Fibocom

Perfect Wireless Experience
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L850-GL Hardware User Manual

Version：V1.0.3

Update date：2/25/2017

Applicability Table

No.	Product model	Description
1	L850-GL	NA

Copyright

Notice

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Version Record

Version	Update date	Remark
V1.0.0	2016-12-08	Draft
V1.0.1	2016-12-16	Modify the PCIe Interface Application; Update the Pin Definition: change pin65 to NC
V1.0.2	2017-02-09	Modify the description Update the content of PCIe Add the power Consumption of 3CA
V1.0.3	2017-02-25	Add product certification of warnings

Contents

1 Foreword

1.1 Introduction

The document describes the electrical characteristics, RF performance, dimensions and application environment, etc. of L850-GL (hereinafter referred to as L850). With the assistance of the document and other instructions, the developers can quickly understand the hardware functions of L850 modules and develop products.

1.2 Reference Standard

The design of the product complies with the following standards:

- 3GPP TS 34.121-1 V10.8.0: User Equipment (UE) conformance specification;Radio transmission and reception (FDD);Part 1: Conformance specification
- 3GPP TS 34.122 V10.1.0: Technical Specification Group Radio Access Network; Radio transmission and reception (TDD)
- 3GPP TS 36.521-1 V10.6.0: User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Conformance testing
- 3GPP TS 21.111 V10.0.0: USIM and IC card requirements
- 3GPP TS 51.011 V4.15.0: Specification of the Subscriber Identity Module -Mobile Equipment (SIM-ME) interface
- 3GPP TS 31.102 V10.11.0: Characteristics of the Universal Subscriber Identity Module (USIM) application
- 3GPP TS 31.11 V10.16.0: Universal Subscriber Identity Module (USIM) Application Toolkit(USAT)
- 3GPP TS 36.124 V10.3.0: ElectroMagnetic Compatibility (EMC) requirements for mobile terminals and ancillary equipment
- 3GPP TS 27.007 V10.0.8: AT command set for User Equipment (UE)
- 3GPP TS 27.005 V10.0.1: Use of Data Terminal Equipment - Data Circuit terminating Equipment (DTE - DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
- PCI Express M.2 Specification Rev1.0

1.3 Related Documents

- L850 Module Performance Testing Report
- RF Antenna Application Design Specification
- L8-Family System Driver Integration and Application Guidance
- L8-Family AT CommandsManual

2 Overview

2.1 Introduction

L850 is a highly integrated 4G wireless communication module that adopts standard PCIe M.2 interface and supports LTE FDD/LTE TDD/WCDMA/ system. It is applicable to most broadband communication networks of the mobile operator across the world.

2.2 Specification

Specification		
Operating Band	LTE FDD: Band 1,2,3,4,5,7,8,11,12,13,17,18,19,20,21,26,28,29,30,66	
	LTE TDD: Band 38, 39, 40, 41	
	WCDMA/HSPA+: Band 1,2,4,5,8	
	GNSS/Beidou: support	
Data Transmission	LTE FDD	450Mbps DL/50Mbps UL(Cat 9)
	LTE TDD	260Mbps DL/30Mbps UL(Cat 9) When LTE TDD achieves maximum DL rate, its UL rate can reach 10Mbps only
	UMTS/HSPA+	UMTS:384 kbps DL/384 kbps UL
		DC-HSDPA+:42Mbps DL(Cat 24)/5.76Mbps UL(Cat6)
Power Supply	DC 3.135V～4.4V,Typical 3.3V	
Temperature	Normal operating temperature:-10°C ～+55°C Expandoperating temperature:-20°C ～+70°C	
	Storage temperature: -40°C ～+85°C	
Physical characteristics	Interface: M.2 Key-B	
	Dimension：30 x 42 x 2.3mm	
	Weight: About5.8 g	
Interface		
Antenna	WWAN Main Antenna x 1	
	WWAN Diversity Antenna x 1	

Function Interface	USIM 3V/1.8V
	USB 2.0（just for debugging）
	PCIe 1.0 X1
	W_Disable#
	BodySar
	LED
	Clock
	Tunable antenna
	I2S(Reserved)
	I2C(Reserved)
	USB3.0(not supported yet)
Software	
Protocol Stack	IPV4/IPV6
AT commands	3GPP TS 27.007 and 27.005
Firmware update	PCIe
Other feature	Multiple carrier
	Windows MBIM support
	Windows update
	AGNSS

Note:

For normal operating temperature, LTE FDD Band 4 and 13 can support the temperature ranging from -20℃ to +60℃.

2.3 Warnings

2.3.1 FCC Statement

Federal Communication Commission Interference Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution:

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

Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This module can be used with Notebook or similar platform with similar dimension, antenna location and RF characteristic.

This device is intended only for OEM integrators under the following conditions:

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and the maximum antenna gain allowed for use with this device is 5 dBi.
2) The transmitter module may not be co-located with any other transmitter or antenna.
3) For portable usage condition, this module has been SAR evaluated in Notebook host with compliance result and can be used with this specific host as described in the certification filing. Other host or platform needs separate approval.

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

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

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "**Contains FCC ID: ZMOL850GL**". The grantee's FCC ID can be used only when all FCC compliance requirements are met.

Manual Information To the End User

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

2.3.2 IC Statement

Industry Canada statement

❶ This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

1) this device may not cause interference, and

2) this device must accept any interference, including interference that may cause undesired operation of the device.

❶ Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1) l'appareil ne doit pas produire de brouillage, et

2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

❷ This Class B digital apparatus complies with Canadian ICES-003.

❷ Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

❸ This device complies with RSS-310 of Industry Canada. Operation is subject to the condition that this device does not cause harmful interference.

❸ Cet appareil est conforme à la norme RSS-310 d'Industrie Canada. L'opération est soumise à la condition que cet appareil ne provoque aucune interférence nuisible.

- ❹ This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter, except tested built-in radios.
- ❹ Cet appareil et son antenne ne doivent pas être situés ou fonctionner en conjonction avec une autre antenne ou un autre émetteur, exception faites des radios intégrées qui ont été testées.
- ❺ The County Code Selection feature is disabled for products marketed in the US/ Canada.
- ❺ La fonction de sélection de l'indicatif du pays est désactivée pour les produits commercialisés aux États-Unis et au Canada.

Radiation Exposure Statement:

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

IC : 21374-L850GL

2.3.3 CE Statement

► EU Regulatory Conformance

Hereby, We, Fibocom Wireless Inc. declares that the radio equipment type L850-GL is in compliance with the Directive 2014/53/EU.

In all cases assessment of the final product must be mass against the Essential requirements of the ***Directive 2014/53/EU*** Articles 3.1(a) and (b), safety and EMC respectively, as well as any relevant Article 3.2 requirements.

The maximum antenna gain for is 5 dBi and the antenna separation distance is 20cm.

► Declaration of Conformity(should include manufacturer contact info.)

Please added certification standard in your user manual which depended on the test standards your device performed., **If the DoC should be a simplified version, please take below as reference,** The full text of the EU declaration of conformity is available at the following internet address: http//www. fibocom.com

2.4 CA combinations

CA Combinations		
2CA	Inter-band	1+3,5,18,19,20,21,26
		2+4,5,12,13,17,29,30,66
		3+5,7,8,19,20,28
		4+5,12,13,17,29,30
		5+7,30,66
		7+20,28
		12+30
		13+66
		29+30
3CA	Inter-band	2,3,4,7,40,41
		1+3+7, 1+3+19, 1+3+20, 1+19+21
		2+4+5, 2+4+13, 2+5+30, 2+12+30, 2+29+30
		3+7+20, 3+7+28
		4+5+30, 4+12+30, 4+29+30
		5+66+2, 13+66+2
	2 contiguous plus inter-band	2+2+5, 2+2+13
		3+3+7, 3+7+7, 3+3+20
		4+4+5, 4+4+13
		5+66+66, 13+66+66, 66+66+2, 66+66+66

2.5 Application Framework

The peripheralapplicationsfor L850 module are shown in Figure 2-1:

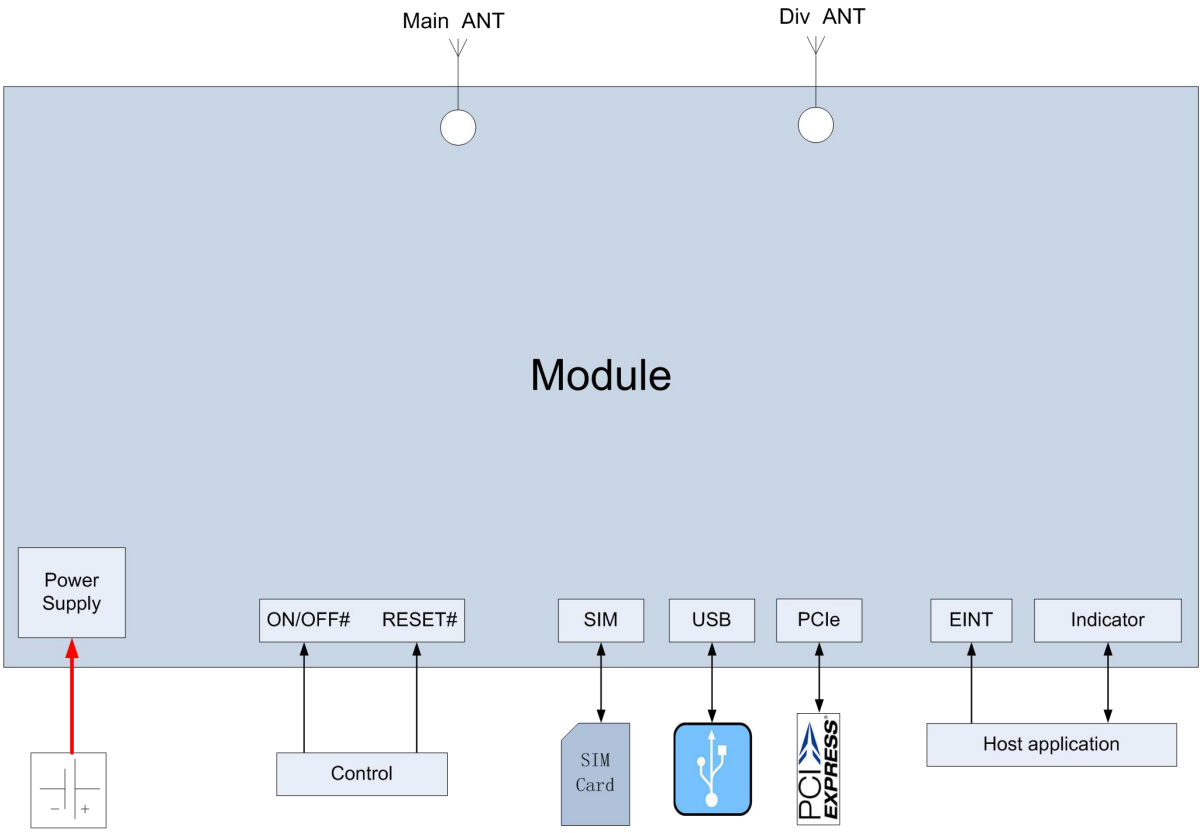


Figure2-1 Application Framework

2.6 Hardware Framework

The hardware framework in Figure 2-2 shows the main hardware functions of L850 module, including base band and RF functions.

Baseband contains the followings:

- •GSM/UMTS/LTE FDD controller/Power supply
- •NAND/internal LPDDR2 RAM
- •Application interface

RF contains the followings:

- •RF Transceiver
- •RF Power/PA
- •RF Front end
- •RF Filter
- •Antenna

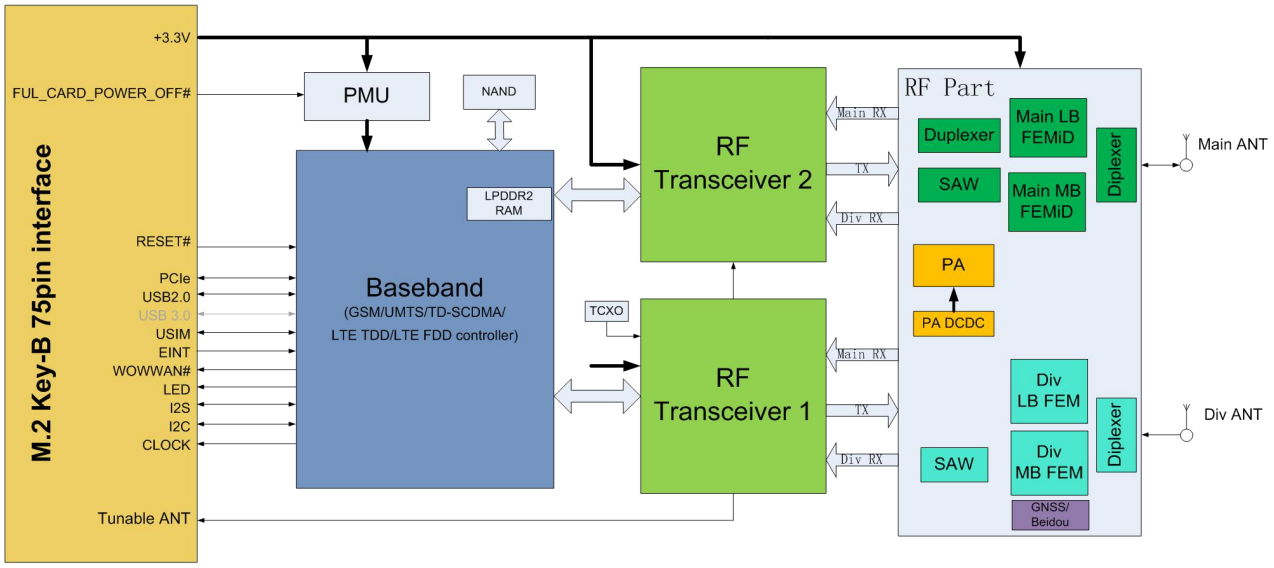


Figure 2-2 Hardware Framework

3 Application Interface

3.1 M.2Interface

The L850 module applies standard M.2 Key-B interface, with a total of 75 pins.

3.1.1 Pin Distribution

L850 Module Pin Map

74	+3.3V	CONFIG_2	75
72	+3.3V	GND	73
70	+3.3V	GND	71
68	NC	CONFIG_1	69
66	SIM_DETECT(1.8V)	RESET#(1.8V)	67
64	COEX1(1.8V)	NC	65
62	COEX2(1.8V)	ANTCTL2(1.8V)	63
60	COEX3(1.8V)	ANTCTL1(1.8V)	61
58	RFE_RFFE2_SDATA(3.3/1.8V)	ANTCTL0(1.8V)	59
56	RFE_RFFE2_SCLK(3.3/1.8V)	GND	57
54	PEWAKE# (3.3V)	REFCLKP	55
52	CLKREQ# (3.3V)	REFCLKN	53
50	PERST# (3.3V)	GND	51
48	TX_BLANKING(1.8V)	PERp0	49
46	SYSCLK(1.8V)	PERn0	47
44	GNSS_IRQ(1.8V)	GND	45
42	GNSS_SDA(1.8V)	PETp0	43
40	GNSS_SCL(1.8V)	PETn0	41
38	NC	GND	39
36	UIM_PWR	USB3.0 - Rx+	37
34	UIM_DATA	USB3.0 - Rx -	35
32	UIM_CLK	GND	33
30	UIM_RESET	USB3.0 - Tx+	31
28	I2S_WA(1.8V)	USB3.0 - Tx -	29
26	W_DISABLE2#(3.3/1.8V)	GND	27
24	I2S_TX(1.8V)	DPR(3.3/1.8V)	25
22	I2S_RX(1.8V)	WOWWAN#(1.8V)	23
20	I2S_CLK(1.8V)	CONFIG_0	21
	Notch	Notch	
	Notch	Notch	
	Notch	Notch	
	Notch	Notch	
10	LED1#(3.3V OD)	GND	11
8	W_DISABLE1#(3.3/1.8V)	USB D-	9
6	FUL_CARD_POWER_OFF#(3.3/1.8V)	USB D+	7
4	+3.3V	GND	5
2	+3.3V	GND	3
		CONFIG_3	1

Figure 3-1 Pin Distribution

Note:

Pin “Notch” represents the gap of the gold fingers.

3.1.2 Pin Definition

The pin definition is as follows:

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
1	CONFIG_3	O	NC	NC,L850 M.2 module is configured as the WWAN – PCIe,USB3.0 interface type	
2	+3.3V	PI		Power input	Power Supply
3	GND			GND	Power Supply
4	+3.3V	PI		Power input	Power Supply
5	GND			GND	Power Supply
6	FUL_CARD_ POWER_OFF#	I	PU	Power enable,Module power on input,internal pull up	CMOS 3.3/1.8V
7	USB D+	I/O		USB Data Plus	0.3---3V
8	W_DISABLE1#	I	PD	WWAN Disable,active low	CMOS 3.3/1.8V
9	USB D-	I/O		USB Data Minus	0.3---3V
10	LED1#	O	T	System status LED,Output open drain,CMOS 3.3V	CMOS 3.3V
11	GND			GND	Power Supply
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	I2S Serial clock, Reserved	CMOS 1.8V
21	CONFIG_0		GND	GND,L850 M.2 module is configured as the WWAN – PCIe,USB3.0 interface type	
22	I2S_RX	I	PD	I2S Serial receive data,	CMOS 1.8V

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
				Reserved	
23	WOWWAN#	O	PD	Wake up host	CMOS 1.8V
24	I2S_TX	O	PD	I2S Serial transmit data, Reserved	CMOS 1.8V
25	DPR	I	PU	Body SAR Detect,active low	CMOS 3.3/1.8V
26	W_DISABLE2#	I	PU	GNSS disable,active low, Reserved	CMOS 3.3/1.8V
27	GND			GND	Power Supply
28	I2S_WA	O	PD	I2S Word alignment/select, Reserved	CMOS 1.8V
29	USB3.0 - Tx -	O		USB3.0 Transmit data minus, Not support now	
30	UIM_RESET	O	L	SIM reset signal	1.8V/3V
31	USB3.0 - Tx+	O		USB3.0 Transmit data plus, Not support now	
32	UIM_CLK	O	L	SIM clock Signal	1.8V/3V
33	GND			GND	Power Supply
34	UIM_DATA	I/O	L	SIM data input/output	1.8V/3V
35	USB3.0 - Rx -	I		USB3.0 receive data minus, Not support now	
36	UIM_PWR	O		SIM power supply,3V/1.8V	1.8V/3V
37	USB3.0 - Rx+	I		USB3.0 receive data plus, Not support now	
38	NC			NC	
39	GND			GND	Power Supply
40	GNSS_SCL	O	PU	I2C Serial clock, Reserved	CMOS 1.8V
41	PETn0	O		PCIe TX Differential signals Negative	
42	GNSS_SDA	I/O	PU	I2C Serial data input/output, Reserved	CMOS 1.8V
43	PETp0	O		PCIe TX Differential signals Positive	

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
44	GNSS_IRQ	I	PD	GNSS Interrupt Request, Reserved	CMOS 1.8V
45	GND			GND	Power Supply
46	SYSCLK	O	PD	26M clock output	1.8V
47	PERn0	I		PCIe RX Differential signals Negative	
48	TX_BLANKING	O	PD	PA Blanking Timer	CMOS 1.8V
49	PERp0	I		PCIe RX Differential signals Positive	
50	PERST#	I	T	PE-Reset is a functional reset to the Add-In card as defined by the PCIe Mini Card CEM specification	CMOS 3.3V
51	GND			GND	Power Supply
52	CLKREQ#	O	T	Clock Request is a reference clock request signal as defined by the PCIe Mini Card CEM specification; Also used by L1 PM Substates	CMOS 3.3V
53	REFCLKN	I		PCIe Reference Clock signal Negative	
54	PEWAKE#	O	L	PCIe PME Wake. Open Drain with pull up on platform,active low	CMOS 3.3V
55	REFCLKP	I		PCIe Reference Clock signal Positive	
56	RFE_RFFE2_ SCLK	O		MIPI Interface Tunable ANT, RFFE2 clock,Open Drain output	CMOS 3.3/1.8V
57	GND			GND	Power Supply
58	RFE_RFFE2_ SDATA	O		MIPI Interface Tunable ANT, RFFE2 data,Open Drain output	CMOS 3.3/1.8V
59	ANTCTL0	O		Tunable ANT CTRL0	CMOS 1.8V
60	COEX3	O	PD	Wireless Coexistence between WWAN and WiFi/BT modules. IDC_UART_TXD, Reserved	CMOS 3.3/1.8V
61	ANTCTL1	O		Tunable ANT CTRL1	CMOS 1.8V
62	COEX2	I	T	Wireless Coexistence between WWAN and WiFi/BT modules, IDC_UART_RXD	CMOS 1.8V

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
				,Reserved	
63	ANTCTL2	O		Tunable ANT CTRL2	CMOS 1.8V
64	COEX1	O	T	Wireless Coexistence between WWAN and WiFi/BT modules, GNSS_EXT_FTA ,Reserved	CMOS 1.8V
65	NC			NC	
66	SIM_DETECT	I	PD	SIM Detect,internal pull up(330KΩ), active high	CMOS 1.8V
67	RESET#	I		WWAN reset input,internal pull up(10KΩ),active low	CMOS 1.8V
68	NC			NC	
69	CONFIG_1	O	GND	GND,L850 M.2 module is configured as the WWAN – PCIe,USB3.0 interface type	
70	+3.3V	PI		Power input	Power Supply
71	GND			GND	Power Supply
72	+3.3V	PI		Power input	Power Supply
73	GND			GND	Power Supply
74	+3.3V	PI		Power input	Power Supply
75	CONFIG_2	O	GND	GND,L850 M.2 module is configured as the WWAN – PCIe,USB3.0 interface type	

Reset Value: The initial status after modulereset, not the status when working.

H:High Voltage Level

L: Low Voltage Level

PD:Pull-Down

PU:Pull-Up

T:Tristate

OD:Open Drain

PP:Push-Pull

PI: Power Input

PO: Power Output

Note:

The unused pins can be left floating.

3.2 Power Supply

The power interface of L850 module as shown in the following table:

Pin	Pin Name	I/O	Pin Description	DC Parameter（V）		
				Minimum Value	Typical Value	Maximum Value
2,4,70,72,74	+3.3V	PI	Power supply input	3.135	3.3	4.4
36	UIM_PWR	PO	USIM power supply		1.8V/3V	

L850 module uses PCIe interface, according to the PCIe specification, the PCIe Vmain should be used as the +3.3V power source, not the Vaux. The Vaux is the PCIe backup power source and it is not sufficient as the power supply. In addition, the DC/DC power supply other than PCIe ports should not be used as the external power cannot control the module status through the PCIe protocol.

3.2.1 Power Supply

The L850 module should be powered through the +3.3V pins, and the power supply design is shown in Figure 3-2:

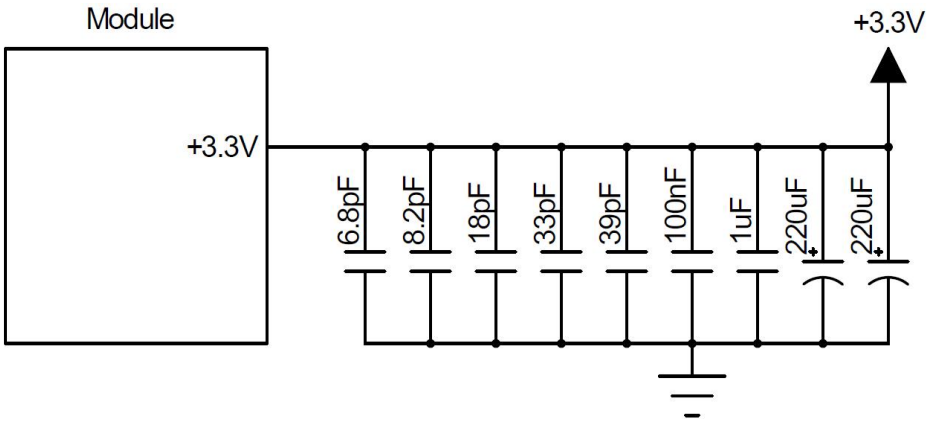


Figure 3-2 Power Supply Design

The filter capacitor design for power supply as shown in the following table:

Recommended capacitance	Application	Description
220uF x 2	Voltage-stabilizing capacitors	Reduce power fluctuations of the module in operation, requiring capacitors with low ESR. ● LDO or DC/DC power supply requires the capacitor of no less than 440uF ● The capacitor for battery power supply can be reduced to 100~200uF
1uF,100nF	Digital signal noise	Filter out the interference generated from the clock and digital signals

Recommended capacitance	Application	Description
39pF,33pF	700/800, 850/900 MHzfrequency band	Filter out low frequency band RF interference
18pF,8.2pF,6.8pF	1500/1700/1800/1900,2100/ 2300,2500/2600MHzfrequen cy band	Filter out medium/high frequency band RF interference

The stable power supply can ensure the normal operation of L850 module;and the ripple of the power supply should be less than 300mV in design. When the module operates with themaximum emission power, the maximum operating current can reach 1000mA, so the power source should be not lower than 3.135V, or the module may shut down or reboot. The power supply limits are shown in Figure 3-3:

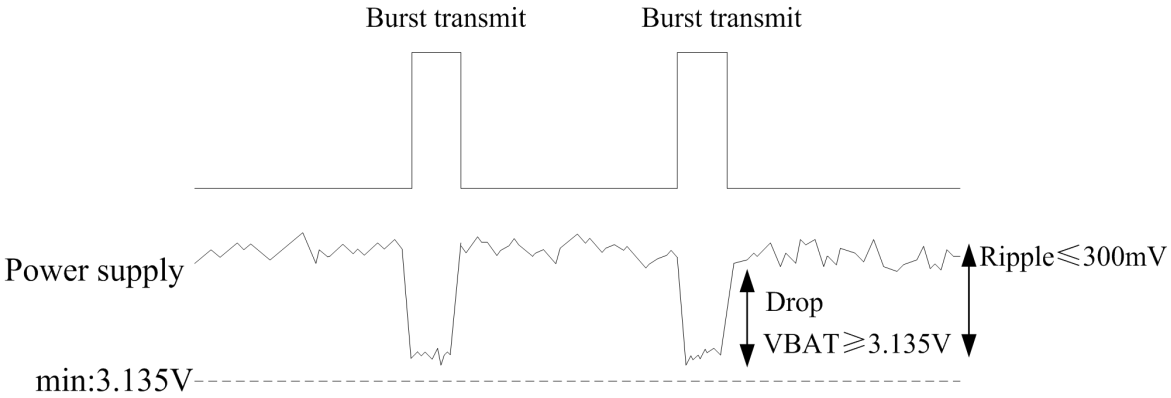


Figure 3-3 Power Supply Limit

3.2.2 Logic level

The L850module 1.8V logic level definitionas shown in the following table:

Parameters	Minimum	Typical	Maximum	Unit
1.8V logic level	1.71	1.8	1.89	V
V_{IH}	1.3	1.8	1.89	V
V_{IL}	-0.3	0	0.5	V

The L850module 3.3V logic level definition as shown in the following table:

Parameters	Minimum	Typical	Maximum	Unit
3.3V logic level	3.135	3.3	3.465	V
V_{IH}	2.3	3.3	3.465	V
V_{IL}	-0.3	0	0.9	V

3.2.3 Power Consumption

In the condition of 3.3V power supply, the L850 power consumption as shown in the following table:

Parameter	Mode	Condition	Average Current(mA)
I_{off}	Power off	Power supply,module power off	0.08
I_{Sleep}	WCDMA	DRX=6	2.5
		DRX=8	1.8
		DRX=9	1.6
	LTE FDD	Paging cycle #64 frames (0.64 sec DRx cycle)	2.6
	LTE TDD	Paging cycle #64 frames (0.64 sec DRx cycle)	2.8
	Radio Off	AT+CFUN=4,Flight mode	1.2
$I_{WCDMA-RMS}$	WCDMA	WCDMA Data transfer Band 1 @+23.5dBm	680
		WCDMA Data transfer Band 2 @+23.5dBm	710
		WCDMA Data transfer Band 4 @+23.5dBm	500
		WCDMA Data transfer Band 5 @+23.5dBm	530
		WCDMA Data transfer Band 8 @+23.5dBm	580
$I_{LTE-RMS}$	LTE FDD	LTE FDD Data transfer Band 1 @+23dBm	760
		LTE FDD Data transfer Band 2 @+23dBm	760
		LTE FDD Data transfer Band 3 @+23dBm	770
		LTE FDD Data transfer Band 4 @+23dBm	710
		LTE FDD Data transfer Band 5 @+23dBm	550
		LTE FDD Data transfer Band 7 @+23dBm	TBD
		LTE FDD Data transfer Band 8 @+23dBm	540
		LTE FDD Data transfer Band 11 @+23dBm	TBD
		LTE FDD Data transfer Band 12 @+23dBm	600
		LTE FDD Data transfer Band 13 @+23dBm	560
		LTE FDD Data transfer Band 17 @+23dBm	580
		LTE FDD Data transfer Band 18 @+23dBm	560
		LTE FDD Data transfer Band 19 @+23dBm	520
		LTE FDD Data transfer Band 20 @+23dBm	630

Parameter	Mode	Condition	Average Current(mA)
		LTE FDD Data transfer Band 21 @+23dBm	TBD
		LTE FDD Data transfer Band 26 @+23dBm	540
		LTE FDD Data transfer Band 28 @+23dBm	530
		LTE FDD Data transfer Band 30 @+23dBm	TBD
		LTE FDD Data transfer Band 66 @+23dBm	700
	LTE TDD	LTE TDD Data transfer Band 38 @+23dBm	450
		LTE TDD Data transfer Band 39 @+23dBm	320
		LTE TDD Data transfer Band 40 @+23dBm	420
		LTE TDD Data transfer Band 41 @+23dBm	440

The power consumption of L850 in 3CA mode as shown in the following tables:

3CA Combination	Condition (LTE FDD 3CA, Full RB)	Average Current(mA)
1+3+7, 1+3+19, 1+3+20, 1+19+21 2+4+5, 2+4+13, 2+5+30, 2+12+30, 2+29+30 3+7+20, 3+7+28 4+5+30, 4+12+30, 4+29+30 5+66+2, 13+66+2 2+2+5, 2+2+13 3+3+7, 3+7+7, 3+3+20 4+4+5, 4+4+13 5+66+66, 13+66+66, 66+66+2, 66+66+66	Band 1 @+22dBm	720
	Band 2 @+22dBm	880
	Band 3 @+22dBm	860
	Band 4 @+22dBm	760
	Band 5 @+22dBm	800
	Band 7 @+22dBm	1110
	Band 12 @+22dBm	790
	Band 13 @+22dBm	630
	Band 19 @+22dBm	760
	Band 20 @+22dBm	750
	Band 21 @+22dBm	950
	Band 28 @+22dBm	720
	Band 30 @+22dBm	1330
	Band 66 @+22dBm	710

Note:

The data above is an average value obtained by testing some samples.

3.3 Control Signal

The L850 module provides two control signals for power on/off and reset operations, the pin defined as shown in the following table:

Pin	Pin Name	I/O	Reset Value	Functions	Type
6	FUL_CARD_POWER_OFF#	I	PU	Power on/off signal,internalpull-up High or floating: Power on Low : Power off	3.3/1.8V
67	RESET#	I		Reset signal, internal 10KΩ pull-up,active low	1.8V

3.3.1 Module Start-Up

3.3.1.1 Start-upCircuit

The FUL_CARD_POWER_OFF# pin needs an external 3.3V or 1.8V pull up for booting up. The VDD_1V8 should be provided from the external circuit. AP (Application Processor) controls the module start-up，and the circuit design is shown in Figure3-4:

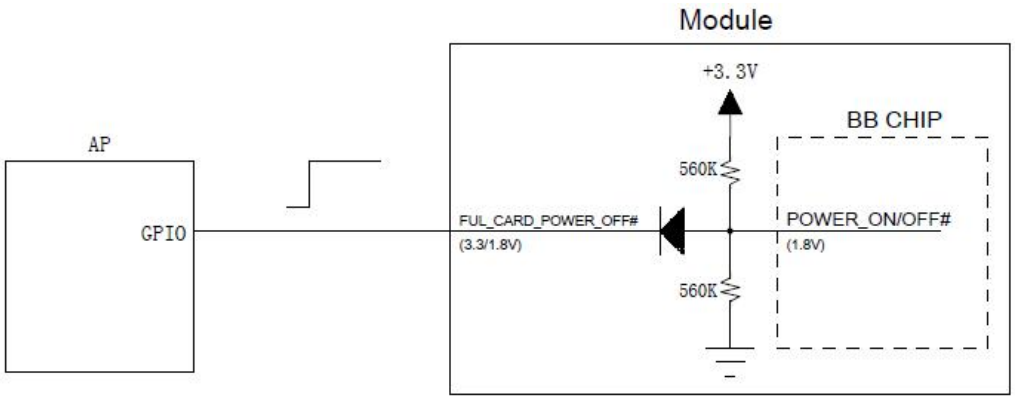


Figure 3-4 Circuit for Module Start-up Controlled by AP

3.3.1.2 Start-upTiming Sequence

After powering on, the module will start-up by pulling upthe FUL_CARD_POWER_OFF# signal for more than 20ms (100msis recommended). Meanwhile, the module will output 1.8V voltage through VSD2_1V8 pin and start the initialization process. The start-up timing is shown in Figure 3-5:

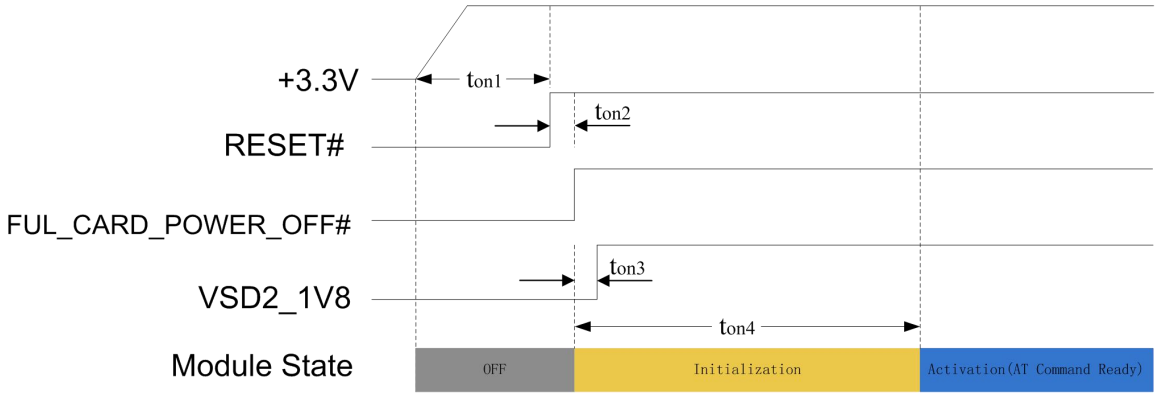


Figure 3-5 Timing Control for Start-up

Note:

The VSD2_1V8 signal is the internal PMU 1.8V output voltage which is not connected to the M.2 interface. The above timing of VSD2_1V8 is only for reference.

The RESET# is required to pull high with a t_{on1} delay after the +3.3V, because it takes some time tocharge thecapacitors for +3.3V power supply. If the +3.3V power supply is already stable before starting upthe module, the delay time can be ignored.

3.3.2 Module Shutdown

The module can be shut down by the following controls:

Shutdown Control	Action	Condition
Software	Sending AT+CPWROFF command	Normal shutdown(recommend)
Hardware	Pull down FUL_CARD_POWER_OFF# pin	Only used whena hardware exception occurs and the software control cannot be used.

The module can be shut downby sending AT+CPWROFF command. When the module receives the software shutdown command, the module will start the finalization process (the reverse process of initialization), andit will be completed after 3s. In the finalization process, the module will save the network, SIM card and some other parameters from memory, then clear the memory and PMU will be powered off. After shutdown, the VSD2_1V8 voltage is also shut down. The software control timing isshown in Figure 3-6:

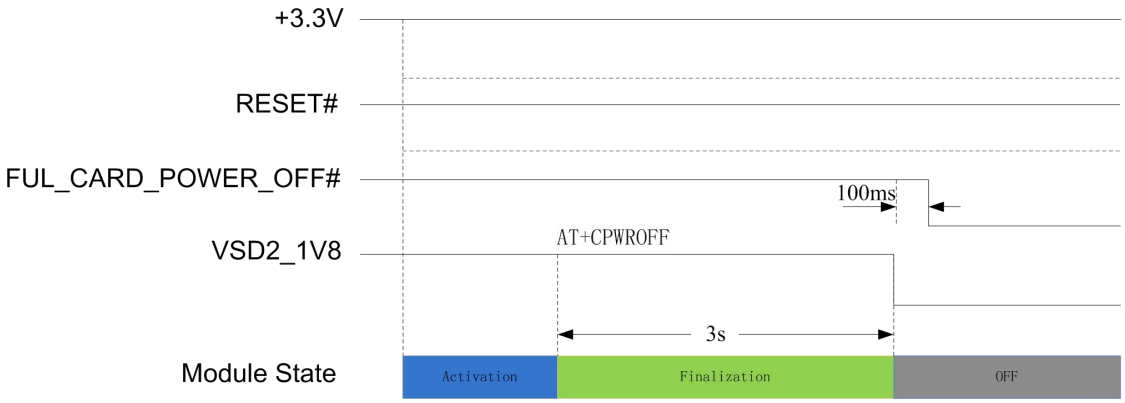


Figure 3-6 Software Shutdown Timing Control

After the software shutdown, the FUL_CARD_POWER_OFF # pin will remain high which prevents the module from restarting again. Toenable the next restart, the FUL_CARD_POWER_OFF#pin should be pulled low after shutting down.

Note:

The VSD2_1V8 signal is the internal PMU 1.8V output voltage which is not connected to the M.2 interface. The above timing of VSD2_1V8 is only for reference.

3.3.3 Module Reset

The L850 module can reset to its initial status by pulling down the RESET# signal for more than 10ms (100msis recommended), and the module will restart after the RESET# signal is released. When the customer executes RESET# function, the PMU remains its power inside the module. The recommended circuit design is shown in the Figure 3-7:

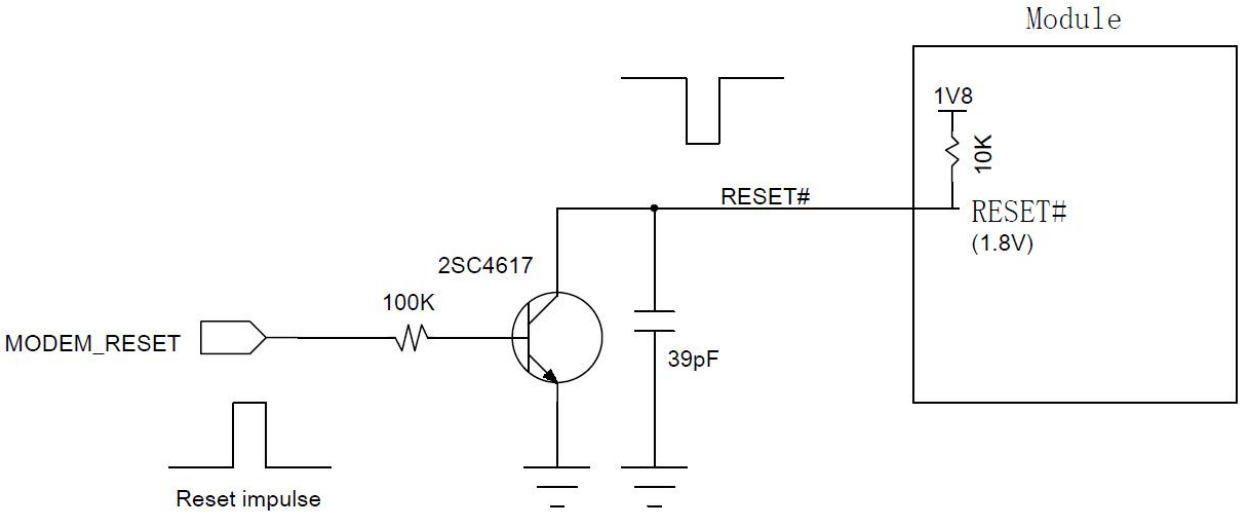


Figure 3-7 Recommended Design for Reset Circuit

The reset control timing is shown in Figure 3-8:

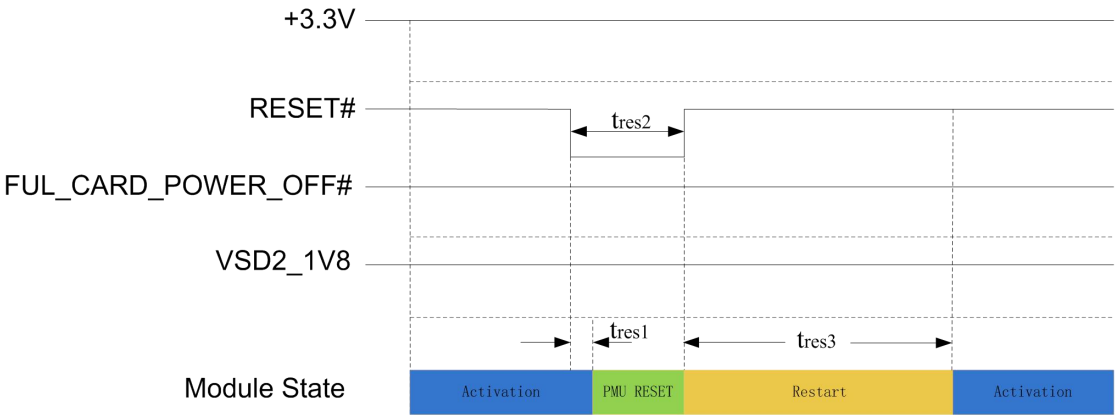


Figure 3-10 Reset Timing Control

Note:

RESET# is a sensitive signal, it's recommended to add a filter capacitor close to the module. In case of PCB layout, the RESET# signal lines should keep away from the RF interference and protected by GND. Also, the RESET# signal lines shall neither near the PCB edge nor route on the surface planes to avoid module from reset caused by ESD problems.

3.4 USB Interface

The L850 module supports USB2.0 which is compatible with USB High-Speed (480 Mbit/s) and USB Full-Speed (12 Mbit/s). For the USB timing and electrical specification of L850 module, please refer to"Universal Serial Bus Specification 2.0".

USB interface just for debugging.

3.4.1 USB Interface Definition

Pin#	Pin Name	I/O	Reset Value	Description	Type
7	USB_D+	I/O		USB Data Plus	0.3---3V, USB2.0
9	USB_D-	I/O		USB Data Minus	0.3---3V, USB2.0

3.4.2 USB2.0 Interface Application

USB interface is used for debugging only, so it only needs to introduce the USB interface test in hardware design.

3.5 PCIe Interface

L850 module supports PCIe 1.0 interface and one data transmission channel.

After L850 module is inserted into PC, PCIe interface can, work with the drive program, map an MBIM port and a GNSS port in Win10 system. While MBIM interface is used for initiating data service in Win10 system and GNSS interface for receiving GNSS data.

3.5.1 PCIe Interface Definition

Pin#	Pin Name	I/O	Reset Value	Description	Type
41	PETn0	O		PCIe TX Differential signals Negative	
43	PETP0	O		PCIe TX Differential signals Positive	
47	PERn0	I		PCIe RX Differential signals NegativeBit0	
49	PERP0	I		PCIe RX Differential signals Positive	
53	REFCLKN	I		PCIe Reference Clock signal Negative	
55	REFCLKP	I		PCIe Reference Clock signal Positive	
50	PERST#	I	T	PE-Reset is a functional reset to the Add-In card as defined by the PCIe Mini Card CEM specification	CMOS 3.3V
52	CLKREQ#	O	T	Clock Request is a reference clock request signal as defined by the PCIe Mini Card CEM specification; Also used by L1 PM Substates	CMOS 3.3V
54	PEWAKE#	O	L	PCIe PME Wake. Open Drain with pull up on platform,active low	CMOS 3.3V

3.5.2 PCIe Interface Application

The reference circuit is shown in Figure 3-9:

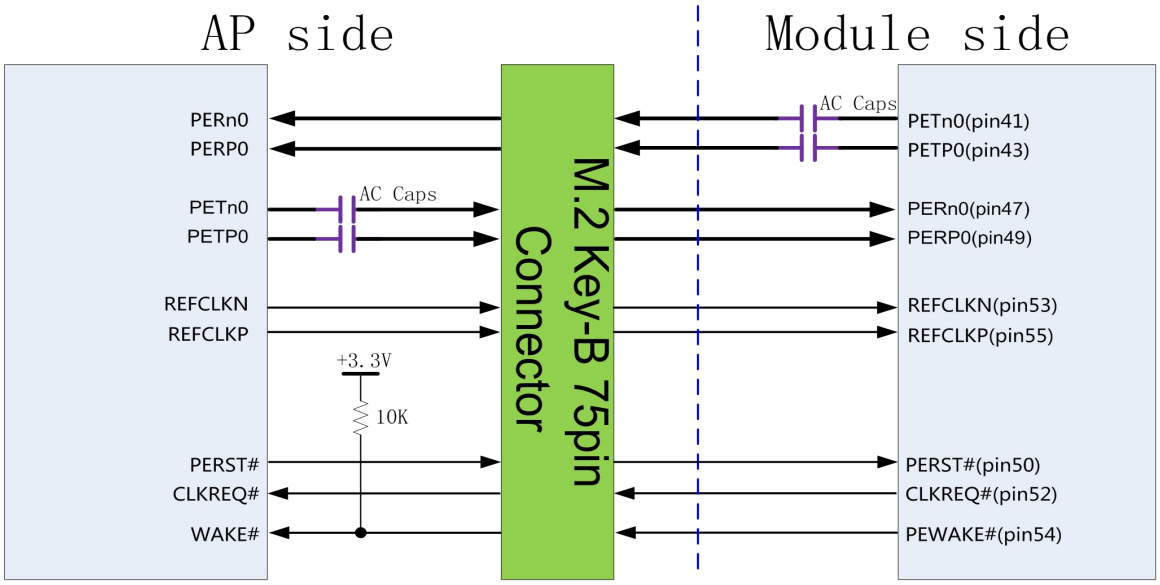


Figure 3-9 Reference Circuit for PCIe Interface

L850 module supports one PCIe 1.0 interface, including three difference pairs: transmit pair TXP/N, receiving pair RXP/N and clock pair CLKP/N.

PCIe can achieve the maximum transmission rate of 2.5 GT/s, and must strictly follow the rules below in PCB Layout:

- The differential signal pair lines shall be parallel and equal in length;
- The differential signal pair lines shall be short if possible and be controlled within 500mm for AP end;
- The impedance of differential signal pair lines is recommended to be 100 ohm, and can be controlled to 80～120 ohm in accordance with PCIe protocol;
- It shall avoid the discontinuous reference ground, such as segment and space;
- When the differential signal lines go through different layers, the via hole of grounding signal should be in close to that of signal, and generally, each pair of signals require 1-3 grounding signal via holes and the lines shall never cross the segment of plane;
- Try to avoid bended lines and avoid introducing common-mode noise in the system, which will influence the signal integrity and EMI of difference pair. As shown in Figure 3-10, the bending angle of all lines should be equal or greater than 135° , the spacing between difference pair lines should be larger than 20mil, and the line caused by bending should be greater than 1.5 times line width at least. When a serpentine line is used for length match with another line, the bended length of each segment shall be at least 3 times the line width (≥3W). The largest spacing between the bended part of the serpentine line and another one of the differential lines must be less than 2 times the spacing of normal differential lines (S1<2S);

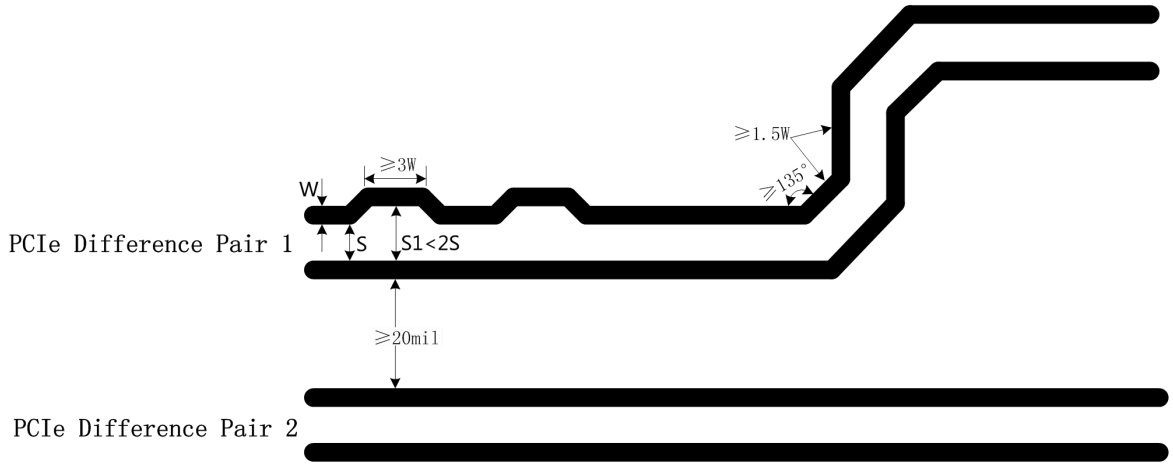


Figure 3-10 Requirement of PCIe Line

•The difference in length of two data lines in difference pair should be within 5mil, and the length match is required for all parts. When the length match is conducted for the differential lines, the designed position of correct match should be close to that of incorrect match, as shown in Figure 3-11. However, there is no specific requirements for the length match of transmit pair and receiving pair, that is, the length match is only required in the internal differential lines rather than between different difference pairs. The length match should be close to the signal pin and pass the small-angle bending design.

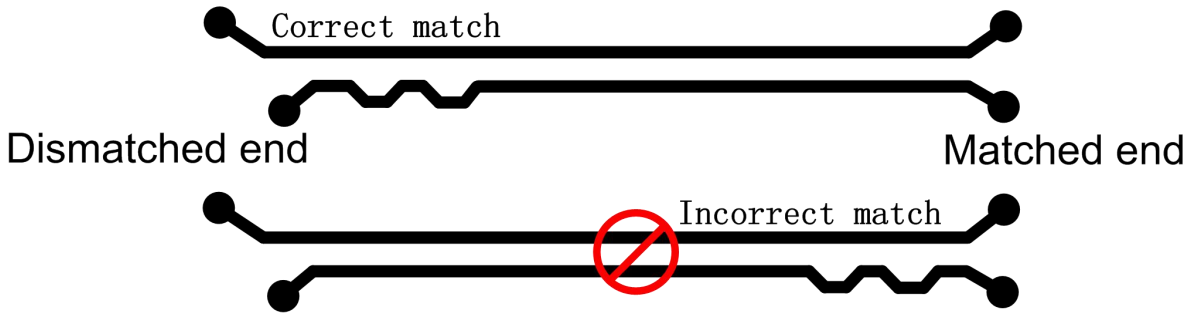


Figure 3-11 Length Match Design of PCIe Difference Pair

3.6 USIMInterface

The L850 module has a built-in USIM card interface, which supports 1.8V and 3V SIM cards.

3.6.1 USIM Pins

The USIM pins descriptionas shown in the following table:

Pin	Pin Name	I/O	Reset Value	Description	Type
36	UIM_PWR	PO		USIM power supply	1.8V/3V

Pin	Pin Name	I/O	Reset Value	Description	Type
30	UIM_RESET	O	L	USIM reset	1.8V/3V
32	UIM_CLK	O	L	USIM clock	1.8V/3V
34	UIM_DATA	I/O	L	USIM data,internal pull up(4.7KΩ)	1.8V/3V
66	SIM_DETECT	I	PD	USIM card detect, internal 390K pull-up. Active high, and high level indicates SIM card is inserted; and low level indicates SIM card is detached.	1.8V

3.6.2 USIM Interface Circuit

3.6.2.1 N.C. SIMCard Slot

The reference circuit design for N.C. (Normally Closed)SIM card slot is shown in Figure 3-12:

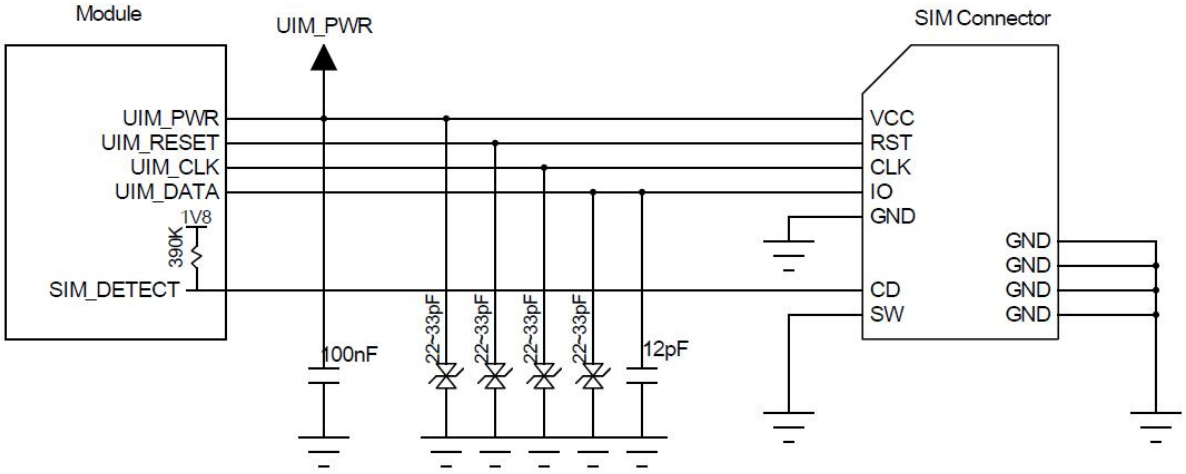


Figure 3-12Reference Circuit for N.C. SIM Card Slot

The principlesof theN.C.SIM card slot are described as follows:

•When the SIM card is detached, it connects the short circuit between CD and SW pins, and drives the SIM_DETECT pin low.

•When the SIM card is inserted, it connects an open circuit between CD and SW pins, and drives the SIM_DETECT pin high.

3.6.2.2 N.O. SIM Card Slot

The reference circuit design for N.O. (Normally Open) SIM card slot is shown in Figure 3-13:

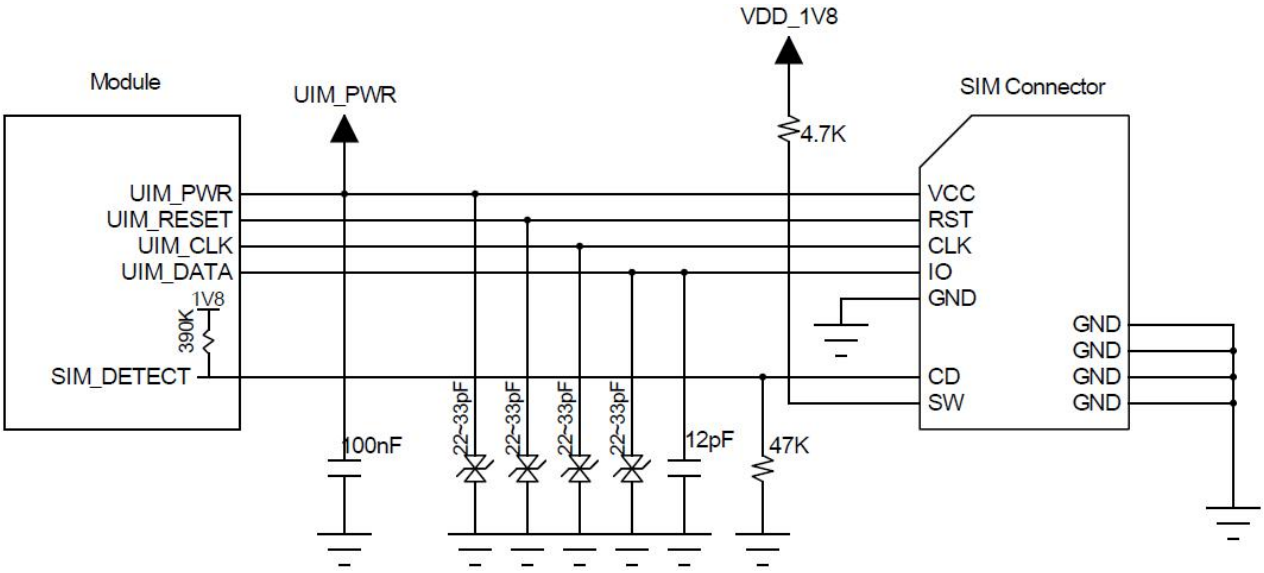


Figure 3-13 Reference Circuit for N.O. SIM Card Slot

The principlesof theN.O.SIM card slot are described as follows:

- When the SIM card is detached, it connects an open circuit between CD and SW pins, and drives the SIM_DETECT pin low.
- When the SIM card is inserted, it connects the short circuit between CD and SW pins, and drives the SIM_DETECT pin high.

3.6.3 USIM Hot-Plugging

The L850 module supports the SIM card hot-plugging function, which determines whether the SIM card is inserted or detached by detecting the SIM_DETECT pin state of the SIM card slot.

The SIM card hot-plugging function can be configuredby “AT+MSMPD” command, and the description for AT command as shown in the following table:

AT Command	Hot-plugging Detection	Function Description
AT+MSMPD=1	Enable	Default value, the SIM card hot-plugging detection function is enabled. The module can detect whether the SIM card is inserted or not through the SIM_DETECT pin state.
AT+MSMPD=0	Disable	The SIM card hot-plugging detect function is disabled. The module readsthe SIM card when starting up, and the SIM_DETECT status will not be detected.

After the SIM card hot-plugging detection functionis enabled, the module detects that the SIM card is insertedwhen the SIM_DETECT pin is high, then executes the initialization program and finish the

network registration after reading the SIM card information. When the SIM_DETECT pin is low, the module determines that the SIM card is detachedand does not read the SIM card.

Note:

By default, SIM_DETECT is active-high, which can be switched to active-low by the AT command. Please refer to the AT CommandsManual for the AT command.

3.6.4 USIM Design

The SIM card circuit design shall meet the EMC standards and ESD requirements with the improvedcapability to resist interference, to ensure that the SIM card can work stably. Thefollowing guidelines should be noted in case of design:

- The SIM card slotplacement should near the module as close as possible, and away from the RF antenna, DC/DC power supply, clock signal lines, and other strong interference sources.
- The SIM card slot with a metal shielding housing can improve the anti-interference ability.
- The trace length between the SIM card slotand the module should not exceed 100mm, or it could reduce the signal quality.
- The UIM_CLK and UIM_DATA signal lines should be isolated by GND to avoid crosstalk interference. If it is difficult for the layout, the whole SIM signal lines should be wrapped with GND as a group at least.
- The filter capacitors and ESDdevices for SIM card signals should be placed near to the SIM card slot, and the ESD devices with 22~33pF capacitance should be used.

3.7 Status Indicator

The L850 module providesthree signals to indicate the operating status of the module, and the status indicator pinsas shown in the following table:

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
10	LED1#	O	PD	System status LED, drain output.	CMOS 3.3V
23	WOWWAN#	O	PU	Module wakes upHost (AP).	CMOS 1.8V
48	TX_BLANKING	O	PD	PA Blanking output, externalGPS control signal.	CMOS 1.8V

3.7.1 LED#1Signal

The LED#1 signal is used to indicate the operating status of the module, and the detailed description as shown in the following table:

Module Status	LED1# Signal
RF function ON	Low level (LED On)
RF function OFF	High level (LED Off)

The LED driving circuit is as follows:

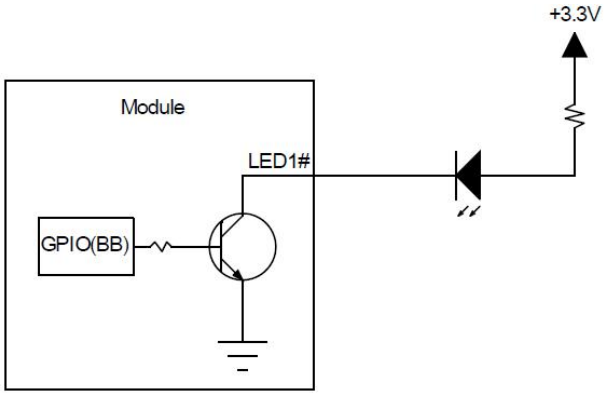


Figure 3-14 LEDDriving Circuit

Note:

The resistance of LED current-limiting resistor is selected according to the driving voltage and the driving current.

3.7.2 WOWWAN#

The WOWWAN# signal is used to wake the Host (AP) when there comes the data request.The definition of WOWWAN# signal is as follows:

Operating Mode	WOWWAN# Signal
data requests	Pull low 1s then pull high (pulse signal).
Idle/Sleep	High level

The WOWWAN# timing is shown in Figure 3-15:

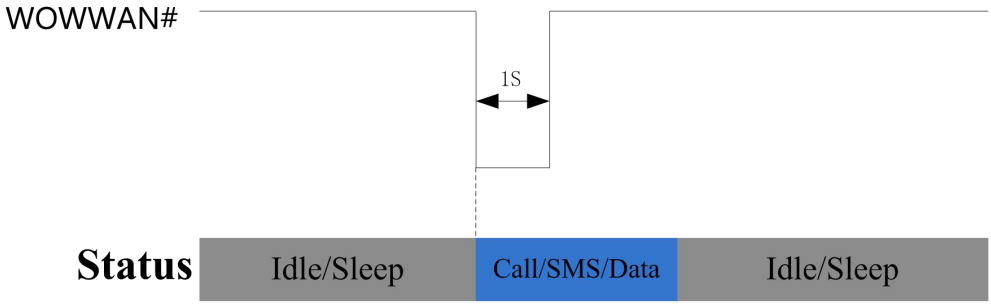


Figure 3-15 WOWWAN#Timing

3.7.3 TX_BLANKING

When the module operates in LTE TDD Band 39, TX_BLANKING outputs the pulse signal synchronous with TDD burst TX timing.

As TDD TX may interfere the receiving of GPS signal, AP will disable GPS or stop GPS data receiving when detecting TX_BLANKING pulse signal, so as to avoid abnormal operation of GPS.

Operating Mode of Module	TX_BLANKING Signal
Default state	Low level
TDD burst TX(Band38)	Output the pulse signal synchronous with TDD burst TX

TX_BLANKING timing is shown in Figure 3-16:

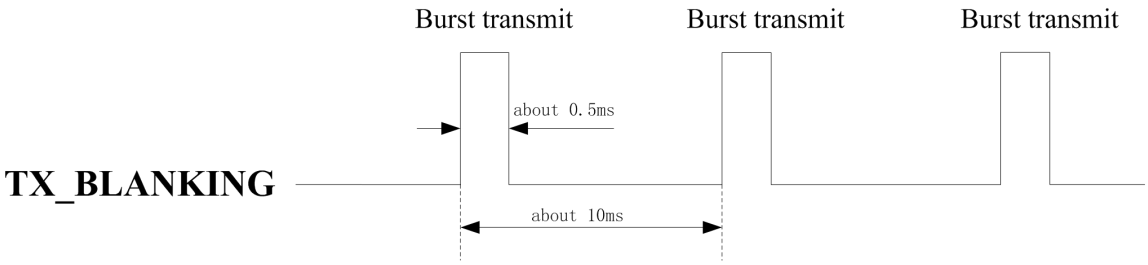


Figure 3-16 TX_BLANKING Timing

3.8 Interrupt Control

The L850 module provides four interrupt signals, and the pin definition is as follows:

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
8	W_DISABLE1#	I	PD	Enable/Disable RF network	CMOS 3.3V
25	DPR	I	PU	Body SAR detection	CMOS 1.8V
26	W_DISABLE2#	I	PU	GNSS Disablesignal, Reserved	CMOS 1.8V
44	GNSS_IRQ	I	PD	GNSS Interrupt Request, Reserved	CMOS 1.8V

3.8.1 W_DISABLE1#

The module provides a hardware pin to enable/disable WWAN RF function, and the function can also be controlled by the AT command. The module enters the Flight mode afterthe RF function is disabled. The definition of W_DISABLE1# signal is as follows:

W_DISABLE1# signal	Function
High/Floating	WWAN function is enabled, the module exits the Flight mode.
Low	WWAN function is disabled, the module entersFlight mode.

Note：

The function of W_DISABLE1# can be customized, please refer to the software porting guide.

3.8.2 BODYSAR

The L850 module supportsBody SARfunction by detecting the DPR pin. The voltage level of DPR is high by default, and when the SAR sensor detects the closing human body, the DPR signal will be pulled down. As the result, the module then lowers down its emission power to its default threshold value, thus reducing theRF radiation onthe human body. The threshold of emission power can be set by the AT Commands. The definition ofDPR signalas shown in the following table:

DPR signal	Function
High/Floating	The module keeps the default emission power
Low	Lower the maximum emission power to the threshold value of the module.

3.9 ClockInterface

The L850 module supports a clock interface, itcan output 26MHz clock.

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
46	SYSCLK	O		26M clock output, default disabled can be used for externalGPS, etc	1.8V

3.10ANT Tunable Interface

The module supports ANT Tunable interfaces with two different control modes, i.e. MIPI interface and 3bit GPO interface. Through cooperating with external antenna adapter switch via ANT Tunable, it can flexibly configure the bands of LTE antenna to improve the antenna's working efficiency and save space for the antenna.

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
56	RFE_RFFE2_ SCLK	O		Tunable ANT control,MIPI Interface, RFFE2 clock,Open Drain output	CMOS 3.3/1.8V
58	RFE_RFFE2_ SDATA	O		Tunable ANT control,MIPI Interface, RFFE2 data,Open Drain output	CMOS 3.3/1.8V
59	ANTCTL0	O		Tunable ANT control,GPO interface,	CMOS 1.8V

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
				Bit0	
61	ANTCTL1	O		Tunable ANT control,GPO interface, bit1	CMOS 1.8V
63	ANTCTL2	O		Tunable ANT control,GPO interface, Bit2	CMOS 1.8V

3.11Config Interface

The L850 module provides four config pins for the configuration as the WWAN-PCIe, USB3.0 type M.2 module:

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
1	CONFIG_3	O		NC	
21	CONFIG_0	O	L	Internally connected to GND	
69	CONFIG_1	O	L	Internally connected to GND	
75	CONFIG_2	O	L	Internally connected to GND	

The M.2 module configuration as the following table:

Config_0 (pin21)	Config_1 (pin69)	Config_2 (pin75)	Config_3 (pin1)	Module Type and Main Host Interface	Port Configuration
GND	GND	GND	NC	WWAN – PCIe,USB3.0	0

Please refer to ”PCI Express M.2 Specification Rev1.0” for more details.

3.12Other Interfaces

The module does not support other interfaces yet.

4 Radio Frequency

4.1 RF Interface

4.1.1 RF Interface Functionality

The L850 module supports two RF connectors used for external antenna connection. As the Figure 4-1 shows, “M” is for Main antenna, used to receive and transmit RF signals; “D/G” is for Diversity antenna, used to receive the diversity RF signals.

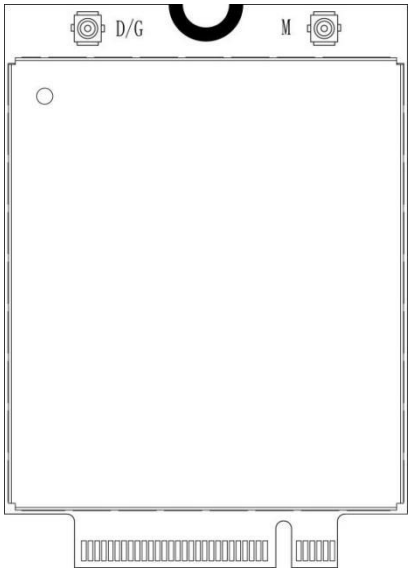


Figure 4-1 RF connectors

4.1.2 RFConnector Characteristic

Rated Condition		Environment Condition
Frequency Range	DC to 6GHz	Temperature Range
Characteristic Impedance	50Ω	–40°C to +85°C

4.1.3 RF Connector Dimension

The L850 module adopts standard M.2 module RF connectors, the model name is 818004607 from ECT company, and the connector size is 2*2*0.6m. The connector dimension is shown as following picture:

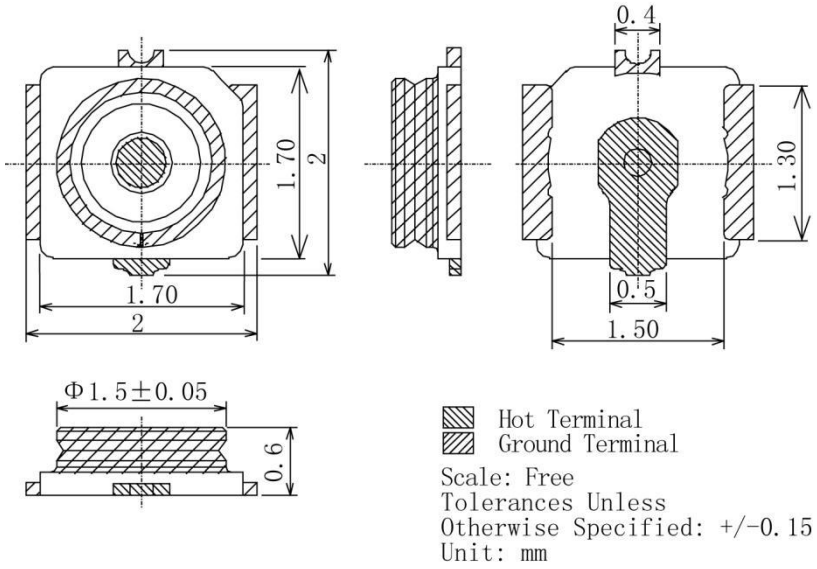


Figure 4-2 RF connector dimensions

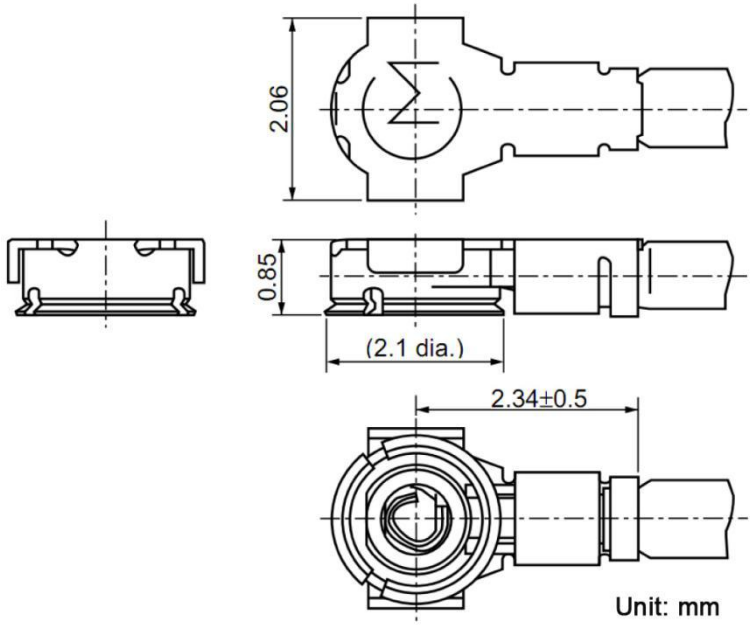


Figure 4-3 0.81mm coaxial antenna dimensions

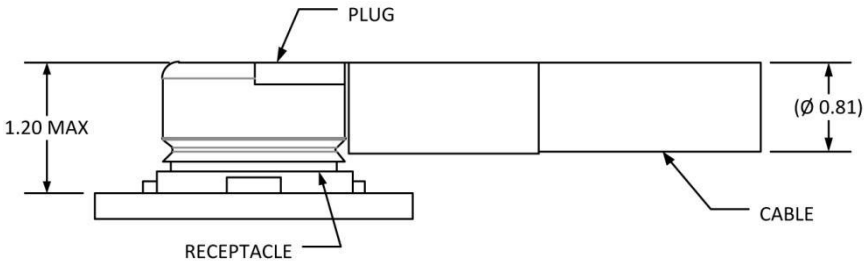


Figure 4-4 Schematic diagram of 0.81mm coaxial antenna connected to the RF connector

4.2 Operating Band

The L850 module operating bands of the antennas are as follows:

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	1850 - 1910	1930 - 1990
Band 3	DCS 1800MHz	LTE FDD	1710 - 1785	1805 - 1880
Band 4	AWS 1700MHz	LTE FDD/WCDMA	1710 - 1755	2110 - 2155
Band 5	CLR 850MHz	LTE FDD/WCDMA	824 - 849	869 - 894
Band 7	IMT-E 2600Mhz	LTE FDD	2500 - 2570	2620 - 2690
Band 8	E-GSM 900MHz	LTE FDD/WCDMA	880 - 915	925 - 960
Band 11	LPDC 1500MHz	LTE FDD	1427.9 - 1447.9	1475.9 - 1495.9
Band 12	LSMH Blocks A/B/C 700MHz	LTE FDD	699 - 716	729 - 746
Band 13	USMH Block C 700MHz	LTE FDD	777 - 787	746 - 756
Band 17	LSMH Blocks B/C 700MHz	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 21	UPDC 1500MHz	LTE FDD	1447.9 - 1462.9	1495.9 - 1510.9
Band 26	ECLR 850MHz	LTE FDD	814 - 849	859 - 894
Band 28	APAC 700MHz	LTE FDD	703 - 748	758 - 803
Band 29	LSMH blocks D/E 700MHz	LTE FDD	N/A	716 - 728
Band 30	WCS blocks A 2300MHz	LTE FDD	2305 - 2315	2350 - 2360
Band 66	1700MHz	LTE FDD	1710 - 1780	2110 - 2200
Band 38	IMT-E 2600MHz	LTE TDD	2570 - 2620	
Band 39	TDD 1900MHZ	LTE TDD	1880 - 1920	

Operating Band	Description	Mode	Tx (MHz)	Rx (MHz)
Band 40	IMT 2300MHz	LTE TDD	2300 - 2400	
Band 41	BRS/EBS 2500MHZ	LTE TDD	2496 - 2690	
GPS L1			N/A	1575.42±1.023
GLONASS L1			N/A	1602.5625±4
BeiDou			N/A	1561.098±2.046

4.3 Transmitting Power

The transmitting power foreach band of the L850 moduleas shown in the following table:

Mode	Band	Tx Power(dBm)	Note
WCDMA	Band 1	23.5±1	
	Band 2	23.5±1	
	Band 4	23.5±1	
	Band 5	23.5±1	
	Band 8	23.5±1	
LTE FDD	Band 1	23±1	10MHz Bandwidth, 1 RB
	Band 2	23±1	10MHz Bandwidth, 1 RB
	Band 3	23±1	10MHz Bandwidth, 1 RB
	Band 4	23±1	10MHz Bandwidth, 1 RB
	Band 5	23±1	10MHz Bandwidth, 1 RB
	Band 7	23±1	10MHz Bandwidth, 1 RB
	Band 8	23±1	10MHz Bandwidth, 1 RB
	Band 11	23±1	10MHz Bandwidth, 1 RB
	Band 12	23±1	10MHz Bandwidth, 1 RB
	Band 13	23±1	10MHz Bandwidth, 1 RB
	Band 17	23±1	10MHz Bandwidth, 1 RB
	Band 18	23±1	10MHz Bandwidth, 1 RB
	Band 19	23±1	10MHz Bandwidth, 1 RB
	Band 20	23±1	10MHz Bandwidth, 1 RB

Mode	Band	Tx Power(dBm)	Note
	Band 21	23±1	10MHz Bandwidth, 1 RB
	Band 26	23±1	10MHz Bandwidth, 1 RB
	Band 28	23±1	10MHz Bandwidth, 1 RB
	Band 30	23±1	10MHz Bandwidth, 1 RB
	Band 66	23±1	10MHz Bandwidth, 1 RB
LTE TDD	Band 38	23±1	10MHz Bandwidth, 1 RB
	Band 39	23±1	10MHz Bandwidth, 1 RB
	Band 40	23±1	10MHz Bandwidth, 1 RB
	Band 41	23±1	10MHz Bandwidth, 1 RB

4.4 Receiver Sensitivity

The receiver sensitivity foreach band of the L850 module as shown in the following table:

Mode	Band	Rx Sensitivity(dBm) Typical	Note
WCDMA	Band 1	TBD	BER<0.1%
	Band 2	TBD	BER<0.1%
	Band 4	TBD	BER<0.1%
	Band 5	TBD	BER<0.1%
	Band 8	TBD	BER<0.1%
LTE FDD	Band 1	TBD	10MHz Bandwidth
	Band 2	TBD	10MHz Bandwidth
	Band 3	TBD	10MHz Bandwidth
	Band 4	TBD	10MHz Bandwidth
	Band 5	TBD	10MHz Bandwidth
	Band 7	TBD	10MHz Bandwidth
	Band 8	TBD	10MHz Bandwidth
	Band 11	TBD	10MHz Bandwidth
	Band 12	TBD	10MHz Bandwidth
	Band 13	TBD	10MHz Bandwidth
	Band 17	TBD	10MHz Bandwidth

Mode	Band	Rx Sensitivity(dBm) Typical	Note
	Band 18	TBD	10MHz Bandwidth
	Band 19	TBD	10MHz Bandwidth
	Band 20	TBD	10MHz Bandwidth
	Band 21	TBD	10MHz Bandwidth
	Band 26	TBD	10MHz Bandwidth
	Band 28	TBD	10MHz Bandwidth
	Band 29	TBD	10MHz Bandwidth
	Band 30	TBD	10MHz Bandwidth
	Band 66	TBD	10MHz Bandwidth
LTE TDD	Band 38	TBD	10MHz Bandwidth
	Band 39	TBD	10MHz Bandwidth
	Band 40	TBD	10MHz Bandwidth
	Band 41	TBD	10MHz Bandwidth

Note:

The above values are measuredfor the dual antennas situation(Main+Diversity). For single main antenna (without Diversity), the sensitivity will drop around 3dBm for each band of LTE.

4.5 GNSS

L850 module supports GNSS/BeiDou and AGNSS functions, and adopts RF Diversity and GNSS/Beidou integrated antenna.

Description	Condition	Test Result
Power	GPS fixing	TBD
	GPS tracking	TBD
	GLONASS fixing	TBD
	GLONASS tracking	TBD
	BeiDou fixing	TBD
	BeiDou tracking	TBD
	Sleep	TBD

Description		Condition	Test Result
TTFF	GPS/GLONASS/BeiDou	Cold start	TBD
		Warm start	TBD
		Hot Start	TBD
	AGNSS	Cold start	TBD
Sensitivity	GPS	Open Sky	TBD
	GLONASS	Open Sky	TBD
	BeiDou	Open Sky	TBD

Note:

Please note that GPS current is tested with RF disabled.

4.6 Antenna Design

The L850module provides main and diversity antenna interfaces, and the antenna design requirements as shown in the following table:

L850 module Main antenna requirements	
Frequency range	The most proper antenna to adapt the frequencies should be used.
Bandwidth(WCDMA)	WCDMA band 1(2100) : 250 MHz WCDMA band 2(1900) : 140 MHz WCDMA band 4(1700) : 445 MHz WCDMA band 5(850) : 70 MHz WCDMA band 8(900) : 80 MHz
Bandwidth(LTE)	LTE band 1(2100): 250 MHz LTE band 2(1900): 140MHz LTE Band 3(1800): 170 MHz LTE band 4(1700): 445MHz LTE band 5(850): 70 MHz LTE band 7(2600): 190 MHz LTE Band 8(900): 80 MHz LTE Band 11(1500): 68 MHz LTE Band 12(700): 47 MHz LTE Band 13(700): 41 MHz

L850 module Main antenna requirements	
	LTE Band 17(700): 42 MHz LTE Band 18(800): 80 MHz LTE Band 19(800): 80 MHz LTE band 20(800): 71 MHz LTE band 21(1500): 63 MHz LTE band 26(850): 80 MHz LTE band 28(700): 100 MHz LTE band 29(700): 12 MHz LTE band 30(2300): 55 MHz LTE band 66(1700): 490MHz LTE band 38(2600): 50 MHz LTE Band 39(1900): 40 MHz LTE band 40(2300): 100 MHz LTE band 41(2500): 194 MHz
Bandwidth(GNSS/BeiDou)	GPS: 2MHz GLONASS: 8MHz BeiDou: 4MHz
Impedance	50Ohm
Input power	> 26dBmaverage power WCDMA & LTE
Recommended standing-wave ratio (SWR)	≤ 2:1

5 Structure Specification

5.1 Product Appearance

The product appearance for L850 module is shown in Figure5-1:

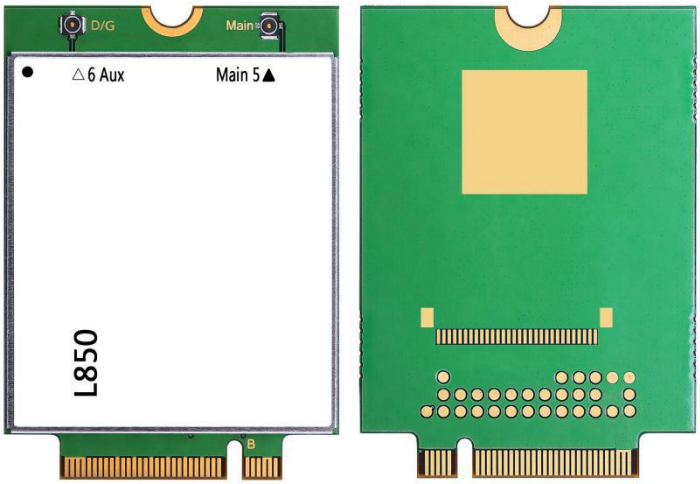


Figure 5-1 Module Appearance

5.2 Dimension of Structure

The structuraldimensionof the L850 module is shown in Figure 5-2:

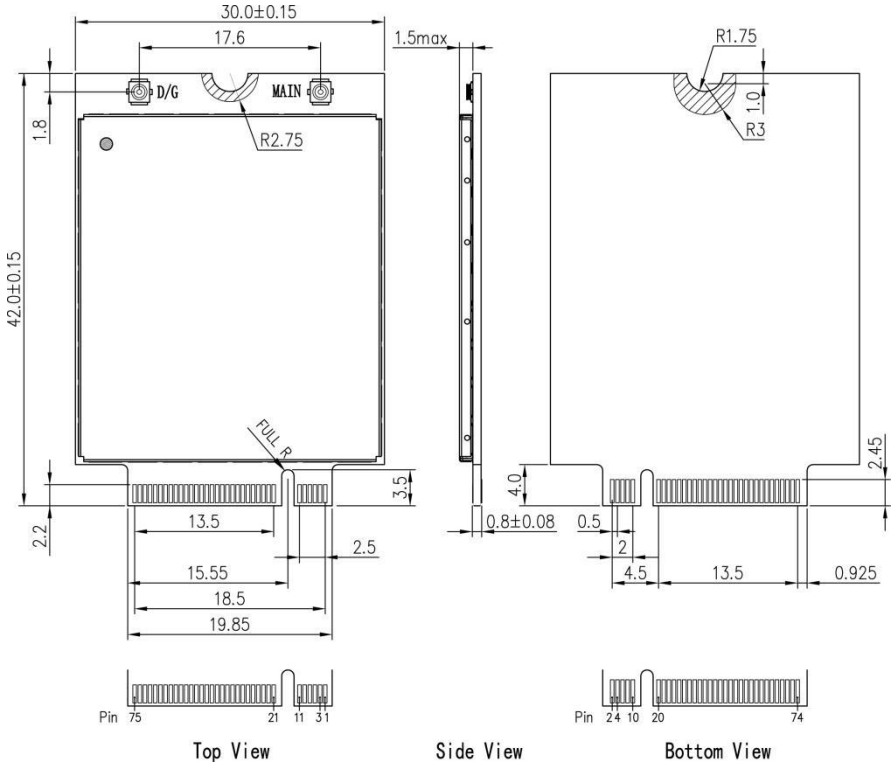


Figure 5-2 Dimension of Structure

5.3 M.2 Interface Model

The L850 M.2 module adopts 75-pin gold finger as external interface, where 67 pins are signal pins and 8 pins are notch pins as shown in Figure 3-1. For module dimension, please refer to chapter 5.2. Based on the M.2 interface definition, L850 module adopts Type 3042-S3-B interface (30x42mm, the component maximum height on t top layer is 1.5mm, PCB thickness is 0.8mm, and KEY ID is B).

Module Nomenclature
Sample type 3042-S3-B

Type XX XX - XX - X - X[1]

Width (mm)
12
16
22
30

Length (mm)
16
26
30
38
42
60
80
110

	Component Max Ht (mm)	
	Top Max[1]	Bottom Max[1]
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

5.4 M.2 Connector

The L850 module connects to AP via M.2 connector, it is recommended to use M.2 connector from LOTES company with the model APCI0026-P001A as shown in Figure 5-3. The package of connector, please refer to the specification.

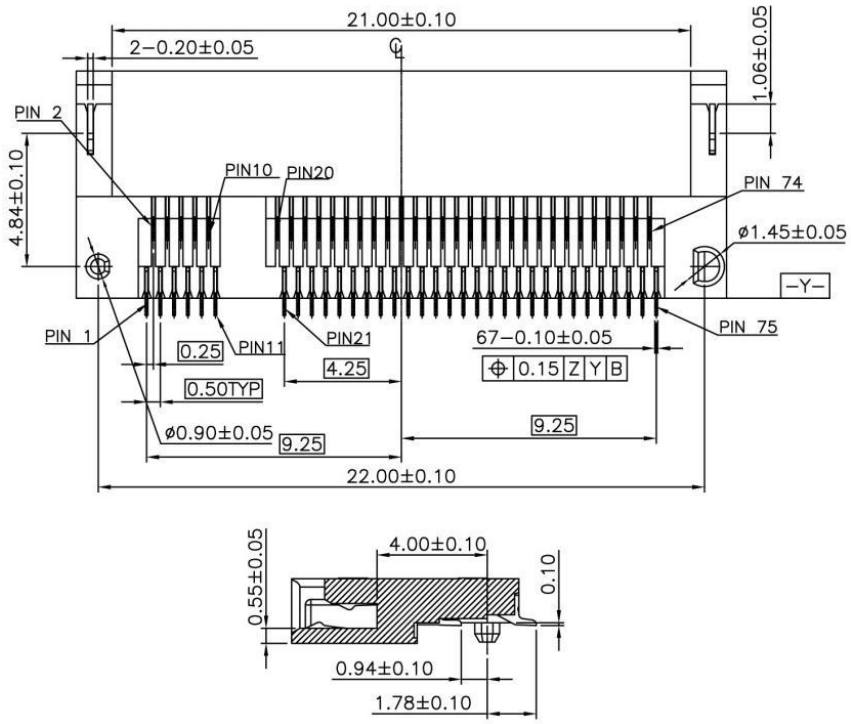


Figure 5-3 M.2 Dimension of Structure

5.5 Storage

5.5.1 Storage Life

Storage Conditions (recommended): Temperature is 23 ± 5 ℃, relative humidity is RH 35-70%.

Storage period (sealed vacuum packing): Under the recommended storage conditions, the storage life is 12 months.

5.6 Packing

The L850 module uses the tray sealed vacuum packing, combined with the outer packing method using the hard cartoon box, so that the storage, transportation and the usage of modules can be protected to the greatest extent.

Note：

The module is a precision electronic product, and may suffer permanent damage if no correct electrostatic protection measures are taken.

5.6.1 Tray Package

The L850 module uses tray package,20 pcs are packed in each tray, with 5 trays in each box and 6 boxes in each case. Tray packaging process is shown in Figure 5-4:

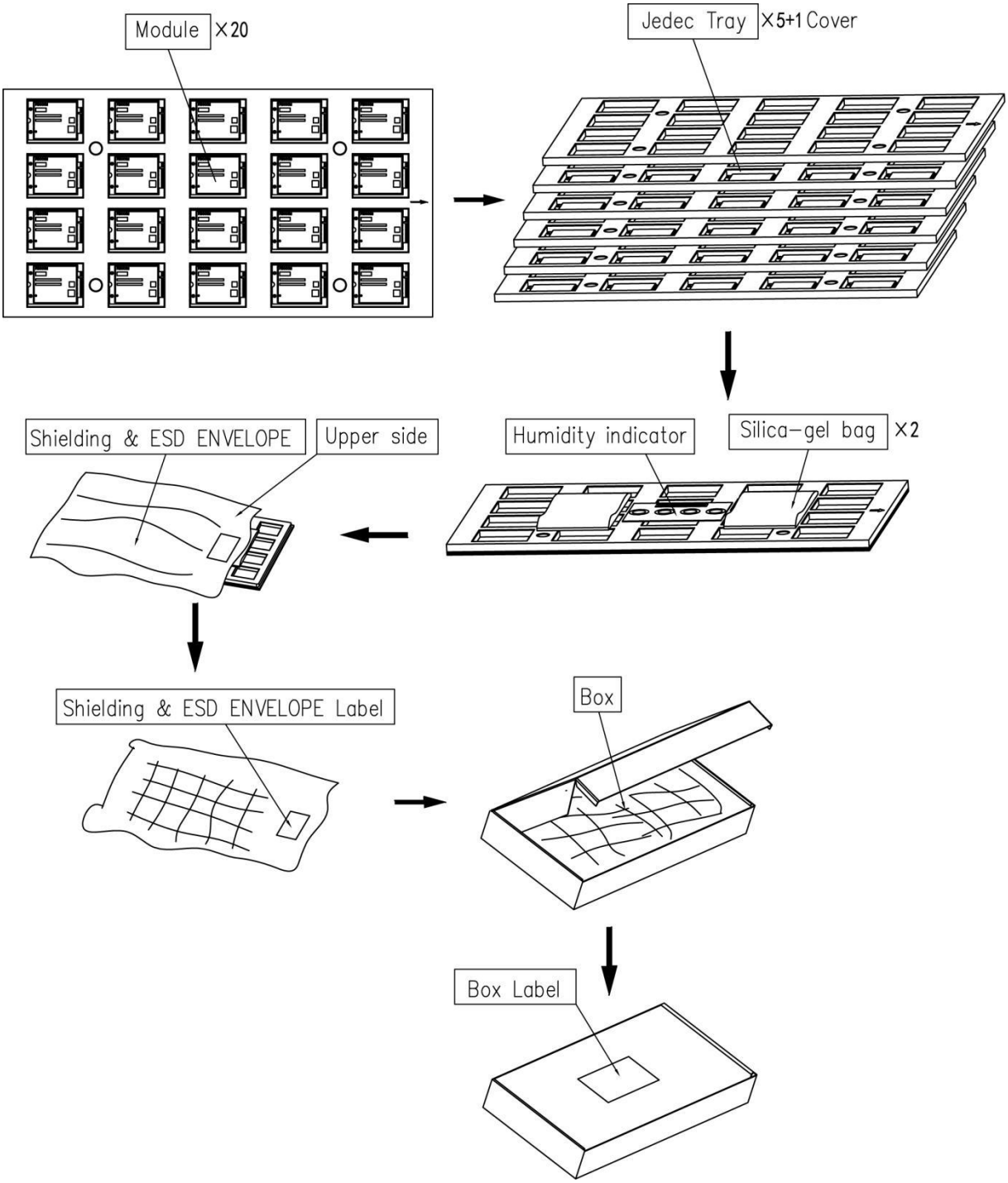
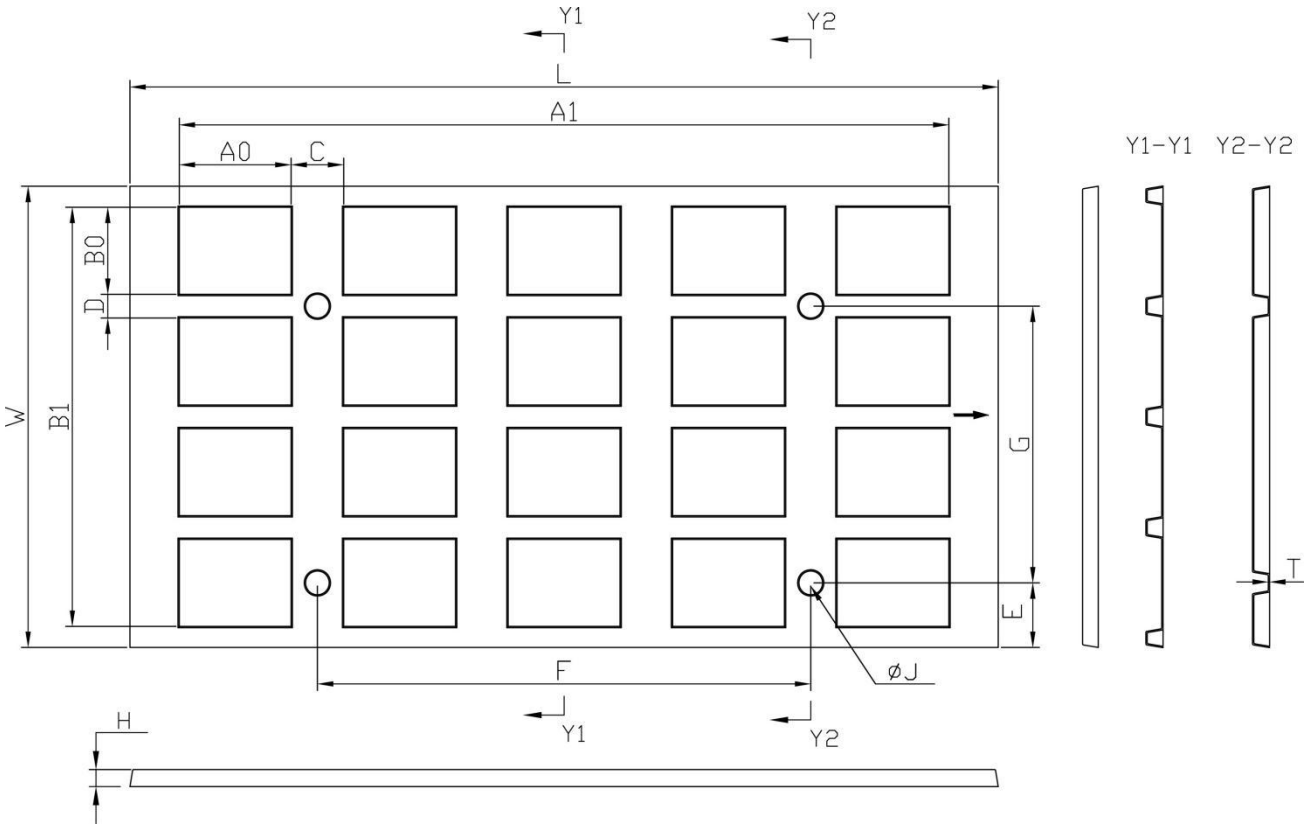


Figure 5-4 Tray Packaging Process

5.6.2 Tray size

The pallet size is 330*175*6.0mm, as shown in Figure 5-5:



ITEM	L	W	H	T	A0	B0
DIM	330.0±0.5	175.0±0.5	6.0±0.3	0.5±0.1	43±0.3	33.0±0.3
ITEM	A1	B1	C	D	E	F
DIM	294.0±0.3	159.0±0.3	20.0±0.5	9.0±0.5	24.5±0.5	187.5±0.2
ITEM	G	J				
DIM	105.0±0.2	9.0±0.2				

Figure 5-5Tray Size (Unit: mm)