CLM920

Hardware user guide

1 Introduction

This document is CLM920 Mini PCIE module hardware interface manual, designed to describe the hardware of CLM920 , component and function characteristics, application interface definition and user instructions, electrical and mechanical characteristics, etc., provide hardware user guide for user application development based on this product.

Abbreviation

ADC	Analog-Digital Converter
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
ARFCN	Absolute Radio Frequency Channel Number
B2B	Board to Board Connector
BER	Bit Error Rate
CDMA	Code Division Multiple Access
DAI	Digital Audio interface
DAC	Digital-to-Analog Converter
DSP	Digital Signal Processor
DTR	Data Terminal Ready
EFR	Enhanced Full Rate
EMC	Electromagnetic Compatibility
EMI	Electro Magnetic Interference
ESD	Electronic Static Discharge
EVDO	Evolution Data Only
FR	Full Rate
GPRS	General Packet Radio Service
HR	Half Rate
IMEI	International Mobile Equipment Identity
ISO	International Standards Organization
PLL	Phase Locked Loop
PPP	Point-to-point protocol
RAM	Random Access Memory
ROM	Read-only Memory
RTC	Real Time Clock
SMS	Short Message Service
UART	Universal asynchronous receiver-transmitter
UIM	User Identifier Management
USB	Universal Serial Bus
VSWR	Voltage Standing Wave Ratio

2 Product Summary

2.1

CLM920 is a wireless communication module with PCI Express Mini Card 1.2 standard interface, support FDD/TDD/UMTS/EDGE/GSM network and Windows 7/Windows8/Windows 10/Android 4.0 or above OS. It can be used for the following scenes:

- Vehicle equipment
- Wireless POS machine
- Wireless advertising/media
- Remote monitoring
- Intelligent metering
- Mobile Broadband
- Industrial automation
- Other wireless terminal

2.2 Module characteristics

MODEL: CLM920		
Chipset:MDM9607		
Package type		Mini PCIE
Dimension (mm)		51*30*3.8
FDD-LTE 150M DL 50M UL @Cat.4	B2	●
	B4	●
	B5	●
	B7	●
WCDMA 42M DL 5.76M UL	B2	●
	B5	●
GSM 236Kbps DL/UL	B2	●
	B5	●
GPS		●
Analog audio		Optional
Digital audio		●
USB(2.0 High Speed)/UART/USIM		●
NDIS/ECM/Gobinet		●

2.3 Module function

CLM920 includes following circuit units:
- Baseband processing unit
- Power management unit
- Memory unit

- RF transceiver unit
- RF front-end unit
- GPS RF receiving unit
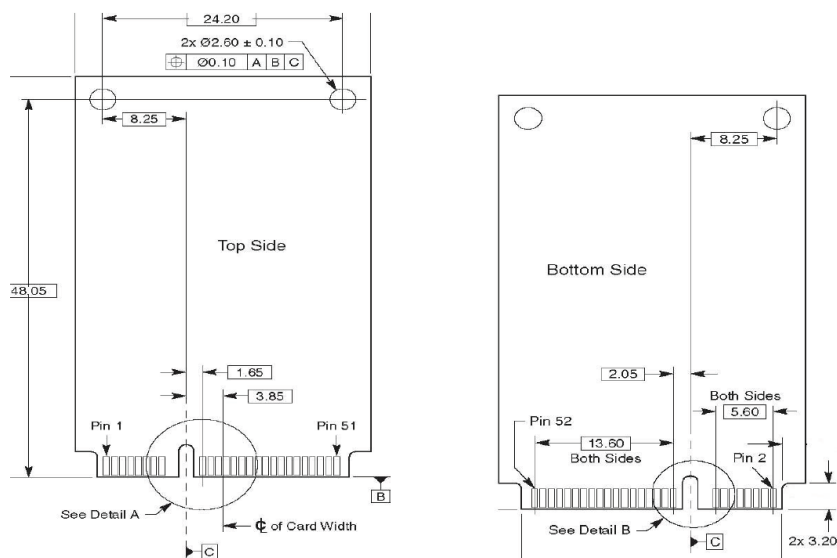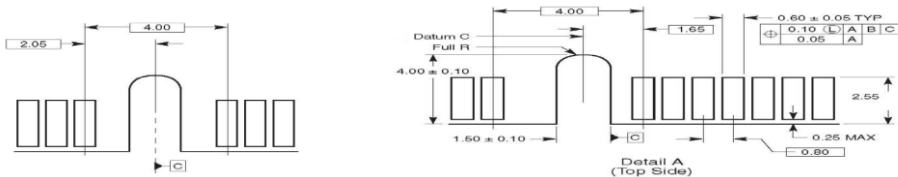
3 Application interface

3.1 Summary

This chapter mainly describes the interface definition and application of this module.
Including the following:
- 52 PIN gold finger
- Interface definition
- Power interface
- USB interface
- USIM interface
- UART interface
- WWAN interface
- PCM/Analog audio interface
- RF antenna interface

3.2 Module interface

3.2.1 52 PIN gold finger

3.2.2 Interface definition

Input and output parameter definition

IO	Bidirectional input and output
PI	Power input
PO	Power output
AI	Analog input
AO	Analog output
DI	Digital input
DO	Digital output

PIN definition

PIN	Standard PIN definition	Module PIN definition	IO	Function	Remarks
1	WAKE#	MIC+	AI	Audio input+	
2	3.3Vaux	VBAT	PI	Power input	
3	COEX1	MIC-	AI	Audio input-	
4	GND	GND		GND	
5	COEX2	SPK+/REC+	AO	Audio output+	AT set headset and speaker mode
6	1.5V	UIM_DET	DI	SIM Hot plug detection	
7	CLKREQ#	SPK-/REC-	AO	Audio output-	AT set headset and speaker mode
8	UIM_PWR	UIM_PWR	PO	SIM power	
9	GND	GND		GND	
10	UIM_DATA	UIM_DATA	IO	SIM data signal	
11	REFCLK-	UART_RX	DI	UART receiving	
12	UIM_CLK	UIM_CLK	DO	SIM clock signal	
13	REFCLK+	UART_TX	DO	UART sending	
14	UIM_RESET	UIM_RESET	DO	SIM reset signal	
15	GND	GND		GND	
16	UIM_VPP	NC			
17	RESERVED	VDD_EXT	PO	1.8V power output	
18	GND	GND		GND	
19	RESERVED	WAKEUP_IN	DI	Sleep mode controlling	
20	W_DISABLE#	RESERVED		RESERVED	
21	GND	GND		GND	
22	PERST#	RESET	DI	Reset controlling	Low level effective

23	PERn0	UART_CTS	DI	UART sending clear	
24	3.3Vaux	VBAT	PI	Power input	
25	PERp0	UART_RTS	DO	UART requests sending	
26	GND	GND		GND	
27	GND	GND		GND	
28	1.5V	ONOFF	AI	Power on	Low level effective
29	GND	GND		GND	
30	SMB_CLK	NC			
31	PETn0	NC			
32	SMB_DATA	WAKEUP_OUT	DO	Module wakeup host	
33	PETp0	NC			
34	GND	GND		GND	
35	GND	GND		GND	
36	USB_D-	USB_DM	IO	USB differential signal-	
37	GND	GND		GND	
38	USB_D+	USB_DP	IO	USB differential signal+	
39	3.3Vaux	VBAT	PI	Power input	
40	GND	GND		GND	
41	3.3Vaux	VBAT	PI	Power input	
42	LED_WWAN#	LED_WWAN	OC	LED indicator	
43	GND	GND		GND	
44	LED_WLAN#	UIM_DET	DI	SIM Hot plug detection	
45	RESERVED	PCM_CLK	DO	PCM Clock pulse	
46	LED_WPAN#	LED	OC	LED indicator	
47	RESERVED	PCM_DOUT	DO	PCM sending data	
48	1.5V	NC			
49	RESERVED	PCM_DIN	DI	PCM receiving data	
50	GND	GND		GND	
51	RESERVED	PCM_SYNC	DO	PCM Frame synchronization signal	
52	3.3Vaux	VBAT	PI	Power input	

NOTE:

- The IO interface level of module is 1.8V (SIM interface level supports 1.8V and 3.3V)
- The RESEVERED and NC PIN is suspended

## 3.3 Power interface

The power interface includes two parts:
- VBAT for module power supply
- USIM_PWR for SIM power supply

Power PIN definition

PIN	Name	I/0	Definition	Min Voltage	Typical Voltage	Max Voltage
2/24/39/41/52	VBAT	PI	Module power	3.3	3.7	4.2

| 8	UIM_PWR	PO	SIM power	0	1.8/2.85	1.98/3.3
4/9/15/18/21/26/27/29/34 /35/37/40/43/50	GND	PI	GND		0	

The module uses a single power supply mode, the module provides 5-way power supply pin, 14-way ground pin to ensure the module's normal operation, all power and ground pins should be connected and get in use. The module power supply range is 3.3 - 4.2V, and it is recommended to use 3.7V/2A power supply. Module in the transmission of data or instant call will produce more than 2A peak current and it's resulting in a larger power supply ripple, so the customer's circuit design of power line should be as short as possible and wide enough. It is recommended to reserve a 220uF capacitors near the power input. It is recommended that customers can use DCDC or LDO

to provide enough current. Then the VBAT is controlled by the MOS tube so that the module can be completely switched off.
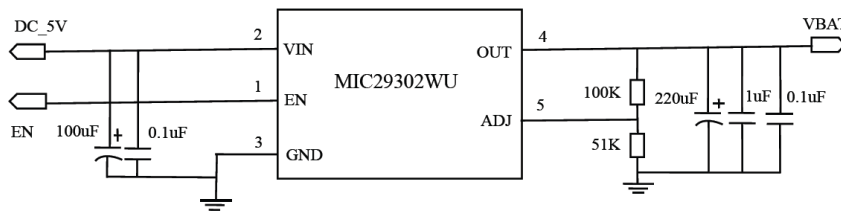
LDO Reference power circuit
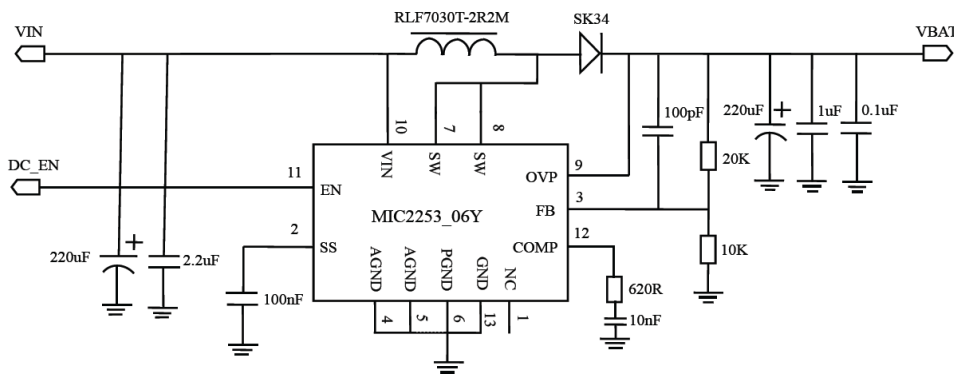
DCDC Reference power circuit
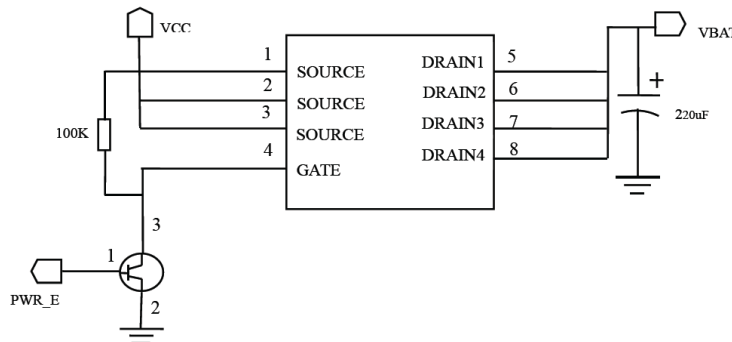
MOS tube control power switch reference circuit

NOTE:

- In order to prevent the damage of the module caused by surge and overvoltage, it is suggested that a 5.1V/500mW zener diode to be connected on the module VBAT pin.
- It is suggested that 3 ceramic capacitors (33pF, 10pF, 100nF) to be added to the VBAT pin and to be placed close to the VBAT pin.
- The minimum operating voltage of the module is 3.3V, because the transmission data or GSM call will produce more than 2A current, resulting in the power supply voltage ripple voltage drop, so the power supply voltage shall not be less than 3.3V.
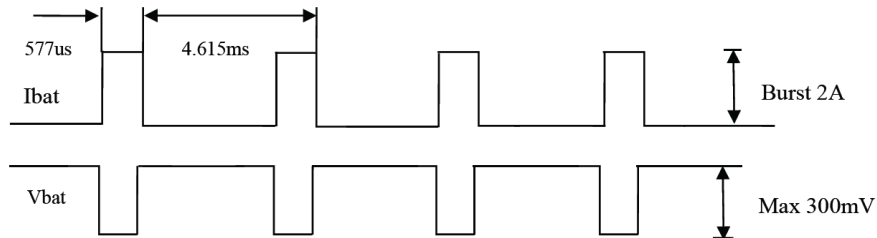
GSM TDMA burst current supply voltage drop

3.4 USB port

The module USB port supports USB2.0 high-speed protocol, supports slave device mode, and does not support USB charging mode. The USB input / output routing needs to follow the USB2.0 characteristic, and the USB interface is defined as follows:

PIN	Signal	IO	Description
36	USB_D-	IO	USB differential signal-
38	USB_D+	IO	USB differential signal+
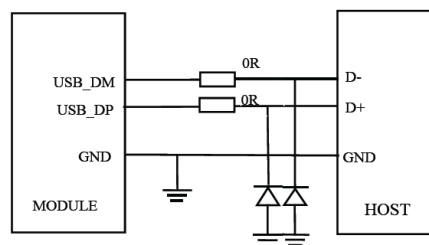
Circuit diagram of USB connection

NOTE:
- USB routing design needs to strictly comply with the requirements of the USB2.0 protocol, note the protection of the data line, differential line, controlling impedance for the line is 90 ohm. The ESD protection device should be added on the data line, and the equivalent capacitance value of the ESD protection device is less than 1pF.
- The power supply voltage of the USB bus is provided inside the module without external supply. At the same time, the USB bus is not provided power. Because of the power of module can only be used as slave device of USB bus.

USB port supports following functions:
- Software download and update
- Data communication
- AT command

3.5 UART port

The module provides a UART port, the serial port level is 1.8V. The AT command can be sent through the serial port, print program log information, etc. The module serial port supports 9600/19200/38400/57600/115200/230400bps baud rate and defaults is 115200bps.

PIN	Signal	I/O	Definition
11	UART_RX	DI	Sending data
13	UART_TX	DO	Receiving data
23	UART_CTS	DI	User enable module sending
25	UART_RTS	DO	Module requests the user to send
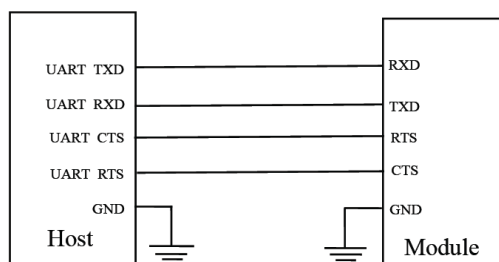
UART port design

Module serial port level is 1.8V, if the serial port needs to be connected with the MCU of 3.3V level, it is necessary to add a level conversion chip to realize the matching, chip connection can refer to the following design:
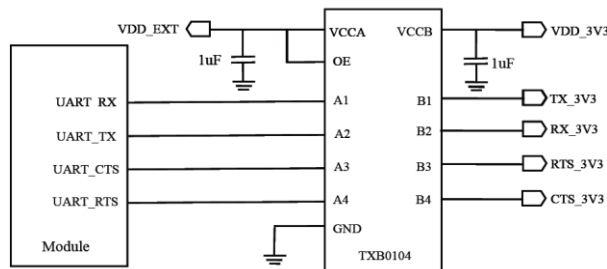

Level conversion circuit

3.6 USIM interface

The module provides a USIM card interface compatible with the ISO 7816-3 standard, and the USIM card power supply is internally powered by the module. The source regulator provides the voltage of 1.8V and 3.0V.

PIN	Signal	I/O	High level	Definition
6	USIM_DET	DI	1.8V	USIM hot plug detection
8	UIM_PWR	PO	1.8V/2.95V	USIM power
10	UIM_DATA	IO	1.8V/2.95V	USIM data
12	UIM_CLK	DO	1.8V/2.95V	USIM clock
14	UIM_RESET	DO	1.8V/2.95V	USIM reset

3.6.1 USIM slot design

The module does not has USIM slot, users need to design USIM slot on their own interface board.

USIM interface reference design diagram is as follow:
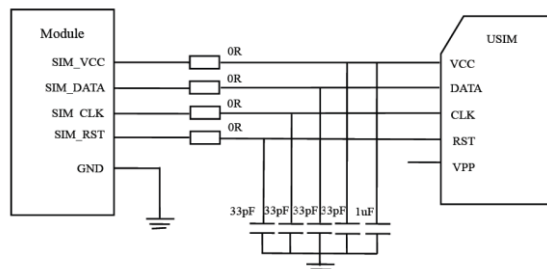
NOTE:

● USIM interface line is recommended to choose ON SEMI SMF15C device to do ESD protection, USIM card peripheral circuit devices should be close to USIM slot.

● The SIM card circuit is susceptible and caused no card. The slot should be placed as far away from the antenna's RF as possible and keep away from the RF line, VBAT and high speed signal line.

● The internal UIM_DATA has been pulled to the USIM_VCC through the 47K resistor, the outside does not need to pull-up.

● USIM_DET is the detection pins of USIM card to detect whether the USIM inserts or does not insert, the default is high level. When hot plug, it needs this pin to detect the USIM status.

● The USIM card and the module's GND needs to maintain good connectivity, UIM_CLK GND should be protected independently.

3.6.2 USIM_DET Hot plug reference design

NO.	USIM_DET status	Definition
1	HIGH	SIM inserted
2	LOW	SIM does not inserted
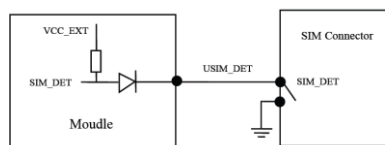
NOTE:

● It is recommended to add a diode protection beside the UIM _DET pin.

● When a normally closed SIM or a normally open SIM card is used, the detection function can be set by the AT command. AT+HOSCFG=1,1 (High level when SIM card is insert)/ AT+HOSCFG=1,0(Low level when SIM card is insert)/ AT+HOSCFG=0.0(Hot plug is disabled)

3.7 GPIO interface

PIN	Signal	I/O	High level	Definition
19	WAKEUP_IN	DI	1.8V	Module sleep control

| 22	RESET	DI	1.8V	Module reset control, low level effective
28	ONOFF	PI	VBAT-0.3V	Low level to power on
32	WAKEUP_OUT	DO	1.8V	Module wakeup host

The module supports sleep wake up function. WAKEUP_IN is the host wakeup module, WAKEUP_OUT is module wakeup host.

Reset: pull this pin down 150-450ms can reset the module, outside the proposed pull-up resistor 10K to VCC_EXT. in module use of an unusual condition or emergency. RESET pin is sensitive to interference and should be paid attention to it when design.
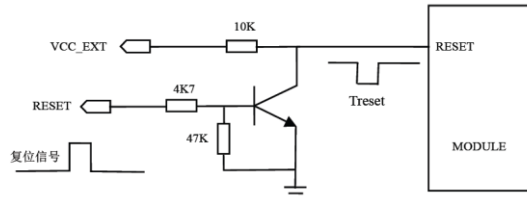
Symbol	Description	Min	Type	Max	Unit
Treset	Low level pulse width	50	100	500	ms
VIH	RESET input high level voltage	1.17	1.8	2.1	V
VIL	RESET input low level voltage	-0.3	0	0.8	V

ONOFF: Pulling down this pin can power on the module.
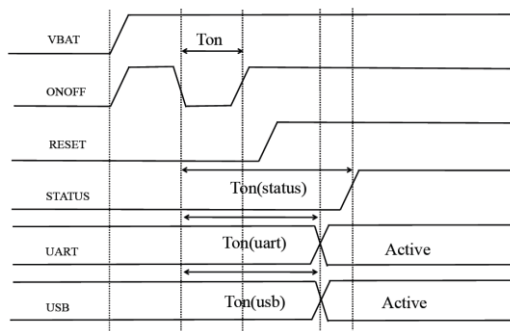
Symbol	Description	Min	Type	Max	Unit
Ton	Booting low level wide	100	500	-	ms
Ton(status)	Boot time (judged by status)	22	-	-	ms
Ton(usb)	Boot time (judged by usb)	-	20	-	ms
Ton(uart)	Boot time (judged by uart)	-	20	-	ms
VIH	RESET input high level voltage	0.6	0.8	1.8	V
VIL	RESET input low level voltage	-0.3	0	0.5	V

3.8 Network instruction interface

The module provides an open GPIO signal to indicate the radio frequency communication state.

| PIN	PIN NO.	I/O	Description
LED_WWAN	42	PI	Network status indicator

Status	LED display
No service	Always light
Module registration is not 4G network	Double flash
Module registration is 4G network or module registration is not 4G network into voice, SMS and other services	Flash quickly
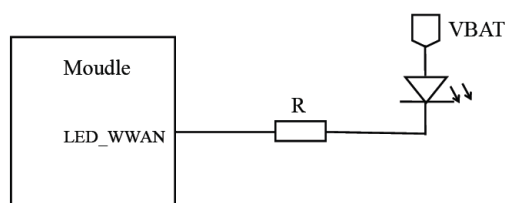
NOTE: The brightness of the LED lamp can be adjusted by adjusting the current limiting resistance, and the maximum current is 40mA.
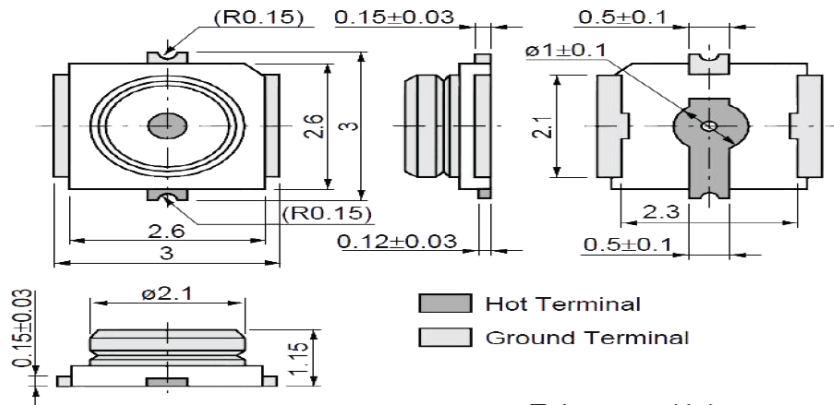
3.9 RF antenna connector
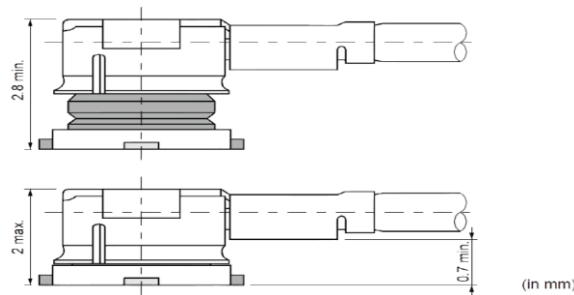
3.9.1 RF antenna connector position
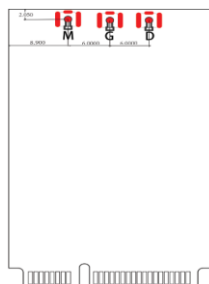
3.9.2 RF antenna connector size

● The antenna connector must use a coaxial connector with 50 ohm characteristic impedance
● Murata's MM9329-2700 connector is recommended

Rated condition	environment condition
Frequency range	DC to 6GHZ –40°C to +85°C
Characteristic impedance	50 Ω –40°C to +85°C

NOTE:

The module provides three channel RF antenna interfaces: main antenna, the diversity antenna and the GPS antenna (optional). The connection with the antenna must be the line of 50 ohm characteristic impedance.

In practical use, according to the user's circuit board line, the antenna factory can optimize the matching device parameter value, the motherboard R1/R2/R3/R4 default is stickered 0 Ohm, C1/C2/C3/C4 default is blank stickers, in order to prevent damage to the internal module of the electrostatic, it is recommended to choose a two-way TVS at the antenna connection D1/D2.
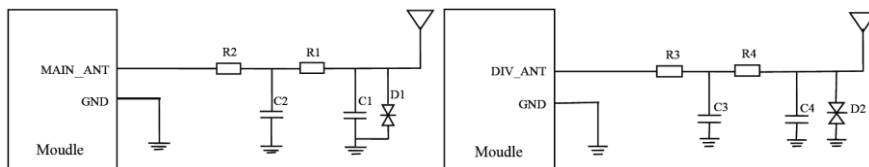
3.10 Analog audio interface

The module provides a set of analog voice interfaces, which consist of one differential input signal (MIC+/MIC-), one way differential output signal SPK+ (REC+) /SPK- (REC-).

PIN	Signal	I/O	Description
1	MIC+	AI	Audio input+
3	MIC-	AI	Audio input-
5	SPK+/REC+	AO	Audio output+
7	SPK-/REC-	AO	Audio output-
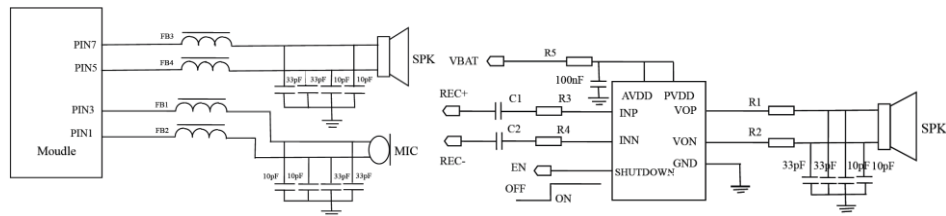
NOTE:

● The MIC+/MIC- channel is used as a microphone differential input, and the Mike signal has the bias voltage needed inside the module without external need. Mike usually uses electret microphone.

● SPK+/SPK- channels are usually used for handles, headphones, or external power amplifiers. If customers need external audio power amplifiers, they are passed AT+CSDVC=4 switch to the headphone channel output signal, and then external audio amplifier amplification signal.

● Audio signal is a sensitive signal, it should be far away from the radiation source and power interface, line as short as possible, and protect sensitive signals.

● In order to prevent the TDD noise, the filter capacitor 10pF and 33pF are reserved to design the audio circuit to remove the RFI signal.

3.11 PCM digital audio

The module provides a set of PCM audio interfaces to support 8 bit A rates, U rates, and 16 bit linear short frame coded lattices. The formula is PCM_SYNC, 8kHZ, PCM_CLK is 2048kHZ.

PIN	Signal	I/O	Description
45	PCM_CLK D0	DO	PCM Clock pulse
47	PCM_DOUT	DO	PCM data output
49	PCM_DIN	DI	PCM data input
51	PCM_SYNC	DO	PCM Frame synchronization signal

Features	Description
Code format	linear
Data bits	16bits
Master-slave mode	Master/slave mode

PCM clock	2048kHz
PCM Frame synchronization signal	Short frame
Data format	MSB
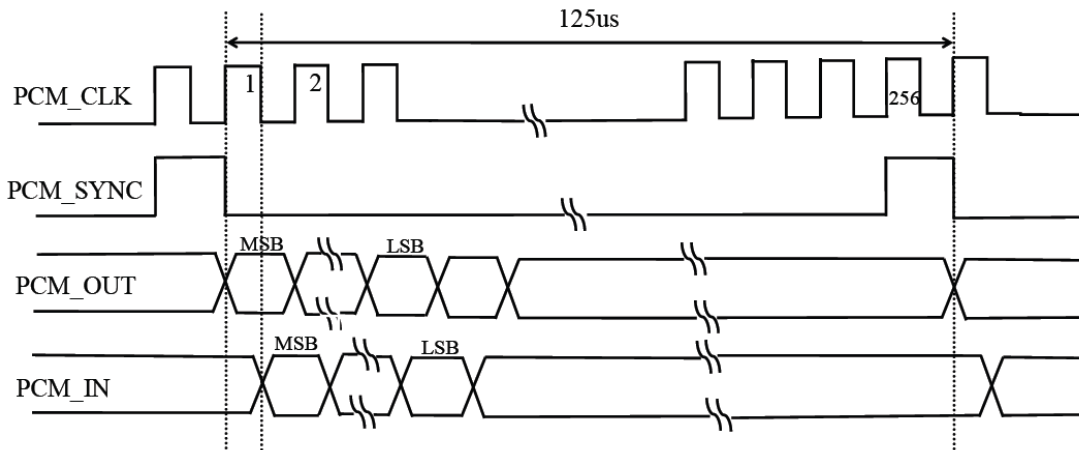
FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment .This equipment should be installed and operated with minimum distance 20cm between the radiator& your body.

FCC Label Instructions
The outside of final products that contains this module device must display a label referring to the enclosed module. This exterior label can use wording such as: "Contains Transmitter Module FCC ID:2AN95-CLM920" or "Contains FCC ID:2AN95-CLM920" Any similar wording that expresses the same meaning may be used.

Single Modular Approval. Output power is conducted. This device is to be used in mobile or fixed applications only. Antenna gain including cable loss must not exceed 5.41dBi in GSM850,11.41dBi in EGPRS850, 2.5dBi in GSM1900, 8.0dBi in EGPRS1900, 10.43dBi in WCDMA Band V, 10.5dBi WCDMA Band II, 11.0dBi in LTE Band 2, 7.0dBi in LTE Band 4, 11.42dBi in LTE Band 5,10.50dBi in LTE Band 7 for the purpose of satisfying the requirements of CFR 47 2.1043 & 2.1091. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operated in conjunction with any antenna or transmitter, except in accordance with FCC multi-transmitter evaluation procedure. Compliance of this device in all final product configurations is the responsibility of the Grantee. Installation of this device into specific final products may require the submission of a Class II permissive change application containing data pertinent to RF Exposure, spurious emissions, ERP/EIRP, and host/module authentication, or new application if appropriate.