FIBOCOM
Perfect Wireless Connection

L831-EA Module Hardware User Manual

Version: V1.0.1

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Confidential Material

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FOR FCC

Federal Communications Commission (FCC) Declaration of Conformity

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 device has been tested and found to comply with the limits for a Class B digital , 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 radiated 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 or more 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.

FCC Caution:

Changes or modifications not expressly approved by the party responsible for compliance could void the user‘s authority to operate the equipment.

RF Exposure Information

This device meets the government’s requirements for exposure to radio waves.

This device is designed and manufactured not to exceed the emission limits for exposure to radio frequency (RF) energy set by the Federal Communications Commission of the U.S. Government.

● This device complies with FCC radiation exposure limits set forth for an uncontrolled environment. In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antenna shall not be less than 20cm (8 inches) during normal operation.

IMPORTANT NOTE:

This module is intended for OEM integrator. The OEM integrator is still responsible for the FCC compliance requirement of the end product, which integrates this module. 20cm minimum distance has to be able to be maintained between the antenna and the users for the host this module is integrated into. Under such configuration, the FCC radiation exposure limits set forth for an population/uncontrolled environment can be satisfied.

Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

USERS MANUAL OF THE END PRODUCT:

In the users manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment. If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual: This device complies with Part 15 of 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.

LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following " Contains TX FCC ID: ZMOL831". If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of 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.

Revision History

Version	Date	Remarks
V1.0.0	2014-12-30	Initial version
V1.0.1	2015-02-12	Update the consumption and the power on/off timing

Applicability Table

No.	Type	Note
1	L831-EA	

The difference of L831-EA wireless module as listed below:

Model Type	LTE FDD	WCDMA	GSM/GPRS/EDGE
L831-EA	Band 1,2,3,4,5,7,8,13,17, 18,19,20	Band 1,2,4,5,8	850/900/1800/1900MHz

Contents

1 Preface

1.1 Outline

The document outlines the electrical, RF performance, mechanical size and application environment of L831-EA wireless module. Under the help of the document and others application notice, the application developer could understand quickly the performance of L831-EA series wireless module, and developing the product.

1.2 Standards

The products `reference design standard as listed below:

- 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 36.101 V9.18.0: User Equipment (UE) radio transmission and reception
- 3GPP TS 36.104 V9.13.0: Base Station (BS) radio transmission and reception
- 3GPP TS 36.106 V9.4.0: FDD Repeater radio transmission and reception
- 3GPP TS 36.113 V9.5.0: Base Station (BS) and repeater ElectroMagnetic Compatibility (EMC)
- 3GPP TS 36.124 V9.2.0: ElectroMagnetic Compatibility (EMC) requirements for mobile terminals and ancillary equipment
- 3GPP TS 36.133 V9.18.0: 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 34.122 V5.7.0: 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 Introduction

2.1 Description

L831-EA modules are highly integrated LTE M.2 wireless communication modules, supports 3 module 12 band and the global main 4G/3G/2G modes (LTE FDD/WCDMA/GSM) These bands support the mobile operators `cellular network of the Europe & Asia-Pacific and American marketing.

2.2 Specifications

Specifications		
Bands	L831-EA	
	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	LTE FDD	Category 4 (150Mbps DL,50Mbps UL)
	UMTS/HSDPA/HSUPA 3GPP Rel.8	DC-HSDPA 42Mbps(Cat24)/42Mbps(Cat20) 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)
Physical	Dimension : 32mm x 42mm x 2.3 mm	
	Interface : M.2	
	Weight : 5.9 grams	
Environment	Operating Temperature: -30℃ ~ +55℃	
	Storage Temperature: -40℃ ~ +85℃	
Performance		
Operating Voltage	Voltage：3.135V ~ 4.4V Normal：3.3V	
Operating Current (Typical Value)	5.5mA (Sleep Mode)	
	3G Idle：16mA	
	LTE FDD Idle: 17mA	
	LTE FDD DATA：700mA	
	WCDMA Talk：580mA	

	2G Talk：300mA (GSM PCL5)
Interfaces	
RF Interface	Antenna : Mainx1，Diversityx1
Function Interface	1 x USB 2.0，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	Support
SMS	MO / MT Text and PDU modes
	Cell broadcast
Audio	Digital Audio
	Voice coders :EFR/HR/FR/AMR
	VoLTE (not support 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
	User Manual
	Developer Kit

Note:

1. Please make sure the temperature for device will not be higher than 55°C.
2. The minimum distance between the user and/or any bystander and the radiating structure of the transmitter is 20cm.
3. Assessment of compliance of the product with the requirements relating to the Radio and Telecommunication Terminal Equipment Directive (EC Directive 1999/5/EC) was performed by PHOENIX TESTLAB (Notified Body No.0700),

CE 0700

2.3 Appearance

The following pictures show the L831-EA wireless module.

Top view:

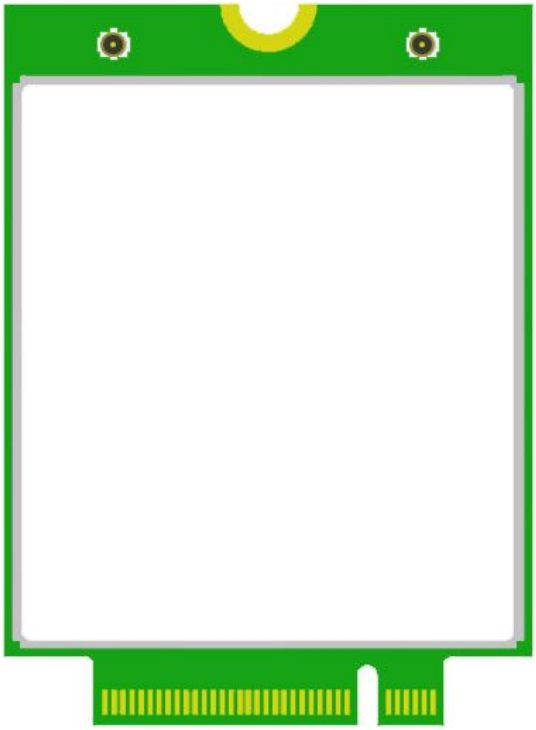

Figure 2- 1 Top View

Bottom view:

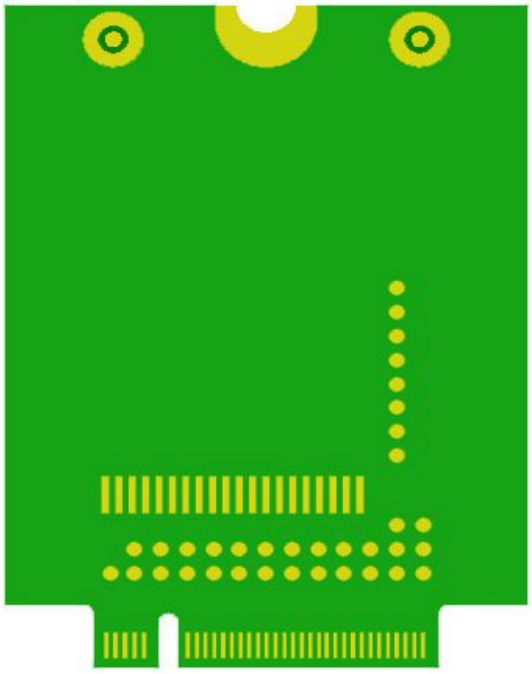

Figure 2- 2 Bottom View

3 Mechanical

3.1 Dimension

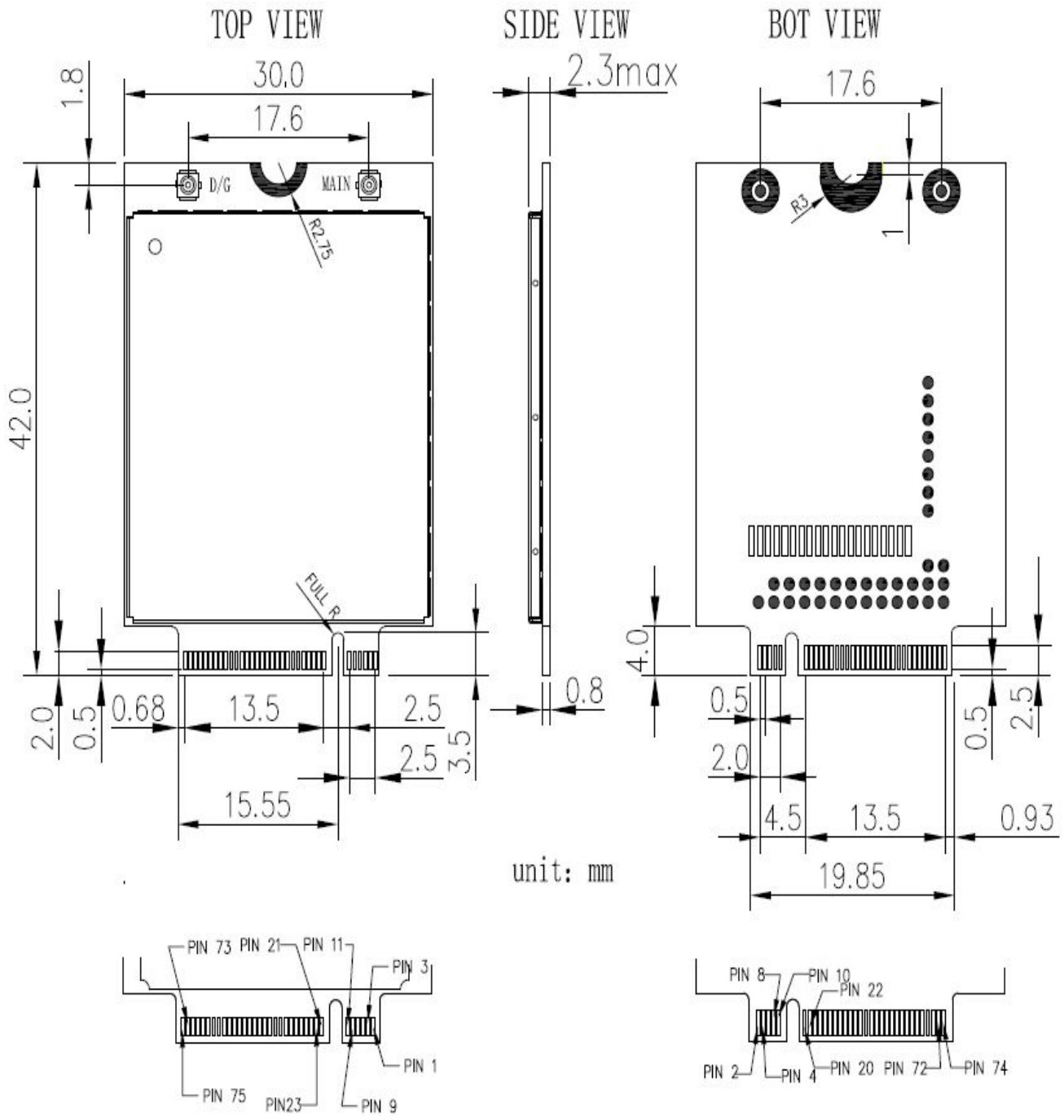

Figure3- 1Dimension Diagram

3.2 Application Interface Description

L831-EA module uses 75-pin gold fingers as the external interface, the size of the module please refer to the section3.1.

As shown in Figure 4-2, L831-EA module uses the 75-pin fingers interface (67pin is the signal interface and Pin8 is notch).

About the naming rules of M.2, L831-EA adopts the Type 3042-S3-B (30mmx42mm,the maximum thickness of element layer of Top surface is 1.5mm, the thickness of PCB is 0.8mm, Key ID is B).

Module Nomenclature
Sample Type 2242-D2-B-M

Type XX XX - XX - X - X*

Width (mm)
12
16
22
30

Length (mm)
16
26
30
42
60
80
110

Lable**	Component Max Ht (mm)	
	Top Max	Bottom Max
S1	1.2	0****
S2	1.35	0****
S3	1.5	0****
D1	1.2	1.35
D2	1.35	1.35
D3	1.5	1.35
D4	1.5	0.7
D5	1.5	1.5

Key ID	Pin	Interface
A	8-15	2x PCIe x1 / USB 2.0 / I2C / DP x4
B	12-19	PCIe x2/SATA/USB 2.0/USB 3.0/HSIC/SSIC/Audio/UIM/I2C
C	16-23	Reserved for Future Use
D	20-27	Reserved for Future Use
E	24-31	2x PCIe x1 / USB 2.0 / I2C / SDIO / UART / PCM
F	28-35	Future Memory Interface (FMI)
G	39-46	Generic (Not used for M.2)***
H	43-50	Reserved for Future Use
J	47-54	Reserved for Future Use
K	51-58	Reserved for Future Use
L	55-62	Reserved for Future Use
M	59-66	PCIe x4 / SATA

* Use ONLY when a double slot is being specified
** Label included in height dimension
*** Key G is intended for custom use. Devices with this key will not be M.2-compliant. Use at your own risk!
**** Insulating label allowed on connector-based designs

3.3 M.2 Connector

Recommend to use the M.2 connector from LOTES, the type is APCI0026-P001A,the package of connector design please refer to the relevant specifications.

As shown in Figure 3-2:

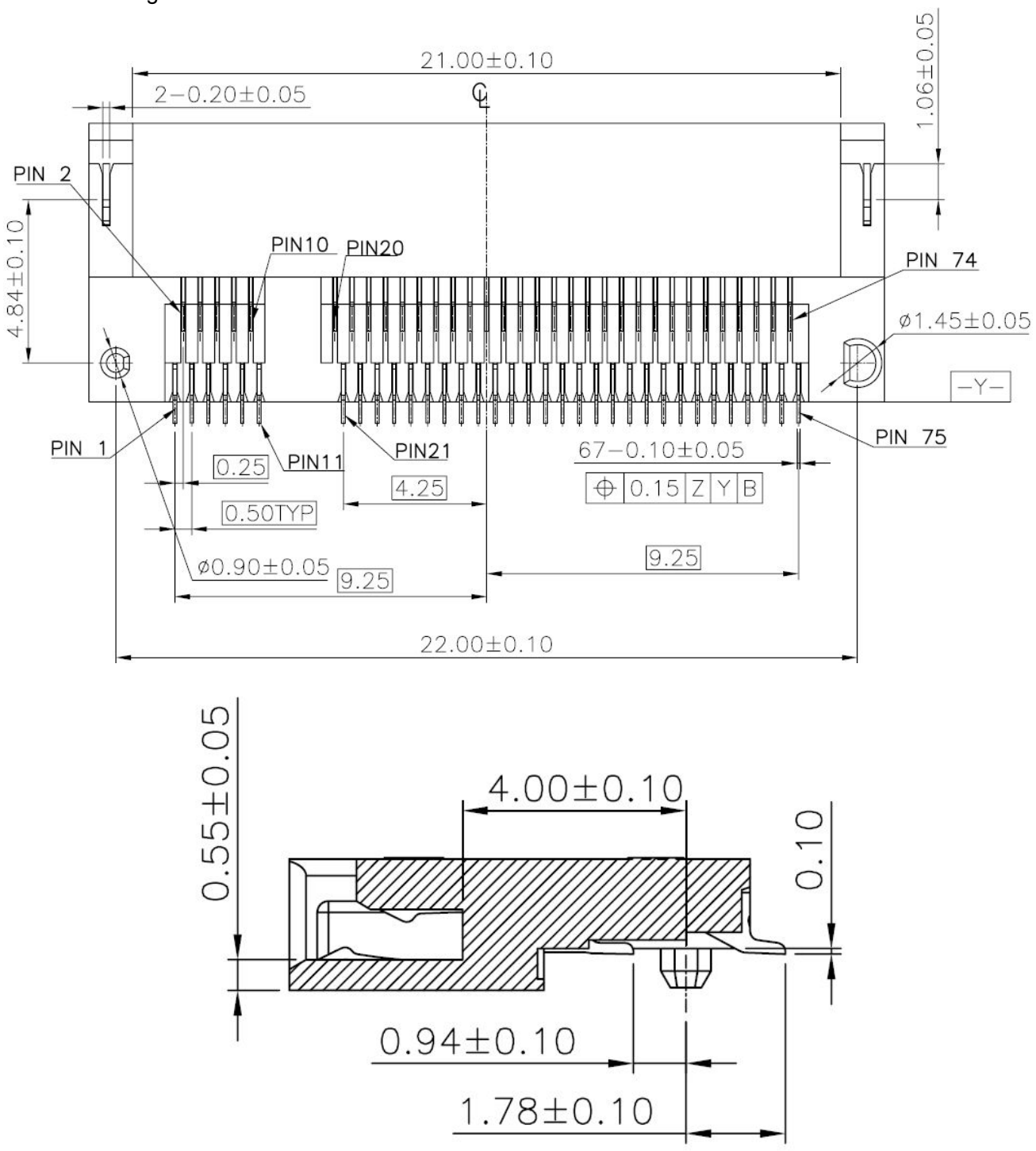

Figure 3-2 Size of APCI0026-P001A M.2 connector

4 Hardware Overview

4.1 Pins Definition

4.1.1 Pins Number

74	+3.3V	CONFIG_2	75
72	+3.3V	GND	73
70	+3.3V	GND	71
68	CLK32K	CONFIG_1	69
66	SIM_DETECT	RESET#	67
64	NC	ANTCTL3	65
62	NC	ANTCTL2	63
60	NC	ANTCTL1	61
58	NC	ANTCTL0	59
56	NC	GND	57
54	NC	NC	55
52	NC	NC	53
50	NC	GND	51
48	TX_BLANKING	NC	49
46	SYSCLK	NC	47
44	GNSS_IRQ	GND	45
42	GNSS_SDA	NC	43
40	GNSS_SCL	NC	41
38	NC	GND	39
36	UIM_PWR	SSIC-TXP/USB3.0-TX+(NC)	37
34	UIM_DATA	SSIC-TXN/USB3.0-TX-(NC)	35
32	UIM_CLK	GND	33
30	UIM_RESET	SSIC-RXP/USB3.0-RX+(NC)	31
28	I2S_WA	SSIC-RXN/USB3.0-RX-(NC)	29
26	W_DISABLE2#	GND	27
24	I2S_RX	DPR	25
22	I2S_TX	WOWWAN#	23
20	I2S_CLK	CONFIG_0	21
	Notch	Notch	
	Notch	Notch	
	Notch	Notch	
	Notch	Notch	
10	LED1#(3.3V)	GND	11
8	W_DISABLE1#(3.3V)	USB D-	9
6	FUL_CARD_POWER_OFF#(1.8V)	USB D+	7
4	+3.3V	GND	5
2	+3.3V	GND	3

Figure4- 2 Pins Definition (Top View)

4.1.2 Pins Description

The description of L831-EA pins as listed below:

Pin#	Name	I/O	Reset Value	Idle Value	Description
1	CONFIG_3	O	L	L	The internal connects with GND, the interface type of L831-EA module is WWAN-SSIC0.
2	+3.3V	PI			The main power input, the voltage range is: 3.135V ~ 4.4V
3	GND				GND
4	+3.3V	PI			The main power input, the voltage range is: 3.135V ~ 4.4V
5	GND				GND
6	FUL_CARD_POWER_OFF#	I	PU	PU	Off control signal，the internal 200K ohm will be pulled down, CMOS 1.8V
7	USB D+	I/O			USB 2.0 signal+
8	W_DISABLE1#	I	PU	PU	WWAN Disable, Low active, CMOS 3.3V
9	USB D-	I/O			USB 2.0 signal-
10	LED1#	O	OD	OD	System status LED，drain output, low level is available, CMOS 3.3V
11	GND				GND
12	Notch				Notch
13	Notch				Notch
14	Notch				Notch
15	Notch				Notch
16	Notch				Notch
17	Notch				Notch
18	Notch				Notch
19	Notch				Notch
20	I2S_CLK	O	T	T	I2S serial clock，CMOS 1.8V
21	CONFIG_0	O	NC	NC	NC，the interface type of L831-EA

					module is WWAN-SSIC0
22	I2S_RX	O	T	T	I2Sserial data output, CMOS 1.8V
23	WOWWAN#	O	PU	PU	The module wake up the Host device signal，low level is available，CMOS 1.8V.
24	I2S_TX	I	T	T	I2Sserial data input, CMOS 1.8V
25	DPR	I			Body SAR Detect，CMOS 1.8V
26	W_DISABLE2#	I	PU	PU	GPS Disable signal, low level is available, CMOS 1.8V (not support yet).
27	GND				GND
28	I2S_WA	O	T	T	I2S left/right channel clock signal, CMOS 1.8V
29	SSIC-RXN/USB3.0-RX-(NC)				NC
30	UIM_RESET	O	PP	PP	Reset signal of USIM card.
31	SSIC-RXP/USB3.0-RX+(NC)	I/O			NC
32	UIM_CLK	O	PP	PP	Clock signal of USIM card.
33	GND				GND
34	UIM_DATA	I/O	PU	PU	Data signal of USIM card. the internal 4.7K resistance will be pulled up.
35	SSIC-TXN/USB3.0-TX-(NC)				NC
36	UIM_PWR	O			Power output of SIM card, 1.8V/3.0V
37	SSIC-TXP/USB3.0-TX+(NC)				NC
38	NC				NC
39	GND				GND
40	GNSS_SCL	O	PU	PU	I2C serial data signal clock, the internal 4.7K resistance will be pulled up, CMOS 1.8V.
41	NC				NC
42	GNSS_SDA	I/O	PU	PU	I2C serial data signal data, the internal 4.7K resistance will be pulled up, CMOS 1.8V

43	NC				NC
44	GNSS_IRQ	I	PU	PU	The switch interrupt signal of Win8/Android system.
45	GND				GND
46	SYSCLK	O	L	L	26MHz clock output.
47	NC				NC
48	TX_BLANKING	O	L	L	GSM TDMA Timer output signal, the GPS control signal, CMOS 1.8V
49	NC				NC
50	NC				NC
51	GND				GND
52	NC				NC
53	NC				NC
54	NC				NC
55	NC				NC
56	NC				NC
57	GND				GND
58	NC				NC
59	ANTCTL0	O			Tunable antenna control signal GPO,CMOS 1.8V (not support yet)
60	NC				NC
61	ANTCTL1	O	L	L	Tunable antenna control signal, MIPI RFFE SDATA, CMOS 1.8V (not support yet)
62	NC				NC
63	ANTCTL2	O	L	L	Tunable antenna control signal, MIPI RFFE SCLK, CMOS 1.8V (not support yet)
64	NC				NC
65	ANTCTL3	O			Tunable antenna control signal, MIPI RFFE VIO, CMOS 1.8V (not support yet)
66	SIM_DETECT	I	PU	PU	SIM Detect，CMOS 1.8V,390K ohm

					will be pulled up.
67	RESET#	I	PU	PU	External reset signal input, CMOS 1.8V
68	CLK32K	O			32KHz clock output.
69	CONFIG_1	O	L	L	The internal connects with GND, the interface type of L831-EA module is WWAN-SSIC0.
70	+3.3V	PI			The main power input, the voltage range is : 3.135V ~ 4.4V
71	GND				GND
72	+3.3V	PI			The main power input, the voltage range is : 3.135V ~ 4.4V
73	GND				GND
74	+3.3V	PI			The main power input, the voltage range is : 3.135V ~ 4.4V
75	CONFIG_2	O	L	L	The internal connects with GND, the interface type of L831-EA module is WWAN-SSIC0.

Note :put the pins not used in circuit design NC directly.

PI：Power Input

H：High Voltage Level

L：Low Voltage Level

PD：Pull-Down

PU：Pull-Up

T：Tristate

OD：Open Drain

PP：Push-Pull

5 Hardware Interface

5.1 Power Interface

5.1.1 Power Supply

L831-EA module requires a 3.135V~ 4.4V DC power supply to provide the maximum GSM emission current with 2A.

Input power supply requirements as listed below:

Parameters	Minimum	Recommended	Maximum	Unit
+3.3V	3.135	3.3	4.4	V

Note:

1. The ripple of Power supply must be lower than 200mV.

2. The minimum value of power supply voltage drops shall more than 3.135V.

The filter capacitor design of the supply circuit is as follows:

Recommended capacitor	Application	Description
330uF	Supply capacitor	Reduce power wave in call. The value of capacitor is bigger better.
1uF,100nF	Digital signal noise	Filtering interference from clock and digital signal.
39pF,33pF	700/850/900 MHz band	Filtering the RF reference.
18pF,8.2pF,6.8pF	1700/1800/1900,2100,2500/2600MHz band	Filtering the RF reference.

5.1.2 VSD2_1V8

VSD2_1V8 is the digital part circle`s` power supply within the module, VSD2_1V8 can use for the index signal and the reference level. With the circle design only use for external low current application （<50mA）, and floating it if not use.

Parameters	Minimum	Recommended	Maximum	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

5.2 Power on/off and Reset Signal

L831-EA wireless module supports 2 control signals for the modules` power on/off and the reset operation.

The definition of the pins as listed below:

Pin#	Pin Name	Electrical Level	Description
6	FUL_CARD_POWER_OFF#	CMOS 1.8V	Power on/off signal
67	RESET#	CMOS 1.8V	External reset signal input.

5.2.1 Power on/off Signal

5.2.1.1 Power on

Clients can pull up the FUL_CARD_POWER_OFF# signal while the module is power on, then the module will turn on.

The Pulse Timing requirements as listed below:

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

The Figure5- 1 shows the power_on timing control:

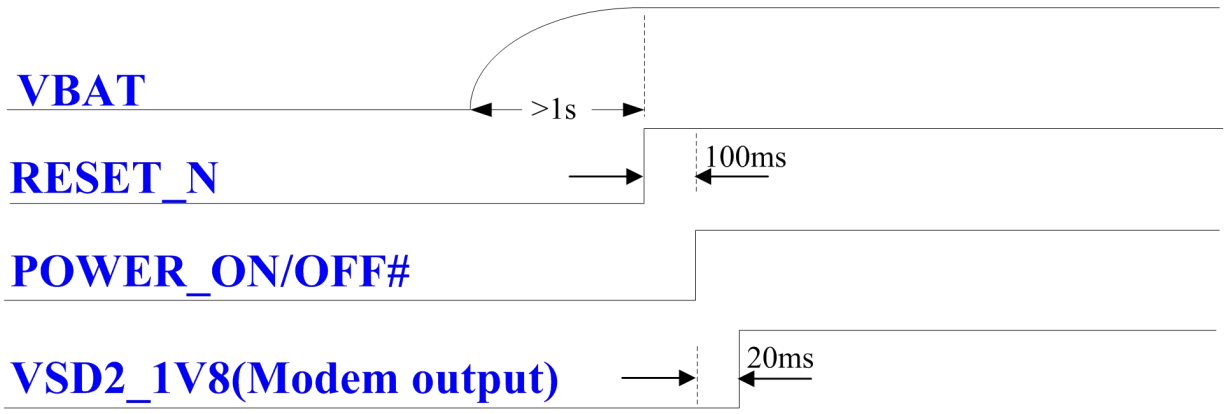

Figure5- 1 Power_on Timing Control

5.2.1.2 Power off

L831-EA module supports two powers off modes. Through the software modes to turn off the module in general condition. If the system halted or happen exceptions, use the following hardware modes to turn

off it, pull down the FUL_CARD_POWER_OFF# or floating. For details as listed below:

Off modes	Methods	Condition
Software	Send AT+CPWROFF commands.	Normal power_off
Hardware	Pull down the FUL_CARD_POWER_OFF# or floating.	Only used for system halted or happens exceptions and the software modes can not be used.

The description of hardware power_off as follows (Pull down the FUL_CARD_POWER_OFF# or floating):

While pulling down the FUL_CARD_POWER_OFF# signals 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 signal must be pulled down before pulling down the FUL_CARD_POWER_OFF# signal, and then the module will be turned off safely.

The Pulse Timing requirements as listed below:

Parameters	Condition	Minimum	Typical	Maximum	Unit
Pulse Width	Power off	5	100		ms

The Figure 5-2 shows the power off timing control:

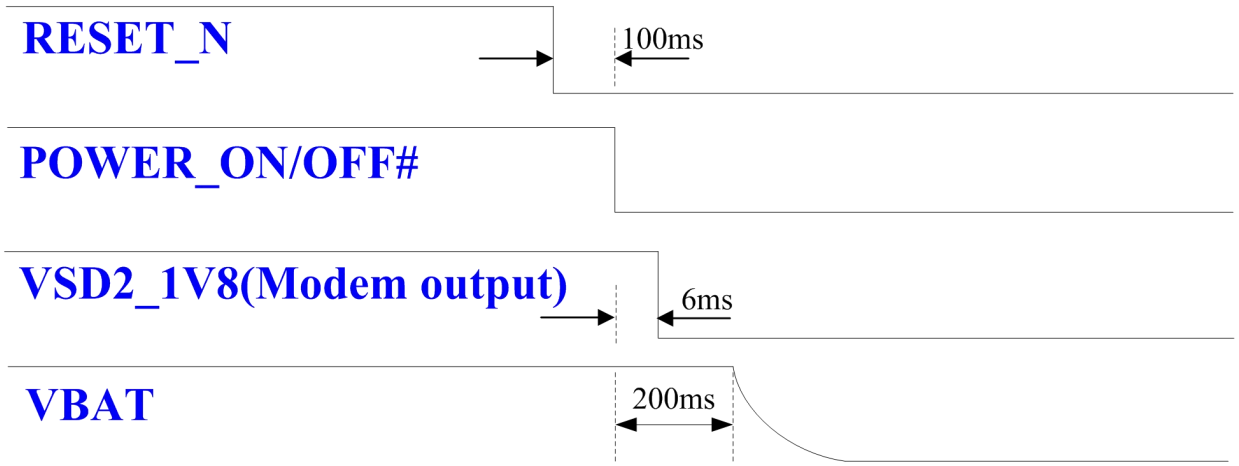

Figure5-2 Power off Timing Control

5.2.1.3 Recommended Circuit Design of Power on/off signals

The recommended design of FUL_CARD_POWER_OFF# signal as follows:

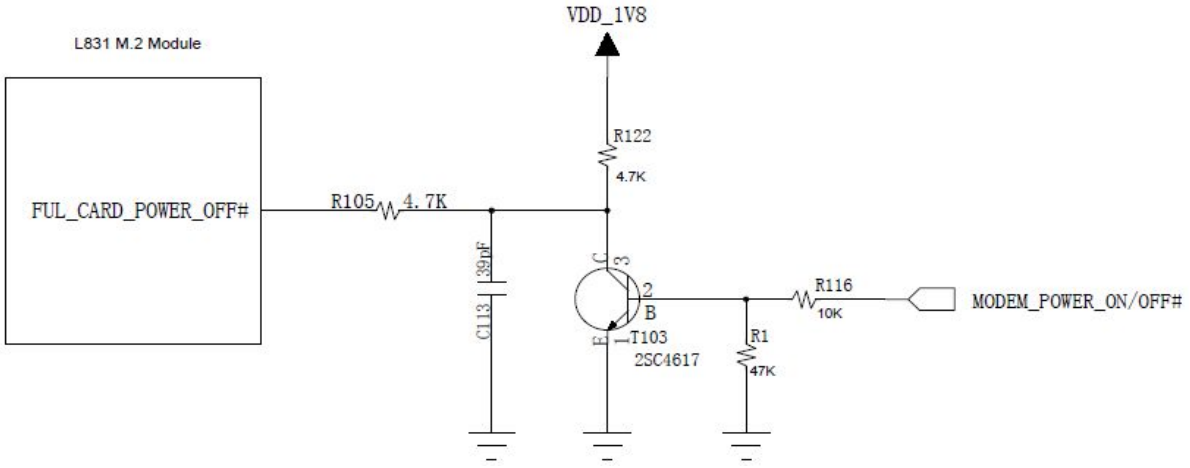

Figure 5-3 the recommended design of FUL_CARD_POWER_OFF# signal

5.2.2 RESET Signal

L831-EA wireless module supports external reset function. The module can back to initial state through Reset _N signal.

While the RESET# signal is active low and keep 100ms, the module will reset and restart. The internal PMU cannot power cut while the clients execute the RESET function.

Note: Reset signal is sensitive signal line , while PCB layout, please keep it away from RF interference, add the surrounding processing and recommend to decouple capacitor near the module. Don't layout the Reset signal in PCB edge or surface to avoid ESD causing system reset.

The requirements of Pulse Timing as listed below:

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

The recommended design as follows:

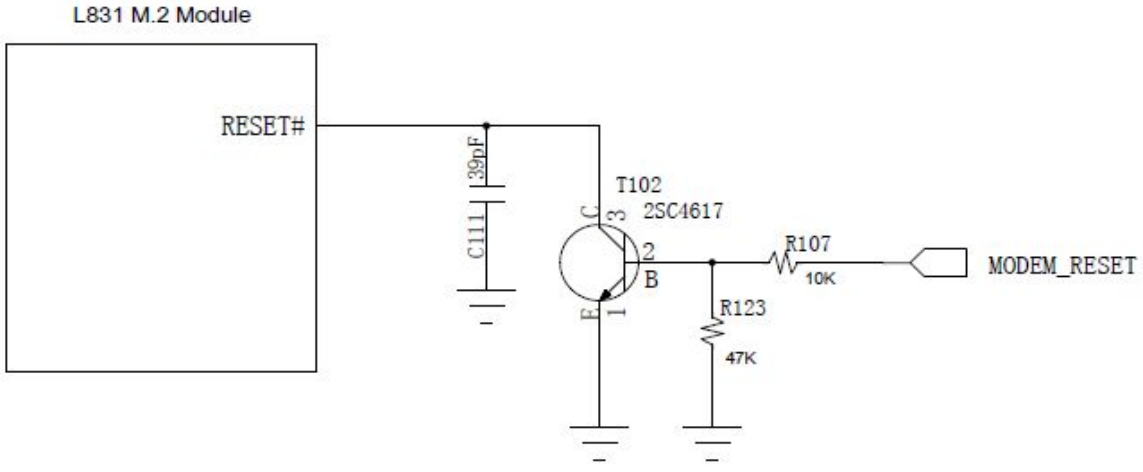

Figure5-4 Recommended design of RESET# circuit

5.3 Index Signal

5.3.1 Index Signal Pins

L831-EA module used for providing drain output signal and indicate RF condition:

Pin #	Name	Description
10	LED1#	Close or open the condition indication of RF network, CMOS 3.3V

The condition description of LED1# signal as listed below :

No.	Condition	LED1#
1	RF open	Low level
2	RF closed	High level

The recommended design as follows:

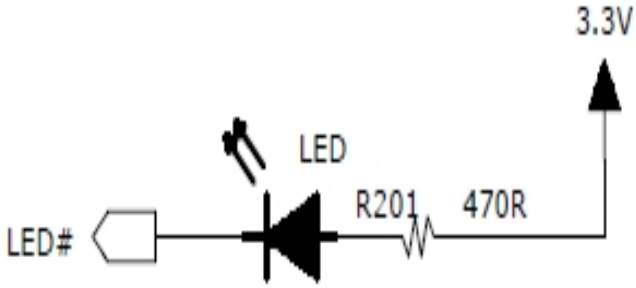

Figure5- 5 Recommended design of LED condition index

5.4 USB Interface

5.4.1 Definition of USB Interface

Pin No	Pin Name	I/O	Description
7	USB_DP	I/O	USB signal+
8	USB_DM	I/O	USB signal-

L831-EA wireless module supports USB 2.0. It should be installed USB driver before using on PC.

While L831-EA wireless module plugged into the PC, the USB interface with the drive can map 3 COM ports and 4 NCM ports at PC end of Windows system, and for details as listed below:

- Two COM ports for sending AT Commands.
- One COM port for tracing LOG information.
- Four NCM ports are VLAN ports, mainly used for initiating data services .

Note: The COM port can used as Modem COM port and initiate data services. But cause of the speed of

Modem COM port is so slow, and cannot up to 100Mbpss, the uplink requirements of LTE. 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.

5.4.2 Application for USB Interface

The recommended circuit design as follows:

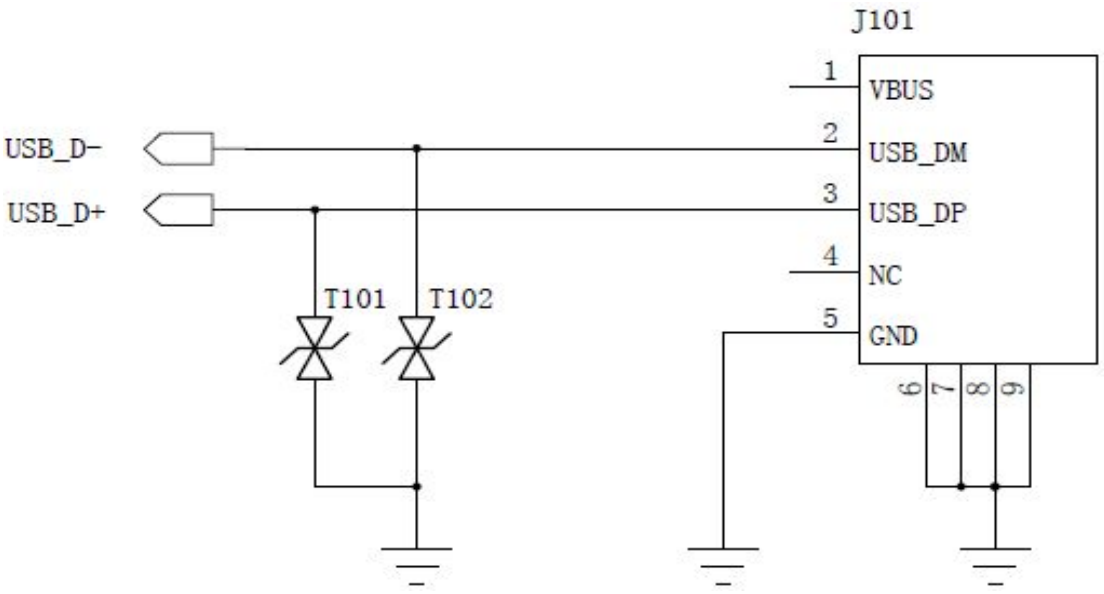

Figure5-6 Recommended circuit design of USB interface

T101 and T102 shall choose the TVS pipes witch less than 1pF.

VUSB supply power has connected within the module, so the VBUS pin of Host end can float.

USB_D+ and USB_D- is high speed differential signal line , the highest transmit speed is up to480Mbps.

Not the following requirements while PCB Layout:

- USB_DP+ and USB_D- signal lines request with the same length, parallel, and try to avoid right angle routing.
- Around the USB_DP +and USB_D- signal lines should be packaged with GND.
- Put the USB2.0 differential signal lines in the signal layer while are nearest to the ground.
- USB signal lines shall far away from strong interference signals, like power supply.
- Do the impedance matching, the impedance requests 90 ohm.

5.5 USIM Interface

L831-EA wireless module supports USIM and high speed SIM card, and does not supports 8-wire smart USIM yet.

5.5.1 USIM Pins

Pin#	Name	Type	Description
36	UIM_PWR	O	USIM power supply signal
30	UIM_RESET	O	USIM Reset signal
32	UIM_CLK	O	USIM clock signal
34	UIM_DATA	I/O	USIM data signal
66	SIM_DETECT	I	The detection signal for SIM insetting The default is 390K ohm resistance pulled up and input. High level: SIM is present. Low level: SIM is absent

5.5.2 Description of USIM

5.5.2.1 "Normally Closed" SIM Circuit Design

Referenced Circuit Design:

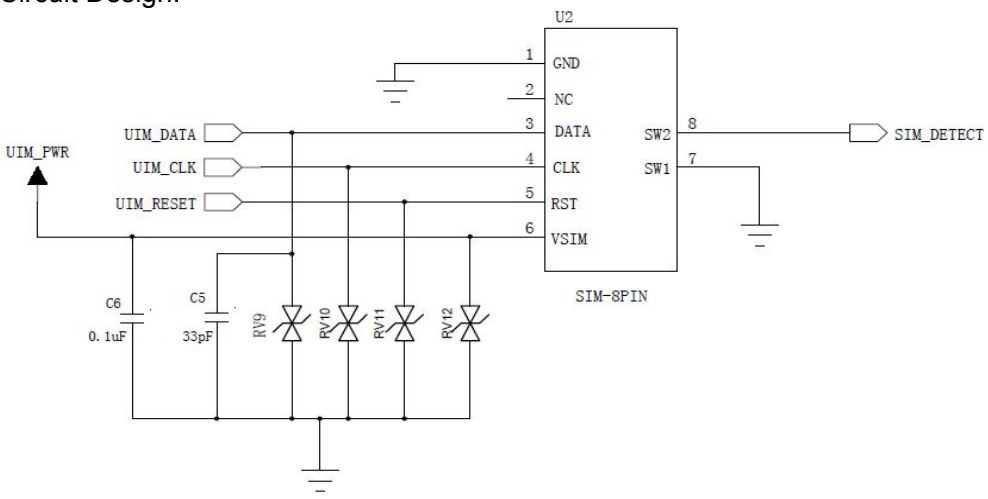

Figure5- 7 Reference Design of "Normally Closed" SIM Card Interface

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.

5.5.2.2 “Normally Open” SIM Circuit Design

Referenced Circuit Design:

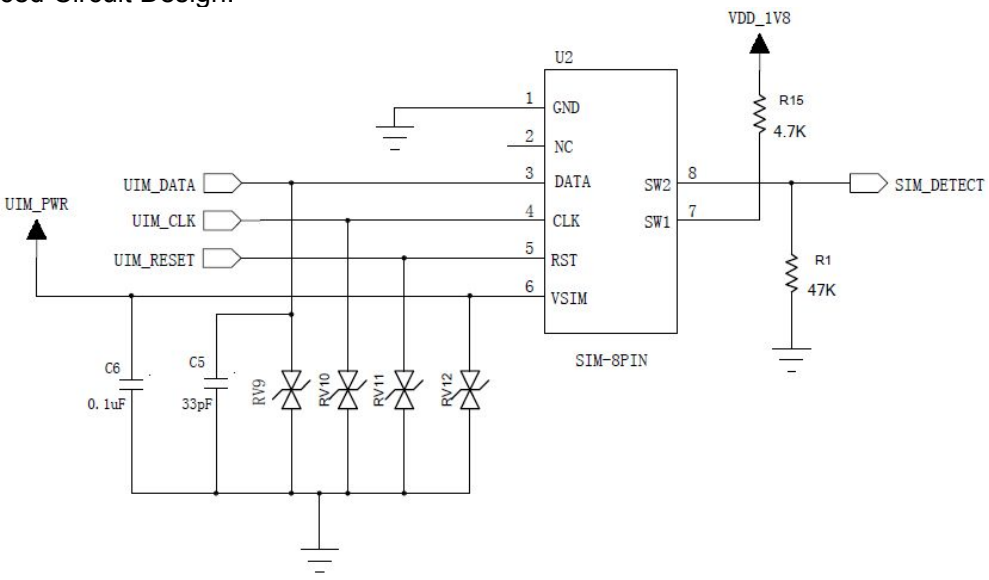

Figure5-8 “Reference Design of “Normally open” SIM Card Interface

Normally Open SIM Connector:

1）Pull out SIM card, pin 7 and pin 8 disconnect.

2）Inset SIM card, pin 7 and pin 8 short-circuit .

Note:

- For improving EMC performance, SIM card connector should be closed to the module.
- For improving the anti-jamming capability of SIM card, please choose the SIM card socket with masking function.
- Filtering capacitor on SIM card should be closed to SIM card pin.
- SIM card signal need add ESD protection (just like TVS pipe), ESD components should be closed to SIM card pin.
- SIM_CD signal connection supports hot plug, default high level is available (switch to low level is available through AT commands). If high level is detected, it means the SIM card is inserted.

5.5.3 USIM Design Points

The design of SIM interface is very important to its own normal working and the module.

There are several design guidelines that must be followed:

- The layout and routing of SIM card should be away from EMI interference source , such as RF antenna and digital switching signals.
- To ensure signal integrity, the routing length between module and SIM card should not exceed 100mm.
- To avoid mutual interference, the routing of UIM_CLK and UIM_DATA signal shall keep separate.

- The signal lines of SIM cards shall do some ESD protection , and it request to choose the ESD protected components with low capacitance, such as Zener diode. Recommend the clients to use the ESD components and the equivalent capacitance shall be less than 33pF. ESD components shall near to SIM card interfaces while layout.

5.5.4 USIM Hot Plug

L831-EA module supports the status detection function, and this function can realize hot plug of SIM card .

5.5.4.1 Hardware Connection

The hot plug function of SIM card needs the cooperation of SIM_DETECT signal.

SIM_DETECT is low level while no SIM card; SIM_DETECT is high level while installing SIM card.

Principle description:

1） For “normally closed” SIM card, as shown in Figure 5-7.SIM_DETECT signal connects Pin8 (SW2) of U2, pull down the Pin7 (SW1) to GND. SW2 and SW1 short-circuit while SIM card is not inserted, so SW2 is low level. SW1 and SW2 disconnect while SIM card installed, SIM_DETECT is pulled high.

2） For “normally open“SIM card, as shown in Figure 5-8. SIM_DETECT signal connects Pin8 (SW2) of U2 and pull down to ground through 47Kohm resistance. Pin 7 (SW1) shall be pulled up with4.7Kohms. SW2 and SW1 is disconnected while SIM card is not inserted, so SW2 is low level. SW1 and SW2 is short-circuiting while SIM card installed, SIM_DETECT is pulled high.

5.5.4.2 Software Configuration

“+MSMPD” is used for setting the state detection of SIM card.

AT+MSMPD=0, state detection function of SIM card is closed. The module does not detect the SIM_DETECT signal.

AT+MSMPD=1, state detection function of SIM card is open. Detect the SIM card if installing or not through the SIM_DETECT Pin .

SIM_DETECT is high level, SIM card is installed, and the module registers the network automatically.

SIM_DETECT is low level, SIM card is not inserted, and the module does not register the network.

Note: The parameters of “+MSMPD” is “1” by default. SIM_DETECT is the detection signal. While the module first power on or plug after that, SIM_DETECT will detect if the SIM card is existing or not. Just only if the SIM_DETECT is low level, the module will cannot read SIM card.

5.6 Digital Audio

L831-EA supports digital audio I2S interface.12S interface can support normal I2S modes and data transmission of PCM modes. The level of I2S interface signal is 1.8V.

The description of I2S signal as listed below:

Pin#	Name	Type	Description
20	I2S2_CLK	O	Bit clock
28	I2S2_WA0	O	Left- right clock (LRCK)
22	I2S2_TX	O	Serial data output
24	I2S2_RX	I	Serial data input

5.6.1 Description of I2S Interface

L831-EA	Signal Direction	Audio CODEC I2S Port
I2S_CLK	→	I2S_CLK
I2S_WA	→	I2S_LRCK
I2S_RX	←	I2S_SDOUT
I2S_TX	→	I2S_SDIN

Note:

- I2S interfaces can be configured to master or slave modes .
- It supports various audio sample rates (48KHz, 44.1KHz, 32KHz, 24KHz, 22.5KHz, 16KHz, 12KHz, 11.025KHz, 8KHz).

5.6.2 Description of PCM Interface

L831-EA	Signal Direction	Audio CODEC PCM Port
I2S_CLK0(PCM_CLK， PCM clock signal)	→	PCM_CLK (PCM clock signal)
I2S_WA0(PCM_SYNC，PCM frame synchronization signal)	→	PCM_SYNC (PCM frame synchronization signal)
I2S_RX(PCM_DIN，PCM data input)	←	PCM_DOUT (PCM data output)
I2S_TX(PCM_DOUT，PCM data output)	→	PCM_DIN (PCM data input)

Description:

- PCM interfaces can be configured to master or slave modes.
- Supports short frame synchronization under16 bit, 32bit, 48bit and 64bit modes.
- Supports sending data in burst modes and continuous modes.
- Supports clock length of frame synchronization signal and rising edge/ falling edge trigger

configuration of data transmission.

- Supports various audio sample rates (48KHz,44.1KHz,32KHz, 24KHz,22.5KHz,16KHz,12KHz,8KHz, 11.025KHz).

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.

5.7 Android/Win8Dual System Switch Control Interface

L831-EA module supports Win8/Android dual system switch, check and achieve the dual system switch through interrupt signal ”GNSS_IRQ”.

Pin#	Name	I/O	Description
44	GNSS_IRQ	I	Win8/Android dual system switch detection signal, CMOS 1.8V

The function definition of GNSS_IRQ signal as listed below:

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

5.8 W_DISABLE# Interface

5.8.1 Description of WWAN_DISABLE# Interface

L831-EA module provides through hardware to open/close the WWAN RF function signal, this function can also controlled by AT commands.

Pin#	Name	I/O	Description
8	W_DISABLE1#	I	WWAN open/close signal ,CMOS 3.3V

The definition of W_DISABLE# signal as listed below:

No.	W_DISABLE#	Function
1	Low	WWAN closed
2	High	WWAN opened
3	Floating	The function of WWAN defined by AT commands , and keep open by default .

5.8.2 Description of GPS_DISABLE# Interface

L831-EA module provides through hardware to open/close GPS function signal, this function can also control by AT commands.

Pin#	Name	I/O	Description	
26	W_DISABLE2#	I	GPS open/close signal , and the signal with 1.8V	

The definition of GPS_DISABLE# signal as listed below:

No.	GPS_DISABLE#	Description
1	Low	GPS closed
2	High	GPS open
3	Floating	The function of GPS defined by AT commands, keeps open by default.

Note: this function don`t support yet.

5.9 TX_BLANKING Interface

Output low level by default, the TX_BLANKING output the pulse signal that synchronized with GSM burst timing while the module works in GSM band. Cause GSM transmitting may interfere the receiving of GPS signal, close GPS or stop the data receiving of GPS while AP detected TX_BLANKING pulse signal.

Pin#	Name	I/O	Description
48	TX_BLANKING	O	External GPS control signal

5.10 The WAKEUP_HOST Interface

The module supports the WAKEUP_HOST function, the pin is high level by default, but it outputs low level while awaking Host.

Pin#	Name	I/O	Description
23	WOWWAN#	O	The module wakes up Host signal with 1.8V，and low level is available.

5.11 BODY_SAR Interface

L831-EA module supports BODY_SAR (DPR pin) function.

BODY_SAR is input signal (the signal is output directly by the AP end), with high level by default, 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#	Name	I/O	Description
25	DPR	I	BODY_SAR detection

5.12 Description of I2C Interface

L831-EA module supports one 12C interface, default configuration is I2C master. The I2C can used for driving external 12C slave device, such as Audio codes and so on.

Pin#	Name	I/O	Description
42	GNSS_SDA	I/O	I2C control signal input/output ,1.8V signal
40	GNSS_SCL	O	I2C control clock signal, 1.8V signal

The signal connection between L831-EA module and external 12C slave device (such as Audio Codec） as listed below:

L831-EA	Direction	Audio Codec I2C Port
GNSS_SDA	← →	I2C_SDA
GNSS_SCL	→	I2C_SCL

5.13 Clock Interface

L831-EA module supports one 26MHz clock output and one 32KHz clock output.

Pin#	Name	I/O	Description
68	CLK32K	O	32K clock output ,
46	SYSCLK	O	26Mclock output , (recommend used for external GPS, and can also used as audio codec`s MCLK)

5.14 Config Interface

L831-EA module provides four config pins and with the configuration of WWAN-USB3.0-0.

PIN#	Name	I/O	Description	Value

1	CONFIG_3	O	Connect to GND within the module	0
21	CONFIG_0	O	NC	-
69	CONFIG_1	O	Connect to GND within the module	0
75	CONFIG_2	O	Connect to GND within the module	0

The configuration of M.2 Socket 2 Module as listed below :

Config_0 (pin21)	Config_1 (pin69)	Config_2 (pin75)	Config_3 (pin1)	Module Type and Main Host Interface	Port Configuration
GND	GND	GND	GND	SSD-SATA	N/A
GND	GND	N/C	GND	WWAN-PCIe	N/A
GND	GND	GND	N/C	WWAN-USB3.0	0

5.15 RF Interface

5.15.1Description of RF Connector

L831-EA module provides two RF connector for the connection of external antenna , the MAIN means the main antenna of RF, and DIV means the diversity antenna .

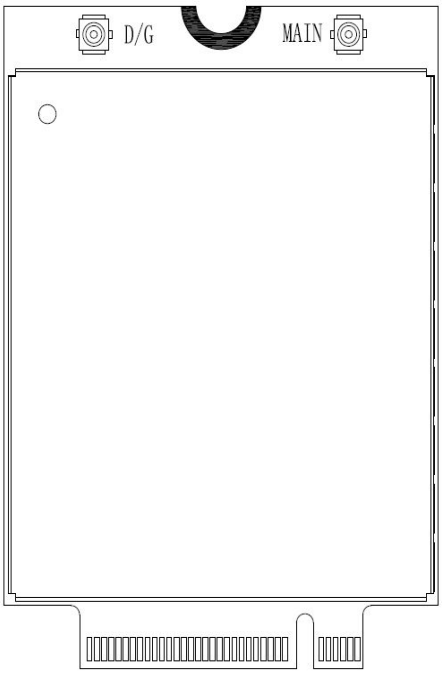

Figure 5-9 RF connectors Diagram

5.15.2Description of RF Connecting Seat

L831-EA module adopts the RF connecting seat with Murata MM4829-2702, the size is 2*2*0.6mm, and the structure diagram as follows:

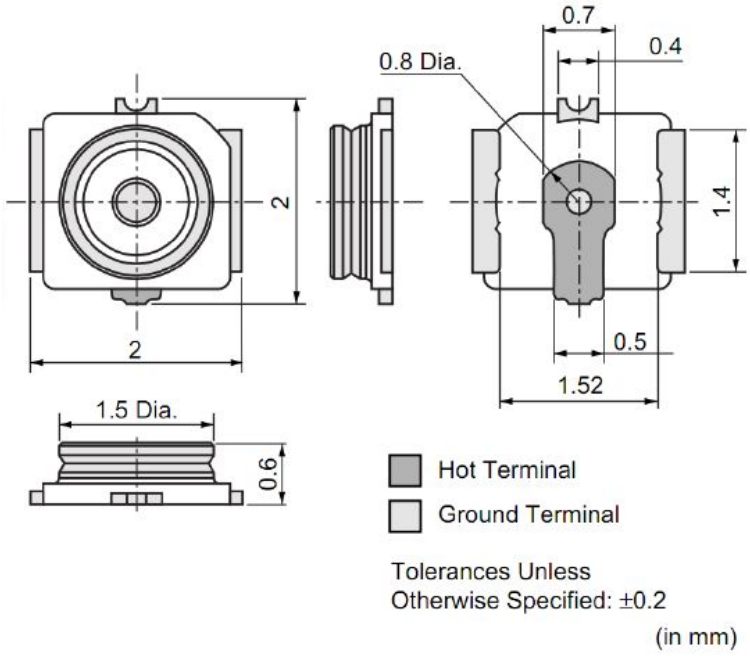

Figure 5-10 Structure diagram of RF connecting seat

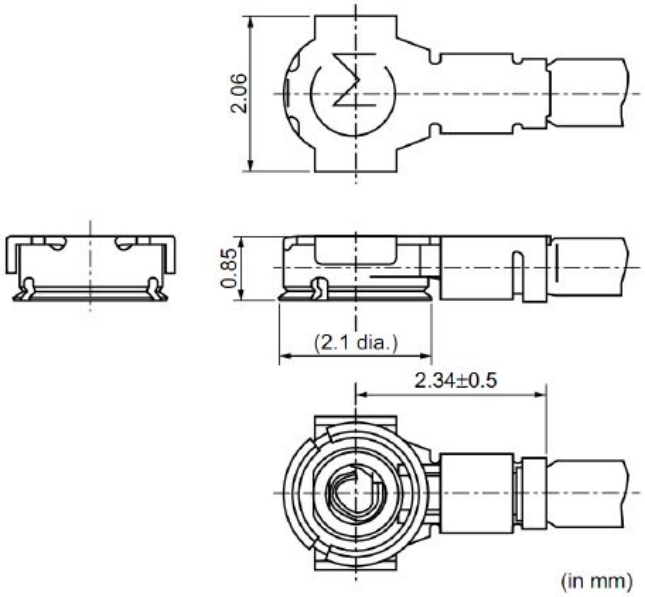

Figure 5-11 0.81mm coaxial line

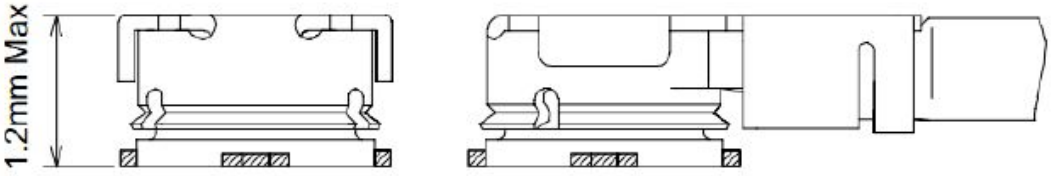

Figure 5-12 RF connector insert into RF connecting seat

5.15.3Main Performance of RF Connector

Rated conditions	Environment condition

Frequency range	DC to 6GHz	Temperature range :
Characteristic impedance	50Ω	–40°C to +85°C

5.16 Other Interfaces

The following interfaces are not supported now: GPIO and Tunable ANT.

6 Electrical and Environmental

6.1 Electrical

This table shows the electrical features range of L831-EA module.

Parameter	Minimum Value	Maximum Value	Unit
Power supply	0	4.4	V
Digital Signal	0	1.9	V

6.2 Environmental

This table shows the environmental features of L831-EA module

Parameter	Minimum Value	Maximum Value	Unit
Operational Temperature	-30	+55	°C
Storage Temperature	-40	+85	°C

7 RF Interface

7.1 Operating Band

7.1.1 Antenna Band

Operating Band	Description	Mode	Tx (MHz)	Rx (MHz)
Band 1	IMT 2100MHz	LTE FDD/WCDMA	1920 - 1980	2110 - 2170
Band 2	PCS 1900MHz	LTE FDD/WCDMA/GSM	1850 - 1910	1930 - 1990
Band 3	DCS 1800MHz	LTE FDD/GSM	1710 - 1785	1805 - 1880
Band 4	AWS 1700MHz	LTE FDD	1710 - 1755	2110 - 2155
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 13	US 700MHz blocks C	LTE FDD	777 - 787	746 - 756
Band 17	US 700MHz blocks B/C	LTE FDD	704 - 716	734 - 746
Band 18	Japan 850MHz	LTE FDD	815 – 830	860 – 875
Band 19	Japan Extend 850MHz	LTE FDD	830 – 845	875 – 890
Band 20	EUDD 800MHz	LTE FDD	832 - 862	791 - 821

7.2 RF PCB Design

7.2.1 Routing Principle

L831-EA module 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 L831-EA module belong to LTE module, the Antenna need double antennas can meet the performance requirements.

7.2.2 Impedance Design

The impedance of RF signal lines should be controlled within 50ohm.

7.3 Antenna Design

7.3.1 Antenna Design Requirements

(1) Antenna Efficiency

Antenna efficiency is the ratio of antenna input power to radiation power. Cause the return loss, material loss, and coupling loss, the radiation power is always lower than the input power.

Recommended value> 40% (–4dB)

(2) S11 or VSWR

S11 can indicates the 50ohm`s matched-degree of antenna .To some degree, it affects the antenna efficiency. It can measure the indicator through VSWR test, recommended value: S11 < –10 dB.

(3) Polarization

The antenna`s polarization means the rotate direction of electric field in the direction of the maximum radiation.

Recommend to use linear polarization: it would be better if the polarization direction of diversity antenna is different from main antenna.

(4) Radiation Pattern

Radiation pattern is the antenna`s electromagnetic-field strength in all directions of far field .Half-wave dipole antenna is the most suitable terminal antenna.

If it is built-in antenna, PIFA antenna is recommended:

Antenna area (H x W x L): 6mm x 10mm x 100mm. PIFA or IFA antenna is recommended.

Radiation Pattern: Omni-directional.

(5) Gain and Direction

The direction of the antenna is the electromagnetic field strength of the electromagnetic wave in all directions. The gain is a collection of antenna efficiency and the direction of antenna.

Recommended antenna gain≤ 3dBi

(6) Interference

Besides the antenna`s performance, the other interference on the PCB board can also affect the module`s performance. To ensure the module`s high performance, we must have a good control to the interference.

Suggestions: such as the routing of Speak, LCD, CPU and FPC, the audio circuits and the power part shall try to keep away from the antenna. At the same time, note the corresponding isolation and shielding,

or do some filtering on the routing.

（**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 1,2,3,5,7,8,13,17,18,19,20 >19dBm

TIS (Total Isotropic Sensitivity)：

- GSM850,GSM 900,DCS1800,PCS1900 <-102dBm
- WCDMA Band1,2,4,5,8<-102dBm
- LTE FDD Band1,2,3,5,7,8,13,17,18,19,20 <-95dBm (10MHz band width)