Reuse I2S_SCLK (keep it floating when not in use)

MCLK				
NO.	Definition	IO	Functional description	Remarks
116	MCLK	DO	12.288M clock output	keep it floating when not in use

ADC interface				
NO.	Definition	IO	Functional description	Remarks



44	ADC1	AI	General analog to digital conversion	keep it floating when not in use
45	ADC0	AI	General analog to digital conversion	keep it floating when not in use

RF interface				
NO.	Definition	IO	Functional description	Remarks
35	ANT_DIV	AI	Diversity antenna	50Ωcharacteristic impedance (keep empty when not in use)
47	ANT_GNSS	AI	GNSS antenna	50Ωcharacteristic impedance (keep empty when not in use)
49	ANT_MAIN	IO	Main antenna	50Ωcharacteristic impedance

RESERVE pin			
NO.	Definition	Functional description	Remarks
18, 23, 28, 29, 30, 31, 32, 33, 34, 37, 38, 39, 40, 43, 55, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 113~144	RESERVE	Reserve pins, please keep open	Please stay vacant

NOTE

- ✧ The module typically has an IO port level of 1.8V (in addition to the SIM, the SIM card port level supports 1.8V and 3.0V).
- ✧ This module defines the RESERVED and NC pins to be left unconnected.

3.3 Power interface

The CLM920 TE3 module power interface consists of three parts:

- ✧ VBAT is the module working power supply
- ✧ UIM_PWR is the working power supply for SIM card
- ✧ VDD_EXT is 1.8V output power (50mA)
- ✧ VDD_SDIO is the SD card pull-up power supply (50mA)



3.3.1 Power supply design

The power interface of the CLM920 TE3 module is as follows:

Table 3-4 Power pin definitions

Pin number	name	I/O	description	Min	Typical	Max
57,58,59,60	VBAT	PI	Module power supply	3.3V	3.7V	4.2V
14	UIM_PWR	PO	SIM power supply	0	1.8V/2.85V	1.98/3.3V
7	VDD_EXT	PO	Output power		1.8V	
34	VDD_SDIO	PO	Output power		1.8V/2.85V	
8,9,10,19,22,36,46,48,50,51,52,53,54,56,72, 85~112	GND		Ground	-	0	-

The CLM920 TE3 module operates in a single-supply mode with four power supply pins. The VBAT power supply range is 3.3-4.2V, and it is recommended to use 3.7V/2A power supply. When transmitting data or talking under HSPA/UTMS/GSM network, the instantaneous high-power transmission will produce a peak current of more than 2A peak, which will cause a large ripple on the power supply. If the instantaneous voltage drop causes the VBAT supply voltage to be too low. Or the supply current is insufficient and the module may shut down or restart. In order to ensure the normal operation of the module, all power pins and ground pins must be connected and provide sufficient power supply capability.

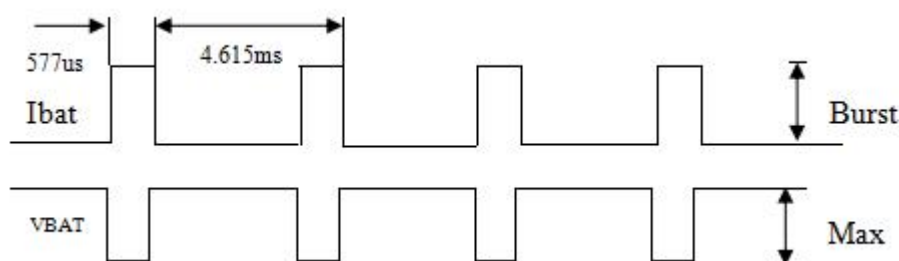


Figure 3-2 Burst current supply voltage drop for GSM TDMA network

Under the premise of ensuring that the VBAT power supply is sufficient, two 470uF/6.3V tantalum capacitors can be connected in parallel with the power input, and then 10pF, 33pF, 0.1uF, 1uF ceramic capacitors.

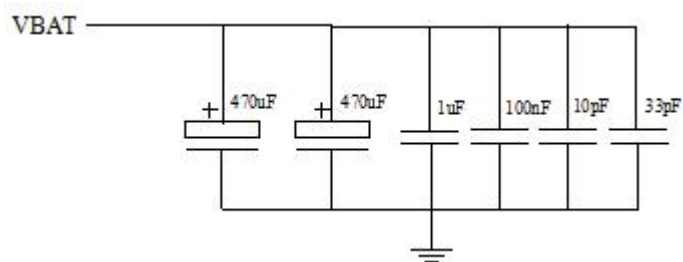


Figure 3-3 VBAT power supply

3.3.2 Power reference circuit

The actual design of the power circuit can use a switching DC power supply or a linear LDO power supply to design the VBAT power supply. Both design circuits need to supply enough current. Refer specifically to the following circuit design:

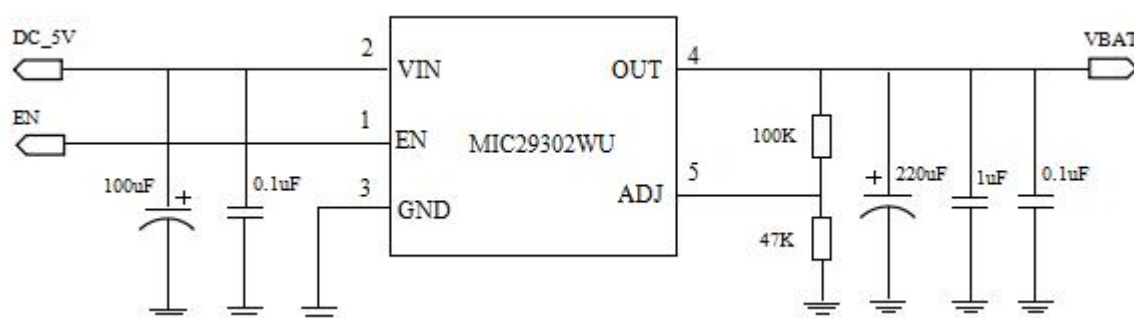


Figure 3-4 LDO linear power reference circuit

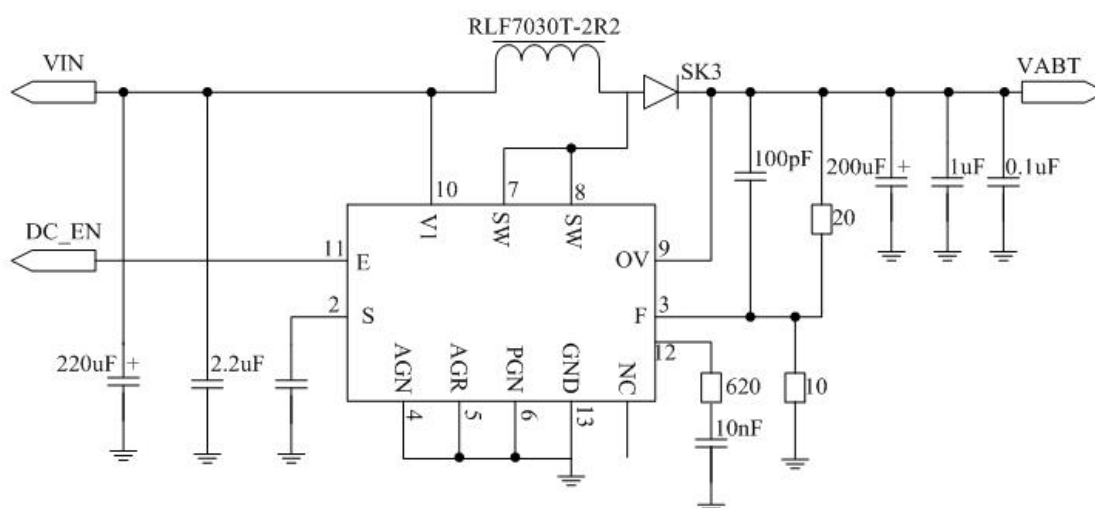


Figure 3-5 DC switching power supply reference circuit

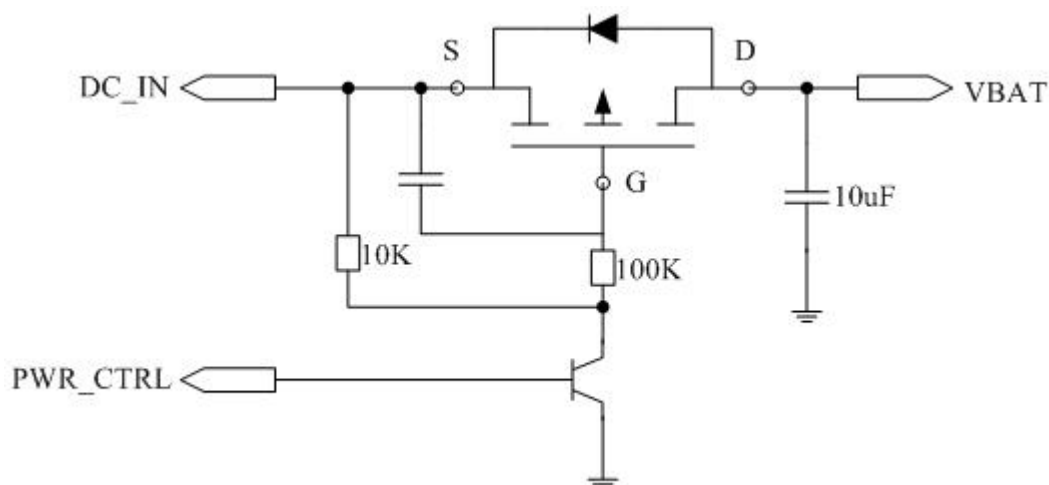


Figure 3-6 PMOS tube control power switch reference circuit

NOTE

- ✧ To prevent damage to the module from surges and overvoltages, it is recommended to connect a 5.1V/500mW Zener diode to the VBAT pin of the module.
- ✧ It is recommended to add 3 ceramic capacitors (33pF, 10pF, 100nF) to the VBAT pin and place them near the VBAT pin.
- ✧ The minimum operating voltage of the module is 3.3V. Since the transmission data or GSM call will generate more than 2A current, the ripple voltage drop will occur on the power supply voltage, so the actual supply voltage must not be lower than 3.3V.

3.3.3 VDD_SDIO 1.8V/2.85V voltage output

The module output VDD_SDIO is configurable at 2.85V/1.8V. The default is 2.85V and the maximum output current is 50mA. It can only be used for SDIO bus pull-up. The SD card power supply needs to be provided from outside the module.

3.3.4 VDD_EXT 1V8 voltage output

After the CLM920 TE3 module is powered on normally, the 17th pin will output 1.8V and the current load will be 50mA. The external master can read the voltage of VDD_EXT to judge whether the module is powered on. VDD_EXT can also be used as an external power supply, such as a level shifting chip.



3.4 Switching machine reset mode

3.4.1 Boot

The 21 pin of the CLM920 TE3 module is the boot pin. The module is powered on at low level. The PWRKEY is pulled low for at least 500ms. When the module is powered on, the user can check whether the module is powered on by querying the high and low levels of the VDD_EXT pin.

When the CLM920 TE3 module is powered on, pull the PWRKEY pin low for at least 1S and release it. The module will perform the shutdown process shutdown (this function is under development).

Table 3-5 Switch pin definition

Pin	Signal name	I/O	High value	description
21	PWRKEY	PI	VBAT-0.3V	Low level boot

3.4.2 Boot timing

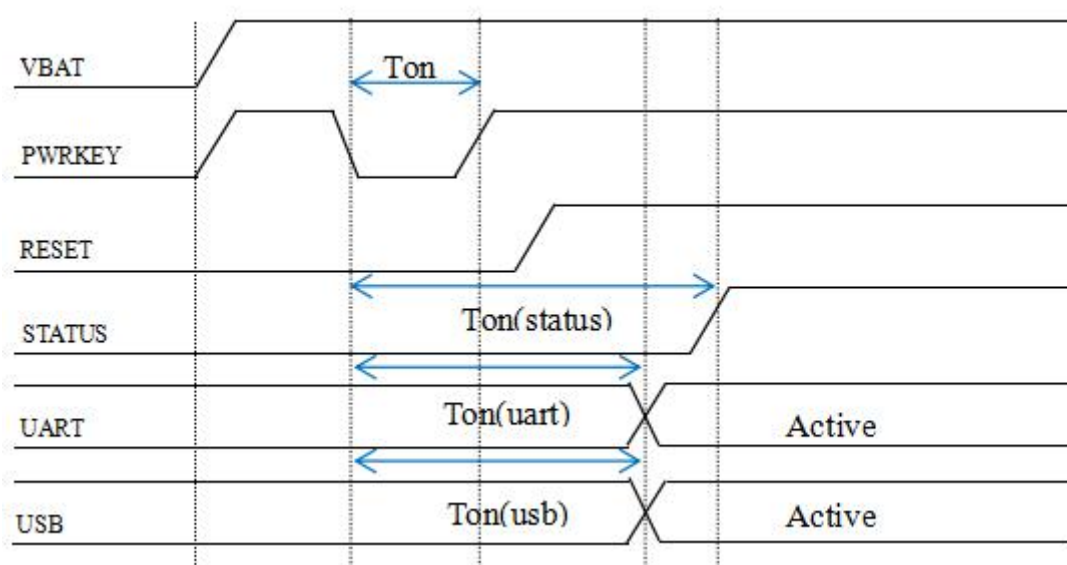


Figure 3-7 Startup timing diagram

Table 3-6 Boot timing parameters

symbol	description	Min	Typical	Max	unit
Ton	Boot low level width	100	500	-	ms
Ton(status)	Boot time (according to status status)	22	-	-	ms



Ton(usb)	Boot time (according to usb status)	-	10	-	s
Ton(uart)	Boot time (according to uart status)	-	6	-	s
VIH	PWRKEY input high level	0.6	0.8	1.8	V
VIL	PWRKEY input low level	-0.3	0	0.5	V

It is recommended to use the open-collector drive circuit to control the PWRKEY, which can be released after the base level is pulled for 500ms. The switch can also be designed with a push button. The button accessory requires a TVS tube for ESD protection.

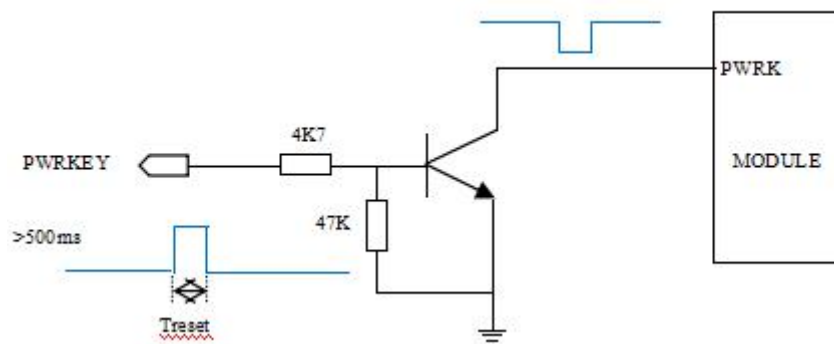


Figure 3-8 Power-on reference circuit

3.4.3 Power down

If the CLM920 TE3 module is to be shut down, the shutdown can be controlled by the PWRKEY pin. At this time, the module performs a normal shutdown process. The module can also be shut down via the AT command (this feature is under development).

3.4.4 Reset control

The CLM920 TE3 module PIN20 signal is the RESET reset pin. When the application detects a module error, the module can be reset when the software is not responding. The module can be reset by pulling the pin low for 100-450ms. The RESET pin is sensitive to interference. A 10 nF to 0.1 μ F capacitor can be placed near the signal for signal filtering. Keep away from RF interference signals when routing.

Table 3-7 Reset foot definition

Pin	Signal name	I/O	High value	description
20	RESET	PI	$1.8V \pm 0.3V$	Active low

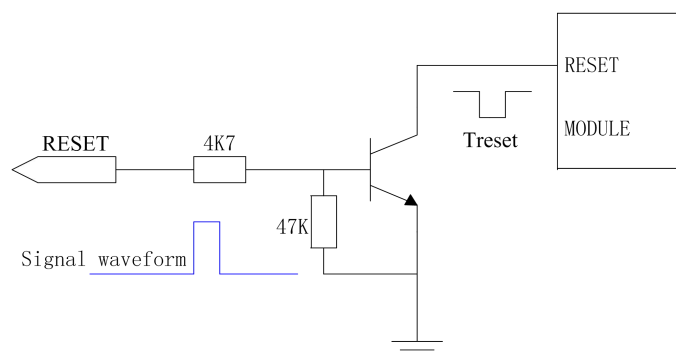


Figure 3-9 Reset reference circuit

Table 3-8 RESET pin parameters

symbol	description	Min	Typical	Max	unit
Treset	Low pulse width	150	200	450	ms
VIH	RESET input high level voltage	1.17	1.8	2.1	V
VIL	RESET input low level voltage	-0.3	0	0.8	V

The reset RESET timing is as follows:

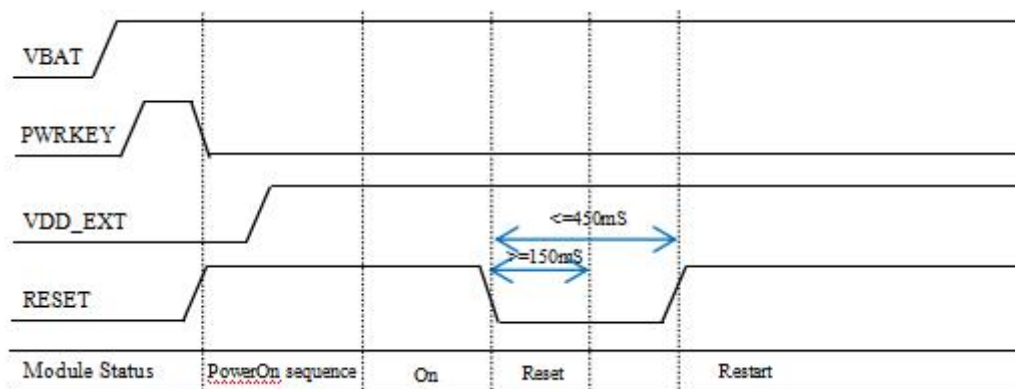


Figure 3-10 Reset timing diagram

The CLM920 TE3 module supports AT command reset, and the AT command is `at+cfun=1,1` to restart the module. Detailed instructions are available in the CLM920 TE3 AT Command Set Manual.

3.5 USB interface

The USB interface of the CLM920 TE3 module provides a USB2.0 High-Speed interface. The interface supports slave mode and does not support USB charging mode. The USB interface pins are



defined as follows:

Table 3-9 USB interface pin definition

Pin number	Signal name	IO	description
71	USB_VBUS	PI	USB detection
70	USB_DM	IO	USB differential signal -
69	USB_DP	IO	USB differential signal +

The module acts as a USB slave device and supports USB sleep and wake-up mechanisms. The USB interface application reference circuit is as follows:

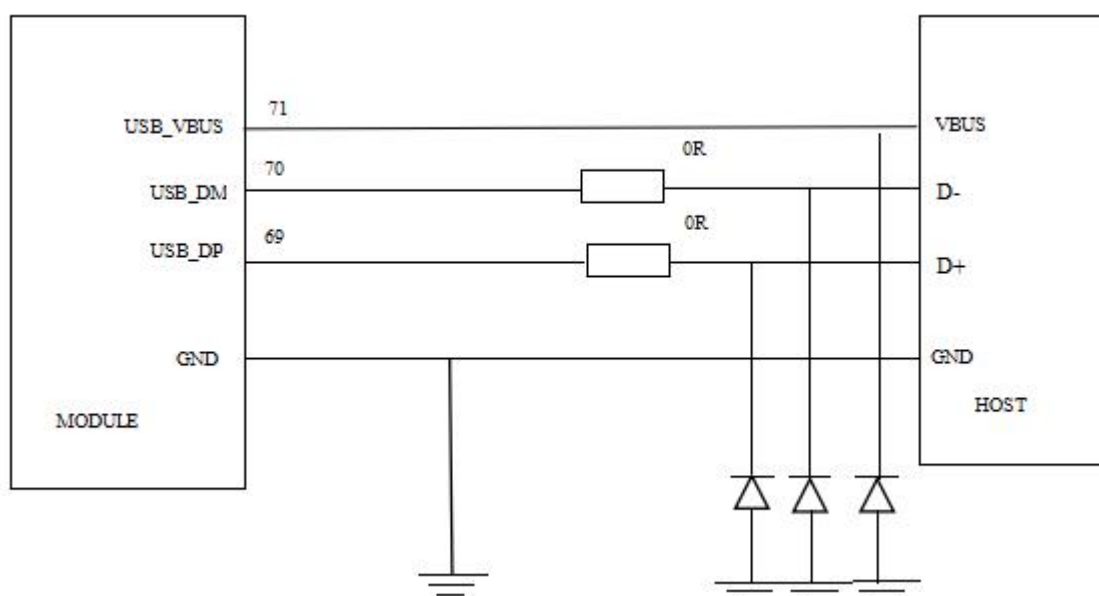


Figure 3-11 USB connection design circuit diagram

NOTE

- ✧ The USB interface supports high-speed (480Mbps) and full-speed (12Mbps) modes, so the trace design needs to strictly follow the USB2.0 protocol requirements, pay attention to the protection of the data line, differential trace, control impedance is $90\ \Omega$.
- ✧ In order to improve the antistatic performance of the USB interface, it is recommended to add an ESD protection device on the data line. The equivalent capacitance of the protection device is less than 2pF.
- ✧ The USB interface bus supply voltage is provided internally by the module and does not need to be externally supplied. At the same time, since the USB interface of the module does not provide USB bus power, the module can only be used as a slave device of the USB bus device.



The USB interface supports the following features:

- ✧ Software download upgrade
- ✧ Data communication
- ✧ AT Command
- ✧ GNSS NMEA output, etc.

3.6 UART interface

3.6.1 Main serial port

The CLM920 TE3 module provides two sets of UART interfaces. Main serial port and debug serial port, the serial port level is 1.8V.

Main serial port:

The serial port can realize AT interactive instructions, print program log information, and interact with peripheral data.

The module's serial port baud rate can be set to 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600bps baud rate, the default is 115200bps.

The UART interface is defined as follows:

Table 3-10 UART serial port signal definition

NO.	NAME	I/O	description	parameter	Level value (V)			remarks
					min	typical	max	
62	UART_ RI	DO	UART ringing output	VOH	1.35	1.8	2	
				VOL	0		0.45	
63	UART_ DCD	DO	UART data carrier detection	VOH	1.35	1.8	2	
				VOL	0		0.45	
64	UART_ CTS	DO	UART clear send	VOH	1.35	1.8	2	
				VOL	0		0.45	
65	UART_ RTS	DI	Send UART request	VIH	1.2	1.8	2	
				VIL	-0.3		0.6	
66	UART_ DTR	DI	UART data is ready	VIH	1.2	1.8	2	
				VIL	-0.3		0.6	
67	UART_ TXD	DO	UART send data	VOH	1.35	1.8	2	
				VOL	0		0.45	
68	UART_ RXD	DI	UART receive data	VIH	1.2	1.8	2	
				VIL	-0.3		0.6	



When users want to use the full-featured serial port, you can refer to the following connection methods.

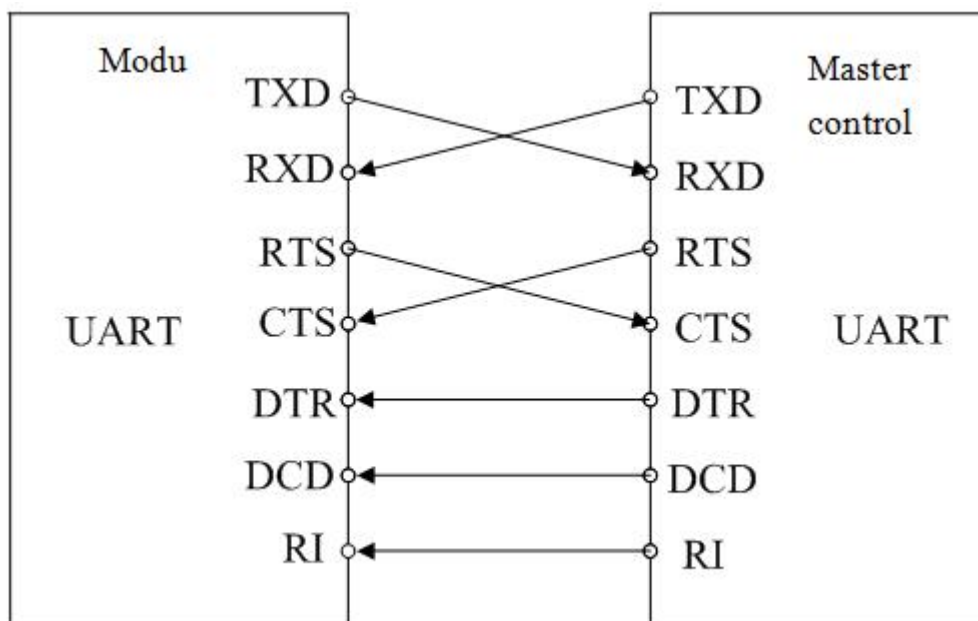


Figure 3-12 Full-featured serial port design

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

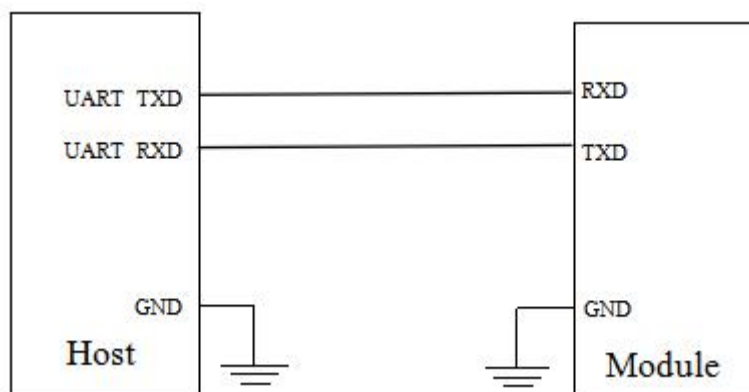


Figure 3-13 UART serial port design

The serial port of the module is TTL 1.8V level. If the serial port needs to be connected to the MCU of 3.3V level, it is necessary to add a level conversion chip externally to achieve level matching. For the chip connection method, refer to the following circuit:

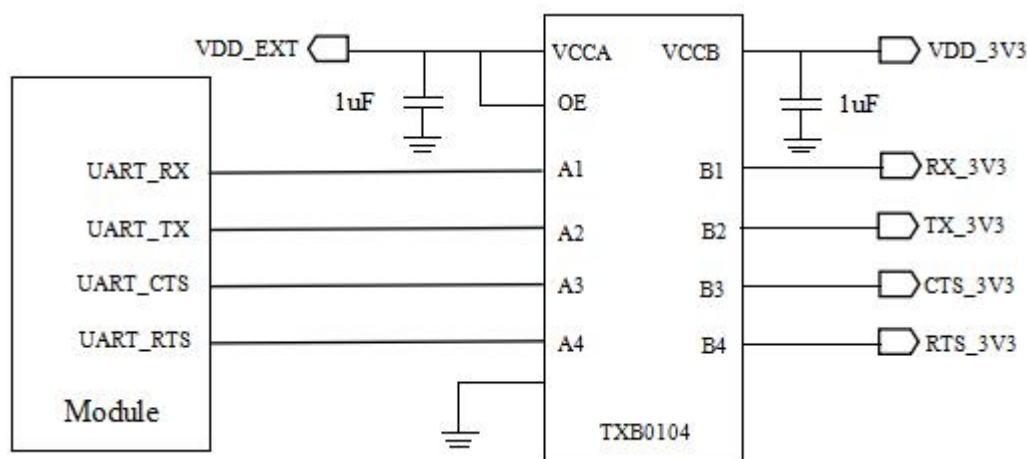


Figure 3-14 Level conversion chip circuit

3.6.2 Debug serial port

The 11th and 12th pins of the module are debug serial port pins, and the debug serial port supports 115200bps baud rate. It is used for Linux control, log printing, and can reserve test points for module debugging. Please do not keep it floating.

Table 3-10 Debug serial port pin definition

NO.	Signal name	I/O	description	parameter	Level value (V)			remarks
					MIN	Typical	MAX	
11	DBG_RXD	DI	UART data reception	VIH	1.2	1.8	2	
				VIL	-0.3		0.6	
12	DBG_TXD	DO	UART data transmission	VOH	1.35	1.8	2	
				VOL	0		0.45	

3.6.3 RI and DTR interface

The CLM920 TE3 module supports the serial sleep wake-up function, and the RI pin can be used as an interrupt to wake up the host.

RI:

The RI pin can be used as an interrupt to wake up the host.

The RI pin idle state is low. When a short message or voice incoming call is received, the RI outputs a rectangular wave with a period of 500ms (high level for 250ms, low level for 250ms) to wake up the host.

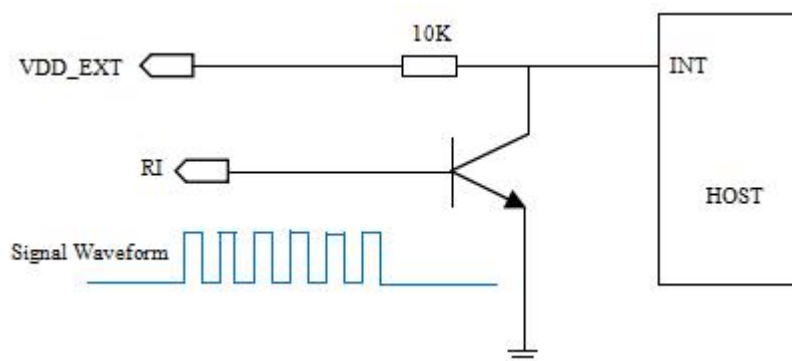


Figure 3-15 RI pin signal waveform

DTR:

The DTR pin can be used as the sleep wake-up pin of the CLM920 TE3 module. When the module enters sleep, the DTR pin can be pulled low to wake up the module.

- ✧ Pull the DTR pin high first
- ✧ Send AT+DISABLEUSB=1, AT+CSCLK=1, after the module enters sleep
- ✧ Low DTR pin wake-up module

3.7 USIM interface

The CLM920 TE3 module provides a USIM card interface compatible with the ISO 7816-3 standard. The USIM card power supply is provided by the module's internal power manager and supports 1.8V/3.0V.

Table 3-11 SIM card signal definition

NO.	Signal name	I/O	description	parameter	Level value (V)			remarks
					min	Typical	max	
13	USIM_DET	DI	USIM card detection	V _{IH}	1.6	1.8	2	This pin signal is internally pulled high. If the USIM_DET pin is not used, keep it floating.
				V _{IL}	0		0.18	
14	USIM_VDD	PO	USIM card power supply	V _{3.0}	2.75	3.0	3.05	USIM_VDD=3.0V
				V _{1.8}	1.75	1.8	1.95	USIM_VDD=1.8V
15	USIM_DATA	IO	USIM card data	V _{IH}	0.65 *V _D D		3.05	USIM_VDD:3.0V /1.8V



				VIL	-0.3	0	0.25* VDD	
				VOH	VD D-0. 45		3.05	
				VOL	0	0	0.45	
16	USIM_ CLK	D O	USIM card clock	VOH	VD D-0. 45		3.05	USIM_VDD:3.0V /1.8V
				VOL	0	0	0.45	
17	USIM_ RST	D O	USIM card reset	VOH	VD D-0. 45		3.05	USIM_VDD:3.0V /1.8V
				VOL	0	0	0.45	

3.7.1 USIM card reference circuit

The CLM920 TE3 module does not come with a USIM card slot. Users need to design a USIM card slot on their own interface board.

The USIM card interface reference circuit is as follows:

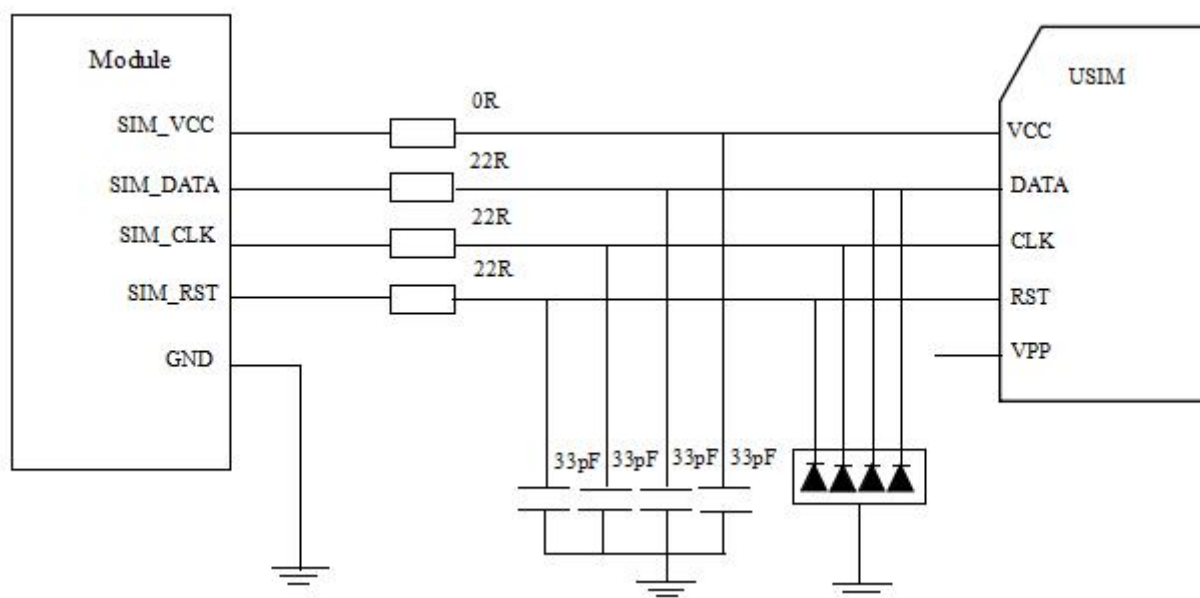


Figure 3-16 USIM design circuit diagram



NOTE

- ✧ The USIM interface cable is recommended to use ONSEMI's SMF15C device for ESD protection. The peripheral circuit components should be placed close to the card holder. The SIM card holder is close to the module layout.
- ✧ The USIM card circuit is susceptible to radio frequency interference and does not recognize or drop the card. Therefore, the card slot should be placed as far as possible from the RF radiation of the antenna. The card trace should be as far away as possible from the RF, power supply and high-speed signal lines.
- ✧ The UIM_DATA has been internally pulled up to VDD_EXT through a 47K resistor, and no external pull-up is required.
- ✧ UIM_DET is the USIM card insertion or non-insertion detection pin. It is high by default. The SIM card status can be detected by this PIN pin during hot plug application.
- ✧ To avoid transient voltage overload, the USIM interface requires a 22R resistor in series with each other on the signal line path.
- ✧ The ground of the USIM deck and the ground of the module should maintain good connectivity.

3.7.2 UIM_DET Hot Swap Reference Design

The CLM920 TE3 module supports the USIM card hot plug function.

The UIM_DET pin acts as an input detection pin to determine whether the USIM card is inserted or not. The UIM_DET pin defaults to a pull-up high. The hot-swap function can be turned on or off with AT+HOSCFG, which is turned off by default (see the CLM920 TE3 AT command set for details).

Table 3-12 SIM card hot swap detection pin definition

NO.	AT command	UIM_DET status	Functional description
1	AT+HOSCFG=1,1	high	SIM card insertion, UIM_DET is high
2	AT+HOSCFG=1,0	low	SIM card insertion, UIM_DET is low

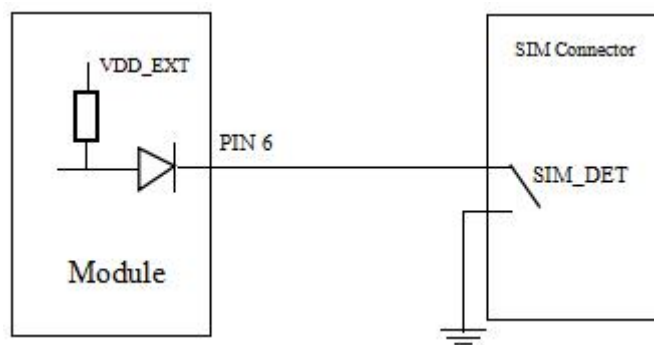


Figure 3-17 Hot swap detection of the USIM card

NOTE

- ✧ It is recommended to add a diode protection next to the UIM _DET pin of the module.
- ✧ When using a normally closed SIM card holder or a normally open SIM card holder, the detection function can be set by the AT command. If AT+HOSCFG=1 is set, the status of the SIM card is high when the SIM card is in position, and AT+HOSCFG=1 is set. When the SIM card is in the state, the status is low. Set AT+HOSCFG=0.0 The SIM card hot swap function is disabled.

3.8 General purpose GPIO interface

The CLM920 TE3 module contains five general control signals. The interface is defined as follows:

Table 3-13 General GPIO Pin Definitions

NO.	Signal name	I/O	description	parameter	Level value (V)			remarks
					MIN	Typical	MAX	
1	WAKEUP_IN	DI	Sleep mode control	VIH	1.2	1.8	2	
				VIL	-0.3		0.6	
2	AP_READY	DI	Sleep state detection	VIH	1.2	1.8	2	This feature is under development
				VIL	-0.3		0.6	
3	GPIO_1	IO	This pin function has not been defined					RESERVE, please keep floating
4	W_DISAB	DI	Flight	VIH	1.2	1.8	2	This feature



	LE#		mode control	VIL	-0.3		0.6	is under development
5	GPIO_2	IO	This pin function has not been defined					RESERVE, please keep floating

WAKEUP_IN:

This pin is the host wake-up module pin. When the WAKEUP_IN signal is pulled low, the host can wake up the module.

AP_READY (this feature is under development)

The AP_READY pin can be used by the module to detect if the host is woken up and can be configured for high level detection or low level detection.

W_DISABLE#:

Flight mode control (this function is under development), when the CLM920 TE3 module W_DISABLE# signal is pulled low, the module RF function can be turned off, the module can enter the flight mode, and the module can be turned on to open the module RF function. It can also be set to flight mode by AT+CFUN. For details, please refer to CLM920 TE3 AT command set.

3.9 Network status indication interface

The CLM920 TE3 module provides an open-drain GPIO signal to indicate the status of the RF communication.

Table 3-14 Network indicator pin definition

Pin	Signal name	I/O	description
6	NET_STATUS	OD	Network status indication

Table 3-15 Network indication status

status	LED display status
no service	Constantly bright
Module registration on non-4G network	Double flash
The module registers 4G network or module to register non-4G network for voice SMS and other services.	Flashing

The LED network indicator reference design is as follows:

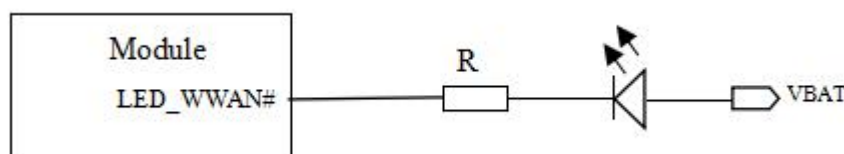


Figure 3-18 Network indicator circuit diagram

NOTE

The brightness of the network indicator can be adjusted by adjusting the current limiting resistor R, which can be adjusted to a maximum of 40 mA.

3.10 Module status indication

The CLM920 TE3 module provides a pin as a working status indicator for the module. This pin can be used to connect to a GPIO or LED with pull-up. It is used to indicate the power-on status of the module. The drive current should be less than 0.8mA. The STATUS pin will output a low level and the rest will be in a high impedance state.

Pin	Signal name	I/O	description	Remarks
61	STATUS	DO	Module power on status indication	External pull-up

The following figure shows the STATUS reference circuit design:

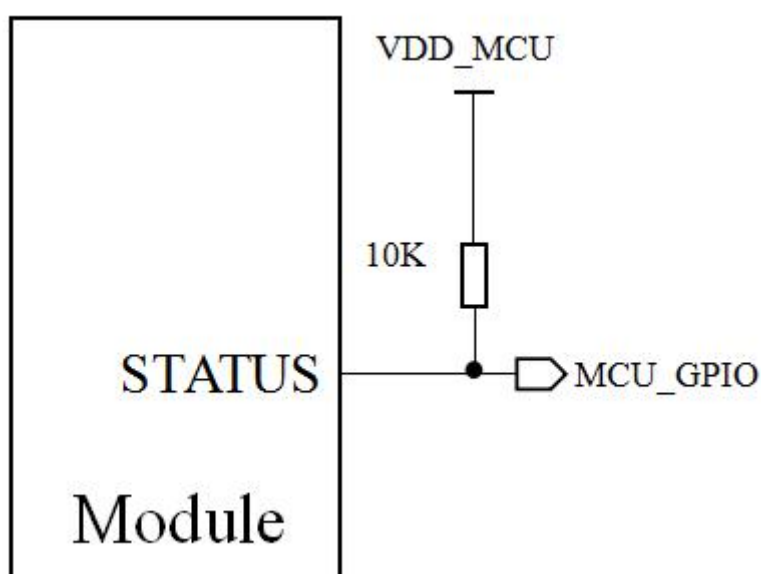


Figure 3-19 STATUS Pin Reference Circuit



3.11 PCM digital voice interface

The CLM920 TE3 module provides a set of PCM audio interfaces supporting 8-bit A-rate, U-rate and 16-bit linear short frame encoding formats with PCM_SYNC of 8kHz and PCM_CLK of 2048kHz.

Table 3-16 PCM pin definition

NO.	Signal name	I/O	description	parameter	Level value (V)			remarks
					min	Typical	max	
24	PCM_IN	DI	PCM data input	VIH	1.2	1.8	2	
				VIL	-0.3		0.6	
25	PCM_OUT	DO	PCM data output	VOH	1.35	1.8	2	
				VOL	0		0.45	
26	PCM_SYNC	DO	PCM frame sync signal	VOH	1.35	1.8	2	
				VOL	0		0.45	
27	PCM_CLK	DO	PCM clock pulse	VOH	1.35	1.8	2	
				VOL	0		0.45	

Table 3-17 PCM specific parameters

characteristic	description
Encoding format	Linear
Data bit	16bits
Master-slave mode	Master/slave mode
PCM clock	2048kHz
PCM frame synchronization	Short frame
Data Format	MSB

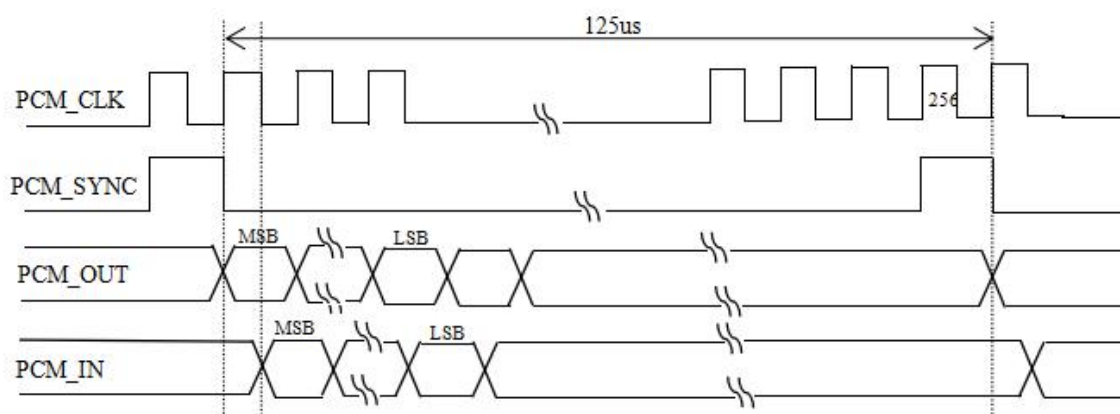


Figure 3-20 PCM short frame mode timing diagram



The recommended circuit for PCM to analog voice is as follows:

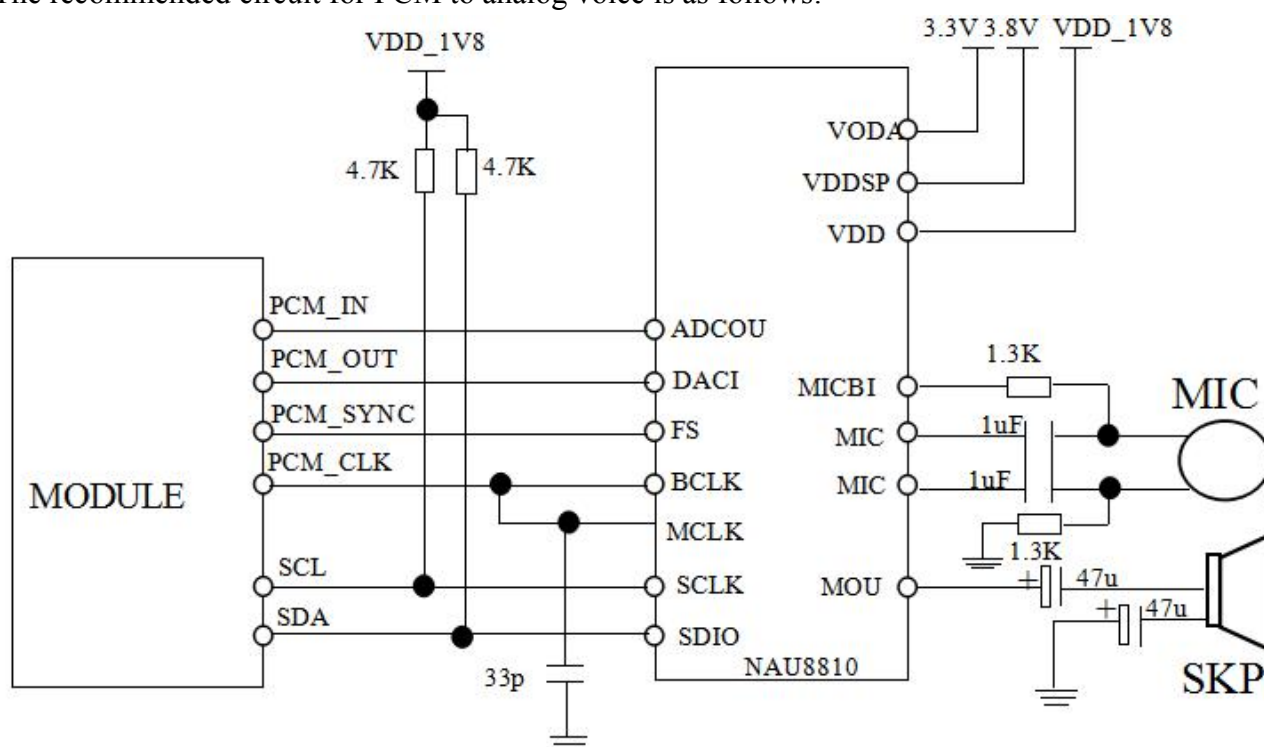


Figure 3-21 PCM to analog voice map

3.12 I2C bus

The CLM920 TE3 module provides a set of hardware bidirectional serial buses with an I2C interface of 1.8V level, a 5.0 protocol interface, and a clock rate of 400KHz.

Table 3-18 I2C pin definition

NO.	Signal name	I/O	description	parameter	Level value (V)			remarks
					min	Typical	max	
41	I2C_SCL	DO	I2C bus clock output	VOH	1.35	1.8	2	
				VOL	0		0.45	
42	I2C_SDA	IO	I2C bus data input and output	VOH	1.35	1.8	2	
				VOL	0		0.45	
				VIH	1.2	1.8	2	
				VIL	-0.3		0.6	



The I2C reference circuit is connected as follows:

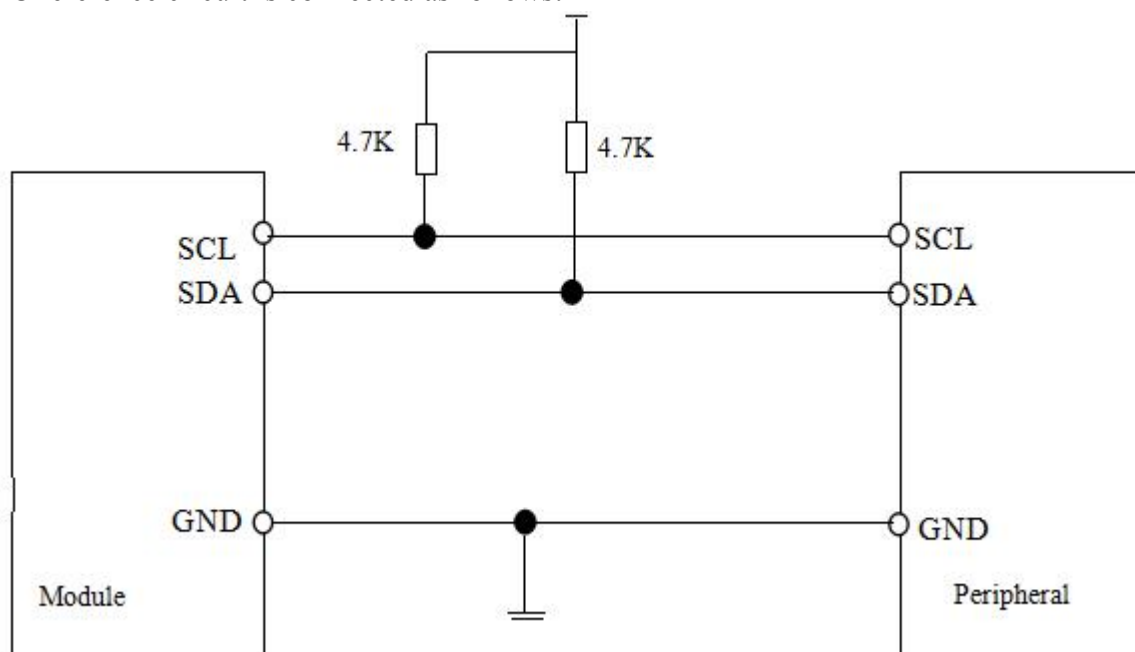


Figure 3-22 I2C interface reference circuit diagram

3.13 SDIO interface

CLM920 TE3 module provides a 4-bit SD/MMC interface, supports 1.8V/2.95V two voltage SD cards, clock frequency up to 50MHz, maximum capacity support 32GB, support SD3.0 protocol.

Table 3-19 SD card pin definition

NO.	Signal name	I/O	description	parameter	Level value (V)			remarks
					min	Typical	max	
23	SD_CARD_DET	DI	SD card insertion detection	VIH	1.2	1.8	2	
				VIL	-0.3		0.6	
28	SDC2_D3	IO	SDIO bus DATA3	VOH	1.35	1.8	2	1.8V voltage domain
				VOL	0		0.45	1.8V voltage domain
				VIH	1.27	1.8	2	1.8V voltage domain
				VIL	-0.3		0.6	1.8V voltage domain



				VOH	0.75* VDD_Px	2.95	VDD_Px	2.95V	voltage domain
				VOL	0		0.125* VDD_Px	2.95V	voltage domain
				VIH	0.625* VDD_Px	2.95	VDD_Px + 0.3	2.95V	voltage domain
				VIL	-0.3		0.25* VDD_Px	2.95V	voltage domain
29	SDC2_D2	IO	SDIO bus DATA2	VOH	1.35	1.8	2	1.8V	voltage domain
				VOL	0		0.45	1.8V	voltage domain
				VIH	1.27	1.8	2	1.8V	voltage domain
				VIL	-0.3		0.6	1.8V	voltage domain
				VOH	0.75* VDD_Px	2.95	VDD_Px	2.95V	voltage domain
				VOL	0		0.125* VDD_Px	2.95V	voltage domain
				VIH	0.625* VDD_Px	2.95	VDD_Px + 0.3	2.95V	voltage domain
				VIL	-0.3		0.25* VDD_Px	2.95V	voltage domain
30	SDC2_D1	IO	SDIO bus DATA1	VOH	1.35	1.8	2	1.8V	voltage domain
				VOL	0		0.45	1.8V	voltage domain
				VIH	1.27	1.8	2	1.8V	voltage domain
				VIL	-0.3		0.6	1.8V	voltage domain
				VOH	0.75* VDD_Px	2.95	VDD_Px	2.95V	voltage domain



				VOL	0		0.125* VDD_Px	2.95V	voltage domain
				VIH	0.625* VDD_Px	2.95	VDD_Px + 0.3	2.95V	voltage domain
				VIL	-0.3		0.25* VDD_Px	2.95V	voltage domain
31	SDC2_D0	IO	SDIO bus DATA0	VOH	1.35	1.8	2	1.8V	voltage domain
				VOL	0		0.45	1.8V	voltage domain
				VIH	1.27	1.8	2	1.8V	voltage domain
				VIL	-0.3		0.6	1.8V	voltage domain
				VOH	0.75* VDD_Px	2.95	VDD_Px	2.95V	voltage domain
				VOL	0		0.125* VDD_Px	2.95V	voltage domain
				VIH	0.625* VDD_Px	2.95	VDD_Px + 0.3	2.95V	voltage domain
				VIL	-0.3		0.25* VDD_Px	2.95V	voltage domain
32	SDC2_CLK	DO	SDIO bus clock	VOH	1.35	1.8	2	1.8V	voltage domain
				VOL	0		0.45	1.8V	voltage domain
				VOH	0.75* VDD_Px	2.95	VDD_Px	2.95V	voltage domain
				VOL	0		0.125* VDD_Px	2.95V	voltage domain
33	SDC2_CM D	IO	SDIO bus command	VOH	1.35	1.8	2	1.8V	voltage domain
				VOL	0		0.45	1.8V	voltage domain



				VIH	1.27	1.8	2	1.8V	voltage domain
				VIL	-0.3		0.6	1.8V	voltage domain
				VOH	0.75* VDD_Px	2.95	VDD_Px	2.95V	voltage domain
				VOL	0		0.125* VDD_Px	2.95V	voltage domain
				VIH	0.625* VDD_Px	2.95	VDD_Px + 0.3	2.95V	voltage domain
				VIL	-0.3		0.25* VDD_Px	2.95V	voltage domain
34	VDD_SDIO	PO	SDIO bus pull-up power supply	IO maximum output 50MA, output 1.8V/2.85V configurable				Cannot be used for SD card power supply	

The SD card reference design for the CLM920 TE3 module is shown below:

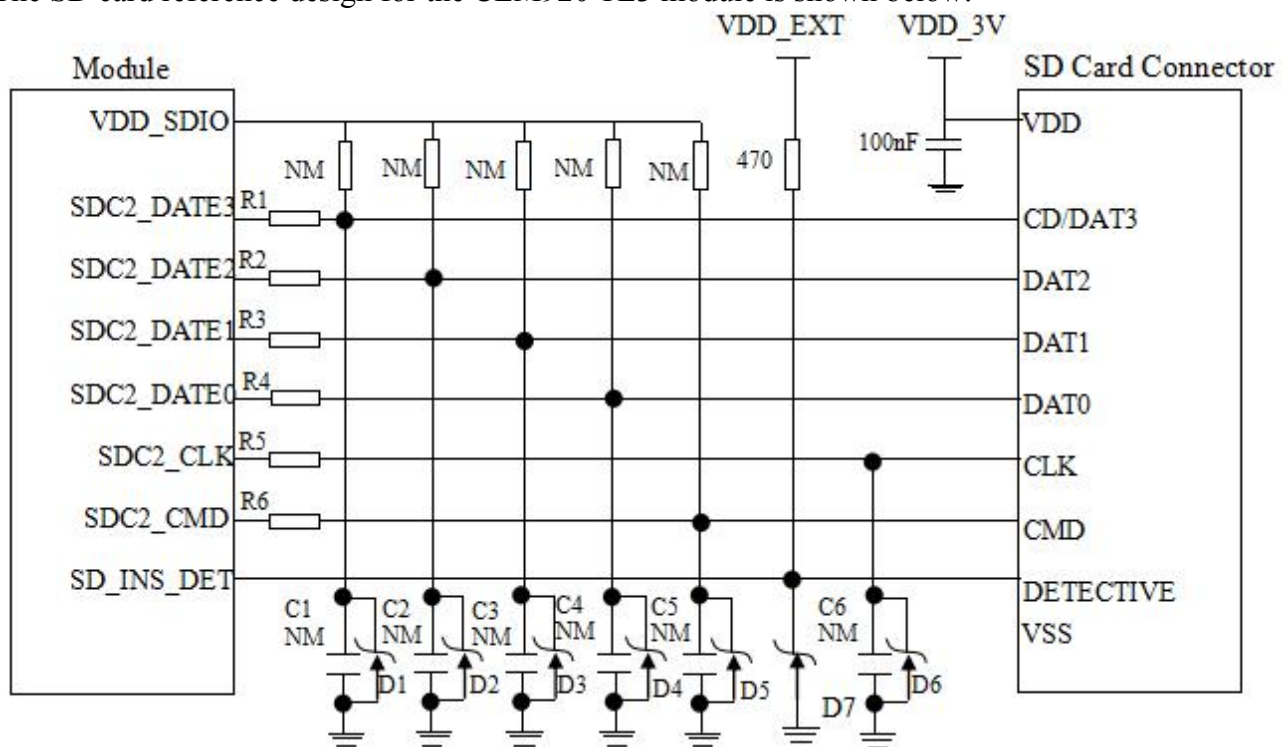


Figure 3-23 SD card interface reference circuit diagram



NOTE

- ✧ SD card circuit routing considerations:
- ✧ The SD card power supply is 3V with a voltage range of 2.7~3.6V, which needs to be externally supplied and has a minimum current of 800mA.
- ✧ The maximum output current of the module output power supply VDD_SDIO is 50mA, which can only be used for SDIO bus pull-up;
- ✧ The SD card has a clock frequency of up to 200 MHz, and the trace is best controlled by 50 ohms.
- ✧ The length of the signal line should be less than 25mm, and the spacing of the signal line should be 2 times the line width and cover the ground and keep away from other possible interference lines.
- ✧ The spacing between the SDIO signal and other signals needs to be greater than 2 times the line width and ensure that the bus load is less than 40pF;
- ✧ Add a pull-up resistor to the SDIO signal with a resistance range of 10~100kΩ, a recommended value of 100kΩ, and pull up to the VDD_SDIO pin of the module.
- ✧ To ensure good ESD performance, it is recommended to add a TVS tube to the SD card pin and place it near the pin.

3.14 SPI interface / multiplexed I2S interface

The CLM920 TE3 provides an SPI interface with a maximum clock rate of 50MHz. In addition, the module can only be used as the master, and the interface voltage domain is 1.8V.

Table 3-20 SPI Pin Definitions

NO.	Signal name	I/O	description	parameter	Level value (V)			remarks
					min	Typical	max	
37	SPI_CS_N	D0	SPI chip selection	VOH	1.35	1.8	2	Multiplexing I2S_D1
				VOL	0		0.45	
38	SPI_MOSI	DO	SPI data output	VOH	1.35	1.8	2	Reuse I2S_WS
				VOL	0		0.45	
39	SPI_MISO	DI	SPIO data input	VIH	1.2	1.8	2	Multiplexing I2S_DO
				VIL	-0.3		0.6	
40	SPI_CLK	DO	SPI clock	VOH	1.35	1.8	2	Multiplexing I2S_CLK
				VOL	0		0.45	



The SPI interface of the CLM920 TE3 module can also be used as I2S. It can be connected to the CODEC. The existing I2S supports the Nuvoton NAU8810 by default.

Table 3-21 I2S pin definition

NO.	Signal name	I/O	description	parameter	Level value (V)			remarks
					min	Typical	max	
37	I2S_D1	IO	I2S serial data	VOH	1.35	1.8	2	
				VOL	0		0.45	
				VIH	1.2	1.8	2	
				VIL	-0.3		0.6	
38	I2S_WS	IO	I2S command selection	VOH	1.35	1.8	2	
				VOL	0		0.45	
				VIH	1.2	1.8	2	
				VIL	-0.3		0.6	
39	I2S_DO	IO	I2S serial data	VOH	1.35	1.8	2	
				VOL	0		0.45	
				VIH	1.2	1.8	2	
				VIL	-0.3		0.6	
40	I2S_CLK	IO	I2S clock	VOH	1.35	1.8	2	
				VOL	0		0.45	
				VIH	1.2	1.8	2	
				VIL	-0.3		0.6	



The following figure shows the reference design of the CLM920 TE3 connection NAU8810.

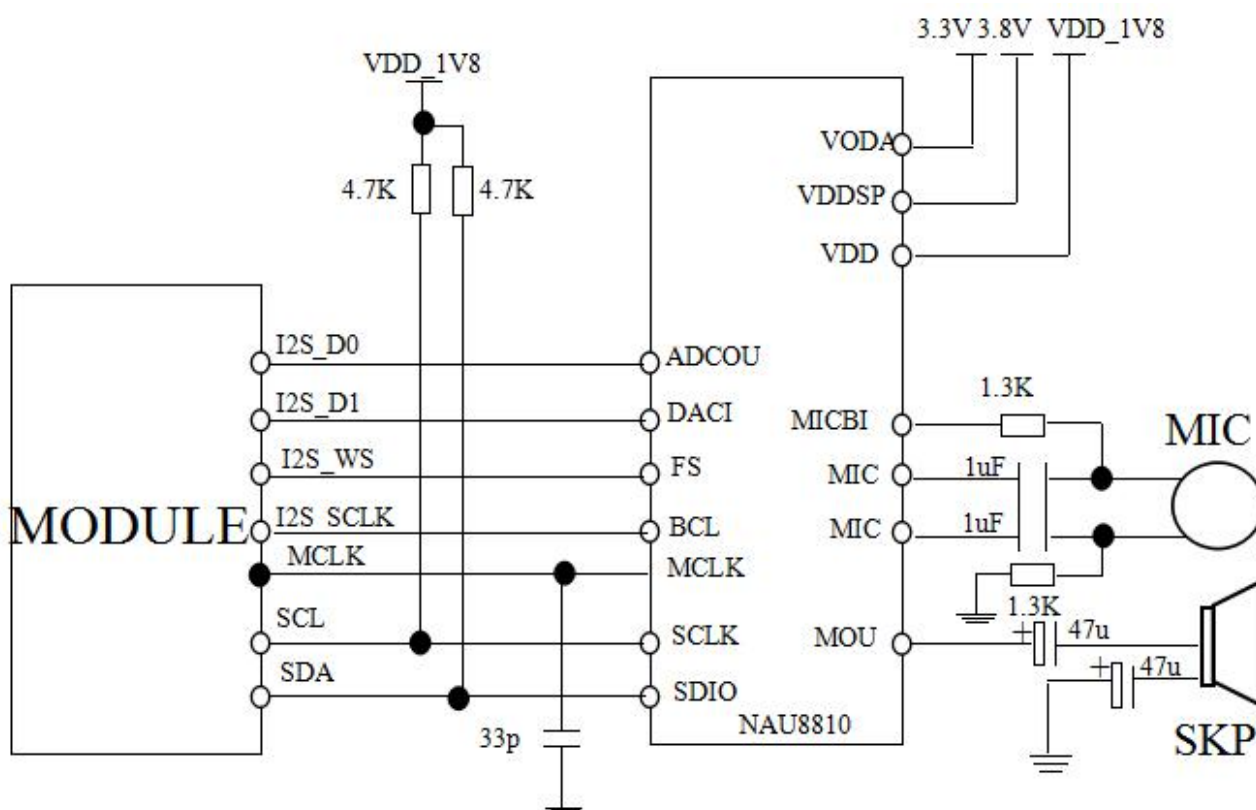


Figure 3-24 I2S to analog voice map

3.15 MCLK interface

The CLM920 TE3 module provides one MCLK and provides a 12.288M clock output. This interface is mainly used to connect the MCLK of the CODEC chip. The main clock frequency of the NAU8810 is supported by default.

Table 3-22 CLK Pin Definition

NO.	Signal name	I/O	description	parameter	Level value (V)			remarks
					min	Typical	max	
116	MCLK	D0	I2S master clock	VOH	1.35	1.8	2	The default output is 12.288M
				VOL	0		0.45	

3.16 ADC interface

The CLM920 TE3 provides two analog-to-digital converter interfaces to read the voltage value. The ADC interface input voltage cannot exceed VBAT. It is recommended that the ADC pin be input with a voltage divider circuit.



Table 3-23 ADC Pin Definitions

NO.	Signal name	description	parameter	Level value (V)			remarks
				min	Typical	max	
44	ADC1	Analog to digital converter interface 1	VIN	0.3		VBAT	ADC resolution 15Bits
45	ADCO	Analog to digital converter interface 0	VIN	0.3		VBAT	ADC resolution 15Bits

3.17 RF interface

The CLM920 TE3 module provides three antenna interfaces, one main set antenna interface, which is responsible for 4G, 3G, 2G signals of the transceiver module, and a diversity antenna interface. It is responsible for receiving 4G and 3G signals, and the signal degradation caused by multipath under high-speed movement. Signals can be enhanced by adding diversity antennas, as well as a GNSS antenna interface for GPS, Beidou, GLONASS, GALILEO signal reception, which can provide positioning solutions for users. The three-way antenna interface has an impedance of 50 ohms.

Table 3-24 Antenna interface pin definition

NO.	Signal name	I/O	description	Remarks
49	ANT_MAIN	IO	Main set antenna interface	50Ω haracteristic impedance
35	ANT_DIV	AI	Diversity antenna interface	50Ω haracteristic impedance
47	ANT_GNSS	AI	GNSS antenna interface	50Ω haracteristic impedance

3.17.1 Main set antenna interface

CLM920 TE3's 49-pin main set antenna interface, in order to facilitate the antenna debugging need to add π -type matching circuit on the motherboard, take 50 ohm impedance line, the recommended circuit is as follows:

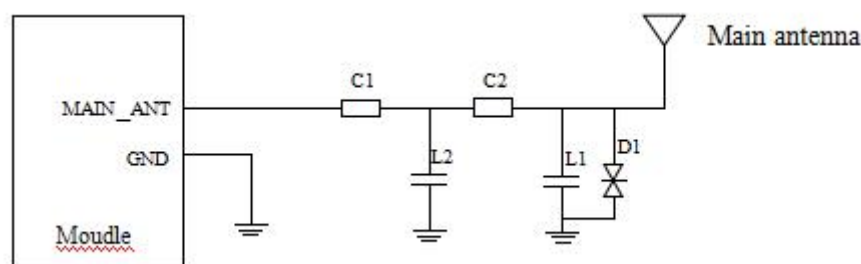


Figure 3-25 Main antenna matching circuit

3.17.2 Diversity antenna interface

CLM920 TE3's 35-pin is a diversity antenna interface. To facilitate antenna debugging, a π -type matching circuit needs to be added to the main board. The 50-ohm impedance line is required. The main antenna and the diversity antenna need to maintain a certain spacing. The recommended circuit is as follows:

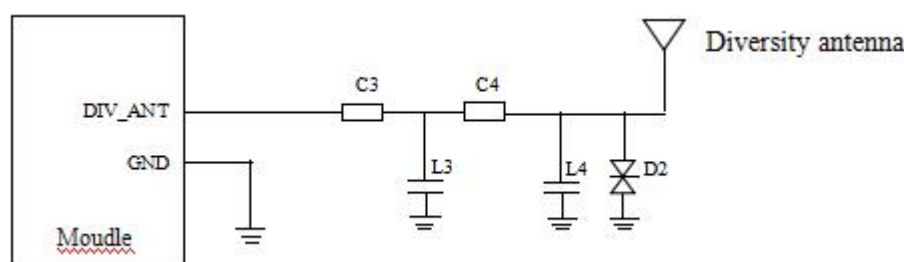


Figure 3-26 Diversity Antenna Matching Circuit

3.17.3 GNSS interface

CLM920 TE3's 47 feet are GNSS antenna interfaces, support GPS, BEIDOU, GLONASS, GALILEO signal reception. If you need to use it, you need to open the GPS with AT command AT+CGPS=1 (for details, please refer to CLM920 TE3 AT command set manual) In order to facilitate the debugging of the antenna, it is necessary to add a π -type matching circuit to the main board, and to take a 50-ohm impedance line. The GNSS antenna needs to maintain a certain distance from the main antenna and the diversity antenna. The GNSS antenna has two antenna connection modes, and the other is a connection. Passive antenna, the other is to connect the active antenna. Since the module itself cannot supply power to the GNSS active antenna, it needs to be externally provided. The recommended circuit is as follows:

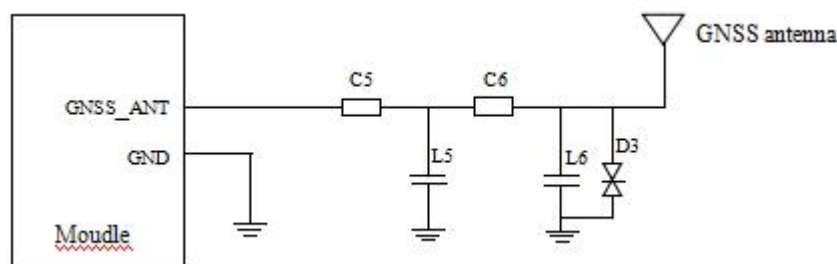


Figure 3-27 GNSS passive antenna reference circuit

The figure below shows L1 in the active antenna matching circuit. L2 is not attached by default. C1 is 0 ohm by default. The specific value is provided by the antenna factory after the antenna is debugged. C2 defaults to 33PF, which is a DC blocking capacitor. The active antenna power supply VDD needs to match the active antenna of the application, and it is recommended that the customer use the LDO/DCDC to power the active antenna, so that when the GNSS function is not used, the LDO/DCDC can be turned off to reduce the current consumption.

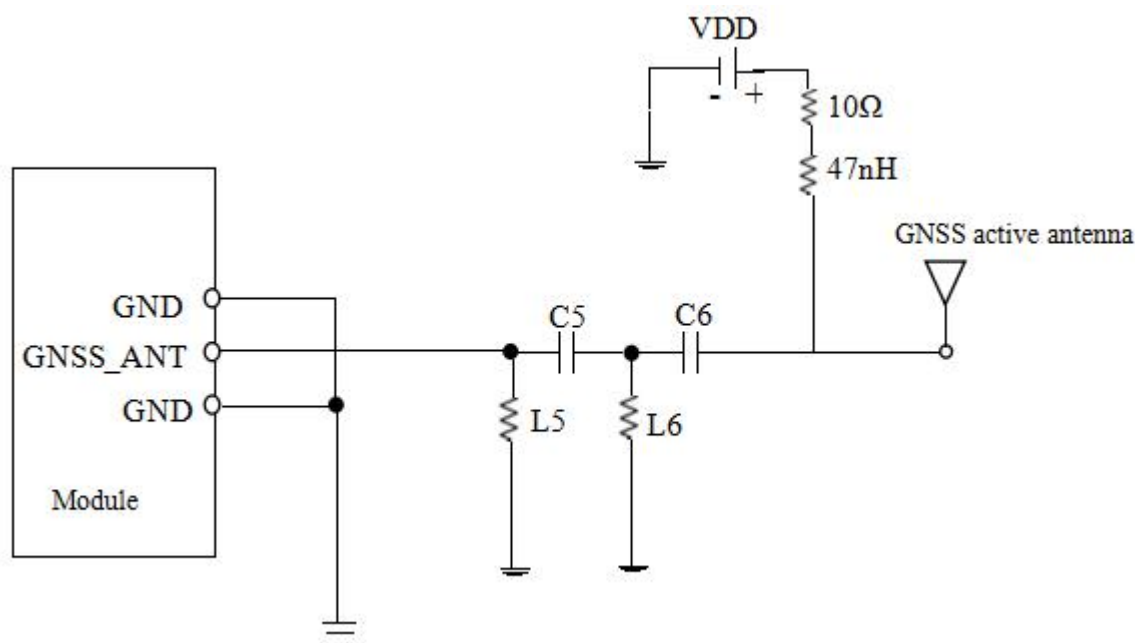


Figure 3-28 GNSS active antenna reference circuit

NOTE

- ✧ CLM920 TE3 module provides three RF antenna interfaces, which are main set antenna, diversity antenna and GPS antenna connection port. The antenna interface must be 50 ohm characteristic impedance trace.
- ✧ In actual use, according to the user's circuit board routing, the antenna factory debugs and optimizes the matching device parameter values. The motherboard C1/C2/C3/C4/C5/C6 defaults to 33pF, L1/L2/L3/L4/L5/L6 defaults. Empty stickers, in order to prevent static damage to the



inside of the module, it is recommended to attach a two-way TVS tube at the antenna connection D1/D2/D3.

- ✧ The parasitic capacitance of the TVS tube pin itself must be small to avoid signal interference. The ESD protection component used on the antenna must take into account the frequency band used by the antenna and the minimum parasitic capacitance that can be accepted by different frequency bands. The ESD protection component usually used on the antenna must have a parasitic capacitance value of less than 0.5pF or even more. low.
- ✧ Antenna impedance traces need to be away from digital signal lines, power supply and other interference signals
- ✧ Antenna impedance traces require three-dimensional grounding and isolation on both sides of the trace.

3.17.4 RF trace reference

For the user, the characteristic impedance of all RF signal lines should be controlled at 50Ω . The impedance of the RF signal line is determined by the dielectric constant of the material, the trace width (W), the ground clearance (S), and the height (H) of the reference ground plane. Use the impedance simulation tool to calculate the impedance of the RF trace. The control of the PCB's characteristic impedance is usually done in microstrip and coplanar waveguides.

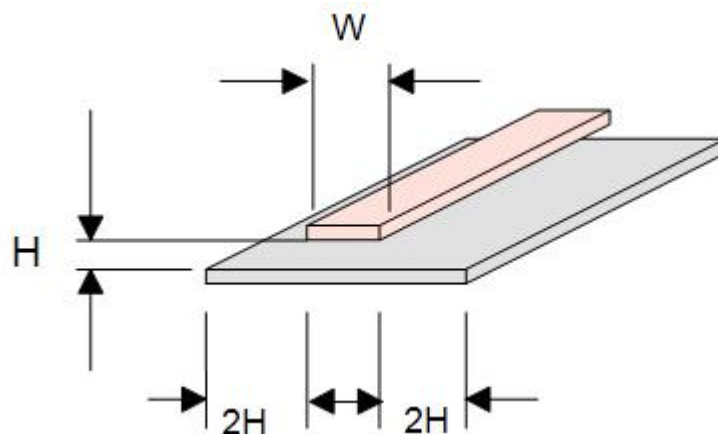


Figure 3- 29 The complete structure of the two-layer PCB microstrip line

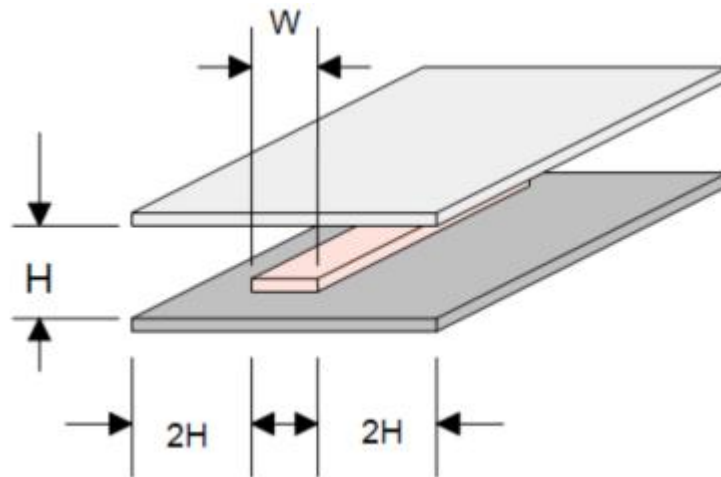


Figure 3-30 The complete structure of the multilayer PCB strip line

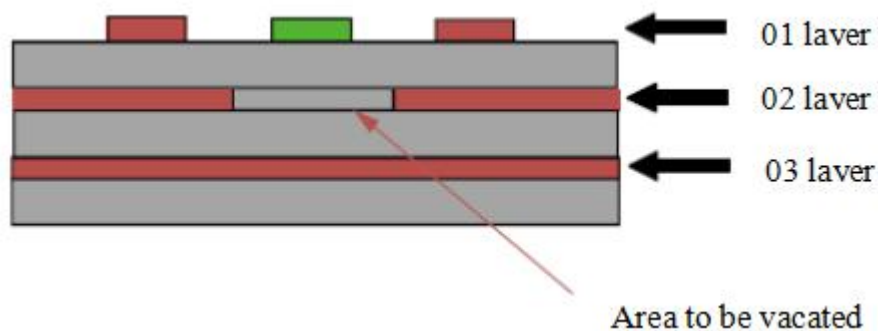


Figure 3-31 Reference ground is the third layer PCB microstrip transmission line structure

3.17.5 RF connector size

- ✧ If the RF connector is used, the antenna connector must use a coaxial connector with a 50 ohm characteristic impedance.
- ✧ Hirose's U.F.L-R-SMT connector is recommended.

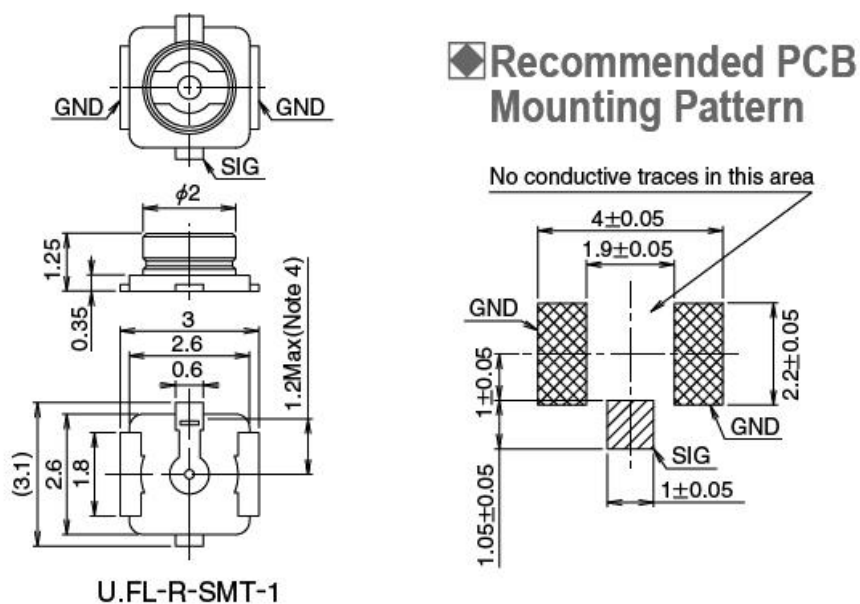


Figure 3-32 RF connector size chart

The RF connector plug for this connector is the U.FL-LP series from HRS.

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

Figure 3-33 Antenna connector matching plug diagram

Table 3-25 Main parameters of the RF connector

Rated condition		Environmental conditions
Frequency Range	DC to 6GHZ	- 40° C to +85° C
Sexual impedance	50 Ω	- 40° C to +85° C

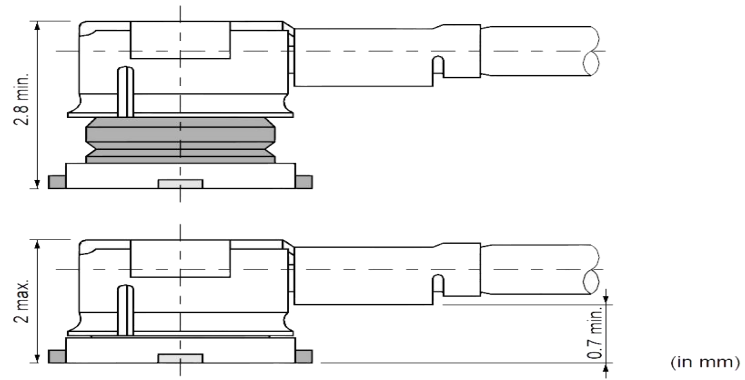


Figure 3-34 Matching coaxial RF line size



Chapter 4. Overall technical indicators

4.1 Chapter overview

The CLM920 TE3 Module RF General Specifications contain the following sections:

- ✧ working frequency;
- ✧ Conducted radio frequency measurement;
- ✧ Conducted receiving sensitivity and transmitting power;
- ✧ GNSS reception performance
- ✧ Antenna requirements
- ✧ Module power consumption characteristics

4.2 GNSS reception performance

Table 4-1 Main parameters of GNSS

Parameter	Comment	Min	Typ	Max	Unit
GPS L1 frequency	Center frequency 1575MHz	1574.4		1576.4	MHz
GLONASS frequency	Center frequency 1601.7MHz	1597.5		1605.9	MHz
BeiDou frequency	Center frequency 1561MHz	1559.1		1563.1	MHz
Galileo E1	Center frequency 1575.42MHz	1573.4		1577.5	MHz
GNSS Support channel	55 channels				
GNSS positioning accuracy	Unobstructed open space	2.5	3		M
GNSS sensitivity	Cold start		-145		dBm
GNSS sensitivity	Recapture		-157		dBm
GNSS sensitivity	track		-158		dBm
GNSS positioning time	Cold start		35		S
GNSS positioning time	Warm start		30		S
GNSS positioning time	Hot Start		2		S
GNSS update frequency	Default 1 Hz		1		Hz



GNSS data format	NMEA-0183				
GNSS current consumption			80	100	mA

4.3 working frequency

Table 4-2 RF frequency table

Frequency band	Uplink frequency	Downstream frequency	mode
LTE B1	1920MHz - 1980MHz	2110MHz - 2170MHz	FDD
LTE B3	1710MHz - 1785MHz	1805MHz - 1880MHz	FDD
LTE B5	824MHz - 849MHz	869MHz - 894MHz	FDD
LTE B7	2500MHz - 2570MHz	2620 MHz - 2690 MHz	FDD
LTE B8	880 MHz - 915 MHz	925 MHz - 960 MHz	FDD
LTE B20	832 MHz - 862 MHz	791 MHz - 821 MHz	FDD
LTE B38	2570MHz - 2620MHz	2570MHz - 2620MHz	TDD
LTE B39	1880MHz - 1920MHz	1880MHz - 1920MHz	TDD
LTE B40	2300MHz - 2400MHz	2300MHz - 2400MHz	TDD
LTE B41	2555MHz - 2655MHz	2555MHz - 2655MHz	TDD
GSM850	824MHz - 849MHz	869MHz - 894MHz	GSM
GSM900	880MHz - 915MHz	925MHz - 960MHz	GSM
GSM1800	1710MHz - 1785MHz	1805MHz - 1880MHz	GSM
UMTS B1	1920MHz - 1980MHz	2110MHz - 2170MHz	WCDMA
UMTS B5	824MHz - 849MHz	869MHz - 894MHz	WCDMA
UMTS B8	880MHz - 915MHz	925MHz - 960MHz	WCDMA
TDS B34	2010MHz - 2025MHz	2010MHz - 2025MHz	TD-SCDMA
TDS B39	1880MHz - 1920MHz	1880MHz - 1920MHz	TD-SCDMA
BC0	824MHz - 849MHz	869MHz - 894MHz	CDMA

4.4 Conducted radio frequency measurement

4.4.1 test environment

Table 4-3 Test instruments

test instrument	power supply	Murata coaxial RF line
R&S CMW500	Agilent 66319	MXHP32HP1000



4.4.2 standard test

The CLM920 TE3 module passes the 3GPP TS 51.010-1, 3GPP TS 34.121-1, 3GPP TS 36.521-1, 3GPP2 C.S0011 and 3GPP2 C.S0033 test standards. Each module is rigorously tested at the factory to ensure reliable quality.

4.5 Conducted receiving sensitivity and transmit power

The CLM920 TE3 module 2G and 3G receive sensitivity and transmit power test indicators are as follows:

Table 4-4 2G3G RF indicators

mode	Up	Down	power	Receiving sensitivity
GSM 850	824MHz - 849MHz	869MHz - 894MHz	$33 \pm 2\text{dBm}$	$< -108\text{dBm}$
GSM 900	880MHz - 915MHz	925MHz - 960MHz	$33 \pm 2\text{dBm}$	$< -109\text{dBm}$
GSM 1800	1710MHz - 1785MHz	1805MHz - 1880MHz	$30 \pm 2\text{dBm}$	$< -109\text{dBm}$
WCDMA B1	1920MHz - 1980MHz	2110MHz - 2170MHz	$23+2/-2\text{dBm}$	$< -109\text{dBm}$
WCDMA B5	824MHz - 849MHz	869MHz - 894MHz	$23+2/-2\text{dBm}$	$< -109\text{dBm}$
WCDMA B8	880MHz - 915MHz	925MHz - 960MHz	$23+2/-2\text{dBm}$	$< -109\text{dBm}$
TD-SCDMA B34	2010MHz - 2025MHz	2010MHz - 2025MHz	$24+1/-3\text{dBm}$	$< -109\text{dBm}$
TD-SCDMA B39	1880MHz - 1920MHz	1880MHz - 1920MHz	$24+1/-3\text{dBm}$	$< -109\text{dBm}$
EVDOorA	824MHz - 849MHz	869MHz - 894MHz	$23+2/-2\text{dBm}$	$< -108\text{dBm}$

The CLM920 TE3 module 4G receiving sensitivity and transmit power test indicators are as follows:

Table 4-5 4G RF sensitivity indicators

Directory (sensitivity)	3GPP	protocol	Min	typical	max
-------------------------	------	----------	-----	---------	-----



	requirements			
LTE B1 (FDD QPSK pass) 95%)	< - 96.3(10 MHz)		-99	-98
LTE B3 (FDD QPSK pass) 95%)	< - 93.3(10 MHz)		-97	-96
LTE B5 (FDD QPSK pass) 95%)	< - 94.3(10 MHz)		-97	-96
LTE B7 (TDD QPSK pass) 95%)	< - 94.3(10 MHz)		-97	-96
LTE B8 (TDD QPSK pass) 95%)	< - 93.3(10 MHz)		-97	-96
LTE B20 (TDD QPSK pass) 95%)	< - 93.3(10 MHz)		-96	-95
LTE B38 (TDD QPSK pass) 95%)	< - 96.3(10 MHz)		-98	-97
LTE B39 (TDD QPSK pass) 95%)	< - 96.3(10 MHz)		-99	-98
LTE B40 (TDD QPSK pass) 95%)	< - 96.3(10 MHz)		-99	-98
LTE B41 (TDD QPSK pass) 95%)	< - 96.3(10 MHz)		-98	-97

Table 4-6 4G RF transmit power indicators

Directory	3GPP Protocol Requirements (dBm)	min	typical	max
LTE B1	21 to 25	22	23	24
LTE B3	21 to 25	22	23	24
LTE B5	21 to 25	22	23	24
LTE B7	21 to 25	22	23	24
LTE B8	21 to 25	22	23	24
LTE B20	21 to 25	22	23	24
LTE B38	21 to 25	22	23	24
LTE B39	21 to 25	22	23	24
LTE B40	21 to 25	22	23	24
LTE B41	21 to 25	22	23	24

4.6 Antenna requirements

CLM920 TE3 module main set antenna and GNSS antenna design requirements:

Table 4-7 Main set antenna indicator requirements

Frequency band	Standing wave ratio	Antenna gain	effectiveness	TRP	TIS
GSM850	<2.5:1	> -4dbi	> 40%	29	<-102
GSM900	<2.5:1	> -4dbi	> 40%	29	<-102
GSM1800	<2.5:1	> -4dbi	> 40%	26	<-102



B1 FDD	<2.5:1	> -4dbi	> 40%	19	<-94
B3 FDD	<2.5:1	> -4dbi	> 40%	19	<-91
B5 FDD	<2.5:1	> -4dbi	> 40%	19	<-94
B7 FDD	<2.5:1	> -4dbi	> 40%	19	<-94
B8 FDD	<2.5:1	> -4dbi	> 40%	19	<-94
B20 FDD	<2.5:1	> -4dbi	> 40%	19	<-94
B38 TDD	<2.5:1	> -4dbi	> 40%	19	<-93
B39 TDD	<2.5:1	> -4dbi	> 40%	19	<-93
B40 TDD	<2.5:1	> -4dbi	> 40%	19	<-93
B41 TDD	<2.5:1	> -4dbi	> 40%	19	<-93
WCDMA B1	<2.5:1	> -4dbi	> 40%	19	<-106
WCDMA B5	<2.5:1	> -4dbi	> 40%	19	<-106
WCDMA B8	<2.5:1	> -4dbi	> 40%	19	<-106
EVDOorA	<2.5:1	> -4dbi	> 40%	19	<-106
B34 TDS	<2.5:1	> -4dbi	> 40%	19	<-106
B39 TDS	<2.5:1	> -4dbi	> 40%	19	<-106

Table 4-8 GNSS antenna indicator requirements

Frequency band	Standing wave ratio	Active antenna noise figure	Active antenna gain	Active antenna embedded LNA gain
GPS L1 1575.41+/-1.023 MHZ	<2:1	<1.5DB	>-2DBi	20DB
GLONASS 1597.5-1605.8 MHZ	<2:1	<1.5DB	>-2DBi	20DB
BeiDou 1559.05-1563.1 4MHZ	<2:1	<1.5DB	>-2DBi	20DB
Galileo E1 1573.4-1577.5 MHZ	<2:1	<1.5DB	>-2DBi	20DB



4.7 Power consumption characteristics

Table 4-9 Three major operators' live network sleep and idle power consumption (GNSS off)

Operator	System	condition	mode	Current consumption mA
CMCC	GSM	GPS off, no USB connection	Sleep mode	1.5
			Idle mode	18.1
	LTE	GPS off, no USB connection	Sleep mode	1.0
			Idle mode	12.6
CUCC	GSM	GPS off, no USB connection	Sleep mode	2.3
			Idle mode	17.9
	WCDMA	GPS off, no USB connection	Sleep mode	2.3
			Idle mode	17.9
	LTE	GPS off, no USB connection	Sleep mode	2.3
			Idle mode	17.9
CTCC	CDMA	GPS off, no USB connection	Sleep mode	2.1
			Idle mode	17.8
	EVDO	GPS off, no USB connection	Sleep mode	2.0
			Idle mode	17.7
	LTE	GPS off, no USB connection	Sleep mode	1.6
			Idle mode	17.2
	SRLTE	GPS off, no USB connection	Sleep mode	2.2
			Idle mode	18.0

Table 4-10 Call Power Consumption (GNSS Off)

Frequency band	Power level	Current consumption mA
EGSM900	5	270
DCS1800	0	190
WCDMA B1	24dBm	480
WCDMA B5	24dBm	460
WCDMA B8	24dBm	470
TD-SCDMA 1900	24dBm	152
TD-SCDMA 2000	24dBm	151
CDMA BC0	24dBm	350



Table 4-11 GPRS data transmission power consumption (GNSS off)

Frequency band	condition	Power level	Current consumption mA
EGSM900	1 received 4 rounds	5	280
DCS1800	1 received 4 rounds	0	190
EGSM900	1 received 4 rounds	5	480
DCS1800	1 received 4 rounds	0	460

Table 4-12 EDGE Data Transmission Power Consumption (GNSS Off)

Frequency band	condition	Power level	Current consumption mA
EGSM900	1 received 4 rounds	8	280
DCS1800	1 received 4 rounds	2	320
EGSM900	1 received 4 rounds	8	220
DCS1800	1 received 4 rounds	2	210

Table 4-13 HSDPA data transmission power consumption (GNSS off)

Frequency band	Power dBm	Current consumption mA
WCDMA B1	23	440
WCDMA B5	23	430
WCDMA B8	23	450

Table 4-14 TD-SCDMA Data Transmission Power Consumption (GNSS Off)

Frequency band	Power dBm	Current consumption mA
TD-SCDMA 1900	23	150
TD-SCDMA 2000	23	155

Table 4-15 EVDO data transmission power consumption (GNSS off)

Frequency band	Power dBm	Current consumption mA
BC0	23	450

Table 4-16 LTE data transmission power consumption (GNSS off)

Frequency band	Test bandwidth	Current consumption mA
LTE-FDD B1	@5Mbps	563
	@10Mbps	570



	@20Mbps	650
LTE-FDD B3	@5Mbps	560
	@10Mbps	570
	@20Mbps	660
LTE-FDD B5	@5Mbps	530
	@10Mbps	540
LTE-FDD B7	@5Mbps	585
	@10Mbps	600
	@20Mbps	655
LTE-FDD B8	@5Mbps	560
	@10Mbps	550
LTE-FDD B20	@5Mbps	520
	@10Mbps	525
	@20Mbps	550
LTE-TDD B38	@5Mbps	300
	@10Mbps	305
	@20Mbps	355
LTE-TDD B39	@5Mbps	317
	@10Mbps	325
	@20Mbps	370
LTE-TDD B40	@5Mbps	330
	@10Mbps	335
	@20Mbps	370
LTE-TDD B41	@5Mbps	320
	@10Mbps	329
	@20Mbps	360



Chapter 5. Interface electrical characteristics

5.1 Chapter overview

- ✧ Working storage temperature
- ✧ Module IO level
- ✧ power supply
- ✧ Electrostatic property
- ✧ Reliability index

5.2 Working storage temperature

Table 5-1 CLM920 TE3 module working storage temperature

parameter	Minimum value	Maximum
Normal operating temperature	-35° C	75° C
Extreme working temperature	-40° C	85° C
storage temperature	-40° C	85° C

5.3 Module IO level

The CLM920 TE3 module IO levels are as follows:

Table 5-2 Electrical Characteristics of CLM920 TE3 Module

parameter	description	Minimum value	Maximum
VIH	High level input voltage	0.65* VDD_EXT	VDD_EXT+0.3V
VIL	Low level input voltage	-	0.35*VDD_EXT
VOH	High level output voltage	VDD_EXT-0.45V	VDD_EXT
VOL	Low level output voltage	0	0.45V

5.4 power supply

The CLM920 TE3 module input power requirements are as follows:

Table 5-3 CLM920 TE3 Module Operating Voltage

parameter	Minimum value	Typical value	Maximum
Input voltage	3.3V	3.7V	4.2V

The power-on time of any interface of the module must not be earlier than the boot time of the



module, otherwise the module may be abnormal or damaged.

5.5 Electrostatic property

There is no overvoltage protection inside the CLM920 TE3 module. When the module is used, the ESD needs to be protected to ensure product quality.

- ✧ EMC design recommendations:
- ✧ The USB port needs to add TVS on VDD, D+, D- for protection, and the TVS parasitic capacitance on D+/D- is $< 2 \text{ pF}$;
- ✧ The module's USIM card external pin needs to be TVS protected for parasitic capacitance requirements $< 10 \text{ pF}$.
- ✧ At the module input power supply, increase the TVS. It is recommended that the clamp voltage VCL (Clamping Voltage) is less than 12 V and the peak power PPP (Peak Pulse Power) is not less than 100 W.
- ✧ The protective device PCB layout should be as close as possible to the “V” shaped line to avoid the “T” shaped line.
- ✧ The ground plane around the module guarantees integrity and should not be split.
- ✧ ESD control of the surrounding environment and operators needs to be taken into account during module production, assembly and laboratory testing.

Table 5-4 CLM920 TE3 ESD Features

Test port	Contact discharge	Air discharge	unit
USB interface	± 4	± 8	KV
USIM interface	± 4	± 8	KV
Analog voice interface	± 4	± 8	KV
VBAT power supply	± 4	± 8	KV

5.6 Reliability index

Table 5-5 CLM920 TE3 Reliability Test

Test items	Test Conditions	Guideline	Test Results
Low temperature work	Temperature: -40°C Working mode: normal work Test duration: 24 h	IEC60068-2-1	Visual inspection: normal Function check: normal RF indicator check: normal



High temperature work	Temperature: 85oC Working mode: normal work Test duration: 24 h	JESD22-A108-C	Visual inspection: normal Function check: normal RF indicator check: normal
Temperature cycle	High temperature: 85oC Low temperature: - 40oC Working mode: normal work Test duration: 30 Cycles;1 h+1h /cycle	JESD22-A105-B	Visual inspection: normal Function check: normal RF indicator check: normal
Alternating hot and humid	High temperature: 55oC Low temperature: 25oC Humidity: 95% $\pm$ 3% Working mode: normal work Test duration: 6 Cycles;12 h+12 h/cycle	JESD22-A101-B	Visual inspection: normal Function check: normal RF indicator check: normal
Temperature shock	High temperature: 85oC Low temperature: - 40oC Temperature change time: < 30s Working mode: no packaging, no Power on, do not boot Test duration: 100 Cycles;15 min+15 Min/cycle	JESD22-A106-B	Visual inspection: normal Function check: normal RF indicator check: normal
Drop test	Height 0.8 m, 6 sides each time, dropped to the horizontal marble platform Working mode: no packaging, no Power on, do not boot	IEC60068-2-32	Visual inspection: normal Function check: normal RF indicator check: normal



Drop test...	Temperature: - 40oC Working mode: no packaging, no power, no boot Test duration: 24 h	JESD22-A119-C	Visual inspection: normal Function check: normal RF indicator check: normal
High temperature storage	Temperature: 85oC Working mode: no packaging, no power, no boot Test duration: 24 h	JESD22-A103-C	Visual inspection: normal Function check: normal RF indicator check: normal



Chapter6. Structural and mechanical properties

6.1 Chapter overview

- ✧ Exterior
- ✧ Module mechanical size

6.2 Exterior

The CLM920 TE3 module is a single-sided PCBA. The appearance of the module is as follows:



Figure 6-1 Appearance of the CLM920 TE3

6.3 CLM920 TE3 module mechanical size

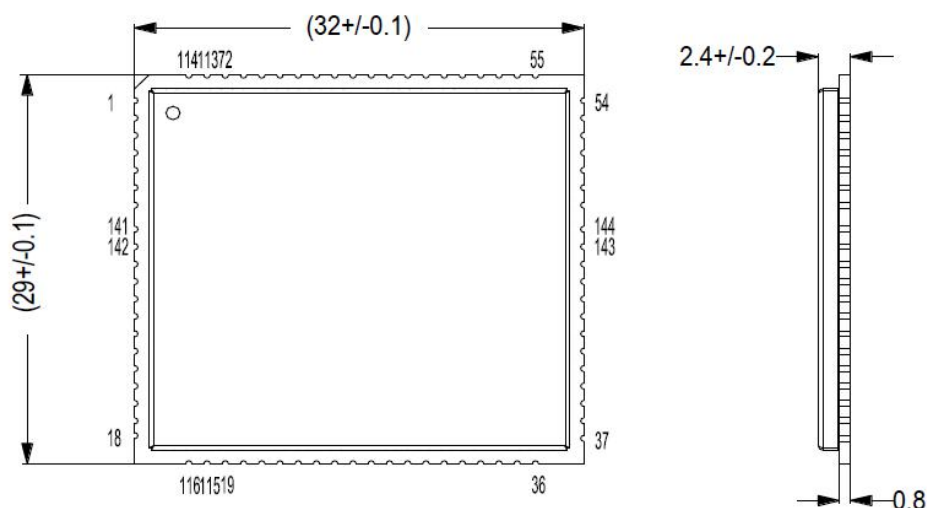


Figure 6-2 Front view and side view of the module (unit: mm)



The figure below shows the bottom view size of the module:

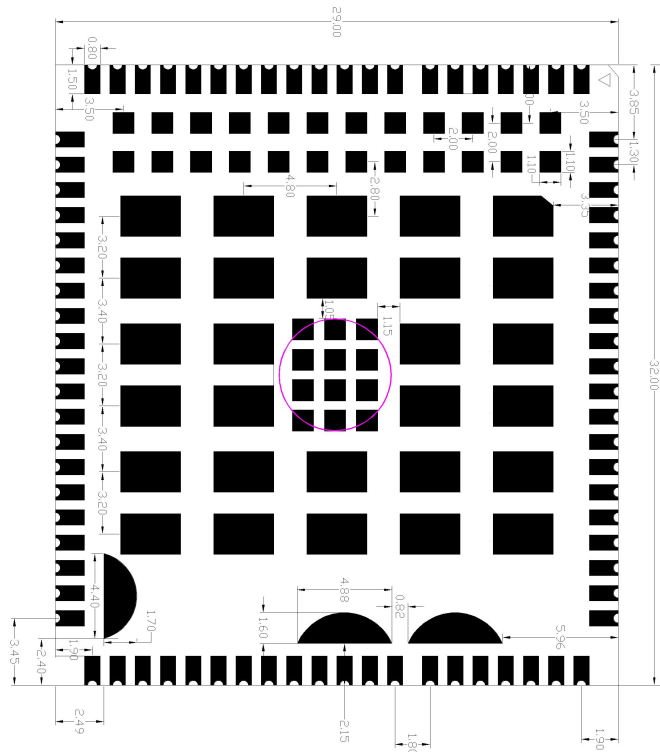


Figure 6-3 Bottom view of the module (unit: mm)

Module recommended package:

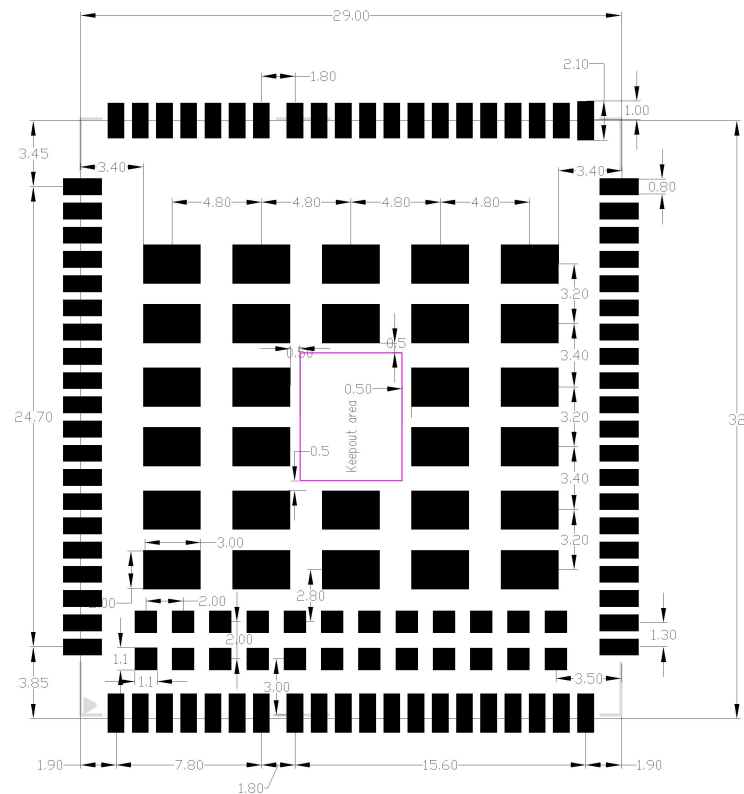


Figure 6-4 Recommended module package (unit: mm)



Chapter7. Packaging and production

7.1 Chapter overview

- ✧ Module packaging and storage
- ✧ Production welding

7.2 Module packaging and storage

The CLM920 TE3 module is packaged in a tray and packaged in a vacuum-sealed bag, with a 10PCS package and a 100PCS package, shipped as a vacuum-sealed bag.

The storage of the CLM920 TE3 module module is subject to the following conditions:

- ✧ The module has a moisture sensitivity rating of 3.
- ✧ When the ambient temperature is greater than 40 degrees Celsius and the air humidity is less than 90%, the module can be stored in a vacuum sealed bag for 12 months.
- ✧ When the vacuum sealed bag is opened, if the ambient temperature of the module is lower than 30 degrees Celsius and the air humidity is less than 60%, the factory can complete the patch within 72 hours, and the module can directly perform reflow soldering or other high temperature process.
- ✧ If the module is in other conditions, it needs to be baked before the patch.
- ✧ If the module needs to be baked, remove the module and bake for 48 hours at 125 degrees Celsius (allowing fluctuations of up to 5 degrees Celsius).

7.3 Production welding

The CLM920 TE3 module is packaged in an anti-static tray. The SMT wire body needs to be equipped with a Tray module. It is recommended to use a reflow oven above 7 temperature zones.

- ✧ To ensure the quality of the module paste, the thickness of the stencil corresponding to the pad portion of the CLM920 TE3 module is recommended to be 0.18 mm.
- ✧ The recommended reflow temperature is 235~245oC, which cannot exceed 260oC.
- ✧ When the PCB is laid out on both sides, the LGA module layout must be machined on the 2nd side. Avoid module falling parts, welding and welding, and poor internal welding of the module caused by the gravity of the module.



The recommended furnace temperature curve is shown below:

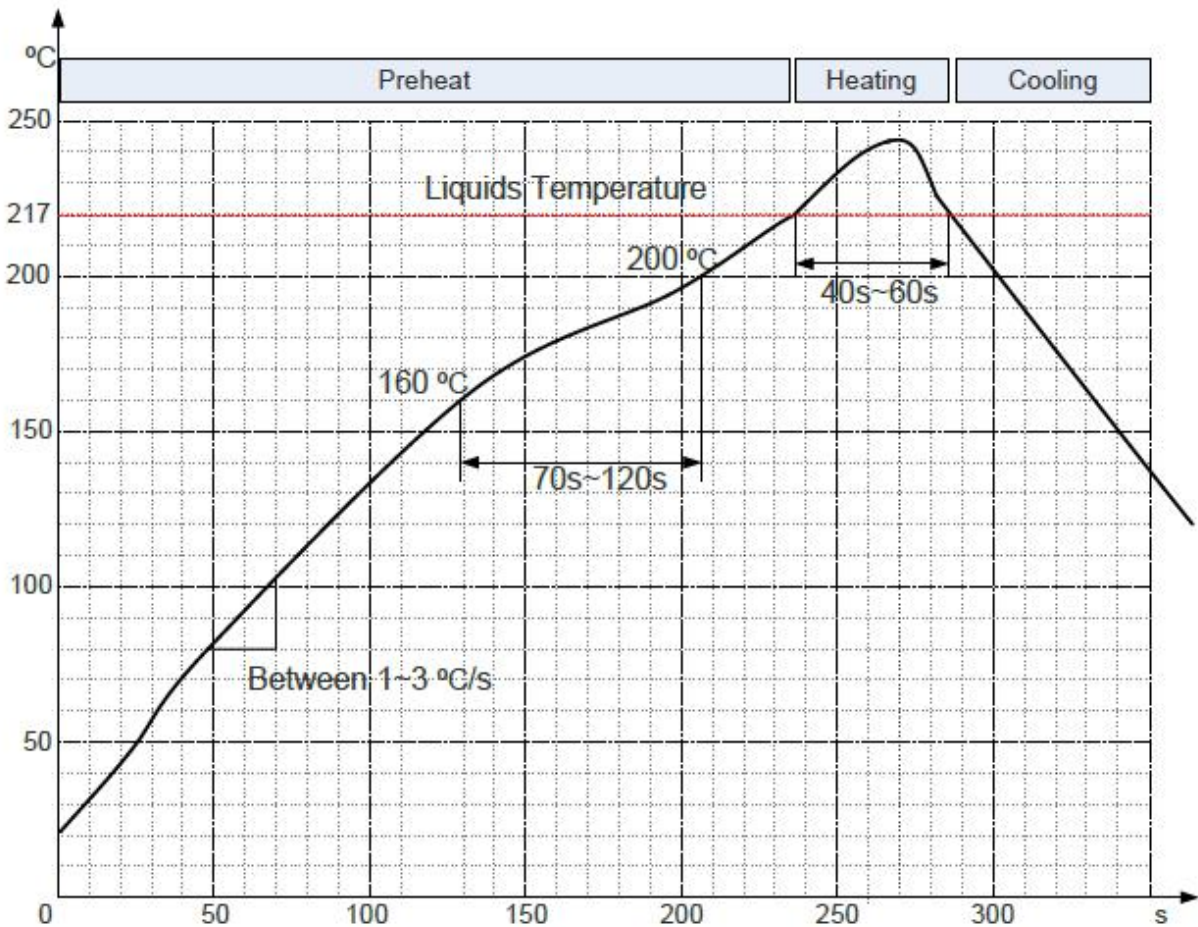


Figure 7-1 Reflow soldering temperature graph

Table 7-1 Reflow process parameter table

Warm zone	time	key parameter
Preheating zone (4°C~ 165°C)		Heating rate: 1°C/ s ~ 3°C / s
Temperature zone (160°C~210°C)	(t1~t2) : 70s~120s	
Recirculation zone (> 217 °C)	(t3~t4) : 40s~60s	Peak temperature: 235 °C ~ 245 °C
Cooling zone	Cooling rate: 2°C/s ≤ Slope ≤ 5°C/s	



Chapter 8. Appendix

8.1 Chapter overview

- ✧ Abbreviations
- ✧ Encoding
- ✧ Safety and precautions

8.2 Abbreviations

Table 8-1 Abbreviations

Abbreviations	Full name
3GPP	Third Generation Partnership Project
AP	Access Point
AMR	Adaptive Multi-rate
BER	Bit Error Rate
CCC	China Compulsory Certification
CDMA	Code Division Multiple Access
CE	European Conformity
CSD	Circuit Switched Data
CTS	Clear to Send
DC	Direct Current
DTR	Data Terminal Ready
DL	Down Link
DTE	Data Terminal Equipment
DRX	Discontinuous Reception
EDGE	Enhanced Data Rate for GSM Evolution
EU	European Union
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
FCC	Federal Communications Commission
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
HSDPA	High-Speed Downlink Packet Access
HSPA	Enhanced High Speed Packet Access
HSUPA	High Speed Up-link Packet Access



IMEI	International Mobile Equipment Identity
LED	Light-Emitting Diode
LTE	Long Term Evolution
NC	Not Connected
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PDU	Protocol Data Unit
PMU	Power Management Unit
PPP	Point-to-point protocol
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RoHS	Restriction of the Use of Certain Hazardous Substances
SMS	Short Message Service
TIS	Total Isotropic Sensitivity
TVS	Transient Voltage Suppressor
TX	Transmitting Direction
UART	Universal Asynchronous Receiver-Transmitter
UMTS	Universal Mobile Telecommunications System
USIM	Universal Subscriber Identity Module
USSD	Unstructured Supplementary Service Data
VSWR	Voltage Standing Wave Ratio
WCDMA	Wideband Code Division Multiple Access
WWAN	Wireless Wide Area Network

8.3 Encoding

Table 8-2 Time slot allocation table for different levels of GPRS/EDGE

Slot class	DL slot number	UL slot number	Active slot number
1	1	1	2
2	2	1	3
3	2	2	3
4	3	1	4
5	2	2	4
6	3	2	4



7	3	3	4
8	4	1	5
9	3	2	5
10	4	2	5
11	4	3	5
12	4	4	5

Table 8-3 Maximum GPRS rate

GPRS coding scheme	Max data rata (4 slots)	Modulation type
CS 1 = 9.05 kb/s / time slot	36.2 kb/s	GMSK
CS 2 = 13.4 kb/s / time slot	53.6 kb/s	GMSK
CS 3 = 15.6 kb/s / time slot	62.4 kb/s	GMSK
CS 4 = 21.4 kb/s / time slot	85.6 kb/s	GMSK

Table 8-4 Maximum EDGE Rate

GPRS coding scheme	Max data rata (4 slots)	Modulation type
MCS 1 = 8.8 kb/s/ time slot	35.2 kb/s	GMSK
MCS 2 = 11.2 kb/s/ time slot	44.8 kb/s	GMSK
MCS 3 = 14.8 kb/s/ time slot	59.2 kb/s	GMSK
MCS 4 = 17.6 kb/s/ time slot	70.4 kb/s	GMSK
MCS 5 = 22.4 kb/s/ time slot	89.6 kb/s	8PSK
MCS 6 = 29.6 kb/s/ time slot	118.4 kb/s	8PSK
MCS 7 = 44.8 kb/s/ time slot	179.2 kb/s	8PSK
MCS 8 = 54.4 kb/s/ time slot	217.6 kb/s	8PSK
MCS 9 = 59.2 kb/s/ time slot	236.8 kb/s	8PSK

Table 8-5 Maximum HSDPA rate

HSDPA device category	Max data rate (peak)	Modulation type
Category 1	1.2Mbps	16QAM,QPSK
Category 2	1.2Mbps	16QAM,QPSK
Category 3	1.8Mbps	16QAM,QPSK
Category 4	1.8Mbps	16QAM,QPSK
Category 5	3.6Mbps	16QAM,QPSK
Category 6	3.6Mbps	16QAM,QPSK



Category 7	7.2Mbps	16QAM,QPSK
Category 8	7.2Mbps	16QAM,QPSK
Category 9	10.2Mbps	16QAM,QPSK
Category 10	14.4Mbps	16QAM,QPSK
Category 11	0.9Mbps	QPSK
Category 12	1.8Mbps	QPSK
Category 13	17.6Mbps	64QAM
Category 14	21.1Mbps	64QAM
Category 15	23.4Mbps	16QAM
Category 16	28Mbps	16QAM
Category 17	23.4Mbps	64QAM
Category 18	28Mbps	64QAM
Category 19	35.5Mbps	64QAM
Category 20	42Mbps	64QAM
Category 21	23.4Mbps	16QAM
Category 22	28Mbps	16QAM
Category 23	35.5Mbps	64QAM
Category 24	42.2Mbps	64QAM

Table 8-6 Maximum HSUPA rate

HSUPA device category	Max data rate (peak)	Modulation type
Category 1	0.96Mbps	QPSK
Category 2	1.92Mbps	QPSK
Category 3	1.92Mbps	QPSK
Category 4	3.84Mbps	QPSK
Category 5	3.84Mbps	QPSK
Category 6	5.76Mbps	QPSK

Table 8-7 LTE-FDD DL maximum rate

LTE-FDD device category	Max data rate (peak)	Modulation type
Category 1	10Mbps	QPSK/16QAM/64QAM
Category 2	50Mbps	QPSK/16QAM/64QAM
Category 3	100Mbps	QPSK/16QAM/64QAM
Category 4	150Mbps	QPSK/16QAM/64QAM



Table 8-8 LTE-FDD UL Maximum Rate

LTE-FDD device category	Max data rate (peak)	Modulation type
Category 1	5Mbps	QPSK/16QAM
Category 2	25Mbps	QPSK/16QAM
Category 3	50Mbps	QPSK/16QAM
Category 4	50Mbps	QPSK/16QAM

8.4 Safety and precautions

In order to use the wireless device safely, the terminal device informs the user of the relevant safety information:

- ✧ **Interference:** When the use of wireless devices is prohibited or the use of the device may cause interference and security of the electronic device, turn off the wireless device. Because the terminal will send and receive RF signals when it is powered on. It can interfere with TV, radio, computer or other electrical equipment.
- ✧ **Medical equipment:** In medical and health care facilities where the use of wireless devices is prohibited in the express text, please follow the regulations of the site and turn off the device. Some wireless devices may interfere with the medical device, causing the medical device to malfunction or cause errors. If interference occurs, turn off the wireless device and consult a physician.
- ✧ **Flammable and explosive areas:** In flammable and explosive areas, please turn off your wireless device and follow the relevant label instructions to avoid an explosion or fire. For example; gas stations, fuel zones, chemical products areas, chemical transportation and storage facilities, areas with explosion hazard signs, areas with “turn off radio equipment” signs, etc.
- ✧ **Traffic Safety:** Please comply with local laws or regulations in your country or region regarding the use of wireless devices when driving a vehicle.
- ✧ **Aviation Safety:** When flying, please follow the airline's regulations and regulations regarding the use of wireless devices. Before taking off, turn off the wireless device to prevent wireless signals from interfering with aircraft control signals.
- ✧ **Environmental Protection:** Please comply with local laws regarding the handling of equipment packaging materials, equipment or accessories, and support recycling operations.
- ✧ **Emergency call:** This device uses wireless signals for propagation. Therefore, there is no guarantee that the network can be connected in all situations, so in an emergency. The wireless device cannot be used as the only contact method.