Perfect Wireless Experience
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L830-EA M.2 Module Hardware User Manual

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Attention

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Versions

Version	Date	Remarks
V1.0.0	2015-06-05	Initial Version
V1.0.1	2015-06-16	Update the supported Cat of HSPA ; Update the description of digital voice ; Update the description of USB and Win8/Android switch ; Update the consumption
V1.0.2	2015-07-07	Update part of error description
V1.0.3	2015-09-19	Delete the Band25, Update the parameters of GPS, and update the logo

Applicability Table

No.	Type	Note
1	L830-EA	NA

The difference of L830-EA M.2 wireless module as listed below:

Model No.	LTE FDD	WCDMA	GSM/GPRS/EDGE
L830-EA	Band 1,2,3,4,5,7,8,9,13,17,18,19,20,26,29	Band 1,2,4,5,6,8	850/900/1800/1900MHz

Content

1 Foreword

1.1 Introduction

The document describes the electrical characteristics, RF performance, dimensions and application environment, etc. of L830-EA M.2 wireless modules. With the assistance of the document and other instructions, developers can quickly understand the performance of L830-EA M.2 wireless 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 36.101 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 Product Overview

2.1 Description

L830-EA M.2 modules are highly integrated 4G wireless modules, supports 3 modes 16 bands that including the main 4G/3G/2G modes (LTE FDD/ WCDMA/ /GSM) and with wide bands, but not TDD mode in China. These bands support the main operators of Europe and North America and the cellular network of parts of the Asia .

2.2 Specifications

Specification		
Operating Frequency Range	L830-EA	
	LTE FDD: Band 1,2,3,4,5,7,8,9,13,17,18,19,20,26,29	
	WCDMA HSPA+: Band 1,2,4,5,6,8	
	GSM/GPRS/EDGE: 850/900/1800/1900MHz	
LTE inter-band CA	1 +5,8,18,19,26	
	2 +4,5,13,17,29	
	3 +5,8,19,20,26	
	4 +5,13,17,29	
	7 +3,20	
LTE intra-band CA	4	
GNSS	Supported	
Weight	5.7 grams	
Data Rate	LTE FDD	Cat6 (300Mbps DL,50Mbps UL)
	UMTS/HSDPA/HSUPA 3GPP Rel.10	DC-HSDPA 42Mbps(Cat 24)
		HSUPA 5.76Mbps(Cat6)
	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 ： 42x 30 x 2.3 mm	

Characteristics	Interface ： M.2
Environment	Operating Temperature：-30℃ ~ +65℃
	Storage Temperature：-40℃ ~ +85℃
Performance	
Operating Voltage	Voltage：3.135V ~ 4.4V Normal：3.3V
Current Consumption (Typical Value)	5mA (Sleep Mode)
	LTE FDD DATA：750mA
	WCDMA：580mA
	2G Talk：300mA (GSM PCL5)
Interface	
RF Interface	Antenna ： Mainx1，Diversityx1
Function Interface	1 x USB 2.0，Multiple Profiles over USB，USB SSIC
	SIM Support ，I2C Support，I2S/PCM Support
	GPIO，Clock
Data Features	
Protocol Stack	External 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	not supported yet
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 65˚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

Note:

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: ZMOL830". 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.

2.3 Appearance

The product appearance of L830-EA M.2 wireless module is shown as below:

Top View：

Figure 2- 1 Top View

Bottom view:

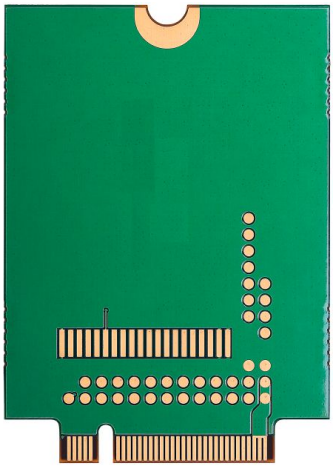

Figure 2- 2 Bottom View

3 Structure

3.1 Dimension Diagram of Structure

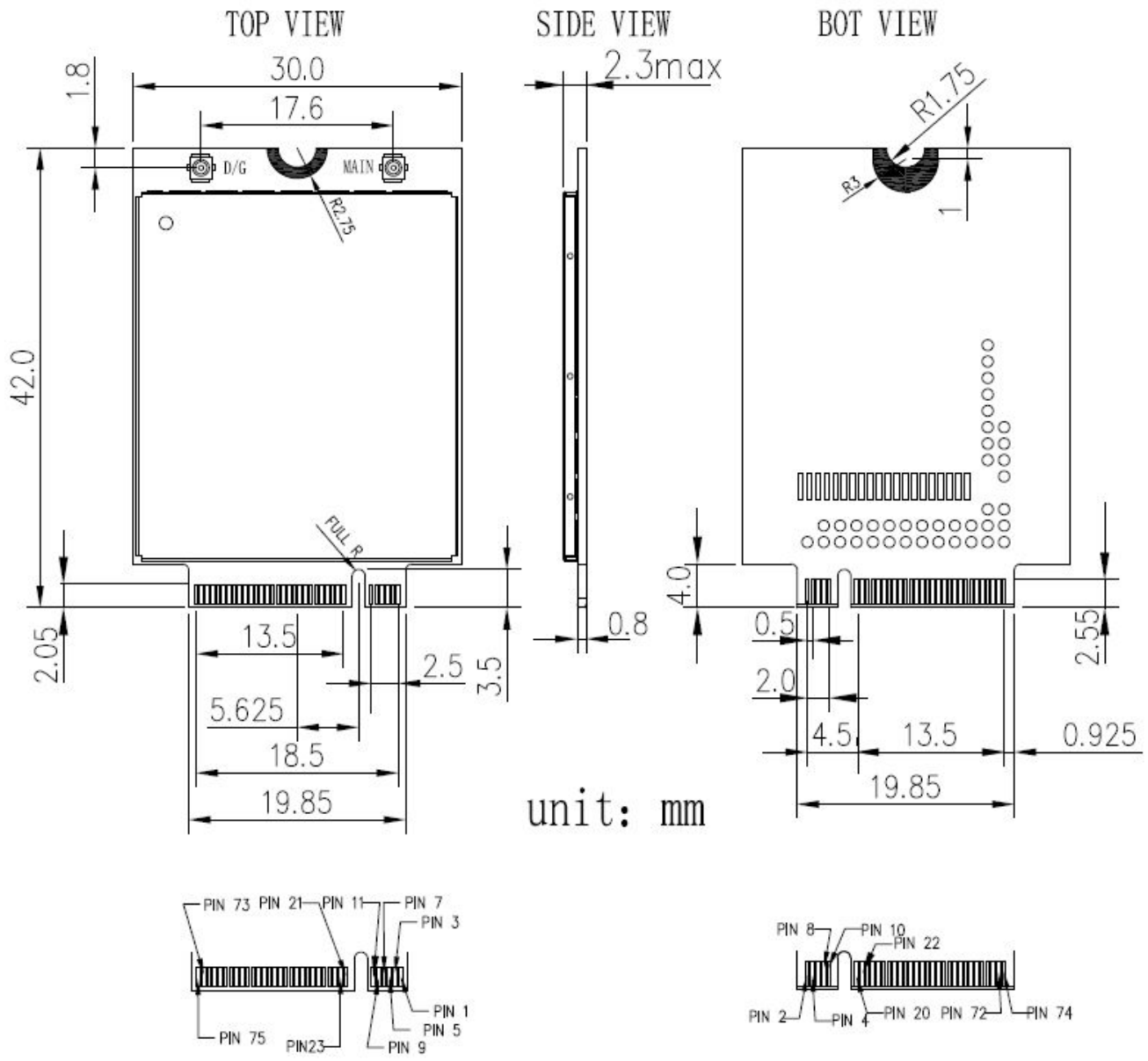

Figure 3- 1 Dimension Diagram of Structure

3.2 Application Interface Description

L830-EA M.2 module uses 75-pin gold fingers as the external interface, the size of the module please refer to the section 3.1.As shown in Figure 4-2, L830-EA M.2 module uses the 75-pin fingers interface (67 pins are the signal interface and 8 pins are notch) .About the naming rules of M.2, L830-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:

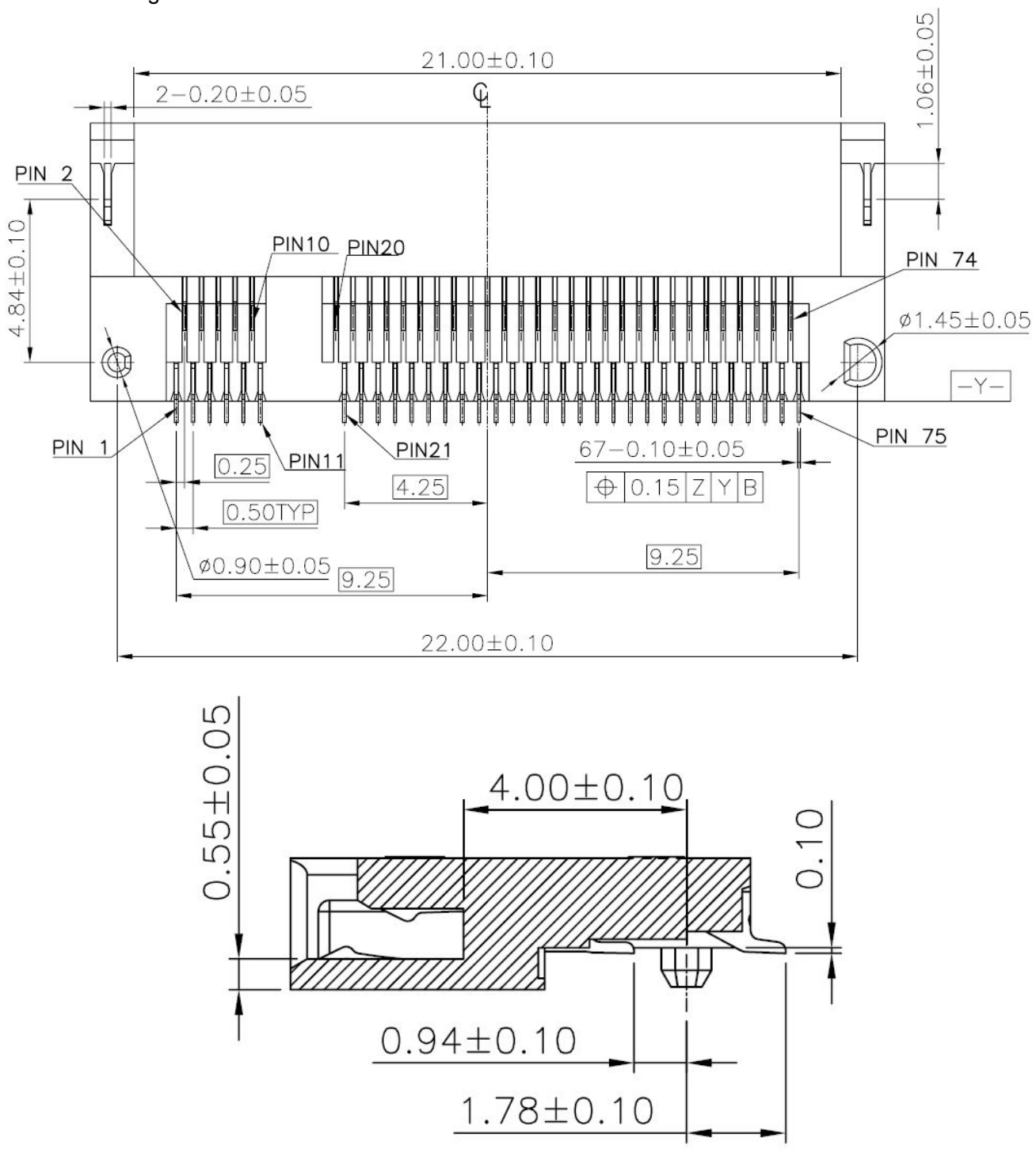

Figure 3- 2 APCI0026-P001A M.2 connector dimension

4 Hardware Introduction

4.1 Pin Definitions

4.1.1 Pin Map

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-RXP	37
34	UIM_DATA	SSIC-RXN	35
32	UIM_CLK	GND	33
30	UIM_RESET	SSIC-TXP	31
28	I2S_WA	SSIC-TXN	29
26	W_DISABLE2#	GND	27
24	I2S_TX	DPR	25
22	I2S_RX	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

Figure 4-2 Pin Diagram (TOP View)

4.1.2 Description of Pins

Pins of L830-EA M.2 modules are described in the table below:

Pin#	PIN Name	I/O	Reset Value	Idle Value	Description
1	CONFIG_3	O	L	L	The internal connected with GND, L830-EA M.2 module shall configure as the WWAN-SSIC0 interface type.
2	+3.3V	PI			Main power supply, voltage range: 3.135V ~ 4.4V
3	GND				GND
4	+3.3V	PI			Main power supply, voltage range: 3.135V ~ 4.4V
5	GND				GND
6	FUL_CARD_POWER_OFF#	I	PU	PU	Power off control signal, internal 200K pull-down resistor, CMOS 1.8V
7	USB D+	I/O			USB2.0 signal +
8	W_DISABLE1#	I	PD	PU	WWAN Disable, Low active, CMOS 3.3V
9	USB D-	I/O			USB2.0 signal -
10	LED1#	O	OD	OD	System status LED, drain output , active low , 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	PD	T	I2S serial clock，CMOS 1.8V ,

					(Not supported yet)
21	CONFIG_0	O	NC	NC	Not connected. L830-EA M.2 module shall configure as the WWAN-SSIC0 interface type.
22	I2S_RX	I	PD	T	I2S serial data input, CMOS 1.8V , (Not supported yet)
23	WOWWAN#	O	PD	PU	The module wake-up Host device signal, active low, CMOS 1.8V
24	I2S_TX	O	PD	T	I2S serial data output，CMOS 1.8V , (Not supported yet)
25	DPR	I	PD	PU	Body SAR Detect，CMOS 1.8V
26	W_DISABLE2#	I	PD	PU	GPS Disable signal, active low, CMOS 1.8V（not supported yet）
27	GND				GND
28	I2S_WA	O	PD	T	I2S left and right channel clock (LRCK) , CMOS 1.8V , (Not supported yet)
29	SSIC-TXN	O			USB SSIC Transmit data minus
30	UIM_RESET	O	PP	PP	USIM card reset signal
31	SSIC-TXP	O			USB SSIC Transmit data plus
32	UIM_CLK	O	PP	PP	USIM card clock signal
33	GND				GND
34	UIM_DATA	I/O	PU	PU	USIM card data signal， internal 4.7K pull-up resistor
35	SSIC-RXN	I			USB SSIC Receive data minus
36	UIM_PWR	O			SIM card power supply output， 1.8V/3.0V
37	SSIC-RXP	I			USB SSIC Receive data plus
38	NC				NC
39	GND				GND
40	GNSS_SCL	O	PU	PU	I2C serial data clock signal， internal 4.7K pull-up resistor， CMOS 1.8V

41	NC				NC
42	GNSS_SDA	I/O	PU	PU	I2C serial data clock signal， internal 4.7K pull-up resistor， CMOS 1.8V
43	NC				NC
44	GNSS_IRQ	I	PU	PU	Win8/Android dual system switch interrupt input signal, CMOS 1.8V
45	GND				GND
46	SYSCLK	O	PD	L	26MHz clock signal output
47	NC				NC
48	TX_BLANKING	O	L	L	GSM TDMA Timer output signal， External 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	L	L	Tunable antenna control signal,bit0, CMOS 1.8V. (Not supported yet)
60	NC				NC
61	ANTCTL1	O	L	L	Tunable antenna control signal, MIPI RFFE SDATA, CMOS 1.8V . (Not supported yet)
62	NC				NC
63	ANTCTL2	O	L	L	Tunable antenna control signal, MIPI RFFE SCLK, CMOS 1.8V. (Not supported yet)

64	NC				NC
65	ANTCTL3	O			Tunable antenna control signal, MIPI RFFE VIO, CMOS 1.8V . (Not supported yet)
66	SIM_DETECT	I	PU	PU	SIM Detect，CMOS 1.8V,390K ohm pull-up resistor
67	RESET#	I	PU	PU	External reset signal input, pull up(100K ohms),CMOS 1.8V
68	CLK32K	O	PD		32KHz clock output
69	CONFIG_1	O	L	L	The inside connect with GND，L830-EA M.2 module configure as the WWAN-SSIC0 interface type.
70	+3.3V	PI			Main power supply input, voltage range: 3.135V ~ 4.4V
71	GND				GND
72	+3.3V	PI			Main power supply input, voltage range: 3.135V ~ 4.4V
73	GND				GND
74	+3.3V	PI			Main power supply input , voltage range: 3.135V ~ 4.4V
75	CONFIG_2	O	L	L	The inside connect with GND，L830-EA M.2 module configure as the WWAN-SSIC0 interface type.

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

Note : the unused pins can NC directly while designing.

5 Hardware Interface

5.1 Power Interface

5.1.1 Power Supply

L830-EA M.2 modules require 3.135V ~ 4.4V 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
+3.3V	3.135	3.3	4.4	V

Points for attention in design:

1. Supply voltage fluctuation shall be lower than 200mV.

2. Minimum supply voltage drop shall be higher than 3.135V.

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	800/1700/1800/1900, 2100/2600MHz	Filter RF interference

5.1.2 VIO_1V8

As the power supply for the digital circuit inside the module, VIO_1V8 can be used as the module`s reference level of the status index signal and digital signal. Only used for internal circuit.

Parameter	Minimum Value	Recommended Value	Maximum Value	Unit

VIO_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

L830-EA M.2 wireless 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
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 Signal

After the M.2 module is connected to the power supply, the user can through pull up the signal of

“ FUL_CARD_POWER_OFF# ” 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:

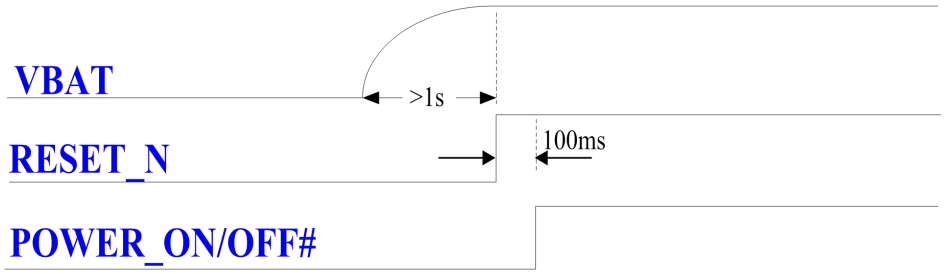

Figure 5-1 Power on Timing Control Diagram

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 and only control the " RESET_N" and "POWER_ON/OFF# " .

5.2.1.2 Power off signal

L830-EA M.2 module supports two power_off modes. Through the software modes to turn off the module in general condition. Only the system halted or happened exceptions, use the following hardware modes to turn off it, pull down the FUL_CARD_POWER_OFF# signal or floating①. For details as listed below:

Off modes	Methods	Condition
Software off	Send AT+CPWROFF commands.	Normal power_off
Hardware off	Pull down the FUL_CARD_POWER_OFF# signal or floating①	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 FUL_CARD_POWER_OFF signal or floating) :

While pulling down the FUL_CARD_POWER_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 FUL_CARD_POWER_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 control is shown in the diagram below:

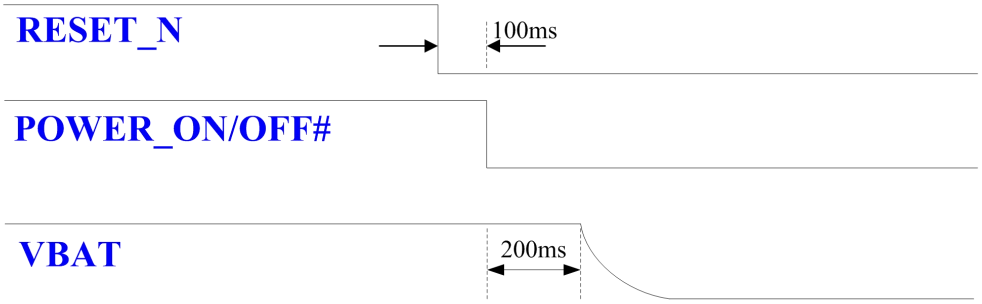

Figure 5-2 Power off Timing Control Diagram

5.2.1.3 The Recommended Design of Power on/off

The recommended design of FUL_CARD_POWER_OFF# signal is as follows:

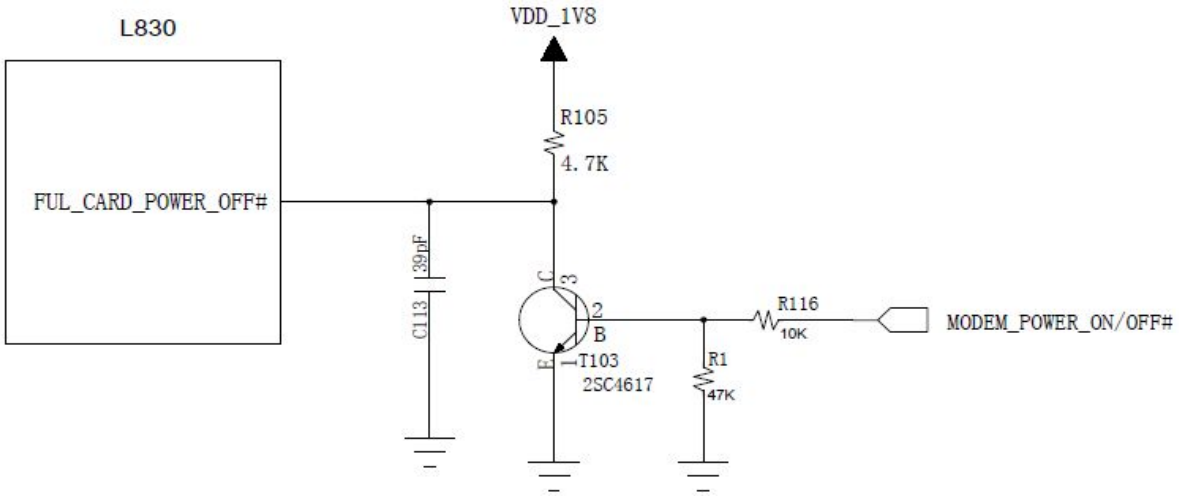

Figure 5-3 Recommended Design of FUL_CARD_POWER_OFF# Signal

5.2.2 RESET Signal

L830-EA M.2 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 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:

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

Recommended design:

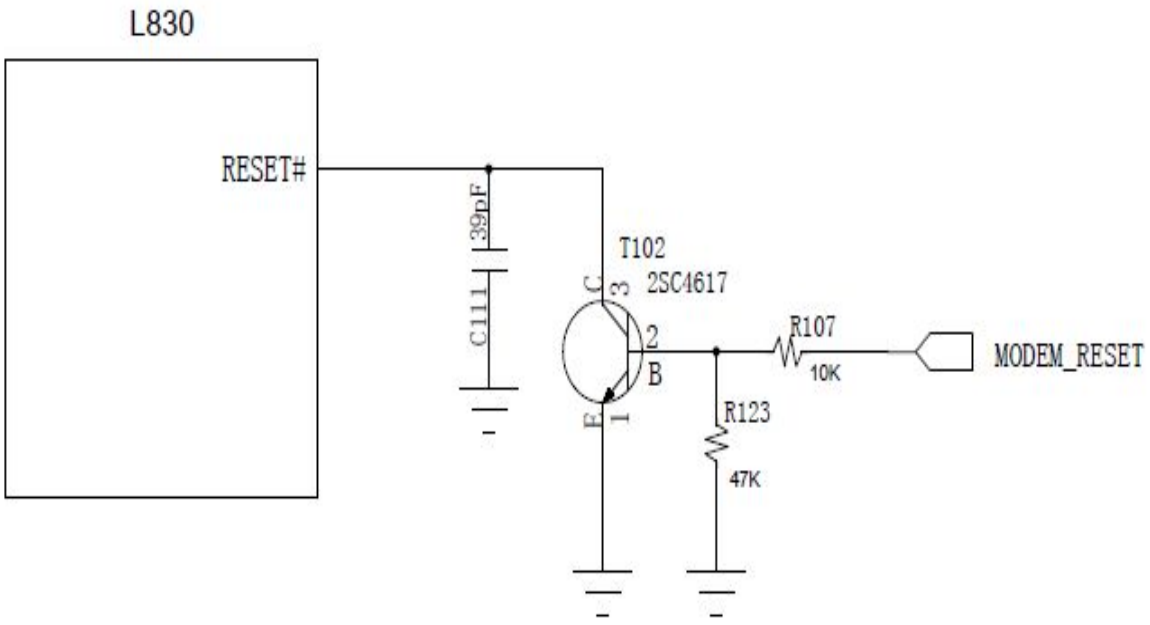

Figure 5-4 Reset# Circuit Recommended Design

5.3 Status Indicating Signal

5.3.1 Status Indicating Pin

L830-EA M.2 modules provide drain output signal for indexing RF status.

Pin#	Pin Name	Description
10	LED1#	Close or open RF network status index, ,CMOS 3.3V

LED# signal description as listed below :

No	Status	LED1#
1	RF function opened	Low level
2	RF function closed	High level

Recommended design:

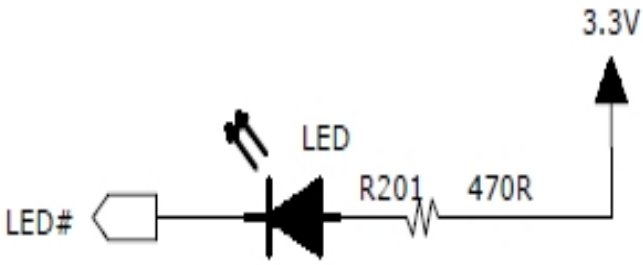

Figure 5-5 Recommended design of LED Status Index

5.4 USB /SSIC Interface

L830-EA M.2 wireless modules support USB 2.0 and USB SSIC. While the L830-EA M.2 module insert into the PC, the USB/SSIC interface will map one MBIM interface and one ACM interface in the PC side on Win8/8.1/10 system. (it will display GNSS Sensor while the ACM port is installed driver). Through the Win8/Android switch pin can switch to three ACM ports and three NCM ports ②. For details as follows:

- Win8/8.1/10 system supports MBIM interface without extra drive. If you need to support GNSS you should install the corresponding ACM port drive.
- Three AOM ports ③ will use for sending AT command(2 of the AOM ports) and grab software LOG information (one of the AOM port).
- Three NCM ports are virtual network ports, mainly for initiating data traffic.

Note②: About the Win8/Android system switch refer to the section 5.7, Android system requires the corresponded drive is installed on PC.

Note③: One of the AOM port can use for Modem COM port and initiate data services. Due to the speed of Modem COM port is too slow to up to DL 300Mbpss, 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.

5.4.1 USB Interface

Pin#	Pin Name	I/O	Description
7	USB_DP	I/O	USB signal+
9	USB_DM	I/O	USB signal-

Reference Circuit Design:

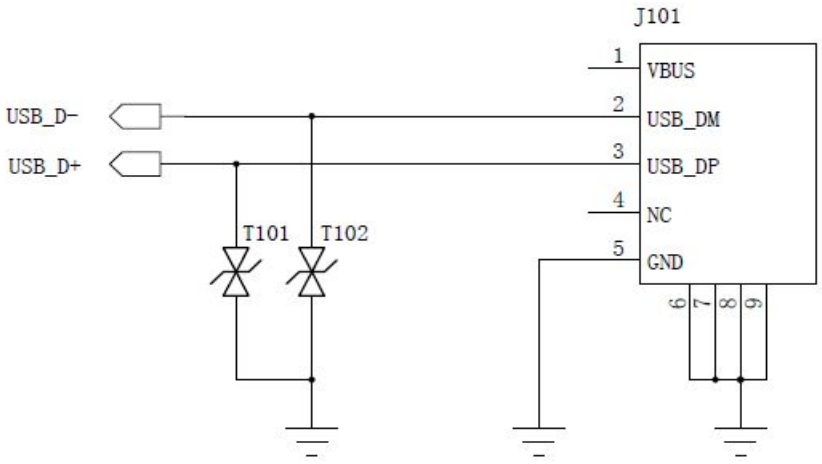

Figure 5-6 USB Interface Reference Circuit Design

T101 and T102 shall be TVS with capacitance lower than 1pF .

VUSB power supply has built connected within the module, so the VBUS PIN of Host side can be floating.

USB_D+ and USB_D- 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_D+ and USB_D- signal lines should have the same length, and should be parallel; avoid right angle wiring.
- USB_D+ and USB_D- 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.
- USB signal line shall be far away from stronger interference signal, such as power supply.
- Ensure impedance matching; impedance is required to be 90ohm.

5.4.2 USB SSIC Interface

L830-EA M.2 wireless modules support USB Super Speed Inter-Chip（USB SSIC, achieve the high speed transmission with low consumption between the chips, meet the high bandwidth transmission requires of the 4G LTE and mobile network.

The definition of USB SSIC interface as listed below:

Pin#	Pin Name	I/O	Function Description
29	SSIC_TXN	O	USB SSIC Transmitter Signal N，connect SSIC_RXN in AP side
31	SSIC_TXP	O	USB SSIC Transmitter Signal P，connect SSIC_RXP in AP side
35	SSIC_RXN	I	USB SSIC Receiver Signal N，connect SSIC_TXN in AP side
37	SSIC_RXP	I	USB SSIC Receiver Signal P，connect SSIC_TXP in AP side

USB SSIC is the high-speed differential signal line, and their highest transmission rate is up to 5Gbps. The following requirements should be followed in designing PCB layout.

- SSIC_TXN/ SSIC_TXP and SSIC_RXN/ SSIC_RXP are two differential signal lines, the routing requires parallel and equal length, meanwhile, it requires to avoid right angle routing;
- TX and RX signal lines should be wrapped with GND at the ends.
- TX and RX signal lines require isolate.
- The differential signal line should be laid at the signal layer closest to the ground layer.
- Ensure impedance matching; impedance is required to be 100ohm.

5.5 USIM Interface

L830 M.2 series wireless modules support USIM and high speed SIM cards. But 8-line intelligent USIM is not supported yet.

5.5.1 USIM Pins

Pin#	Pin Name	I/O	Function 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	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.

5.5.2 USIM Interface Design

5.5.2.1 "Normal Closed" SIM Card Circuit Design

Reference Circuit Design:

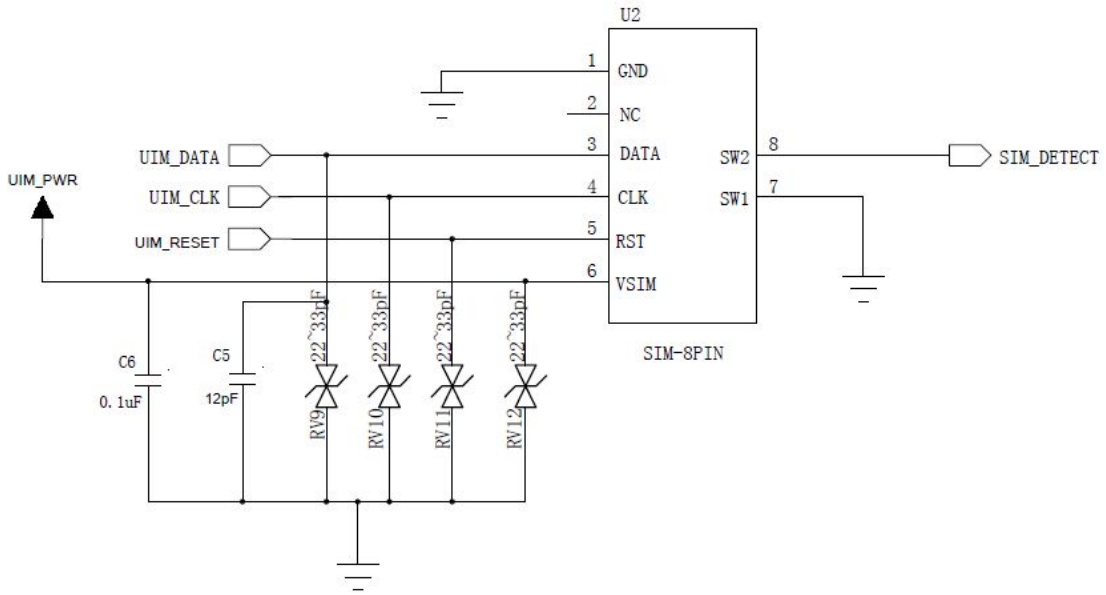

Figure 5-7 Reference Design of "Normally Closed" SIM Card Interface

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.

5.5.2.2 "Normally Open" SIM Circuit Design

Referenced Circuit Design:

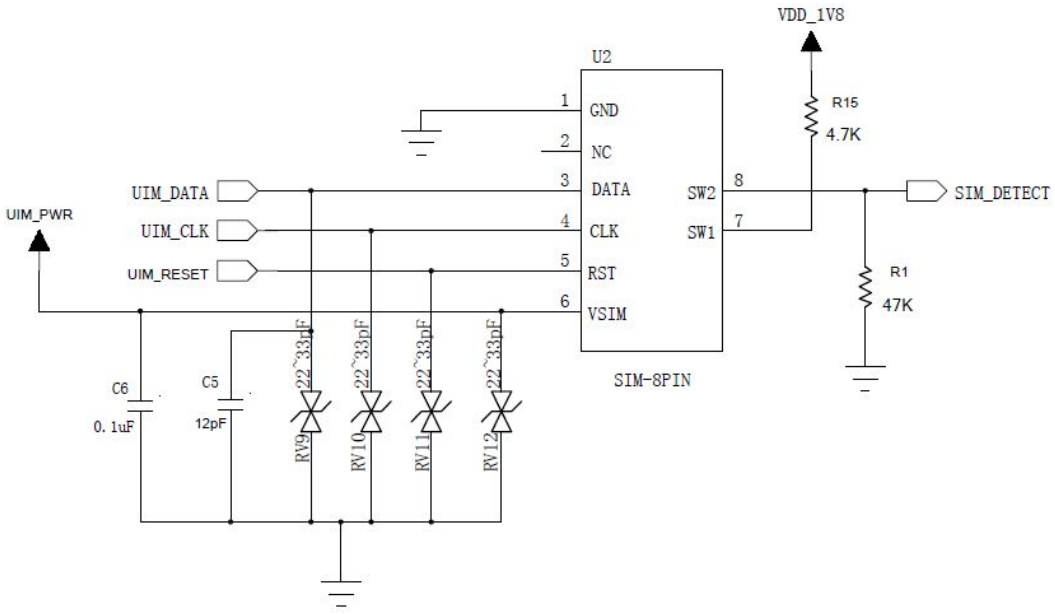

Figure 5- 8 Reference Design of “Normally Open” SIM Card Interface

Normally Open SIM Connector:

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

2）Insert SIM card, pin 7 and pin 8 will short-circuit

Note:

- 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.
- SIM card connector shall be with shielding function, to improve the anti-jamming capability of SIM card
- 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.

5.5.3 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.

5.5.4 USIM Hot-Plugging

L830-EA M.2 module supports SIM card status-detection function. This function allows the hot-plugging of SIM card.

5.5.4.1 Hardware Connection

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

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

Note :

- For “Normal closed” SIM card, as shown in the figure 5-7, SIM_DETECT 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, SIM_DETECT level will be pulled up.
- For “Normal opened” SIM card, as shown in the figure 5-8, SIM_DETECT 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, SIM_DETECT level will be pulled up.

5.5.4.2 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 SIM_DETECT 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 SIM_DETECT Pin.
- If SIM_DETECT is at high level, which indicates SIM card is inserted, the module will automatically register it to the network.

- If SIM_DETECT is at low level, 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_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

L830-EA M.2 module supports digital audio I2S interface④ 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
20	I2S_CLK	O	Bit Clock
28	I2S_WA	O	Left and right channel clock (LRCK)
22	I2S_RX	I	Serial data input
24	I2S_TX	O	Serial data output

Note④ : The digital audio interface is not supported yet.

5.6.1 I2S Interface

L830-EA M.2	Signal Direction	Audio CODEC I2S Port
I2S_CLK	→	I2S_CLK
I2S_WA	→	I2S_LRCK
I2S_RX	←	I2S_SDOUT
I2S_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).

5.6.2 PCM Port Description

L830-EA M.2	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）

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.

5.7 Win8/Android Switch Control Interface

L830-EA M.2 module supports the Win8/Android dual system switch. Check and achieve the switch function

through interrupt signal ”GNSS_IRQ”.

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

The definition of GNSS_IRQ signal function as listed below :

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

Note：

1. Check and achieve the Win8/Android system switch through GNSS_IRQ level while module starting . Keep the GNSS_IRQ level stability during starting.
2. Check and achieve the Win8/Android system switch through GNSS_IRQ rising edge/ falling edge while the module starting. The de-bouncing time sets as 100ms. The module will reboot once meeting all the requirements and switch different system supports.

3. ”Win8” refers to Windows version above the Win8, including Win8 / 8.1/10 systems that support MBIM port. For the low version of Windows 7 system, still use the Android system of ACM.

5.8 W_DISABLE# Interface

5.8.1 Description of WWAN_DISABLE# Interface

L830-EA M.2 module supports open/close the WWAN RF functional signal through hardware, and this function can also be controlled by AT commands.

Pin#	Name	I/O	Description
8	W_DISABLE1#	I	WWAN on/off signal, CMOS 3.3V

The definition of W_DISABLE# signal as listed below:

No.	W_DISABLE#	Function
1	Low	WWAN off
2	High	WWAN on
3	Floating	WWAN function is controlled by AT commands, it is on by default.

5.8.2 GPS_DISABLE# Interface

L830-EA M.2 module supports open/close GPS functional signal, and this function is also controlled by AT commands.

Pin#	Name	I/O	Description
26	W_DISABLE2#	I	GPS on/off signal , 1.8V

The definition of GPS_DISABLE# signal as listed below:

No.	GPS_DISABLE#	Function
1	Low	GPS off
2	High	GPS on
3	Floating	GPS function is controlled by AT commands, it is on by default.

Note: This function is not supported yet.

5.9 TX_BLANKING Interface

Output the low level by default. While the module works in GSM bands, TX_BLANKING will output the pulse signal that synchronized with GSM burst timing sequence. Because of the GSM TX will interface

GPS signal receiving, suggest to close GPS or stop GPS data receiving while AP has detected the TX_BLANKING pulse signal.

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

5.10 WAKEUP_Host Interface

L830-EA M.2 module supports WAKEUP_Host; the pin is high level by default. Output low level while awaking host.

Pin#	Name	I/O	Description
23	WOWWAN#	O	L830-EA M.2 module wakes up the Host signal, 1.8V signal， low level is available

5.11 BODY_SAR Interface

L830-EA M.2 module supports BODY_SAR（DPR pin）.

BODY_SAR is input signal(this signal is output by AP-side) and with high level by default. Low level is available. AP can detect the human body`s nearing through distance sensor, then output the BODY_SAR signal with low level. Once the module detect the signal through interrupt detection, it will reduce the TX power. The reduced threshold value can be set by AT commands.

Pin#	Name	I/O	Description
25	DPR	I	BODY_SAR detection

5.12 I2C Interface

L830-EA M.2 module supports a 12C interface and with I2C master by default. This I2C used for drive external I2C slave device, such as Audio codec 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 of L830-EA I2C and external 12C slave device (such as Audio Codec）as listed below:

L830-EA M.2	Direction	Audio Codec I2C Port

GNSS_SDA	⟷	I2C_SDA
GNSS_SCL	→	I2C_SCL

5.13 Clock Interface

L830-EA M.2 module supports a 26MHz clock output and a 32KHz clock output.

Pin#	Name	I/O	Description
46	SYSCLK	O	26MHz clock output (recommend the external GPS to use it, and can also use as MCLK of audio codec)
68	CLK32K	O	32KHz clock output

5.14 Config Interface

L830-EA M.2 module supports 4 config pins and the module is configured to WWAN-SSIC-0:

Pin#	Pin Name	I/O	Description	Value
1	CONFIG_3	O	The internal connect to GND	0
21	CONFIG_0	O	NC	-
69	CONFIG_1	O	The internal connect to GND	0
75	CONFIG_2	O	The internal connect to GND	0

The configuration of L830-EA M.2 Socket 2 Module type 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
N/C	GND	GND	GND	WWAN-SSIC	0

5.15 RF Interface

5.15.1 RF Connector Interface

L830-EA M.2 module provide 2 RF connected interface, used for the connection of external antenna. M is the RF main antenna, D/G is the Diversity/GNSS antenna.

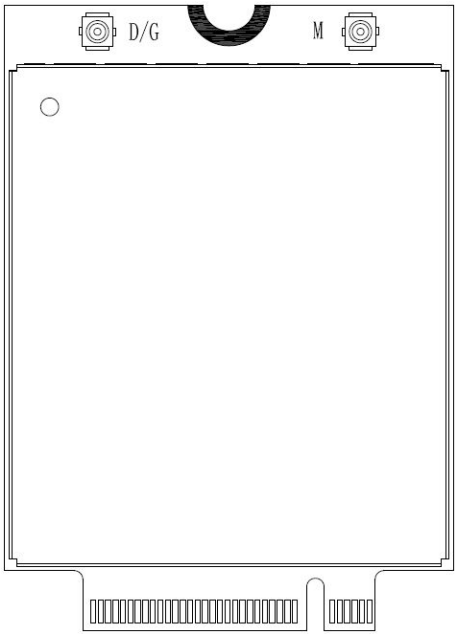

Figure 5-9 RF connector diagram

5.15.2 RF Connecting Seat

L830-EA M.2 module adopts the Murata MM4829-2702 RF connecting seat.
The dimension is 2.0*2.0*0.6mm. The structure diagram as follows :

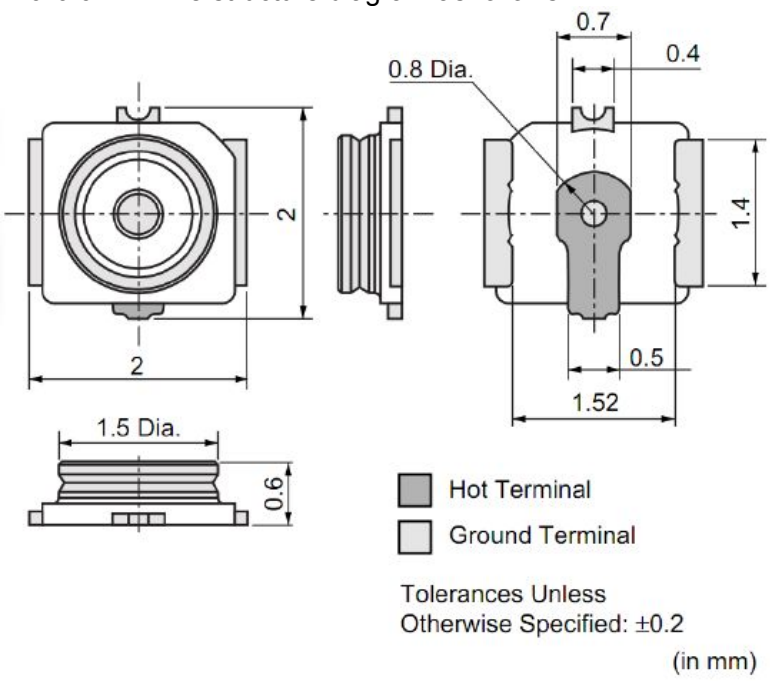

Figure 5-10 Structure diagram of RF connecting seat

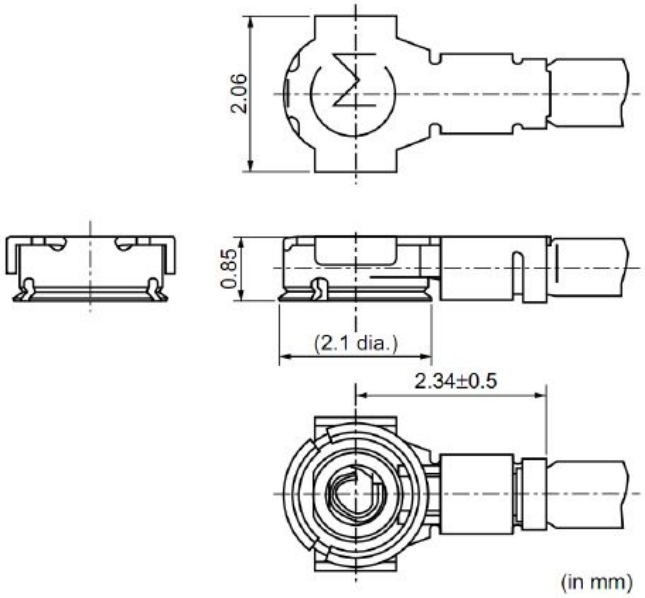

Figure 5-11 0.81mm coaxial cable matching RF connector

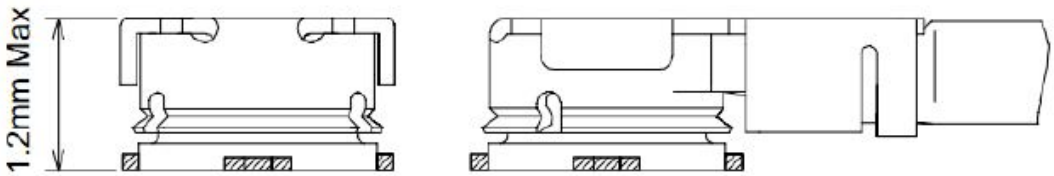

Figure 5-12 the RF connector insert into RF connecting seat

5.15.3 Main Performance of RF Connector

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

5.16 Other Interfaces

L830-EA M.2 module does not support the GPIO and Tunable ANT interface yet.

6 Electrical and Environmental Features

6.1 Electrical Features

The table below lists the range of L830-EA module ’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 L830-EA.

Parameters	Minimum Value	Maximum Value	Unit
Operational Temperature	-30	+65	°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 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/WCDMA	1710 - 1755	2110 - 2155
Band 5	CLR 850MHz	LTE FDD/WCDMA/GSM	824 - 849	869 - 894
Band 6	UMTS 800MHz	WCDMA	830 - 840	875 - 885
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 9	UMTS 1700MHz	LTE FDD	1749.9 -1784.9	1844.9 -1879.9
Band 13	USMH Block C	LTE FDD	777 - 787	746 - 756
Band 17	LSMH Blocks B/C	LTE FDD	704 - 716	734 - 746
Band 18	Japan Lower 800Mhz	LTE FDD	815 - 830	860 - 875
Band 19	Japan Upper 800Mhz	LTE FDD	830 - 845	875 - 890
Band 20	EUDD 800MHz	LTE FDD	832 - 862	791 - 821
Band 26	ECLR 850MHz	LTE FDD	814 - 849	859 - 894
Band 29	LSMH blocks D/E	LTE FDD	N/A	716 - 728
GPS L1				1574.42 -1576.42
GLONASS L1				1597.55 -1605.89

7.2 Receiving Sensitivity

For different modes , the receiving sensitivity of L830-EA bands as listed below :

Mode	Band	Rx Sensitivity(dbm)	Note
GSM	GSM850	-109	BER<2.43%
	GSM900	-109	BER<2.43%
	DCS1800	-109	BER<2.43%
	PCS1900	-109	BER<2.43%
WCDMA	Band 1	-110	BER<0.1%
	Band 2	-110	BER<0.1%
	Band 4	-110	BER<0.1%
	Band 5	-110	BER<0.1%
	Band 6	-110	BER<0.1%
	Band 8	-110	BER<0.1%
LTE FDD	Band 1	-101	10MHz Band width
	Band 2	-99	10MHz Band width
	Band 3	-101	10MHz Band width
	Band 4	-100	10MHz Band width
	Band 5	-101	10MHz Band width
	Band 7	-98	10MHz Band width
	Band 8	-100	10MHz Band width
	Band 9	-100	10MHz Band width
	Band 13	-100	10MHz Band width
	Band 17	-100	10MHz Band width
	Band 18	-100	10MHz Band width
	Band 19	-100	10MHz Band width
	Band 20	-101	10MHz Band width
	Band 26	-100	10MHz Band width
	Band 29	-100	10MHz Band width

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.

7.3 GNSS

L830-EA M.2 module supports GPS , GLONASS and aGPS. The antenna with RF Diversity and GNSS.Through the AT order can open or close the GNSS functions, please reference the AT order manual.

- For Android system, GNSS output by ACM according to the data format of NEMA0183 , and the baud rate is 115200;
- For Win8/8.1/10 system, GNSS output by GNSS Sendor.

Description		Condition	Test Result
Power		GPS fixing	70mA
		GPS tracking	70mA
		GLONASS fixing	65mA
		GLONASS tracking	65mA
		Sleep	3.5mA
TTFF	GPS/ GLONASS	Cold start	38s/–130dBm
		Warm start	35s/–130dBm
		Hot Start	1s/–130dBm (GPS signal powers off 1s)
	aGPS	Cold start	1s/–130dBm
Sensitivity	GPS	–158dBm	–160dBm
	GLONASS	–157dBm	–158dBm

Note：The current of GNSS is testing under the situation of RF disable.

7.4 RF PCB Design

7.4.1 Wiring Principle

L830-EA 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 L830-EA project is for LTE module, the Antenna need double antennas can meet the performance requirements.

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

7.5.1 Main 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 ≤ 3dBi.

(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)：

- GSM850/900>28dBm
- DCS1800/PCS1900 >25dBm
- WCDMA Band 1, 2, 4, 5, 6, 8>19dBm
- LTE FDD Band 1, 2, 3, 4, 5, 7, 8, 9, 13, 17, 18, 19, 20, 26 >19dBm

TIS (Total Isotropic Sensitivity)：

- GSM850/900/DCS1800/PCS1900 <-102dBm
- WCDMA Band 1, 2, 4, 5, 6, 8<-102dBm
- LTE FDD Band 1, 2, 3, 4, 5, 7, 8, 9, 13, 17, 18, 19, 20, 26 <-95dBm (10MHz Band width)