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L811 LGA Series Module Hardware User Manual

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Versions

Version	Date	Remarks
V1.0.0	2014-10-17	Initial Version.
V1.0.1	2015-08-25	Update the logo.
V1.0.2	2015-09-08	Modify descriptions for power on and RTC timing.

Applicable Model List

No.	Type	Note
1	L811-EA-00	

The supported frequency bands of L811 LGA series wireless modules as shown in the following tables:

Model No.	LTE FDD	WCDMA	GSM/GPRS/EDGE
L811-EA-00	Band 1,2,3,4,5,7,8,13,17, 18,19,20	Band 1,2,4,5,8	850/900/1800/1900 MHz

Content

1 Foreword

1.1 Introduction

The document describes the electrical characteristics, RF performance, dimensions and application environment, etc. of L811 LGA series wireless modules. With the assistance of the document and other instructions, developers can quickly understand the performance of L811 LGA series wireless modules and develop products.

1.2 Reference Standard

The design of the product complies 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

2 Product Overview

2.1 Description

The L811 LGA series modules are highly integrated wireless communication LTE modules, which support three modes and twelve bands, including the 4G/3G/2G mainstream modes (LTE FDD/WCDMA/GSM) for Europe and North America and cover a wide range of frequency bands. The modules support the cellular communication networks of Europe, North America as well as the mobile operators in some regions of Asia.

2.2 Specifications

Specifications		
Operating Frequency Range	L811-EA-00	
	LTE FDD: Band 1,2,3,4,5,7,8,13,17,18,19,20	
	WCDMA HSPA+: Band 1,2,4,5,8	
	GSM/GPRS/EDGE: 850/900/1800/1900MHz	
Data Rate	LTE FDD	Category 4 (150Mbps DL,50Mbps UL)
	UMTS/HSDPA/HSUPA 3GPP Rel.10	DC-HSDPA 42Mbps(Cat24) HSUPA 11.5Mbps(Cat7)
	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)
GPS	Not supported.	
Physical Characteristics	Dimension：32mm x 26mm x 2.0mm	
	Interface：LGA	
	Weight：4 grams	
Environment	Operating Temperature：-30℃ ~ +85℃	
	Storage Temperature：-40℃ ~ +85℃	

Performance	
Operating Voltage	Voltage: 3.3V ~ 4.4V Normal: 3.8V
Current Consumption (Typical Value)	4mA (Sleep Mode)
	LTE FDD DATA：700mA
	WCDMA Talk：570mA
	2G Talk：250mA (GSM PCL5)
Interfaces	
RF Interface	Antenna：Main x1，Diversity x1
Function Interface	USB 2.0 x1，Multiple Profiles over USB
	SIM Support，I2C Support，I2S/PCM Support
	GPIO，Clock
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 Scheme MCS1~4
CSD	UMTS(14.4kbps)，GSM(9.6kbps)
USSD	Supported
SMS	MO / MT Text and PDU modes
	Cell broadcast
Audio	Digital Audio
	Voice Coders: EFR/HR/FR/AMR
	VoLTE（not supported yet）
Audio Control	Gain Control
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

Top View：

Figure 2- 1 Top View

Bottom view:

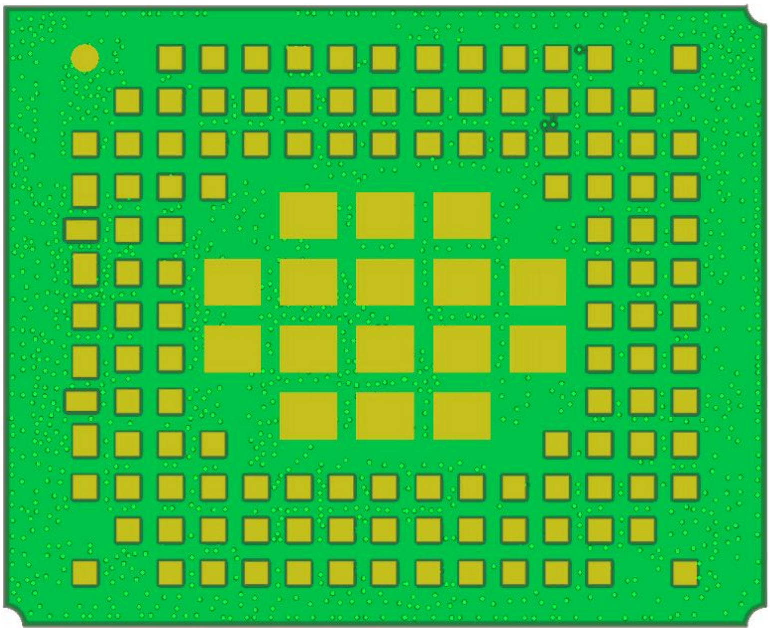


Figure 2- 2 Bottom View

3 Structure

3.1 Dimension Diagram of Structure

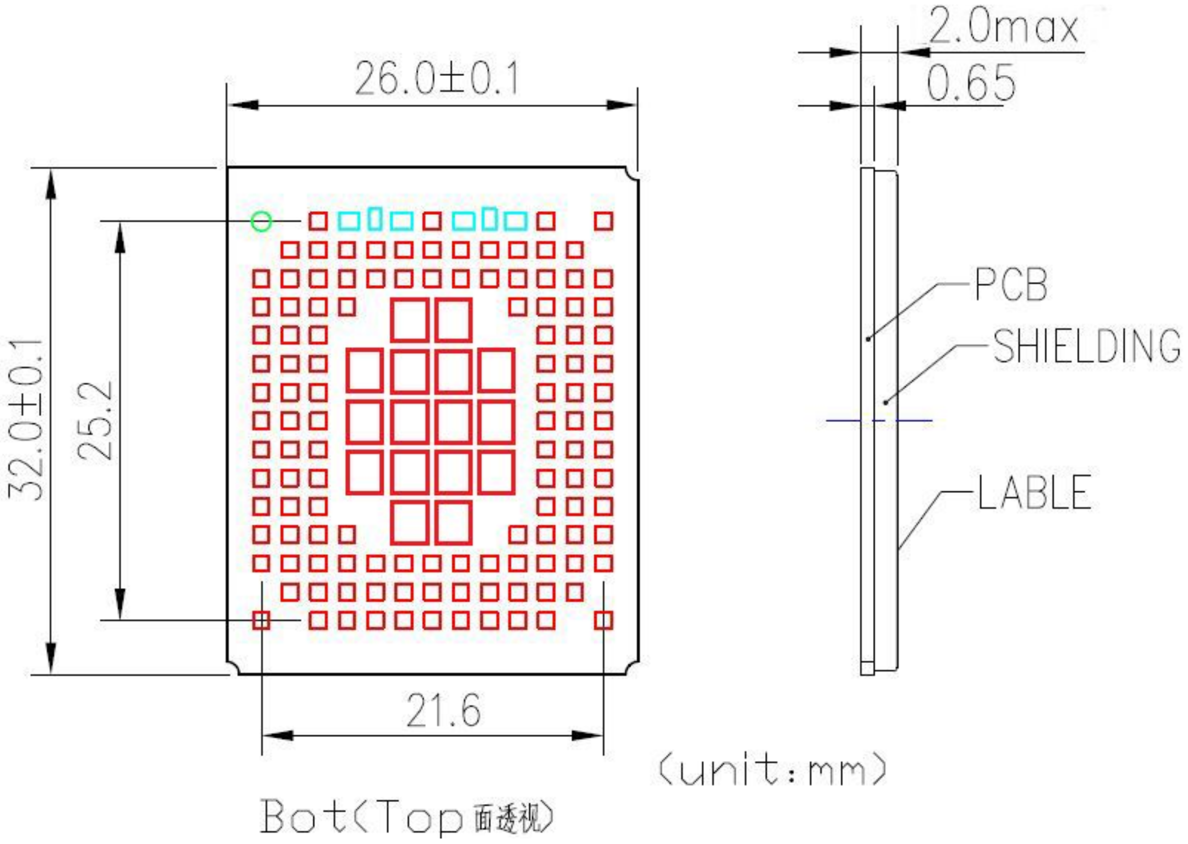


Figure 3- 1 Dimension Diagram of Structure

3.2 Recommended PCB Layout Design

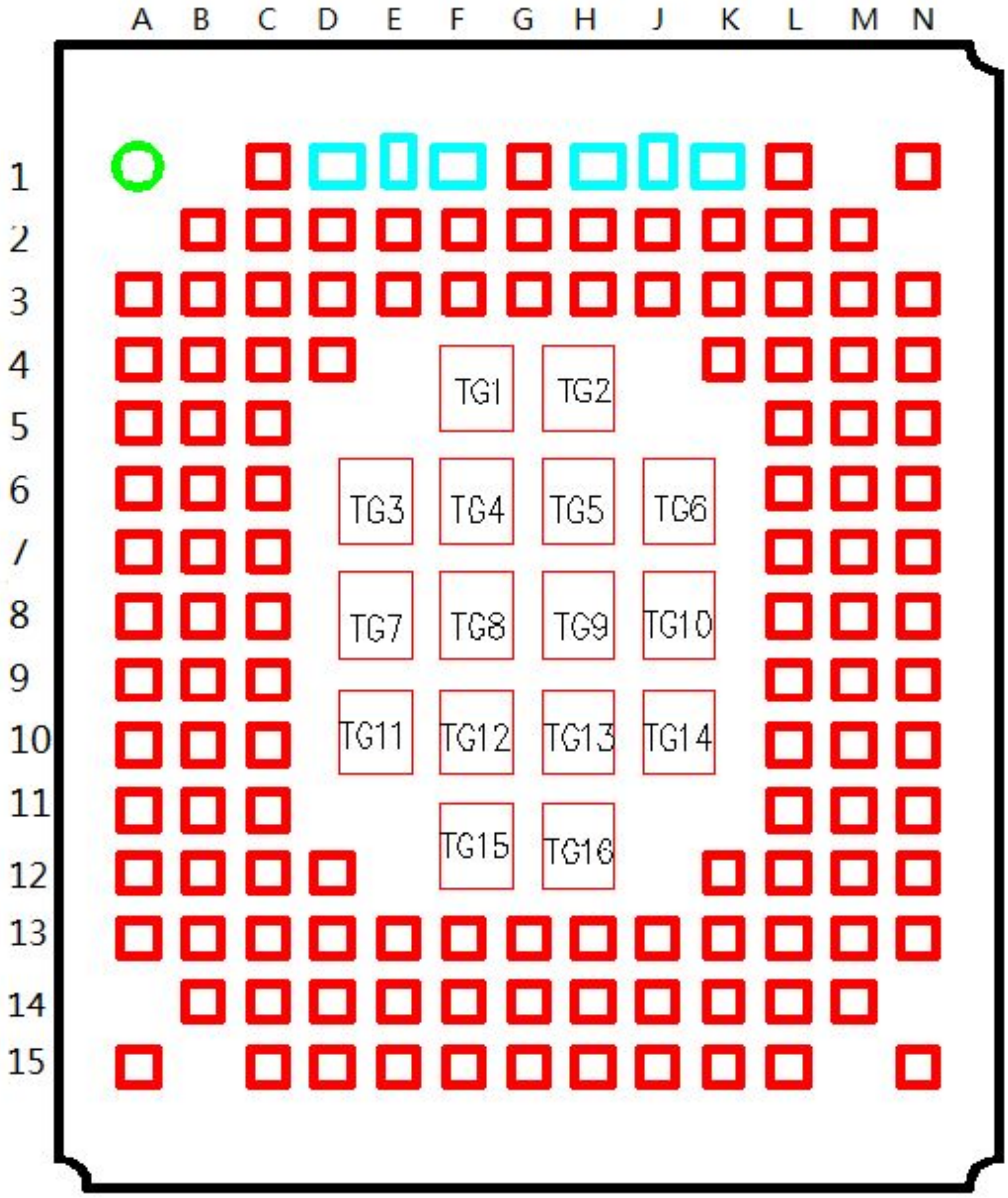


Figure 3- 2 Perspective drawing of top view

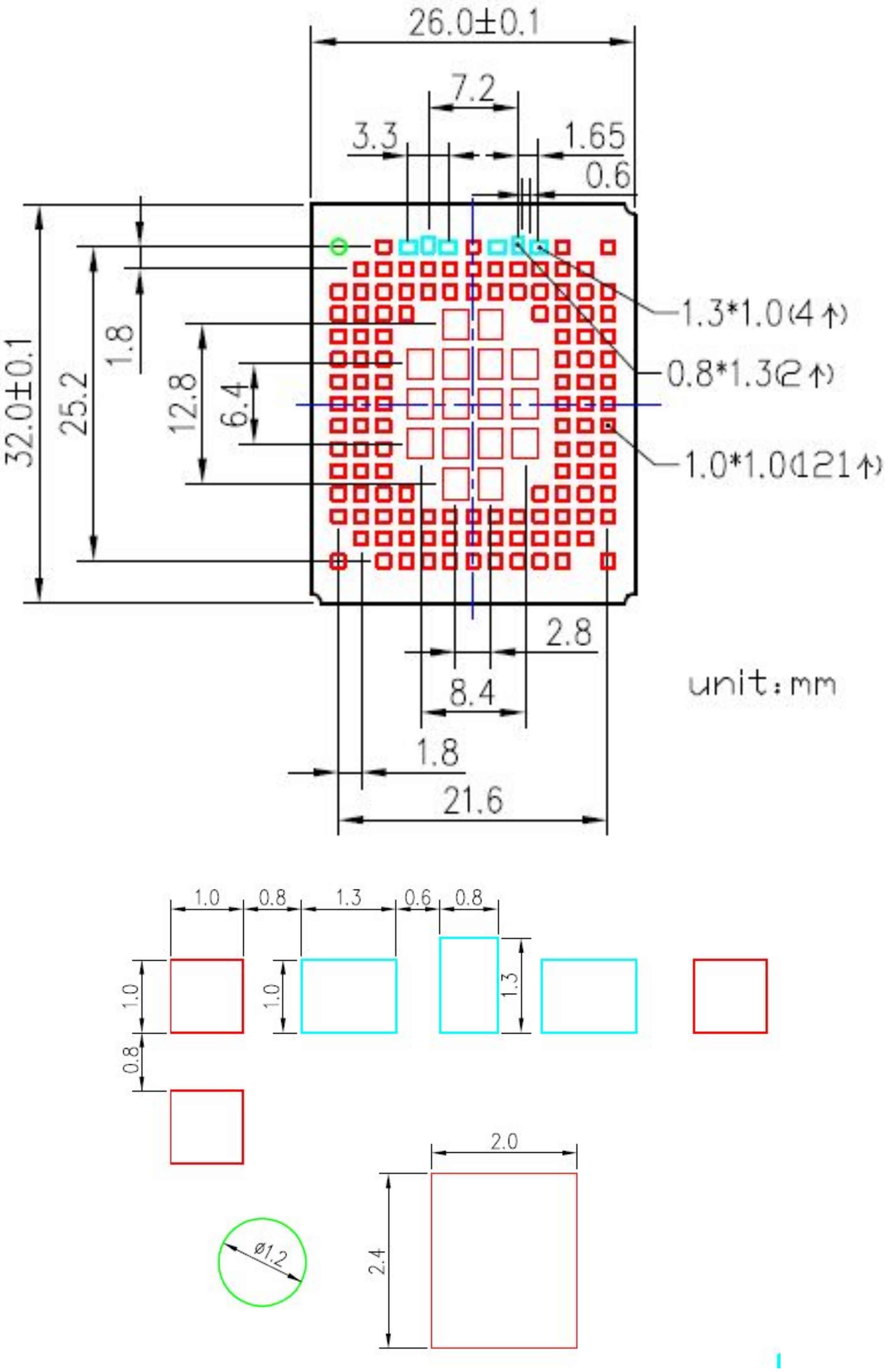


Figure 3- 3 Structure Diagram of PCB Layout

4 Hardware Introduction

4.1 Hardware Diagram

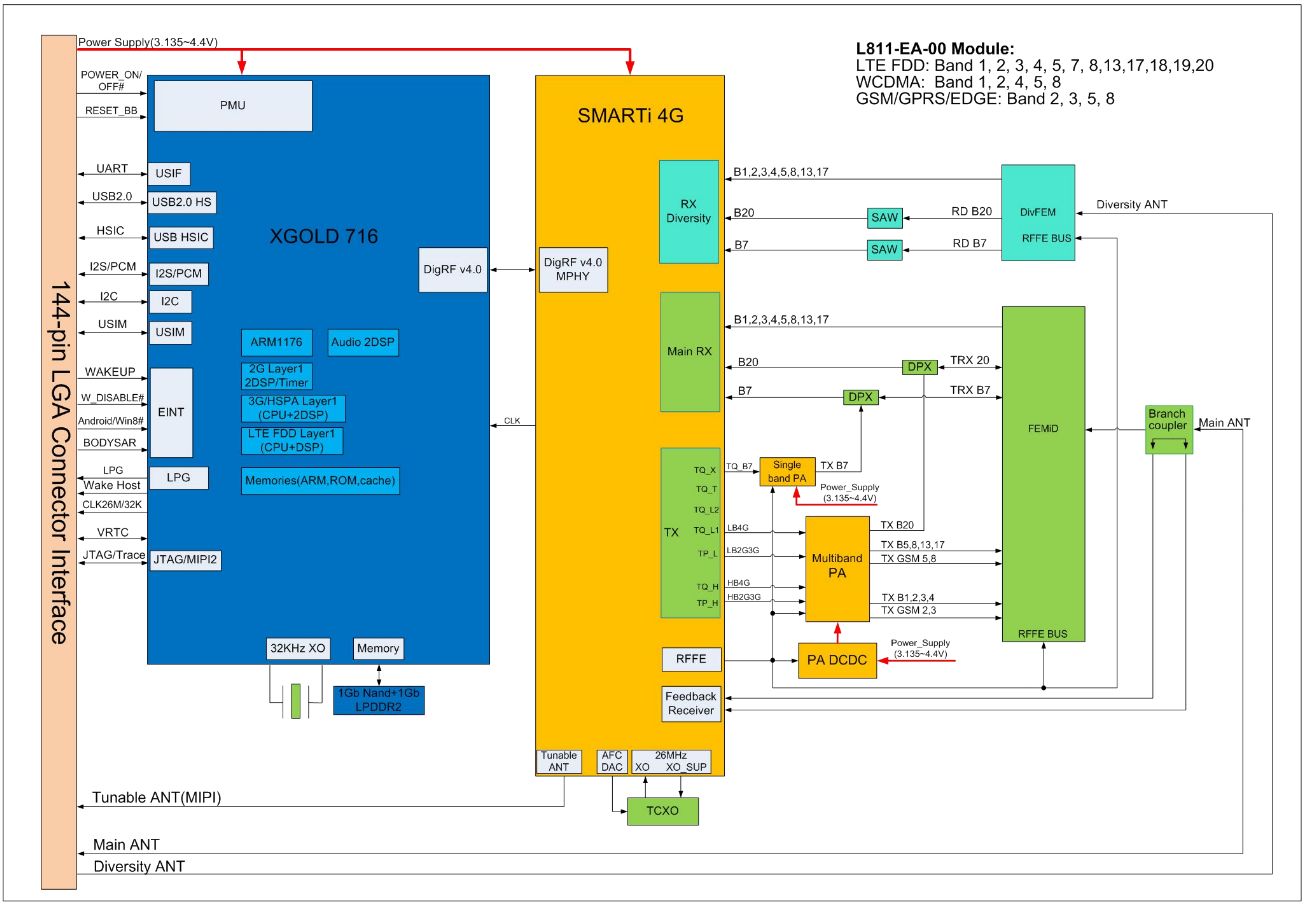
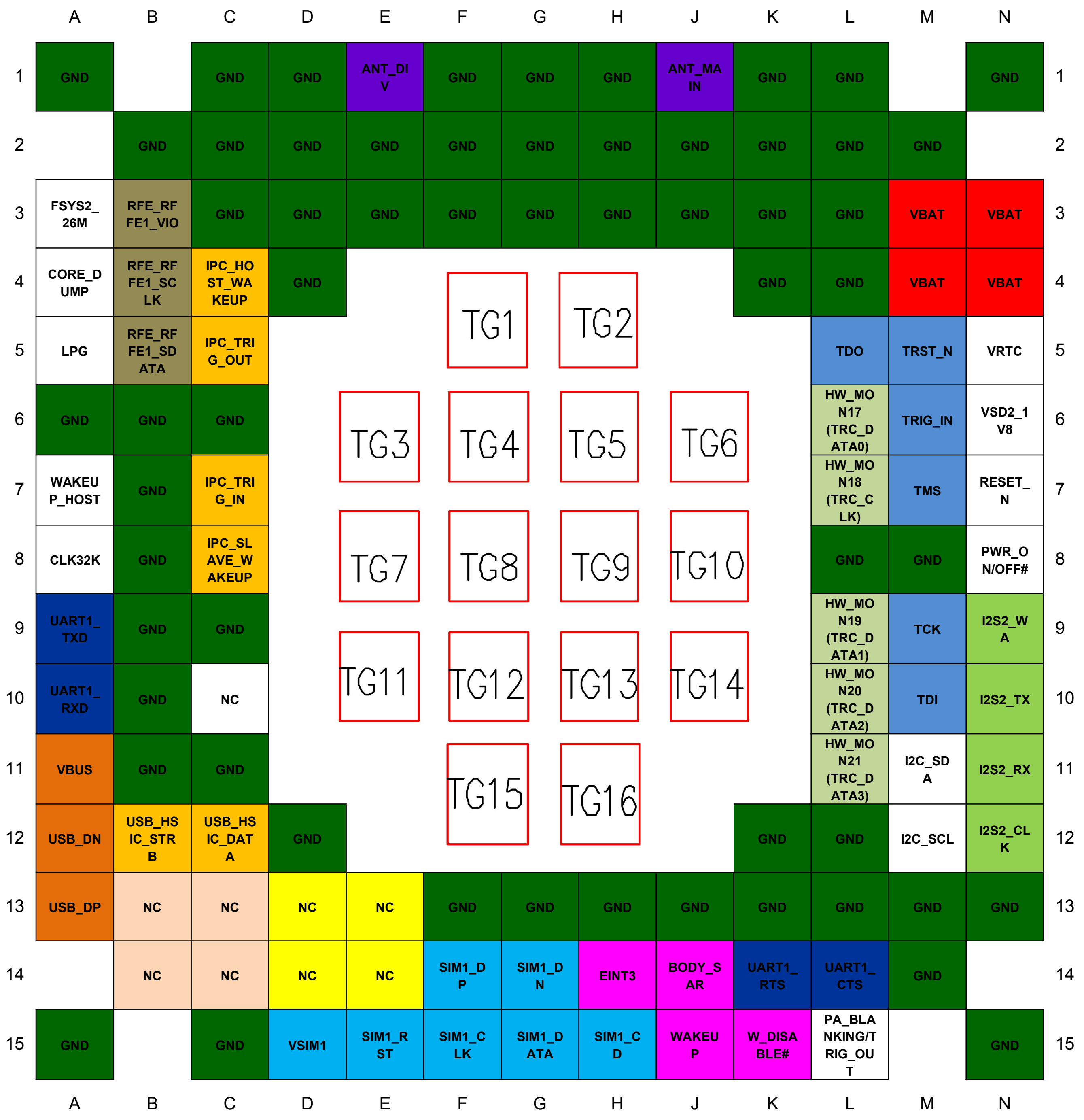


Figure 4- 1 Block Diagram

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_WA	9
10	UART1_RXD	GND	NC								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	NC	NC	NC	NC	GND	GND	GND	GND	GND	GND	GND	GND	13
14		NC	NC	NC	NC	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 Pins Definition

(TOP View)

4.2.2 Description of Pins

The logic signal level of L811 series module is 1.8V.

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_WA	O	PD	T	I2S LRCK,CMOS 1.8V
N10	I2S2_TX	O	PD	T	I2S data transmit, CMOS 1.8V
N11	I2S2_RX	I	PD	T	I2S data receive, 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	NC				
B13	NC				
C14	NC				
B14	NC				
HSIC					
B12	USB_HSIC_STRB	IO			High speed Inter IC clock (not supported now)
C12	USB_HSIC_DATA	IO			High speed Inter IC data (not supported now)
C4	IPC_HOST_WAKEUP	O	PU	H	IPC host wakeup (not supported now)
C5	IPC_TRIG_OUT	O	PD	L	IPC trig out (not supported now)
C7	IPC_TRIG_IN	I	PU	PU	IPC trig in (not supported now)
C8	IPC_SLAVE_WAKEUP	I	PD		IPC slave wake up (not supported now)
SSIC					
D14	NC				
E14	NC				
D13	NC				
E13	NC				
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	PD	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	NC				
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
TG1	GND				GND
TG2	GND				GND
TG3	GND				GND
TG4	GND				GND
TG5	GND				GND
TG6	GND				GND
TG7	GND				GND
TG8	GND				GND
TG9	GND				GND
TG10	GND				GND
TG11	GND				GND
TG12	GND				GND
TG13	GND				GND
TG14	GND				GND
TG15	GND				GND
TG16	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 be left floating in case of circuit design.

5 Hardware Interface

5.1 Power Interface

5.1.1 Power Supply

The L811 module requires a 3.3V - 4.5V DC power supply that capable of supplying maximum GSM emission current which may up to 2A.

Input power supply requirements:

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

Important notes for the power supply:

1. Voltage fluctuation of the power supply should be lower than 200mV.

2. VBAT should not lower than 3.135V when the voltage dropping occurs.

The filtering capacitors for designing the power supply as shown in the following tables:

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

5.1.2 Power Consumption

Parameter	Description	Condition		Current (mA)
I_{off}	RTC mode	Power off		0.112
I_{Idle}	GSM	MFRMS	5	12.76
	WCDMA	DRX	8	12.29
	LTE FDD			13.21

	Radio Off	RF Disable(Flight Mode)	AT+CFUN=4	11.54
I_{Sleep}	GSM	MFRMS	2	2.54
			5	2.39
			9	1.81
	WCDMA	DRX	6	2.19
			8	1.22
			9	1.29
	LTE FDD	DRX	8	2.7
	Radio Off	RF is disabled.	AT+CFUN=4	1
$I_{GSM-RMS}$	GSM voice RMS Current	GSM850 PCL	5	239
			12	83
			19	56
		EGSM900 PCL	5	237
			12	80
			19	54
		DCS1800 PCL	0	190
			7	74
			15	52
		PCS1900 PCL	0	162
			7	69
			15	51
$I_{GSM-MAX}$	GSM voice Peak current	GSM850 PCL	5	1734
			12	425
			19	181
		EGSM900 PCL	5	1715
			12	431
			19	182
		DCS1800 PCL	0	1317
			7	361
			15	163

		PCS1900 PCL	0	1086
			7	308
			15	157
$I_{GPRS-RMS}$ CS4 $I_{GPRS-RMS}$ CS4	GPRS 1Rx slot nTX slot GPRS 1Rx slot nTX slot	GSM850 PCL=5（3）	1	249
			4	613
		GSM850 PCL=10（8）	1	114
			4	325
		EGSM900 PCL=5（3）	1	246
			4	589
		EGSM900 PCL=10（8）	1	110
			4	307
		DCS1800 PCL=0（3）	1	202
			4	534
		DCS1800 PCL=10（13）	1	71
			4	151
		PCS1900 PCL=0（3）	1	172
			4	458
		PCS1900 PCL=10（13）	1	70
			4	134
$I_{EGPRS-RMS}$ MCS9	EGPRS 1Rx slot nTX slot	GSM850 PCL=8（6）	1	158
			4	414
		GSM850 PCL=15（13）	1	83
			4	198
		EGSM900 PCL=8（6）	1	166
			4	429
		EGSM900 PCL=15（13）	1	95
			4	247
		DCS1800 PCL=2（5）	1	192
			4	451
		DCS1800 PCL=10（13）	1	110

			4	252
		PCS1900 PCL=2（5）	1	181
			4	445
		PCS1900 PCL=10（13）	1	111
			4	259
IWCDMA-RMS	WCDMA	Band 1	24dBm(23.5)	503
			10dBm	164
			1dBm(0)	126
		Band 2	24dBm(23.5)	474
			10dBm	159
			1dBm(0)	125
		Band 4	24dBm(23.5)	611
			10dBm	165
			1dBm(0)	126
		Band 5	24dBm(23.5)	460
			10dBm	160
			1dBm(0)	121
		Band 8	24dBm(23.5)	592
			10dBm	175
			1dBm(0)	125
ILTE-RMS	LTE FDD	B1	23dBm	580
			10dBm	259
			0dBm	210
		B2	23dBm	590
			10dBm	272
			0dBm	211
		B3	23dBm	611
			10dBm	262
			0dBm	210
		B4	23dBm	613

			10dBm	265
			0dBm	212
		B5	23dBm	564
			10dBm	249
			0dBm	208
		B7	23dBm	895
			10dBm	327
			0dBm	224
		B8	23dBm	582
			10dBm	256
			0dBm	212
		B13	23dBm	590
			10dBm	252
			0dBm	207
		B17	23dBm	455
			10dBm	244
			0dBm	205
		B18	23dBm	561
			10dBm	246
			0dBm	208
		B19	23dBm	556
			10dBm	248
			0dBm	208
		B20	23dBm	615
			10dBm	254
			0dBm	210

5.1.3 VSD2_1V8

VSD2_1V8 is the power source of the internal digital circuits, it can be also used as the power indicator and the reference voltage. For circuit design, it can be only used for low current application (<50mA), floating if not used.

Parameters	Minimum Value	Typical 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 for the internal RTC of the module. In order to let RTC work for a certain time when lost the VBAT power, as the backup power, it is recommended to add a big capacitor at the VRTC pin.

The voltage range of the VRTC as shown in the following tables:

Parameters	Minimum Value	Recommended Value	Maximum Value	Unit
RTC working voltage	0.4	1.8	1.89	V

Voltage of VRTC	RTC Current Consumption
0.4V ~ 1V	1 uA
1V ~ 1.89V	2 uA

The reference design of VRTC circuit shown as follows:

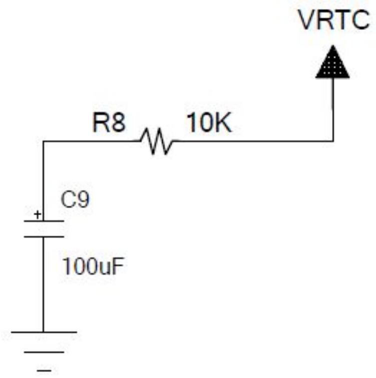


Figure 5- 1 VRTC Reference Design

Note:

- R8 is a current-limiting resistor, used to ensure the VRTC works properly and free from being affected by peripheral circuits. R8 ≥ 1k Ohm.
- The current consumption is about 2A when 1.8V VRTC is supplied from the external capacitor.
- The value of C9 will affect the retaining time of RTC after VBAT is lost. The remaining time of RTC can be roughly calculated by the following formula:

(1.8-1)*C/2 + (1-0.4)*C/1 = 0.4C + 0.6C = 1C

Ex.

When using a 100uF capacitor, the remaining time is 1*100 = 100 Sec.

When using a 330uF capacitor, the remaining time is 1*330 = 330 Sec.

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

5.2 Power on/off and Reset Signal

The L811 module provides two control signals for power on/off and reset functions.

Pin definition as shown in the following tables:

Pin#	Pin Name	Electrical Level	Description
N8	POWER_ON/OFF#	CMOS 1.8V	Power on/off signal
N7	RESET_N	CMOS 1.8V	External reset signal input, active low.

5.2.1 Power on /off Signal

5.2.1.1 Power on

After the power is applied to the module, pull up the POWER_ON/OFF# signal for at least 20ms then the module will boot up.

The timing sequence diagram as follows:

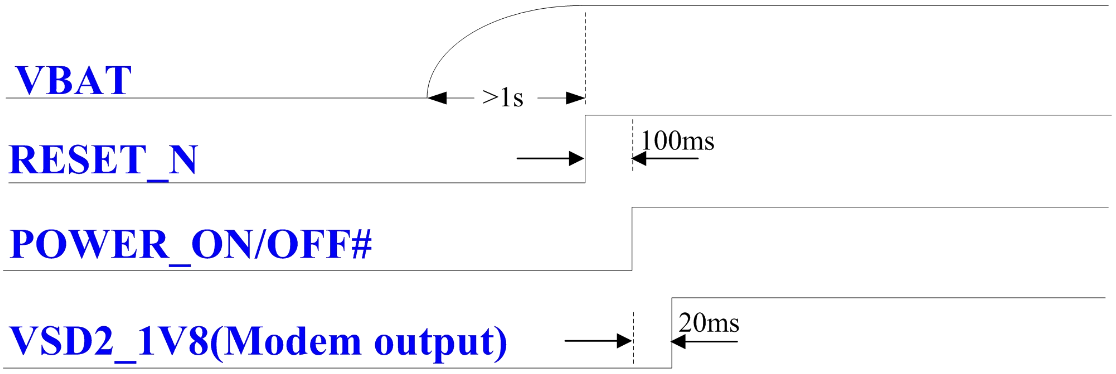


Figure 5-2 Power on Timing Control Diagram

Note :

The “>1s” time starts from the external capacitor being charged when the power is applied to the module. If VBAT is already applied to the module then the time can be ignored, and AP(Application Processor) only needs to control the timing of RESET_N and POWER_ON/OFF# signals.

5.2.1.2 Power off

The L811 module can be turned off by software or hardware control. Software control is preferred for normal cases, only when software control is not usable, then use the hardware control. By pulling down or float the POWER_ON/OFF# signal, the module will be shut down. ①

For details as shown in the following tables:

Control Method	Action	Condition
Software	AT+CPWROFF	Normal control for power off.
Hardware	Pull down or floating the POWER_ON/OFF# signal.	Only used when a hardware exception occurs and the software control cannot be used.

The hardware control description:

By pulling down or float the POWER_ON/OFF# signal, the PMU (Power Management Unit) of the module will be reset, which results in the state changes from the working state to the shutdown state.

The timing sequence diagram as follows:

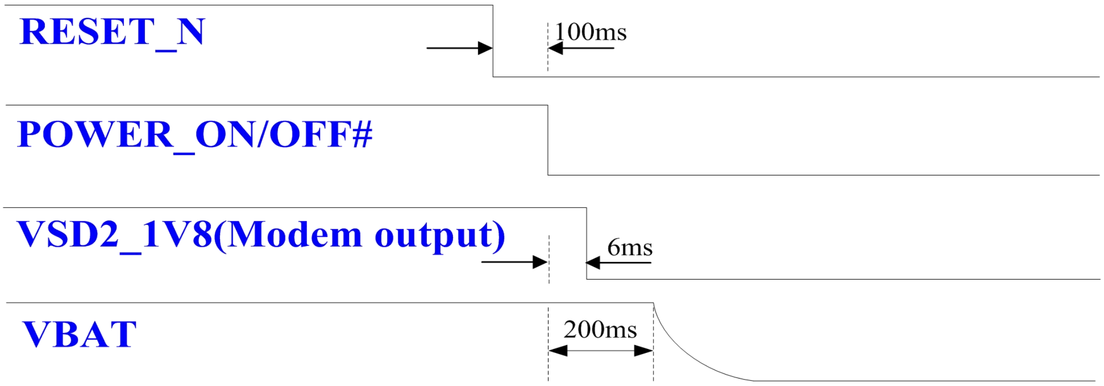


Figure 5- 3 Power off Timing Sequence Diagram

Note ①: To safely shut down the module, the RESET_N signal must be pulled down (for at least 100ms) before pulling down the POWER_ON/OFF# signal.

5.2.1.3 The Recommended Design of Power on/off

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

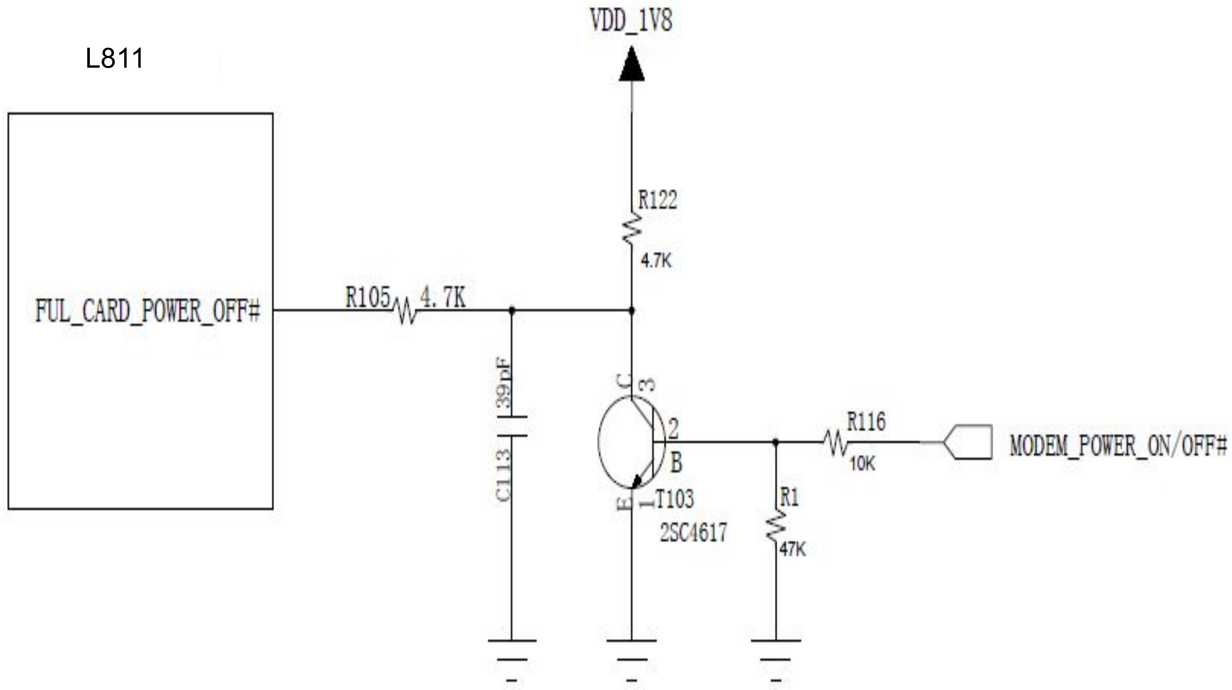


Figure 5-4 Recommended Design of POWER_ON/OFF# Signal

5.2.2 RESET Signal

The L811 module supports the external reset function. By controlling the RESET_N signal, the module will reset to its initial state. When pulling down the RESET_N signal for 100ms, the module will be reset and restarted. If the module is already turned on and working before the reset, there is no need to control POWER_ON/OFF# signal to turn it on. PMU inside the module remains its power during the reset procedure.

Note:

The reset signal is very sensitive. It should be kept away from RF interference and well wrapped with ground planes in case of PCB layout. It is recommended to add a filter capacitor close to the module. Also, RESET_N signal trace shall neither near the PCB edge nor route on the surface planes to avoid module from reset caused by ESD.

The timing sequence requirement as follows:

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

Recommended design:

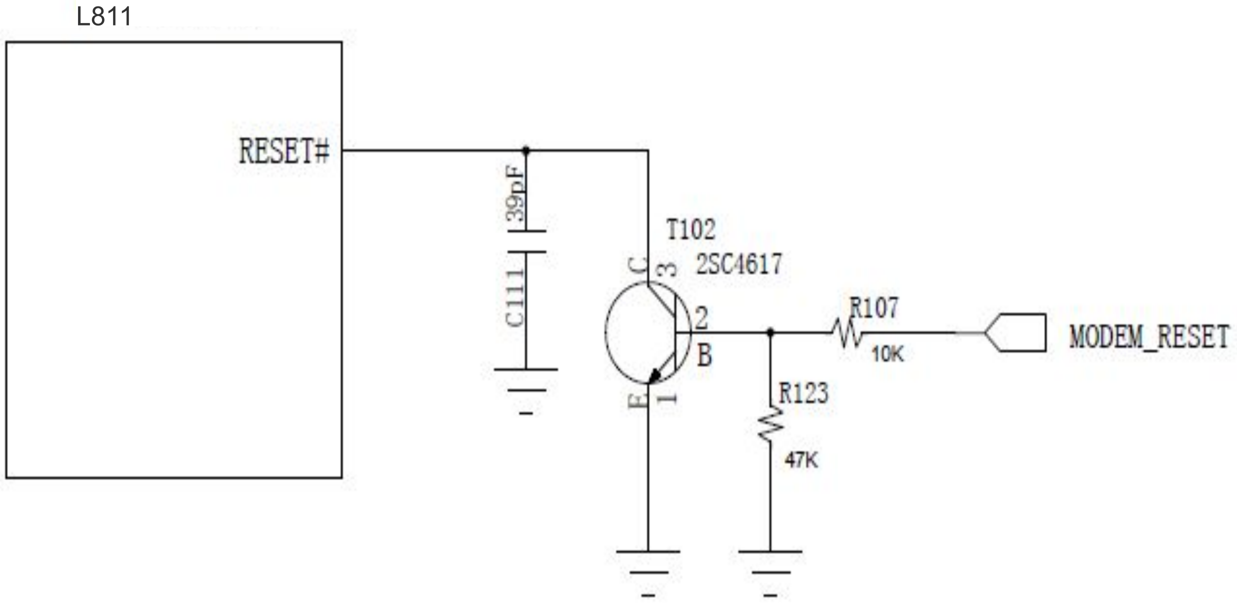


Figure 5- 5 Recommended Design of Reset Circuit

5.3 Status Indicating Signals

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 wakes up the host (Application processor).
L15	PA_BLANKING	O	PA Blanking output, external GPS control signal.

5.3.1 CORE DUMP Indicating

The CORE_DUMP signal is used to indicate the mode of the module.

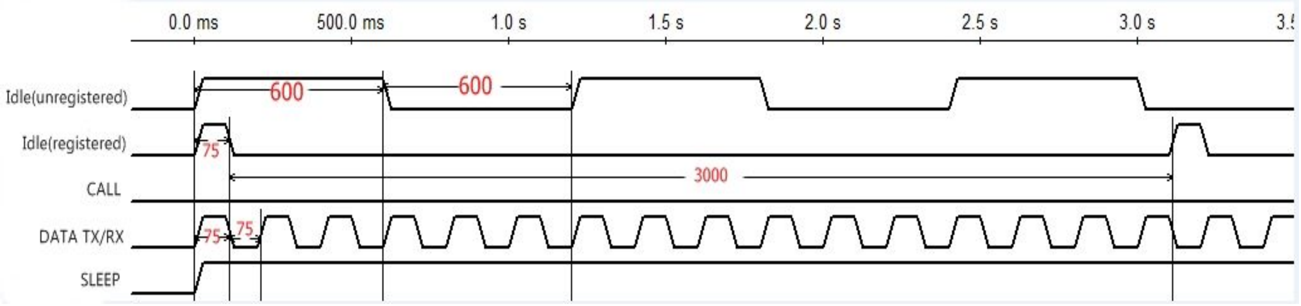
Status	Mode
Normal mode	Low level
Core Dump	High level

5.3.2 LPG Signal

The LPG signal timing description as shown in the following tables:

Operating Modes	LPG signal

Idle (unregistered)	600ms high level and 600ms low level
Idle (registered)	75ms high level and 3s low level
Voice communication (Call)	Always low level
Data communication	75ms high level and 75ms low level
Sleep (sleep mode)	Always high level



5.3.3 WAKEUP_HOST Signal

The WAKEUP_HOST signal is used to wake up the host when there are incoming calls, SMS or other data requests.

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

5.3.4 PA_BLANKING Signal

The default is low for the signal. While the module works in GSM frequency band, PA_BLANKING will output the pulses that synchronized with the GSM burst timing sequence.

Due to the GSM TX may interfere the receiving of the GPS signal, AP can turn off GPS or stop receiving data from the GPS when it detecting the PA_BLANKING pulses.

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 interrupt control signals as shown in the following tables:

Pin#	**Name**	**I/O**	**Description**
J15	WAKEUP	I	Wake up the module.
K15	W_DISABLE#	I	Enable/Disable RF network.
H14	EINT3	I	Android & Linux/Win8 & Win10 dual systems switch.
J14	BODY_SAR	I	Body SAR detection.

5.4.1 WAKE_UP Signal

WAKE_UP signal description as shown in the following tables:

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

5.4.2 W_DISABLE# Signal

The module provides a hardware signal to enable/disable WWAN RF function, it can be controlled by an AT command also. The module will enter the Airplane mode by disabling RF function.

The definition of W_DISABLE# signal as shown in the following tables:

No.	**W_DISABLE#**	**Function**
1	Low	WWAN disabled, module enters Airplane mode.
2	High	WWAN enabled, module exits Airplane mode.
3	Floating	The WWAN function is defined by the AT command, enabled by default.

5.4.3 Android & Linux / Win8 & Win10 Dual Systems Switch Control Signal

The L811 module supports Android & Linux / Win8 & Win10 dual systems switch by detecting the voltage level of the interrupt signal EINT3.

The function of EINT3 signal as shown in the following tables:

No.	**EINT3**	**Function**

1	High/Floating	For Android or Linux system, the module`s USB ports mapped as 3*ACM ports.
2	Low	For Win8 or Win10 system, the module`s USB port is mapped as a MBIM mode.

Description:

1. During booting, the implementation of Android & Linux / Win8 & Win10 system change is done by detecting the level of EINT3 signal. The voltage level of EINT3 should be kept stable during booting.
2. After boot up, the implementation of Android & Linux / Win8 & Win10 system change is done by detecting the rising or falling edge of the EINT3 interrupt with the debounce time of 100ms. If the interrupt event meets the condition, the module will restart and change over its USB mode for the desired system.

5.4.4 BODY_SAR Signal

BODY_SAR is an input signal (or the output signal from the AP or the SAR sensor). The voltage level is high by default, and low when enabled. When the SAR sensor detects the closing human body, the BODY_SAR signal will be pulled low by AP or the SAR sensor. As the result, the module then lowers down its emission power. The threshold values of emission power can be set by 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 D+ signal
A12	USB_DN	I/O	USB D- signal
A11	VBUS	I	USB power input

The L811 wireless communication module supports USB 2.0 interface. Before connecting it to the Win7 system, it is necessary to install the USB driver (For Android & Linux system, no USB driver needed but configuring the related kernel settings). After connecting the USB port to a PC, the USB driver resides in the Windows system will map three ACM ports and four NCM ports, as listed below:

- 2 ACM ports used for AT Commands.
- 1 ACM ports used for LOG information captured by the debug software.

- 4 NCM ports are virtual network ports, mainly used for initiating data transmission serves.

Note:

One of the ACM ports can be used as a Modem COM port to initiate the data services. It is not recommended to use due to the speed of Modem COM port is insufficient for the 100Mbps download speed of the LTE standard. Only when the NCM ports are not available, the Modem COM port could initiate the data service as the temporary solution.

5.5.2 USB Interface Application

Reference Circuit Design:

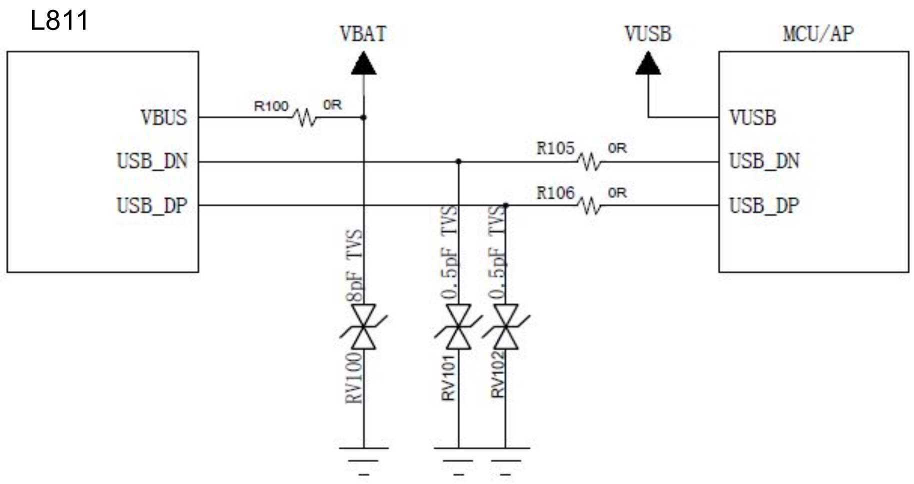


Figure 5-6 USB Interface Reference Circuit Design

The choice of capacitance for RV101 and RV102 TVS diodes should not greater than 1pF, it is recommended to use 0.5pF TVS diodes. There is no recommended capacitance value for RV100.

VUSB pin supplies the power for USB, the recommended power range is 3.3V ~ 4.5V. VBUS pin should not floated or it will become the unknown device.

USB_DP and USB_DM are the high-speed differential signals, and the maximum data rate is 480Mbps. The following requirements should be followed in case of PCB layout.

- USB_DP and USB_DN signal traces should be parallel and have the equal length, avoid right angle layout.
- USB_DP and USB_DN signal traces should be wrapped with GND on both sides.
- USB2.0 differential signal traces should be routed on the layer nearest to the ground plane.
- Ensure the match of impedance, which is required to be 90 Ohm.

Note:

VBUS is the power for USB detection (it’s the low current signal, current value < 100uA). In circuit design, it’s not permitted to apply VBUS power individually when the USB_DN and USB_DP are disconnected, or the module will not go into the sleep mode.

5.6 UART Interface

5.6.1 UART Interface Description

The L811 module provides one 4-wire UART port. The UART1 port supports AT commands, the users can receive and transmit AT commands through UART1.

The definition of UART1 signals as shown in the following tables:

Pin#	Pin Name	I/O	Description
L14	UART1_CTS	I	Clear to send
K14	UART1_RTS	O	Request to send
A9	UART1_TXD	O	Data Transmit
A10	UART1_RXD	I	Date Receive

5.6.2 UART Interface Application

The signal direction when connecting the UART1 of L811 module (DCE) and MCU (DTE) as shown in the following tables:

MCU (DTE) application	Signal direction	L811 module (DCE)
RXD	←	UART1_TXD
TXD	→	UART1_RXD

Note:

The voltage level of UART interface is 1.8V. When connecting to 2.8V or 3.3V I/O, it is necessary to convert the voltage level. In circuit design, it is recommended to use a SN74LVC2G07 to convert the voltage level from 1.8V to 3.3V. For connecting to a PC, first convert 1.8V to 3.3V, then use a SPIEX3232EEA to convert it to RS-232 level. The direction of the signals should be properly handled.

5.7 USIM Interface

The L811 module supports USIM and high speed SIM cards (The 8-wire USIM is not supported yet).

5.7.1 USIM Pins

Pin#	Pin Name	I/O	Function Description
D15	VSIM1	O	USIM power, 1.8V/2.8V
E15	SIM1_RST	O	USIM reset

F15	SIM1_CLK	O	USIM clock
G15	SIM1_DATA	I/O	USIM data
H15	SIM1_CD	I	USIM card detection signal, pulled up with a 390k resistor by default. High when SIM card is inserted. Low when SIM card is not inserted.

5.7.2 USIM Interface Design

5.7.2.1 “Normally Closed” SIM Card Circuit Design

Reference Circuit Design:：

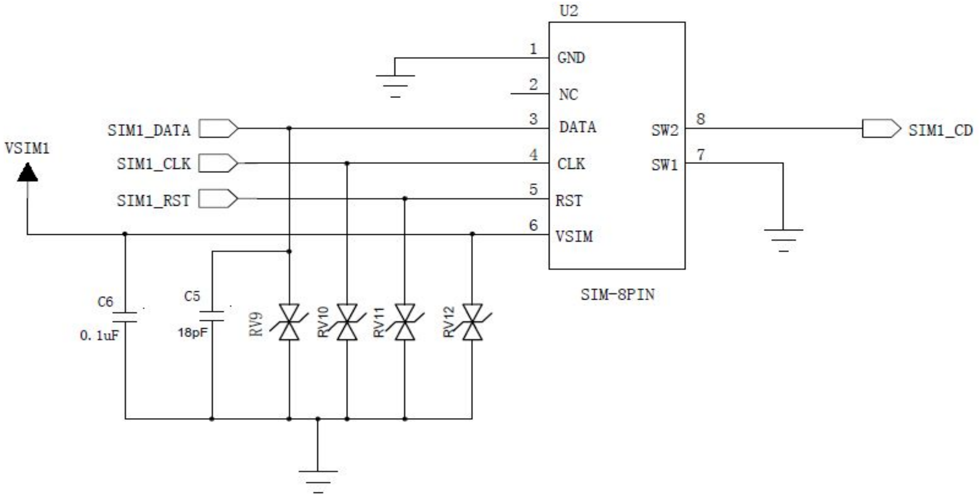


Figure 5-7 Reference Design of “Normally Closed” SIM Card Interface

Normally closed SIM Connector:

1）When detaching the SIM card, pin 7 and pin 8 shorted together.

2）When inserting the SIM card, pin 7 and pin 8 opened.

5.7.2.2 “Normally Open” SIM Circuit Design

Referenced Circuit Design:

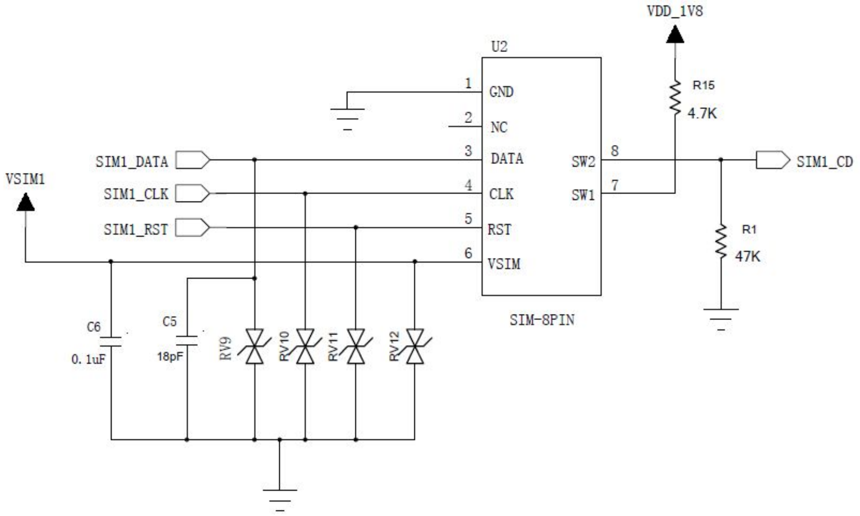


Figure 5-8 Reference Design of “Normally Open” SIM Card Interface

Normally open SIM Connector:

1）When detaching the SIM card, pin 7 and pin 8 opened .

2）When inserting the SIM card, pin 7 and pin 8 shorted.

Note:

- In order to improve the EMC performance, the SIM card slot should be close to the module as much as possible.
- The filter capacitors for the SIM card signals should be placed close to the SIM card slot as much as possible.
- The ESD devices (e.g. TVS) shall be added to the SIM card signals for ESD protection. They should be placed close to the SIM card slot as much as possible.
- SIM1_CD signal supports hot-plugging. Active high by default (It can be changed to active low by an AT command). If the module detects the signal with high level, it means a card insertion has detected.

5.7.3 Highlights for USIM Design

The SIM card interface design is very important to have the module and SIM card work normally.

The rules should be followed carefully as below:

- SIM card slot and signal routing must keep away from the EMI interference sources, e.g. RF antenna and digital signals.
- The trace length between the module and SIM card should not exceed 100mm.
- To avoid crosstalk, USIM_CLK and USIM_IO signals should keep away in case of layout. It’s recommended to wrap them with ground planes.
- SIM card signals should be ESD protected. The ESD devices should have low capacitance (e.g. Zener diode). It’s recommended to choose ESD devices with capacitance equal or less than 33pF. In case of layout, ESD devices should be close to the SIM card interface.

5.7.4 USIM Hot-Plugging

The L811 module supports the insert detection of the SIM card. With this function, the hot-plugging of SIM card can be designed.

5.7.4.1 Hardware Connection

The function of SIM card hot-plugging is done by the SIM_CD signal. The SIM1_CD signal is low when the SIM card is detached, high when the SIM card is inserted.

Note：

- For “Normally closed” design, as shown in the figure5-7, the SIM1_CD signal 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 are shorted, and SW2 is low. When the SIM card is inserted, SW2 and SW1 are opened, and the SIM1_CD signal will be pulled high.
- For “Normally open” design, as shown in the figure5-8, the SIM1_CD signal is connected to U2’s Pin8 (SW2), and Pin7 (SW1) is pulled up with a 4.7K resistor. When the SIM card is not inserted, SW2 and SW1 are opened, and SW2 is low. When the SIM card is inserted, SW2 and SW1 are shorted, and SIM1_CD signal will be pulled high.

5.7.4.2 Software Setup

“+MSMPD” command is used for the SIM card detection function:

- If set AT+MSMPD=0, the SIM card detection function is disabled, and the module will not detect the SIM1_CD signal.
- If set AT+MSMPD=1, the SIM card detection function is enabled, and the module will detect the insertion of the SIM card via SIM1_CD Pin.
- If SIM1_CD is high, which indicates the insertion of a SIM card, and the module will automatically register to the network.
- If SIM1_CD is low or disconnected, which indicates the SIM card is not inserted, and the module will not register to the network.

Note:

The default value of +MSMPD is “1”. The SIM_CD signal is used for SIM card detection. The module detects the presence of the SIM card via the SIM1_CD signal during the first booting. After the module boots up, it detects the SIM card by the level change of the SIM1_CD signal. In other words, if SIM1_CD is at low level, the module cannot access the SIM card.

5.8 Digital Audio

The L811 module supports I2S interface for digital audio. The I2S port supports normal I2S mode and PCM mode for data transfer. I2S interface is at 1.8V voltage level.

I2S signal description as shown in the following tables:

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 Interface

L811	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 master or slave mode.
- It supports various audio sampling rates (48KHz, 44.1KHz, 32KHz, 24KHz, 22.5KHz, 16KHz, 12KHz, 11.025KHz and 8KHz).

5.8.2 PCM Mode Description

L811	Signal Direction	Audio CODEC PCM Port
I2S2_CLK(PCM_CLK ,PCM clock signal)	→	PCM_CLK（PCM clock signal）
I2S2_WA(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 port can be configured as master or slave mode.

- It supports short frame sync for 16, 32, 48, and 64 bit mode.
- It supports burst and continuous transmission modes.
- It supports clock length trigger for frame sync signal and rising/falling edge trigger for data transmission.
- It supports various audio sampling rates (48KHz, 44.1KHz, 32KHz, 24KHz, 22.5KHz, 16KHz, 12KHz, 11.025KHz and 8KHz).

Note:

Because of the timing of I2S mode is simpler than PCM mode, it is recommended to use I2S mode for audio transmission. For PCM mode, the audio quality issues caused by the PCM timing adjusting must be avoided.

5.9 I2C Interface

L811 module supports one I2C interface, default configured as I2C master. The I2C master is used for driving external I2C slave devices, such as audio codecs and so on.

Pin#	Name	I/O	Description
M11	I2C_DATA	I/O	I2C data signal,1.8V signal level
M12	I2C_SCL	O	I2C clock signal, 1.8V signal level

The signal connection of L811 I2C master and external I2C slave (such as an audio codec） as shown in the following tables:

L811	Signal Direction	Audio Codec I2C Port
I2C_SDA	↔	I2C_SDA
I2C_SCL	→	I2C_SCL

5.10 Clock Interface

L811 module supports one 26MHz clock output and one 32KHz clock output.

Pin#	Pin Name	I/O	Description
A3	FSYS2_26M	O	26MHz clock output, 1.8V level. (It is recommended to be used for external GPS, and it can also be used for the main clock of the audio codec)
A8	CLK32K	O	32K clock output, 1.8V level.

5.11 Other Interfaces

The module does not support the following ports yet: HSIC、ANT Tunable、GPIO.

6 Electrical and Environmental Characteristic

6.1 Electrical Characteristic

The table below lists the range of L811’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 Characteristic

This table below shows the environmental features of L811.

Parameters	Minimum Value	Maximum Value	Unit
Operating Temperature	-30	+85	°C
Storage Temperature	-40	+85	°C

7 RF Interface

7.1 Operating Frequency Band

The RF operating frequency band as shown in the following tables:

Operating Band	**Mode**	**Tx (MHz)**	**Rx (MHz)**
Band 1	LTE FDD/WCDMA	1920 - 1980	2110 - 2170
Band2	LTE FDD/WCDMA /GSM	1850-1910	1930-1990
Band 3	LTE FDD/GSM	1710 - 1785	1805 - 1880
Band 4	LTE FDD/WCDMA	1710-1755	2620-2690
Band 5	LTE FDD/WCDMA/GSM	824 - 849	869 - 894
Band 7	LTE FDD	2500 - 2570	2620 - 2690
Band 8	LTE FDD/WCDMA/GSM	880 - 915	925 - 960
Band 13	LTE FDD	777-787	746-756
Band 17	LTE FDD	704-716	734-746
Band 18	LTE FDD	815-830	860-875
Band 19	LTE FDD	830-845	875-890
Band 20	LTE FDD	832 - 862	791 - 821

7.2 TX Power

For different modes , the TX power of L811 bands as shown in the following tables :

Mode	**Band**	**Tx Power(dBm)**	**Note**
GSM	CLR850	32.5	±1dBm
	GSM900	32.5	±1dBm
	DCS1800	29.5	±1dBm
	PCS1900	29.5	±1dBm
WCDMA	Band 1	22.5	±1dBm
	Band 2	22.5	±1dBm
	Band 4	22.5	±1dBm
	Band 5	22.5	±1dBm

	Band 8	22.5	±1dBm
LTE FDD	Band 1	22.5	±1dBm
	Band 2	22.5	±1dBm
	Band 3	22.5	±1dBm
	Band 4	22.5	±1dBm
	Band 5	22.5	±1dBm
	Band 7	22.5	±1dBm
	Band 8	22.5	±1dBm
	Band 13	22.5	±1dBm
	Band 17	22.5	±1dBm
	Band 18	22.5	±1dBm
	Band 19	22.5	±1dBm
	Band 20	22.5	±1dBm

7.3 Receiver Sensitivity

For different modes, the receiver sensitivity of L811 for each band as shown in the following tables:

Mode	Band	Rx Sensitivity(dbm)	Note
GSM	CLR850	-108	BER<2.43%
	GSM900	-108	BER<2.43%
	DCS1800	-108	BER<2.43%
	PCS1900	-108	BER<2.43%
WCDMA	Band 1	-109	BER<0.1%
	Band 2	-109	BER<0.1%
	Band 4	-109	BER<0.1%
	Band 5	-109	BER<0.1%
	Band 8	-109	BER<0.1%
LTE FDD	Band 1	-100	10MHz Bandwidth
	Band 2	-98	10MHz Bandwidth
	Band 3	-97	10MHz Bandwidth

	Band 4	-100	10MHz Bandwidth
	Band 5	-98	10MHz Bandwidth
	Band 7	-98	10MHz Bandwidth
	Band 8	-97	10MHz Bandwidth
	Band 13	-97	10MHz Bandwidth
	Band 17	-97	10MHz Bandwidth
	Band 18	-100	10MHz Bandwidth
	Band 19	-100	10MHz Bandwidth
	Band 20	-97	10MHz Bandwidth

Note:

The above values are measured for double antenna situation (Main+Diversity). For single antenna (without Diversity), the sensitivity value will drop around 3dbm for each band.

7.4 RF PCB Design

7.4.1 Wire Routing Principle

The L811 module supports double RF antennas, the MAIN_ANT is for transmitting and receiving, and the DIV_ANT is for receiving. Diversity antenna can improve the receiver sensitivity as well as the downlink speed.

The RF connectors or solder joints must be connected to the L811 module by the trace lines. It is recommended to use the microstrip line for RF line. It should be as short as possible with the insertion loss controlled below 0.2dB, and has the impedance of 50 Ohm.

For antenna fine tuning, it is recommended to reserve a π circuit (the parallel inductors should connect to the main ground) between L811 module and the antenna connector (or the solder joint).

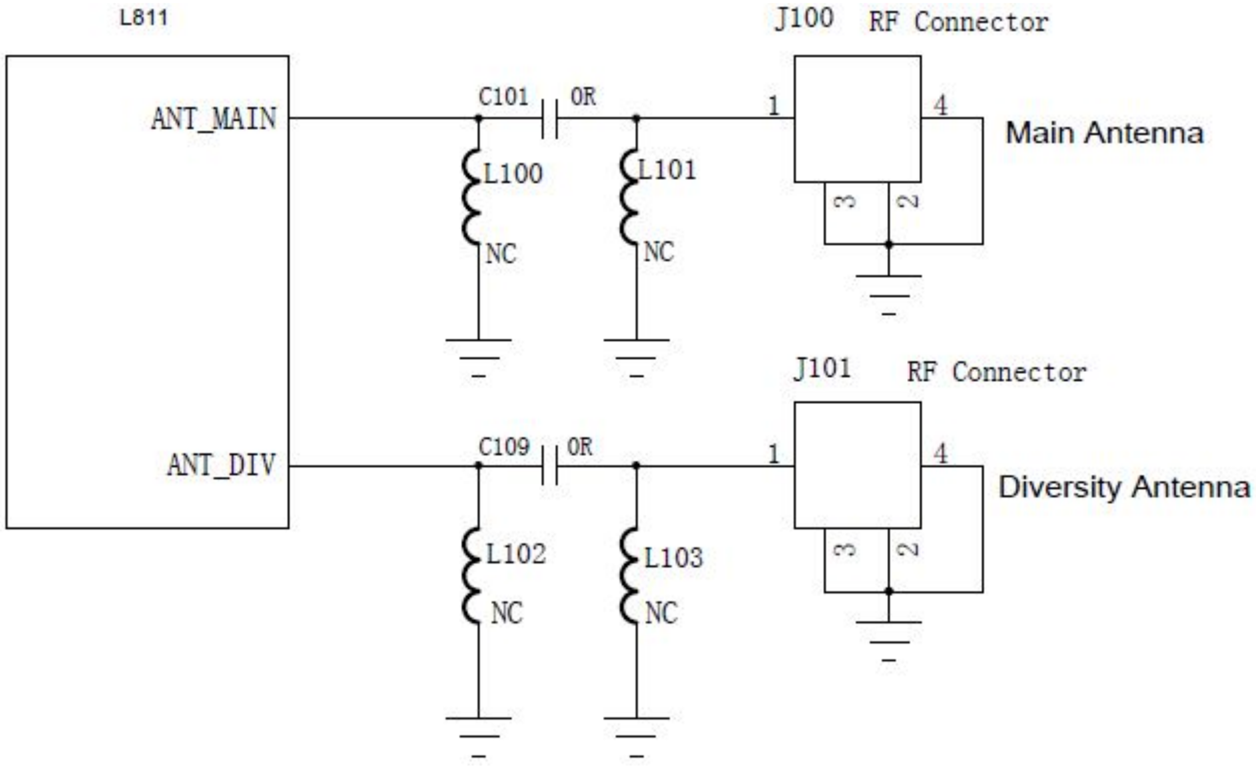


Figure 7- 1 L811 π-type Circuit

7.4.2 Impedance

The impedance of the RF signal line needs to be controlled at 50 Ohm.

7.5 Antenna Design

7.5.1 Main Antenna Design Requirements

(1) Antenna efficiency

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

(2) S11 or VSWR

S11 indicates the matching level of the 50 Ohm impedance for the antenna. It affects the antenna efficiency in a certain extent. The VSWR testing method could be used for measuring purposes. The recommended value for S11 is less than –10dB.

(3) Polarization

Polarization refers to the rotation direction of electric field while the antenna is in the direction of maximum radiation. Linear polarization is recommended. It is recommended to use the diversity antenna which has the different polarization direction from the main antenna.

(4) Radiation pattern

The radiation pattern refers to the intensity of the electromagnetic field while the antenna is in every direction of the far field. Dipole antenna is perfect as the terminal antenna. For built-in antenna, it is recommended to use PIFA or IFA antennas.

- Antenna dimension: 6mm * 10mm * 100mm (H*W*L).
- Antenna radiation direction: Omnidirectional.

(5) Gain and directivity

Antenna directivity refers to the intensity of the electromagnetic field while the electromagnetic wave is in all directions. Gain is the collection of of the efficiency and directivity of the antenna. It is recommended that antenna gain is less than or equal to 2.5dBi.

(6) Interference

In addition to antenna performance, some other interference from the PCB will also affect the module performance. To ensure the high performance of the module, the interference must be under control. Suggestions: Keep speaker, LCD, CPU, FPC wire routing, audio circuits, and power supply away from the antenna, and add appropriate filtering and shielding protection, or adding filtering devices on the traces.

(7) TRP/TIS

TRP (Total Radiated Power)：

- GSM850/900>28dBm
- GSM DCS1800/PCS1900 >25dBm
- WCDMA Band 1,2,4,5,8>19dBm
- LTE FDD Band 1,2,3,4,5,7,8,13,17,18,19,20>19dBm

TIS (Total Isotropic Sensitivity)：

- GSM850/900/DCS1800/PCS1900<-102dBm
- WCDMA Band 1,2,4,5,8<-102dBm
- LTE FDD Band 1,2,3,4,5,7,8,13,17,18,19,20<-95dBm (10MHz Bandwidth)