PERFECT WIRELESS EXPERIENCE

FIBOCOM MC610 Series Hardware Guide

Version: V1.0.1

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Applicability Type

No.	Product Model	Description
1	MC610-LA-00	Support MAIN_ANT, FDD/GSM, Bluetooth
2	MC610-LA-02	Support MAIN_ANT, FDD/GSM, WIFI-Scan and Bluetooth
3	MC610-EU-02	Support MAIN_ANT, FDD/GSM, WIFI-Scan and Bluetooth

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Change History

Version	Author	Reviewer	Approver	Update	Description
V1.0.1	Xu Kaiqiang	Wang Liuxia	Jin Haibo	2021-06-23	Modify voltage range and RF index, add WIFI /BT index additional MC610-LA-02 additional MC610-EU-02
V1.0.0	Zhao Meiqing	Wang Bo Wang Yuanguang	Liu Ke	2020-11-20	Initial version

Contents

1 About This Document

1.1 Description

This document describes information on electrical characteristics, RF performance, structural dimension, application environment, etc. of the MC610 series wireless module. With the help of this document and other related documents, the application developer can quickly understand the hardware functions of MC610 series modules and develop the hardware of the product.

1.2 Safety Instructions

Observing the following safety principles can ensure personal safety and be conducive to protecting products and work environment from potential damages. Product manufacture should communicate the following safety instructions to end users. If these safety principles are not followed, Fibocom Wireless Inc. will not be responsible for the consequences caused by incorrect use of users.

Road safety first! When you are driving, do not use handheld mobile terminal equipment, even if it has a hands-free function.

Please stop and then call!

Please turn off the mobile terminal equipment before boarding. The wireless function of the mobile terminal is forbidden to be turned on in the aircraft to prevent interference with aircraft communications system.

Ignoring the prompt may lead to flight unsafety and even violation of the law.

Please pay attention to whether there are restrictions on the use of the mobile terminal equipment when in hospitals or health care facilities. RF interference may cause abnormal operation of medical devices. Therefore, it is possible to turn off the mobile terminal equipment.

The mobile terminal equipment does not guarantee effective connection under any circumstances, for example, when the mobile terminal equipment is defaulted or (U) SIM is invalid.

In case of the above situations in an emergency, remember to use the emergency call, and make sure your device is turned on and in an area of sufficient signal strength.

Your mobile terminal equipment will receive and transmit RF signals when it is turned on. RF interference occurs when it is close to televisions, radios, computers or other electronic devices

Keep the mobile terminal equipment away from flammable gases. Please turn off the mobile terminal equipment when it is near gas stations, oil depots, chemical plants or explosive workplaces.

There are potential safety hazards in the operation of electronic devices in any potential explosion hazard area.

1.3 References

This product is designed with reference to the following standards:

- *3GPP TS 51.010-1 V10.5.0: Mobile Station (MS) conformance specification; Part 1: Conformance specification*
- *3GPP TS 34.121-1 V10.8.0: User Equipment (UE) conformance specification; Radio transmission and reception (FDD); Part 1: Conformance specification*
- *3GPP TS 34.122 V10.1.0: Technical Specification Group Radio Access Network; Radio transmission and reception (TDD)*
- *3GPP TS 36.521-1 V13.6.0: User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Conformance testing*
- *3GPP TS 21.111 V10.0.0: USIM and IC card requirements*
- *3GPP TS 51.011 V4.15.0: Specification of the Subscriber Identity Module -Mobile Equipment (SIM-ME) interface*

- *3GPP TS 31.102 V10.11.0: Characteristics of the Universal Subscriber Identity Module (USIM) application*
- *3GPP TS 31.11 V10.16.0: Universal Subscriber Identity Module (USIM) Application Toolkit(USAT)*
- *3GPP TS 36.124 V10.3.0: Electro Magnetic Compatibility (EMC) requirements for mobile terminals and ancillary equipment*
- *3GPP TS 27.007 V10.0.8: AT command set for User Equipment (UE)*
- *3GPP TS 27.005 V10.0.1: Use of Data Terminal Equipment - Data Circuit terminating Equipment (DTE - DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)*

1.4 Related Documents

- FIBOCOM ADP-MC610 User Guide
- FIBOCOM MC610 Series SMT Design Guide
- FIBOCOM MC610 Series Design Guide_RF Antenna
- FIBOCOM MC610 Series AT Commands
- FIBOCOM MC610 GPIO Function Multiplexing
- FIBOCOM MC610 Series Reference Design

2 Product Overview

2.1 Product Introduction

MC610 series module is a kind of broadband wireless terminal product suitable for FDD-LTE multiple network systems and multiple bands.

Item	LTE FDD	LTE TDD	GSM	ANT	Built-in ESIM
MC610-LA-00	Band 1, 2, 3, 4, 5, 7, 8, 28, 66	Not supported	850/900/1800/1900	Main	Not supported
MC610-LA-02	Band 1, 2, 3, 4, 5, 7, 8, 28, 66	Not supported	850/900/1800/1900	Main+WIFI/BT	Not supported
MC610-EU-02	Band1,3,7,8,20,28	Not supported	900/1800	Main+WIFI/BT	Not supported

2.2 Product Specification

Table 2-1 Product Specification

Operating band	See Section 2.1 for details.	
Data transmission	LTE FDD Rel.13	DL/UL 10.3 Mbps (20M) /5.1 Mbps (10M)
	GPRS	85.6Kbps DL/85.6Kbps UL
Power	3.4 V to 4.2 V (recommended value: 3.8 V)	
Temperature	Normal operation: -30°C to +75°C	
	Extended operation: -40°C to +85°C	
	Storage: -40°C to +90°C	
Power consumption	Sleep mode: 1.2 mA	
Physical	Package: LCC 52PIN+LGA 76PIN	

characteristics	Dimensions: 24.2 × 26.2 × 2.1 mm
	Weight: about 2 g.
Interfacing	
Antenna	Antenna: main set ×1, WIFI_SCAN/BT ×1
Functional interface	USIM3.0V/1.8V ×2
	USB2.0 × 1
	System state indicator
	ADCx4, UARTx3, I2C, SPI, KEY, SPK, MIC, HEADMIC, HP
Software	
Protocol stack	Embedded TCP/IP and UDP/IP protocol stack
AT command	3GPP TS 27.007 and 27.005, and proprietary FIBOCOM AT
Firmware update	USB
Voice service	HR, FR, EFR, AMR, caller display, call transfer, call holding, call waiting, multi-party call, etc.
SMS business	Point-to-point MO, MT, cell broadcast, support Text and PDU mode

Note:

When the temperature exceeds the normal operating temperature range of -30°C to +75°C, the RF performance of the module may slightly exceed the 3GPP specification.

2.3 Hardware Diagram

Figure 2-1 shows the main hardware functions of MC610 series modules, including baseband and RF functions.

The baseband section contains:

- LTE FDD controller
- PMIC
- UART, SIM, I2C, SPI, ADC, KEY, SPK, MIC, HEADMIC and HP

The RF part includes:

- RF PA
- RF filter
- Antenna

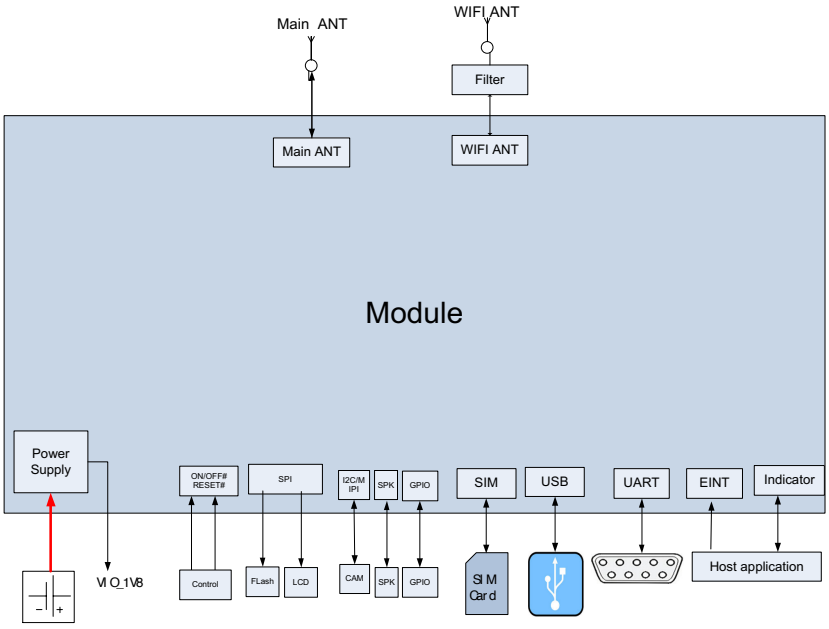

Figure 2-1 Hardware diagram

2.4 Operating Mode

Table 2-2 Operating mode

Mode	Description
Idle	The module is registered on the network, in a standby mode, without data transmission.
Talk/Data	The module is connected to the network, in a working state, with data transmission in the voice call.
Airplane	The RF part of the module does not work, only the baseband part works, which is equivalent to the function of ordinary MCU.
Sleep	In this mode, the module's power consumption will be reduced to a very low level, but the module can still receive paging, SMS, phone calls and TCP/UDP data.
Power off	Power off mode, PMU stops supplying power to the baseband and RF parts, software

	stops working, and the serial port is blocked.But the VBAT pins are still powered up.

3 Application Interface

3.1 LCC+LGA Interface

MC610 series modules are packaged with LCC 52PIN+LGA 76PIN, with 128 pins in total.

3.1.1 Pin Distribution

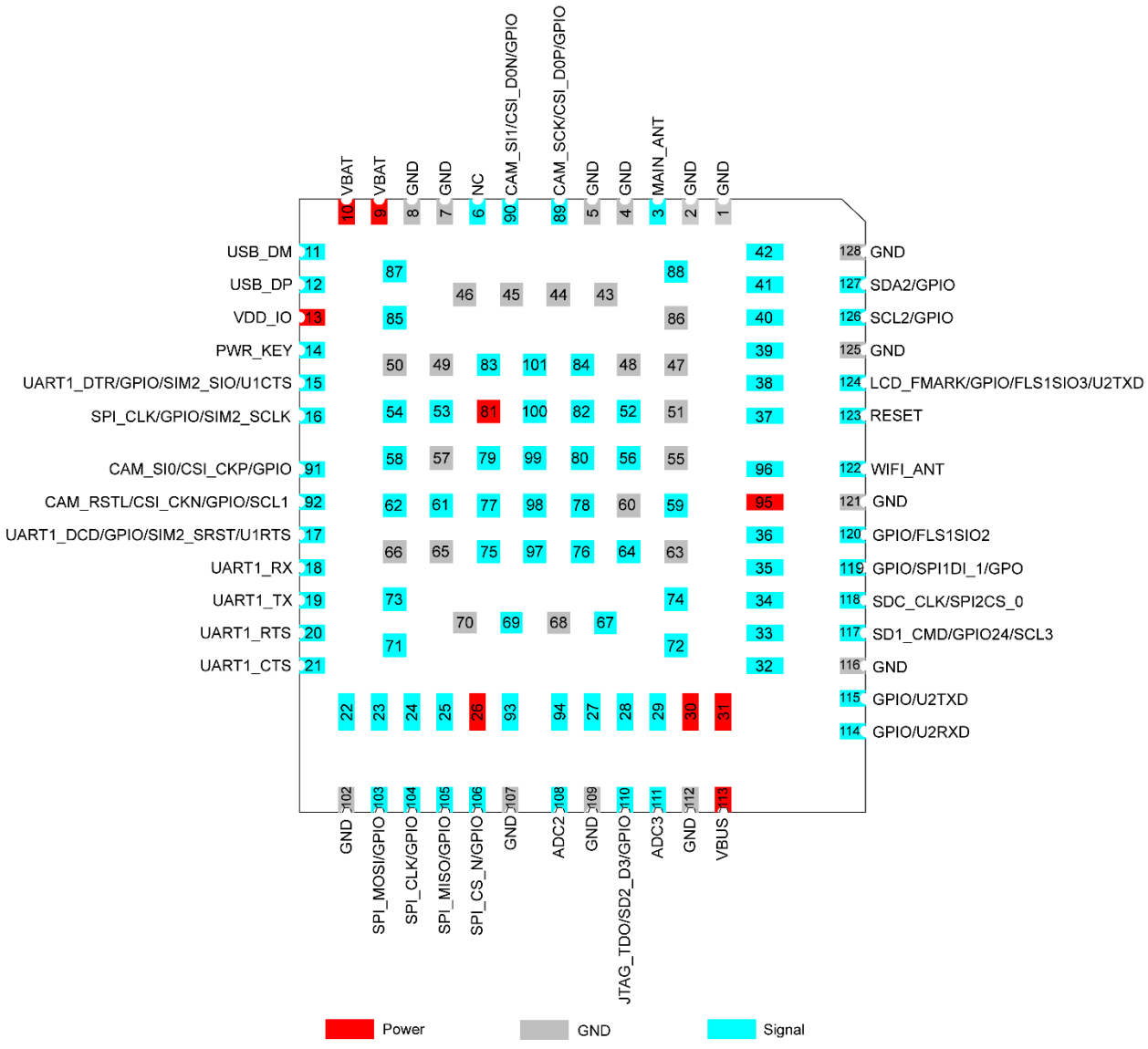

Figure 3-1 Pin distribution (top perspective view)

3.1.2 Pin Definition

Table 3-1 Pin definition

Pin	Pin Name	I/O	Voltage Domain	Reset Value	Description
1	GND	G	-	-	Ground
2	GND	G	-	-	Ground
3	ANT_MAIN	I/O	-	-	Main set antenna
4	GND	G	-	-	Ground
5	GND	G	-	-	Ground
6	NC	-	-	-	-
7	GND	G	-	-	Ground
8	GND	G	-	-	Ground
9	VBAT	PI	Vmax=4.2V Vmin=3.4V Vnorm=3.8V	-	VBAT_GSM power input (3.4 to 4.2 V)
10	VBAT	PI	Vmax=4.2V Vmin=3.4V Vnorm=3.8V	-	VBAT_GSM power input (3.4 to 4.2 V)
11	USB_DM	I/O	-	-	USB signal DM
12	USB_DP	I/O	-	-	USB signal DP
13	VDD_IO	PO	1.8V	-	Module digital level, 1.8 V output
14	PWRKEY	I	VBAT	-	Module on/off, low level valid
15	SIM2_SIO	I/O	1.8V/3.0V	-	USIM2 data signal line Support function GPIO30/SIM2_SIO/U1CTS
16	SIM2_SCLK	O	1.8V/3.0V	-	USIM clock signal line Support function GPIO29/SIM2_SCLK
17	SIM2_SRST	O	1.8V/3.0V	-	USIM reset signal line

Pin	Pin Name	I/O	Voltage Domain	Reset Value	Description
					Support function GPIO31/SIM2_SRST/U1RTS
18	UART1_RX	I	1.8V	-	Data receiving of module serial port 1
19	UART1_TX	O	1.8V	-	Data transmission of module serial port 1
20	UART1_RTS	I	1.8V	-	DTE request to transmit data
21	UART1_CTS	O	1.8V	-	Module clearing transmitting It can be modified by software as a CPlog port. It is recommended to reserve test points
22	GPIO	I/O	1.8V	L	GPIO26 Support function U2TXD/U3RTS/SPI2CLK
23	SIM1_DATA	I/O	1.8V/3.0V	-	USIM1 data signal line
24	SIM1_CLK	O	1.8V/3.0V	-	USIM1 clock signal line
25	SIM1_RST	O	1.8V/3.0V	-	USIM1 reset signal line
26	VSIM1	PO	1.8V/3.0V	-	USIM1 power supply
27	SIM_DET	I	1.8V	-	Module SIM hot-plug detection pin 10 k grounding is recommended when it is not in use. Support function SIM_DET/FLSIO3/GPIO5/PWT*
28	MIC_N	I	-	-	Main MIC differential output negative
29	MIC_P	I	-	-	Main MIC differential output positive
30	MIC_BIAS	PO	1.8V	-	Main MIC bias voltage output MIC differential output connection is not used inside, and it must be connected when using
31	VBUS_IN	PI	Vmax=5.2V Vmin=4.5V	-	Charging voltage input detection

Pin	Pin Name	I/O	Voltage Domain	Reset Value	Description
			Vnorm=5.0V		
32	GND	G	-	-	Ground
33	HP_R	O	-	-	Earphone right channel signal output
34	HP_L	O	-	-	Earphone left channel signal output
35	SPK_P	O	-	-	Loudspeaker positive output
36	SPK_N	O	-	-	Loudspeaker negative output
37	EMERG_RST	I	VBAT	-	Module reset signal, low level valid
38	LPG	O	1.8V	L	Module state representation
39	U2RXD	I	1.8V	-	Data receiving of module serial port 2 Multiplexing function KEY_IN1/U2RXD
40	U2TXD	O	1.8V		Data receiving of module serial port 2 Multiplexing function KEY_IN2/U2TXD
41	WAKEUP_IN	I	1.8V	L	External device wakeup function Multiplexing function FLSIO2/GPIO4/PWL*
42	GND	G	-	-	Ground
43	GND	G	-	-	Ground
44	GND	G	-	-	Ground
45	GND	G	-	-	Ground
46	GND	G	-	-	Ground
47	GND	G	-	-	Ground
48	GND	G	-	-	Ground
49	GND	G	-	-	Ground
50	GND	G	-	-	Ground
51	GND	G	-	-	Ground
52	I2C_SDA0	I/O	1.8V	-	I2C interface data signal Multiplexing function I2C_SDA0/GPIO17

Pin	Pin Name	I/O	Voltage Domain	Reset Value	Description
53	KEY_OUT0	O	1.8V	-	KEYOUT0 KEYOUT cannot be used as a key function alone.
54	LCD_CLK	O	1.8V/3V*	-	Clock signal line of LCD SPI Multiplexing function LCD_CLK/GPIO2
55	GND	G	-	-	Ground
56	I2C_SCL0	O	1.8V	-	I2C interface clock signal I2C_SCL0/GPIO16 When using GPIO, GPIO16 can only be used for output.
57	GND	G	-	-	Ground
58	LCD_SIO	I/O	1.8V/3V*	-	Data signal line of LCD SPI Multiplexing function LCD_SIO/GPIO0
59	ADC1	I	-	-	Analog-to-digital converter interface 1 1k in series when in use
60	GND	G	-	-	Ground
61	WAKEUP_OUT	O	1.8V	-	Module output wakeup signal Multiplexing function WAKEUP_OUT/GPIO25
62	LCD_SDC	I/O	1.8V/3V*	-	4-line SPI LCD command and data selection signal Multiplexing function LCD_SDC/GPIO1
63	GND	G	-	-	Ground
64	ADC0	I	-	-	Analog-to-digital converter interface 0 1k in series when in use
65	GND	G	-	-	Ground
66	GND	G	-	-	Ground

Pin	Pin Name	I/O	Voltage Domain	Reset Value	Description
67	ISENSE	I	-	-	Charging current detection signal
68	GND	G	-	-	Ground
69	LCD_CS	O	1.8V	-	LCD chip selection signal Multiplexing function LCD_CS/GPIO3
70	GND	G	-	-	Ground
71	USB_BOOT/KEY_IN0	I	1.8V	-	Key pad input 0 USB_BOOT rise to be in the DL mode KEYIN cannot be used as a key alone.
72	VBAT_SENSE	I	Vmax=4.2V Vmin=3.4V Vnorm=3.8V	-	The battery voltage detection signal should be close to the anode of the battery terminal as far as possible. If the charging function is not used, it should be connected to VBAT.
73	VDRV	O	-	-	Charging drive control voltage of external PMOS
74	LCD_RSTB	O	1.8V/3V*	-	LCD_RST This pin does not support GPIO function.
75	KEY_OUT1	O	1.8V	-	KEYOUT1 KEYOUT cannot be used alone. Multiplexing function KEY_OUT1/U2CTS
76	KEY_OUT2	O	1.8V	-	KEYOUT2 KEYOUT cannot be used alone. Multiplexing function KEY_OUT2/U2RTS
77	U3RXD	I	1.8V/3V*	-	Data receiving of module serial port 3 Multiplexing function SD1_D2/GPIO27/U2CTS/U3RXD/SPI2DIO_0
78	U3TXD	O	1.8V/3V*	-	Data transmission of module serial port 3 Multiplexing function

Pin	Pin Name	I/O	Voltage Domain	Reset Value	Description
					SD1_D3/GPIO28/U2RTS/U3TXD/SPI2DI_1
79	CAM_PWDN	O	1.8V	-	SPI camera power down Multiplexing function CAM_PWDN/GPIO19/SDA1
80	CAM_REFCLK	O	1.8V	-	SPI camera reference CLK Multiplexing function CAM_REFCLK/GPIO20
81	HEADMIC_BIAS	PO	-	-	Bias voltage of earphone MIC which is not connected internally, must receive the HEADMIC signal when using externally
82	I2S2_SDAT_O	O	1.8V	-	I2S data output signal Multiplexing function FLSIO1/GPIO3/DSI_D1P/I2S2_SDAT_O
83	I2S2_BCK	O	1.8V	-	I2S bit (serial) clock signal Multiplexing function FLSCLK/GPIO0/DSI_CKN/I2S2_BCK
84	I2S2_LRCK	O	1.8V	-	I2S frame clock or WS for channel switching Multiplexing function FLSCS/GPIO1/DSI_CKP/I2S2_LRCK
85	I2S2_SDAT_I	I	1.8V	-	I2S data input signal Multiplexing function GPIO2/DSI_D1N/I2S2_SDAT_I/FLSIO0
86	GND	G	-	-	Ground
87	KEY_OUT3	O	1.8V	-	KEYOUT3 KEYOUT cannot be used alone.
88	KEY_IN3	I	1.8V	-	Key pad input 3 KEYIN cannot be used alone.

Pin	Pin Name	I/O	Voltage Domain	Reset Value	Description
89	CSI_D0P	I/O	1.8V	-	MIPICSI_DATA_P0, CAM MIPI data 0 positive terminal Multiplexing function CAM_SCK/CSI_D0P/GPIO23
90	CSI_D0N	I/O	1.8V	-	MIPICSI_DATA_N0, CAM MIPI data 0 negative terminal Multiplexing function CAM_SI1/CSI_D0N/GPIO22
91	CSI_CKP	O	1.8V	-	MIPICSI_CLOCK_P, CAM MIPI clock positive terminal Multiplexing function CAM_SI0/CSI_CKP/GPIO21
92	CSI_CKN	O	1.8V	-	MIPICSI_CLOCK_N, CAM MIPI clock negative terminal Multiplexing function CAM_RSTL/CSI_CKN/GPIO18/SCL1
93	DEBUG_TXD	O	1.8V	-	DEBUG serial port transmission It is recommended to reserve test points
94	DEBUG_RXD	I	1.8V	-	DEBUG serial port receiving It is recommended to reserve test points
95	VSIM2	PO	1.8/3.0V	-	SIM2 supply output
96	NC				
97	SINK1	I	-	-	RGB LED current source input 1 The OPEN version can configure the current size.Imax=54mA
98	SINK2	I	-	-	RGB LED current source input 2 The OPEN version can configure the current

Pin	Pin Name	I/O	Voltage Domain	Reset Value	Description
					size.Imax=54mA
99	HEADMIC_P	I	-	-	Earphone MIC input positive
100	HEADMIC_N	I	-	-	Earphone MIC input negative
101	KEY_IN4	I	1.8V	-	Key pad input 4 KEYIN cannot be used alone. Keep it floating if not used.
102	GND	G	-	-	Ground
103	SPI_MOSI	I	1.8V	-	SPI_MOSI Multiplexing function SPI_MOSI/GPIO Keep it floating if not used.
104	SPI_CLK	O	1.8V	-	SPI_CLK Multiplexing function SPI_CLK/GPIO Keep it floating if not used.
105	SPI_MISO	O	1.8V	-	SPI_MISO Multiplexing function SPI_MISO/GPIO Keep it floating if not used.
106	SPI_CS	I	1.8V		SPI_CS Multiplexing function SPI_CS_N/GPIO Keep it floating if not used.
107	GND	G	-	-	Ground
108	ADC2	I	-	-	Analog-to-digital converter interface 2 1k in series when in use
109	GND	G	-	-	Ground
110	GPIO	I/O	1.8V	L	GPIO12 Support function JTAG_TDO/SD2_D3
111	ADC3	I	-	-	Analog-to-digital converter interface 3

Pin	Pin Name	I/O	Voltage Domain	Reset Value	Description
					1k in series when in use
112	GND	G	-	-	Ground
113	VBUS	I	5V	-	USB insertion detection Keep it floating if not used.
114	U2RXD	I	1.8V/3V*	-	Data receiving of module serial port 2 Multiplexing function GPIO/U2RXD
115	U2TXD	O	1.8V/3V*	-	Data transmission of module serial port 2 Multiplexing function GPIO/U2TXD
116	GND	G	-	-	Ground
117	GPIO	I/O	1.8V	L	GPIO24 Support function SD1_CMD/GPIO24/SCL3
118	SDC_CLK/SPI2CS_0	O	1.8V	-	SDC_CLK/SPI2CS_0 Keep it floating if not used.
119	GPIO	I/O	1.8V	L	GPIO12 Support function GPIO/SPI1DI_1/GPO
120	GPIO	I/O	1.8V	L	GPIO4 Support function GPIO/FLS1SIO2
121	GND	G	-	-	Ground
122	WIFI ANT	I/O	-	-	WIFI_SCAN/BT antenna
123	RESET_N	I	-	-	Module reset signal, low level valid
124	GPIO	I/O	1.8V	L	GPIO5 Support function LCD_FMARK/GPIO/FLS1SIO3/U2TXD
125	GND	G	-	-	Ground
126	GPIO	I/O	1.8V	L	GPIO14 Support function SCL2/GPIO

Pin	Pin Name	I/O	Voltage Domain	Reset Value	Description
127	GPIO	I/O	1.8V	L	GPIO15 Support function SDA2/GPIO
128	GND	G	-	-	Ground

Note:

- Unused pins are keep floating.
- A single KEYIN/OUT key cannot be used, and it needs to be used with KEYOUT/IN.
- 3V* in the above table indicates that the pin supports 3 V voltage domain, but the software configuration needs to be changed in the OPEN version.
- For details of 1.8 V and 3 V high and low level range, see Table 5-3.

3.1.3 Pin Multiplexing

- The above pin definition only represents the default definition in the standard version. For other function multiplexing requirements, see *FIBOCOM MC610 GPIO Function Multiplexing*.

3.2 Power

The power interface of MC610 series modules is shown in the following table:

Table 3-2 Power supply

Pin Name	I/O	Pin	Description
VBAT	PI	9,10	Module system power supply, 3.4 V to 4.2 V, nominal value of 3.8 V
VDD_IO	PO	13	Voltage output, 1.8 V (80 mA)
GND	G	1,2,4,5,7,8,32,42,43,44,45,46, 47,48,49,50,51,855,57,60,63,65, 66,68,70,86,102,107,109,112,	Ground

		116,121,125,128	

3.2.1 Power Supply

MC610 series modules need to provide power supply through VBAT pins. The recommended power supply design is shown in the following figure:

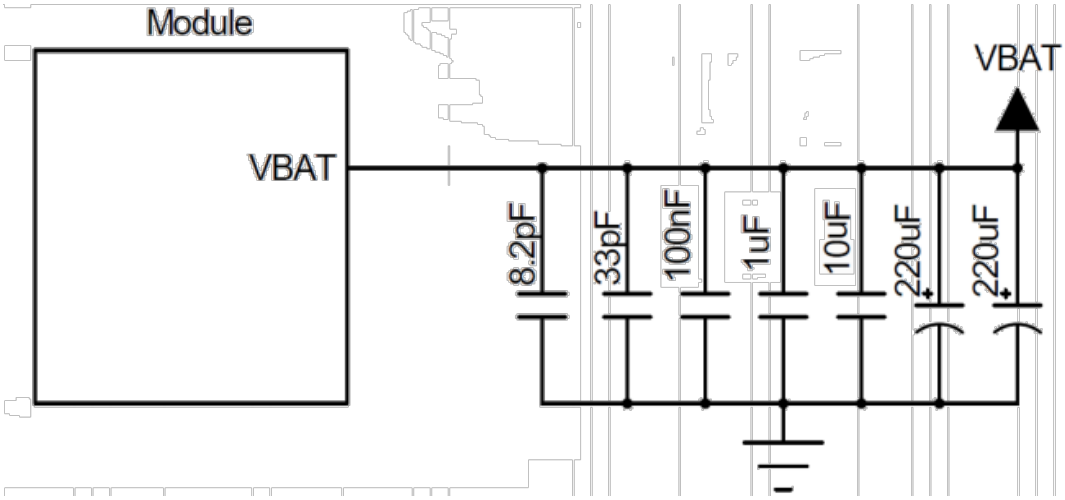

Figure 3-2 Recommended power supply design

Note:

VBAT power supply needs star route, and the filter capacitor design of power supply is shown in the following table:

Table 3-3 VABT capacitance

Recommended Capacitance	Application	Description
220uFx2, 10uF,22uF	Stabilized capacitance	Low ESR capacitance is required to reduce the power fluctuation of the module during operation. LDO or DCDC power supply requirements are not less than 440 uF capacitance. Battery power supply can be reduced to

Recommended Capacitance	Application	Description
		100 uF-220 uF capacitance.
1uF,100nF	Digital signal noise	Filter out the interference caused by clock and digital signal.
33pF	700 MHz, 850 MHz/900 MHz band	Filter out RF interference of LF band
8.2pF	1,700 MHz/1,800 MHz/1,900MHz, 2,100 MHz/2,300 MHz, 2,500 MHz/ 2,600 MHz band	Filter out RF interference of MF/HF band

The stability of power supply can ensure the normal operation of MC610 modules. During the design, it is necessary to pay special attention to that the ripple wave of power supply is lower than 300 mV (line ESR<150 mΩ), and ensure that the power supply voltage is not less than 3.4 V at the maximum operating current of the module (about 2 A); otherwise, the module may be powered down, shut down or restarted. The power supply limitation is shown in the following figure:

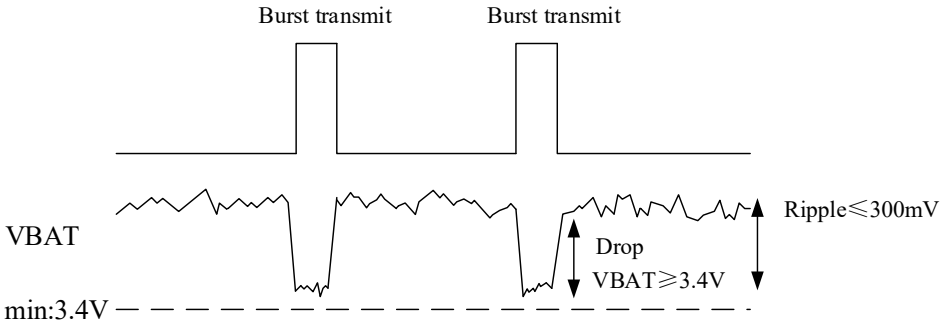

Figure 3-3 Power supply limitation

Note:

It is suggested that customers should add TVS (recommended model: SMBJ5.0A) to VBAT input to improve the surge protection capability of products.

3.2.2 1.8 V Output

MC610 series modules output 1.8 V voltage through VDD_IO for the use of the internal digital circuit of

the module. The voltage is the logic level voltage of the module, which can be used to indicate the module to start up, and can also be used for external small current circuit applications. If it is not used, it can be in suspension. The logic level of VDD_IO is defined as shown in the following table:

Table 3-4 1.8 V level

Parameter	Minimum Value	Typical Value	Maximum Value	Unit
VDD_IO	1.71	1.8	1.89	V

3.2.3 Power Consumption

In the case of 3.8 V power supply, the power consumption of MC610 series modules is shown in the following table:

Table 3-5 Power consumption

Parameter	Scenario	Condition	Average Current (mA)
I/Off	Power off	Module power off	TBD
I_{sleep}	Airplane	CFUN=0	TBD
	GSM	MFRMS=5	TBD
	LTE FDD	Paging cycle #128 frames	TBD
IGSM-RMS	GSM	GSM850	260
		GSM900	260
		DCS1800 PCL0	200
		PCS1900 PCL0	200
IGPRS-RMS CS4	GPRS	GPRS Data transfer GSM850; PCL=5; 1Rx/4Tx	500
		GPRS Data transfer GSM900; PCL=5; 1Rx/4Tx	500
		GPRS Data transfer DCS1800; PCL=0;	450

Parameter	Scenario	Condition	Average Current (mA)
		1Rx/4Tx	
		GPRS Data transfer PCS1900; PCL=0; 1Rx/4Tx	450
ILTE-RMS	LTE FDD	LTE FDD Data transfer Band 1 @+23dBm	700
		LTE FDD Data transfer Band 2 @+23dBm	700
		LTE FDD Data transfer Band 3 @+23dBm	700
		LTE FDD Data transfer Band 4 @+23dBm	700
		LTE FDD Data transfer Band 5 @+23dBm	600
		LTE FDD Data transfer Band 7 @+23dBm	750
		LTE FDD Data transfer Band 8 @+23dBm	600
		LTE FDD Data transfer Band 28 @+23dBm	600
		LTE FDD Data transfer Band 66 @+23dBm	700

Note:

The above results are laboratory test data, with a deviation of ±10%.

3.3 Control Signal

MC610 series modules provide 2-channel control signals to start up/shut down and reset the module. The pin definition is defined as shown in the following table:

Table 3-6 Control signal

Pin Name	I/O	Pin	Description
EXTRST	I	37, 123	When the module is working, provide RESET with a Tst (100 ms) low level, and then rise, reset the module.
PWRKEY	I	14	The minimum duration of low level is 2 s when it is started up at a low level, and 3.1 s when it is shut down at a low level.

3.3.1 Module Startup

3.3.1.1 Startup Circuit Reference

When MC610 series modules are shut down, the module can be started up by lowering PWRKEY for at least 2 s. It is recommended to use OC/OD drive circuit to control PWRKEY pins. The reference circuit is shown in the following figure:

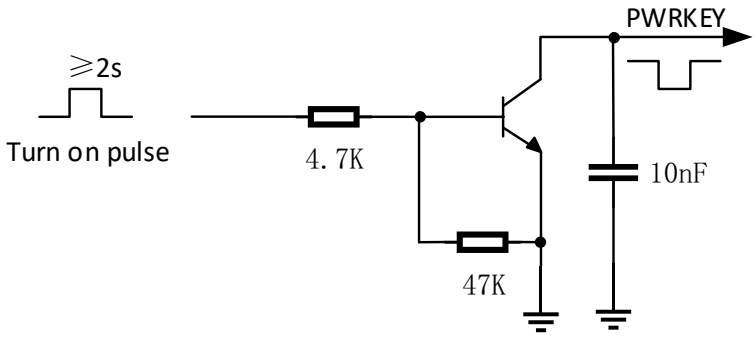

Figure 3-4 OC/OD drive reference startup circuit

Another way to control PWRKEY pins is to directly use a button switch. A TVS (recommended ESD9X5VL-2/TR) should be placed near the button for ESD protection. The reference circuit is shown in the following figure:

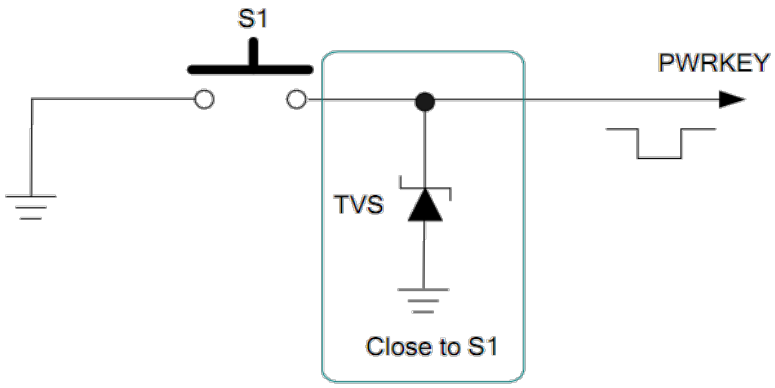

Figure 3-5 Key startup reference circuit

3.3.1.2 Startup Timing Sequence

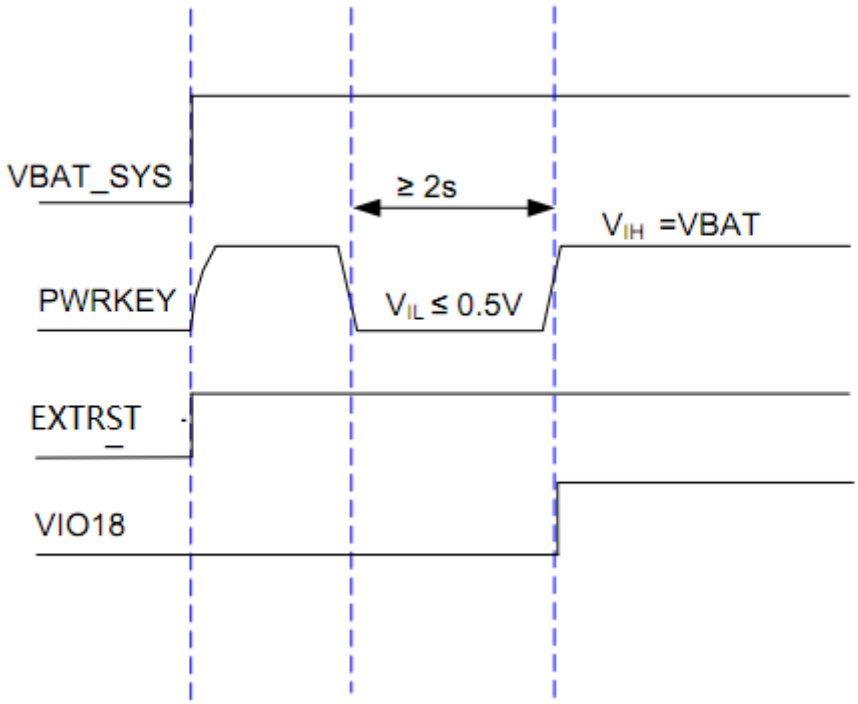

Figure 3-6 Startup timing sequence control chart

Note:

Before lowering PWRKEY pins, VBAT voltage must be stable. It is suggested that the interval from VBAT energization to PWRKEY pin lowering should not be less than 30 ms.

3.3.1.3 Automatic Startup

If the module needs to be powered on for automatic startup, PWRKEY pins can be directly connected to the ground. In this way, the module can only be powered off directly for shutdown.

3.3.2 Module Shutdown

The module supports the following three shutdown modes:

Table 3-7 Module shutdown mode

Shutdown Mode	Shutdown Method	Applicable Scenarios
Low voltage shutdown	Shutdown when VBAT voltage is too low or powered down	At this time, the module does not follow the normal shutdown process or the process of logging off from the base station.
Hardware shutdown	Lowering PWRKEY (more than 3.1 s), and then releasing	Normal shutdown
AT shutdown	AT+CPWROFF	Software shutdown

1. When the module works normally, do not cut off the power supply of the module immediately, to avoid damaging the Flash inside the module. It is strongly recommended to turn off the module through PWRKEY or AT command before disconnecting the power supply.
2. When the AT command is shut down, it is not applicable to automatic startup.

3.3.2.1 Shutdown Timing Sequence

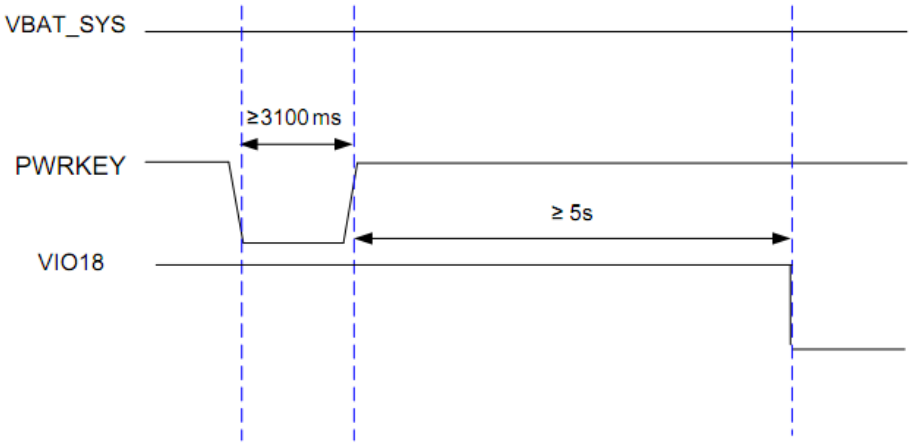

Figure 3-7 Shutdown timing sequence control chart

3.3.3 Module Reset

There are two reset methods for MC610 series modules: hardware reset and AT command reset.

Table 3-8 Module reset mode

Reset Mode	Reset Method
Hardware reset	Provide EXTRST with a Tst (100 ms) low level, and then rise it.
AT command reset	AT+CFUN=15

3.3.3.1 Reset Circuit

The reset reference circuit is shown in the following figure, which is similar to PWRKEY control circuit.

Customers can use OC/OD drive circuit or button to control EXTRST pins.

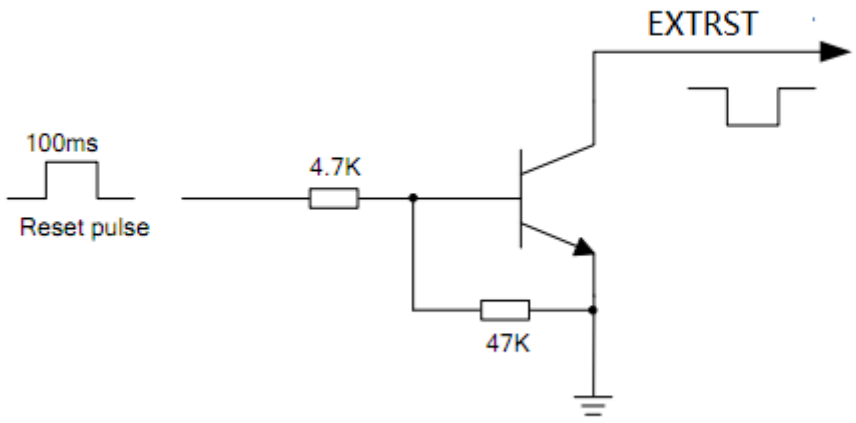

Figure 3-8 EXTRST reset OC/OD reference circuit

Another reset control is shown in the following figure:

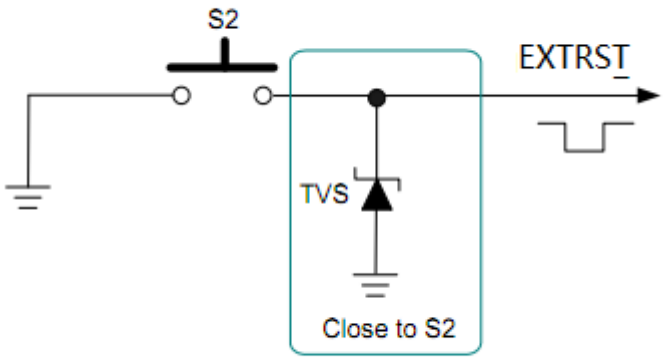

Figure 3-9 EXTRST reset button reference circuit

3.3.3.2 EXTRST Control Timing Sequence

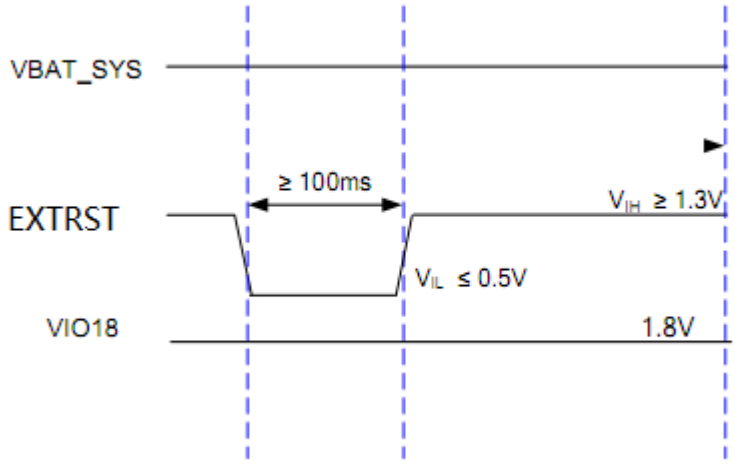

Figure 3-10 EXTRST control timing sequence

Note:

EXTRST is a sensitive signal. It is suggested to add a debounce capacitor near the module end. PCB layout should be away from RF interference and proper surrounding with grounding lines should be made, and routes on PCB edge and surface layer should be avoided (avoid module reset caused by ESD).

3.4 USB Interface

MC610 series modules support USB2.0 and are compatible with USB High-Speed (480 Mbits/s) and USB Full-Speed (12 Mbits/s). For timing sequence and electrical characteristics of USB buses of MC610 series modules, see "Universal Serial Bus Specification 2.0".

3.4.1 USB Interface Definition

Table 3-9 USB interface

Pin Name	I/O	Pin	Description
USB_DM	I/O	11	USB differential data bus
USB_DP	I/O	12	USB differential data bus
VUSB/VCHG	PI	31,113	USB insertion detection

For more information about the USB Specification 2.0, visit http://www.usb.org/home.

Note:

Since the module supports USB 2.0 High-Speed, the equivalent capacitance of the TVS tube on the USB_DM/DP differential signal line is required to be less than 1 pF, and TVS with capacitance of 0.5 pF is recommended;

It is recommended to connect serial 0 Ω resistors on the USB_DM/DP differential line;

USB_DM and USB_DP are high-speed differential signal lines with a maximum transmission rate of 480 Mbits/s. PCB Layout must observe the following rules:

- The control differential impedance of USB_DM and USB_DPUSB_DP signal lines is 90 Ω;
- USB_DM and USB_DP signal lines are required to be equal in length and parallel to avoid right-angle route;
- USB_DM and USB_DP signal lines are laid in the signal layer nearest to the ground, and protected by surrounding grounding lines in all directions of the line.

3.5 USIM Interface

MC610 series modules support USIM interfaces, 1.8 V and 3.0 V SIM cards.

3.5.1 USIM Pins

USIM pins are shown in the following table:

Table 3-10 USIM pins

Pin Name	I/O	Pin	Description
SIM1_SIO	I/O	23	USIM/SIM1DATA
SIM1_CLK	O	24	USIM/SIM1 Clock Signal
SIM1_RST	O	25	USIM/SIM1 RESET Signal
VSIM1	PO	26	USIM/SIM1Power
SIM1_DET	I	27	Detect USIM/SIM card for Hot-swap
SIM2_SIO	I/O	15	USIM/SIM2 DATA
SIM2_CLK	O	16	USIM/SIM2 Clock Signal
SIM2_RST	O	17	USIM/SIM2 RESET Signal
VSIM2	PO	95	USIM/SIM2 Power

3.5.2 USIM Interface Circuit

3.5.2.1 SIM Card Slot with Detection Signal

SIM card slot (recommended model: SIM016-8P-220P) is required for USIM/SIM design, and hot-plug card slot with SIM card detection function is recommended.

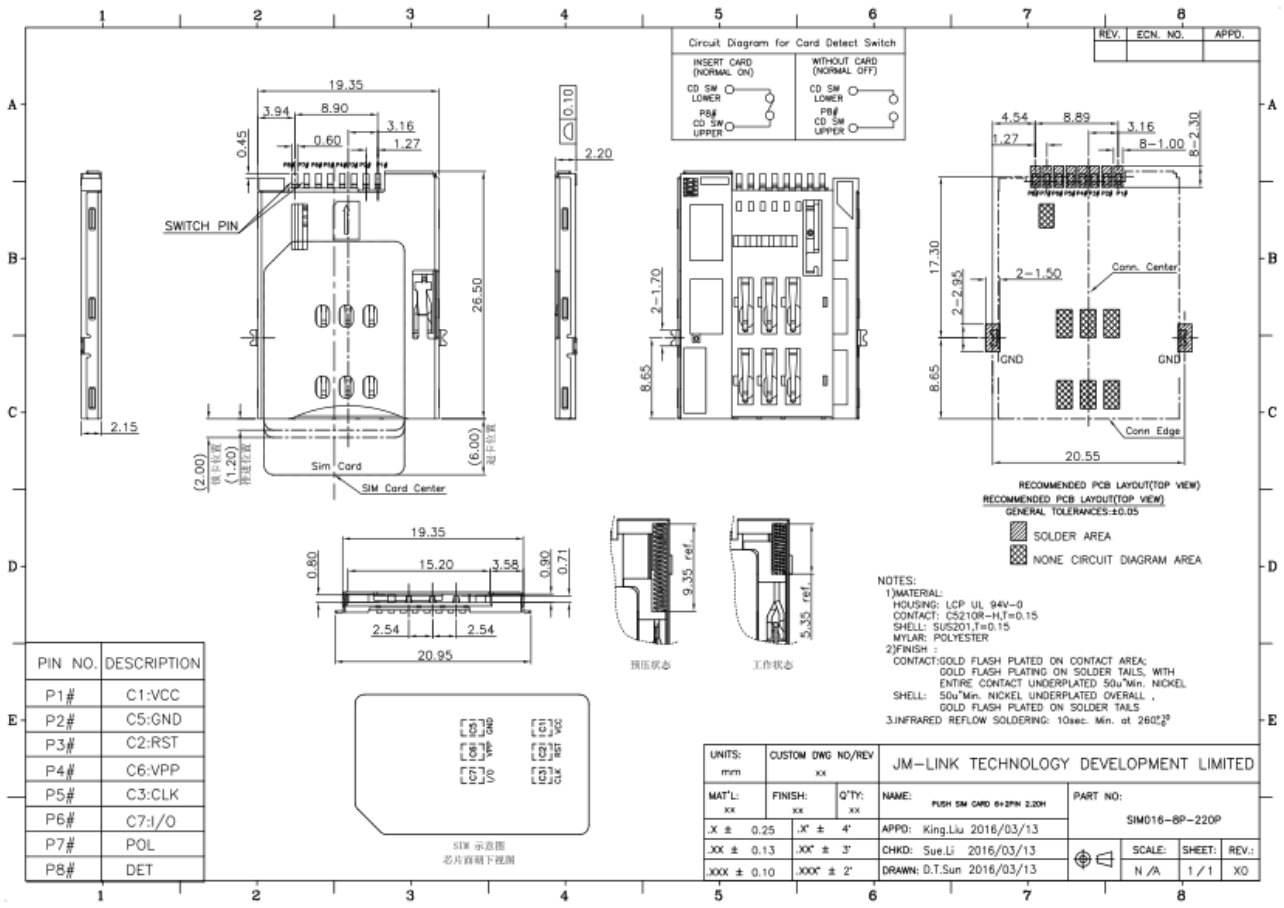

Figure 3-11 Schematic diagram of SIM card slot SIM016-8P-220P

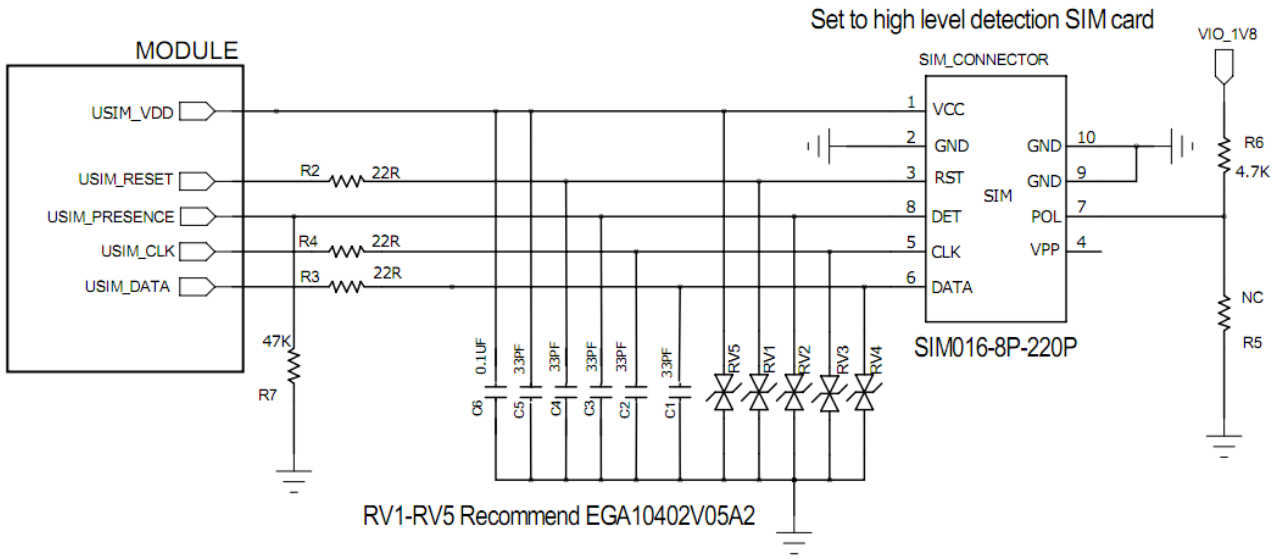

Figure 3-12 Reference design diagram for MC610 series USIM/SIM interface with detection signal

The principle of SIM card slot with detection signal is described as follows:

When SIM card is inserted, USIM_PRESENCE is high level.

When SIM card is pulled out, USIM_PRESENCE is low level.

3.5.2.2 SIM Card Slot Without Detection Signal

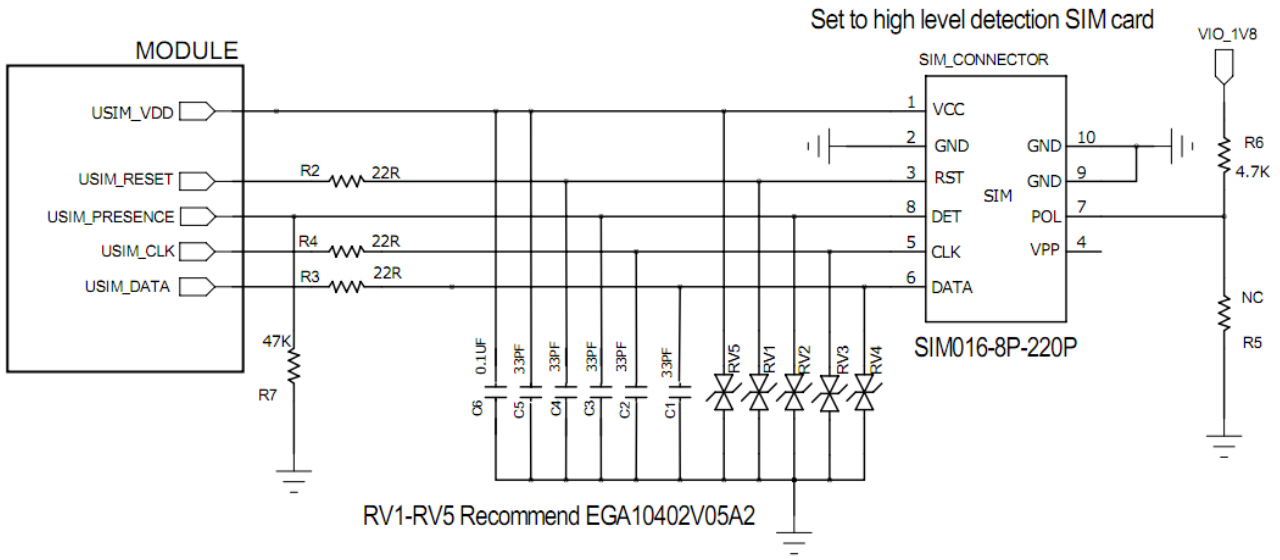

Figure 3-13 Reference design diagram for MC610 series USIM/SIM interfaces without detection signal

Note:

SIM_IO does not require a pull-up resistor.

SIM card slot without detection signal, module USIM_ PRESENCE pins are subject to 10 kV grounding in series.

3.5.3 USIM Design Requirements

The circuit design of SIM card needs to comply with EMC standards and ESD requirements, and needs to improve the electromagnetic susceptibility to ensure that the SIM card can work stably. The following points should be strictly observed in the design:

- The layout of SIM card slot should be close to the module as far as possible, and away from RF antenna, DCDC power supply, clock signal line and other strong interference sources;
- The SIM card slot with metal shielding shell is used to improve the electromagnetic susceptibility;

- The length of route from the module to the SIM card slot should not exceed 100 mm, and too long route will reduce the signal quality;
- SIM_CLK and SIM_IO signals are isolated by ground line to avoid mutual interference. If it is difficult to complete it, at least SIM signal needs to be used for a group of signal protection signal;
- The filter capacitor and ESD device of SIM card signal line are placed close to the SIM card slot, and the upper limit of equivalent capacitance of ESD device is 33 pF.

3.6 UART Interface

3.6.1 UART Interface Definition

There are four groups of serial ports in MC610 modules: main serial port UART1, downloading interface UART2, serial port UART3 and serial port DEBUG. The main features of four serial ports are described below:

Main serial ports UART1 and UART3 support the baud rate of 2,400 bps, 4,800 bps, 9, 600 bps,14,400 bps,19,200 bps, 28,800 bps, 33,600 bps, 38,400 bps, 57,600 bps, 115,200 bps, 230,400 bps, 460,800 bps, 921,600 bps and 1,000,000 bps. The default baud rate is 115,200 bps, which is used for data transmission and AT command transmission. But only UART1 can continuously send the AT command to wake up the module after the module is sleeping, and other serial ports are unavailable.

DEBUG serial port supports the baud rate of 115,200 bps, which is used for FIBOCOM internal debugging.

Each serial port pin is described as shown in the following table:

Table 3-11 UART1 pins

Pin Name	I/O	Pin	Description
UART1_RX	I	18	Module receiving data
UART1_TX	O	19	Module transmitting data
UART1_RTS	O	20	DTE request to transmit data
UART1_CTS	I	21	Module clearing transmitting

Table 3-12 UART2 pins

Pin Name	I/O	Pin	Description
U2RXD	I	39	Module receiving data
U2TXD	O	40	Module transmitting data
U2CTS	I	75	Module clearing transmitting
U2RTS	O	76	DTE request to transmit data

Table 3-13 UART3 pins

Pin Name	I/O	Pin	Description
U3RXD	I	77	Module receiving data
U3TXD	O	78	Module transmitting data

Table 3-14 DEBUG serial port pins

Pin Name	I/O	Pin	Description
DBG_RXD	I	94	Module receiving data
DBG_TXD	O	93	Module transmitting data

3.6.2 UART Interface Application

The serial port level of MC610 series modules is 1.8 V by default. If the level of the customer host system is 3.3 V or others, it is necessary to add a level converter in the serial port connection between the module and the host. The following figure shows the design of reference circuit using level conversion chip:

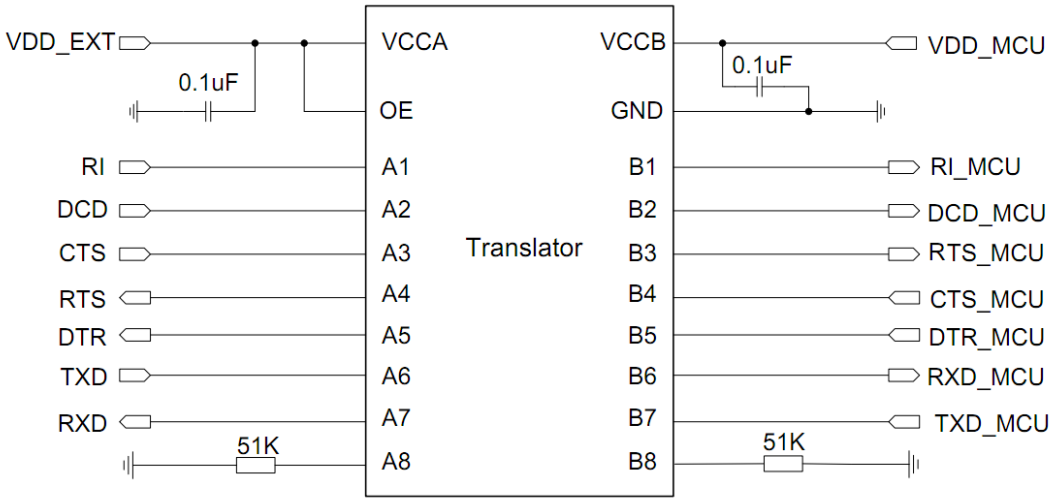

Figure 3-14 UART signal connection 1

Another level conversion circuit is shown in the following figure. The design of input and output circuits of the following dotted line part can be with reference to the solid line part, but pay attention to the connection direction.

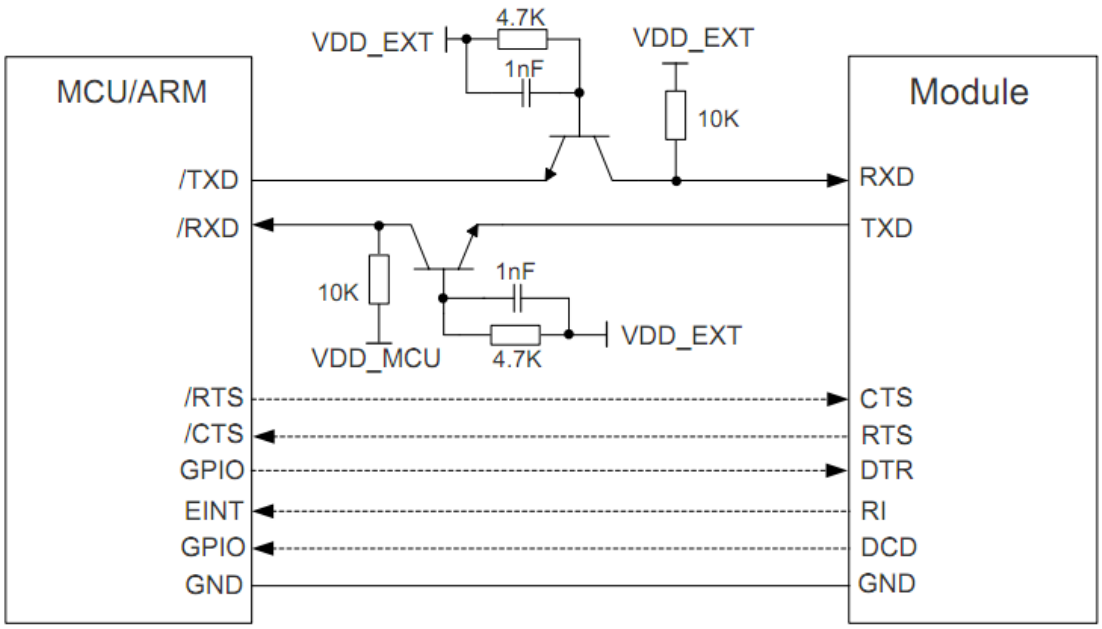

Figure 3-15 UART signal connection 2

Note:

The level conversion circuit is not suitable for applications with baud rate over 460 Kbps.

3.7 Status Indication

3.7.1 LPG Signal

MC610 series modules provide an interface of network indicator output signal.

Table 3-15 LPG pin

Pin Name	I/O	Pin	Description
LPG	O	38	Module status indication

Description of LPG status of MC610 series module network indicator.

Table 3-16 LPG status

Mode	LPG	Description
1	Quick flash (600 ms High/600 ms Low)	No SIM card SIM PIN Being registered (T<15 S) Registration failure
2	Slow flash (75 ms Low/3,000 ms High)	Standby
3	Fast flash (75 ms Low/75 ms High)	Data link establishment
4	High	Sleep
5	Low	Voice call

The reference circuit of network indicator interface of MC610 series modules is shown in the following figure:

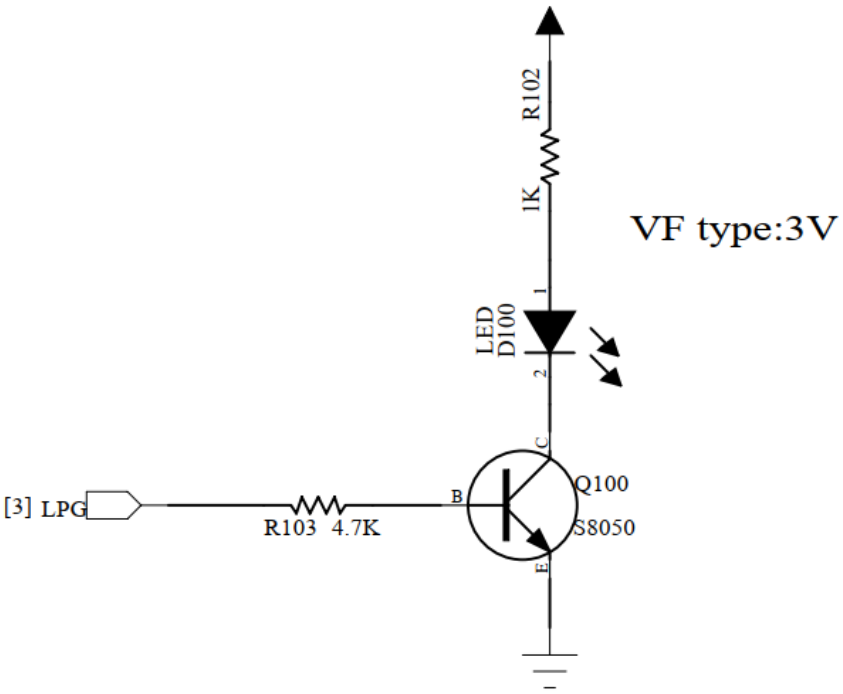

Figure 3-16 Reference design diagram of network indicator for MC610 series modules

3.8 Low Power Mode

3.8.1 Sleep Mode

3.8.1.1 Only UART Port Data Communication Between AP and Module

The sleep mode can be activated by module by the following ways:

1. The ATS24 command makes the module to sleep, and the wake-up keeping time depends on </value> in the command **ATS24 = [<value>].** Send the AT command: **ATS24=2**. The module will enter the Sleep mode in 2 s, and the setting will not be saved after the module is powered down.
2. Set the sleep mode through AT+GTSET="LPMMODE". x set and save the settings after power failure.

   x=1 --- level wakeup, WAKEUP_IN indicates that sleep is not allowed at low level;

   x=2 --- level wakeup, WAKEUP_IN indicates that sleep is not allowed at high level;

3.8.1.2 Instructions for Module Sleep and Wakeup:

MC610 modules provide a KEYINT for module wakeup. When the module is in the sleep mode, lower or rise the WAKEUP_IN pin to wake up the module. If the wakeup module function is disabled, the WAKEUP_IN pin is suspended.

1. The block is not in the sleep mode by default. A non-0 value must be set by the ATS24 command, and then the module can sleep.
2. x Set the wakeup mode by AT+GTSET="LPMMODE".

   x=0 --- interrupt the wakeup. After the module is in the sleep mode, wake up the module by level conversion. IDLE will be in the sleep mode again after a period of time for wakeup (it is 0 by default);

   X=1 --- level wakeup, WAKEUP_IN indicates that sleep is not allowed at low level;

   X=2 --- level wakeup, WAKEUP_IN indicates that sleep is not allowed at high level.

For details of the sleep mode, see *FIBOCOM MC610 Series AT Commands*.

3.9 ADC Function

MC610 provides 4-channel analog-to-digital converter interface, 11 bits. Use AT + MMAD = <Index>, <index> = 1, 2, 3, 4, and then the voltage value of each ADC can be read, the default range of ADC is 0-VBAT, and the voltage range is adjustable in the OPEN version.

Table 3-17 ADC pins

Pin Name	I/O	Pin	Description
ADC0	I	64	Analog-to-digital converter interface 1
ADC1	I	59	Analog-to-digital converter interface 2
ADC2	I	108	Analog-to-digital converter interface 3
ADC3	I	111	Analog-to-digital converter interface 4

The following is the ADC precision tested on ADP-MC610-LA:

Table 3-18 ADC precision

Voltage Range (V)	Precision (mV)
0-1.1	3
1.2-3.3	40
3.3-VBAT	10

Note:

In case of higher requirements for precision, it is recommended to use a lower voltage range.

It is recommended that the ADC should be surrounded with grounding lines, so as to improve the precision of ADC voltage measurement;

When using the ADC, a 1 K resistor must be connected in series.

3.10 Analog Audio Interface

The module has a built-in audio encoding and decoding chip, provides an analog audio output channel, and supports calls and playback and other functions. Users can connect SPK directly to the periphery of the module, or choose to add an audio power amplifier.

3.10.1 Audio Interface Pin Definition

Table 3-19 SPK pin

Pin Name	I/O	Pin	Description
SPK_P	O	35	Loudspeaker output positive
SPK_N	O	36	Loudspeaker output negative

SPK_P and SPK_N channels are used for the differential output of the handset or speaker (requiring an external audio power amplifier) and do not support single-ended output.

SPK supports Class-D and CLASS-AB output modes, Class-D mode gain level is 0/1.5/3 dB, and Class-AB mode gain level is -3/0/1.16 dB (3-bit programmable gain).

SPK output power: 800 mW @ 4.2 V on 8 Ω load in Class-D mode, 600 mW @ 4.2 V on 8 Ω load in Class-AB mode.

The default power amplifier of the module is Class-AB output. When an external power amplifier is required, the recommended model is: AW87359FCR (2 W @ 8 Ω).

Table 3-20 SPK pins

HP_R	O	33	Earphone right channel signal
HP_L	O	34	Earphone left channel signal

Module earphone output power: 25 mW @ ± 1.8 V on 32 Ohm load, gain range: -18 dB to + 0 dB with 3 dB steps (4-bit programmable gain).

Table 3-21 MIC pins

HEADMIC_P	I	99	Earphone MIC input positive
HEADMIC_N	I	100	Earphone MIC input negative
HEADMIC_BIAS	PO	81	Bias voltage of earphone MIC
MIC_P	I	29	MIC input positive
MIC_N	I	28	MIC input negative
MIC_BIAS	PO	30	MIC bias voltage

8 levels of gain amplification within MIC input are adjustable, range: 0 dB to +36 dB (3-bit programmable gain, 0/3/6/12/18/24/30/36 dB).

3.10.2 Preventing TDD and Other Noises

Handheld microphones and hands-free microphones are recommended to adopt built-in RF filter dual-capacitance (such as 10 pF and 33 pF) electret microphones to filter out RF interference from the source of interference, which will greatly improve the coupling TDD noise. 33 pF capacitor is used to filter high frequency interference when the module is working at 900 MHz, and 10 pF capacitor is used to filter high frequency interference when working at 1,800 MHz. If the capacitor is not added, TDD noise may be

heard during a call. It should be noted that since the capacitor resonance point largely depends on the capacitor material and manufacturing process, when choosing a capacitor, it is recommended to consult the capacitor supplier and choose the most suitable capacitance to filter out the high-frequency noise when working in EGSM900/DCS1800.

The severity of high frequency interference during GSM transmission usually depends on the customer's application design. In some cases, the TDD noise of EGSM900 is more serious, and in some cases, the TDD noise of DCS1800 is more serious. Therefore, customers can choose the required filter capacitor according to the test results (MC615 module has no GSM).

The RF filter capacitor on the PCB board should be placed as close as possible to the audio device or audio interface, and the route should be as short as possible, and must be passed through the filter capacitor to other connection points. The antenna position should be as far away as possible from audio components and audio routes to reduce radiation interference. The power lines and audio lines should not be parallel, and the power lines should be as far away as possible from the audio lines. Differential audio routes must follow the wiring rules for differential signals.

3.10.3 Handset Interface Circuit

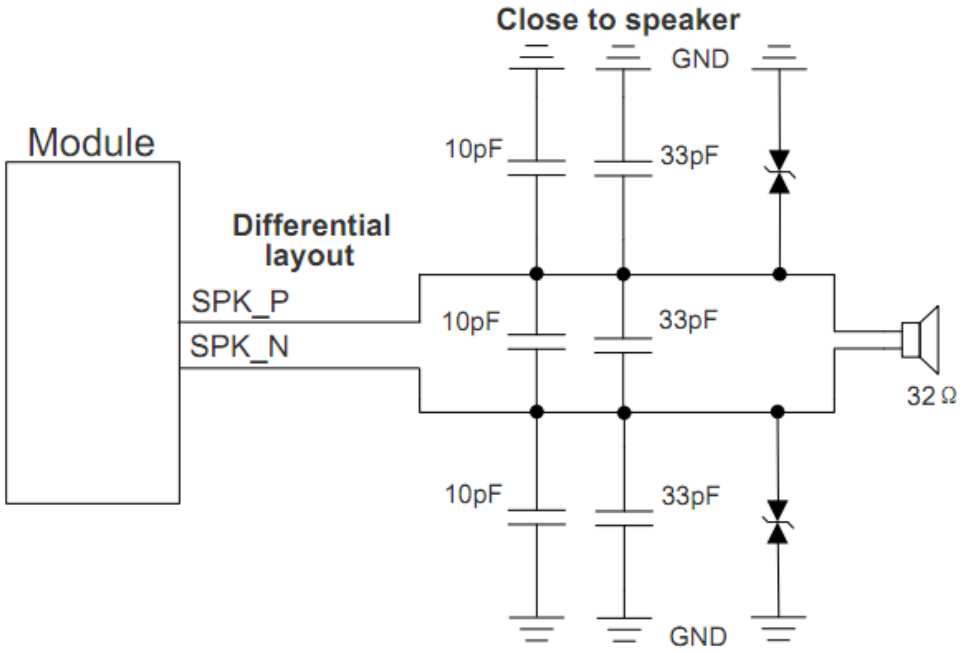

Figure 3-17 Reference circuit of SPK output

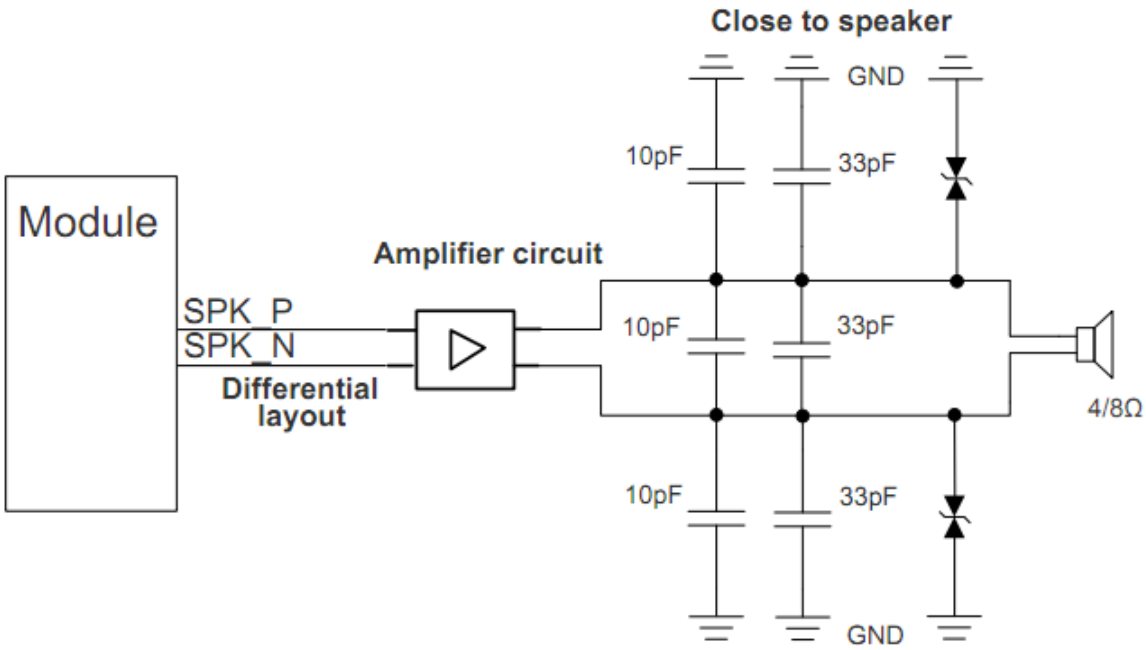

Figure 3-18 Reference circuit of Audio Power Amplifier Output

3.11 Camera Interface

MC610 supports two camera interfaces, SPI and MIPI.

The following table describes the pin description of the CAMERA interface:

Table 3-22 CAMERA interface

Pin name	I/O	Pin	Description
CAM_REFCLK	O	80	CAMERA CLK signal
CAM_PWDN	O	79	CAMERA POWER DOWN signal
CSI_D0N	I/O	92	CAMERA MIPI data D0 negative terminal; CAM_SI1 SPI CAM serial data signal 1
CSI_D0P	I/O	91	CAMERA MIPI data D0 positive terminal; CAM_SCK SPI CAM serial clock signal
CSI_CKN	O	90	CAMERA MIPI clock CLK negative terminal; CAM_RSTL SPI CAM reset signal

Pin name	I/O	Pin	Description
CSI_CKP	O	89	CAMERA MIPI clock CLK positive terminal; CAM_SI0 SPI CAM serial data signal 0
I2C_SDA0	I/O	52	CAMERA I2C data signal
I2C_SCL0	O	56	CAMERA I2C clock signal

Note:

For the detailed design of CAMERA, see the latest *MC610 Series Reference Design*.

3.12 LCD Interface

MC610 OPEN can support SPI LCD interface screen.

The following table shows the pin description of the LCD interface:

Table 3-23 LCD interface

Pin name	I/O	Pin	Description
LCD_SDC*	I/O	62	LCD command and data switching control signal
LCD_RSTB*	O	74	LCD reset signal This pin cannot be reused as GPIO function
LCD_CS*	O	69	LCD chip selection signal
LCD_CLK*	O	54	Clock signal line of LCD SPI
LCD_SIO*	I/O	58	Data signal line of LCD SPI

Note:

For the detailed design of LCD, see the latest *MC610 Series Reference Design*.

4 RF Interface

4.1 MC610 Working Frequency

Table 4-1 Working frequency

Operating Band	Description	Mode	Tx (MHz)	Rx (MHz)
Band 1	IMT 2100MHz	LTE FDD	1920 - 1980	2110 - 2170
Band 2	PCS 1900 MHz	GSM/LTE FDD	1850 - 1910	1930 - 1990
Band 3	DCS 1800MHz	GSM/LTE FDD	1710 - 1785	1805 - 1880
Band 4	AWS-1 1700	LTE FDD	1710 - 1755	2110 - 2155
Band 5	CLR 850MHz	LTE FDD	824 - 849	869 - 894
Band 7	IMT-E 2600MHz	LTE FDD	2500 - 2570	2620 - 2690
Band 8	E-GSM 900MHz	GSM/LTE FDD	880 - 915	925 - 960
Band 28	APAC 700MHz	LTE FDD	703 - 748	758 - 803
Band 66	AWS-1 1700	LTE FDD	1710 - 1780	2110 - 2180

4.2 RF Output Power of MC610

The RF output power of MC610 series modules is shown in the following table.

Table 4-2 Output power

Mode	Band	Tx Power (dBm)	Note
GSM	GSM 850	33±2	
	GSM 900	33±2	
	DCS 1800	30±2	
	PCS 1900	30±2	
LTE FDD	Band 1	23±2	10MHz Bandwidth, 1 RB

Mode	Band	Tx Power (dBm)	Note
	Band 2	23±2	10MHz Bandwidth, 1 RB
	Band 3	23±2	10MHz Bandwidth, 1 RB
	Band 4	23±2	10MHz Bandwidth, 1 RB
	Band 5	23±2	10MHz Bandwidth, 1 RB
	Band 7	23±2	10MHz Bandwidth, 1 RB
	Band 8	23±2	10MHz Bandwidth, 1 RB
	Band 28	23±2	10MHz Bandwidth, 1 RB
	Band 66	23±2	10MHz Bandwidth, 1 RB

4.3 RF Receiving Sensitivity of MC610 Series Modules

Table 4-3 Receiving sensitivity

Mode	Band	Rx Sensitivity (dBm) Typical	Note
GSM	GSM850	-108.5	BER<2.43%
	GSM 900	-108.5	BER<2.43%
	DCS 1800	-108.0	BER<2.43%
	PCS1900	-108.0	BER<2.43%
LTE FDD	Band 1	-98.5	10MHz Band width
	Band 2	-98.5	10MHz Band width
	Band 3	-98	10MHz Band width
	Band 4	-98	10MHz Band width
	Band 5	-98.5	10MHz Band width
	Band 7	-97	10MHz Band width
	Band 8	-98.5	10MHz Band width
	Band 28	-98.5	10MHz Band width

	Band 66	-98	10MHz Band width

4.4 WIFI/BT

MC610 series products support WIFI and BT function except MC610-LA-00, please refer chapter 2.1.

They share one channel antenna ANT_WIFI, WIFI only support WIFI-SCAN.

WIFI/BT receiving sensitivity is shown in the following table:

Function	Mode	Rx Sensitivity (dBm)	Note
WIFI	11b	-90	PER<8%
BT	BLE	-91	PER<30.8%

BT Transmit Power is shown in the following table:

Function	Mode	Tx Power (dBm)	Note
BT	BLE	6±3	-DC power supply=3.8V

BT Power Consumption is shown in the following table:

Function	Mode	Power Consumption (mA)	Note
BT	BLE	75	-DC power supply=3.8V

Note：

It is recommended to add a TVS (recommended model: ESD9D5U-2/TR) to improve the anti-surge capability of the product.

4.5 RF PCB Design

4.5.1 Antenna RF Connector

The antenna of the MC610 series modules is led from bonding pads. It is recommended that customers use the U.FL-R-SMT-1 antenna connector and use the matching RF adapter lines.

The antenna is a sensitive device and is easily affected by the external environment. For example, the position of the antenna, the occupied space, and the surrounding grounding may affect the performance of the antenna. In addition, the RF cable connected to the antenna and the fixed antenna position will also affect the antenna performance.

Figure 4-1 shows the reference circuit design of the main set antenna. These matches need to be placed close to the antenna:

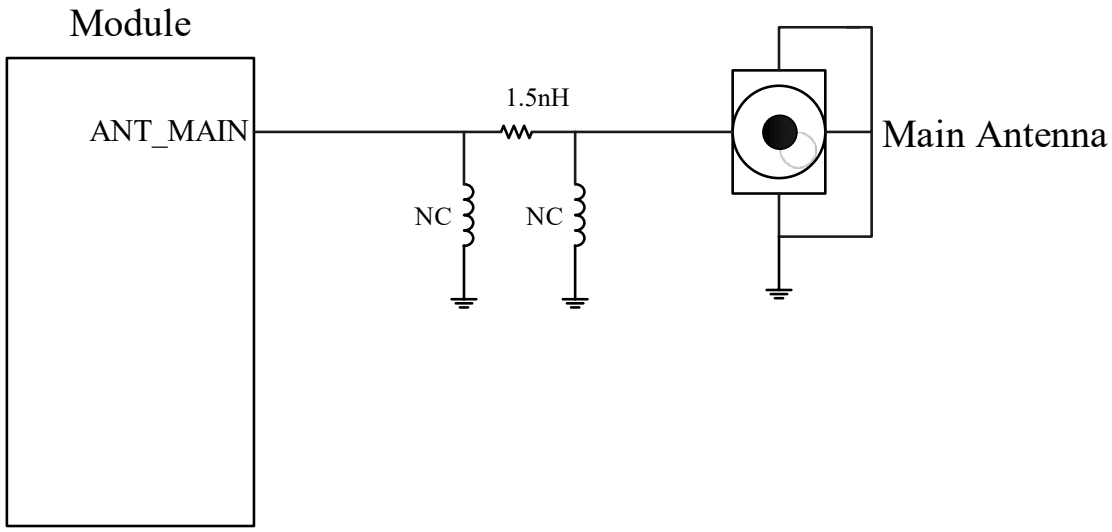

Figure 4-1 RF Reference circuit design

- Ensure that the characteristic impedance of the transmission line is 50 Ω.
- As the antenna line loss is less than 0.3 dB, keep the PCB routes as short as possible.
- PCB LAYOUT avoids passing through holes and overturning layers as much as possible, and also right-angle and acute-angle route.
- There should be a good reference ground around the PCB routes to avoid other signal lines close to the antenna.
- It is recommended to use intact formations as reference ground.
- The ground around the antenna strengthens the connection with the main ground.

Note:

Refer to *FIBOCOM Design Guide_RF* Antenna for detailed design.

4.6 Antenna Design

1. **Antenna Requirements**

   Antenna efficiency is the ratio of antenna input power to radiation power. Because of the return loss, material loss, coupling loss and radiation power of the antenna are lower than the input power, it is recommended that the antenna should be more than 40% (-4 dB).

2. **S11 or VSWR**

   S11 shows the matching degree of 50 Ω impedance of the antenna, which affects the antenna efficiency to a certain extent. The VSWR test can be used to measure this index. S11 < - 10 dB is recommended.

3. **Polarization**

   Polarization is the rotation direction of the electric field in the maximum radiation direction of the antenna.

   Linear polarization is recommended.

4. **Radiation Pattern**

   Radiation pattern refers to the intensity of electromagnetic field in all directions of far-field. Half wave dipole antenna is the most suitable terminal antenna. If it is a built-in antenna, it is recommended to use PIFA antenna or IFA antenna:

   Antenna area: 6 mm (height) × 10 mm (width) × 100 mm (length).

   Antenna radiation direction: Omni _ Directional.

5. **Gain and Directivity**

   The directivity of antenna refers to the electromagnetic field strength of electromagnetic wave in all directions. Gain is the combination of antenna efficiency and antenna directivity.

   The recommended antenna gain is ≤ 2.5 dBi

6. **Interference**

   In addition to the antenna performance, other interference on the PCB board will also affect the module performance. In order to ensure the high performance of the module, the interference must be well controlled. Suggestions: for example, LCD, CP, FPC wiring, audio circuit, power supply part should be as far away from the antenna as possible, and the corresponding isolation and shielding,

or filtering processing should be made on the path.

7. Antenna Index Requirements

Table 4-4 Antenna index

Main Antenna Requirements of MC610 Series Module	
Frequency range	The most suitable antenna must be used to fit the relevant bands
Bandwidth (GSM/GPRS)	GSM850: 70 MHz GSM900: 80 MHz GSM1800(DCS): 170 MHz GSM1900(PCS): 140 MHz
Bandwidth (LTE)	LTE band 1(2100): 250 MHz LTE Band 2(1900): 140 MHz LTE Band 3(1800): 170 MHz LTE Band 4(2100): 145 MHz LTE Band 5(850): 70 MHz LTE Band 7(2500): 190 MHz LTE Band 8(900): 80 MHz LTE Band 28(800): 100 MHz LTE Band 66(2100): 470 MHz
Impedance	50Ω
Input power	> 33 dbm (2 W) peak power GSM > 23 dbm average power LTE
Standing wave ratio recommendation	≤ 2:1

4.7 BT&WIFI_ SCAN External Design

There is no integrated WiFi filter in the module mc610. When WiFi function is required, filter design should be added externally. Refer to the following figure:

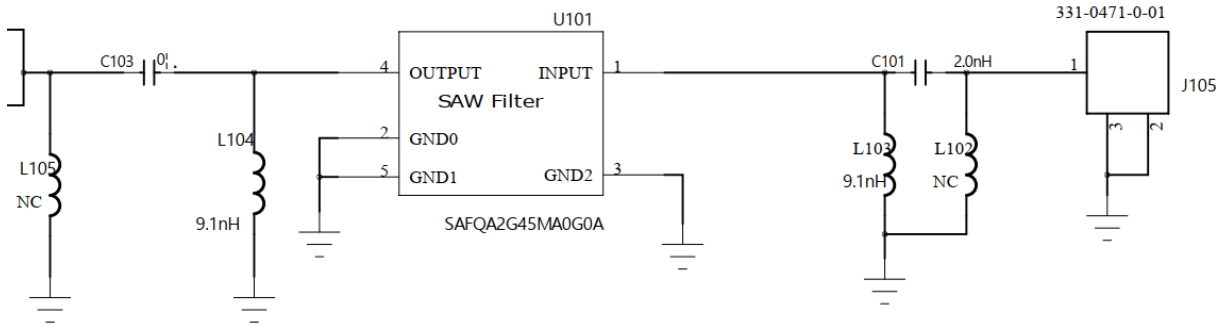

Figure 4-2 Design of WiFi reference circuit

Note:

WiFi only supports WIFI-SCAN, BT only supports BLE.

5 Electrical Characteristics

5.1 Limiting Voltage Range

The limiting voltage range refers to the maximum voltage range that the module power supply voltage and digital and analog I / O interfaces can withstand.

The voltage range of MC610 series module is shown in the table below.

Table 5-1 Limiting voltage

Parameter	Description	Min	Typ	Max	Unit
VBAT	Power supply	-0.3	-	4.6	V
GPIO	Level supply voltage of digital I/O	-0.3	-	2.0/3.2V	V

5.2 Ambient Temperature Range

MC610 series modules are recommended to work at - 30 - + 75°C. It is suggested that the temperature control measures should be considered in the application end under the harsh environment. At the same time, the limited working temperature range of the module is provided. Under this temperature condition, some RF indexes may exceed the standard. At the same time, it is suggested that the module application terminal should be stored at a certain temperature. Beyond this range, the module may not work properly or be damaged.

Table 5-2 Temperature range

Temperature	Min	Typ	Max	Unit
Operating temperature	-30	25	75	°C
Restricted operating temperature	-40	-	85	°C
Storage temperature	-40	-	90	°C

5.3 Electrical Characteristics of Interface Working State

V_L: logic low level;

V_H: logic high level;

Table 5-3 IO Interface level

Level	Signal	VL		VH		Unit
		Min	Max	Min	Max	
1.8 V	Digital input I	-	0.54	1.26	2.0	V
	Digital output O	-	0.36	1.44	-	V
3V	Digital input I	-	0.45	2.1	3.2	V
	Digital output O	-	0.45	2.1	-	V

Table 5-4 Power Interface level

Parameter	I/O	Min	Typ	Max	Unit
VBAT	I	3.4	3.8	4.2	V
SIM_VCC	O	1.7/2.75	1.8/2.85	1.9/2.95	V

5.4 Environment and Reliability Requirements

Table 5-5 Environmental reliability

Test Item	Test Condition
Low-temperature storage test	The temperature Is - 45 °C ± 3 °C, and the Power OFF state lasts for 24 hours
High-temperature and low-temperature storage test	The temperature Is +90 ± 3°C, and the Power OFF state lasts for 24 ours
Temperature impact test	In the Power OFF state, 24 cycles shall be carried out under -

Test Item	Test Condition	
	40 °C and +85 °C for 0.5 h, and the temperature conversion time is < 3 min	
High temperature and humidity test	The temperature is +65 °C ± 3 °C, the humidity is 90 to 95% RH, and the Power OFF state lasts for 88 hours	
Low-temperature running test	The temperature Is -30 °C ± 3 °C, and the working condition lasts for 24 hours	
High-temperature running test	The temperature is +75°C ± 3°C, and the working condition lasts for 24 hours	
Vibration test	Frequency	Random vibration ASD (acceleration spectral density)
	5 to 20Hz	0.96m^2/s^3
	20 to 500Hz	0.96 m^2/s^3 (at 20Hz), other -3dB/octave
Test for connector lifetime	Insert and pull the RF antenna interface cable for 30 times	

5.5 ESD Characterization

In the design of MC610 series modules, ESD problems have been considered and ESD protection has been done. However, ESD problems may occur during transportation and secondary development. Therefore, developers should consider the protection of ESD problems of final products. In addition to anti-static treatment of packaging, customers should refer to the recommended circuit of interface design in the document.

Refer to the following table for the allowable ESD discharge range of MC610 series modules.

Table 5-6 ESD Characterization

Location	Air Discharge	Contact Discharge
GND	±15KV	±8KV
Antenna interface	±15KV	±8KV
Other interfaces	±1KV	±0.5KV

Note:

The data in the above table are tested on ADP-MC610-LA-00.

6 Structural Specification

6.1 Product Appearance

The appearance of MC610 series modules is shown in the figure:

Figure 6-1 Module product appearance (top)

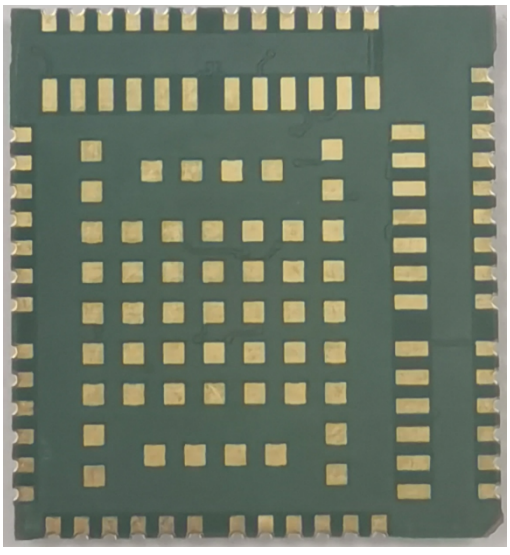

Figure 6-2 Module product appearance (bottom)

6.2 Structure Size

The structure size of MC610 series modules is shown in the following figure:

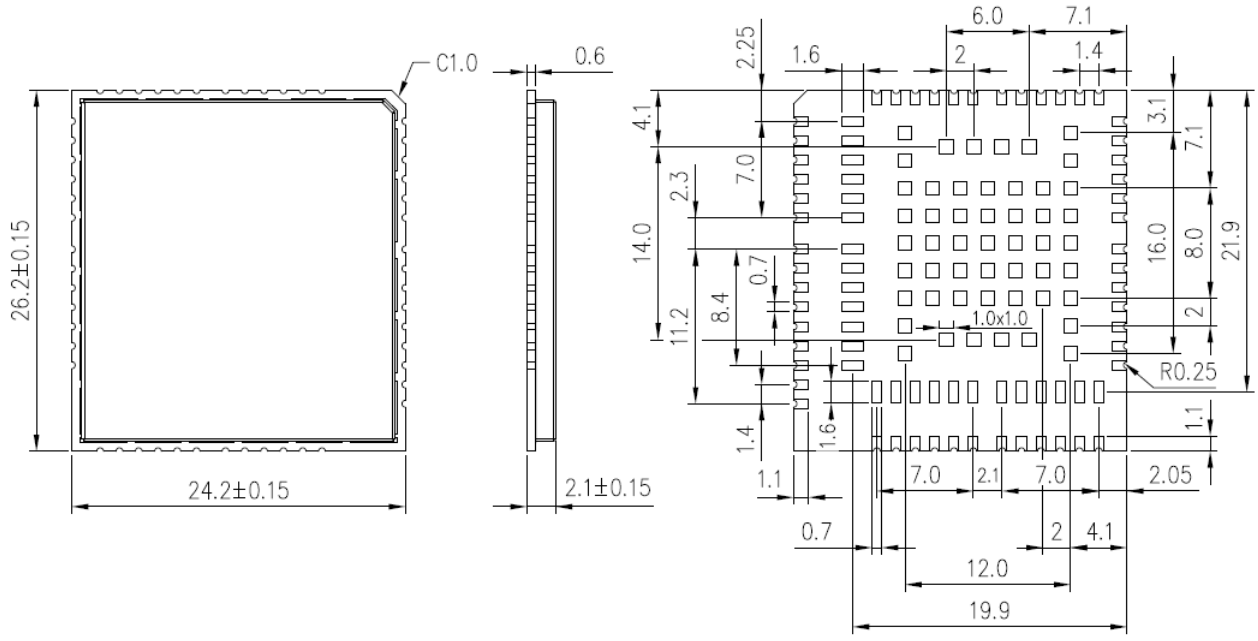

Figure 6-3 Structural dimension drawing (unit: mm)

6.3 SMT Paster

- Please refer to *FIBOCOM MC610 Series SMT Design Guide* for module steel mesh design, solder paste and furnace temperature control.

6.4 Packaging

MC610 module adopts tray sealed vacuum packaging mode, combined with the external packaging mode of hard cartoon, which plays a maximum protective role in the storage, transportation and use of the module.

7 Warning

7.1 CE warning

The EUT is a mobile device; maintain at least a 20 cm separation between the EUT and the user's body and must not transmit simultaneously with any other antenna or transmitter.

7.2 FCC warning

OEM/Integrators Installation Manual

Important Notice to OEM integrators 1. This module is limited to OEM installation ONLY. 2. This module is limited to installation in mobile or fixed applications, according to Part 2.1091(b). 3. The separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations. 4. For FCC Part 15.31 (h) and (k): The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part 15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be transmitting, and the evaluation should confirm that the module's intentional emissions are compliant (i.e. fundamental and out of band emissions). The host manufacturer must verify that there are no additional unintentional emissions other than what is permitted in Part 15 Subpart B or emissions are complaint with the transmitter(s) rule(s). The Grantee will provide guidance to the host manufacturer for Part 15 B requirements if needed.

End Product Labeling

When the module is installed in the host device, the FCC/IC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text: “Contains FCC ID: ZMOMC610LA”. The FCC ID can be used only when all FCC compliance requirements are met.

Antenna

(1) The antenna must be installed such that 20 cm is maintained between the antenna and users,

(2) The transmitter module may not be co-located with any other transmitter or antenna.

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid, and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, maximum antenna gain (including cable loss) must not exceed

Test Mode	Antenna Gain (dBi)	Test Mode	Antenna Gain (dBi)
GSM 850	1.5	LTE B5	1.5
PCS 1900	0.9	LTE B7	2.3
LTE B2	0.9	LTE B66	1.4
LTE B4	1.3	2.4GHz	1.0

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual

Federal Communication Commission Interference Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

List of applicable FCC rules

This module has been tested and found to comply with part 15C, part 22, part 24, part 27 requirements for Modular Approval.
The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

This device is intended only for OEM integrators under the following conditions: (For module device use)

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

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 20 cm between the radiator & your body.

8 Appendix

8.1 Abbreviation

Table 8-1 Abbreviations

Abbreviation	Description
AMR	Adaptive Multi-rate
bps	Bits Per Second
CS	Coding Scheme
DRX	Discontinuous Reception
FDD	Frequency Division Duplexing
GMSK	Gaussian Minimum Shift Keying
GSM	Global System for Mobile Communications
HSDPA	High Speed Down Link Packet Access
IMEI	International Mobile Equipment Identity
Imax	Maximum Load Current
LTE	Long Term Evolution
SCell	Secondary Cell for CA
PCB	Printed Circuit Board
RF	Radio Frequency
RHCP	Right Hand Circularly Polarized RMS
RMS	Root Mean Square
RTC	Real Time Clock
Rx	Receive

Abbreviation	Description
SMS	Short Message Service
TDMA	Time Division Multiple Access
TE	Terminal Equipment
TX	Transmitting Direction
TDD	Time Division Duplexing
UART	Universal Asynchronous Receiver & Transmitter
UMTS	Universal Mobile Telecommunications System
URC	Unsolicited Result Code
(U)SIM	(Universal) Subscriber Identity Module
USSD	Unstructured Supplementary Service Data
Vmax	Maximum Voltage Value
Vnorm	Normal Voltage Value
Vmin	Minimum Voltage Value
VIHmax	Maximum Input High Level Voltage Value
VIHmin	Minimum Input High Level Voltage Value
VILmax	Maximum Input Low Level Voltage Value
VILmin	Minimum Input Low Level Voltage Value
VImax	Absolute Maximum Input Voltage Value
VImin	Absolute Minimum Input Voltage Value
VOHmax	Maximum Output High Level Voltage Value
VOHmin	Minimum Output High Level Voltage Value
VOLmax	Maximum Output Low Level Voltage Value
VOLmin	Minimum Output Low Level Voltage Value

Abbreviation	Description
VSWR	Voltage Standing Wave Ratio
WCDMA	Wideband Code Division Multiple Access

8.2 Contact

Company website: http://www.fibocom.com.cn/

Tel: +86 755-26733555

Fax: +86 755-26520841