

# **H380 M.2 Series Module Hardware User Manual**

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## Revision History

| Version | Date       | Remarks                                                                |
|---------|------------|------------------------------------------------------------------------|
| V1.0.0  | 2014-03-20 | Initial version                                                        |
| V1.0.1  | 2014-04-18 | 1.Change current part.<br>2.Change GPS part.<br>3.Change temperature . |
| V1.0.2  | 2014-06-04 | Add support spec of Win 8 / android dual system switch .               |
|         |            |                                                                        |

## Applicability Table

| No. | Type        | Note |
|-----|-------------|------|
| 1   | H380-Q50-00 |      |
|     |             |      |
|     |             |      |

The difference M.2 wireless communication module of H380 series as listed below:

| Model No.   | GSM/GPRS/EDGE<br>Band(MHz) | WCDMA Band(MHz)   | HSDPA<br>(Mbps) | HSUPA<br>(Mbps) |
|-------------|----------------------------|-------------------|-----------------|-----------------|
| H380-Q50-00 | 850/900/1800/1900          | 850/900/1900/2100 | 21              | 5.76            |

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# 1 Preface

## 1.1 Outline

The document outlines the electrical, RF performance, mechanical size and application environment of H380 series M.2 wireless communication module. Under the help of the document and others application notice, the application developer could understand quickly the performance of H380 series M.2 wireless communication module, and developing the product.

## 1.2 Standards

The products`reference design standard as listed below:

- 3GPP TS 27.007 -v6.9.0: AT command set for User Equipment (UE)
- 3GPP TS 27.005 -v6.0.1: Use of Data Terminal Equipment -Data Circuit terminating Equipment (DTE-DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
- 3GPP TS 23.040 -v6.9.0: Technical realization of Short Message Service (SMS)
- 3GPP TS 24.011 -v6.1.0: Point- to - Point (PP) Short Message Service (SMS) support on mobile radio interface.
- 3GPP TS 27.010 -v6.0.0: Terminal Equipment to User Equipment (TE-UE) multiplexer protocol
- 3GPP TS 27.060 -v6.0.0: Packet domain; Mobile Station (MS) supporting Packet Switched services
- 3GPP TS 25.304-v6.10.0: User Equipment (UE) procedures in idle mode and procedures for cell reselection in connected mode.
- 3GPP TS 25.308 -v6.4.0: High Speed Downlink Packet Access (HSDPA); Overall description; Stage 2.
- 3GPP TS 25.309 -v6.6.0: FDD enhanced uplink; Overall description; Stage 2.
- 3GPP TS 23.038 -v6.1.0: Alphabets and language - specific information
- 3GPP TS 21.111 -v6.3.0: USIM and IC card requirements.
- 3GPP TS 31.111 -v6.11.0 "USIM Application Toolkit (USAT)".
- 3GPP TS 45.002 -v6.12.0: Multiplexing and multiple access on the radio path.
- 3GPP TS 51.014 -v4.5.0: Specification of the SIM Application Toolkit for the Subscriber Identity Module - Mobile Equipment (SIM-ME) interface.
- 3GPP TS 51.010 -1 -v6.7.0: Mobile Station (MS) conformance specification; Part 1: Conformance specification.
- 3GPP TS 22.004 -v6.0.0: General on supplementary services.
- 3GPP TS 23.090 -v6.1.0: Unstructured Supplementary Service Data (USSD); Stage 2
- 3GPP TS 24.008 v6.19, Mobile radio interface Layer 3 specification;

- PCIe\_M.2\_Electromechanical\_Spec\_Rev0.9-3\_07312013\_RS\_Clean[1]

## 2 Introduction

### 2.1 Description

H380 M.2 series modules are highly integrated 3G wireless communication modules, support GSM / GPRS / EDGE and UMTS / HSDPA / HSUPA / HSPA+ , GPS/GNSS(follow-up support ).

### 2.2 Specifications

| Specifications                       |                                                             |
|--------------------------------------|-------------------------------------------------------------|
| Bands                                | UMTS (WCDMA/FDD): 850/900/1900/2100MHz                      |
|                                      | GSM/GPRS/EDGE: 850/900/1800/1900MHz                         |
| Data                                 | UMTS/HSDPA/HSUPA 3GPP release 7                             |
|                                      | HSUPA 5.76Mbps (Cat 6)                                      |
|                                      | HSDPA 21Mbps (Cat 14) or 7.2Mbps (Cat 8)                    |
|                                      | GSM 3GPP release 7                                          |
|                                      | EDGE (E-GPRS) multi-slot class 33(296kbps DL, 236.8kbps UL) |
|                                      | GPRS multi-slot class 33(107kbps DL, 85.6kbps UL)           |
| GPS                                  | GPS/GNSS(follow-up support)                                 |
| Physical                             | Dimension: 22mm x 42mm x 2.35mm                             |
|                                      | Interface: M.2                                              |
|                                      | Weight: 5.0 grams                                           |
| Environment                          | Operating Temperature: -30℃ ~ +75℃                          |
|                                      | Storage Temperature: -40℃ ~ +85℃                            |
| Performance                          |                                                             |
| Operating Voltage                    | Voltage: 3.135V ~ 4.4V    Normal: 3.3V                      |
| Operating Current<br>(Typical Value) | 3mA (Sleep Mode)                                            |
|                                      | 3G Talk: 660mA                                              |
|                                      | 2G Talk: 270mA (GSM PCL5)                                   |
| Transmit Power<br>(Typical Value)    | Class 4 (2W): 850/900 MHz, GSM                              |
|                                      | Class 1 (1W): 1800/1900 MHz, GSM                            |
|                                      | Class E2 (0.6W): 850/900 MHz, EDGE                          |
|                                      | Class E2 (0.5W): 1800/1900 MHz, EDGE                        |



|                                   |                                                           |
|-----------------------------------|-----------------------------------------------------------|
|                                   | Class 3 (0.25W): 900/850/1900/2100 MHz, WCDMA             |
| Rx Sensitivity<br>(Typical Value) | UMTS/HSPA: -109dBm                                        |
|                                   | GSM: -108dBm                                              |
| <b>Interfaces</b>                 |                                                           |
| RF Interface                      | Main Antenna, Diversity Antenna(RF diversity and GPS Aux) |
| Connectivity                      | 1 x USB 2.0, Multiple Profiles over USB                   |
|                                   | I2C Support, I2S/PCM Support                              |
|                                   | GPIO Connectivity                                         |
| <b>Data Features</b>              |                                                           |
| Protocol Stack                    | Embedded TCP/IP and UDP/IP protocol stack                 |
| EDGE                              | Multi-slot class 33(5 Down; 4 Up; 6 Total)                |
|                                   | Coding Scheme MCS1~9                                      |
| GPRS                              | Multi-slot class 33(5 Down; 4 Up; 6 Total)                |
|                                   | Coding Scheme CS1~4                                       |
| CSD                               | UMTS(14.4kbps), GSM(9.6kbps)                              |
| USSD                              | Support                                                   |
| SMS                               | MO / MT Text and PDU modes                                |
|                                   | Cell broadcast                                            |
| Voice Features                    | Digital Audio                                             |
|                                   | Voice coders: EFR/HR/FR/AMR                               |
| Audio Control                     | Gain Control                                              |
| Character Set                     | IRA                                                       |
|                                   | GSM                                                       |
|                                   | UCS2                                                      |
|                                   | HEX                                                       |
| AT Commands                       | FIBOCOM proprietary AT commands                           |
|                                   | GSM 07.05                                                 |
|                                   | GSM 07.07                                                 |
| Accessories                       | Firmware Loader Tool over USB/UART                        |
|                                   | User Manual                                               |
|                                   | Developer Kit                                             |

## 2.3 Appearance

The following picture shows the H380 M.2 WWAN Module.

Top view:

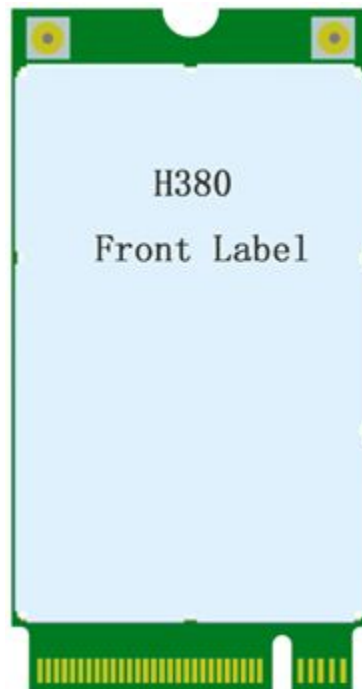


Figure 2- 1 Top View

Bottom view:

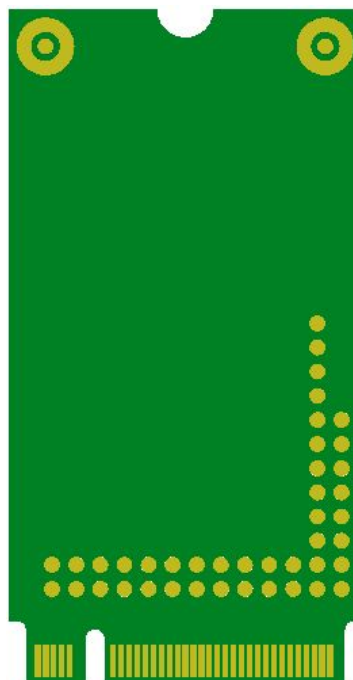


Figure 2- 2 Bottom View

## 3 Mechanical

### 3.1 Size

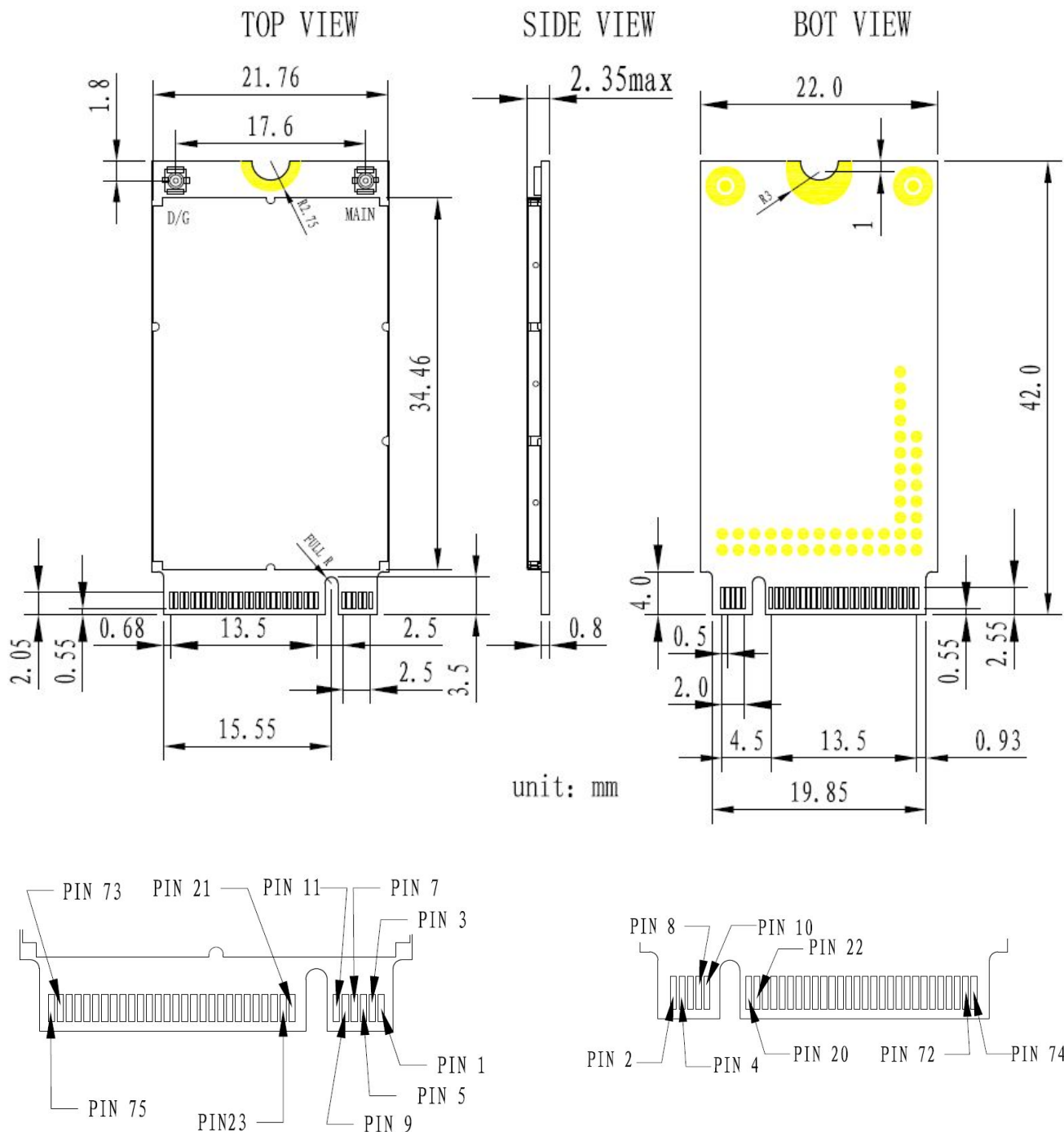


Figure 3-1 Mechanical size

## 3.2 Application Interface Description

H380 M.2 module uses 75-pin gold fingers as the external interface, the size of the module please refer to the Section 3.1.

As shown in Figure 4-2, H380 M.2 module uses the 75-pin fingers interface (67 pin is signal interface and 8 is notch).

About the naming rules of M.2, H380 uses the Type 2242-S3-B (22mmx42mm, Top surface element layer maximum thickness is 1.5mm, the thickness of PCB is 0.8mm, Key ID is B)

### Module Nomenclature Sample Type 2242-D2-B-M

Type XX-XX-XX-X-X<sup>0</sup>

| Width (mm) | Length (mm) | Label** | Component Max Ht (mm) |            | Key ID | Pin   | Interface                                            |
|------------|-------------|---------|-----------------------|------------|--------|-------|------------------------------------------------------|
|            |             |         | Top Max               | Bottom Max |        |       |                                                      |
| 12         | 16          | S1      | 1.2                   | 0****      | A      | 8-15  | 2x PCIe x1 / USB 2.0 / I2C / DP x4                   |
| 16         | 26          | S2      | 1.35                  | 0****      | B      | 12-19 | PCIe x2/SATA/USB 2.0/USB 3.0/HSIC/SSIC/Audio/UIM/I2C |
| 22         | 30          | S3      | 1.5                   | 0****      | C      | 16-23 | Reserved for Future Use                              |
| 30         | 42          | D1      | 1.2                   | 1.35       | D      | 20-27 | Reserved for Future Use                              |
|            | 60          | D2      | 1.35                  | 1.35       | E      | 24-31 | 2x PCIe x1 / USB 2.0 / I2C / SDIO / UART / PCM       |
|            | 80          | D3      | 1.5                   | 1.35       | F      | 28-35 | Future Memory Interface (FMI)                        |
|            | 110         | D4      | 1.5                   | 0.7        | G      | 39-46 | Generic (Not used for M.2)***                        |
|            |             | D5      | 1.5                   | 1.5        | H      | 43-50 | Reserved for Future Use                              |
|            |             |         |                       |            | J      | 47-54 | Reserved for Future Use                              |
|            |             |         |                       |            | K      | 51-58 | Reserved for Future Use                              |
|            |             |         |                       |            | L      | 55-62 | Reserved for Future Use                              |
|            |             |         |                       |            | M      | 59-66 | PCIe x4 / SATA                                       |

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

### 3.3 M.2 Connector

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

As shown in Figure 3-2::

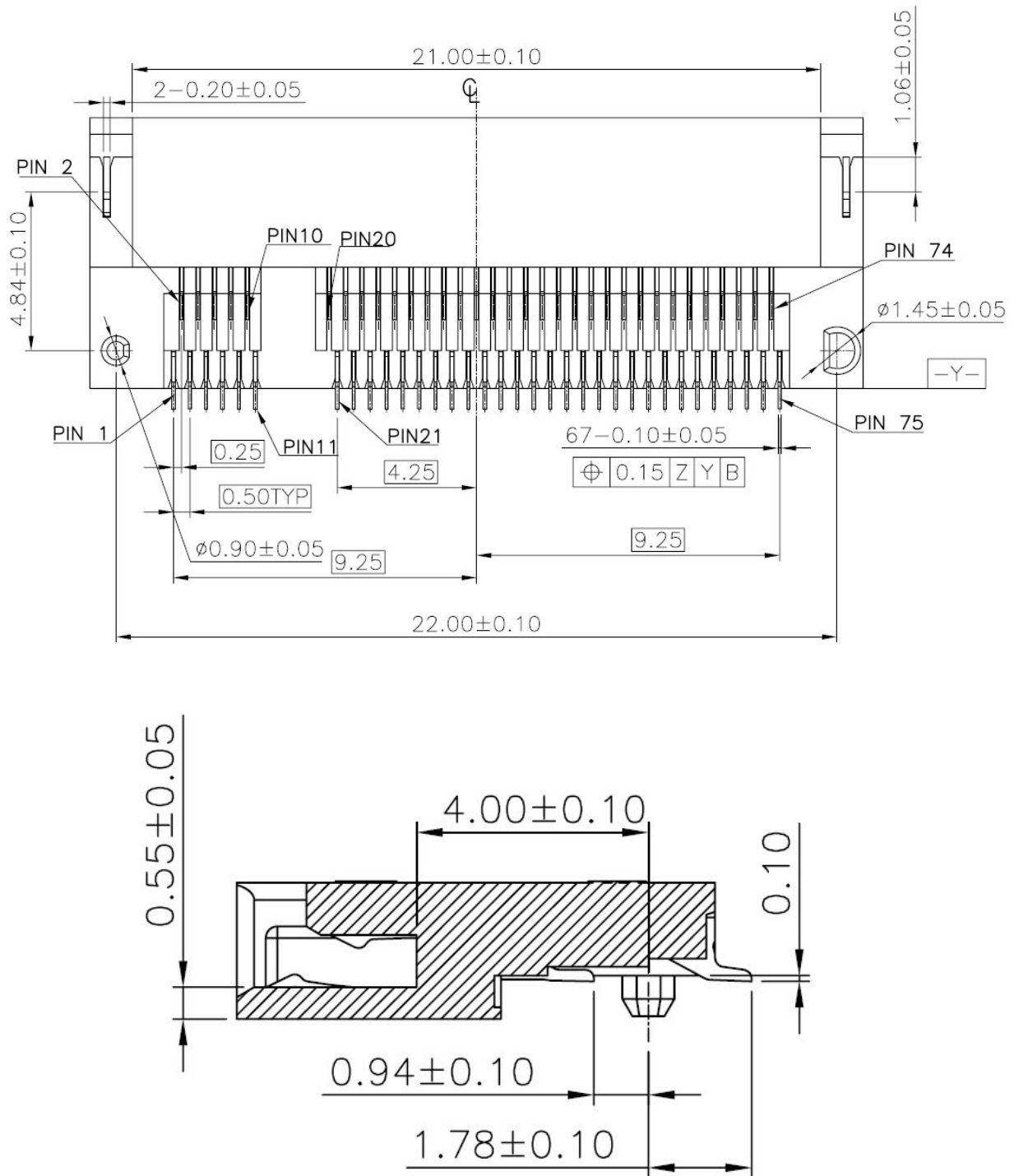


Figure 3-2 APCI0026-P001A M.2 connector dimension

# 4 Hardware Overview

## 4.1 Block Diagram

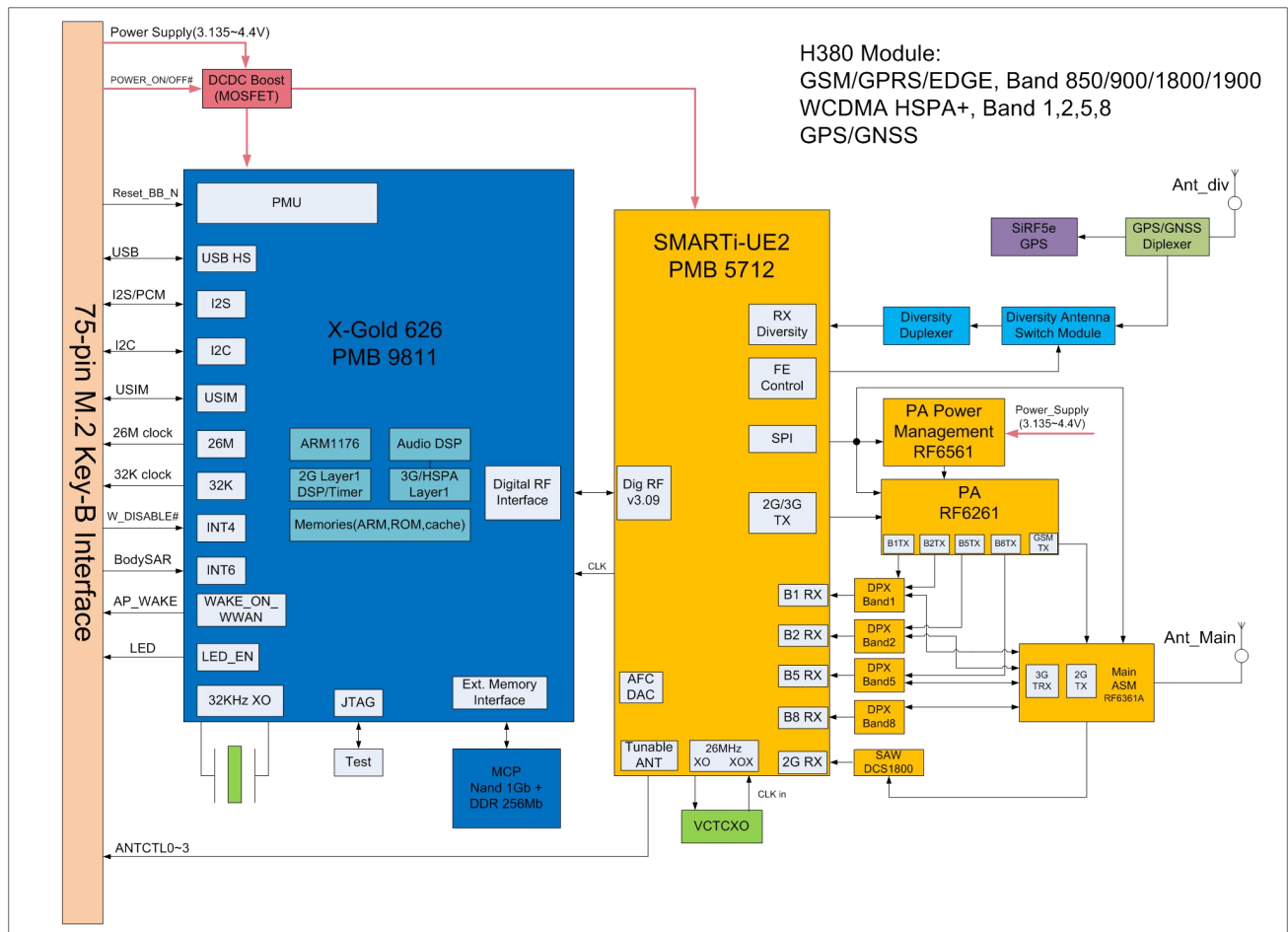


Figure 4- 1 Block Diagram

## 4.2 Pin Definition

Pin Map

|    |                           |          |    |
|----|---------------------------|----------|----|
| 74 | +3.3V                     | CONFIG_2 | 75 |
| 72 | +3.3V                     | GND      | 73 |
| 70 | +3.3V                     | GND      | 71 |
| 68 | CLK32K                    | CONFIG_1 | 69 |
| 66 | SIM_DETECT                | RESET#   | 67 |
| 64 | NC                        | ANTCTL3  | 65 |
| 62 | NC                        | ANTCTL2  | 63 |
| 60 | NC                        | ANTCTL1  | 61 |
| 58 | NC                        | ANTCTL0  | 59 |
| 56 | NC                        | GND      | 57 |
| 54 | NC                        | NC       | 55 |
| 52 | NC                        | NC       | 53 |
| 50 | NC                        | GND      | 51 |
| 48 | TX_BLANKING               | NC       | 49 |
| 46 | SYSCLK                    | NC       | 47 |
| 44 | GNSS_IRQ                  | GND      | 45 |
| 42 | GNSS_SDA                  | NC       | 43 |
| 40 | GNSS_SCL                  | NC       | 41 |
| 38 | NC                        | GND      | 39 |
| 36 | UIM_PWR                   | NC       | 37 |
| 34 | UIM_DATA                  | NC       | 35 |
| 32 | UIM_CLK                   | GND      | 33 |
| 30 | UIM_RESET                 | NC       | 31 |
| 28 | I2S_WA                    | NC       | 29 |
| 26 | W_DISABLE2#               | GND      | 27 |
| 24 | I2S_RX                    | DPR      | 25 |
| 22 | I2S_TX                    | WOWWAN#  | 23 |
| 20 | I2S_CLK                   | CONFIG_0 | 21 |
|    | Notch                     | Notch    |    |
|    | Notch                     | Notch    |    |
|    | Notch                     | Notch    |    |
|    | Notch                     | Notch    |    |
| 10 | LED1#(3.3V)               | GND      | 11 |
| 8  | W_DISABLE1#(3.3V)         | USB D-   | 9  |
| 6  | FUL_CARD_POWER_OFF#(1.8V) | USB D+   | 7  |
| 4  | +3.3V                     | GND      | 5  |
| 2  | +3.3V                     | GND      | 3  |
|    |                           | CONFIG_3 | 1  |

Figure 4- 2 Pin Definition

### 4.2.1 Pin Description

The description of pin-out of H380 as listed below:

| No | Name                | I/O | Reset Value | Idle Value | Description                                                                         |
|----|---------------------|-----|-------------|------------|-------------------------------------------------------------------------------------|
| 1  | CONFIG_3            | O   | L           | L          | Connected to Ground internally, H380 is configured as a WWAN-SSIC0 interface module |
| 2  | +3.3V               | PI  |             |            | Power Supply, voltage range: 3.135V ~ 4.4V                                          |
| 3  | GND                 |     |             |            | GND                                                                                 |
| 4  | +3.3V               | PI  |             |            | Power Supply, voltage range: 3.135V ~ 4.4V                                          |
| 5  | GND                 |     |             |            | GND                                                                                 |
| 6  | FUL_CARD_POWER_OFF# | I   | PU          | PU         | The control signal of power off, internal pull-up(47K ohms), CMOS 1.8V              |
| 7  | USB D+              | I/O |             |            | USB signal (+)                                                                      |
| 8  | W_DISABLE1#         | I   | PU          | PU         | WWAN Disable, Low active, CMOS 3.3V                                                 |
| 9  | USB D-              | I/O |             |            | USB signal(-)                                                                       |
| 10 | LED1#               | O   | OD          | OD         | System status LED, open-drain output, low level is available, CMOS 3.3V             |
| 11 | GND                 |     |             |            | GND                                                                                 |
| 12 | Notch               |     |             |            | Notch                                                                               |
| 13 | Notch               |     |             |            | Notch                                                                               |
| 14 | Notch               |     |             |            | Notch                                                                               |
| 15 | Notch               |     |             |            | Notch                                                                               |
| 16 | Notch               |     |             |            | Notch                                                                               |
| 17 | Notch               |     |             |            | Notch                                                                               |
| 18 | Notch               |     |             |            | Notch                                                                               |
| 19 | Notch               |     |             |            | Notch                                                                               |
| 20 | I2S_CLK             | O   | T           | T          | I2S serial clock, CMOS 1.8V                                                         |



| No | Name        | I/O | Reset Value | Idle Value | Description                                                                                   |
|----|-------------|-----|-------------|------------|-----------------------------------------------------------------------------------------------|
| 21 | CONFIG_0    |     |             |            | NC                                                                                            |
| 22 | I2S_TX      | O   | T           | T          | I2S serial data output, CMOS 1.8V                                                             |
| 23 | WOWWAN#     | O   | PU          | PU         | The signal of module wake up the Host device, low level is available, CMOS 1.8V               |
| 24 | I2S_RX      | I   | T           | T          | I2S serial data input, CMOS 1.8V                                                              |
| 25 | DPR         | I   |             |            | Body SAR Detect, CMOS 1.8V                                                                    |
| 26 | W_DISABLE2# | I   | PU          | PU         | GPS Disable, active low, CMOS 1.8V (not support now)                                          |
| 27 | GND         |     |             |            | GND                                                                                           |
| 28 | I2S_WA      | O   | T           | T          | I2S Left/Right clock signal, CMOS 1.8V                                                        |
| 29 | NC          |     |             |            | NC                                                                                            |
| 30 | UIM_RESET   | O   | PP          | PP         | USIM card reset                                                                               |
| 31 | NC          |     |             |            | NC                                                                                            |
| 32 | UIM_CLK     | O   | PP          | PP         | USIM card clock                                                                               |
| 33 | GND         |     |             |            | GND                                                                                           |
| 34 | UIM_DATA    | I/O | PU          | PU         | USIM card data, internal 4.7K resistor pull up                                                |
| 35 | NC          |     |             |            | NC                                                                                            |
| 36 | UIM_PWR     | O   |             |            | SIM Card power output, 1.8V/3.0V                                                              |
| 37 | NC          |     |             |            | NC                                                                                            |
| 38 | NC          |     |             |            | NC                                                                                            |
| 39 | GND         |     |             |            | GND                                                                                           |
| 40 | GNSS_SCL    | O   | PD          | PD         | Android/Win8 system can switch INTIN signal, internal resistance was pulled-up 10K, CMOS 1.8V |
| 41 | NC          |     |             |            | NC                                                                                            |
| 42 | GNSS_SDA    | I/O | PU          | PU         | I2C serial data, internal pull-up (4.7K ohms), CMOS 1.8V                                      |
| 43 | NC          |     |             |            | NC                                                                                            |

| No | Name        | I/O | Reset Value | Idle Value | Description                                                          |
|----|-------------|-----|-------------|------------|----------------------------------------------------------------------|
| 44 | GNSS_IRQ    | I   | PU          | PU         | Android/Win8 I2C interrupt request (not support now), CMOS 1.8V      |
| 45 | GND         |     |             |            | GND                                                                  |
| 46 | SYSCLK      | O   | L           | L          | 26MHz clock output                                                   |
| 47 | NC          |     |             |            | NC                                                                   |
| 48 | TX_BLANKING | O   | L           | L          | GSM TDMA Timer output signal, external GPS control signal, CMOS 1.8V |
| 49 | NC          |     |             |            | NC                                                                   |
| 50 | NC          |     |             |            | NC                                                                   |
| 51 | GND         |     |             |            | GND                                                                  |
| 52 | NC          |     |             |            | NC                                                                   |
| 53 | NC          |     |             |            | NC                                                                   |
| 54 | NC          |     |             |            | NC                                                                   |
| 55 | NC          |     |             |            | NC                                                                   |
| 56 | NC          |     |             |            | NC                                                                   |
| 57 | GND         |     |             |            | GND                                                                  |
| 58 | NC          |     |             |            | NC                                                                   |
| 59 | ANTCTL0     | O   | L           | L          | Tunable antenna control signal, bit0, CMOS 1.8V(not support now)     |
| 60 | NC          |     |             |            | NC                                                                   |
| 61 | ANTCTL1     | O   | L           | L          | Tunable antenna control signal, bit1, CMOS 1.8V (not support now)    |
| 62 | NC          |     |             |            | NC                                                                   |
| 63 | ANTCTL2     | O   | L           | L          | Tunable antenna control signal, bit2, CMOS 1.8V(not support now)     |
| 64 | NC          |     |             |            | NC                                                                   |
| 65 | ANTCTL3     | O   | L           | L          | Tunable antenna control signal, bit3, CMOS 1.8V(not support now)     |
| 66 | SIM_DETECT  | I   |             |            | SIM Detect ,CMOS 1.8V                                                |
| 67 | RESET#      | I   | PU          | PU         | External reset signal input, CMOS                                    |

| No | Name     | I/O | Reset Value | Idle Value | Description                                                                         |
|----|----------|-----|-------------|------------|-------------------------------------------------------------------------------------|
|    |          |     |             |            | 1.8V                                                                                |
| 68 | CLK32K   | O   |             |            | 32KHz Clock output                                                                  |
| 69 | CONFIG_1 | O   | L           | L          | Connected to Ground internally, H380 is configured as a WWAN-SSIC0 interface module |
| 70 | +3.3V    | PI  |             |            | The main power supply, voltage range: 3.135V ~ 4.4V                                 |
| 71 | GND      |     |             |            | GND                                                                                 |
| 72 | +3.3V    | PI  |             |            | The main power supply, voltage range: 3.135V ~ 4.4V                                 |
| 73 | GND      |     |             |            | GND                                                                                 |
| 74 | +3.3V    | PI  |             |            | The main power supply, voltage range: 3.135V ~ 4.4V                                 |
| 75 | CONFIG_2 | O   | L           | L          | Connected to Ground internally, H380 is configured as a WWAN-SSIC0 interface module |

PI: Power Input

H: High Voltage Level

L: Low Voltage Level

PD: Pull-Down

PU: Pull-Up

T: Tristate

OD: Open Drain

PP: Push-Pull

## 5 Hardware Interface

### 5.1 Power Interface

#### 5.1.1 Power Supply

H380 module requires a 3.135 V~ 4.4V DC power supply to provide 2A current during the GSM transmitting burst.

Input power supply requirements as listed below:

| Parameter | Minimum | Typical | Maximum | Unit |
|-----------|---------|---------|---------|------|
| +3.3V     | 3.135   | 3.3     | 4.4     | V    |

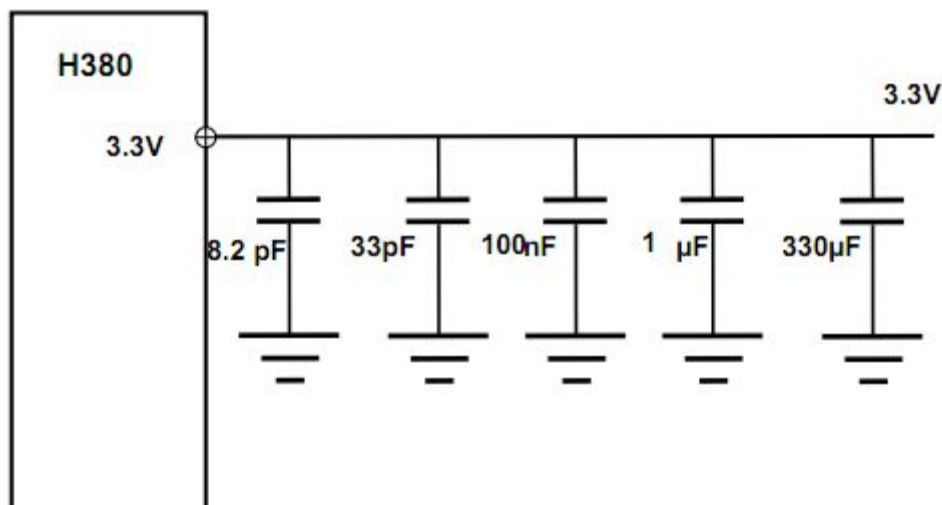
#### Note:

1. The ripple of Power supply must be lower than 200mV.
2. Power supply voltage does not drops below 3.135V during the 2G transmitting burst.

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

| Recommended capacitor | Application              | Description                                                                   |
|-----------------------|--------------------------|-------------------------------------------------------------------------------|
| 300uF                 | Supply capacitor         | Reduce power wave in call. The value of capacitor is more bigger more better. |
| 10nF, 100nF           | Digital signal noise     | Filtering interference from clock and digital signal.                         |
| 8.2pF, 10pF           | 1800/1900/2100 MHz bands | Filtering the RF reference.                                                   |
| 33pF, 39pF            | 850/900 MHz bands        | Filtering the RF reference.                                                   |

Recommended design:



## 5.1.2 Power Consumption

| Parameter | Description                                                             | Condition   |    | Typical Value<br>(3.3V power supply) | Unit |
|-----------|-------------------------------------------------------------------------|-------------|----|--------------------------------------|------|
| I OFF     | RTC mode                                                                |             |    | 100                                  | uA   |
| I SLEEP   | Low power mode<br>(GSM)                                                 | DRX         | 2  | 2.86                                 | mA   |
|           |                                                                         |             | 5  | 2.56                                 |      |
|           |                                                                         |             | 9  | 2.26                                 |      |
|           | Low power mode<br>(WCDMA)                                               | DRX         | 6  | 3.16                                 | mA   |
|           |                                                                         |             | 8  | 2.46                                 |      |
|           |                                                                         |             | 9  | 2.36                                 |      |
| I GSM-RMS | GSM voice -<br>1 TX slot<br>1 RX slot Peak<br>current<br>During TX slot | GSM850 PCL  | 5  | 265.4                                | mA   |
|           |                                                                         |             | 10 | 104.2                                |      |
|           |                                                                         |             | 15 | 73.6                                 |      |
|           |                                                                         |             | 19 | 69.2                                 |      |
|           |                                                                         | EGSM900 PCL | 5  | 270.2                                |      |
|           |                                                                         |             | 10 | 107.0                                |      |
|           |                                                                         |             | 15 | 73.9                                 |      |
|           |                                                                         |             | 19 | 69.2                                 |      |
|           |                                                                         | DCS1800 PCL | 0  | 185.8                                |      |
|           |                                                                         |             | 5  | 94.1                                 |      |
|           |                                                                         |             | 10 | 71.4                                 |      |
|           |                                                                         |             | 15 | 67.7                                 |      |
|           |                                                                         | PCS1900 PCL | 0  | 187.8                                |      |
|           |                                                                         |             | 5  | 97.3                                 |      |
|           |                                                                         |             | 10 | 72.7                                 |      |
|           |                                                                         |             | 15 | 69.7                                 |      |
| I GSM-MAX |                                                                         | GSM850 PCL  | 5  | 1999.9                               | mA   |
|           |                                                                         |             | 10 | 507.5                                |      |
|           |                                                                         |             | 15 | 177.6                                |      |
|           |                                                                         |             | 19 | 141.3                                |      |
|           |                                                                         | EGSM900 PCL | 5  | 2189.2                               |      |
|           |                                                                         |             | 10 | 503.9                                |      |
|           |                                                                         |             | 15 | 194.1                                |      |

| Parameter      | Description   | Condition                          |              | Typical Value<br>(3.3V power supply) | Unit |   |
|----------------|---------------|------------------------------------|--------------|--------------------------------------|------|---|
|                |               | DCS1800 PCL                        | 19           | 157.2                                |      |   |
|                |               |                                    | 0            | 1335.8                               |      |   |
|                |               |                                    | 5            | 394.6                                |      |   |
|                |               |                                    | 10           | 165.3                                |      |   |
|                |               |                                    | 15           | 140.9                                |      |   |
|                |               | PCS1900 PCL                        | 0            | 1473.1                               |      |   |
|                |               |                                    | 5            | 395.7                                |      |   |
|                |               |                                    | 10           | 178.9                                |      |   |
|                |               |                                    | 15           | 149.7                                |      |   |
|                |               | I GPRS                             | GSM850 PCL=5 | GSM voice -<br>1RX slot TX<br>slot   |      | 1 |
| GSM850 PCL=10  | 4             |                                    | 408.3        |                                      |      |   |
|                | 1             |                                    | 91.8         |                                      |      |   |
| EGSM900 PCL=5  | 4             |                                    | 232.4        |                                      |      |   |
|                | 1             |                                    | 251.7        |                                      |      |   |
| EGSM900 PCL=10 | 4             |                                    | 428.1        |                                      |      |   |
|                | 1             |                                    | 90.6         |                                      |      |   |
| DCS1800 PCL=0  | 4             |                                    | 234.3        |                                      |      |   |
|                | 1             |                                    | 175.7        |                                      |      |   |
| DCS1800 PCL=10 | 4             |                                    | 305.3        |                                      |      |   |
|                | 1             |                                    | 78.8         |                                      |      |   |
| PCS1900 PCL=0  | 4             |                                    | 123.0        |                                      |      |   |
|                | 1             |                                    | 205.2        |                                      |      |   |
| PCS1900 PCL=10 | 4             |                                    | 326.1        |                                      |      |   |
|                | 1             | 78.8                               |              |                                      |      |   |
| I EGPRS-RMS    | GSM850 PCL=8  | GSM voice -<br>1RX slot TX<br>slot | 4            | 124.1                                | mA   |   |
|                | GSM850 PCL=15 |                                    | 1            | 216.5                                |      |   |
|                |               |                                    | 4            | 581.1                                |      |   |
|                | EGSM900 PCL=8 |                                    | 1            | 82.2                                 |      |   |
|                |               |                                    | 4            | 130.6                                |      |   |
|                |               |                                    | 1            | 213.2                                |      |   |
|                | 4             | 578.9                              |              |                                      |      |   |

| Parameter   | Description    | Condition |       | Typical Value<br>(3.3V power supply) | Unit |
|-------------|----------------|-----------|-------|--------------------------------------|------|
|             | EGSM900 PCL=15 |           | 1     | 88.7                                 |      |
|             |                |           | 4     | 156.7                                |      |
|             | DCS1800 PCL=2  |           | 1     | 230.7                                |      |
|             |                |           | 4     | 565.6                                |      |
|             | DCS1800 PCL=10 |           | 1     | 87.9                                 |      |
|             |                |           | 4     | 134.0                                |      |
|             | PCS1900 PCL=2  |           | 1     | 234.7                                |      |
|             |                |           | 4     | 582.7                                |      |
|             | PCS1900 PCL=10 |           | 1     | 87.1                                 |      |
|             |                |           | 4     | 133.1                                |      |
| I WCDMA-RMS | WCDMA          | Band1     | 24dBm | 639.4                                | mA   |
|             |                |           | 10dBm | 202.3                                |      |
|             |                |           | 1dBm  | 148.0                                |      |
|             |                | Band2     | 24dBm | 662.4                                |      |
|             |                |           | 10dBm | 200.4                                |      |
|             |                |           | 1dBm  | 148.7                                |      |
|             |                | Band5     | 24dBm | 442.9                                |      |
|             |                |           | 10dBm | 180.8                                |      |
|             |                |           | 1dBm  | 142.7                                |      |
|             |                | Band8     | 24dBm | 492.0                                |      |
|             |                |           | 10dBm | 183.0                                |      |
|             |                |           | 1dBm  | 148.4                                |      |

## 5.2 The signal of on/off and reset

### 5.2.1 Pin Definition

H380 wireless communication module has two control signals: power on/off and reset.

Pin Definition as listed below:

| Pin No | Pin Name            | Electrical Level | Description                 |
|--------|---------------------|------------------|-----------------------------|
| 6      | FUL_CARD_POWER_OFF# | CMOS 1.8V        | Power on/off signal         |
| 67     | RESET#              | CMOS 1.8V        | External reset signal input |

## 5.2.2 ON/OFF Signal

After power supply on H380 M.2 module, pull up FUL\_CARD\_POWER\_OFF# signal and keep it more than 300ms, then module startup.

The Figure 5- 1 shows the startup timing control :

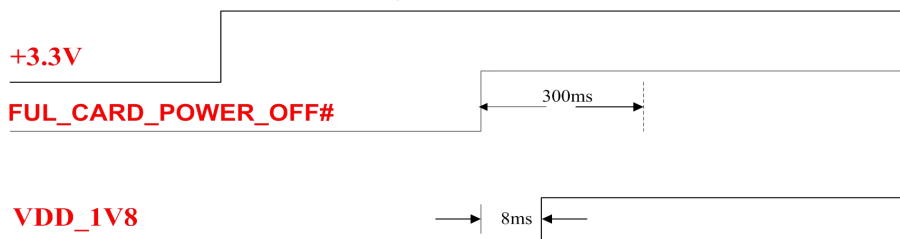


Figure 5- 1 Power ON Timing

Pull down FUL\_CARD\_POWER\_OFF# signal and keep more than 100ms, the H380 M.2 module will shut down.

The Figure 5-2 shows the shutdown timing:

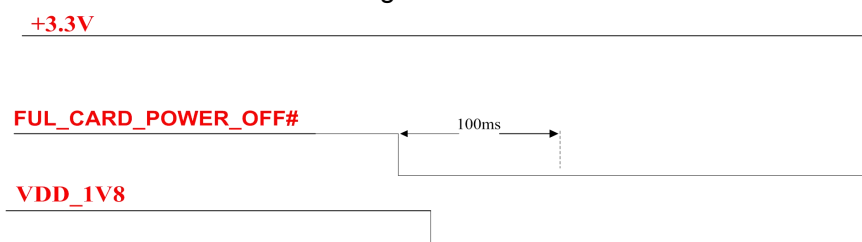


Figure 5-2 Power OFF Timing

Reference design of the FUL\_CARD\_POWER\_OFF#:

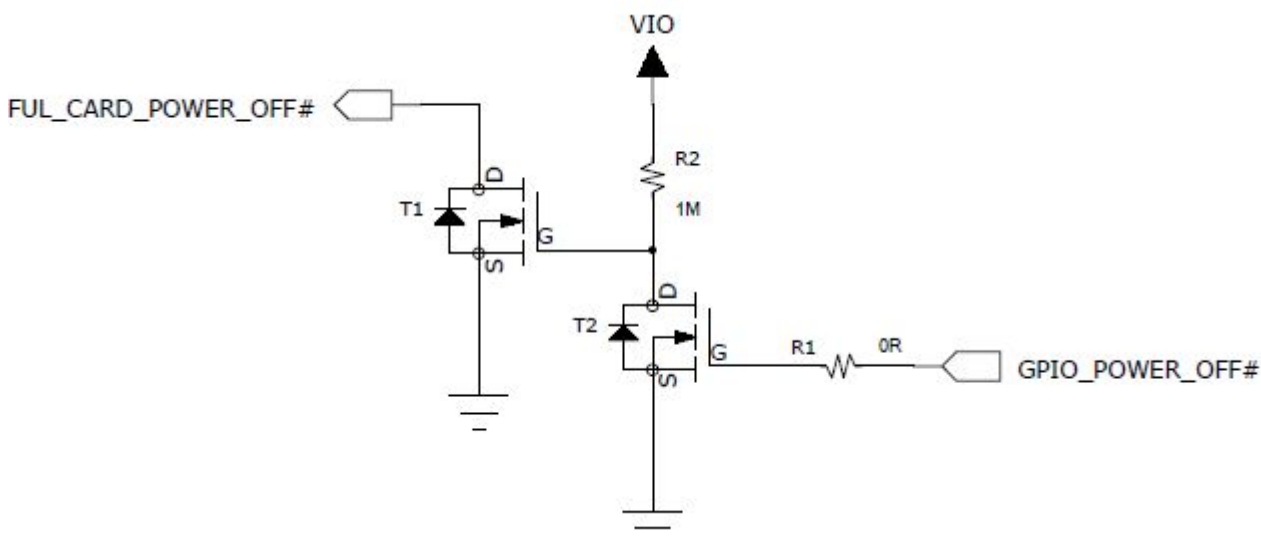


Figure 5-3 FUL\_CARD\_POWER\_OFF# Reference design

## 5.2.3 Reset Signal

H380 wireless communication module supports external reset. Module will reset to initial state through Reset signal.



When Reset signal is active low and keep 100ms, the module will reset and restart. The module PMU internal is still on during reset.

**Note:** Reset signal is sensitive, when PCB layout, please keep it away from RF noise, adding decoupling capacitor near the module is recommended. Don't trace the Reset signal in PCB edge or surface, avoid ESD causing system reset.

Pulse Timing requirements as listed below:

| Parameters  | Condition | Minimum | Typical | Maximum | Unit |
|-------------|-----------|---------|---------|---------|------|
| Pulse Width |           | 100     | 300     | 3000    | ms   |

Recommended design:

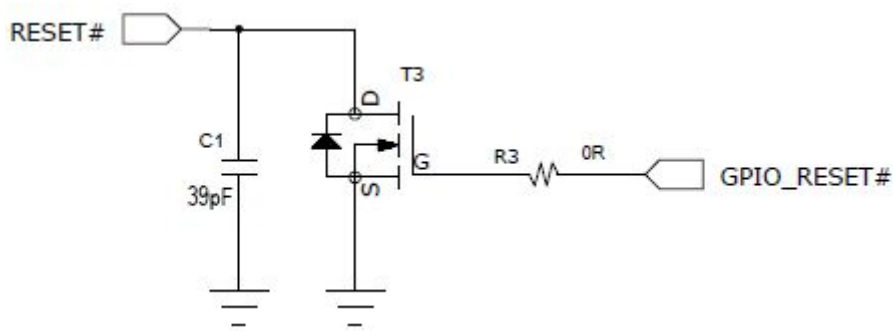


Figure 5-4 Reset Recommended Design

## 5.3 Indicator Signal

### 5.3.1 Pin Description

The H380 M.2 module provides an open drain output signal for indicating RF status.

| Pin No | Pin Name | Description                                |
|--------|----------|--------------------------------------------|
| 10     | LED1#    | Open/close RF network indicator, CMOS 3.3V |

LED1# signal description:

| No | M.2 Module status         | LED1#       |
|----|---------------------------|-------------|
| 1  | RF function is turned on  | Outputs Low |
| 2  | RF function is turned off | Output High |

Recommended design:

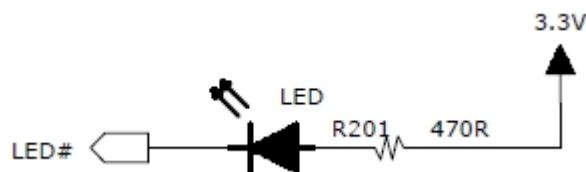


Figure 5-5 LED Status Indicator Recommended Design

## 5.4 USB Interface

### 5.4.1 USB Interface definition

| Pin No | Pin Name | I/O | Description               |
|--------|----------|-----|---------------------------|
| 7      | USB_DP   | I/O | USB differential Data (+) |
| 9      | USB_DM   | I/O | USB differential Data (-) |

H380 wireless communication module supports USB 2.0. It should install USB driver before use on PC. After H380 module plugged into the PC, the USB can enumerate seven ports:

- One 3G Modem/AT port for data transmission
- Three ports for sending AT Command
- One port for trace LOG information
- Two ports reserved currently.

### 5.4.2 USB Interface Application

Reference Design as follow:

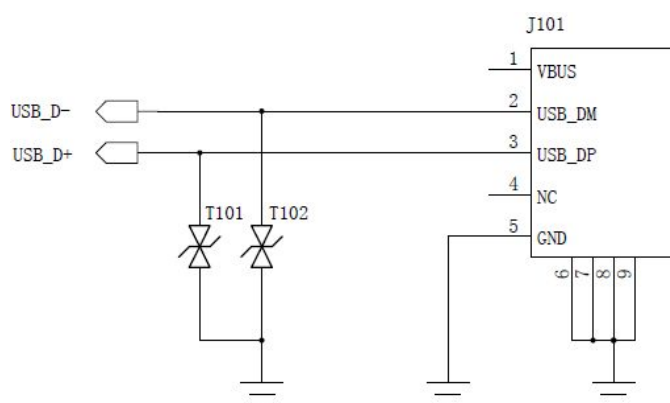


Figure 5-6 USB Interface Reference Design

The capacitor of TVS(T101 and T102) must be less than 1pF. VUSB power supply has been connected internal, so the VBUS pin of HOST can float.USB\_D+ and USB\_D- are high speed differential serial signals, the highest transmit speed is up to 480 Mbps.

#### PCB Layout note:

- USB\_D+ and USB\_D- signals trace same length, parallel, as short as possible.
- USB\_D+ and USB\_D- should be isolated by Ground in same and adjacent layer. It is better for USB performance when adding more GND VIA.
- USB2.0 signal should trace near the Ground layer of PCB.
- Impedance control of USB differential signals is 90 ohm.
- USB signal should keep away from any strong noise signal like power supply etc.

## 5.5 USIM Interface

H380 WIRELESS COMMUNICATION module supports USIM and high speed SIM card, does not support 8 line smart USIM yet.

### 5.5.1 USIM pin-out

| Pin No | Name       | Type | Description                                                                                                                    |
|--------|------------|------|--------------------------------------------------------------------------------------------------------------------------------|
| 36     | UIM_PWR    | O    | USIM POWER                                                                                                                     |
| 30     | UIM_RESET  | O    | USIM Reset                                                                                                                     |
| 32     | UIM_CLK    | O    | USIM clock                                                                                                                     |
| 34     | UIM_DATA   | I/O  | USIM data                                                                                                                      |
| 66     | SIM_DETECT | I    | The detection signal for SIM inserting.<br>The interior of M.2 module has pulled up.<br>H: SIM is present.<br>L: SIM is absent |

### 5.5.2 USIM

#### 5.5.2.1 Normally Closed SIM Circuit Design

Reference Design:

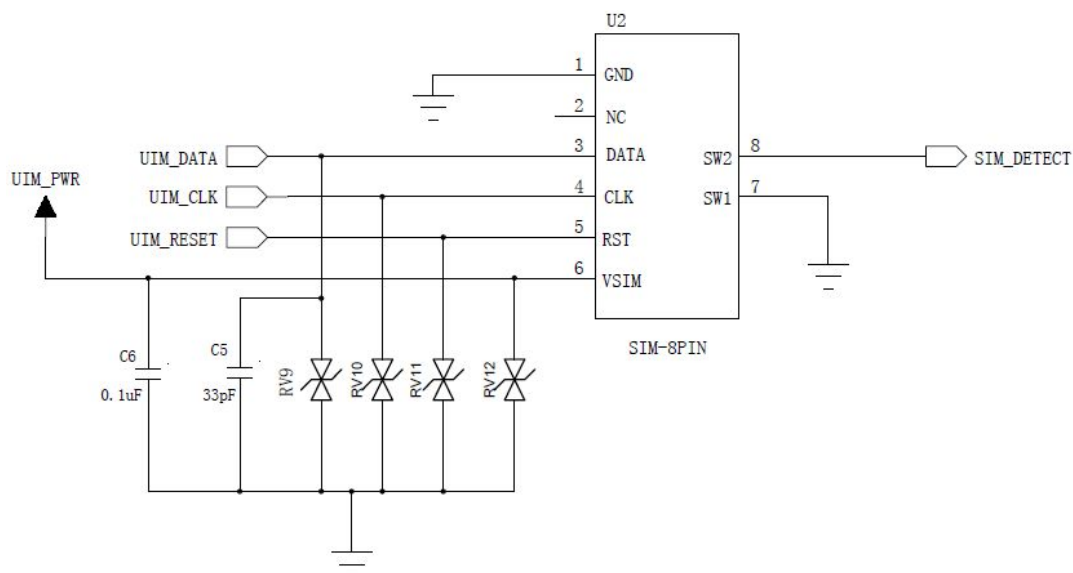


Figure 5-7 Normally Closed SIM Circuitr Reference Design

Normally closed SIM Connector:

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

2) Insert SIM card, pin 7 and pin 8 disconnect.

### 5.5.2.2 Normally Open SIM Circuit Design

Reference Design:

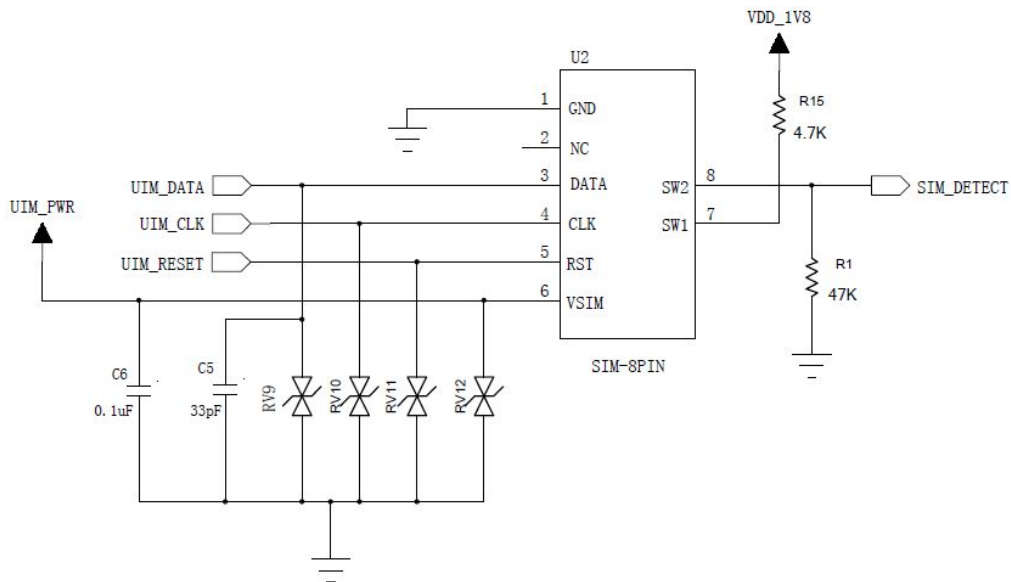


Figure 5-8 Normally Open SIM Connector Reference Design

Normally Open SIM Connector:

- 1) Pull out SIM card, pin 7 and pin 8 disconnect.
- 2) Inset SIM card, pin 7 and pin 8 short.

#### Note:

- For improving EMC performance, SIM card connector should be closed to module
  - Filtering capacitor should be closed to SIM card pin
  - The interface need ESD protection, ESD should be closed to SIM card pin
  - USIM\_DATA is already pulled up(4.7K ohms) inside the module
- SIM\_DETECT support SIM hot plug, high level activated default (detect level can be changed by AT command). If high level is detected, it means SIM card is inserted.

### 5.5.3 USIM Design Notice

The SIM interface and signals design is extremely important.

There are several design guidelines that must be followed:

- The signals of the SIM card layout should be away from any possible EMI noise, such as RF antenna and digital switching signals.
- To ensure signal integrity, the length between SIM interface signals and module should not exceed 100 mm
- To avoid crosstalk between USIM\_CLK and USIM\_IO, it is recommended to route them separately on the application board, and preferably isolated by Ground layer.

- The SIM card signals should be protected by ESD component (low capacitance capacitor, such as Zener diode). The recommended part no of ESD component is AVR-M1005C080MTAAB (TDK). ESD component should layout with SIM connector closely.

### 5.5.4 USIM Hot Plug

H380 supports the detection function of SIM status, and this function can realize SIM hot plug.

#### 5.5.4.1 Hardware Connection

SIM hot plug function need support of SIM\_DETECT signal.

When no SIM card, SIM\_DETECT is low level; insert SIM, SIM\_DETECT is high level.

Explanation:

1) For normally closed SIM connector circuit, as shown in Figure 5-7. SIM\_DETECT connects Pin8 (SW2) of U2, Pin7 (SW1) short GND. When there is no SIM card, SW2 and SW1 short, SW2 is low level. When SIM card inserted, SW1 and SW2 disconnect, SIM\_DETECT is pulled high.

2) For normally open SIM connector circuit, as shown in Figure 5-8. SIM\_DETECT connects Pin8 (SW2) of U2, and it also be pulled low by 47K ohms resistor. Pin 7 is pulled high by 4.7K ohms resistor. When no SIM card, SW2 and SW1 disconnect, SW2 is low. After SIM inserted, SW2 and SW1 short, SIM\_DETECT is pulled high.

#### 5.5.4.2 Software Configuration

“+MSMPD” AT command control SIM card hot plug function on/off.

AT+MSMPD=0, SIM card hot plug deactivated. Module does not detect SIM\_DETECT signal.

AT+MSMPD=1, SIM card hot plug activated. Module support SIM hot plug by SIM\_DETECT pin signal status.

SIM\_DETECT High level, SIM card is present, module registers the network automatically.

SIM\_DETECT Low level, SIM card is absent, module drops out the network.

**Note:** The “+MSMPD” default value is “1”. SIM\_DETECT is only used for SIM card hot plug detection, Module don't detect SIM\_DETECT signal at the first startup (it means the module will read SIM card data and register network at the first startup, no matter pin SIM\_DETECT is high or low).

## 5.6 Digital Audio

H380 M.2 supports digital audio I2S interface. It can support normal I2S mode or PCM mode. The voltage level of I2S interface is 1.8V.

I2S signal description as listed below:

| Pin # | Name    | Type | Description |
|-------|---------|------|-------------|
| 20    | I2S_CLK | O    | Clocked     |

|    |          |     |                                 |
|----|----------|-----|---------------------------------|
| 28 | I2S_WA   | O   | Left/Right clock                |
| 22 | I2S_TX   | O   | data output                     |
| 24 | I2S_RX   | I   | data input                      |
| 42 | GNSS_SDA | I/O | I2C control signal input/output |
| 40 | GNSS_SCL | O   | I2C control clock               |

### 5.6.1 I2S Interface Description

| H380     | Signal Direction | Audio CODEC I2S Port |
|----------|------------------|----------------------|
| I2S2_CLK | ————→            | I2S_CLK              |
| I2S2_WA  | ————→            | I2S_LRCK             |
| I2S2_RX  | ←————            | I2S_SDIN             |
| I2S2_TX  | ————→            | I2S_SDOUT            |
| SYSCCLK  | ————→            | I2S_MCLK             |

### 5.6.2 I2C Interface Description

| H380     | Signal Direction | Audio CODEC I2C Port |
|----------|------------------|----------------------|
| GNSS_SDA | ←————→           | I2C_SDA              |
| GNSS_SCL | ————→            | I2C_SCL              |

#### Note:

- I2S support master or slave mode
- It supports various audio sample rates (48 KHz, 44.1 KHz, 32 KHz, 24 KHz, 22.5 KHz, 16 KHz, 12 KHz, 11.025 KHz and 8 KHz).

### 5.6.3 PCM Mode Interface Description

| H380                                                 | Signal Direction | Audio CODEC PCM Port                         |
|------------------------------------------------------|------------------|----------------------------------------------|
| I2S_CLK (PCM_CLK, PCM clock signal )                 | ————→            | PCM_CLK (PCM clock signal)                   |
| I2S_WA (PCM_SYNC, PCM frame synchronization signal ) | ————→            | PCM_SYNC (PCM frame synchronization signal ) |
| I2S_RX (PCM_DIN, PCM data input)                     | ←————            | PCM_DOUT (PCM data output)                   |
| I2S_TX (PCM_DOUT, PCM data output)                   | ————→            | PCM_DIN (PCM data input)                     |

#### Note:

- PCM support master or slave mode
- PCM support master or slave mode
- It supports short frame synchronization of 16 bit, 32bit, 48bit and 64bit.
- Supports sending data in burst mode and continuous mode
- It supports various audio sample rates (48 KHz, 44.1 KHz, 32 KHz, 24 KHz, 22.5 KHz, 16 KHz, 12 KHz, 11.025 KHz and 8 KHz).

\* \* The software not support PCM function now!

## 5.7 Win8/Android Dual System Switch

H380 module supports Win8/Android dual system switch, check and achieve the system switch through interrupt signal "GNSS\_IRQ".

| NO. | Name     | Type | Description                                                  |
|-----|----------|------|--------------------------------------------------------------|
| 29  | GNSS_IRQ | I    | Win8/Android dual system switch detection signal , CMOS 1.8V |

Definition of GNSS\_IRQ signal function as listed below :

| No. | GNSS_IRQ     | Functions                                                                |
|-----|--------------|--------------------------------------------------------------------------|
| 1   | Low/Floating | Support Win8 system, the module's USB ports shall set as MBIM modes.     |
| 2   | High         | Support Android system, the module's `USB ports shall set as 7ACM modes. |

Description:

1. Check and achieve the Win8/Android system switch through GNSS\_IRQ level when module boot.  
Keep the GNSS\_IRQ level stability during booting.
2. Check and achieve the Win8/Android system switch through GNSS\_IRQ rising edge/ falling edge, setting the de-bouncing time as 100ms. the module will reboot after meeting the requirements and can switch different system supports.
3. Note:Need high level when switching GNSS\_IRQ to android system. Due to internal resistance of GNSS\_IPQ was pulled-up 10K, for achieving high level ,external resistance can not be pulled-up over 20Kohm while circuit design.

## 5.8 W\_DISABLE# Interface

### 5.8.1 WWAN\_DISABLE# Interface Description

H380 module uses the hardware to open / close WWAN RF function signal , the function is also could

controlled by AT command.(please refer to AT manual)

| Pin No | Name        | Type | Description                       |
|--------|-------------|------|-----------------------------------|
| 8      | W_DISABLE1# | I    | WWAN open/close signal, CMOS 3.3V |

W\_DISABLE# signal function as defined below:

| No | W_DISABLE# | Function                                                      |
|----|------------|---------------------------------------------------------------|
| 1  | Low        | WWAN function close                                           |
| 2  | High       | WWAN function open                                            |
| 3  | Floating   | WWAN function is defined by AT command , turned on by default |

## 5.8.2 GPS\_DISABLE# Interface Description

H380 module uses the hardware to open / close GPS function, the function is also controlled by AT command.

| No | Name        | Type | Description                      |
|----|-------------|------|----------------------------------|
| 26 | W_DISABLE2# | I    | GPS open/close signal, CMOS 1.8V |

GPS\_DISABLE# function definitions as follow:

| No | GPS_DISABLE# | Function                                                  |
|----|--------------|-----------------------------------------------------------|
| 1  | Low          | GPS function close                                        |
| 2  | High         | GPS function open                                         |
| 3  | Floating     | GPS function is defined by AT command , turned on default |

Note: Not support this function now.

## 5.9 TX\_BLANKING

The default value(output) is low. When module works with GSM network, TX Blanking outputs as same pulse as GSM transmitting burst. To avoid interference with GPS, AP will close GPS or stop GPS reception when AP detected TX\_BLANKING signal.

| No | Name        | Type | Description                        |
|----|-------------|------|------------------------------------|
| 48 | TX_BLANKING | O    | External GPS device control signal |

## 5.10 Wakeup Host Interface

H380 M.2 module support wake up the host. Module output low(high default) when need to wake up the host.

| No | Name | Type | Description |
|----|------|------|-------------|
|----|------|------|-------------|



|    |         |   |                                                                                           |
|----|---------|---|-------------------------------------------------------------------------------------------|
| 23 | WOWWAN# | O | Module wake up the Host signal ,1.8V signal,<br>Input low level when wake up Host signal. |
|----|---------|---|-------------------------------------------------------------------------------------------|

## 5.11 BODY\_SAR Interface

H380 M.2 support BODY\_SAR function.

BODY\_SAR is an input signal (comes from AP output), high default, low active. AP can detect the closing human body and output BODY\_SAR low through proximity sensor. Module will reduce RF transmitting power by BODY\_SAR interrupt.

The threshold transmitting power can be configured by AT command.

| No | Name | Type | Description        |
|----|------|------|--------------------|
| 25 | DPR  | I    | BODY_SAR detection |

## 5.12 Clock Interface

H380 M.2 support a 26MHz clock output, a 32KHz clock output.

| No | Name    | Type | Description                                             |
|----|---------|------|---------------------------------------------------------|
| 46 | SYSCCLK | O    | 26MHz clock output(for GPS device, as audio codec MCLK) |
| 68 | CLK32K  | O    | 32KHz clock output                                      |

## 5.13 Config

H380 M.2 provides 4 configuration pins, the module is configured as WWAN-SSIC 0.

| No | Name     | Type | Description                    | Value |
|----|----------|------|--------------------------------|-------|
| 1  | CONFIG_3 | O    | Connected to Ground internally | 0     |
| 21 | CONFIG_0 | O    | NC                             | -     |
| 69 | CONFIG_1 | O    | Connected to Ground internally | 0     |
| 75 | CONFIG_2 | O    | Connected to Ground internally | 0     |

H380 M.2 Socket 2 Module type configuration as follows:

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

## 5.14 RF Interface

### 5.14.1 RF Connector Interface Description

H380 provides two RF interfaces for connecting to the external antenna. D/G is Diversity/GPS Aux RF antenna, MAIN is RF main antenna.



Figure 5-9 RF connector diagram

### 5.14.2 RF Connector Description

H380 M.2 use Murata MM4829-2702 RF connector, 2\*2\*0.6mm dimension. The connector's dimension is as

follow:

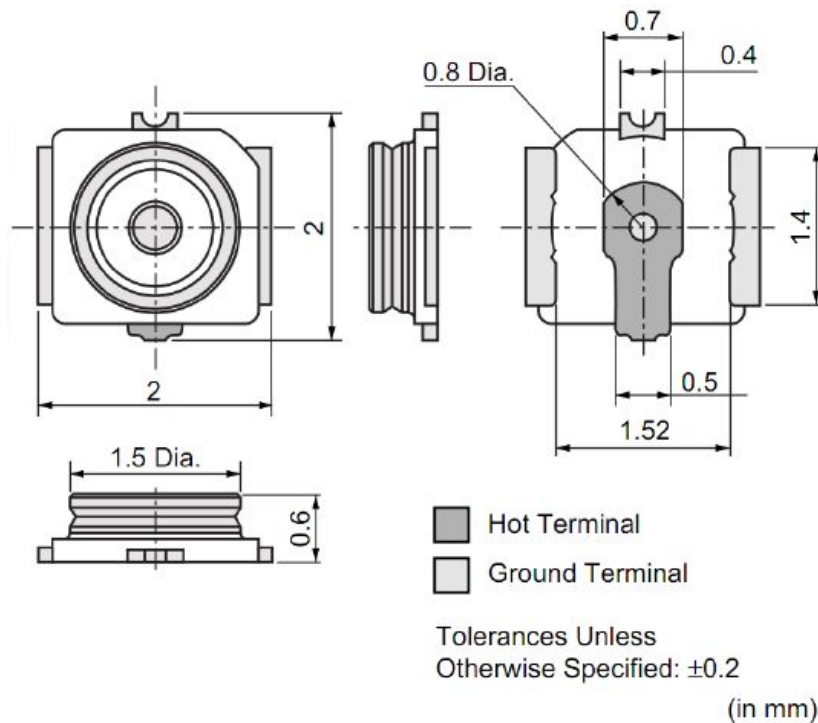


Figure 5-10 RF connector dimension

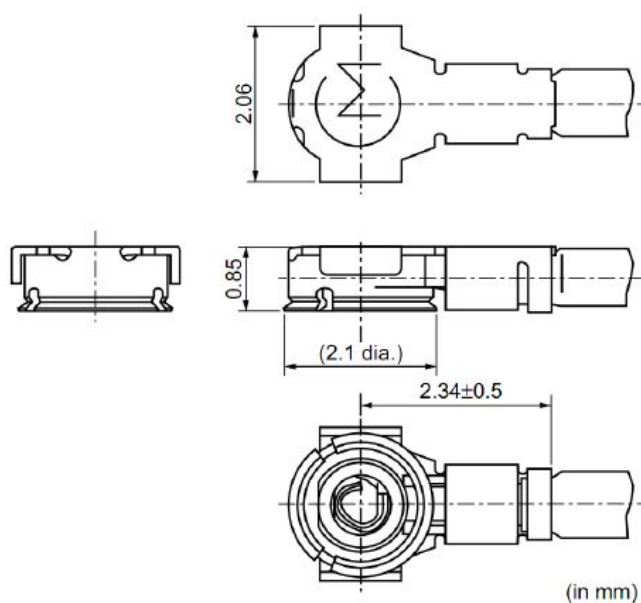


Figure 5-11 0.81mm coaxial cable matching RF connector

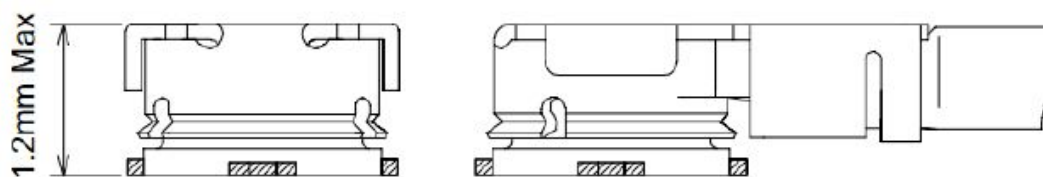


Figure 5-12 the connection between the RF connector and the 0.81 mm cable

### 5.14.3 RF Connector main performance index

| Rated condition          |            | Environmental condition              |
|--------------------------|------------|--------------------------------------|
| Frequency range          | DC to 6GHz | Temperature range:<br>-40°C to +85°C |
| Characteristic impedance | 50Ω        |                                      |

## 5.15 Others

The interface of GPIO and Tunable ANT of the M.2 module does not support yet..

## 6 Electrical and Environmental

### 6.1 Electrical

This table shows the electrical features range of H380 M.2.

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

### 6.2 Environmental

This table shows the environmental features of H380 M.2.

| Parameter               | Minimum Value | Maximum Value | Unit |
|-------------------------|---------------|---------------|------|
| Operational Temperature | -30           | +75           | °C   |
| Storage Temperature     | -40           | +85           | °C   |

## 7 RF Interface

### 7.1 Operating Band

#### 7.1.1 Antenna Band

| Operating Band           | Tx            | Rx            |
|--------------------------|---------------|---------------|
| UMTS 2100 (Band I IMT)   | 1920–1980 MHz | 2110–2170 MHz |
| UMTS 1900 (Band II IMT)  | 1850–1910 MHz | 1930–1990 MHz |
| UMTS 850 (Band V IMT)    | 824–849 MHz   | 869–894 MHz   |
| UMTS 900 (Band VIII IMT) | 880–915 MHz   | 925–960 MHz   |
| GSM 850                  | 824–849 MHz   | 869–894 MHz   |
| GSM 900                  | 880–915 MHz   | 925–960 MHz   |
| DCS 1800                 | 1710–1785 MHz | 1805–1880 MHz |
| PCS 1900                 | 1850–1910 MHz | 1930–1990 MHz |

#### 7.1.2 Diversity Antenna Band

| Operating Band           | Rx            |
|--------------------------|---------------|
| UMTS 2100 (Band I IMT)   | 2110–2170 MHz |
| UMTS 1900 (Band II PCS)  | 1930–1990 MHz |
| UMTS 850 (Band V CLR)    | 869–894 MHz   |
| UMTS 900 (Band VIII GSM) | 925–960 MHz   |

### 7.2 RF PCB Design

#### 7.2.1 Impedance Design

The impedance of RF should be matched 50 ohm.

### 7.3 Antenna Design

#### 7.3.1 Main Antenna Design Requirements

##### (1) Antenna Efficiency

Antenna efficiency is the ratio between antenna input power and radiation power. The radiation power of an antenna is always lower than the input power due to the following factors: return loss, material loss,

and coupling loss.

Efficiency of the master antenna > 40% (−4dB)

## **(2) S11 or VSWR**

S11 (return loss) indicates the degree to which the input impedance of an antenna matches the reference impedance (50 ohm). S11 shows the resonance feature and impedance bandwidth of an antenna. Voltage standing wave ratio (VSWR) is another expression of S11. S11 relates to the antenna efficiency. S11 can be measured by vector analyzer.

S11 of the master antenna < −10 dB

## **(3) Polarization**

The polarization of an antenna is the orientation of the electric field vector that rotates with time in the direction of maximum radiation.

Linear polarization is recommended: it would be better if the polarization direction of diversity antenna is different from main antenna.

## **(4) Radiation Pattern**

Radiation pattern refers to the directional dependence of the strength of radio waves from the antenna or other source.

The radiation pattern of half wave dipole antennas is the best for wireless terminals. If it is built-in antenna, PIFA antenna is recommended:

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

Radiation Pattern: Omni-directional

## **(5) Gain and Directivity**

The directivity of the antenna is the electromagnetic field strength of the electromagnetic wave in each direction. An antenna's power gain is a key performance Figure which combines the antenna's directivity and electrical efficiency.

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

## **(6) Interference**

Besides the antenna performance, the interference on the PCB board also affects the radio performance (especially the TIS) of the module. To guarantee high performance of the module, the interference sources on the user board must be properly controlled. On the PCB board, there are various interference sources that can affect the module, such as the speaker, LCD, CPU, FPC trace and audio circuits, the power supply should be far away from antenna, notice isolation, shield and filtering processing issues.

## **(7) TRP/TIS**

TRP (Total Radiated Power):

- W900/W850/W1900/W2100>19dBm
- GSM850/GSM900>28dBm
- DCS1800/PCS1900>25dBm

TIS (Total Isotropic Sensitivity) :

- W900/W850<-102dBm
- W1900/W2100<-103dBm
- GSM850/GSM900<-102dBm
- DCS1800/PCS1900<-102dBm

### **7.3.2 Diversity Antenna Design**

Diversity reception function of H380 M.2 is optional, Please add a diversity antenna if necessary.

The design methods of diversity antenna and main antenna are the same, its efficiency indicators allows to reduce 3dB.

The isolation between main antenna and diversity antenna should be higher than 12dB.

## **IMPORTANT NOTE:**

This module is intended for OEM integrator. The OEM integrator is still responsible for the FCC compliance requirement of the end product, which integrates this module. 20cm minimum distance has to be able to be maintained between the antenna and the users for the host this module is integrated into.

Under such configuration, the FCC radiation exposure limits set forth for an population/uncontrolled environment can be satisfied.

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

## **USERS MANUAL OF THE END PRODUCT:**

In the users manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied.

The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment. If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual:

This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference.

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

To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, the maximum antenna gain including cable loss in a mobile-only exposure condition must not exceed 2.5dBi in the cellular band and 2.5dBi in the PCS band.

A user manual with the end product must clearly indicate the operating requirements and conditions that must be observed to ensure compliance with current FCC RF exposure guidelines. The end product with an embedded H380.

Module may also need to pass the FCC Part 15 unintentional emission testing requirements and be properly authorized per FCC Part 15.

Note: If this module is intended for use in a portable device, you are responsible for separate approval to satisfy the SAR requirements of FCC Part 2.1093.



## **LABEL OF THE END PRODUCT:**

The final end product must be labeled in a visible area with the following " Contains TX FCC ID: ZMOH38F ". If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of FCC rules.

Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.