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L810-GL LGA Module Hardware User Manual

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Date：2015.09.24

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Versions

Version	Date	Remarks
V1.0.0	2014-10-17	Initial Version
V1.0.1	2014-11-24	Update the related specifications of bands
V1.0.2	2014-12-15	1.Change the definition of SIM2/ MMC(SDIO) pin to GND; 2.Update the related circuit and description of SIM1_CD and POWER_ON/OFF.
V1.0.3	2015-02-06	1. Update the module appearance and power on/off timing diagram. 2. Modify the capacitance of SIM_DATA 3. Update the consumption, RF indicator and sensitivity 4. Modify the reset value of BODY_SAR and IPC_WAKEUP_HOST to PU. 5. Add the high-low range of voltage and the description of unused pin design. Modify the format : add a space behind of the "Band", change the format of "LTE FDD"and "FDD LTE" to "LTE FDD", change the format of

		"TDD LTE" to "LTE TDD",and simplify the hardware diagram.
V1.0.4	2015-04-21	Add the description of "Bottom(Perspective)" in PCB Layout
V1.0.5	2015-05-18	Update the translation of all the whole document .
V1.0.6	2015-07-07	Update the title to "L810-GL Hardware User Manual"
V1.0.7	2015-08-25	Update the logo.
V1.0.8	2015-09-24	Change the data of Specifications

Applicability Type

No.	Type	Note
1	L810-GL-00	

The difference of L810 LGA series wireless module as listed below:

Model No.	LTE FDD	LTE TDD	WCDMA	TD-SCDMA	GSM/GPRS/EDGE
L810-GL-00	Band 1, 3, 5, 7, 8, 20	Band 38, 39, 40, 41	Band Ⅰ,Ⅷ	Band A, F	900/1800MHz

Content

1 Foreword

1.1 Introduction

The document describes the electrical characteristics, RF performance, dimensions and application environment, etc. of L810 series wireless communication modules. With the assistance of the document and other instructions, developers can quickly understand the performance of L810 series wireless communication modules and develop products.

1.2 Reference Standard

The design of the product compiles with the following standards ：

- 3GPP TS　27.007 -v6.9.0: AT command set for User Equipment (UE)
- 3GPP TS　27.005 -v6.0.1: Use of Data Terminal Equipment -Data Circuit terminating Equipment (DTE-DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
- 3GPP TS　23.040 -v6.9.0: Technical realization of Short Message Service (SMS)
- 3GPP TS　24.011 -v6.1.0: Point- to - Point (PP) Short Message Service (SMS) support on mobile radio interface
- 3GPP TS　27.010 -v6.0.0: Terminal Equipment to User Equipment (TE-UE) multiplexer protocol
- 3GPP TS　27.060 -v6.0.0: Packet domain; Mobile Station (MS) supporting Packet Switched services
- 3GPP TS　25.304-v6.10.0: User Equipment (UE) procedures in idle mode and procedures for cell reselection in connected mode
- 3GPP TS 25.308 -v6.4.0: High Speed Downlink Packet Access (HSDPA); Overall description;Stage 2
- 3GPP TS　25.309 -v6.6.0: FDD enhanced uplink; Overall description; Stage 2
- 3GPP TS　23.038 -v6.1.0: Alphabets and language - specific information
- 3GPP TS　21.111 -v6.3.0: USIM and IC card requirements
- 3GPP TS　31.111 -v6.11.0 "USIM Application Toolkit (USAT)"
- 3GPP TS　45.002 -v6.12.0: Multiplexing and　multiple access on the radio path
- 3GPP TS　51.014 -v4.5.0: Specification of the SIM Application Toolkit for the Subscriber Identity Module -
  Mobile Equipment (SIM-ME) interface
- 3GPP TS　51.010 -1 -v6.7.0: Mobile Station (MS) conformance specification; Part 1: Conformance specification
- 3GPP TS　22.004 -v6.0.0: General on supplementary services

- 3GPP TS 23.090 -v6.1.0: Unstructured Supplementary Service Data (USSD); Stage 2

- 3GPP TS 24.008 v6.19, Mobile radio interface Layer 3 specification;

- 3GPP TS 25.101 V7.18.0: User Equipment (UE) radio transmission and reception (FDD)

- 3GPP TS 36.101V9.18.0: User Equipment (UE) radio transmission and reception

- 3GPP TS 36.104V9.13.0: Base Station (BS) radio transmission and reception

- 3GPP TS 36.106V9.4.0: FDD Repeater radio transmission and reception

- 3GPP TS 36.113V9.5.0: Base Station (BS) and repeater ElectroMagnetic Compatibility (EMC)

- 3GPP TS 36.124V9.2.0: ElectroMagnetic Compatibility (EMC) requirements for mobile terminals and ancillary equipment

- 3GPP TS 36.133V9.18.0:Requirements for support of radio resource management

- 3GPP TS 34.121-1 version 7.2.0: The requirements and this test apply to all types of UTRA for the FDD UE

- 3GPP TS 36.521-1 User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Conformance testing

- 3GPP TS 34.122V5.7.0: Technical Specification Group Radio Access Network; Radio transmission and reception (TDD)

- 3GPP TS 45.005 9.4.0: Digital cellular telecommunications system (Phase 2+);Radio transmission and reception

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2 Product Overview

2.1 Description

L810 LGA series are highly integrated 4G wireless modules, supports 5 modes and 11 bands,including the main 4G/3G/2G modes (LTE FDD/LTE TDD/WCDMA/TD-SCDMA/GSM) and with wide bands. These bands support the cellular network of the global major operators excepting part of the American and Japan bands.

2.2 Specifications

Specifications		
Operating Frequency Range	L810-GL	
	LTE FDD: Band 1, 3, 5, 7, 8, 20	
	LTE TDD: Band 38, 39, 40, 41	
	WCDMA HSPA+: Band Ⅰ,Ⅷ	
	TD-SCDMA: Band A, F	
	GSM/GPRS/EDGE: 900/1800MHz	
Data Rare	LTE FDD	Category 4 (150Mbps DL,50Mbps UL)
		Category 6 (300Mbps DL,50Mbps UL) in future
	LTE TDD	Cat 4 (112Mbps DL , 10Mbps UL)
	UMTS/HSDPA/HSUPA 3GPP Rel.10	DC-HSDPA 42Mbps(Cat24)/42Mbps(Cat20) HSUPA 5.76Mbps(Cat7)
	TD-SCDMA	DL 2.8Mbps, UL 2.2Mbps(Monolithic integration)
	GSM 3GPP release 7	EDGE (E-GPRS) multi-slot class 33(296kbps DL, 236.8kbps UL)
		GPRS multi-slot class 33 (107kbps DL, 85.6kbps UL)
Physical Characteristics	Dimension：32mm x 26mm x 2.0mm	
	Interface：LGA 128	
	Weight：4.0 grams	

Environment	Operating Temperature：-30℃ ~ +75℃
	Storage Temperature：-40℃ ~ +85℃

Performance	
Operating Voltage	Voltage: 3.3V ~ 4.4V Normal: 3.8V
Current Consumption (Typical Value)	Sleep Mode: 5mA
	WCDMA/TD-SCDMA/LTE TDD Idle: 26mA
	LTE FDD Idle: 28mA
	LTE FDD DATA: 650mA
	LTE TDD DATA: 380mA
	WCDMA Talk: 500mA
	TD-SCDMA Talk: 130mA
	2G Talk: 260mA (GSM PCL5)

Interfaces	
RF Interface	Antenna：Mainx1，Diversityx1
Function Interface	1 x USB 2.0
	1 x USB 3.0（not supported yet）
	1 x UART
	MUX Over UART1
	Multiple Profiles over USB
	SIM Support
	I2C Support
	I2S Support
	JTAG/MIPI Trace
	HSIC/SSIC（not supported yet），
	EINT，System Indicator，A/D，Clock, RTC

Data Features	

Protocol Stack	Embedded TCP/IP and UDP/IP protocol stack
EDGE	Multi-slot class 33 (5 Down; 4 Up; 6 Total)
	Coding Scheme MCS1~9
GPRS	Multi-slot class 33 (5 Down; 4 Up; 6 Total)
	Coding SchemeMCS1~4
CSD	UMTS(14.4kbps)，GSM(9.6kbps)
USSD	Support
SMS	MO / MT Text and PDU modes
	Cell broadcast
Audio	Digital Audio
	Voice Coders: FR/HR/EFR/AMR-NB/AMR-WB
	VoLTE（not supported yet）
Audio Control	Gain Control , Echo Cancellation, Noise Suppression, EQ Modulation.
Character Set	IRA，GSM，UCS2，HEX
AT Commands	FIBOCOM proprietary AT commands
	GSM 07.05
	GSM 07.07
Accessories	Firmware Loader Tool over USB/UART
	User Manual
	Developer Kit

2.3 Appearance

The product appearance of L810 series wireless module is shown as below:

Top View：
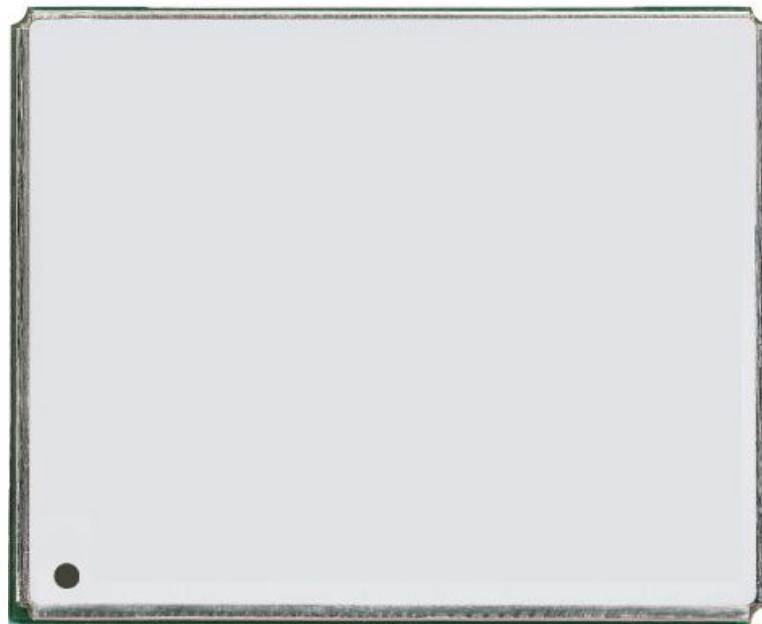
Figure 2- 1 Top View

Bottom view:
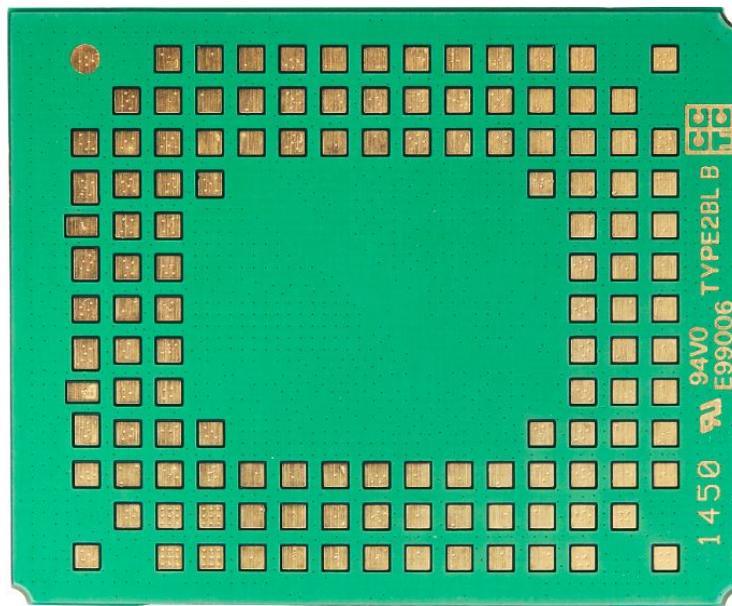
Figure 2- 2 Bottom View

3 Structure

3.1 Dimension Diagram of Structure
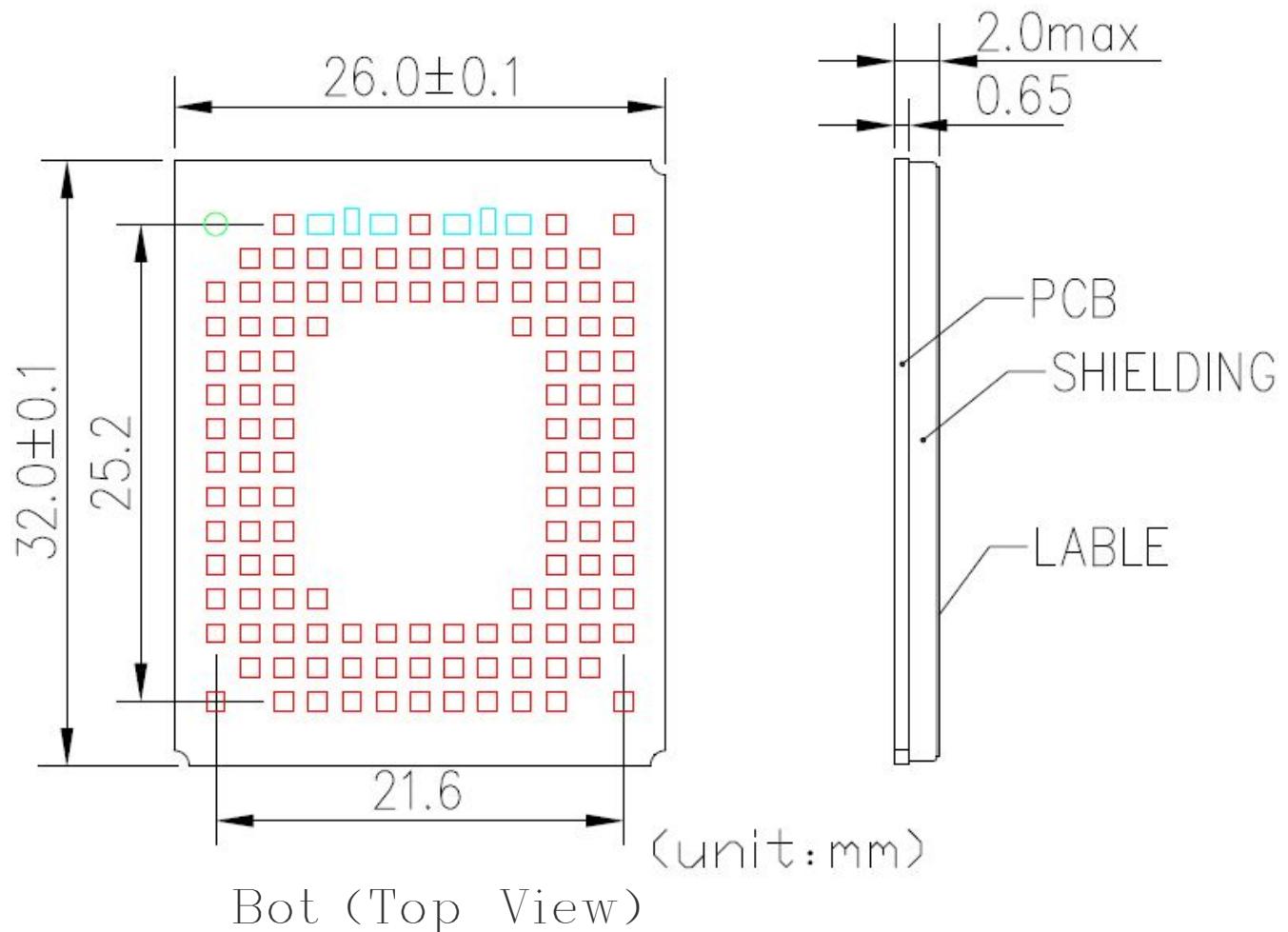
Figure 3- 1 Dimension Diagram of Structure

3.2 Recommended PCB Layout Design

unit:mm
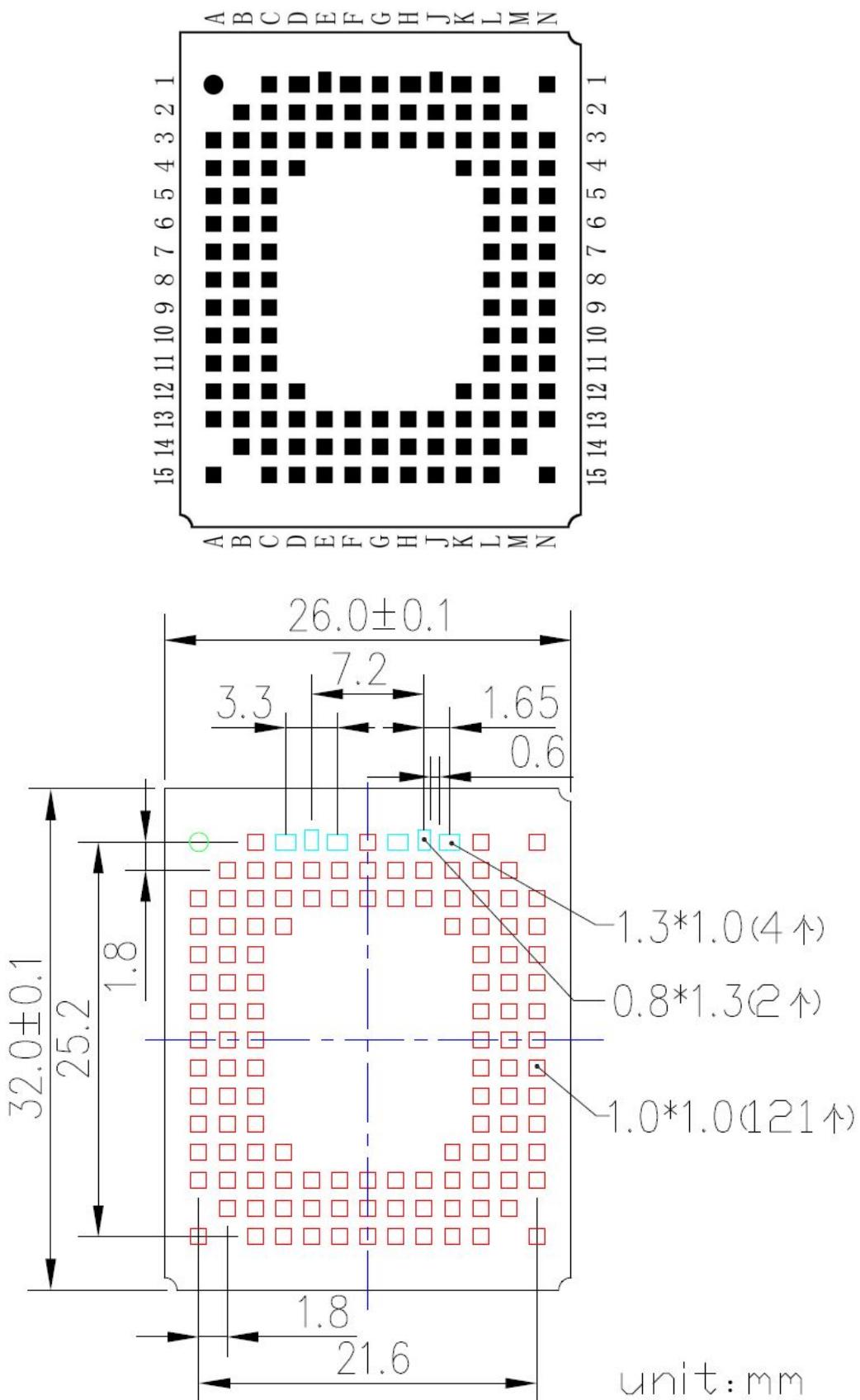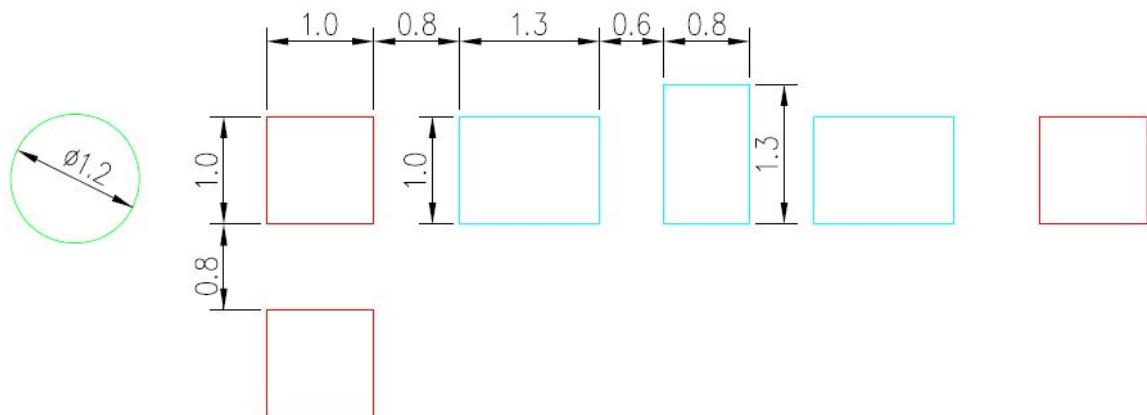
Figure 3- 2 Recommended PCB Layout

(Top View)

4 Hardware Introduction

4.1 Hardware Diagram
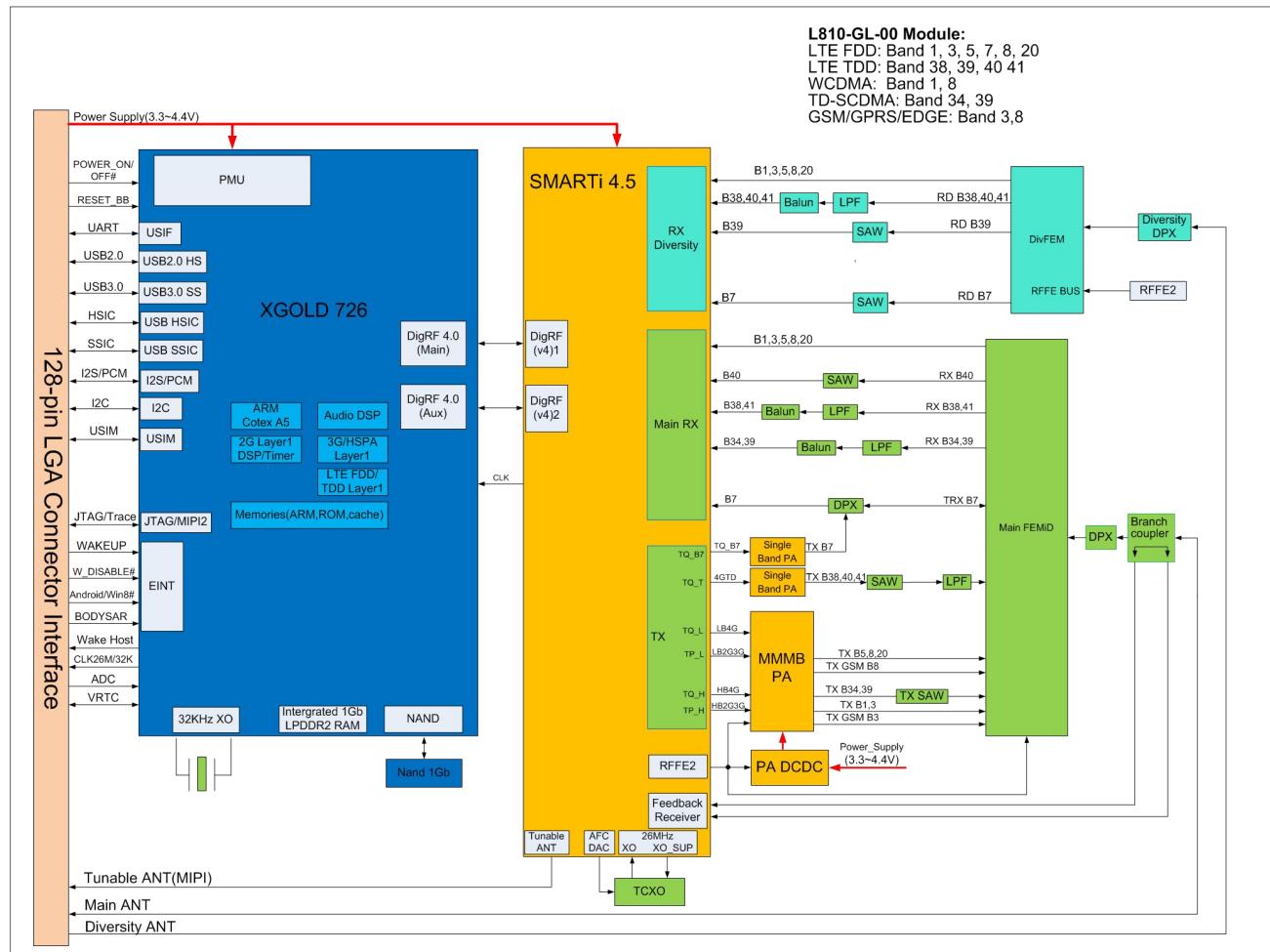
Figure 4- 1 Block Diagram

4.2 Pin Definition

4.2.1 Pin Map

	A	B	C	D	E	F	G	H	J	K	L	M	N	
1	GND		GND	GND	ANT_DIV	GND	GND	GND	ANT_MAIN	GND	GND		GND	1
2		GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		2
3	FSYS2_26M	RFE_RFFE1_VIO	GND	GND	GND	GND	GND	GND	GND	GND	GND	VBAT	VBAT	3
4	CORE_DUMP	RFE_RFFE1_SCLK	IPC_HOST_WAKEUP	GND						GND	GND	VBAT	VBAT	4
5	LPG	RFE_RFFE1_SDATA	IPC_TRIG_OUT								TDO	TRST_N	VRTC	5
6	GND	GND	GND								HW_MON17 (TRC_DATA0)	TRIG_IN	VSD2_1V8	6
7	WAKEUP_HOST	GND	IPC_TRIG_IN								HW_MON18 (TRC_CLK)	TMS	RESET_N	7
8	CLK32K	GND	IPC_SLAVE_WAKEUP								GND	GND	PWR_ON/OFF#	8
9	UART1_TXD	GND	GND								HW_MON19 (TRC_DATA1)	TCK	I2S2_WA0	9
10	UART1_RXD	GND	ADC								HW_MON20 (TRC_DATA2)	TDI	I2S2_TX	10
11	VBUS	GND	GND								HW_MON21 (TRC_DATA3)	I2C_SDA	I2S2_RX	11
12	USB_DN	USB_HSIC_STRB	USB_HSIC_DATA	GND						GND	GND	I2C_SCL	I2S2_CLK	12
13	USB_DP	USB30_TX_DN	USB30_TX_DP	SSIC_RXP	SSIC_RXN	GND	GND	GND	GND	GND	GND	GND	GND	13
14		USB30_RX_DN	USB30_RX_DP	SSIC_TXP	SSIC_TXN	SIM1_DP	SIM1_DN	EINT3	BODY_SAR	UART1_RTS	UART1_CTS	GND		14
15	GND		GND	VSIM1	SIM1_RST	SIM1_CLK	SIM1_DATA	SIM1_CD	WAKEUP	W_DISABLE#	PA_BLANKING/TRIG_OUT		GND	15
	A	B	C	D	E	F	G	H	J	K	L	M	N	

Figure 4-2 Pin Diagram

(TOP View)

4.2.2Description of Pins

The logic signal lever of L810 series is 1.8V

Pins of L810 series are described in the table below:

Pin#	Pin Name	I/O	Reset Value	Idle Value	Description
Power					
N3	VBAT	PI			Power input
N4	VBAT	PI			Power input
M3	VBAT	PI			Power input
M4	VBAT	PI			Power input
N5	VRTC	PO			VRTC output
N6	VSD2_1V8	PO			VSD2_1V8 output
Power_ON/OFF#,RESET					
N7	RESET_N	I			Module reset input,pull up(100K ohms),1.8V
N8	POWER_ON/OFF#	I			Module Power ON/OFF# signal,pull down (200K ohms),1.8V
I2S					
N9	I2S2_WA0	O	PD	T	I2S LRCK,CMOS 1.8V
N10	I2S2_TX	O	PD	T	I2S transmit data,CMOS 1.8V
N11	I2S2_RX	I	PD	T	I2S receive data,CMOS 1.8V
N12	I2S2_CLK	O	PD	T	I2S serial clock,CMOS 1.8V
I2C					
M11	I2C_SDA	IO	PU	PU	I2C serial data,pull up(4.7K ohms)CMOS 1.8V
M12	I2C_SCL	O	PU	PU	I2C serial clock,pull up(4.7K ohms)CMOS 1.8V
Clock					
A3	FSYS2_26M	O			26MHz clock output,1.8V
A8	CLK32K	O	PD	PD	32kHz clock output,1.8V
SIM1					
D15	VSIM1	PO			SIM1 power supply,1.8V/2.8V
E15	SIM1_RST	O	L		SIM1 reset
F15	SIM1_CLK	O	L		SIM1 clock
G15	SIM1_DATA	IO	L		SIM1 data,internal 4.7K resistor pull up

H15	SIM1_CD	I	T		SIM1 detect, pull up(390K ohms)CMOS 1.8V
F14	SIM1_DP	IO	PD		USB data plus for SIM1 card
G14	SIM1_DN	IO	PD		USB data minus for SIM1 card
USB2.0					
A11	VBUS	PI			USB VBUS Supply
A12	USB_DN	IO	T		USB Data Minus
A13	USB_DP	IO	T		USB Data Plus
USB3.0					
C13	USB30_TX_DP	IO			USB3.0 Transmit data plus(not support now)
B13	USB30_TX_DN	IO			USB3.0 Transmit data minus(not support now)
C14	USB30_RX_DP	IO			USB3.0 receive data plus(not support now)
B14	USB30_RX_DN	IO			USB3.0 receive data minus(not support now)
HSIC					
B12	USB_HSIC_STRB	IO			High speed Inter IC clock(not support now)
C12	USB_HSIC_DATA	IO			High speed Inter IC data(not support now)
C4	IPC_HOST_WAKEUP	O	PU	H	IPC host wakeup(not support now)
C5	IPC_TRIG_OUT	O	PD	L	IPC trig out(not support now)
C7	IPC_TRIG_IN	I	PU	PU	IPC trig in(not support now)
C8	IPC_SLAVE_WAKEUP	I	PD		IPC slave wakeup(not support now)
SSIC					
D14	SSIC_TXP	IO			SSIC transmit data plus(not support now)
E14	SSIC_TXN	IO			SSIC transmit data minus(not support now)
D13	SSIC_RXP	IO			SSIC receive data plus(not support now)
E13	SSIC_RXN	IO			SSIC receive data minus(not support now)
UART1					
A9	UART1_TXD	O	PU	PP	UART1 transmit Data,CMOS 1.8V
A10	UART1_RXD	I	PD	PU	UART1 receive Data,CMOS 1.8V
K14	UART1_RTS	O	PU	PP	UART1 Request To Send,CMOS 1.8V
L14	UART1_CTS	I	PU	PU	UART1 Clear To Send,CMOS 1.8V
EINT					
J15	WAKEUP	I	PD	PU	WAKEUP,CMOS 1.8V
K15	W_DISABLE#	I	PD	PU	W_DISABLE#,CMOS 1.8V
H14	EINT3	I	PD	PU	EINT3,CMOS 1.8V

J14	BODY_SAR	I	PU	PU	BODY_SAR,CMOS 1.8V
System status indicator					
A4	CORE_DUMP	O	PD	L	Core dump indicator,CMOS 1.8V
A5	LPG	O	PD		LPG,CMOS 1.8V
A7	WAKEUP_HOST	O	PU	L	WAKEUP_HOST,CMOS 1.8V
L15	PA_BLANKING/ TRIG_OUT(T_OUT1)	O	PD	L	PA blanking output/Monitoring Signal Output,CMOS 1.8V
ADC					
C10	ADC	I			General purpose A/D,1.2V max voltage
JTAG					
L5	TDO	O	T		Serial Data Out
M10	TDI	I	PU		Serial Data Input
M7	TMS	I	PU		State machine control signal
M9	TCK	I	PD		JTAG clock input
M5	TRST_N	I	PD		Reset/Module enable
M6	TRIG_IN	I	PD		Monitoring Signal Input,CMOS 1.8V
MIPI2 Trace					
L7	MIPI2_TRC_CLK	O	PD	PP	MIPI2 trace clock,CMOS 1.8V
L6	MIPI2_TRC_DATA0	IO	PD	PP	MIPI2 trace data0,CMOS 1.8V
L9	MIPI2_TRC_DATA1	IO	PD	PP	MIPI2 trace data1,CMOS 1.8V
L10	MIPI2_TRC_DATA2	IO	PD	PP	MIPI2 trace data2,CMOS 1.8V
L11	MIPI2_TRC_DATA3	IO	PD	PP	MIPI2 trace data3,CMOS 1.8V
ANT Tunable					
B5	RFE_RFFE1_SDATA	IO		PP	RFFE1 serial data for tunable ANT,CMOS 1.8V
B4	RFE_RFFE1_SCLK	O		PP	RFFE1 serial clock for tunable ANT,CMOS 1.8V
B3	RFE_RFFE1_VIO	PO			RFFE1 VIO for tunable ANT,1.8V
ANT					
J1	ANT_MAIN	IO			Main antenna
E1	ANT_DIV	I			Diversity antenna
B8	GND				GND
B9	GND				GND
B10	GND				GND
B11	GND				GND

C11	GND				GND
F13	GND				GND
L12	GND				GND
M13	GND				GND
L13	GND				GND
G13	GND				GND
H13	GND				GND
J13	GND				GND
K13	GND				GND
A6	GND				GND
B2	GND				GND
B6	GND				GND
B7	GND				GND
C1	GND				GND
C2	GND				GND
C3	GND				GND
C6	GND				GND
C9	GND				GND
C15	GND				GND
D1	GND				GND
D2	GND				GND
D3	GND				GND
D4	GND				GND
D12	GND				GND
E2	GND				GND
E3	GND				GND
F1	GND				GND
F2	GND				GND
F3	GND				GND
G1	GND				GND
G2	GND				GND
G3	GND				GND
H1	GND				GND
H2	GND				GND
H3	GND				GND

J2	GND				GND
J3	GND				GND
K1	GND				GND
K2	GND				GND
K3	GND				GND
K4	GND				GND
K12	GND				GND
L1	GND				GND
L2	GND				GND
L3	GND				GND
L4	GND				GND
L8	GND				GND
M2	GND				GND
M8	GND				GND
M14	GND				GND
N13	GND				GND
A1	GND				GND
A15	GND				GND
N1	GND				GND
N15	GND				GND

H：High Voltage Level

L：Low Voltage Level

PD：Pull-Down

PU：Pull-Up

T：Tristate

OD：Open Drain

PP：Push-Pull

Note : the unused pins can NC directly while designing.

5 Hardware Interface

5.1 Power Interface

5.1.1 Power Supply

L810 modules require 3.3V~4.5V direct current power supply, which can provide the maximum GSM emission current of 2A.

Input power supply requirements:

Parameter	Minimum Value	Recommended Value	Maximum Value	Unit
VBAT	3.3	3.8	4.4	V

Points for attention in design:

1. Supply voltage fluctuation shall be lower than 300mV.

2. Minimum supply voltage drop shall be higher than 3.1V.

The filter capacitor design of power supply circuit as follows:

Recommended capacitor	Application	Description
330uF	Supply capacitance	Reduce power-supply fluctuation during phone call. The capacitance value bigger is better
1uF,100nF	Digital signal noise	Filter the interference caused by clock and digital signals
39pF,33pF	700 /850 /900 MHz	Filter RF interference
18pF,8.2pF,6.8pF	1700/1800/1900, 2100/2300,2500/2600MHz	Filter RF interference

5.1.2 Consumption

Under the situation of 3.8V supply power , the consumption of L810 module as listed below :

Parameter	Description	Condition		Current(mA)
I_{off}	RTC mode	Power off		0.21
I_{Idle}	GSM	MFRMS	5	25
	WCDMA	DRX	8	25

	TD-SCDMA		8	28
	LTE FDD		8	27
	LTE TDD		8	28
	Radio Off	RF is disabled.	AT+cfun=4/1	24.5
I_{Sleep}	GSM	MFRMS	2	3.5
			5	2.9
			9	2.6
	WCDMA	DRX	6	3.5
			8	2.7
			9	2.6
	TD-SCDMA		8	3.2
	LTE FDD	DRX	8	4.9
	LTE TDD		8	4.6
	Radio Off	RF is disabled.	AT+cfun=4/1	2.2
$I_{GSM-RMS}$	GSM voice RMS Current	EGSM900 PCL	5	280
			12	121
			19	90
		DCS1800 PCL	0	217
			7	110
			15	87
$I_{GSM-MAX}$	GSM voice Peak current	EGSM900 PCL	5	1829
			12	473
			19	207
		DCS1800 PCL	0	1303
			7	384
			15	183
$I_{GPRS-RMS}$ CS4	GPRS 1Rx slot nTX slot	EGSM900 PCL=5（3）	1	275
			4	701
		EGSM900 PCL=10（8）	1	153
			4	362
		DCS1800 PCL=0（3）	1	224
			4	521
		DCS1800 PCL=10（13）	1	107

			4	172
$I_{EGPRS-RMS}$ MCS9	EGPRS 1Rx slot nTX slot	EGSM900 PCL=8（6）	1	198
			4	455
		EGSM900 PCL=15（13）	1	111
			4	189
		DCS1800 PCL=2（5）	1	181
			4	419
		DCS1800 PCL=10（13）	1	106
			4	170
$I_{WCDMA-RMS}$	WCDMA	Band 1	24dBm	667
			10dBm	188
			1dBm(0)	153
		Band 8	23.5dBm	588
			10dBm	187
			1dBm(0)	142
$I_{TD-SCDMA-RMS}$	TD-SCDMA	Band 34	23dBm	128
			10dBm	90
			1dBm(0)	85
		Band 39	23dBm	129
			10dBm	91
			1dBm(0)	84
$I_{LTE-RMS}$	LTE FDD	B1	22dBm	576
			10dBm	272
			0dBm	224
		B3	21dBm	686
			10dBm	281
			0dBm	232
		B5	22.5dBm	649
			10dBm	266
			0dBm	221
		B7	22dBm	691
			10dBm	285
			0dBm	236

			22dBm	680
		B8	10dBm	275
			0dBm	222
			22.5dBm	654
		B20	10dBm	270
			0dBm	219
	LTE TDD		23dBm	376
		B38	10dBm	200
			0dBm	175
			22.5dBm	298
		B39	10dBm	191
			0dBm	171
			22.5dBm	341
		B40	10dBm	199
			0dBm	172
			23dBm	368
		B41	10dBm	198
			0dBm	176

5.1.3 VSD2_1V8

As the power supply for the digital circuit inside the module, VSD2_1V8 can be used as the module`s reference level of the status index signal and digital signal. In circuit designing, only used for external low current application(<50mA). Of course , it can be kept floating if not used.

Parameters	Minimum Value	Recommended Value	Maximum Value	Unit
VSD2_1V8	1.7135	1.8	1.8865	V
V_{IH}	0.7* VSD2_1V8	1.8	1.8865	V
V_{IL}	-0.3	0	0.3* VSD2_1V8	V

5.1.4 VRTC

VRTC is the power supply of the RTC inside the module, and it can be used as the backup power signal as well.

Parameters	Minimum Value	Recommended Value	Maximum Value	Unit

| VRTC output voltage	1.71	1.8	1.89	V
VRTC input voltage (RTC is in normal)	1.0	1.8	1.89	V
VRTC input current (RTC is in normal)			20	uA

The reference design of VRTC circuit is as follows:
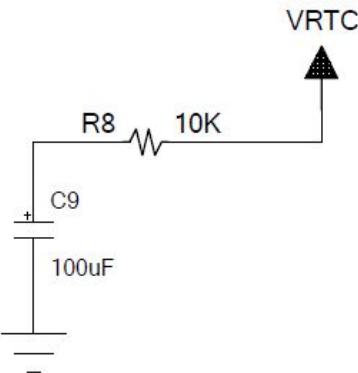
Figure 5- 1 VRTC Reference Design

Note:

- R8 is a current-limiting resistor, used to ensure the VRTC module works properly, free from being affected by peripheral circuits. R8≥1k ohm.

- VRTC power consumption current is about 10uA.

- The value of C9 will affect the retaining time of RTC after VBAT powers off. The retaining time of RTC can be roughly calculated by the following formula:

  T= (1.8-0.5)*C/1=1.3C, unit: second. Namely, if the value of C9 is 300uF, the retaining time of RTC will be around 30s.

- If the RTC backup power function is not required, VRTC pin can be floating.

5.2 Power on/off and Reset Signal

L810 wireless communication modules provide two control signals to power on /power off and reset the modules.

Pins definition as listed below :

Pin#	Pin Name	Electrical Level	Description
N8	POWER_ON/OFF#	CMOS 1.8V	Power off signal, power on with high level, power off or floating with low level.

N7	RESET_N	CMOS 1.8V	External reset signal input,active low.

5.2.1Power on /off Signal

5.2.1.1Power on Signal

After the module is connected to the power supply, the user can through pull up the start up the Power on/off signal to make the module power on.

Timing sequence requirement of the startup pulse:

Parameter	Condition	Minimum Value	Typical Value	Maximum Value	Unit
Pulse Width	Power on	20	100		ms

The timing sequence control is shown in the diagram below:
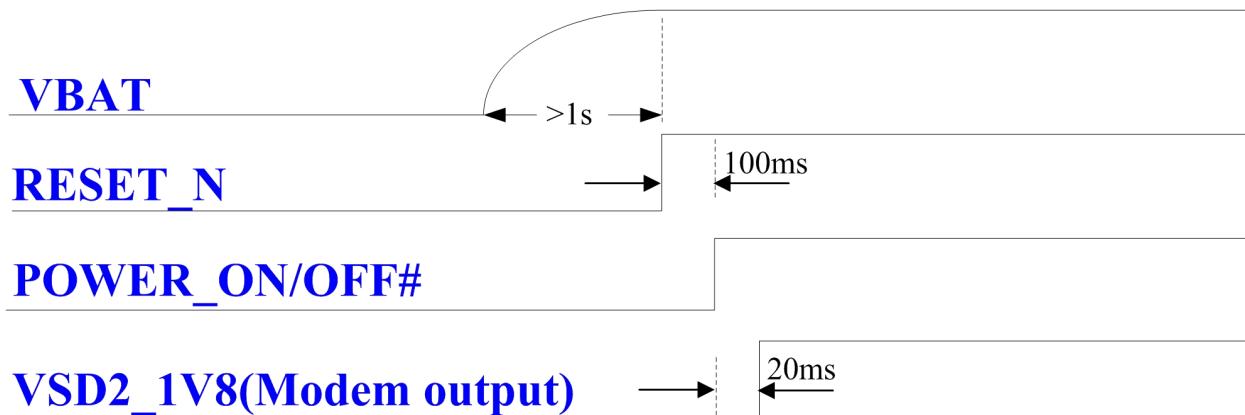
Figure 5- 2 Power on Timing Control Diagram

Note : the "＞1s" of VBAT is the time aim at the module power supply(that is the capacitance charging). If the VBAT is already set up or supplied in the long term,then the control time that aimed at VBAT can ignore. AP-side only control the " RESET_N" and "POWER_ON/OFF# ".

5.2.1.2Power off signal

L810 module supports two power_off modes. Through the software modes to turn off the module in general condition. If the system halted or happened exceptions, use the following hardware modes to turn off it, pull down the POWER_ON/OFF# signal or floating[①]. For details as listed below:

Off modes	Methods	Condition
Software off	Send AT+CPWROFF commands.	Normal power_off

Hardware off	Pull down the POWER_ON/OFF# or floating.	Only used for system halted or happens exceptions and the software modes cannot be used.

The description of hardware power_off as follows (Pull down the POWER_ON/OFF# signal or floating) :

While pulling down the POWER_ON/OFF# signal or floating, the modules` PMU (Power Management Unit) will be reset, then the module will get into off modes from working modes.

Note [①]: the RESET_N must be pulled down before pulling down the POWER_ON/OFF# signal, and then the module will be turned off safely.

The timing sequence requirements of the pulse are as follows:

| Parameter	Condition	Minimum Value	Typical Value	Maximum Value	Unit
Pulse Width	Power off	5	100		ms

The timing sequence diagram as follows:
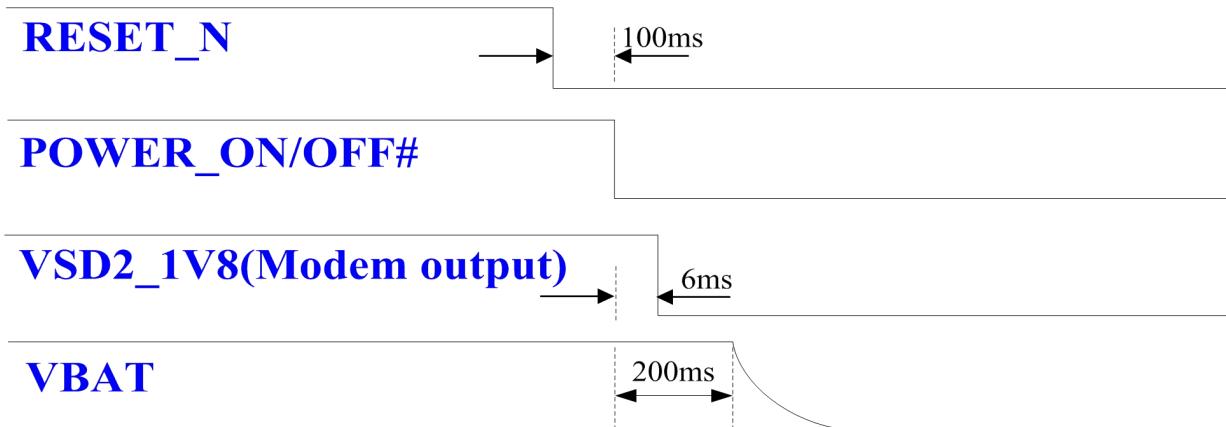
Figure 5- 3 Power off Timing Sequence Diagram

5.2.1.3The Recommended Design of Power on/off

The recommended design of POWER_ON/ OFF signal is as follows:

![Fibocom logo]
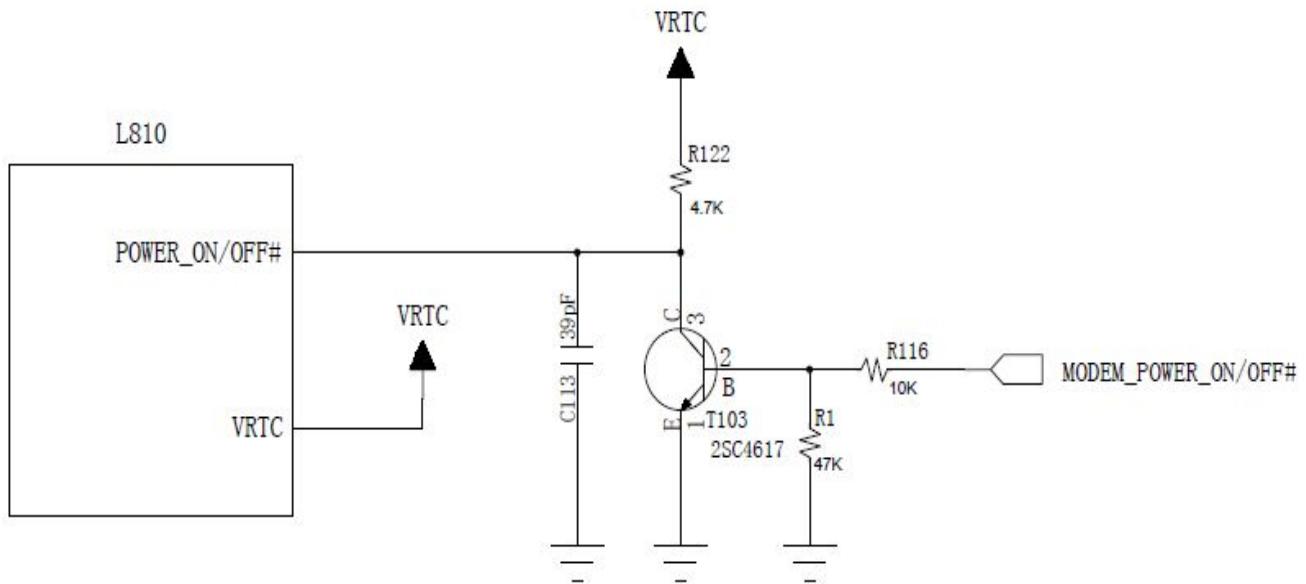
Figure 5- 4 Recommended Design of POWER_ON/OFF# Signal

5.2.2RESET Signal

L810 wireless modules support external reset function. It is feasible to reset the module back to the

original state by the Reset Signal.

When setting the Reset Signal low for 100ms, the module will be reset and restarted. When the user uses

the Reset_N function, the PMU inside the module will not lose power.

Note: Reset signal is a sensitive signal line. In designing PCB layout, please keep the line away from RF

interference, and make it well wrapped with ground wire. And it is advised to add an anti-shaking

capacitor at the place close to the module end. At the same time, Reset_N signal line shall avoid the PCB

edge and the surface, then reset the ESD can be avoided.

The timing sequence requirements of its pulse are as follows:

| Parameter	Condition	Minimum Value	Typical Value	Maximum Value	Unit
Pulse Width	Reset	7	100	1000	ms

Recommended design:
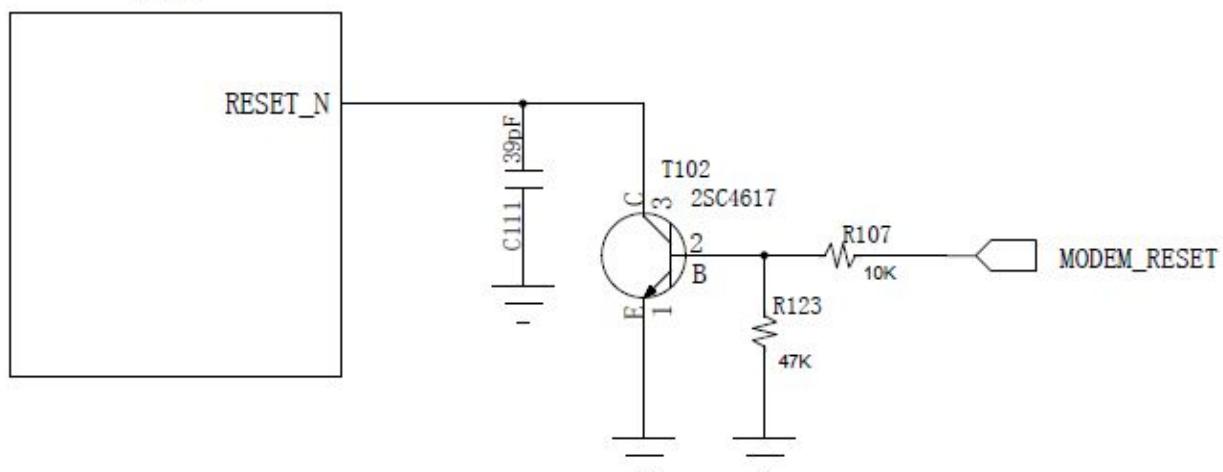
Figure 5- 5　Recommended Design of Reset Circuit

5.3 Status Indicating Signal

The pins of status indicating signal as listed below:

Pin#	Pin Name	I/O	Description
A4	CORE_DUMP	O	Core Dump Indicator
A5	LPG	O	LPG status Indicating
A7	WAKEUP_HOST	O	The module wake-up Host（Application processor）
L15	PA_BLANKING	O	PA Blanking output, external GPS control signal

5.3.1 CORE DUMP Indicating

Indicating for the module system is get into Core dump.

Status	Mode
Normal mode	Low level
Core Dump	High level

5.3.2 LPG Signal

LPG signal description as listed below :

Status	Mode
idle(unregistered)	600ms high level, 600ms low level
idle(registered)	75ms high level, 3s low level
Voice communication (Call)	low level
Data communicating	75ms high level, 75ms low level
Sleep (sleep mode)	high level

5.3.3 WAKEUP_HOST

The WAKEUP_HOST signal is for waking up the HOST while there are calls ,SMS or other data request.

Status	WAKEUP_HOST Signal
Default	High level
Waking HOST （telephone ringing/SMS/other data request）	Low level

5.3.4 PA_BLANKING Interface

The default output is low level .While the module works in GSM frequency band, PA_BLANKING will output the pulse signal that synchronize with the GSM Burst timing sequence.

While the GSM TX may influence the GPS signal receiving, close GPS or stop receiving GPS data when AP detected the PA_BLANKING pulse signal.

Operating modes	PA_BLANKING Signal
Default modes	low level
GSM TX	output the pulse signal that synchronize with the GSM Burst

5.4 Interrupt Control Signal

The pins of interrupt control signal as listed below:

Pin#	Name	I/O	Description
J15	WAKEUP	I	AP wake up module
K15	W_DISABLE#	I	Close or open RF network
H14	EINT3	I	Android/Win8 dual system switch

J14	BODY_SAR	I	Body_SAR detection

5.4.1WAKE_UP Signal

WAKE_UP signal description as listed below :

Module Mode	WAKE_UP Signal	Description
Sleep	Low level	Wake up the module from Sleep mode to Idle mode
	High level	Keep the module in Sleep mode
Idle/Call	Low level	Keep the module in Idle/Call mode
	High level	The module will not get into Sleep mode

5.4.2W_DISABLE# Interface

The module provides hardware ways to open/close WWAN RF functional signal, for this function can be controlled by AT commands. The module will get into Fight modes while closing RF function.

The definition of W_DISABLE# signal as list below:

No.	W_DISABLE#	Function
1	Low	WWAN closed, the module get into Flight modes.
2	High	WWAN opened, the module exit Flight modes.
3	Floating	The function of WWAN defined by AT commands , and keep open by default .

5.4.3Android/Win8 Dual System Switch Control Interface

L810 module supports Win8/Android dual system switch, check and achieve the dual system switch through interrupt signal"EINT3".

The function definition of EINT3 signal as listed below:

No.	EINT3	Function
1	High/Floating	Support Android system, the module`s `USB ports shall set as 3ACM modes.
2	Low	Support Win8 system, the module`s USB ports shall set as MBIM modes.

Description:

1. Check and achieve the Win8/Android system switch through GNSS_IRQ level when the module power on. Keep the GNSS_IRQ level stability during booting.

2. Check and achieve the Win8/Android system switch through GNSS_IRQ rising edge/ falling edge while the module power on, the de-bouncing time sets as 100ms. The module will reboot after meeting the requirements and can switch different system supports.

5.4.4 BODY_SAR Interface

L810 module supports BODY_SAR function.

BODY_SAR is input signal (the signal is output directly by the AP or SAR SENSOR), the default is high level, and low level is effectively. While the human nearing, AP can detect it through the distance sensor, then output the BODY_SAR signal with low level. While the module detected the signal through the interruption, the module `s Tx power will be reduced and the threshold value can be set by the AT commands.

Pin#	Pin Name	I/O	Function Description
J14	BODY_SAR	I	BODY_SAR Detection

5.5 USB Interface

5.5.1 USB Interface Definition

Pin#	Pin Name	I/O	Description
A13	USB_DP	I/O	USB signal+
A12	USB_DN	I/O	USB signal-
A11	VBUS	I	USB power input

L810 wireless communication modules support USB 2.0. Before connecting it to PC, it is necessary to install the related USB driver.

After inserting the L810 wireless modules to PC, the USB interface will work with the driver and map three COM ports and four NCM ports on PC-side, as follows:

- Two COM ports for transmitting AT Command.
- One COM ports for capturing LOG information of the software.
- Four NCM ports are virtual network ports,mainly for initiating data traffic.

Note: One of the COM port can use for Modem COM port and initiate data services. Due to the speed of Modem COM port is too slow to up to100Mbpss, the LTE downlink rate requirement,so it is not suggested. The Modem COM can be used to initiate data services temporarily only while the client`s NCM port is useless.

5.5.2 USB Interface Application

Reference Circuit Design:
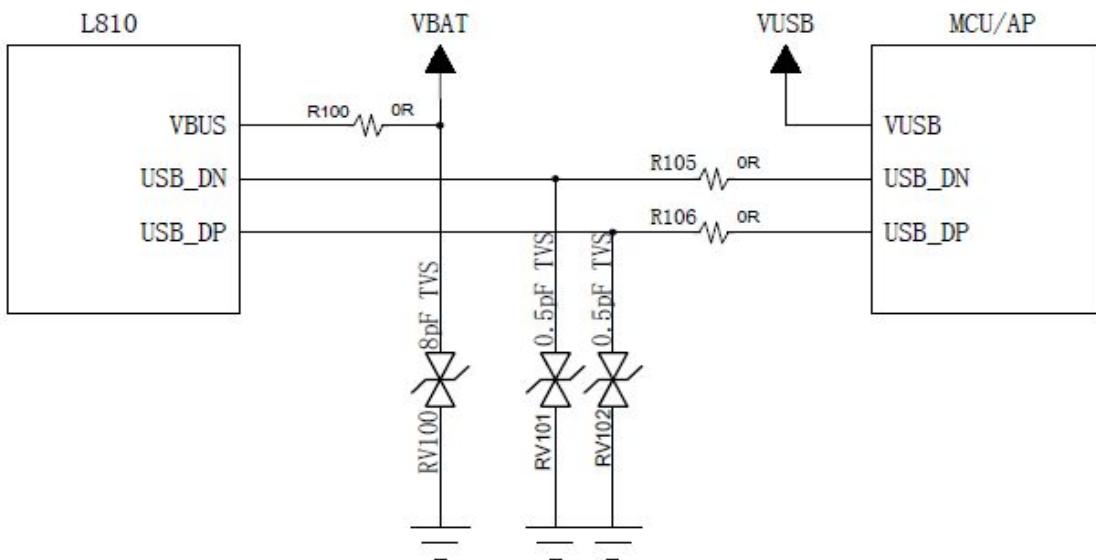
Figure 5-6 USB Interface Reference Circuit Design

RV101 and RV102 shall be TVS with capacitance lower than 1pF; recommend to use the TVS with 0.5pF. There is no specific limitation for the capacitance of RV100 TVS.

VUSB pin supplies power for USB. The recommended power supply range is 3.3V ~ 4.5V. In designing VUSB, there must be input, or it cannot recognize USB port.

USB_DP and USB_DM are the high-speed differential signal line, and their highest transmission rate is 480Mbps. The following requirements should be followed in designing PCB layout.

- USB_DP and USB_DN signal lines should have the same length, and should be parallel; avoid right angle wiring;
- USB_DP and USB_DN signal lines should be wrapped with GND at the ends.
- USB2.0 differential signal line should be laid at the signal layer closest to the ground layer.
- Ensure impedance matching; impedance is required to be 90ohm.

Note:VBUS shall detect power supply for module USB (belong to low current signal, current value<100uA). In circuit design, it shall not supply power to VBUS individually while the USB_DN and USB_DP disconnect, or the module will cannot get into sleep modes.

5.6 UART Interface

5.6.1UART Interface Description

L810 wireless modules provide one 4-wire UART for the users; the UART1 supports AT commands, the users can receive and transmit AT commands through UART1.

The definitions of UART1 signal interfaces are as follows:

Pin#	Pin Name	I/O	Description

L14	UART1_CTS	I	UART1 Clear to send
K14	UART1_RTS	O	UART1 Request to send
A9	UART1_TXD	O	UART1 Transmitted Data
A10	UART1_RXD	I	UART1 Received Data

5.6.2UART Interface Application

Connect UART1 of L810 wireless communication module (DCE) to PC, and the signal direction of (DTE) is as follows:

MCU (DTE) application	Signal direction	L810 module (DCE)
RXD	←	UART1_TXD
TXD	→	UART1_RXD

Note: the high level of the module's UART interface is 1.8V. If it needs to connect it to 2.8V or 3.3V IO interface, it is necessary to switch the level.

In design: it is recommended to use SN74LVC2G07 to switch the level from 1.8V to 3.3V. During the communication between UART1 and PC, firstly raise the level from 1.8V to 3.3V, and then, employSP3238 to switch the level.

5.7 USIM Interface

L810 series wireless modules support USIM and high speed SIM cards. But 8-line intelligent USIM is not supported yet.

5.7.1USIM Pins

Pin#	Pin Name	I/O	Function Description
D15	VSIM1	O	USIM power supply signal ，1.8V/2.8V
E15	SIM1_RST	O	USIM Reset Signal
F15	SIM1_CLK	O	USIM clock signal
G15	SIM1_DATA	I/O	USIM data signal
H15	SIM1_CD	I	USIM Plug-in detection signal , 390K resistor will be pulled up by default. High level indicates that SIM card is inserted. Low level indicates that card is not inserted.

5.7.2 USIM Interface Design

## 5.7.2.1 "Normal Closed" SIM Card Circuit Design

Reference Circuit Design::
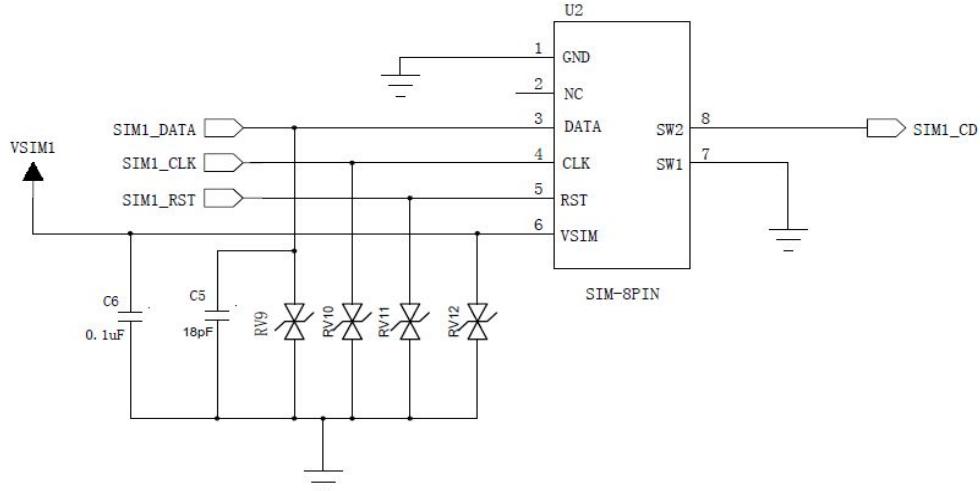
Figure 5- 7 Reference Design of "Normally Closed" SIM Card Interface

Normally closed SIM Connector:

1）Pull out SIM card, pin 7 and pin 8 will short-circuit .

2）Insert SIM card, pin 7 and pin 8 will disconnect.

## 5.7.2.2 "Normally Open" SIM Circuit Design

Referenced Circuit Design:
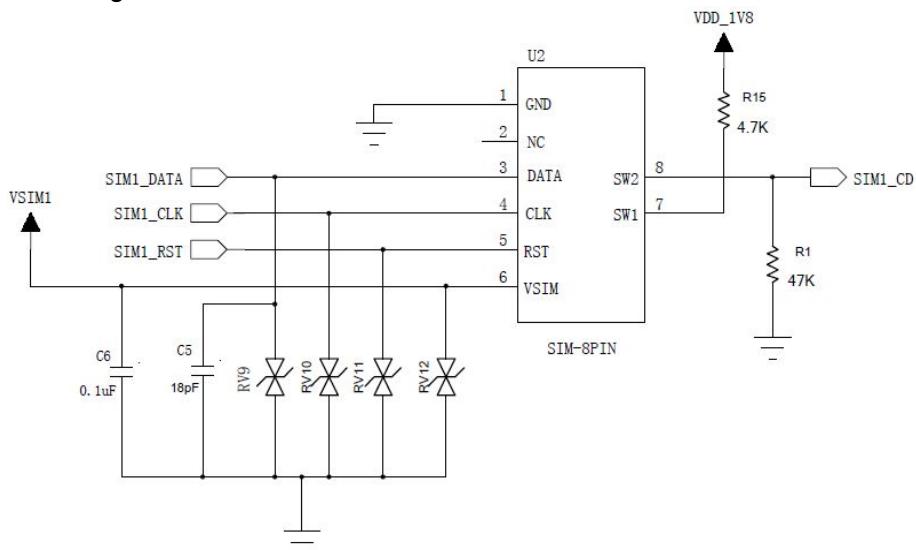
Figure 5- 8 Reference Design of "Normally Closed" SIM Card Interface

Normally closed SIM Connector:

1）Pull out SIM card, pin 7 and pin 8 short-circuit .

2）Insert SIM card, pin 7 and pin 8 disconnect.

Note:

![Fibocom logo]

- In order to improve EMC performance, the SIM card slot should be close to the module to the largest extent.
- The filter capacitor on the SIM-card signal circuit should be placed close to SIM card pin to the largest extent.
- ESD device (like TVS) shall be added to the SIM-card signal circuit protection. ESD device should be placed close to SIM card pin.
- SIM1_CD signal connection supports hot-plugging; active high level by default(change to active low through AT commands). If the module detects the signal at high level, it means there is a card in the module.

5.7.3 Points for Attention in USIM Design

SIM card interface design is very important for the normal operation of the module and SIM card.

The following points need to be complied with during the design:

- SIM card layout and wiring must keep away from EMI interference source, like RF antenna and digital switch signal.
- In order to ensure signal completeness, the wire distance between the module and SIM card should not exceed 100mm.
- In order to avoid mutual interference, USIM_CLK and USIM_IO signals should be separated in wiring. It would be best to wrap them with ground wire respectively.
- SIM card signal line should be protected with ESD. These protective devices should have small capacitance (like Zener diode, etc.). Users are recommended to select ESD devices with equivalent capacitance lower than 33pF. During layout, ESD device should be close to the SIM card interface.

5.7.4 USIM Hot-Plugging

L810 supports SIM card status-detection function. This function allows the hot-plugging of SIM card.

5.7.4.1 Hardware Connection

SIM card hot-plugging function needs to work with USIM_CD signal.

USIM_CD will be at low level without SIM card; after inserting SIM card, USIM_CD will be at high level.

Note：

- For "Normal closed" SIM card, as shown in the figure5-7, SIM1_CD signal line is connected to U2's Pin8 (SW2), and Pin7 (SW1) is connected to the ground. When the SIM card is not inserted, SW2 and SW1 short circuit, SW2 will be at low level. When the SIM card is inserted, SW2 and SW1 will be disconnected, SIM1_CD level will be pulled up.
- For "Normal opened" SIM card, as shown in the figure5-8, SIM1_CD signal line is connected to U2's

Pin8 (SW2), and Pin7 (SW1) will be pulled up 4.7K resistor . When the SIM card is not inserted, SW2 and SW1 will be disconnected, then SW2 will be at low level. When the SIM card is inserted, SW2 and SW1 will short circuit, SIM1_CD level will be pulled up.

5.7.4.2 Software Settings

"+MSMPD" configures AT command for the SIM card status-detection function.

- If set AT+MSMPD=0, SIM card status-detection function will be closed, and the module will not detect SIM1_CD signal.

- If set AT+MSMPD=1, SIM card status-detection function will be in operation, and the module will detect if the SIM card is inserted by SIM1_CD Pin.

- If SIM1_CD is at low level, which indicates SIM card is inserted, the module will automatically register it to the network.

- If SIM1_CD is at high level or unconnected, which indicates SIM card is not inserted, the module will not register it to the network.

Note: the default of +MSMPD parameter is "1".SIM_CD is the detection signal. While the module first power on or plug after that, SIM1_CD will detect if the SIM card is existing or not. Just only if the SIM1_CD is low level, the module will cannot read SIM card.

5.8 Digital Audio

L810 supports digital audio I2S interface that supports normal I2S mode and PCM mode. I2S interface level is 1.8V on average.

I2S signal description:

Pin#	Pin Name	I/O	Description
N12	I2S2_CLK	O	Bit Clock，1.8V signal
N9	I2S2_WA0	O	Left and right channel clock (LRCK) ，1.8V signal
N10	I2S2_TX	O	Serial data output ，1.8V signal
N11	I2S2_RX	I	Serial data input ，1.8V signal

5.8.1 I2S

L810	Signal Direction	Audio CODEC I2S Port
I2S2_CLK0	⟶	I2S_CLK
I2S2_WA0	⟶	I2S_LRCK

I2S2_RX	←	I2S_SDOUT
I2S2_TX	→	I2S_SDIN

Description:

- I2S interface can be configured as client-server work mode.

- Suitable for various audio sampling frequencies(48KHz, 44.1KHz, 32KHz, 24KHz, 22.5KHz, 16KHz, 12KHz, 11.025KHz and 8KHz).

5.8.2 PCM Port Description

L810	Signal Direction	Audio CODEC PCM Port
I2S2_CLK0(PCM_CLK ,PCM clock signal)	→	PCM_CLK（PCM clock signal）
I2S2_WA0(PCM_SYNC , PCM frame synchronization signal)	→	PCM_SYNC（PCM frame synchronization signal）
I2S2_RX(PCM_DIN , PCM data input)	←	PCM_DOUT（PCM data output）
I2S2_TX(PCM_DOUT , PCM data output)	→	PCM_DIN（PCM data input）

Note:

- PCM interface can be configured as client-server work mode.

- Support short frame synchronization at 16, 32, 48, and 64 bit mode

- Support burst and continuous mode transmission

- Supports clock length of frame synchronization signal and rising edge/ falling edge trigger configuration of data transmission.

- Suitable for various audio sampling frequencies(48KHz, 44.1KHz, 32KHz, 24KHz, 22.5KHz, 16KHz, 12KHz, 11.025KHz and 8KHz).

Note: Cause the timing of I2S modes is easier than PCM modes and easier to fit, recommend clients to use transmission audio of I2S mode. While transmission with PCM modes, the PCM timing sequence is difficult to fit to make the tone quality become bad.

5.9 I2C

L810 module supports one 12C interface, default configuration is I2C master. The I2C can use for driving external 12C slave device, such as Audio codes and so on.

Pin#	Name	I/O	Description
M11	I2C_DATA	I/O	I2C control signal input/output ,1.8V signal
M12	I2C_SCL	O	I2C control clock signal, 1.8V signal

![Fibocom logo]

The signal connection of L810 I2C and external 12C slave device (such as Audio Codec）as listed below:

L810	Signal Direction	Audio Codec I2C Port
I2C_SDA	←————→	I2C_SDA
I2C_SCL	————→	I2C_SCL

5.10   Clock Interface

L810 module supports one 26MHz clock output and one 32KHz clock output.

Pin#	Pin Name	I/O	Description
A3	FSYS2_26M	O	26Mclock output,1.8V (recommend used for external GPS, and can also used for main clock of audio codec)
A8	CLK32K	O	32K clock output , 1.8V

5.11ADC Interface

L810 supports ADC detection, with precision of 10bit. ADC input voltage is required to be 0~1.2V.

ADC signal description:

Pin#	Pin Name	I/O	Description
C10	ADC1	I	ADC input

5.12   Other Interfaces

The module does not support the following ports yet: USB3.0、HSIC、SSIC、SIM2、ANT Tunable、SDIO、GPIO .

6 Electrical and Environmental Features

6.1 Electrical Features

The table below lists the range of L810's electrical characteristics:

Parameters	Minimum Value	Maximum Value	Unit
Power supply signal	0	4.4	V
Digital signal	0	1.9	V

6.2 Environmental Features

This table below shows the environmental features of L810.

Parameters	Minimum Value	Maximum Value	Unit

Operational Temperature	-30	+75	°C
Storage Temperature	-40	+85	°C

7 RF Interface

7.1 Operating Frequency Band

The RF operating frequency band as listed below:

Operating Band	Description	Mode	Tx (MHz)	Rx (MHz)
Band 1	IMT 2100MHz	LTE FDD/WCDMA	1920 - 1980	2110 - 2170
Band 3	DCS 1800MHz	LTE FDD/GSM	1710 - 1785	1805 - 1880
Band 5	CLR 850MHz	LTE FDD/WCDMA/GSM	824 - 849	869 - 894
Band 7	IMT-E 2600Mhz	LTE FDD	2500 - 2570	2620 - 2690
Band 8	E-GSM 900MHz	LTE FDD/WCDMA/GSM	880 - 915	925 - 960
Band 20	EUDD 800MHz	LTE FDD	832 - 862	791 - 821
Band 34	IMT 2100MHz	TDSCDMA	2010 - 2025	
Band 38	IMT-E 2600MHz	LTE TDD	2570 - 2620	
Band 39	TDD 1900MHZ	LTE TDD/TDSCDMA	1880 - 1920	
Band 40	IMT 2300MHz	LTE TDD	2300 - 2400	
Band 41	BRS/EBS 2500MHZ	LTE TDD	2496 - 2690	

7.2 TX Power

For different modes , the TX power of L810 bands as listed below :

Mode	Band	Tx Power(dBm)	Note
GSM	GSM 900	32.5	±1dBm
	DCS 1800	29.5	±1dBm
WCDMA	Band 1	22.5	±1dBm
	Band 8	22.5	±1dBm
LTE FDD	Band 1	22.5	±1dBm
	Band 3	22.5	±1dBm

	Band 5	22.5	±1dBm
	Band 7	22.5	±1dBm
	Band 8	22.5	±1dBm
	Band 20	22.5	±1dBm
LTE TDD	Band 38	22.5	±1dBm
	Band 39	22.5	±1dBm
	Band 40	22.5	±1dBm
	Band 41	22.5	±1dBm
TD-SCDMA	Band 34	22.5	±1dBm
	Band 39	22.5	±1dBm

7.3 Receiving Sensitivity

For different modes , the receiving sensitivity of L810 bands as listed below :

Mode	Band	Rx Sensitivity(dbm)	Note
GSM	GSM 900	-108	BER<2.43%
	DCS 1800	-108	BER<2.43%
WCDMA	Band 1	-109	BER<0.1%
	Band 8	-109	BER<0.1%
LTE FDD	Band 1	-100	10MHz Band width
	Band 3	-101	10MHz Band width
	Band 5	-102	10MHz Band width
	Band 7	-99	10MHz Band width
	Band 8	-101.5	10MHz Band width
	Band 20	-101	10MHz Band width
LTE TDD	Band 38	-100	10MHz Band width
	Band 39	-100	10MHz Band width

	Band 40	-99.5	10MHz Band width
	Band 41	-99.5	10MHz Band width
TD-SCDMA	Band 34	-109.5	BER<0.1%
	Band 39	-109.5	BER<0.1%

Note : The above values are tested in the double antenna situation (Main+Diversity). If used the single antenna (without Diversity), the value of sensitivity will accordingly drop by some 3dbm.

![Fibocom Logo]

7.4 RF PCB Design

7.4.1 Wiring Principle

L810 adopts double RF antennas, the MAIN_ANT used for transmitting and receiving, the DIV_ANT used for receiving. On the one hand, diversity antenna can improve the receiving sensitivity, on the other hand, it can also improve the download speed. Because the L810 project is for LTE module, the Antenna need double antennas can meet the performance requirements.

Because L810 has no RF connector, the user needs to connect a length of RF line to the antenna, or design a connector on the board. So, it is recommended to use microstrip line for RF line. It should be as short as possible with loss controlled below 0.2dB, and impedance of 50 ohm.

Reserve a π circuit (the earth terminals of the two parallel devices should be directly connected to the main ground) between L810 module and the antenna connector (or feed point) for antenna tuning.
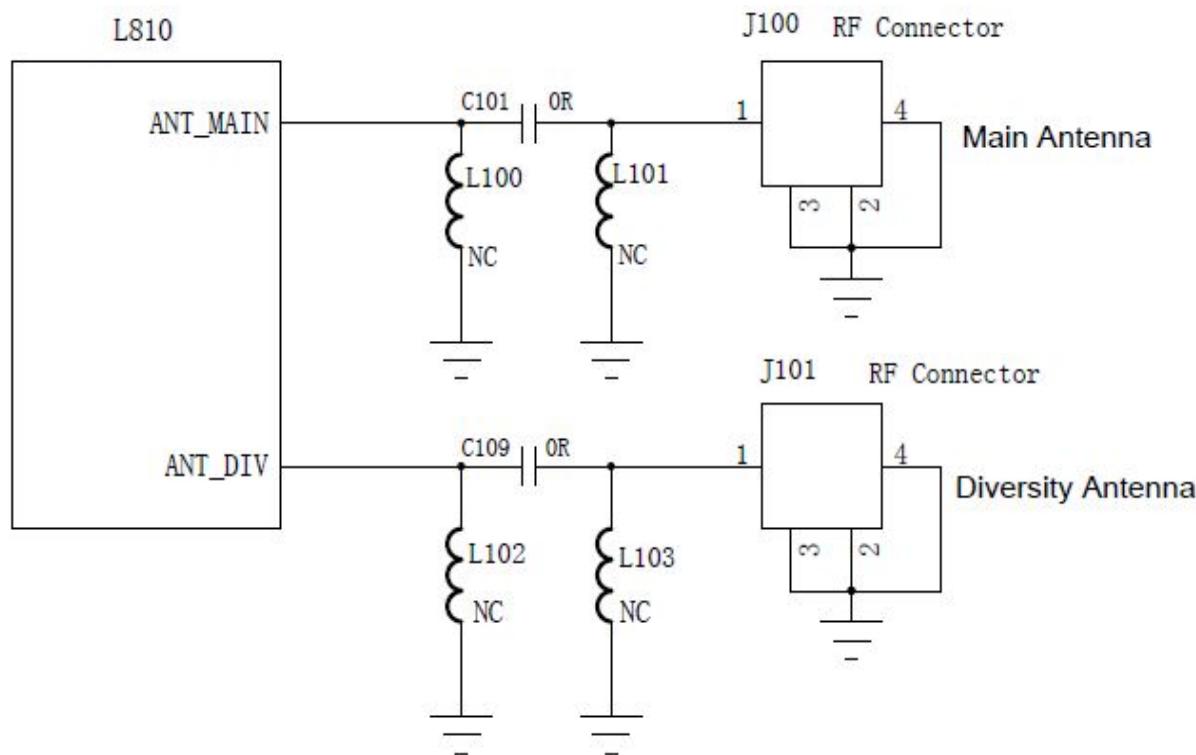

Figure 7- 1π-type Circuit

7.4.2 Impedance Design

The impedance of RF signal line of antenna interface needs to be controlled at 50 ohm.

7.5 Antenna Design

7.5.1Main Antenna Design Requirements

(1) Antenna efficiency

Antenna efficiency is the ratio of the input power and radiant power. Because of the antenna's return loss, material loss and coupling loss, the radiant power is always lower than the input power. The ratio is recommended to be > 40% (–4dB).

(2) S11 or VSWR

S11 shows the matching degree of the antenna's 50 ohm impedance, which affects antenna efficiency to a certain extent. It is feasible to use VSWR testing method to measure the index. It is recommended that S11 < –10dB.

(3) Polarization

Polarization is the rotation direction of the electric field of the antenna at the direction of the largest radiation.

It is recommended to use linear polarization; for diversity antenna, it is recommended to use different polarization directions from that of the main antenna.

(4) Radiation pattern

Radiation pattern refers to the electromagnetic field intensity at various directions in the far field of the antenna. Half-wave doublet antenna is the perfect terminal antenna. In the case of built-in antenna, it is recommended to use PIFA.

- Antenna area: H 6mm * W 10mm * L 100mm. It is recommended to use PIFA or IFA.
- Antenna radiation direction: Omni-directional.

(5) Gain and directivity

Antenna directivity refers to the electromagnetic field intensity at various directions of the electromagnetic wave. Gain is the combination of the antenna efficiency and antenna directivity. It is recommended that antenna gain ≤ 2.5dBi.

(6) Interference

In addition to antenna performance, other interference from the PCB will also affect the module performance. In order to ensure the high performance of the module, the interference must be under control. Suggestions: keep speaker, LCD, CPU, FPC wiring, audio circuit, and power supply away from the antenna; add appropriate separation and shielding devices, or conduct filtering on the path.

(7) TRP/TIS

TRP (Total Radiated Power)：

- GSM900>28dBm

- GSM DCS1800 >25dBm

- WCDMA Band 1 ,8>19dBm

- TD-SCDMA Band 34,39>19dBm

- LTE FDD Band 1, 3, 5,7,8, 20>19dBm

- LTE TDD Band 38,39,40,41>19dBm

TIS (Total Isotropic Sensitivity)：

- GSM900,DCS1800<-102dBm

- WCDMA Band 1,8<-102dBm

- TD-SCDMA Band 34,39<-102dBm

- LTE FDD Band 1,3,5,7,8,20<-95dBm (10MHz Band width)

- LTE TDD Band 38,39,40,41<-95dBm (10MHz Band width)