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M910-GL Series Hardware User Manual

Version: V1.0.1

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Applicability Table

No.	Product model	Description
1	M910-GL-00-00	MCP is 1G + 512M and supports MAIN_ANT and GNSS_ANT

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Version Record

Version	Update Date	Description
V1.0.0	2017-12-24	Initial version
V1.0.1	2018-03-21	Add VBUS feature description

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1 Foreword

1.1 Introduction

This document describes the electrical characteristics, RF performance, structure size, application environment, etc. of M910-GL module. With the assistance of the document and other instructions, the developers can quickly understand the hardware functions of the M910-GL module and develop products.

1.2 Safety Instruction

By following the safety guidelines below, you can protect the personal safety and help protect the product and work environment from potential damage. Product manufacturers need to communicate the following safety instructions to end users. In case of failure to comply with these safety rules, Fibocom will not be responsible for the consequences caused by the user's misuse.



Road safety first! When you drive, do not use the handheld devices even if it has a hand-free feature. Please stop and call!



Please turn off the mobile device before boarding. The wireless feature of the mobile device is not allowed on the aircraft to prevent interference with the aircraft communication system. Ignoring this note may result in flight safety issue or even breaking the law.



When in a hospital or health care facility, please be aware of restrictions on the use of mobile devices. Radio frequency interference may cause medical equipment to malfunction, so it may be necessary to turn off the mobile device.



The mobile device does not guarantee that an effective connection can be made under any circumstances, for example, when there is no prepayment for the mobile device or the SIM is invalid. When you encounter the above situation in an emergency, remember to use an emergency call, while keeping your device turned on and in areas where signal is strong.



Your mobile device receives and transmits RF signals when it is powered on.

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Radio interference occurs when it is near televisions, radios, computers, or other electronic devices.



Keep the mobile device away from flammable gases. Turn off the mobile device when near gas stations, oil depots, chemical plants or explosive workplaces. There is a safety hazard in operating electronic equipment in any potentially explosive environment.

1.3 Reference Standards

This design of the product complies with the following standards:

- 3GPP TS 51.010-1 V10.5.0: Mobile Station (MS) conformance specification; Part 1: Conformance specification
- 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: Electro Magnetic 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)

1.4 Related Document

FIBOCOM M910-GL LGA SMT Application Design Instruction

1.5 EU Declaration of Conformity (DoC)

Hereby we,

Name of manufacturer:	Fibocom Wireless Inc.
Address:	5/F,Tower A,Technology Building II,1057 Nanhai Avenue
Zip code & City:	Shenzhen
Country:	China
Telephone number:	+86 755 26525092

declare that this DoC is issued under our sole responsibility and that this product:

Product description:	LTE(CatM1, NB-IoT) Module
Type designation(s):	M910-GL
Trademark:	Fibocom
Batch / Serial number:	

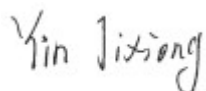
Object of the declaration (further identification of the radio equipment allowing traceability; it may include a color image for the identification of the radio equipment):
is in conformity with the relevant Union harmonization legislation:
Radio Equipment directive: **2014 / 53 / EU**

with reference to the following standards applied:

EN 301 489-1 V2.1.1;	EN 301 489-19 V2.1.0;
EN 301 489-52 V1.1.0;	EN 303 413 V1.1.1
EN 301 511 V12.5.1;	EN 301 908-1 V11.1.1
EN 301 908-13 V11.1.2	
EN 62311:2008	
EN 60950-1 : 2006+ A11:2009 + A1:2010 + A12:2011 + A2:2013	

The Notified Body SGS United Kingdom Limited, with Notified Body number 0890 performed:

Modules: B+C and issued the EU-type examination certificate.

Signed: 

Printed name: Yin Jixiong

Place and date of issue: 2018-07-24

On behalf of Company name: Fibocom Wireless Inc.

Position within Company: Regulatory Principal Engineer

1.6 Federal Communication Commission Interference Statement

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

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 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.

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.

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 transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

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 Max allowed antenna gain is as following table showed:

Operating Band	Antenna Gain (dBi)
GSM850	5.46
GSM1900	3
LTE-M1 BAND 2	9.5
LTE-M1 BAND 4	6.5
LTE-M1 BAND 12	12.94
LTE-M1 BAND 13	13.42
LTE-M1 BAND 26(814-824)	11.65
LTE-M1 BAND 26(824-849)	14.46
LTE-NB1 BAND 2	9.5
LTE-NB1 BAND 4	6.5
LTE-NB1 BAND 12	12.95
LTE-NB1 BAND 13	13.42
LTE-NB1 BAND 26(814-824)	11.65
LTE-NB1 BAND 26(824-849)	14.46

2) The transmitter module may not be co-located with any other transmitter or antenna.

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

Host manufacturer is responsible for ensuring that the host continues to be compliant with the Part 15 subpart B unintentional radiator requirements after the module is installed and operational.

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: ZMOM910GL”** .The grantee's FCC ID can be used only when all FCC compliance

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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.

1.7 IC Statement

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.

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.

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.\

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

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

The Innovation, Science and Economic Development Canada certification label of a module shall be clearly visible at all times when installed in the host device; otherwise,

the host device must be labeled to display the Innovation, Science and Economic Development Canada certification number for the module, preceded by the words "Contains transmitter module IC: 21374-M910GL

2 Product Overview

2.1 Product Introduction

The M910-GL is a multi-mode (LTE Cat.M1, LTE Cat.NB1 and EGPRS) IoT wireless communication module that supports half-duplex LTE and GSM. It can provide data connection in LTE-FDD, LTE-TDD, GPRS and EGPRS networks, and also supports GNSS and VOLTE (LTE Cat.M1).

2.2 Product Specifications

Specification		
Operating frequency band	LTE FDD : B1/B2/B3/B4/B5/B8/B12/B13/B18/B19/B20/B26/B28	
	LTE TDD : B39 (Cat.M1 only)	
	GSM : GSM850/GSM900/DCS1800/PCS1900	
Data transmission	LTE features	Support Cat.M1 and Cat.NB1
		Cat.M1: The maximum uplink rate 375kbps, the maximum downlink rate 375kbps
		Cat.NB1: The maximum uplink rate 70kbps, the maximum downlink rate 32kbps
	GSM features	GPRS: the maximum downlink rate 107kbps, the maximum uplink rate 85.6kbps
		EDGE: The maximum downlink rate 296kbps, the maximum uplink rate 236.8kbps
Power supply voltage	3.3V~4.3V (3.8V recommended)	
Temperature	Normal: -30°C~+75°C	
	Extended: -40°C ~+85°C	
	Storage: -40°C ~+85°C	
Physical characteristics	Package: LGA 120Pin	
	Size: 27.6×25.4×2.3 mm	
	Weight: TBD	
Interface		
Antenna	Antenna: Main x 1、GNSS x 1	

Functional interface	USIM 3.0V/1.8V
	USB 2.0 x 1
	UART, SIM, PCM, I2C
	System Indicator
	Clock
	ADC
Software	
Protocol Stack	Support PPP/TCP/UDP/SSL/TLS/FTP(S)/HTTP(S) protocols
AT Command	3GPP TS 27.007 and 27.005, and proprietary FIBOCOM AT
Firmware update	FOTA
Voice service	Support
SMS	Text and PDU mode; point-to-point SMS; SMS broadcast
MMS service	TBD



Note:

When the temperature is beyond the normal operating temperature range (-30 °C to +75 °C), the RF performance of the module may slightly exceed the 3GPP specifications.

2.3 Hardware Diagram

Figure 2-1 hardware diagram shows the main hardware features of the M910-GL module.

- PMIC
- MCP
- Clock
- Function interface
- Transceiver
- RF PA
- RF filter
- RF switch

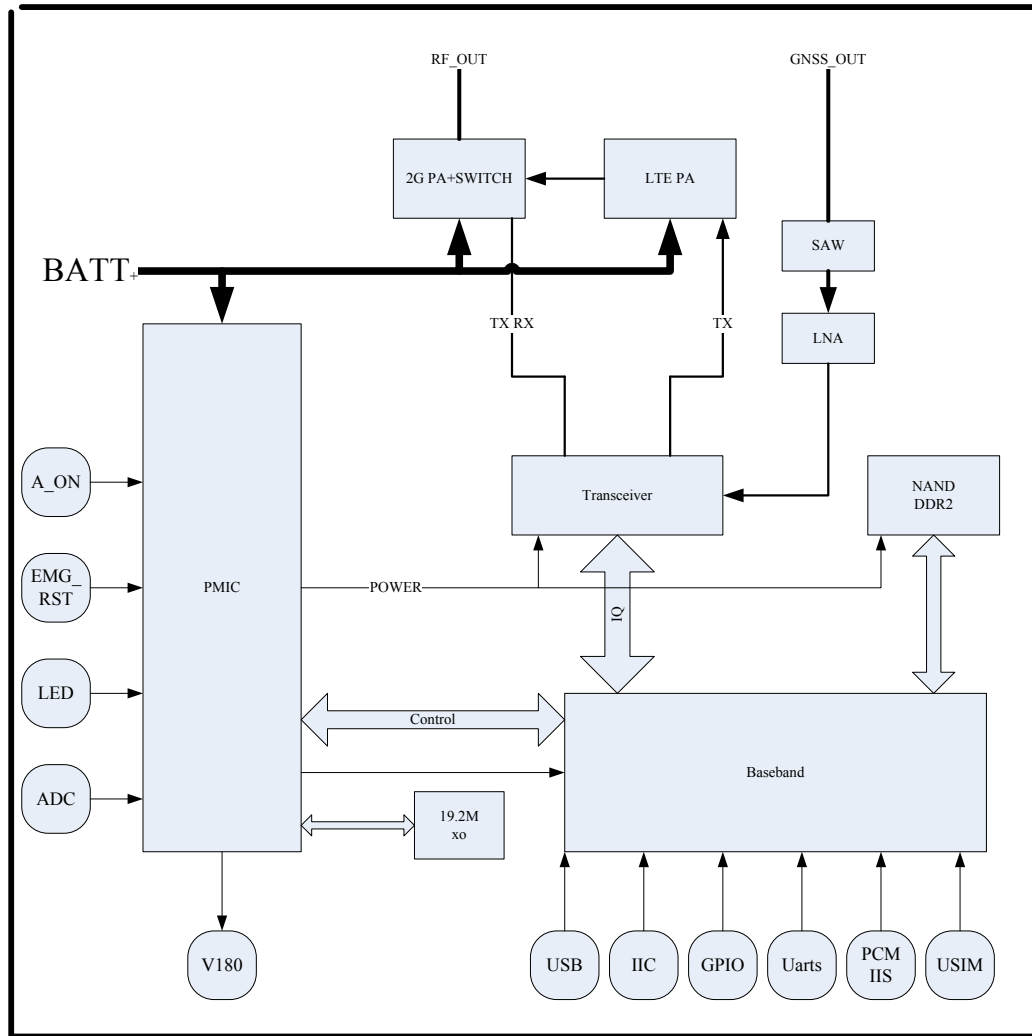


Figure 2-1 Hardware Diagram

3 Application Interface

3.1 LGA Interface

M910-GL module adopts LGA packaging with a total of 120 pins. It can be applied to the client's wireless application platform. The function of interface:

- Power supply
- Power on/off, reset
- (U)SIM interface
- USB interface
- UART interface
- PCM/IIS
- I2C interface
- Status indication interface
- Emergency download interface

3.1.1 Pin Distribution

M910	PWM1 109	GPIO8 110	BATT+ 53	GND 54	GND 55	GND 56	GND 57	GND 58	RF_OUT 59	GND 60	GND 61	GND 62	GND 63	AGND 64	DNC 65	DNC 66	DNC 111	GPIO15 112
DNC 52																		DNC 1
LED 51																		DNC 2
GND 50																		GND 3
HSICSTB 49								89 GND	85 GND	81 GND								BATT+ 4
HSICDAT A 48						118 GND	119 GND	90 GND	86 GND	82 GND	120 GND	113 GND						GND 5
USB_DW 47						100 GND	93 GND				74 DNC	67 DNC						ADC1 6
USB_DP 46						101 GND	94 GND				75 DNC	68 DNC						ON 7
VBUS 45						102 GND	95 GND				76 DNC	69 DNC						GND 8
DTRO 44						103 GND	96 GND				77 DNC	70 DNC						V180 9
DCDO 43						104 MISO	97 GND				78 DNC	71 DNC						RXDO 10
DSRO 42						105 MOSI	98 CLK				79 A_ON	73 A_ON						CTS0 11
DNC 41						106 SSN	99 GND				80 DNC	73 DNC						TXDO 12
DNC 40						117 DL	116 DNC	91 DNC	87 DNC	83 GND	115 DNC	114 DNC						RING0 13
GND 39								92 GND	88 GND	84 GND								RTS0 14
DNC 38																		DNC 15
GND 37																		OCYST 16
GNSS 36																		GCIN 17
GND 35																		CCIO 18
	GPIO11 108	GPIO12 34	EMO_RST 33	CTS1 32	RTS1 CP_WAKE 31	RXD1 GPIO16 30	TXD1 GPIO17 29	I2CCLK 28	I2CDAT 27	SCLK 26	RXDDAI 25	TPSDAI 24	TXDDAI 23	DNC 22	CCCLK 21	CCVOC 20	GPIO13 19	GPIO14 107

Figure 3-1 Pin Distribution Diagram



Note: It is recommended that the heat sink pad is reserved for the PCB packaging and welded.

3.1.2 Pin definition

The pin definitions are as shown in the following table:

Pin	Pin Name	I/O	Level	Description
1	DNC	-	-	
2	DNC	-	-	
3	GND	G	-	Ground
4	BATT+	I	3.8V	RF PA power input (3.3V-4.3V)
5	GND	G	-	Ground
6	ADC	I	-	Analog input
7	ON	I	1.8V	High level power-on control pin; can be floating
8	GND	G	-	Ground
9	V180	O	1.8V	Module digital level, 1.8V output, 80mA
10	RXD0	I	1.8V	Serial interface signal
11	CTS0	O	1.8V	Serial interface signal
12	TXD0	O	1.8V	Serial interface signal
13	RING0	O	1.8V	Serial interface signal
14	RTS0	O	1.8V	Serial interface signal
15	DNC	-	-	
16	CCRST	O	1.8V or 3.0V	SIM reset signal line
17	CCIN	O	1.8V	SIM card hot plug detection
18	CCIO	O	1.8V or 3.0V	SIM data signal line
107	GPIO14	I/O	1.8V	GPIO
19	GPIO13	I/O	1.8V	GPIO
20	CCVCC	O	1.8V or 3.0V	SIM power supply
21	CCCLK	O	1.8V or 3.0V	SIM clock signal line
22	DNC	-		
23	TXDDAI	O	1.8V	Digital voice interface
24	TFSDAI	IO	1.8V	Digital voice interface
25	RXDDAI	I	1.8V	Digital voice interface

Pin	Pin Name	I/O	Level	Description
26	SCLK	I/O	1.8V	Digital voice interface
27	I2CDAT	OD	-	I2C interface data signal
28	I2CCLK	OD	-	I2C interface clock signal
29	TXD1	O	1.8V	Serial interface signal
30	RXD1	I	1.8V	Serial interface signal
31	RTS1	O	1.8V	Serial interface signal
32	CTS1	O	1.8V	Serial interface signal
33	EMG_RST	I	1.8V	Module reset signal
34	GPIO12	I/O	1.8V	GPIO
108	GPIO11	I/O	1.8V	GPIO
35	GND	G	-	Ground
36	GNSS	I	-	GNSS antenna interface
37	GND	G	-	Ground
38	DNC	-	-	
39	GND	G	-	Ground
40	DNC	-	-	
41	DNC	-	-	
42	DSR0			
43	DCD0	O	1.8V	Serial interface signal
44	DTR0	I	1.8V	Serial interface signal
45	VBUS	I	1.8V	USB plug detect signal
46	USB_DP	I/O	USB 2.0 Specification	USB differential data positive signal
47	USB_DM	I/O	USB 2.0 Specification	USB differential data negative signal
48	DNC	-	-	
49	DNC	-	-	
50	GND	G	-	Ground
51	LED	OD	-	Network indicator
52	DNC	-	-	
109	PWM1	O	1.8V	Adjustable pulse signal
110	GPIO8	I/O	1.8V	GPIO
53	BATT+	I	3.8V	PMIC power input (3.3V-4.3V)

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Pin	Pin Name	I/O	Level	Description
54	GND	G	-	Ground
55	GND	G	-	Ground
56	GND	G	-	Ground
57	GND	G	-	Ground
58	GND	G	-	Ground
59	RF_OUT	I/O		Main antenna interface
60	GND	G	-	Ground
61	GND	G	-	Ground
62	GND	G	-	Ground
63	GND	G	-	Ground
64	GND	G	-	Ground
65	DNC	-	-	
66	DNC	-	-	
111	DNC	-	-	
112	GPIO15	I/O	1.8V	GPIO
67	DNC	-	-	
68	DNC	-	-	
69	DNC	-	-	
70	DNC	-	-	
71	DNC	-	-	
72	A_ON	I	1.8V	Power on/off signal; low level power on /off
73	DNC	-	-	
74	DNC	-	-	
75	DNC	-	-	
76	DNC	-	-	
77	DNC	-	-	
78	DNC	-	-	
79	A_ON	I	1.8V	Power on/off signal; low level power on /off
80	DNC	-	-	
81	GND	G	-	Ground
82	GND	G	-	Ground

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Pin	Pin Name	I/O	Level	Description
83	GND	G	-	Ground
84	GND	G	-	Ground
85	GND	G	-	Ground
86	GND	G	-	Ground
87	DNC	-	-	
88	GND	G	-	Ground
89	GND	G	-	Ground
90	GND	G	-	Ground
91	DNC	-	-	
92	GND	G	-	Ground
93	GND	G	-	Ground
94	GND	G	-	Ground
95	GND	G	-	Ground
96	GND	G	-	Ground
97	GND	G	-	Ground
98	DNC	-	-	CLK
99	GND	G	-	Ground
100	GND	G	-	Ground
101	GND	G	-	Ground
102	GND	G	-	Ground
103	GND	G	-	Ground
104	DNC	-	-	MISO
105	DNC	-	-	MOSI
106	DNC	-	-	SSN
113	GND	G	-	Ground
114	DNC	-	-	
115	DNC	-	-	
116	DNC	-	-	
117	DL	I	1.8V	Emergency download point
118	GND	G	-	Ground
119	GND	G	-	Ground
120	GND	G	-	Ground



Note:

DNC pins remain floating.

3.2 Power Supply

The power interfaces of M910-GL module are as shown in the following table:

Pin Name	I/O	Pin	Description
BATT+	I	4,53	Module power supply, 3.3 ~ 4.3, nominal value 3.8V
V180	O	9	Voltage Output, 1.8V, 80mA
GND	-		Ground

3.2.1 Power Supply

The power supply range of the M910-GL module is 3.3V-4.3V.

While ensuring the sufficient BATT + power supply capacity (2A load), the design shall follow:

Connect a 100uF low-ESR (less than 0.5Ω) ceramic voltage-stabilizing capacitor near the BATT + input. Since the price of small sized high-capacity ceramic capacitor is higher, it is recommended to replace it with a 220uF tantalum capacitor, and then connect a 0.1uF ~ 1uF ceramic capacitor.

3.2.2 1.8V Output

The M910-GL outputs a 1.8V voltage using for the internal digital circuit of the module. The voltage is the IO level voltage of the module and can be used to indicate that the module is on or off, or for external low current (<80mA) circuit. If it is not in use, keep it in floating status. The logic level of V180 is defined as follows:

Parameter	Minimum	Typical	Maximum	Unit
V180	1.71	1.8	1.89	V
V _{IH}	1.3	1.8	1.89	V
V _{IL}	-0.3	0	0.5	V

3.2.3 Power consumption

In the case of 3.8V power supply , the power consumption of M910-GL module is shown in the following table:

Parameter	Mode	Condition	Average Typ.Current(mA)
I _{off}	Power off	Module power off	0.008
I _{sleep}	PSM		0.01
	e-DRX		TBD
I _{idle}	RRC_Idle		<5mA
	RRC_Connect		<42 mA
I _{GPRS-RMS} CS4	GPRS	GPRS Data transfer GSM850; PCL=5; 1Rx/4Tx	513
		GPRS Data transfer GSM900; PCL=5; 1Rx/4Tx	510
		GPRS Data transfer DCS1800; PCL=0; 1Rx/4Tx	409
		GPRS Data transfer PCS1900; PCL=0; 1Rx/4Tx	381
I _{EGPRS-RMS} MCS9	EDGE	EDGE Data transfer GSM850; PCL=8; 1Rx/4Tx	437
		EDGE Data transfer GSM900; PCL=8; 1Rx/4Tx	468
		EDGE Data transfer DCS1800; PCL=2; 1Rx/4Tx	400
		EDGE Data transfer PCS1800; PCL=2; 1Rx/4Tx	383
I _{LTE-RMS}	LTE FDD	LTE FDD B1 @+23dBm	Cat.M1: 222 Cat.NB1: 272
		LTE FDD B2 @+23dBm	Cat.M1: 223 Cat.NB1: 304
		LTE FDD B3 @+23dBm	Cat.M1: 218 Cat.NB1: 336
		LTE FDD B4 @+23dBm	Cat.M1: 216 Cat.NB1: 332
		LTE FDD B5 @+23dBm	Cat.M1: 224 Cat.NB1: 267
		LTE FDD B8 @+23dBm	Cat.M1: 241 Cat.NB1: 275
		LTE FDD B12 @+23dBm	Cat.M1: 249 Cat.NB1: 308
		LTE FDD B13 @+23dBm	Cat.M1: 229 Cat.NB1: 282
		LTE FDD B17 @+23dBm @NB only	Cat.NB1: 306
		LTE FDD B18 @+23dBm	Cat.M1: 221 Cat.NB1: 262

Parameter	Mode	Condition	Average Typ.Current(mA)
		LTE FDD B19 @+23dBm	Cat.M1: 221 Cat.NB1: 263
		LTE FDD B20@+23dBm	Cat.M1: 219 Cat.NB1: 253
		LTE FDD B26@+23dBm	Cat.M1: 220 Cat.NB1: 279
		LTE FDD B28@+23dBm	Cat.M1: 245 Cat.NB1: 298
	LTE TDD	LTE TDD B39 @+23dBm @eMTC only	Cat.M1: TBD



Note:

PSM: The M910-GL module can further reduce its own power consumption by entering the PSM. PSM is similar to switch off, but the module is still registered on the network. After waking up from PSM mode, the module does not need to reattach or reestablish a PDN connection. Therefore, after the module enters the PSM, it can not immediately respond to user requests. When the module needs to use the PSM, it will request an activity time value during each attach and TAU process. If the network side supports PSM and accepts the module to use the PSM, then the network confirms PSM usage by assigning the module an activity time value. If the module wants to change the activity time value, for example when the conditions in the module change, the module will request the desired value during the TAU.

If the network side supports PSM, PSM function can be enabled by AT command.

Wake up the module from the PSM state as follows:

1. Pull PWRKEY pin to low level to wake up the module;
2. Wait for the timer (T3412) overflow, the module will automatically wake up.

3.3 Control Signal

The M910-GL module provides two control signals for power on/off and reset operations. The pin definitions are as follows:

Pin name	I/O	Pin	Description
EMG_RST	I	33	When the module is in work, give it a Tst (150 ~ 460ms) low level, and then pull it high, the module is reset

A_ON	I	72\79	When pulling down the level to power on, the shortest duration of low level is 100ms, and when pulling down the level to power off, the minimum duration is 2s
------	---	-------	--

3.3.1 Module start-up

3.3.1.1.1 Start-up circuit reference

When the M910-GL module is in shutdown mode, the module will start up by pulling down A_ON for at least 100ms. It is recommended to use open-drain drive circuit for control. The reference circuit is shown in Figure 3-2:

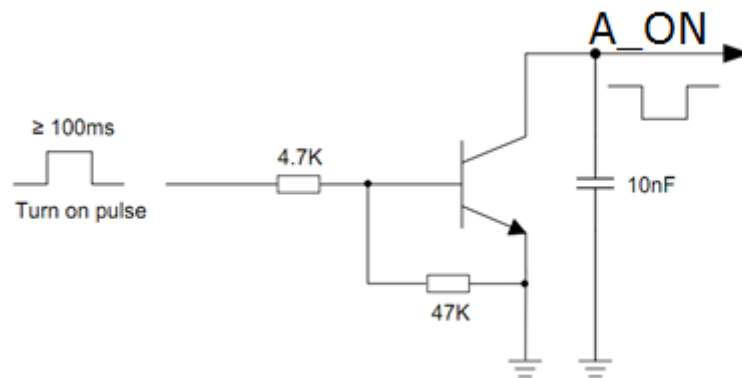


Figure 3-2 Open Set Reference Start-up Circuit

Another control method is to directly control through a button, and place a TVS near the button for ESD protection. The reference circuit is shown in Figure 3-3:

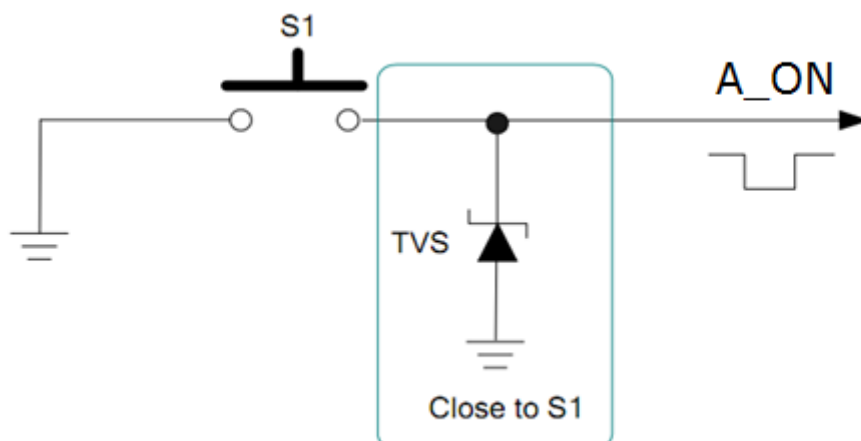


Figure 3-3 Button Start-up Reference Circuit

3.3.1.2 Start-up timing

The start-up timing is shown in Figure 3-4:

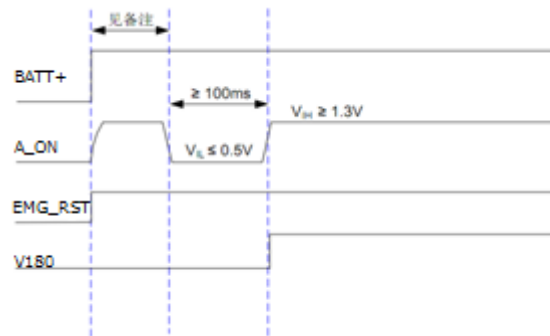


Figure 3-4 Start-up Timing Control Diagram



Note:

Before pulling down the A_ON pin, make sure the BATT + voltage is stable. It is recommended that the interval between powering up BATT + and pulling down A_ON pin should not be less than 100ms.

3.3.2 Module shutdown

The module supports the following three shutdown modes:

Shutdown Mode	Shutdown Method	Applicable scenarios
Low-voltage shutdown	When BATT + powers down, the module will shut down	The module does not shut down through normal process, i.e. logout process from the base station
Hardware shutdown	Pull down A_ON (more than 1.5s)	Normal shutdown
AT shutdown	TBD	

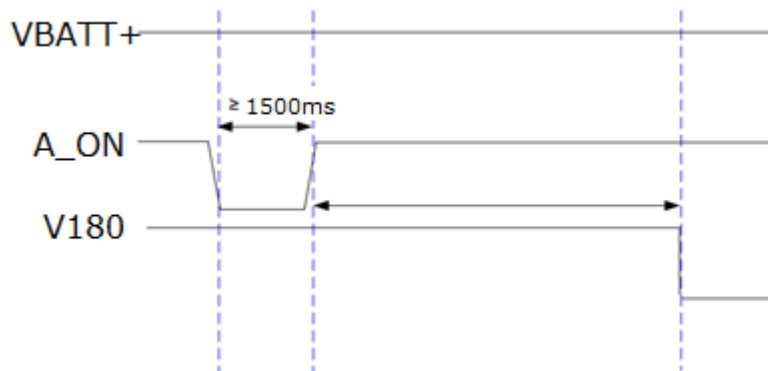


Figure 3-5 Shutdown Timing Control Diagram

3.3.2.1 Shutdown Timing

1. When the module is working properly, do not cut off the power to the module immediately to avoid damaging the internal Flash of the module. It is strongly recommended to shut down the module by A_ON or AT command before disconnecting the power supply.
2. When using the AT command to shut down, make sure that the A_ON is in a high level state after the shutdown command is executed, otherwise the module will start up again after the shutdown is completed.

3.3.3 Module reset

M910-GL module can reset by hardware and AT command.

3.3.3.1 Reset circuit

Refer to Figure 3-6 and Figure 3-7. It is similar to the start-up/shutdown control circuit. The client can control the EMG_RST pin using an open-drain drive circuit or push button.

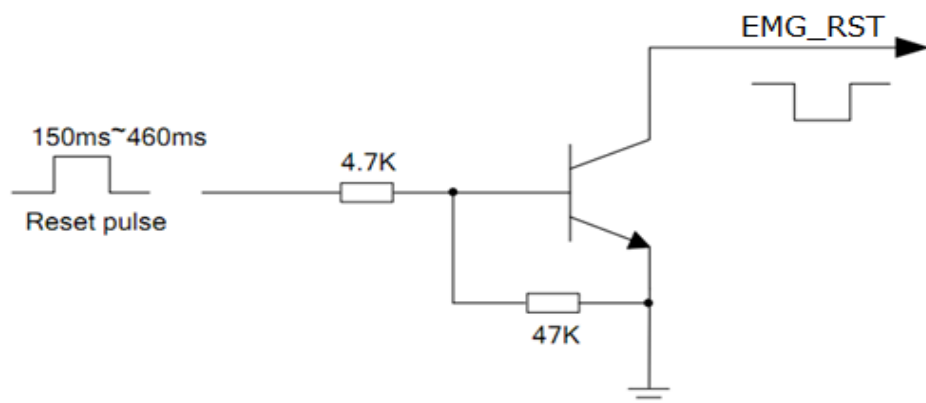


Figure 3-6 EMG_RST Reset Open Reference Circuit

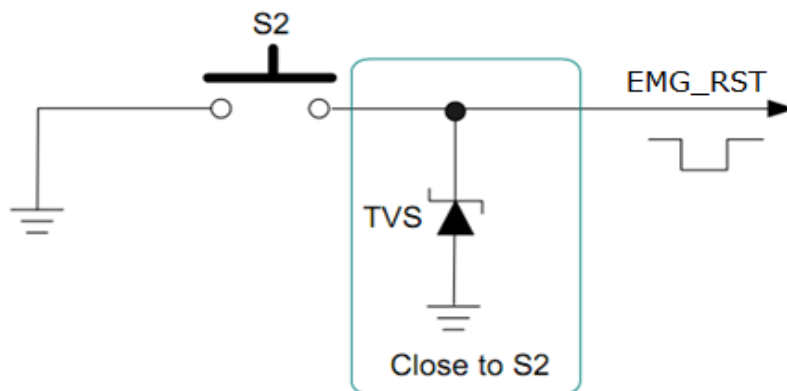


Figure 3-7 EMG_RST Reset Button Reference Circuit

3.3.3.2 RESET control timing

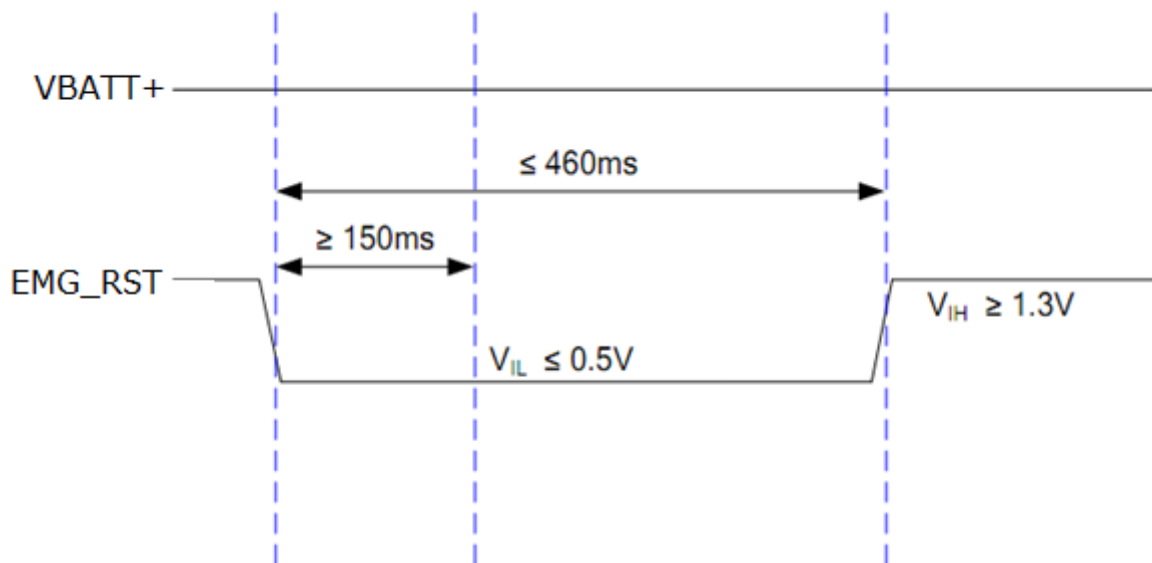


Figure 3-8 Reset Control Timing



Note:

RESET is a sensitive signal, so it is 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 be protected by nice Ground. Also, the RESET signal lines shall be neither near the PCB edge nor route on the surface planes to avoid module from reset caused by ESD problems.

Software reset: TBD

3.4 USB Interface

The M910-GL provides a USB interface that conforms to the USB 2.0 specification and supports high-speed (480Mbps) and full-speed (12Mbps) modes. The USB interface can be used for AT command transmission, data transmission, software debugging and software upgrades.

For more information about the USB 2.0 specification, visit <http://www.usb.org/home>.

3.4.1 USB interface definition

Pin Name	I/O	Pin	Description
USB_DN	I/O	47	USB differential data bus
USB_DP	I/O	46	USB differential data bus
VBUS	I	45	USB plug detection; 1.8V input level

We recommend that clients reserve USB interface for software upgrades.

In the design of USB interface circuit, in order to ensure the USB performance, the following principles are recommended in circuit design:

- 1) The USB data lines need to be grounded, with 90Ω impedance differential cable;
- 2) Do not take the USB cable under the crystal, oscillator, magnetic device or RF signal. It is recommended to take the inner differential cable and the cable shall be grounded at all directions;
- 3) The model selection for ESD protection of USB data cable requires special attention, and the parasitic capacitance must not exceed 2pF;
- 4) ESD protector of USB should be placed close to the USB interface.
- 5) As a USB plug-in testing, the input level of VBUS does not exceed 1.8V, and VBUS connects USB USB_VBUS pin through the partial pressure resistor.

3.5 USIM Interface

M910-GL module supports the USIM card interface (1.8V and 3.0V cards).

3.5.1 USIM pin

USIM pin is shown in the following table:

Pin Name	I/O	Pin	Description
CCRST	I/O	15	RESET Signal
CCIN (USIM_DET)	O	17	Detect USIM/SIM card for Hot-swap
CCIO	O	18	Data Signal
CCVCC	O	20	Power
CCCLK	I	21	Clock Signal

3.5.2 USIM interface circuit

3.5.2.1 SIM card slot with detection signal

USIM/SIM design requires the use of SIM card slot (Fibocom recommend: SIM016-8P-220P). We recommend using hot plug holder with SIM_DETECT feature.

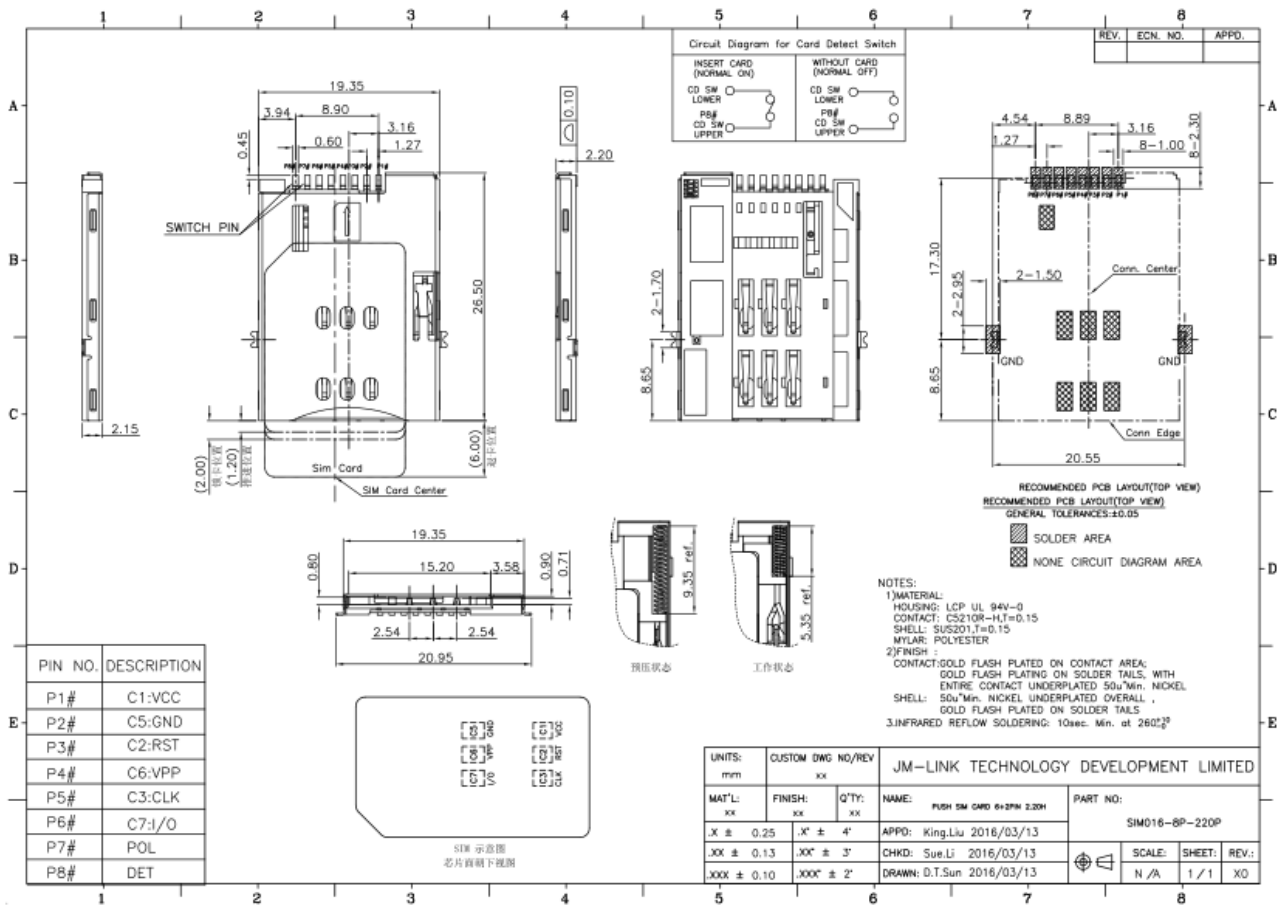


Figure 3-9 SIM Card Slot Diagram SIM016-8P-220P

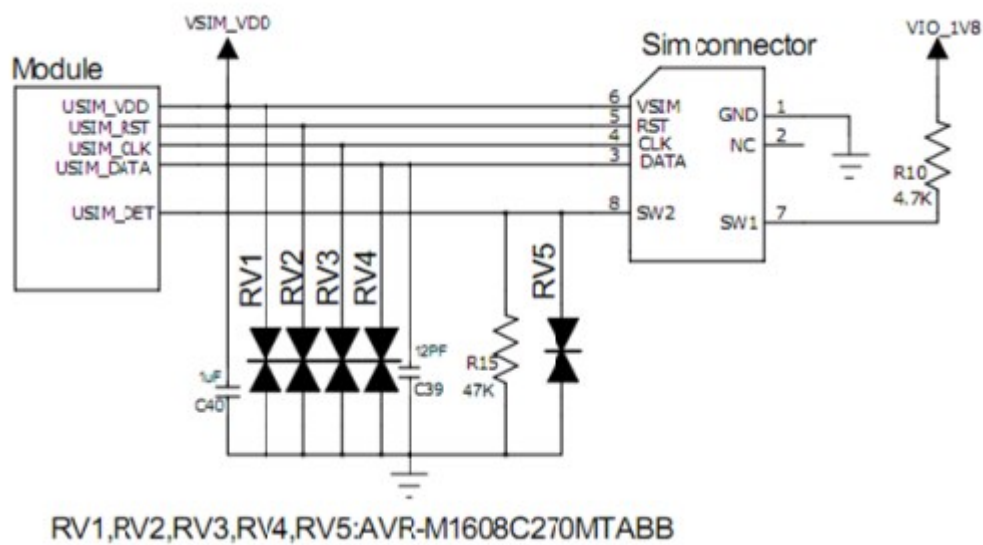


Figure 3-10 M910-GL USIM/SIM Interface with Detection Reference Design

Principles of SIM card slot with detection signal are as follows:

SIM card is plugged, CCIN is high level

SIM card is unplugged, CCIN is low level

For SIM card slot without detection signal, CCIN remains floating.



Note:

SIM card hot plug feature can be enabled by AT command for logic level control. Please refer to the AT command manual for the specific AT command.

3.5.3 USIM design requirements

SIM card circuit design shall meet EMC standards and ESD requirements, and at the same time, it shall improve anti-interference ability to ensure that the SIM card can work stably. The design needs to strictly observe the following rules:

- SIM card slot is placed as close to the module as possible, away from the RF antenna, DCDC power, clock signal lines and other strong interference sources;
- Adopt the SIM card slot with metal shield shell to improve anti-interference ability;
- The length of cable from the module to the SIM card slot shall not exceed 100mm. Longer cable reduces signal quality.
- CCCLK and CCIO signals are isolated to avoid mutual interference. If it is difficult to do so, SIM signal needs to be protected as a set;
- The filter capacitor and ESD device of SIM card signal cable are placed close to the SIM card slot. Select 22 ~ 33pF capacitor for ESD device equivalent capacitor.

3.6 UART Interface

3.6.1 UART interface definition

M910-GL module has two serial interfaces: serial interface 0 and serial interface 1. The following describes the main features of these two serial interfaces:

Support 4800bps, 9600bps, 19200bps, 38400bps, 57600bps, 115200bps, 230400bps, 460800bps, 921600bps baud rate, and the default baud rate is 115200bps, used for data transmission and AT command transmission.

The following table describes the serial interface 0 pin:

Pin Name	I/O	Pin	Description
RXD0	I	10	Serial interface RXD
CTS0	DO	11	Serial interface CTS
TXD0	O	12	Serial interface TXD
RING0	DO	13	Serial interface RI

Pin Name	I/O	Pin	Description
RTS0	DI	14	Serial interface RTS
DSR0	DO	42	Serial interface DSR
DCD0	DO	43	Serial interface DCD
DTR0	DI	44	Serial interface DTR

The following table describes the serial interface 1 pin:

Pin Name	I/O	Pin	Description
TXD1	DO	29	Serial interface TXD
RXD1	DI	30	Serial interface RXD
RTS1	DI	31	Serial interface RTS
CTS1	DO	32	Serial interface CTS

3.6.2 UART interface application

The serial interface level of M910-GL module is 1.8V. If the level of the client host system is 3.3V or other, a level shifter shall be added to the serial interface connection between the module and the host. The following figure shows the reference circuit design using level shifter chip:

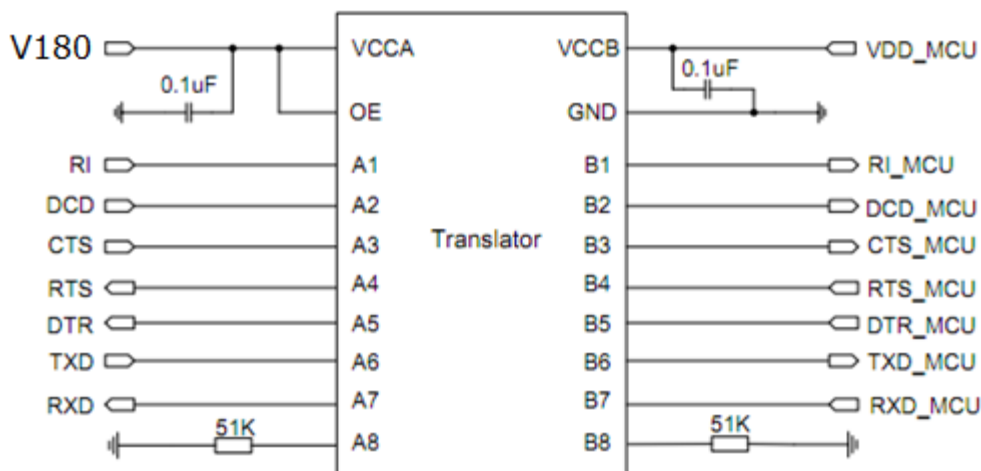


Figure 3-11 UART Signal Connection 1

3.7 Status Indicator

M910-GL module provides a signal to indicate the operating status of the module, and status indicator pin is shown in the following table:

Pin Name	I/O	Pin	Description
LED	O	51	TBD

LED reference circuit is shown in Figure 3-12:

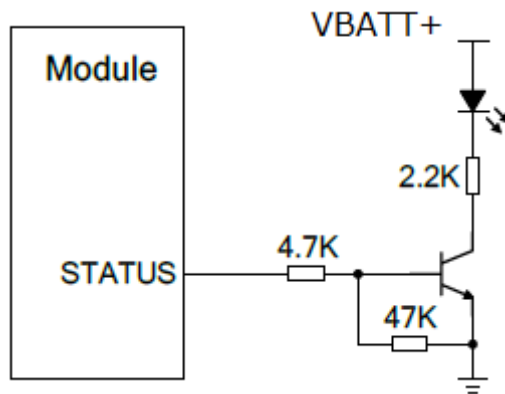


Figure 3-12: M910-GL LED Reference Design Diagram

3.8 PCM/IIS

The M910-GL provides a digital voice interface for communication with digital audio devices such as external CODECs.

RXDDAI data sends the external CODEC MIC to the DSP code channel inside the module; the TXDDAI signal is sent from the internal DSP code channel to the external CODEC Speaker. M910-GL main chip provides PCM/IIS signal using the mainstream European E1 standard.

3.8.1 Digital voice interface definition

PIN Name	I/O	PIN Num.	Description
TXDDAI	I	23	Digital voice output signal
TFSDAI	O	24	Digital voice synchronization signal
RXDDAI	I	25	Digital voice input signal
SCLK	O	26	Digital voice clock signal

3.8.2 Interface description

TBD

3.8.3 Signal description

TBD

3.9 ADC function

TBD

4 Antenna Interface

M910-GL provides two antenna interfaces:

- ✧ MAIN Connector 50Ω impedance
- ✧ GNSS Connector 50Ω impedance

4.1 Antenna design

4.1.1 Antenna RF connector

M910-GL has two antennas, led by welding plate.

Antenna is a sensitive device, susceptible to the external environment. For example, the size of the module, the location of the antenna, the space it occupies, and the surrounding ground all may affect antenna performance. In addition, the RF cable connecting the antenna, and the location of the fixed antenna also may affect the performance of the antenna.

The figure below shows the reference circuit design of the main antenna and GNSS antenna.

These matches need to be placed close to the antenna:

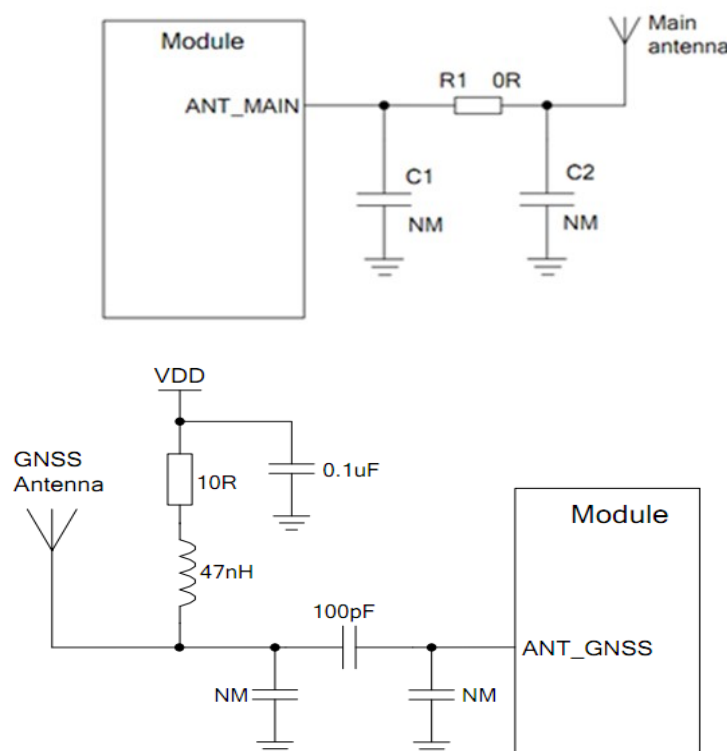


Figure 4-1 RF Reference Circuit Design

The module has no special requirements for the type of antenna. The user can adjust the antenna

gain, antenna size, shape, TRP, TIS, according to the actual structure of the whole machine,

combined with the net space environment.

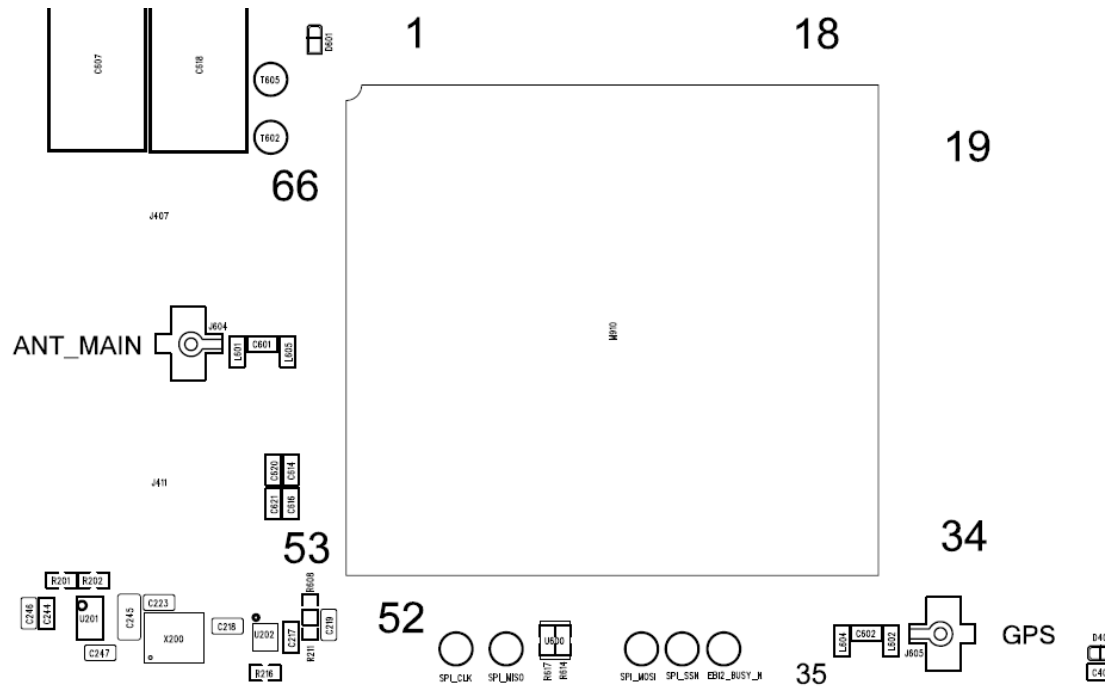


Figure 4-2 ANT Reference layout Design

Make sure the characteristic impedance of the transmission line is 50 ohms.

Since the antenna loss should be less than 0.3dB, keep the PCB cable as short as possible.

PCB cable should have a good reference ground to avoid other signal cable near the antenna.

Recommend a complete ground, and use this complete ground as a reference ground.

4.1.2 RF output power of M910-GL

The RF output power of M910-GL is shown in the following table.

Network mode	Band	Max	Min
GSM	GSM850	32.5 dBm±1dB	5dBm±3.5dB
	EGSM900	32.5 dBm±1dB	5dBm±3.5dB
	DCS1800	29.5dBm±1dB	0dBm±3.5dB
	PCS1900	29.5dBm±1dB	0dBm±3.5dB

Network mode	Band	Max	Min
TDD-LTE	Band39	TBD	TBD
FDD-LTE	Band1	23dBm±1dB	<-44dBm
	Band2	23dBm±1dB	<-44dBm
	Band3	23dBm±1dB	<-44dBm
	Band4	23dBm±1dB	<-44dBm
	Band5	23dBm±1dB	<-44dBm
	Band8	23dBm±1dB	<-44dBm
	Band12	23dBm±1dB	<-44dBm
	Band13	23dBm±1dB	<-44dBm
	Band18	23dBm±1dB	<-44dBm
	Band19	23dBm±1dB	<-44dBm
	Band20	23dBm±1dB	<-44dBm
	Band26	23dBm±1dB	<-44dBm
	Band28	23dBm±1dB	<-44dBm

4.1.3 RF receiving sensitivity of M910-GL

Network mode	Band	Sensitive(dbm)
GSM(8-PSK)	GSM850	-86
	EGSM900	-86
	DCS1800	-86
	PCS1900	-86

Network mode	Band	Cat.M1 Sensitive/3GPP(dbm)-5MHz	Nb-iot Sensitive/3GPP(dbm)
TDD-LTE	Band39	TBD	no support
FDD-LTE	Band1	-99.8/-102.3	-116/-107.5
	Band2	-100.3/-100.3	-115.6/-107.5
	Band3	-100.6/-99.3	-114.5/-107.5
	Band4	-99.6/-102.3	-115.8/-107.5
	Band5	-100.6/-100.8	-117.4/-107.5

Network mode	Band	Cat.M1 Sensitive/3GPP(dbm)-5MHz	Nb-iot Sensitive/3GPP(dbm)
	Band8	-100.9/-99.8	-116.2/-107.5
	Band12	-101.9/-99.3	-118.4/-107.5
	Band13	-101.2/-99.3	-117.7/-107.5
	Band18	-101.2/-102.3	-117.2/-107.5
	Band19	-101/-102.3	-117.2/-107.5
	Band20	-101.5/-99.8	-117.3/-107.5
	Band26	-100.8/-100.3	-116.7/-107.5
	Band28	-101.2/-100.8	-117.5/-107.5

4.1.4 Operating frequency of M910-GL supported bands (MHz)

Network mode	Band	Receive	Transmit
GSM	GSM850	869~894	824~849
	EGSM900	925~960	880~915
	DCS1800	1805~1880	1710~1785
	PCS1900	1930~1990	1850~1910
TDD-LTE	Band39	1880~1920	1880~1920
FDD-LTE	Band1	2110~2170	1920~1980
	Band2	1930~1990	1850~1910
	Band3	1805~1880	1710~1785
	Band4	2110~2155	1710~1755
	Band5	869~894	824~849
	Band8	925~955	880~910
	Band12	728~746	699~716
	Band13	746~757	777~787
	Band18	860~874.9	815~829.9
	Band19	875~889.9	830~844.9
	Band20	791~821	832~862
	Band26	859~893.9	814~848.9
	Band28	758~803	703~748

4.2 Antenna Design

4.2.1 Antenna design requirements

1) Antenna efficiency

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

Recommend > 40% (-4dB).

2) S11 or VSWR

S11 shows that the matching degree of the antenna's 50 ohm impedance, to a certain extent, affects the antenna efficiency. VSWR test methods can be used to measure this parameter.

Recommend S11 < -10dB.

3) Polarization

Polarization is the rotation direction of the electric field in the maximum radiation direction of the antenna.

It is recommended to use linear polarization.

4) Radiation pattern

Radiation pattern refers to the antenna's electromagnetic field strength in the far field in all directions. Half-wave dipole antenna is the most suitable terminal antenna. For built-in antenna, PIFA antennas or IFA antennas are recommended:

Antenna area: 6mm high*10mm wide*100mm long.

Antenna radiation direction: Omni_directional.

5) Gain and directivity

Antenna directivity refers to the electromagnetic field strength of electromagnetic wave in all directions. Gain is a collection of antenna benefits and antenna directivity.

Recommended antenna gain $\leq 2.5\text{dBi}$.

6) Interference

In addition to the antenna performance, other interferences on the PCB also may affect the performance of the module. In order to ensure the high performance of the module, interference must be controlled. Suggestions: For example, LCD, CPU, FPC cable, audio circuit, power supply should be as far as possible away from the antenna, and make the appropriate isolation and shielding, or filtering on the path.

7) Antenna index requirements

M910-GL module main antenna requirements	
Frequency range	It shall use the most suitable antenna to adapt

M910-GL module main antenna requirements	
	to the relevant frequency band
Bandwidth (GPRS/EDGE)	
Bandwidth (LTE)	
Impedance	50 ohms
Input power	
Standing wave ratio recommended	

5 Electrical Characteristics

5.1 Limiting voltage range

The limiting voltage range refers to the power voltage of the module and the maximum voltage range that the digital and analog input/output interface can withstand. Working outside this range may cause damage to the product.

The voltage range of M910-GL is shown in the following table.

Parameter	Description	Min	Typ	Max	Unit
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Parameter	Description	Min	Typ	Max	Unit
BATT+	Power supply	3.3	3.8	4.3	V
	RMS average supply current	0		0.5	A
	The IVBAT peak current may reach 2A (power transmission at each 4.6ms slot) at the instantaneous voltage drop in each time slot			400	mV
GPIO	Digital IO level supply voltage	-0.3	1.8	2.0	V
	Supply voltage in shutdown mode	-0.25		0.25	V

5.2 Environment temperature range

M910-GL module is recommended to operate at $-30\sim+75^{\circ}\text{C}$. It is recommended that the application uses temperature control measures under harsh environmental conditions. At the same time, the limited operating temperature range of the module should be provided. Under these temperature conditions, some RF parameters may exceed the limit. It is recommended that the module application terminal be stored in certain temperature conditions. Modules outside this range may not operate or may be damaged.

Temperature	Min	Typ	Max	Unit
Operating temperature	-30	25	75	$^{\circ}\text{C}$
Limited operating temperature	-40		85	$^{\circ}\text{C}$
Storage temperature	-40		85	$^{\circ}\text{C}$

5.3 Electrical characteristics of the interface in operating status

V_L : logic low level;

V_H : logic high level;

Signal	VL		VH		Unit
	Min	Max	Min	Max	

Digital input	-0.3	$0.3 \times V_{pin_min}$	$0.3 \times V_{pin_max}$	V_{pin_max}	V
Digital output	GND	0.2	$V_{pin_min} - 0.2$	V_{pin}	V

Note: $V_{pin_min} = 1.45V$, $V_{pin_max} = 2.0V$ (V_{pin} is digital interface high level, $V_{pin} = 1.8V$)

Parameter	I/O	Min	Typ	Max	Unit
BATT+	I	3.3	3.8	4.3	V
CCVCC	O	1.7/2.75	1.8/2.85	1.9/2.95	V

5.4 Environmental reliability requirements

Test items	Test conditions	
Low temperature storage test	Temperature $-40^{\circ}C \pm 3^{\circ}C$, 24 hours in shutdown state	
High temperature storage test	Temperature $+85^{\circ}C \pm 3^{\circ}C$, 24 hours in shutdown state	
Temperature shock test	In shutdown state, 0.5 hour at $-40^{\circ}C$ and $+85^{\circ}C$ environment respectively, the temperature conversion time $< 3min$, for 24 cycles	
High temperature and humidity test	Temperature $+85^{\circ}C \pm 3^{\circ}C$, humidity 90 ~ 95% RH, 24 hours in shutdown state	
Low temperature operating test	Temperature $-30^{\circ}C \pm 3^{\circ}C$, 24 hours in operating state	
High temperature operating test	Temperature $+75^{\circ}C \pm 3^{\circ}C$, 24 hours in operating state	
Vibration test	Conduct vibration test according to the requirements shown in the table below:	
	Frequency	Random vibration ASD (Acceleration Spectral Density)
	5~20Hz	$0.96m^2/s^3$

Test items	Test conditions	
	20~500Hz	0.96m ² /s ³ (20Hz), other -3dB/octave
Connector life test	50 times of insertion/removal for board to board connector interface; 30 times of insertion/removal for RF antenna interface cable	
ESD test	1 Test module antenna interface, power PAD and large ground area in call state, ESD should meet the following conditions: 1) Contact discharge should pass $\pm 0.5\text{KV}$ test 2) Air discharge should pass $\pm 2\text{KV}$ test 2. Test EVB SIM card slot while the module is in shutdown state, ESD should meet the following conditions: 1) Contact discharge should pass $\pm 0.5\text{KV}$ test 2) Air discharge should pass $\pm 2\text{KV}$ test	

5.5 ESD characteristics

M910-GL is a consumer product. Although the design of the module has considered the ESD issue and provided ESD protection, the ESD issue may occur in the transport and secondary development, so developers should consider ESD protection for the final product. In addition to considering anti-static treatment for packaging, please refer to recommended circuit for interface design in the document for client's application.

Refer to the following table for the ESD allowable discharge range of the M910-GL module.

Part	Air discharge	Contact discharge
BATT+,GND	$\pm 2\text{KV}$	$\pm 0.5\text{KV}$
Antenna port		$\pm 8\text{KV}$
Other port	$\pm 2\text{KV}$	$\pm 0.5\text{KV}$

6 Structure Specification

6.1 Product Appearance

The product appearance for M910-GL module is shown in Figure 6-1 and Figure 6-2:



Figure 6-1 Module Product Appearance (Top)

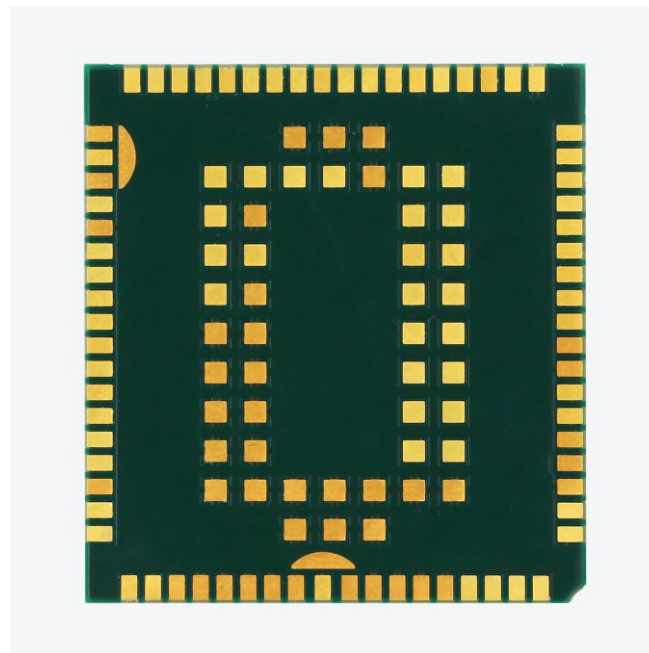


Figure 6-2 Module Product Appearance (Bottom)

6.2 Dimension of Structure

The structural dimension of the M910-GL module is shown in Figure 6-3:

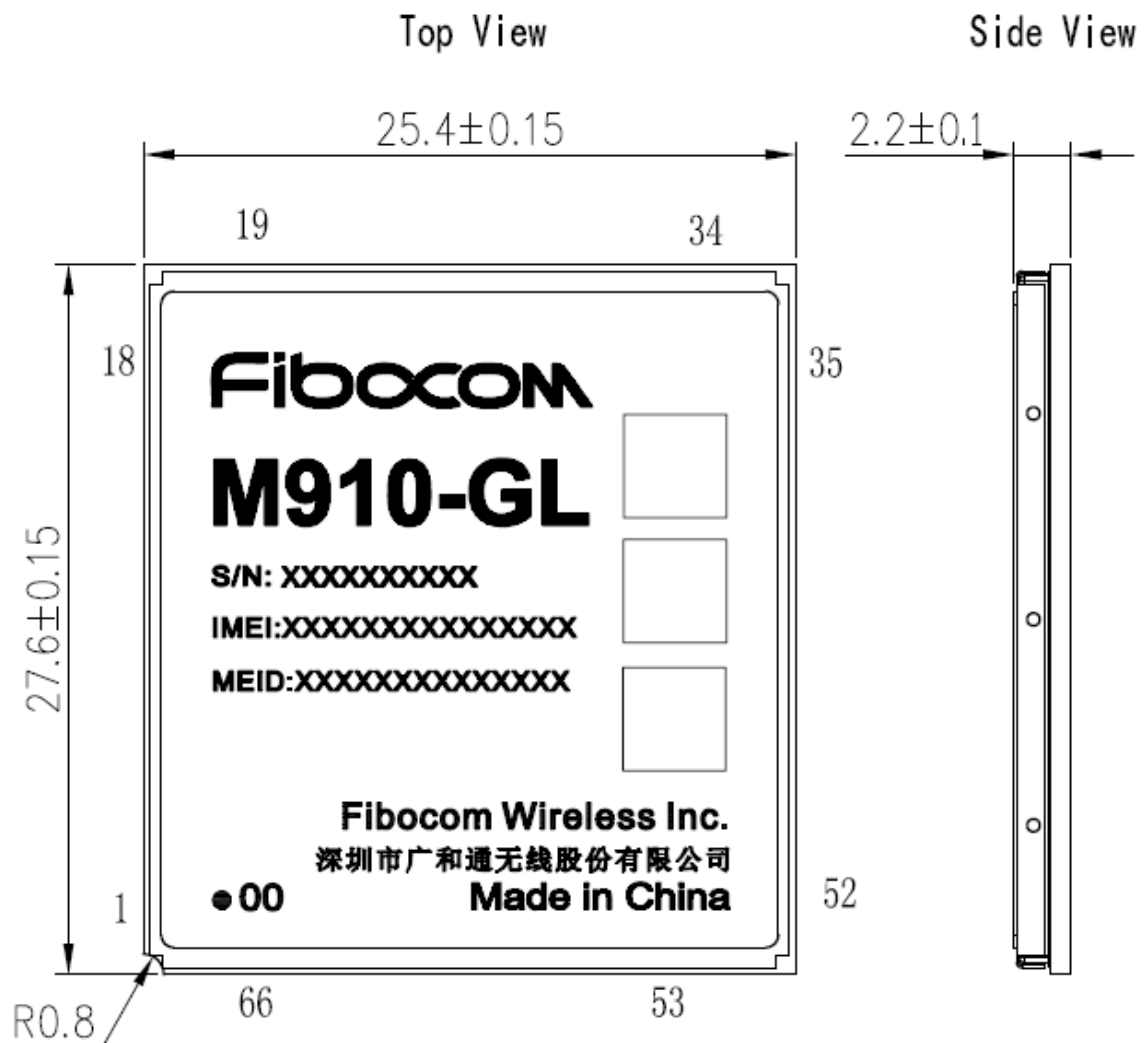


Figure 6-3 Dimension of Structure (Unit: mm)

6.3 SMT Patch

For module steel net design, please refer to SMT Application Design Instructions for the solder paste and furnace temperature control.

6.4 Storage

6.4.1 Storage life

M910-GL is shipped in a vacuum-sealed bag. The module storage should follow the following conditions:

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1. If the ambient temperature is below 40°C and the air humidity is less than 90%, the module can be stored in a vacuum-sealed bag for 12 months.

2. When the vacuum-sealed bag is opened, if the following conditions are met, the module can be directly re-soldered or go through other high temperature process:

Air humidity for module storage is less than 10%.

The module ambient temperature is below 30°C, air humidity less than 60%, and the factory completes patch within 168 hours.

6.4.2 Baking

If the module is in the following conditions, it needs to be baked before patching:

1. When the ambient temperature is 23°C ($\pm 5^\circ\text{C}$ allowed), the humidity indicator shows that the humidity is more than 10%.
2. When the vacuum-sealed bag is opened, the module's ambient temperature is below 30°C, air humidity is less than 60%, but the factory failed to complete the patch within 168 hours
3. When the vacuum-sealed bag is opened, the air humidity for module storage is more than 10%.
4. If the baking is required, bake the module for 48 hours at 125°C ($\pm 5^\circ\text{C}$ allowed).



Note:

The package of the module cannot withstand high temperature baking. Therefore, please remove the module package before the module is baked.

6.5 Packaging

M910-GL module adopts tray sealed vacuum packaging, combined with the outer packaging method using the hard carton box, so that the storage, transportation and the usage of modules can be protected to the greatest extent.



Note:

The vacuum bag contains desiccant. The module is a moisture-sensitive device, with the moisture sensitive level 3, and it is in line with the standards of the JEDEC. Please avoid permanent damage to the product caused by moisture.

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

6.5.1 Tape packaging

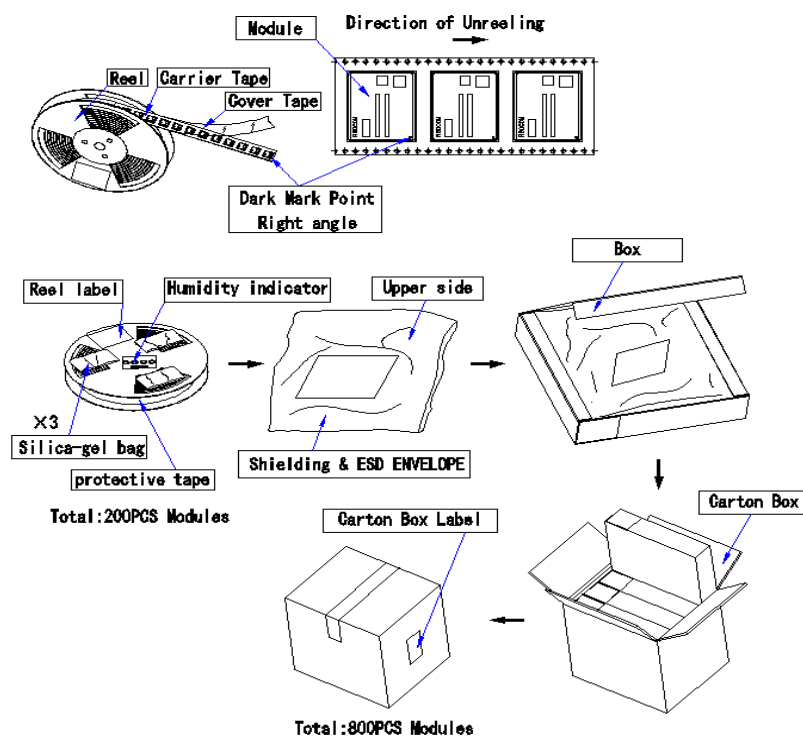


Figure 6-4 Tape Packaging Flowchart

6.5.2 Packaging list (TBD)

No.	Name	Description	Quantity	Conform to RoHS
1	Module	Product module		
2	M910-GL_Inner box label	Dimension (mm) 1 for each reel, 1 for each antistatic bag, 1 for each inner box		
3	M910-GL_Outer box label	Dimension (mm), 1 for Outer box		
4	Tape	1 for each inner box		
5	Reel	Dimension of the reel centering hole must match with SMT machine feeder area		
6	Tape seal sticky tape	1 for each inner box		
7	Humidity card	Four-point humidity card, 1 for each reel		
8	Silica desiccant	General silica desiccant, 3 bags per reel		

No.	Name	Description	Quantity	Conform to RoHS
9	Anti-static bag	Anti-static vacuum bag, with silk anti-static and moisture-sensitive warning signs		
10	Inner box	Dimension: 340×340×75mm		
11	Outer box	Dimension 365×330×365mm		
12	Sealing label	1 for each inner box, 2 for outer box		
13	Sealing tape	_BOPP_transparent		