Fibocom

Perfect Wireless Experience
完美无线体验

H380-GL Hardware User Manual

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Applicability Table

No.	Product model	Description
1	H380-GL	NA

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Version Record

Version	Update Date	Description
V1.0.0	2016-03-21	Draft
V1.0.1	2016-04-20	Modify the pictures

Contents

1 Foreword

1.1 Introduction

This document describes the electrical characteristics, RF performance, dimension of structure, application environment and other information of H380-GL (hereinafter referred to as H380) module. With the help of this document and other related documents, application developers can quickly understand the hardware functions of H380 module and implement the hardware development of products.

1.2 Reference Standard

The design of this product refers to 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 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 Rev0.9-3

1.3 Related Documents

- H380 Module Performance Test Report
- RF Antenna Application Design Specification
- H3-Family Driver & Dial-up Application Design Specification
- H3-Family AT Command Manual

2 Overview

2.1 Description

H380, as a highly-integrated 3G wireless communication module, applies standard PCIe M.2 interface and supports GSM/GPRS/EDGE and UMTS /HSDPA / HSUPA/HSPA+ cellular communications network.

2.2 Specification

Specification		
Operating Band	WCDMA/HSPA+: Band I, II, V, VIII	
	GSM/GPRS/EDGE: 850/900/1800/1900MHz	
Data Transmission	UMTS/HSPA+	UMTS:384 kbps DL/384 kbps UL
		DC-HSDPA+:21Mbps DL(Cat 14)/5.76Mbps UL(Cat6)
	GPRS/EDGE	GPRS:107kbps DL/85.6kbps UL(multi-slot class 33)
		EDGE(E-GPRS):296kbps DL/236.8kbps UL (multi-slot class 33)
Power	DC 3.135V~4.4V,Typical 3.3V	
Temperature	Normal operating temperature: –20°C to +65°C	
	Storage temperature: -40°C ~+85°C	
Physical	Interface: M.2 Key-B	
	Dimension: 22mm x 42mm x 2.3mm	
	Weight: About 4.5 g	
Interface		
Antenna	WWAN Main Antenna x 1	
	WWAN Diversity Antenna x 1	
Functional Interface	USIM 3V/1.8V	
	USB 2.0 x 1	
	I2S (not supported)	
	I2C (not supported)	
	EINT, System Indicator	

	Clock
Software	
Protocol Stack	IPV4/IPV6
AT Commands	3GPP TS 27.007 and 27.005, and proprietary FIBOCOM AT commands
Firmware update	USB

Note:

When the temperature goes beyond the normal operating temperature range of -20°C~+65°C, the RF performance of the module may be slightly off 3GPP specifications.

FOR FCC

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.

NOTE: 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.

FCC Caution:

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

RF Exposure Information

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

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

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

R&TTE Regulation:

In all cases assessment of the final product must be mass against the Essential requirements of the R&TTE Directive Articles 3.1(a) and (b), safety and EMC respectively, as well as any relevant Article 3.3 requirements.

Human proximity to the antenna shall not be less than 20cm (8 inches) during normal operation.

The maximum antenna gain for frequency 900 is 3dBi; for frequency 1800 is 5 dBi.

CE0560

EU Regulatory Conformance

Hereby, FIBOCOM Wireless Inc. declares that this device is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

IC Canada Statement :

This device complies with Part 15 of the FCC Rules and with RSS-247 of Industry Canada. 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.

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.

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.

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 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.

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: ZMOH380GL**". The grantee's FCC ID can be used only when all FCC compliance requirements are met.

The final end product will be laptop, tablet, M2M or similar product.

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 Application Framework

The peripheral application of H380 module is shown in Figure 2-1:

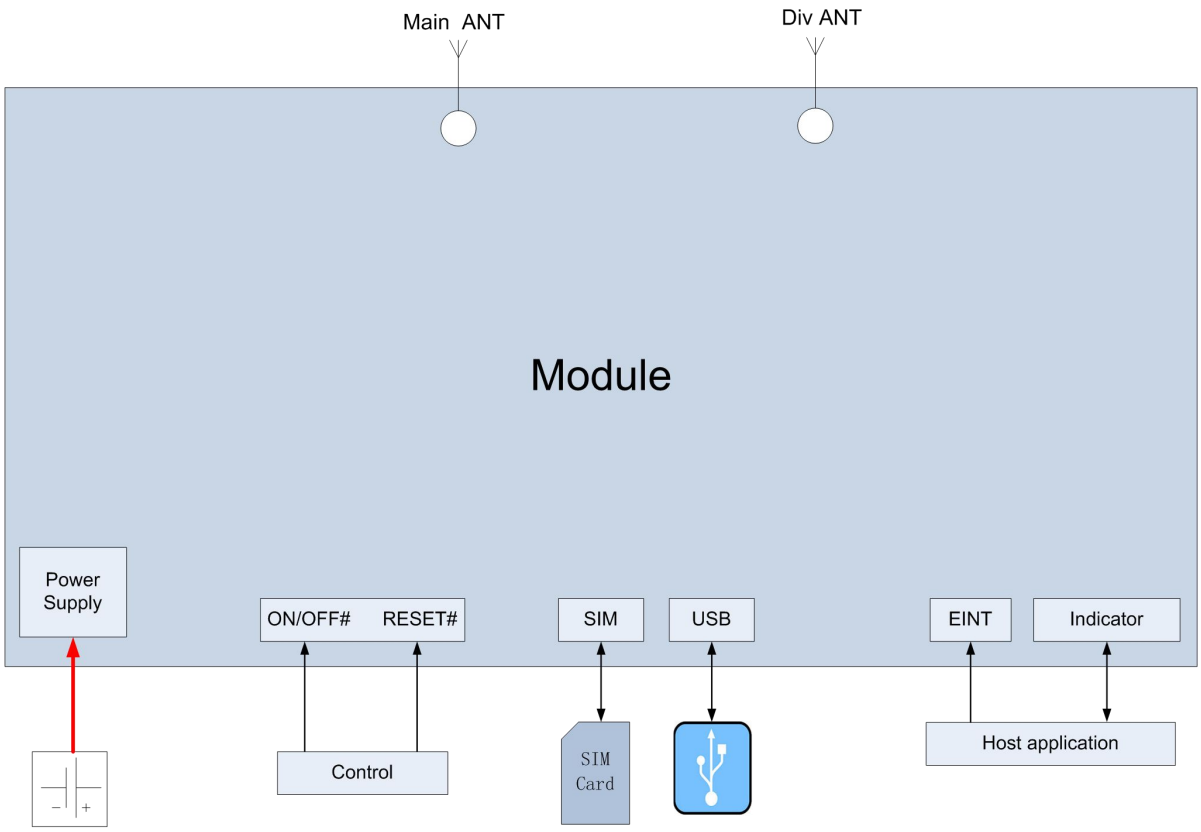

Figure 2-1 Application Framework

2.4 Hardware Framework

The hardware framework in Figure 2-2 shows the main hardware functions of H380 module, including baseband and RF functions.

Baseband contains the followings:

- GSM/UMTS controller/Power supply
- NAND+LPDDR RAM
- Application interface

RF contains the followings:

- RF Transceiver
- RF Power/PA
- RF Front end
- RF filter

- Antenna

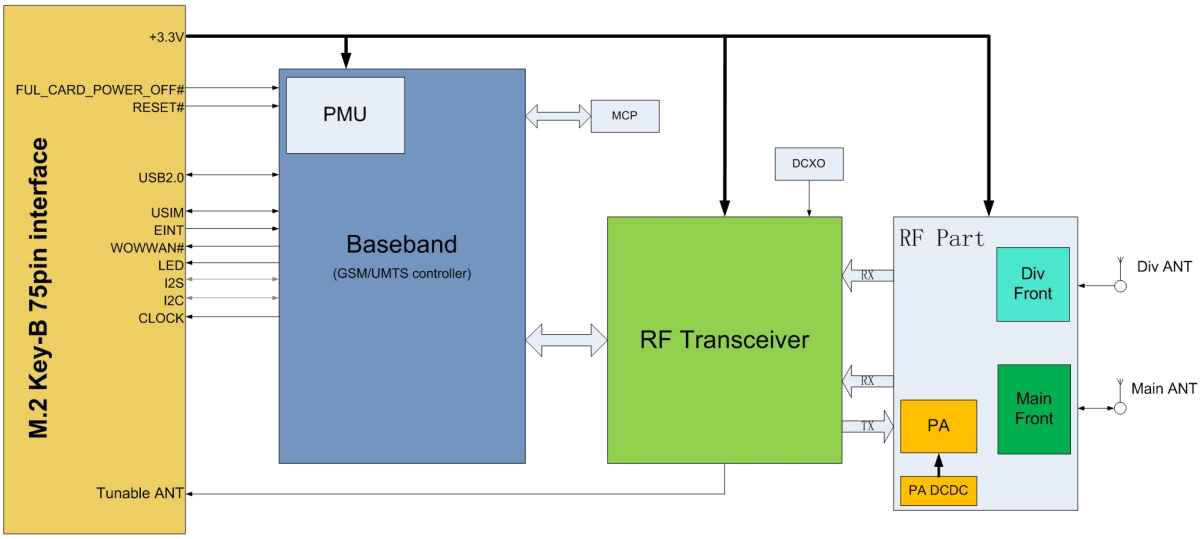

Figure 2-2 Hardware Framework

3 Application Interface

3.1 M.2 Interface

The L816 module adopts the standard M.2 Key-B Interface, with a total of 75 pins.

3.1.1 Pin Distribution

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

Note:

Pin “Notch” refers to the notch of the Gold Finger.

3.1.2 Pin Definition

The pin definition is as below:

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
1	CONFIG_3	O	L	Internally connected to GND, H380 M.2 module configured as WWAN-SSIC-0 interface type module	
2	+3.3V	PI		Main power input	Power supply
3	GND			GND	Power supply
4	+3.3V	PI		Main power input	Power supply
5	GND			GND	Power supply
6	FUL_CARD_POWER_OFF#	I	PU	Start-up and shutdown control signals, internal 200KΩ pull-up resistance	CMOS 3.3/1.8V
7	USB D+	I/O		USB 2.0 signal+	0.3---3V
8	W_DISABLE1#	I	PU	WWAN Disable, Internal pull up, Active low	3.3V/1.8V
9	USB D-	I/O		USB 2.0 signal-	0.3---3V
10	LED1#	O	OD	System status LED, drain output	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	

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
18	Notch			Notch	
19	Notch			Notch	
20	I2S_CLK	O	T	I2S serial clock (not supported)	CMOS 1.8V
21	CONFIG_0	O		Not connected, H380 M.2 module configured as WWAN-SSIC-0 interface type module	
22	I2S_RX	I	T	I2S serial data input (not supported)	CMOS 1.8V
23	WOWWAN#	O	L	Module wakes up Host equipment signal, drain output	CMOS 3.3/1.8V
24	I2S_TX	O	T	I2S serial data output (not supported)	CMOS 1.8V
25	DPR	I	PU	Body SAR Detect, Internal pull up	CMOS 3.3/1.8V
26	NC			NC	
27	GND			GND	Power supply
28	I2S_WA	O	T	I2S left/right channel clock signal (not supported)	CMOS 1.8V
29	NC			NC	
30	UIM_RESET	O	PP	USIM card reset signal	1.8V/3V
31	NC			NC	
32	UIM_CLK	O	PP	USIM card clock signal	1.8V/3V
33	GND			GND	Power supply
34	UIM_DATA	I/O	PU	USIM card data signal, internal 4.7KΩ pull-up resistance	1.8V/3V
35	NC			NC	
36	UIM_PWR	O		USIM card power output	1.8V/3V

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
37	NC			NC	
38	NC			NC	
39	GND			GND	Power supply
40	GNSS_SCL	O	PU	I2C serial data signal clock, internal 4.7KΩ pull-up resistance (not supported)	CMOS 1.8V
41	NC			NC	
42	GNSS_SDA	I/O	PU	I2C serial data signal data, internal 4.7KΩ pull-up resistance (not supported)	CMOS 1.8V
43	NC			NC	
44	GNSS_IRQ	I	PU	Module system switch input interrupt signal, Internal pull up	CMOS 1.8V
45	GND			GND	Power supply
46	SYSCLK	O	L	26MHz clock output	1.8V
47	NC			NC	
48	TX_BLANKING	O	L	GSM TDMA Timer output signal, external GPS control signal	CMOS 1.8V
49	NC			NC	
50	NC			NC	
51	GND			GND	Power supply
52	NC			NC	
53	NC			NC	
54	NC			NC	
55	NC			NC	
56	NC			NC	

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
57	GND			GND	Power supply
58	NC			NC	
59	ANTCTL0	O	L	Tunable antenna control signal,bit0 (currently not supported)	CMOS 1.8V
60	NC			NC	
61	ANTCTL1	O	L	Tunable antenna control signal,bit1 (currently not supported)	CMOS 1.8V
62	NC			NC	
63	ANTCTL2	O	L	Tunable antenna control signal, bit2 (currently not supported)	CMOS 1.8V
64	NC			NC	
65	ANTCTL3	O	L	Tunable antenna control signal, bit3 (currently not supported)	CMOS 1.8V
66	SIM_DETECT	I		SIM Detect, internal 390KΩ pull-up resistance	CMOS 1.8V
67	RESET#	I	PU	External reset signal input, internal 200KΩ pull-up resistance	CMOS 3.3/1.8V
68	NC			NC	
69	CONFIG_1	O	L	Internally connected to GND, H380 M.2 module configured as WWAN-SSIC-0 interface type module	
70	+3.3V	PI		Main power input	Power supply
71	GND			GND	Power supply
72	+3.3V	PI		Main power input	Power supply

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
73	GND			GND	Power supply
74	+3.3V	PI		Main power input	Power supply
75	CONFIG_2	O	L	Internally connected to GND, H380 M.2 module configured as WWAN-SSIC-0 interface type module	

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:

To ensure that unused pins are floating.

3.2 Power Supply

The power interface for H380 module is as follows:

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 input	3.135	3.3	4.4
36	UIM_PWR	PO	USIM power supply		1.8V/3V	

3.2.1 Power Supply

H380 module provides power supply by using +3.3V pin, and the power supply design is shown in Figure 3-2:

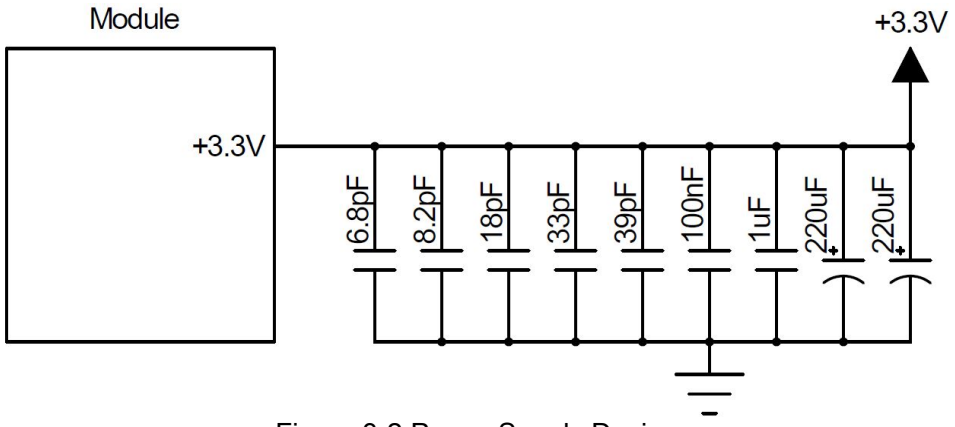

Figure 3-2 Power Supply Design

The filter capacitor design of power supply is as follows:

Recommended Capacitance	Application	Description
220uF x 2	Voltage-stabilizing capacitance	To reduce power supply fluctuation in the operating process of the module, low ESR capacitance shall be adopted ● LDO or DC/DC power supply shall not be less than 440uF capacitance ● Battery power supply can be reduced to 100~220uF capacitance
1uF,100nF	Digital signal noise	Filter the interference produced by clock and digital signal
39pF,33pF	850,900 MHz band	Filter the RF interference of low band
18pF,8.2pF,6.8pF	1800/1900,2100,2500MHz band	Filter the RF interference of middle/high band (including third harmonic of low band)

The stable power supply ensures the normal operation of H380 module. In the design, it's should be noted that the ripple of power supply shall be lower than 300mV. When the module is operating in GSM mode (Burst transmit), the maximum operating current is up to 2A, and the power supply voltage shall not be less than 3.135V; otherwise, the module may shut down or restart due to outage. The power supply limit is shown in Figure 3-3:

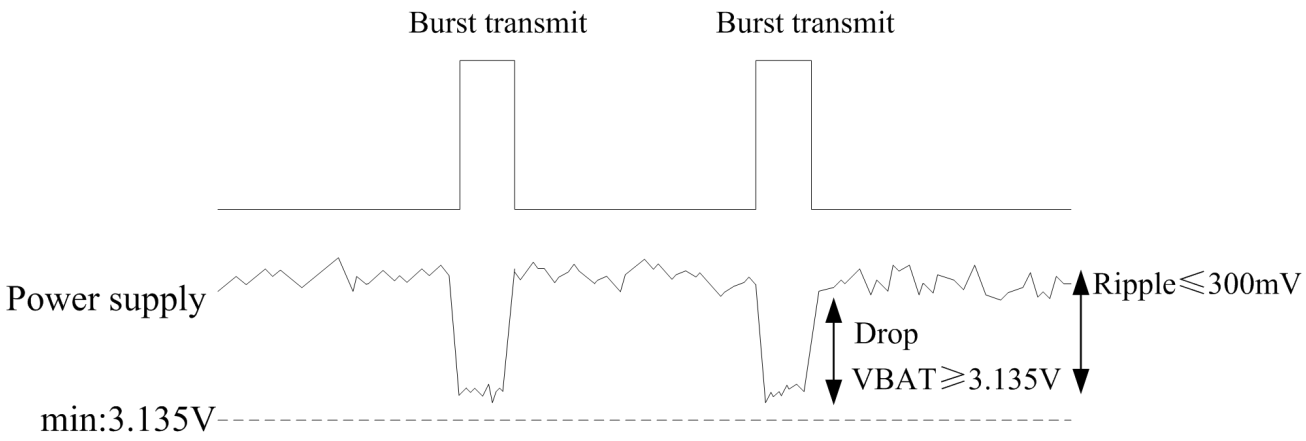

Figure 3-3 Power Supply Limit

3.2.2 Logic Level

The 1.8V logic level of H380 module is defined as follows:

Parameter	Minimum Value	Typical Value	Maximum Value	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 3.3V logic level of H380 module is defined as follows:

Parameter	Minimum Value	Typical Value	Maximum Value	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

When the power supply is 3.3V, the power consumption of H380 module is as below.

The shutdown and sleep currents are as below:

Description	Bands	Average Current (mA)	Notes/Configuration
Power off		0.07	3.3 V is on and Power_On_Off pin is pulled to low.
HSPA+/ WCDMA (Standby)	UMTS supported bands	2.2	DRX cycle=8 (2.56 s) Module is registered on and not connected to the 3G network.

Description	Bands	Average Current (mA)	Notes/Configuration
			USB is in suspend.
		2.9	DRX cycle=6 (0.64 s) Module is registered on and not connected to the 3G network. USB is in suspend.
GPRS/EDGE (Standby)	GSM bands	2.4	MFRMS=5 (1.175 s) Module is registered on and not connected to the 2G network. USB is in suspend.
		2.3	MFRMS=2 (0.47 s) Module is registered on and not connected to the 2G network. USB is in suspend.
HSPA+/ WCDMA (Connect Standby)	UMTS bands	3.3	DRX cycle=8 (2.56 s) Module is registered on the 3G network, and PDP is activated, No data transmission. USB is in suspend.
			DRX cycle=6 (0.64 s) Module is registered on the 3G network, and PDP is activated, No data transmission. USB is in suspend.
GPRS/EDGE (Connect Standby)	GSM bands	2.6	MFRMS=5 (1.175 s) Module is registered on the 2G network, and PDP is activated, No data transmission. USB is in suspend.
			MFRMS=2 (0.47 s) Module is registered on the 2G network, and PDP is activated, No data transmission. USB is in suspend.

The power consumption in HSPA/WCDMA mode is as below:

Description	Band	Test Value(mA)	Power
WCDMA	Band 1 (IMT2100)	635	23.5 dBm Tx Power
		191	10 dBm Tx Power
		150	1 dBm Tx Power
	Band 2 (PCS 1900)	653	23.5 dBm Tx Power
		182	10 dBm Tx Power
		155	1 dBm Tx Power
	Band 5 (850 MHz)	529	23.5 dBm Tx Power
		185	10 dBm Tx Power
		150	1 dBm Tx Power
	Band 8 (900 MHz)	561	23.5 dBm Tx Power
		176	10 dBm Tx Power
		152	1 dBm Tx Power
HSDPA	Band 1 (IMT2100)	176	1 dBm Tx Power
		215	10 dBm Tx Power
		652	23.5 dBm Tx Power
	Band 2 (PCS 1900)	175	1 dBm Tx Power
		212	10 dBm Tx Power
		634	23.5 dBm Tx Power
	Band 5 (850 MHz)	174	1 dBm Tx Power
		217	10 dBm Tx Power
		678	23.5 dBm Tx Power
	Band 8 (900 MHz)	186	1 dBm Tx Power
		234	10 dBm Tx Power
		679	23.5 dBm Tx Power

The power consumption in GPRS/EDGE mode is as below:

Description	Test Value 1#	PCL	Configuration
GPRS850	265	5	1 Up/1 Down
	353		2 Up/1 Down
	399		4 Up/1 Down
	99	10	1 Up/1 Down
	150		2 Up/1 Down
	237		4 Up/1 Down
GPRS900	265	5	1 Up/1 Down
	357		2 Up/1 Down
	407		4 Up/1 Down
	99	10	1 Up/1 Down
	154		2 Up/1 Down
	238		4 Up/1 Down
GPRS1800	181	0	1 Up/1 Down
	239		2 Up/1 Down
	278		4 Up/1 Down
	65	10	1 Up/1 Down
	85		2 Up/1 Down
	107		4 Up/1 Down
GPRS1900	179	0	1 Up/1 Down
	228		2 Up/1 Down
	278		4 Up/1 Down
	65	10	1 Up/1 Down
	85		2 Up/1 Down
	108		4 Up/1 Down

Description	Test Value 1#	PCL	Configuration
EDGE850	185	8	1 Up/1 Down
	290		2 Up/1 Down
	419		4 Up/1 Down
	68	15	1 Up/1 Down
	90		2 Up/1 Down
	125		4 Up/1 Down
EDGE900	185	8	1 Up/1 Down
	295		2 Up/1 Down
	411		4 Up/1 Down
	75	15	1 Up/1 Down
	105		2 Up/1 Down
	151		4 Up/1 Down
EDGE1800	200	2	1 Up/1 Down
	216		2 Up/1 Down
	286		4 Up/1 Down
	74	10	1 Up/1 Down
	96		2 Up/1 Down
	117		4 Up/1 Down
EDGE1900	198	2	1 Up/1 Down
	213		2 Up/1 Down
	290		4 Up/1 Down
	73	10	1 Up/1 Down
	95		2 Up/1 Down
	118		4 Up/1 Down

3.3 Control Signal

H380 module provides 2 channel control signals for start-up/shutdown and reset operations of the module, and the pins are defined as follows:

Pin	Pin Name	I/O	Reset Value	Functions	Type
6	FUL_CARD_POWER_OFF#	I	PU	Start-up/shutdown signal, internal 200KΩ pull-up resistance High level start-up, low level or floating shutdown	3.3/1.8V
67	RESET#	I	PU	Reset signal, internal 200KΩ pull-up resistance Low-active	3.3/1.8V

3.3.1 Module Start-up

3.3.1.1 Start-up Circuit

The module start-up pin FUL_CARD_POWER_OFF# requires external pull-up 18.V voltage (VDD_1V8 provided externally), and the module has two start-up modes:

- AP (Application Processor) controls the module start-up, and the circuit design is shown in Figure 3-4:
- Automatically start-up when powered on, and the circuit design is shown in Figure 3-5:

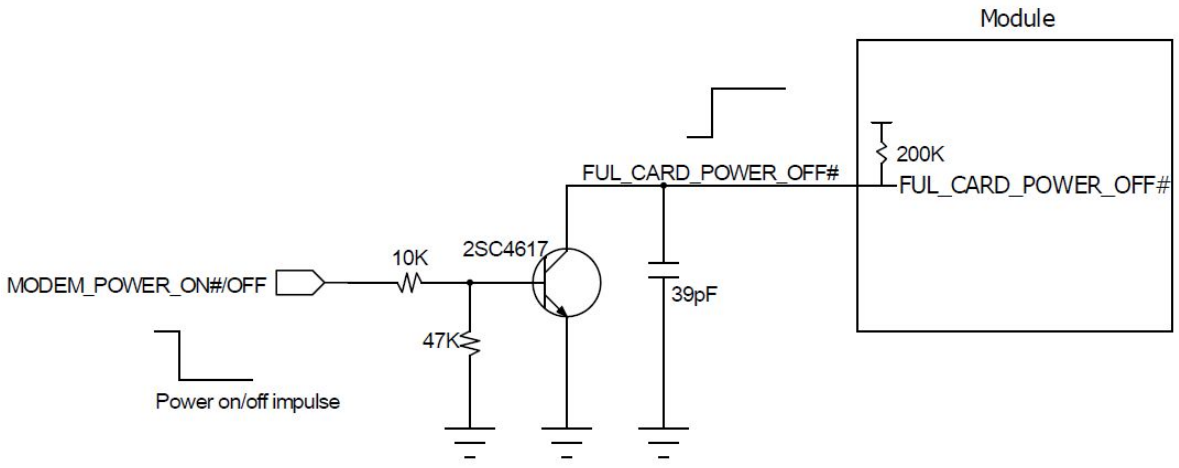

Figure 3-4 Circuit for Module Start-up Controlled by AP

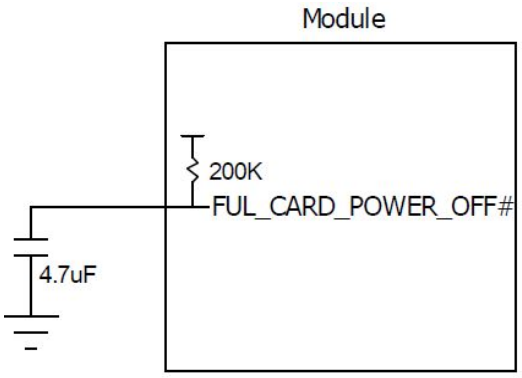

Figure 3-5 Circuit for Automatic Start-up

3.3.1.2 Start-up Timing

After the module is powered on, when the FUL_CARD_POWER_OFF# signal pulls up and exceeds 20ms (the recommended value is 100ms), the module starts up. Meanwhile, VSD2_1V8 inside the module outputs 1.8V voltage, and the module begins the process of start-up initialization. The start-up timing is shown in Figure 3-6:

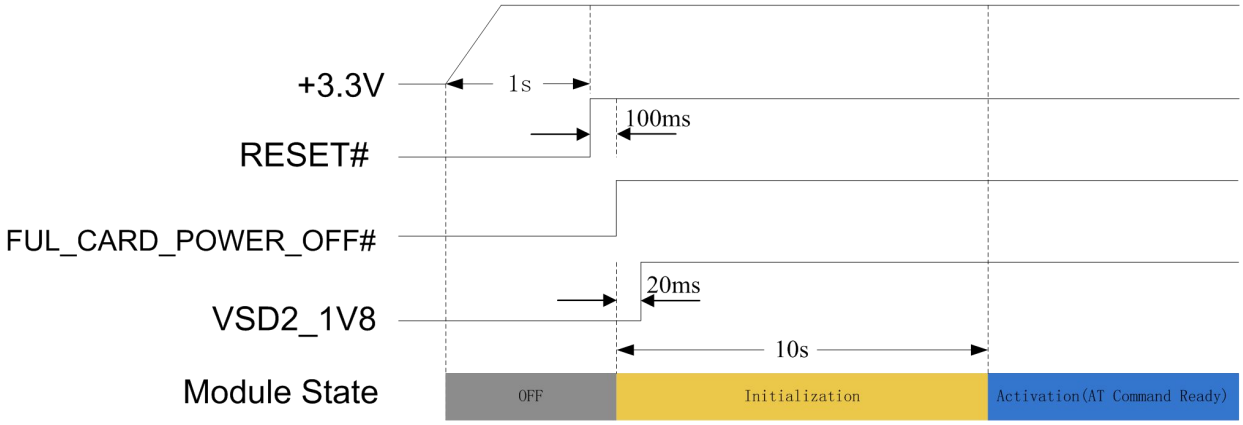

Figure 3-6 Start-up Timing Control Diagram

Note:

VSD2_1V8 is a PMU inside the module, it outputs 1.8V voltage and has not been led out via M.2 interface, the appearance of this voltage in timing chart is mainly purposed to facilitate the understanding of timing;

RESET# is required to delay its pull-up for 1s compared with +3.3V, because the module needs time for power-on of +3.3V power supply (capacitor charging). If +3.3V maintains as ordinary power supply, then the delay time is negligible.

3.3.2 Module Shutdown

The module supports two shutdown modes as shown below:

Shutdown Mode	Shutdown Method	Applicable Scenario
Software shutdown	Send AT+CPWROFF command	Normal shutdown
Hardware shutdown	Pull down FUL_CARD_POWER_OFF#	When software shutdown is unavailable in case of module abnormity

3.3.2.1 Software Shutdown

AT+CPWROFF command can be sent to shut down the module.

When the module receives software shutdown command, the module starts ending process (finalization, a reverse process of initialization), and the module completes shutdown after about 3s. When ending process, the module will save the parameters such as network and SIM card in the memory, and then empty the memory, and switch off PMU power supply. After shutdown, VSD2_1V8 voltage inside the module will also switch off. The software shutdown timing is shown in Figure 3-7:

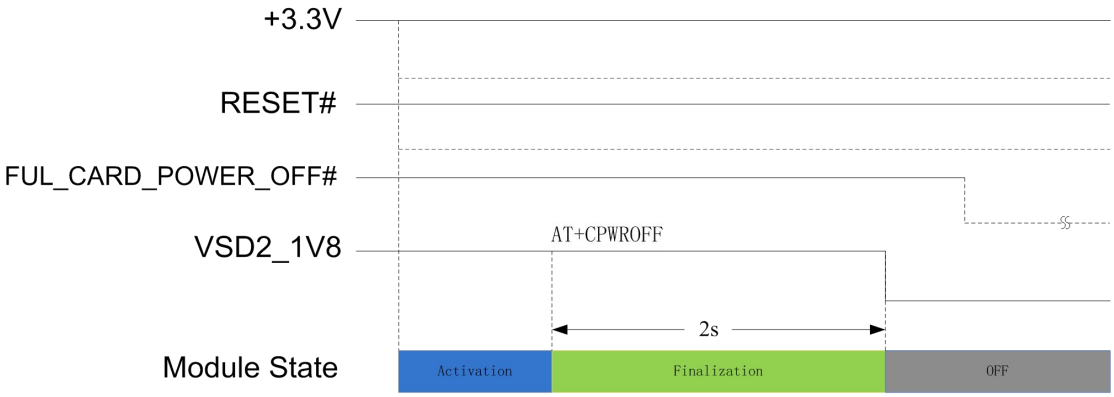

Figure 3-7 Software Shutdown Timing Control Diagram

After the completion of software shutdown, FUL_CARD_POWER_OFF# still remains at high level, at this moment, the module will not start up again. To facilitate the next start-up of the module, FUL_CARD_POWER_OFF# should be pulled down first.

Note:

VSD2_1V8 is a PMU inside the module, it outputs 1.8V voltage and has not been led out via M.2 interface, the appearance of this voltage in timing chart is mainly purposed to facilitate the understanding of timing.

3.3.2.2 Hardware Shutdown

By pulling down FUL_CARD_POWER_OFF# for more than 10ms (the recommended value is 100ms), the power management unit (PMU) of the module powers down, and then the module achieves hardware shutdown. The PMU of the module powers down when pulling down FUL_CARD_POWER_OFF#, the module may be damaged after several start-ups and shutdowns; therefore, RESET# pin shall be pulled down for 100ms before pulling down FUL_CARD_POWER_OFF#. The hardware shutdown control timing is shown in Figure 3-8:

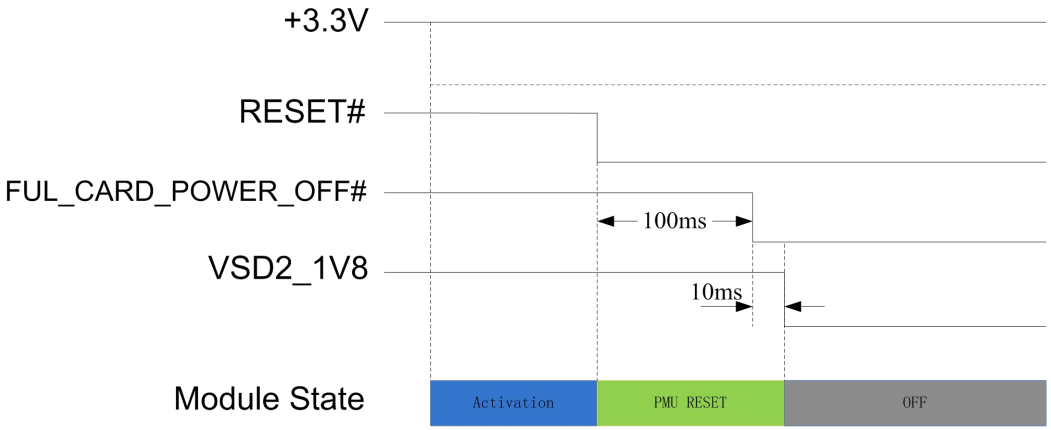

Figure 3-8 Hardware Shutdown Control Timing

Note:

VSD2_1V8 is a PMU inside the module, it outputs 1.8V voltage and has not been led out via M.2 interface, the appearance of this voltage in timing chart is mainly purposed to facilitate the understanding of timing.

3.3.3 Module Reset

The module supports reset function. Pulling down RESET# signal for more than 10ms (the recommended value is 100ms) can reset the module to the initial state, and the module restarts after releasing RESET#. When performing Reset function, PMU inside the module will not power down. The recommended circuit design is shown in Figure 3-9:

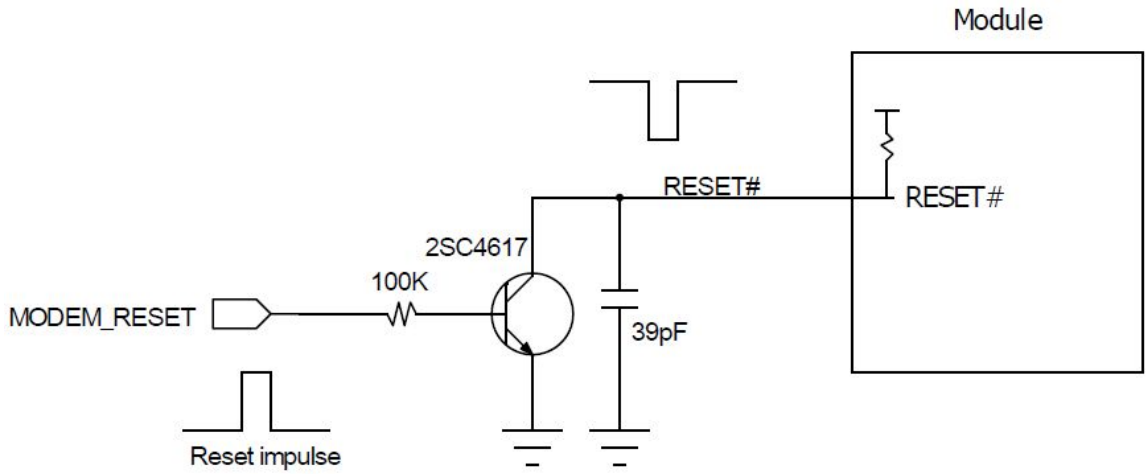

Figure 3- 9 Recommended Design of Reset Circuit

The control timing of RESET is shown in Figure 3-10:

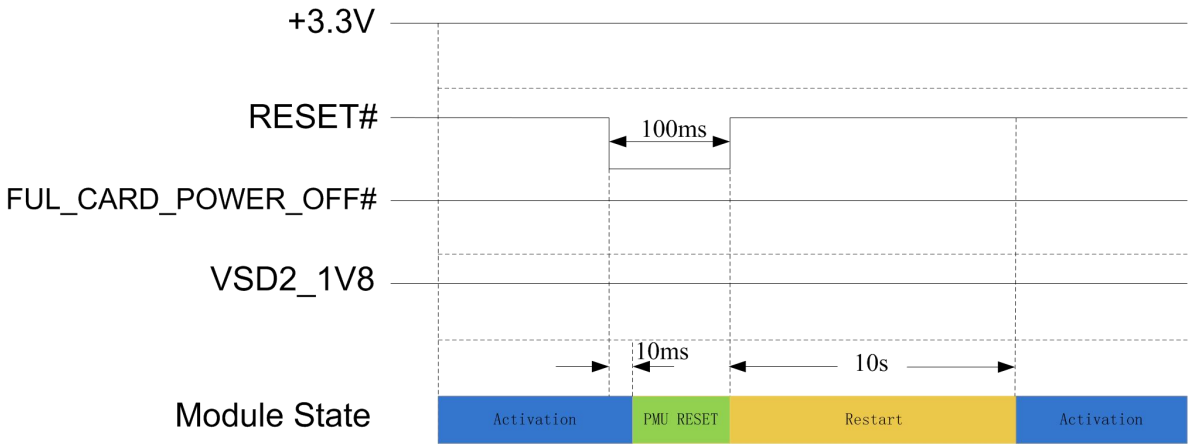

Figure 3- 10 Reset Control Timing

Note:

RESET# is a sensitive signal, filter capacitor is recommended to be added close to the module end. PCB layout shall be away from RF interference and shall have proper grounding handling; meanwhile, wiring at PCB edge and surface shall be avoided (so as to avoid ESD causing module reset).

3.4 USB Interface

H380 module supports USB2.0 and is compatible with USB High-Speed (480 Mbits/s) and USB Full-Speed (12 Mbits/s). Please refer to “Universal Serial Bus Specification 2.0” for timing and electrical characteristics of the USB of the module.

After inserting H380 module into PC, the USB can map 1 MBIM interface on Win8.1/Win10 system-based PC and map 7 ACM ports on Android/Linux system-based PC. Please refer to Section 3.7.2 for details of

system switching.

- MBIM interface is used for initiating data service;
- For 7 ACM ports:
  1 port is 3G Modem/AT port, which is mainly used for initiating data service
  3 ports are used for sending AT Command
  1 port is used for capturing software LOG information
  2 ports are reserved for future use

3.4.1 USB Interface Definition

Pin	Pin Name	I/O	Reset Value	Pin 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

The reference circuit is shown in Figure 3-11:

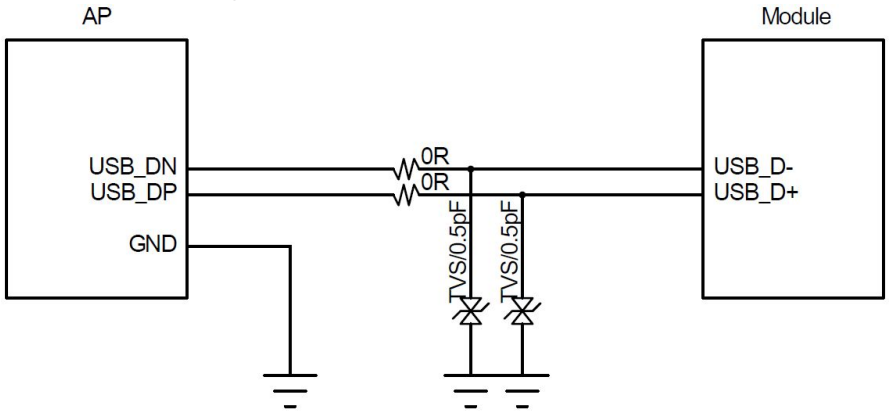

Figure 3- 11 Reference Circuit for USB2.0 Interface

The module supports USB 2.0 High-Speed, so the TVS equivalent capacitance on USB_D-/D+ differential signal line shall be lower than 1pF, it's recommended to adopt TVS with 0.5pF capacitance.

USB_D- and USB_D + are high-speed differential signal lines, the maximum transmission rate is up to 480 Mbits/s, the PCB Layout shall strictly adhere to the following rules:

- USB_D- and USB_D+ signal line controls 90 Ω differential impedance;
- USB_D- and USB_D+ signal line shall be isometric and parallel, rectangular wiring shall be avoided;
- The cabling of USB_D- and USB_D+ signal line shall be located on the signal layer closest to the ground, up, down, left and right grounding protections shall be completed for wiring.

3.5 USIM Interface

H380 module has built-in USIM card interface that supports 1.8V and 3V SIM card.

3.5.1 USIM Pins

USIM pins are as below:

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
36	UIM_PWR	PO		USIM power supply	1.8V/3V
30	UIM_RESET	O	PP	USIM reset	1.8V/3V
32	UIM_CLK	O	PP	USIM clock	1.8V/3V
34	UIM_DATA	I/O	PU	USIM data, Internal pull up(4.7KΩ)	1.8V/3V
66	SIM_DETECT	I		USIM detect, pull up(390KΩ) High-active, high level indicates SIM card inserted, and low level indicates SIM card removed	1.8V

3.5.2 USIM Interface Circuit

3.5.2.1 N.C. SIM card slot

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

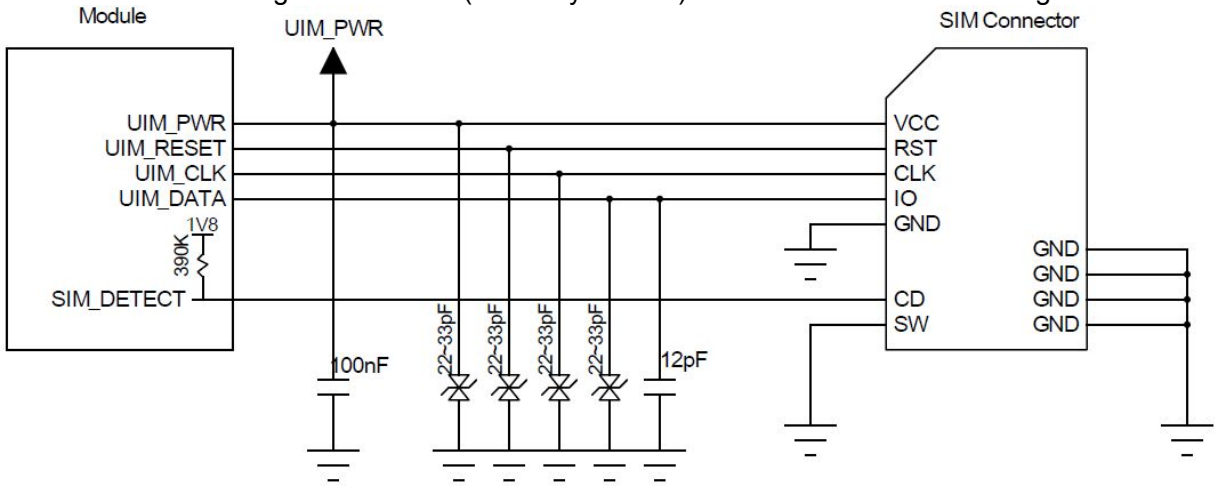

Figure 3-12 Reference Circuit for N.C. SIM Card Slot

The principle description for N.C. SIM card slot is as follows:

- When the SIM card is detached, the CD and SW pins will short, and the SIM_DETECT is low.
- When the SIM card is inserted, the CD and SW pins will open, and the SIM_DETECT is high.

3.5.2.2 N.O. SIM card slot

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

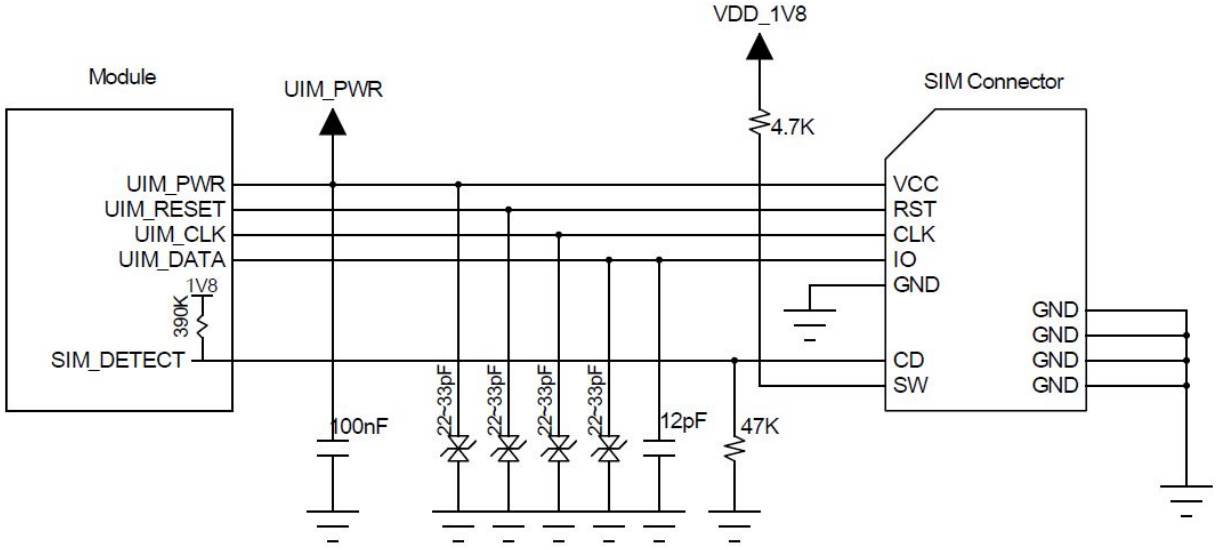

Figure 3-13 Reference Circuit for N.O. SIM Card Slot

The principle description for N.O. SIM card slot is shown in the following:

- When the SIM card is detached, the CD and SW pins will open, and the SIM_DETECT is low.
- When the SIM card is inserted, the CD and SW pins will short, and the SIM_DETECT is high.

3.5.3 USIM Hot-Plugging

H380 supports SIM card hot-plugging function; it judges whether SIM card is inserted or removed by detecting SIM_DETECT pin state of SIM card slot, so as to support SIM card hot-plugging function.

SIM card hot-plugging function can be configured by “AT+MSMPD” command, and the description of AT command is as below:

AT Command	Detection of SIM Card Hot-plugging Function	Function Description
AT+MSMPD=1	On	Default value, SIM card hot-plugging detection function is on The module detects whether SIM card is inserted or not by detecting SIM_DETECT pin state
AT+MSMPD=0	Off	SIM card hot-plugging detection function is off When start-up, the module reads SIM card and does not detect SIM_DETECT state

When SIM card hot-plugging detection function is on and SIM_DETECT is at high level, the module executes SIM card initialization program after detected SIM card inserted, and the module conducts

network registration after read SIM card information. When SIM_DETECT is at low level, the module judges that SIM card has been removed, and then it does not read SIM card.

Note:

SIM_DETECT is high-active by default and can be switched to low-active by AT command. Please refer to AT command manual for specific AT command.

3.5.4 USIM Design

SIM card circuit design shall meet EMC standard and ESD requirements and shall improve the anti-interference capability, so as to ensure the stable operation of SIM card. In the design, the followings shall be strictly complied with:

- The layout of SIM card slot shall be as close as possible to the module and away from RF antenna, DC/DC power supply, clock signal line and other strong interference sources;
- SIM card slot with metal shield shall be applied to improve the anti-interference capability;
- The cable between the module and SIM card slot shall not be longer than 100mm, as redundant cable will degrade the quality of signal;
- UIM_CLK and UIM_DATA signal shall be isolated by grounding protection, so as to avoid mutual interference. If impossible, then a grounding protection shall be completed at least for SIM signal as a group;
- The filter capacitor and ESD devices of SIM card signal line shall be placed close to SIM card slot, and 22~33pF capacitance shall be chose for equivalent capacitance of ESD devices.

3.6 Status Indicator

H380 module provides 3 signals for displaying the operating state of the module, and the status indicator pins are as below:

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	L	Module wakes up Host(AP) signal, drain output	CMOS 3.3/1.8V
48	TX_BLANKING	O	PD	PA Blanking output, external GPS control signal	CMOS 1.8V

3.6.1 LED1# Signal

LED1# signal is used to indicate the operating state of the module, and the detailed description is as follows:

Operating Mode of Module	LED1# Signal
RF function is on	Low level (LED light on)
RF function is off	High level (LED light off)

LED drive circuit is shown in Figure 3-15:

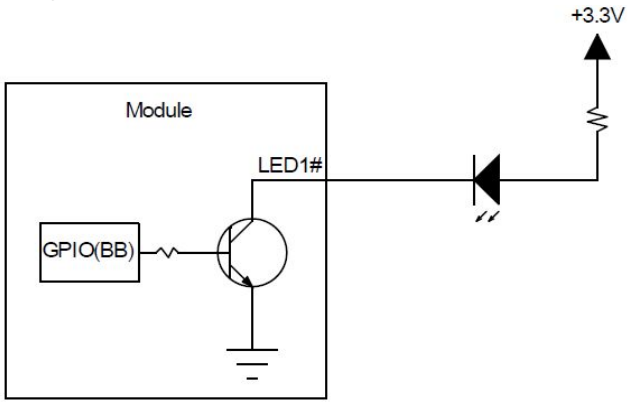

Figure 3-15 LED Drive Circuit

Note:

The current-limiting resistance value of LED light is configured according to driving voltage and driving current of the light.

3.6.2 WOWWAN#

The module wakes up Host (AP) by WOWWAN# signal when receiving incoming call/SMS or data request. WOWWAN# signal is drain output; therefore, external pull-up is required, WOWWAN# supports 3.3V or 1.8V external voltage pull-up. WOWWAN# signal is defined as follows:

Operating Mode	WOWWAN# Signal
Ringing/SMS or data requests	An 1s low level pulse by default
Idle/Sleep	High level

WOWWAN# timing is shown in Figure 3-16:

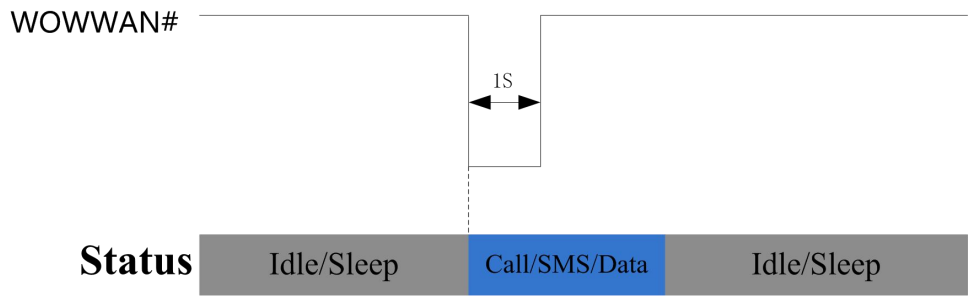

Figure 3-16 WOWWAN# Timing

3.6.3 TX_BLANKING

When the module is operating on GSM band, TX_BLANKING outputs pulse signal synchronized with GSM burst TX timing.

Because GSM TX timing may interfere with GPS signal receiving, the AP switches off GPS or stops GPS data receiving after detected TX_BLANKING pulse signal, so as to avoid abnormal GPS operation.

Operating Mode of Module	TX_BLANKING Signal
Default state	Low level
GSM burst TX	Output pulse signal synchronized with GSM burst TX

TX_BLANKING timing is shown in Figure 3-17:

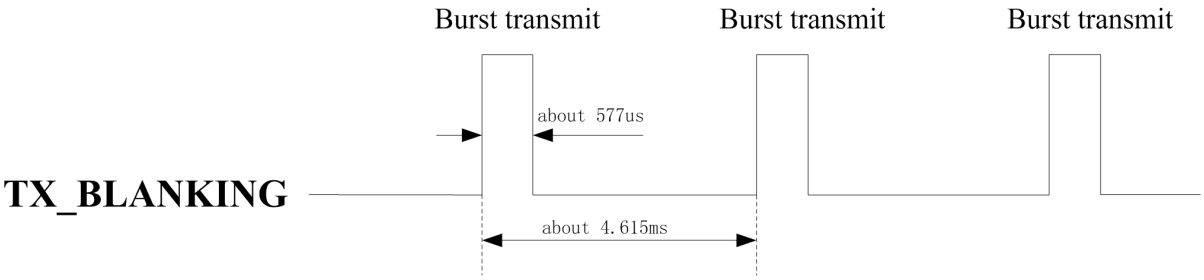

Figure 3-17 TX_BLANKING Timing

3.7 Interrupt Control

H380 module provides 3 interrupt signals, and the pins are defined as below:

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
8	W_DISABLE1#	I	PU	Switch on or off RF network	CMOS 3.3V
25	DPR	I	PU	Body SAR detection	CMOS 1.8V
44	GNSS_IRQ	I	PU	MBIM/ACM interface system switching	CMOS 1.8V

3.7.1 W_DISABLE1#

The module provides hardware for switching on/off WWAN RF function signal, and this function can also be controlled by AT command. The module enters Flight mode when switching off RF function. W_DISABLE1# signal function is defined as follows:

W_DISABLE1# Signal	Function
High/Floating	WWAN function is on, the module exits Flight mode
Low	WWAN function is off, the module enters Flight mode

3.7.2 System Switching Control

The module supports switching between MBIM and ACM interfaces, which are respectively designed for supporting Win8.1/Win10 and Android/Linux/Win7 systems. The detection of interrupt signal GNSS_IRQ is used for achieving system function switching. GNSS_IRQ signal function is defined as follows:

GNSS_IRQ Signal	Function
High/Floating	Set the USB port of the module as MBIM interface to support Win8.1/Win10 system
Low	Set the USB port of the module as ACM interface to support Android/Linux/Win7 system

Note:

- When starting up, the module switches MBIM and ACM interfaces by detecting GNSS_IRQ level, the stability of GNSS_IRQ level shall be maintained in start-up process;
- After start-up, the module switches MBIM and ACM interfaces by detecting GNSS_IRQ rising/falling edge, the filter time is 100ms. When the condition is met, the module will restart and switch to another interface.

3.7.3 BODY SAR

H380 module supports BODY SAR function through DPR pin detection. DPR is at high level by default, the AP pulls down the DPR when approaching human body is detected by using SAR Sensor (distance sensor), then the module reduces the transmit power to a preset threshold value, decreasing RF radiation on the human body. The preset threshold value can be set by the relevant AT command or DPR Tool. DPR function is defined as follows:

DPR Signal	Function
High/Floating	The module maintains default transmit power
Low	Reduce the threshold value of maximum transmit power of the module

3.8 Clock Interface

H380 module supports 1 channel clock and can respectively output 26MHz clock.

Pin	Pin Name	I/O	Reset Value	Pin Description	Type
46	SYSCLK	O		26M clock output (available for external GPS or Audio Codec)	1.8V

3.9 Config Interface

H380 module provides 4 config pins and is configured as WWAN-SSIC-0 type M.2 module:

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

M.2 module configuration is as follows:

Config_0 (pin21)	Config_1 (pin69)	Config_2 (pin75)	Config_3 (pin1)	Module Type and Main Host Interface	Port Configuration
NC	GND	GND	GND	WWAN-SSIC	0

Please refer to “PCI Express M.2 Specification Rev0.9-3” for details.

3.10 Other Interfaces

The ANT Tunable interface of the module is currently not supported.

4 RF Interface

4.1 RF Interface

4.1.1 RF Interface Function

H380 module provides 2 RF connectors for connecting with external antennas. As shown in Figure 4-1, “M” refers to RF main antenna, which is used for sending and receiving RF signals; “D” refers to Diversity antenna, which is used for receiving diversity RF signals.

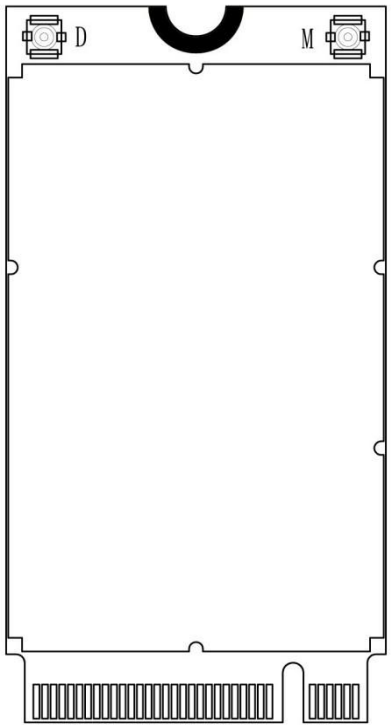

Figure 4-1 Schematic Diagram of RF Interface

4.1.2 RF Connector Performance

Rated Conditions		Environmental Conditions
Frequency Range	DC to 6GHz	Temperature Range:
Characteristic Impedance	50Ω	–40°C to +85°C

4.1.3 RF Connector Dimension

H380 module applies standard M.2 module RF connector, the model is Murata MM4829-2702, and the dimension of connector is 2*2*0.6mm. The dimension of connector is as below:

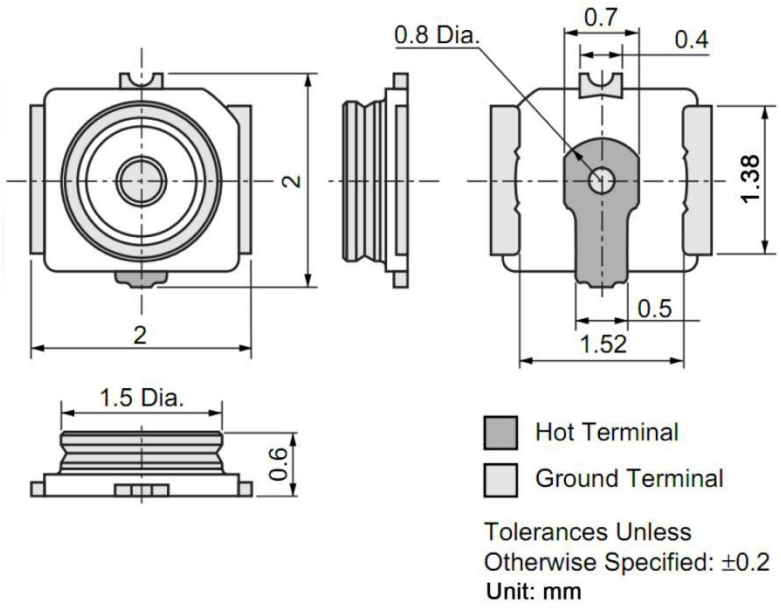

Figure 4-2 Dimension Figure of RF Connector

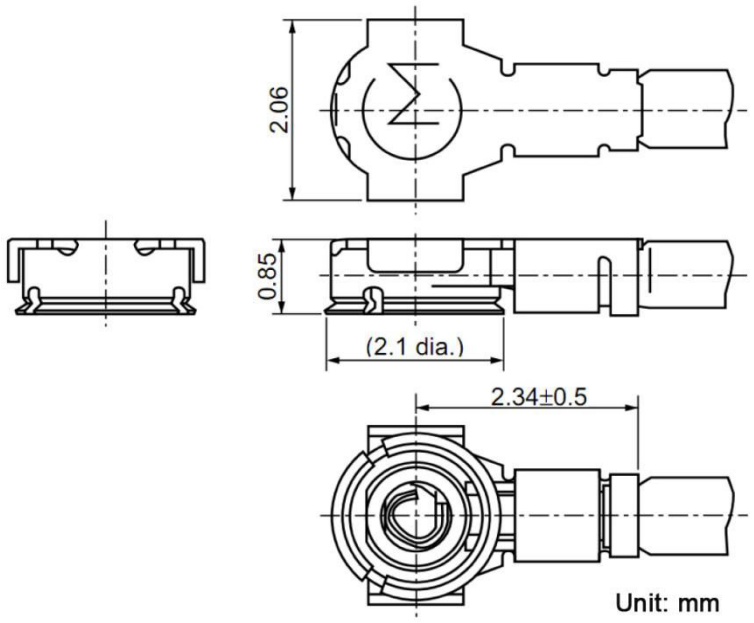

Figure 4-3 Dimension Figure of 0.81mm Coaxial Line Coupling with RF Connector

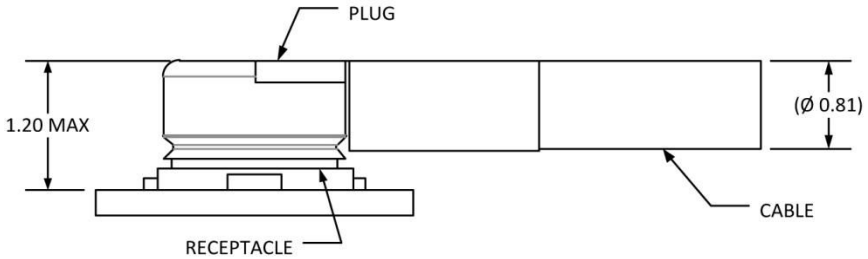

Figure 4-4 Schematic Diagram of 0.81mm Coaxial Line Locking into RF Connector

4.2 Operating Band

The operating band of H380 module antenna is as below:

Operating Band	Description	Mode	Tx (MHz)	Rx (MHz)
Band 1	IMT 2100MHz	WCDMA	1920 - 1980	2110 - 2170
Band 2	PCS 1900MHz	WCDMA/GSM	1850 - 1910	1930 - 1990
Band 3	DCS 1800MHz	GSM	1710 - 1785	1805 - 1880
Band 5	CLR 850MHz	WCDMA/GSM	824 - 849	869 - 894
Band 8	E-GSM 900MHz	WCDMA/GSM	880 - 915	925 - 960

4.3 Transmitting Power

The transmitting power of various bands of H380 module is as below:

Mode	Condition	Band	Transmit Power (dBm)		
			Min	Type	Max
GSM	GMSK (1TX Slot)	GSM850	31.5	32.5	33.5
		GSM900	31.5	32.5	33.5
		DCS1800	28.5	29.5	30.5
		PCS1900	28.5	29.5	30.5
EGPRS	8PSK (1TX Slot)	GSM850	26	27	28
		GSM900	26	27	28
		DCS1800	25	26	27
		PCS1900	25	26	27
WCDMA		I	22.5	23.5	24.5
		II	22.5	23.5	24.5
		V	22.5	23.5	24.5
		VIII	22.5	23.5	24.5

4.4 Receiving Sensibility

The sensitivity of various bands of H380 module is as below:

Mode	Band	Rx Sensitivity (dBm)		Conditions
		Typ	Max	
GPRS	GSM850	-112.5	-109	GMSK (CS1,BLER<10%)
	GSM900	-112	-109	
	DCS1800	-112.5	-109	
	PCS1900	-112	-109	
EGPRS	GSM850	-104.5	-101.5	8PSK (MCS5,BLER<10%)
	GSM900	-104	-101	
	DCS1800	-104.5	-101.5	
	PCS1900	-104.5	-101.5	
WCDMA (Main)	I	-110	-108	(BER<0.1%)
	II	-110.5	-108	
	V	-110.5	-108	
	VIII	-110	-108	
WCDMA (Diversity)	I	-110.5	-108	(BER<0.1%)
	II	-110	-108	
	V	-111	-108	
	VIII	-111	-108	

4.5 Antenna Design

H380 module provides two antenna connectors, i.e., main and diversity antenna connectors, and the design requirements of antenna is as below:

Requirements of H380 Module Main Antenna	
Frequency range	The most appropriate antenna shall be used to adapt to the relevant bands
Bandwidth (GSM/EDGE)	GSM850: 70 MHz GSM900: 80 MHz GSM1800(DCS): 170 MHz GSM1900(PCS): 140 MHz
Bandwidth (WCDMA)	WCDMA band I(2100): 250 MHz WCDMA band II(1900): 140 MHz WCDMA band V(850): 70 MHz WCDMA band VIII(900): 80 MHz
Impedance	50Ω
Input power	> 33dBm(2 W) peak power GSM > 23.5dBm average power WCDMA
Standing-wave ratio (SWR) recommended	≤ 2:1

5 Structure Specification

5.1 Product Appearance

The product appearance for the H380 module is shown in Figure 5-1:

Figure 5-1 Top View & Bottom View

5.2 Dimension of Structure

The dimension of structure of H380 module is shown in Figure 5-2:

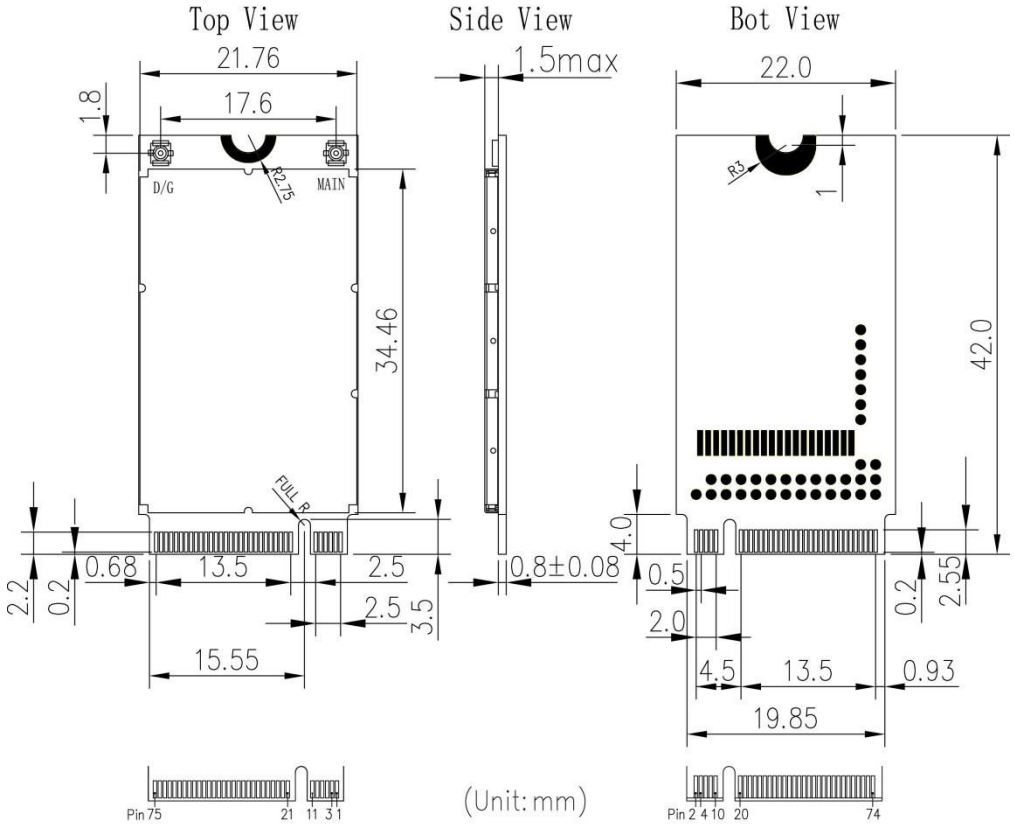

Figure 5-2 Dimension of Structure

5.3 M.2 Interface Type

H380 M.2 module applies 75-pin Gold Finger as the external interface, of which 67 pins are signal interfaces, and 8 pins are a notch (as shown in Figure 3-1). Please refer to the description in Section 5.2 for dimension of the module. According to the definition of M.2 interface, H380 module applies Type 2242-S3-B interface (22x42mm, the thickness of element layer on Top surface is up to 1.5mm, the thickness of PCB is 0.8mm, and Key ID is B).

Module Nomenclature
Sample type 2242-D2-B-M

Type XX XX - XX - X - X[0]

Width (mm)
12
16
22
30

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

	Component Max Ht (mm)	
	Top Max[00]	Bottom Max[00]
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

H380 module connects with the AP by using M.2 connector, LOTES M.2 connector is recommended, the model is APCI0026-P001A, as shown in Figure 5-3. Please refer to specification design for connector package.

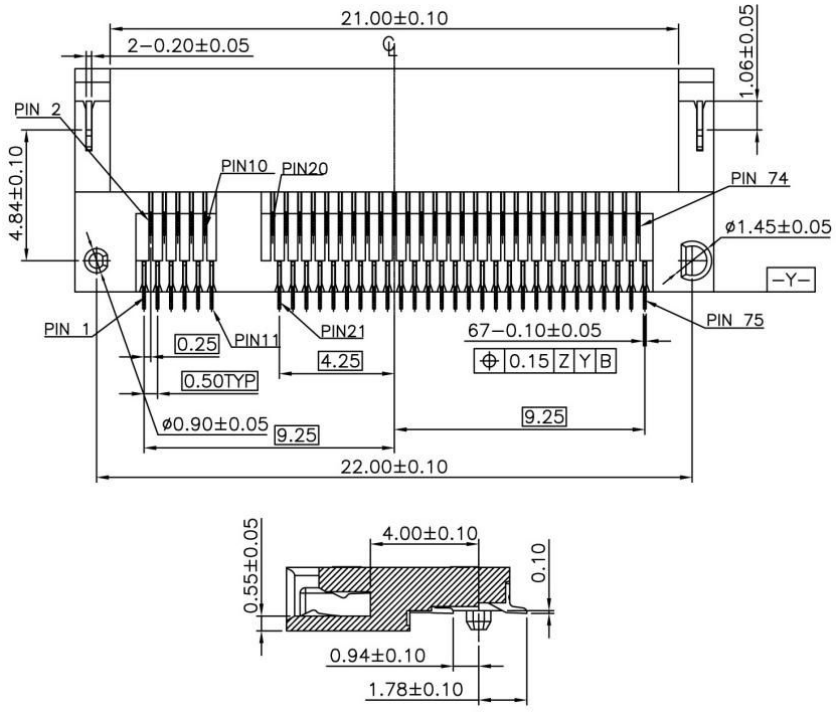

Figure 5-3 Dimension of M.2 Connector

5.5 Storage

5.5.1 Storage Life

Storage conditions (recommended): Temperature: 23±5°C, relative humidity (RH): 35-70%.

Storage period (sealed vacuum packing): 12 months under the recommended storage conditions.

5.6 Package

The H380 module uses the tray sealed vacuum packing, combined with the hard cartoon box outer packing method, so that the storage, transportation and the usage of the module can be protected to the greatest extent.

Note:

The vacuum package bag includes the humidity card and a desiccant. The module is the humidity sensitive device, and the humidity sensitivity level is Class 3, which meets the requirements of the American Electronic Component Industry Association (JEDEC). Please protect the module to avoid the permanent damage to the product caused by humidity.

The module is a sophisticated electronic product and may suffer permanent damage if no proper ESD protection measures are taken.

5.6.1 Tray Package

The L816 module uses tray package, 20pcs are packed in each tray, with 5 trays in each box and 6 boxes in one case. Tray packing process is shown in Figure 5-4:

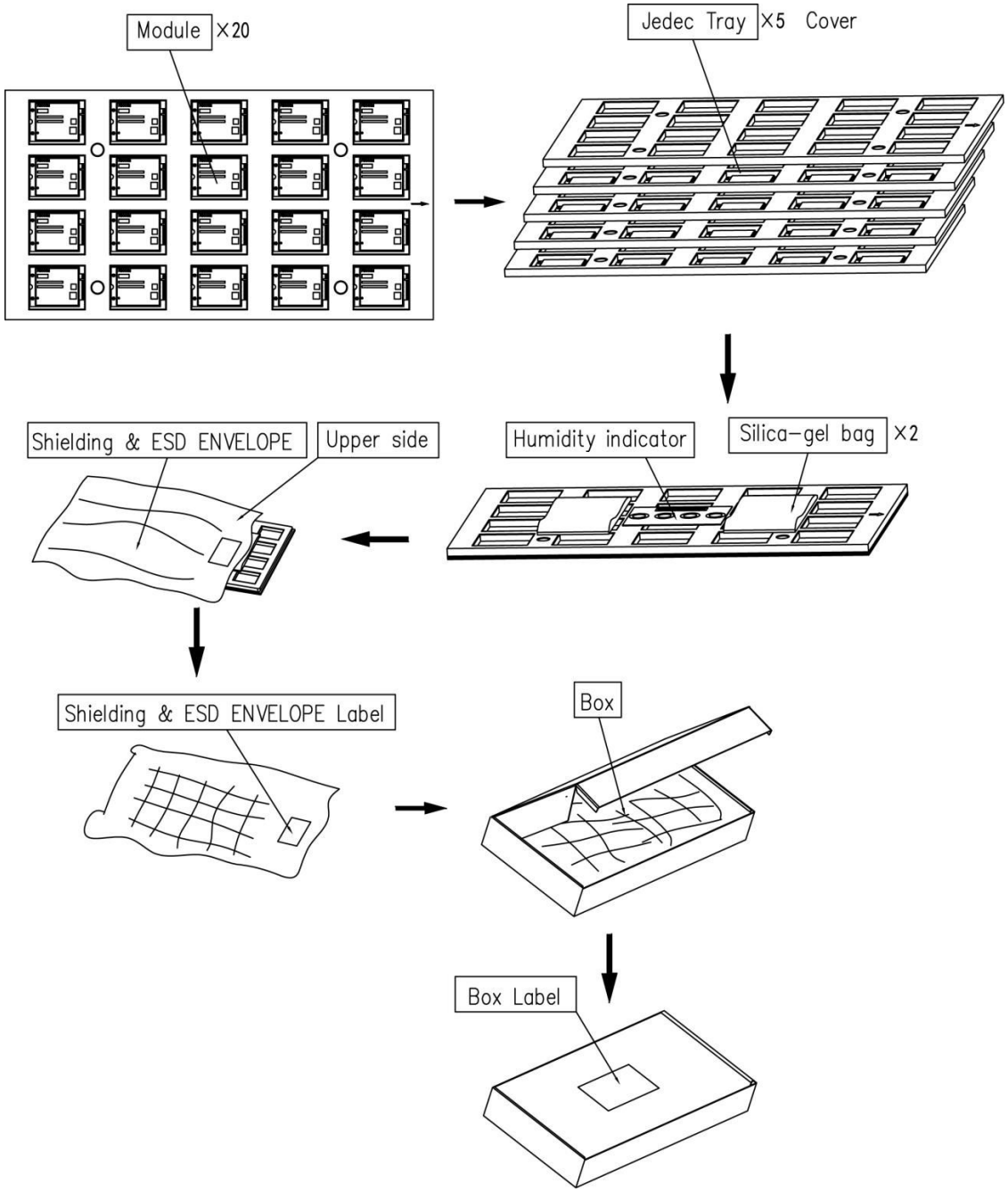

Figure 5-4 Tray Packing Process

5.6.2 Tray Size

The type of tray is C (43*23mm), and its size is 329*176*9.5mm, as shown in Figure 5-5:

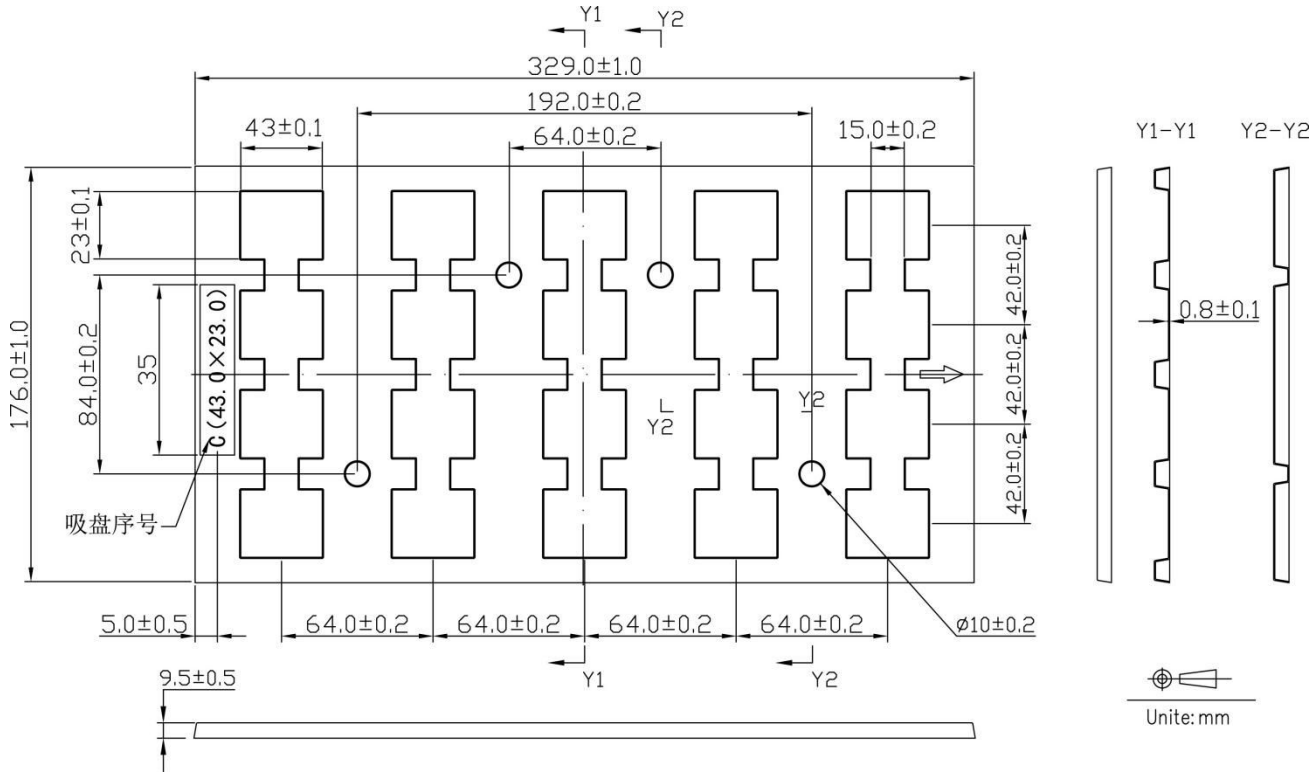

Figure 5-5 Tray Size