HUAWEI MU736 HSPA+ M.2 Module

Hardware Guide

Issue 05

Date 2014-01-14

Huawei Technologies Co., Ltd. provides customers with comprehensive technical support and service. For any assistance, please contact our local office or company headquarters.

Huawei Technologies Co., Ltd.

Huawei Industrial Base, Bantian, Longgang, Shenzhen 518129, People's Republic of China
Tel: +86-755-28780808 Global Hotline: +86-755-28560808 Website: www.huawei.com
E-mail: mobile@huawei.com

Please refer color and shape to product. Huawei reserves the right to make changes or improvements to any of the products without prior notice.

Trademarks and Permissions

HUAWEI, HUAWEI, and are trademarks or registered trademarks of Huawei Technologies Co., Ltd.
Other trademarks, product, service and company names mentioned are the property of their respective owners.

Notice

Some features of the product and its accessories described herein rely on the software installed, capacities and settings of local network, and may not be activated or may be limited by local network operators or network service providers, thus the descriptions herein may not exactly match the product or its accessories you purchase.
Huawei Technologies Co., Ltd. reserves the right to change or modify any information or specifications contained in this manual without prior notice or obligation.

NO WARRANTY

THE CONTENTS OF THIS MANUAL ARE PROVIDED "AS IS". EXCEPT AS REQUIRED BY APPLICABLE LAWS, NO WARRANTIES OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE MADE IN RELATION TO THE ACCURACY, RELIABILITY OR CONTENTS OF THIS MANUAL.
TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, IN NO CASE SHALL HUAWEI TECHNOLOGIES CO., LTD. BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, OR LOST PROFITS, BUSINESS, REVENUE, DATA, GOODWILL OR ANTICIPATED SAVINGS.

Import and Export Regulations

Customers shall comply with all applicable export or import laws and regulations and will obtain all necessary governmental permits and licenses in order to export, re-export or import the product mentioned in this manual including the software and technical data therein.

About This Document

Revision History

Document Version	Date	Chapter	Descriptions
01	2013-03-08		Creation
02	2013-05-09	3.7	Updated Tunable Antenna Control
		4.4.2	Updated Table 4-4
		4.5.1	Updated Antenna Design Indicators
		4.5.3	Updated GSM/WCDMA/GPS Antenna Requirements
		5.5.2	Updated Table 5-9, Table 5-10
		8.2	Updated Table 8-1
		9.8	Updated WEEE Approval
		9.9	Updated RoHS Approval
		9.11	Updated Care and Maintenance
		9.13	Deleted Specific Absorption Rate (SAR)
		9.13	Updated Regulatory Information
03	2013-08-22	2.2	Updated Table 2-1 Features
		3.2	Updated Table 3-1 Definitions of pins on the M.2 interface
		3.4.5	Added Figure 3-16 Connections of the W_DISABLE# pin
		3.4.6	Added Figure 3-17 Connections of the GPS_DISABLE# pin
		3.4.8	Updated Figure 3-20 Connections of the BodySAR_N pin
		3.4.9	Updated Figure 3-21 Connections of the SIM_DET pin

Document Version	Date	Chapter	Descriptions
		3.7	Updated Table 3-11 List of ANTCTL pins
		3.9	Updated Table 3-15 List of NC pins
		5.2	Updated Table 5-1 Absolute ratings for the MU736 module
		5.5.2	Updated Table 5-12 DC power consumption (GPS)
		5.6	Updated Table 5-13 Test conditions and results of the reliability of the MU736 module
		6.2	Updated Figure 6-1 Dimensions of MU736
		6.4	Updated Figure 6-4 Packet system
04	2013-10-21	5.6	Updated Table 5-13 Test conditions and results of the reliability of the MU736 module
05	2014-01-14	5.5.2	Updated Power Consumption
		5.7	Updated EMC and ESD Features

Contents

1 Introduction

This document describes the hardware application interfaces and air interfaces that are provided when HUAWEI MU736 HSPA+ M.2 Module (hereinafter referred to the MU736 module) is used.

M.2 is the new name for NGFF (Next Generation Form Factor).

This document helps you to understand the interface specifications, electrical features and related product information of the MU736 module.

2 Overall Description

2.1 About This Chapter

This chapter gives a general description of the MU736 module and provides:

- Function Overview
- Circuit Block Diagram

2.2 Function Overview

Table 2-1 Features

Feature	Description
Physical Features	• Dimensions (L × W × H): 42 mm × 30 mm × 2.3 mm • Weight: about 6 g
Operating Bands	WCDMA/HSDPA/HSUPA/HSPA+: 850 MHz/900 MHz/1700 MHz (AWS)/1900 MHz/2100 MHz GPRS/EDGE: 850 MHz/900 MHz/1800 MHz/1900 MHz GPS: L1
Operating Temperature	Normal operating temperature: –10°C to +55°C Extended operating temperature[1]: –20°C to +70°C
Storage Temperature	–40°C to +85°C
Moisture	RH5% to RH95%
Power Voltage	3.135 V to 4.4 V (3.3 V is typical)
AT Commands	See the *HUAWEI MU736 HSPA+ M.2 Module AT Command Interface Specification*
Application	USIM (3.0 V or 1.8 V)

Feature	Description
Interface (75-pin Gold Finger)	USIM Hot Swap Detection
	USB 2.0 (high speed)
	Power_On_Off pin
	RESET# pin
	LED# pin
	W_DISABLE# pin
	GPS_DISABLE# pin
	Tunable Antenna Control (4 GPIOs)
	Wake_On_WWAN# pin
	BodySAR_N pin
	Power supply (5 pins)
Antenna Interface	MAIN and AUX (supports Diversity and GPS simultaneously) MM4829-2702RA4 by MURATA or other equivalent parts
SMS	New message alert
	Management of SMS: read SMS, write SMS, send SMS, delete SMS and SMS list.
	Supporting MO and MT. Point-to-point
Data Services	GPRS: UL 85.6 kbps/DL 107 kbps
	EDGE: UL 236.8 kbps/DL 296 kbps
	WCDMA CS: UL 64 kbps/DL 64 kbps
	WCDMA PS: UL 384 kbps/DL 384 kbps
	HSPA+: UL 5.76 Mbps/DL 21.6 Mbps
Operating System	Windows 7/8/8.1, Android 4.0 or later, Chrome OS

NOTE

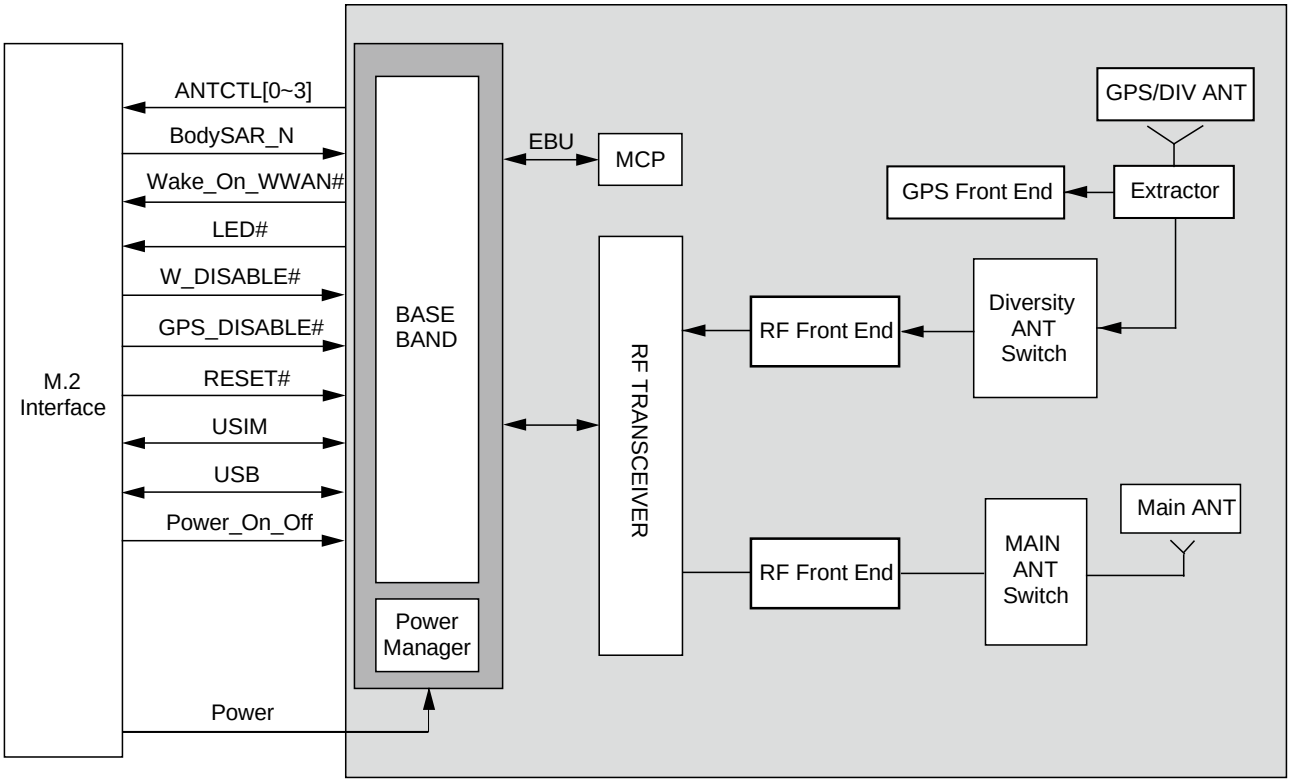
[1] When the MU736 module works at this temperature, **NOT** all its RF performances comply with the 3GPP TS 45.005 specifications.

2.3 Circuit Block Diagram

Figure 2-1 shows the circuit block diagram of the MU736 module. The application block diagram and major functional units of the MU736 module contain the following parts:

- Baseband controller
- Power manager
- Multi-chip package (MCP) memory
- Radio frequency (RF) transceiver
- RF interface
- RF PA

Figure 2-1 Circuit block diagram of the MU736 module



3 Description of the Application Interfaces

3.1 About This Chapter

This chapter mainly describes the external application interfaces of the MU736 module, including:

- 75-pin Gold Finger
- Power Interface
- Signal Control Interface
- USB Interface
- USIM Card Interface
- Tunable Antenna Control
- Config Pins
- NC Pins
- RF Antenna Interface

3.2 75-pin Gold Finger

The MU736 module uses a 75-pin Gold Finger as its external interface. For details about the module and dimensions, see "6.2 Dimensions of MU736".

Figure 3-1 shows the sequence of pins on the 75-pin signal interface of the MU736 module.

Figure 3-1 TOP view of sequence of Gold Finger interface pins

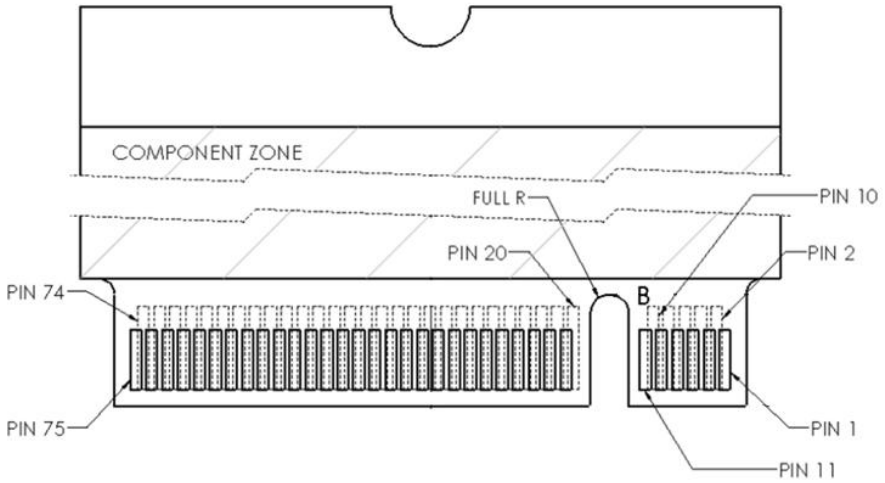


Table 3-1 shows the definitions of pins on the 75-pin signal interface (67 for signals and 8 for notch) of the MU736 module.

As the M.2 naming nomenclature, MU736 is Type 3042-S3-B (30 mm × 42 mm, Component Max Height on top is 1.5 mm and single-sided, Key ID is B.)

Module Nomenclature
Sample type 2242-D2-B-M

Type XX XX - XX - X - X*

Width (mm)
12
16
22
30

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

	Component Max Ht(mm)	
	T Max**	B Max**
S1	1.2	0τ
S2	1.35	0τ
S3	1.5	0τ
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	PCIe x2 / USB / I2C / DP x4
B	12-19	PCIe x2 / SATA / USB / PCM / IUM / SSIC / UART-I2C
C	16-23	Reserved for Future Use
D	20-27	Reserved for Future Use
E	24-31	PCIe / USB / I2C-ME / 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 designed for Non-M.2 compliant devices. Intended for custom use. Use at your own risk!
τ Insulating label allowed on connector-based designs

Table 3-1 Definitions of pins on the M.2 interface

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
	Normal			Min.	Typ.	Max.
1	CONFIG_3	O	Connected to Ground internally. MU736 is configured as WWAN-SSIC 0.	-	0	-
2	3.3V	PI	Power supply	3.135	3.3	4.4
3	Ground	PI	Ground	-	0	-
4	3.3V	PI	Power supply	3.135	3.3	4.4
5	Ground	PI	Ground	-	0	-
6	Power_On_Off	I	A single control to turn On/Off WWAN. H: WWAN is powered on. L: WWAN is powered off. It is internally pulled to low. It is 3.3 V tolerant but can be driven by either 1.8 V or 3.3 V GPIO.	–0.3	1.8	3.6
7	USB_D+	IO	USB Data + defined in the USB 2.0 Specification	-	-	-
8	W_DISABLE#	I	WWAN disable function H: WWAN function is determined by software AT command. Default enabled. L: WWAN function is turned off.	–0.3	3.3	3.6
9	USB_D-	IO	USB Data - defined in the USB 2.0 Specification	-	-	-
10	LED#	O	It is an open drain, active low signal, used to allow the M.2 card to provide status indicators via LED devices that will be provided by the system.	Open drain and a pull-up resistor is required on the host		
11	Ground	PI	Ground	-	0	-
12	Notch	-	-	-	-	-
13	Notch	-	-	-	-	-
14	Notch	-	-	-	-	-
15	Notch	-	-	-	-	-
16	Notch	-	-	-	-	-
17	Notch	-	-	-	-	-
18	Notch	-	-	-	-	-
19	Notch	-	-	-	-	-

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
	Normal			Min.	Typ.	Max.
20	Reserved	-	Reserved for Future Use, please keep it NC in host side.	-	-	-
21	CONFIG_0	O	Not Connected internally. MU736 is configured as WWAN-SSIC 0.	-	-	-
22	Reserved	-	Reserved for Future Use, please keep it NC in host side.	-	-	-
23	Wake_On_WWAN#	O	WWAN to wake up the host. It is open drain and active low.	Open drain and a pull-up resistor is required on the host		
24	Reserved	-	Reserved for Future Use, please keep it NC in host side.	-	-	-
25	BodySAR_N	I	Hardware pin for BodySAR Detection, active low. H: No TX power backoff (default). L: TX power backoff.	–0.3	1.8	3.6
26	GPS_DISABLE#	I	GPS disable function H: GPS function is determined by software AT command. Default enabled. L: GPS is turned off.	–0.3	3.3	3.6
27	Ground	PI	Ground	-	0	-
28	NC	-	Not Connected	-	-	-
29	NC	-	Not Connected	-	-	-
30	UIM_RESET	O	USIM Reset	–0.3	1.8/2.85	1.98 /3.0
31	NC	-	Not Connected	-	-	-
32	UIM_CLK	O	USIM Clock	–0.3	1.8/2.85	1.98 /3.0
33	Ground	PI	Ground	-	0	-
34	UIM_DATA	IO	USIM DATA	–0.3	1.8/2.85	1.98 /3.0
35	NC	-	Not Connected	-	-	-
36	UIM_PWR	PO	USIM POWER	–0.3	1.8/2.85	1.98 /3.3
37	NC	-	Not Connected	-	-	-

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
	Normal			Min.	Typ.	Max.
38	NC	-	Not Connected	-	-	-
39	Ground	PI	Ground	-	0	-
40	I2C_SCL	IO	I2C clock This function is under development.	–0.3	1.8	2.1
41	NC	-	Not Connected	-	-	-
42	I2C_SDA	IO	I2C data This function is under development.	–0.3	1.8	2.1
43	NC	-	Not Connected	-	-	-
44	I2C_IRQ	I	Interrupt signal to wake up the module. This function is under development.	–0.3	1.8	2.1
45	Ground	PI	Ground	-	0	-
46	SYSCLK	O	System clock output for external GNSS module. MU736 does not support GLONASS. This function is under development.	–0.3	1.8	2.1
47	NC	-	Not Connected	-	-	-
48	TX_BLANKING	-	Tx blanking signal for external GNSS module. MU736 doesn’t support GLONASS. This function is under development.	–0.3	1.8	2.1
49	NC	-	Not Connected	-	-	-
50	NC	-	Not Connected	-	-	-
51	Ground	PI	Ground	-	0	-
52	NC	-	Not Connected	-	-	-
53	NC	-	Not Connected	-	-	-
54	NC	-	Not Connected	-	-	-
55	NC	-	Not Connected	-	-	-
56	NC	-	Not Connected	-	-	-
57	Ground	PI	Ground	-	0	-
58	NC	-	Not Connected	-	-	-
59	ANTCTL0	O	Tunable antenna control signal, bit 0. It is a push-pull type GPIO.	–0.3	1.8	2.1

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
	Normal			Min.	Typ.	Max.
60	Reserved	-	Reserved for Future Use, please keep it NC in host side.	-	-	-
61	ANTCTL1	O	Tunable antenna control signal, bit 1. It is a push-pull type GPIO.	–0.3	1.8	2.1
62	Reserved	-	Reserved for Future Use, please keep it NC in host side.	-	-	-
63	ANTCTL2	O	Tunable antenna control signal, bit 2. It is a push-pull type GPIO.	–0.3	1.8	2.1
64	Reserved	-	Reserved for Future Use, please keep it NC in host side.	-	-	-
65	ANTCTL3	O	Tunable antenna control signal, bit 3. It is a push-pull type GPIO.	–0.3	1.8	2.1
66	SIM_DET	I	SIM hot swap detection pin. Rising edge for insertion; falling edge for removal. H: SIM is present. L: SIM is absent.	–0.3	1.8	2.1
67	RESET#	I	System reset, active low.	–0.3	1.8	3.6
68	NC	-	Not Connected	-	-	-
69	CONFIG_1	O	Connected to Ground internally. MU736 is configured as WWAN-SSIC 0.	-	0	-
70	3.3V	PI	Power supply	3.135	3.3	4.4
71	Ground	PI	Ground	-	0	-
72	3.3V	PI	Power supply	3.135	3.3	4.4
73	Ground	PI	Ground	-	0	-
74	3.3V	PI	Power supply	3.135	3.3	4.4
75	CONFIG_2	O	Connected to Ground internally. MU736 is configured as WWAN-SSIC 0.	-	0	-

NOTE

P indicates power pins; **I** indicates pins for digital signal input; **O** indicates pins for digital signal output.

3.3 Power Interface

3.3.1 Overview

The power supply part of the MU736 module contains:

- 3.3V pins for the power supply
- UIM_PWR pin for USIM card power output

Table 3-2 lists the definitions of the pins on the power supply interface.

Table 3-2 Definitions of the pins on the power supply interface

Pin No.	Signal Name	I/O	Description	DC Characteristics (V)		
				Min.	Typ.	Max.
2, 4, 70, 72, 74	3.3V	PI	Power supply for MU736, 3.3 V is recommended	3.135	3.3	4.4
36	UIM_PWR	PO	Power supply for USIM card	–0.3	1.8/2.85	1.98/3.3
3, 5, 11, 27, 33, 39, 45, 51, 57, 71, 73	Ground	PI	Ground	-	0	-

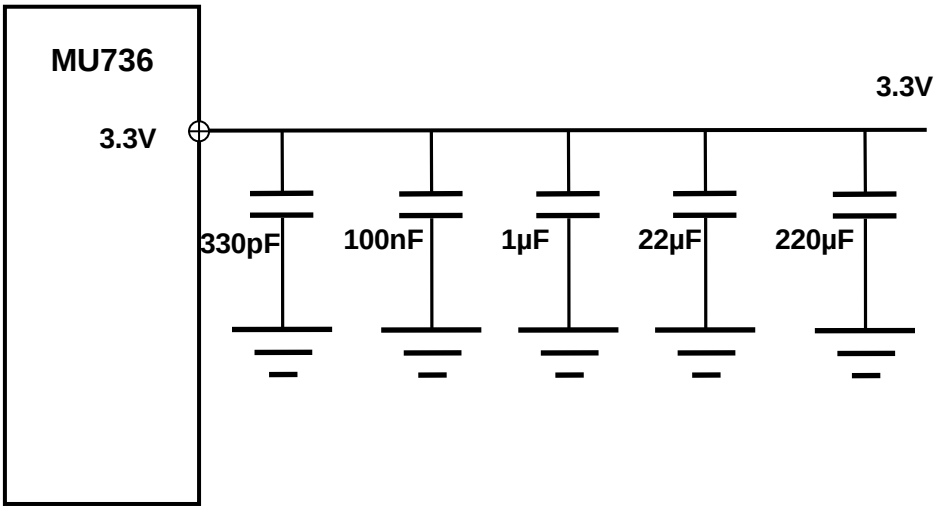
3.3.2 Power Supply 3.3V Interface

When the MU736 module works normally, power is supplied through the 3.3V pins and the voltage ranges from 3.135 V to 4.4 V (typical value is 3.3 V). The MU736 provides 5 power pins, and 11 Ground pins. To ensure that the MU736 module works normally, all the pins must be connected. The M.2 connector pin is defined to support 500 mA/Pin continuously.

When the MU736 module works at 2G mode, the module transmits at the maximum power, the transient peak current may reach 2.5 A. In this case, the power pin voltage will drop. Make sure that the voltage does not drop below 3.135 V in any case. The traces of the power supply should be as short and wide as possible. It is recommended that at least a 220 µF capacitance is added onto the 3.3 V power rails and as close to the M.2 connector as possible. Customer can reduce the capacitance if it can be guaranteed that 3.3V pin does not drop below 3.135 V in any case.

Figure 3-2 shows the recommended power circuit of the MU736 module.

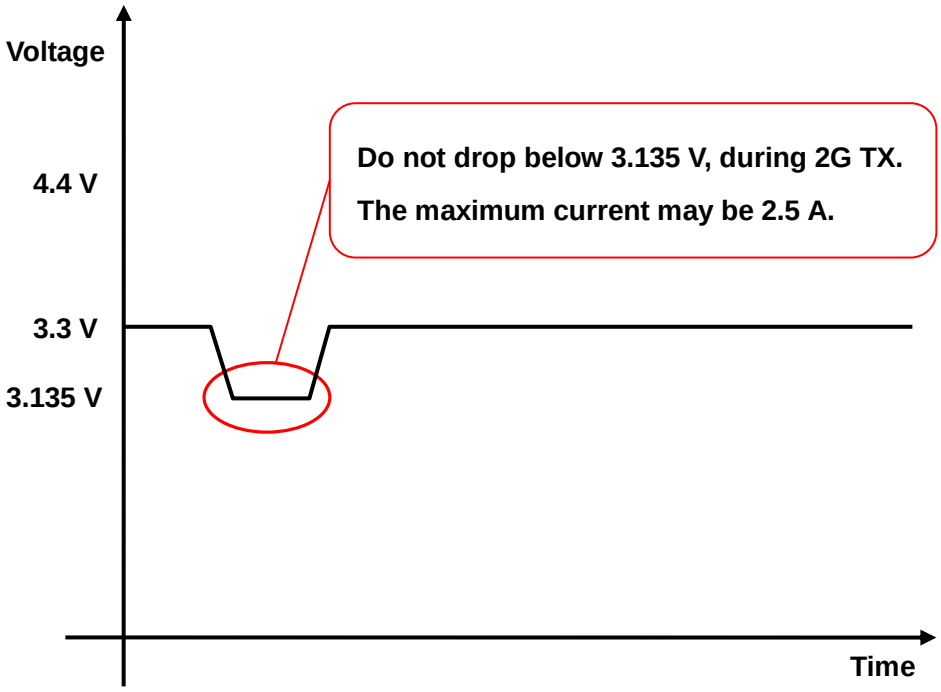
Figure 3-2 Recommended power circuit of the MU736 module



NOTE

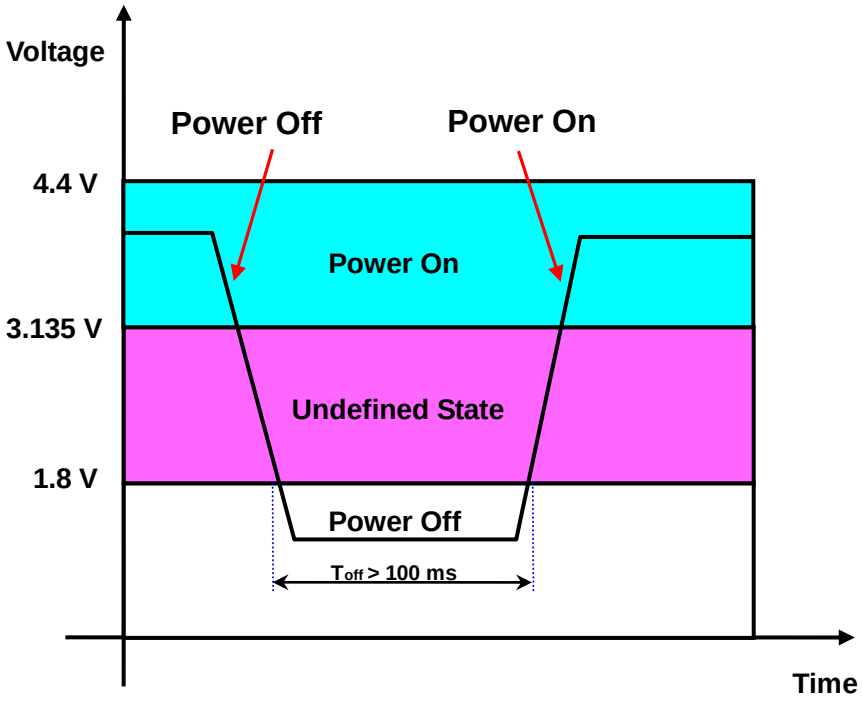
3.3V pin must never be under 3.135 V during the 2G transmitting burst, as shown in Figure 3-3 .

Figure 3-3 VCC drop during 2G transmitting



If customer wants to power cycle MU736, the 3.3V pin must stay below 1.8 V for more than 100 ms. The sequence is shown as in Figure 3-4 .

Figure 3-4 MU736 power supply time sequence for power cycling



Parameter	Remarks	Time(Min.)	Unit
T_{off}	Power off time	100	ms

3.3.3 USIM Power Output UIM_PWR

Output power supply interface is UIM_PWR. Through the UIM_PWR power supply interface, the MU736 module can supply 1.8 V or 2.85 V power to UIM card. The max current can reach 200 mA, so special attention on PCB design should be taken at the host side.

3.4 Signal Control Interface

3.4.1 Overview

The signal control part of the interface in the MU736 module consists of the following:

- Power On/Off (Power_On_Off) pin
- System reset (RESET#) pin
- LED control (LED#) pin
- WWAN disable control (W_DISABLE#) pin
- GPS disable control (GPS_DISABLE#) pin
- Wake signal out from module (Wake_On_WWAN#) pin

- BodySAR detection (BodySAR_N) pin
- UIM detection (SIM_DET) pin

Table 3-3 lists the pins on the signal control interface.

Table 3-3 Pins on the signal control interface

Pin No.	Pin Name	I/O	Description	DC Characteristics(V)		
				Min.	Typ.	Max.
6	Power_On_Off	I	A single control to turn On/Off WWAN. When It is High, WWAN is powered on. H: Power on L: Power off It is internally pulled to low. It is 3.3 V tolerant but can be driven by either 1.8 V or 3.3 V GPIO.	–0.3	1.8	3.6
67	RESET#	I	System reset, active low	–0.3	1.8	3.6
10	LED#	O	It is an open drain, active low signal, used to allow the M.2 card to provide status indicators via LED devices that will be provided by the system.	Open drain and a pull-up resistor is required on the host		
8	W_DISABLE#	I	WWAN disable function H: WWAN function is determined by software AT command. Default enabled. L: WWAN function is turned off.	–0.3	3.3	3.6
26	GPS_DISABLE#	I	GPS disable function H: GPS function is determined by software AT command. Default enabled. L: GPS is turned off.	–0.3	3.3	3.6
23	Wake_On_WWAN#	O	It is open drain, WWAN to wake up the host, active low.	Open drain and a pull-up resistor is required on the host		
25	BodySAR_N	I	Hardware pin for BodySAR detection. H: No TX power backoff (default). L: TX power backoff.	–0.3	1.8	3.6
66	SIM_DET	I	SIM hot swap detection pin. Rising edge for insertion; falling edge for removal. H: SIM is present. L: SIM is absent.	–0.3	1.8	2.1

3.4.2 Power_On_Off Control Pin

The MU736 module can be controlled to be powered on/off by the Power_On_Off pin.

Table 3-4 Two states of Power_On_Off

Item.	Pin state	Description
1	High	MU736 is powered on. **NOTE: If MU736 needs to be powered on automatically, the Power_On_Off pin must be pulled up to 3.3 V.**
2	Low	MU736 is powered off. **It is internally pulled to low.**

MU736 is powered by regulated 3.3 V

If MU736 is powered by 3.3 V voltage regulator (such as notebook or Ultrabook), Power_On_Off pin should be pulled up to 3.3 V through a resistor.

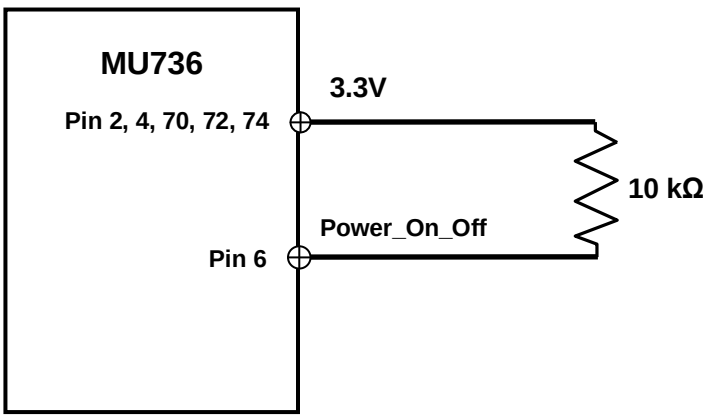
The pull-up resistor should be **not larger than 10 kΩ**.

The following are the power On/Off sequences:

1. The module gets 3.3 V when power supply for the module is switched on.
2. The module is turned on since Power_On_Off pin is pulled up directly to 3.3 V.
3. Host cuts off 3.3V supply to power off the module.

The recommended circuit is shown as in Figure 3-5 .

Figure 3-5 Recommended connections of Power_On_Off pins (Auto power)

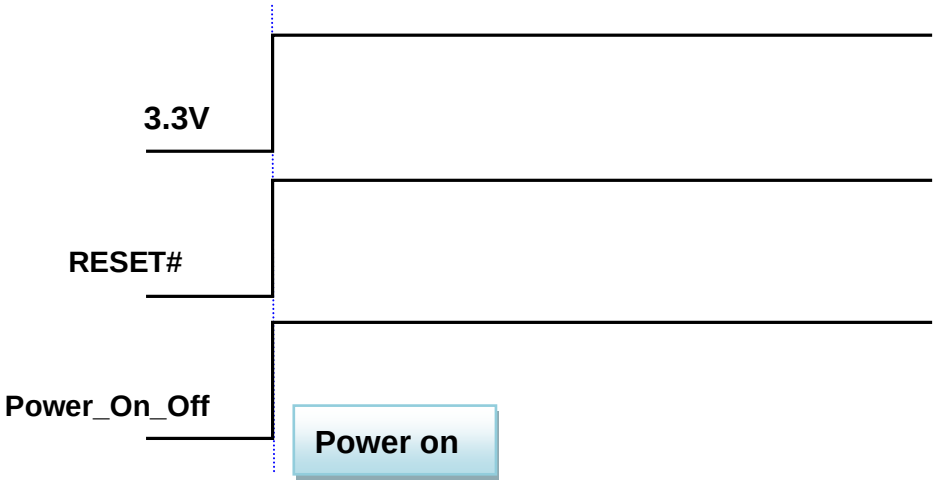


Power on sequence

Do not toggle RESET# pin during the power on sequence. Pulling RESET# pin low will extend time for module startup.

Recommended power on timing is shown as in Figure 3-6 .

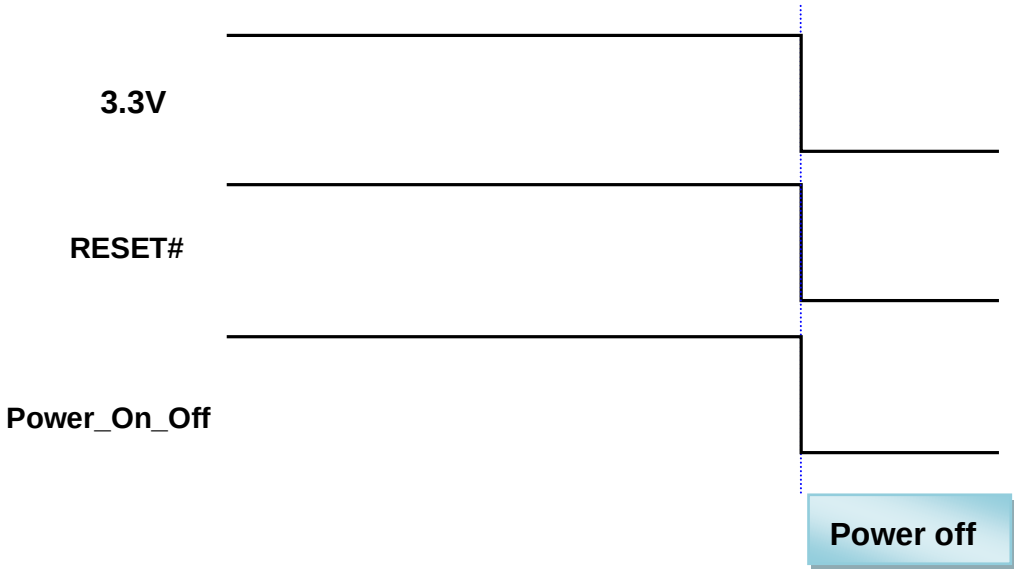
Figure 3-6 Recommended power on off timing



Power off Sequence

Cutting off 3.3V will power off the module.

Figure 3-7 Recommended power off timing (cut off 3.3V)



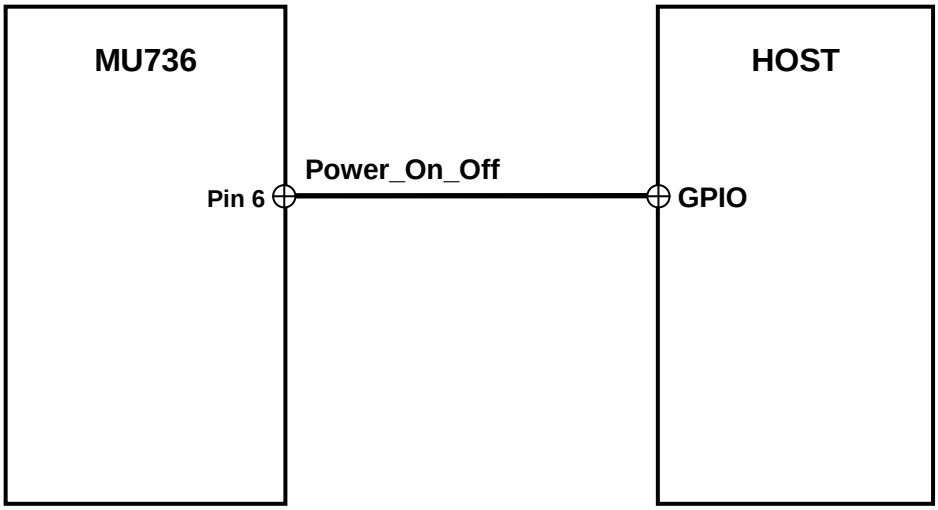
MU736 is powered directly to battery

For use case MU736 is connected directly to battery, such as tablet platforms, Power_On_Off pin should be controlled by a GPIO from host to control MU736 power On/Off.

It is critical to make sure the module is safely powered off when the Tablet SoC is shut off. There will be current leakage if the module is not powered off properly. So It is important to keep Power_On_Off pin logic low for more than **500 ms** to power off the module.

The recommended connections are shown as in Figure 3-8 .

Figure 3-8 Recommended connections of Power_On_Off pins (Control)

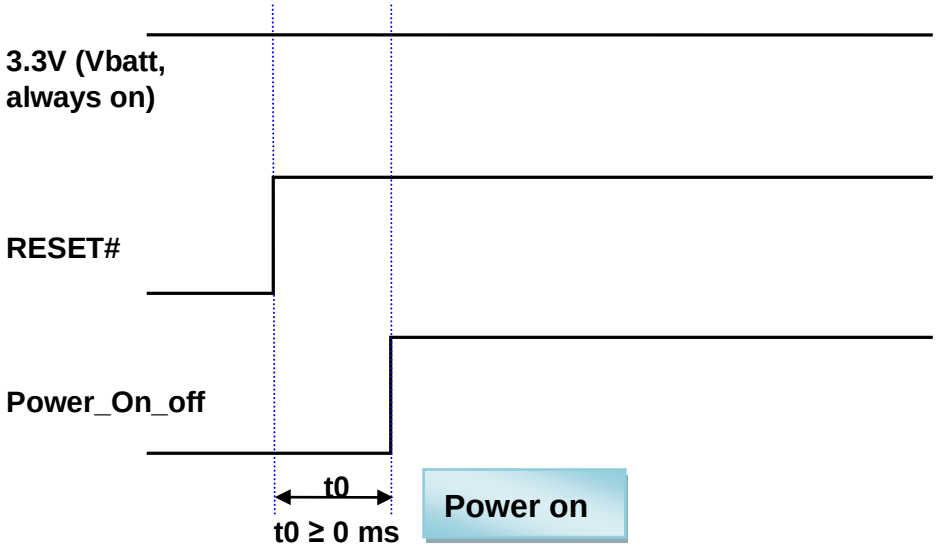


Power on sequence

Do not toggle RESET# pin during power on sequence. Pulling RESET# pin low will extend time for module startup.

Recommended power on timing is shown as in Figure 3-9 .

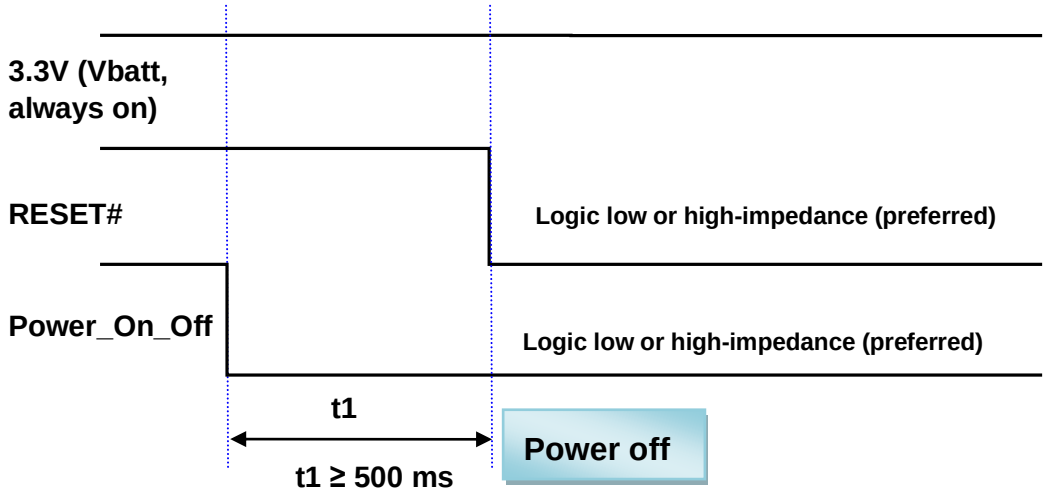
Figure 3-9 Recommended power on timing



Power off Sequence

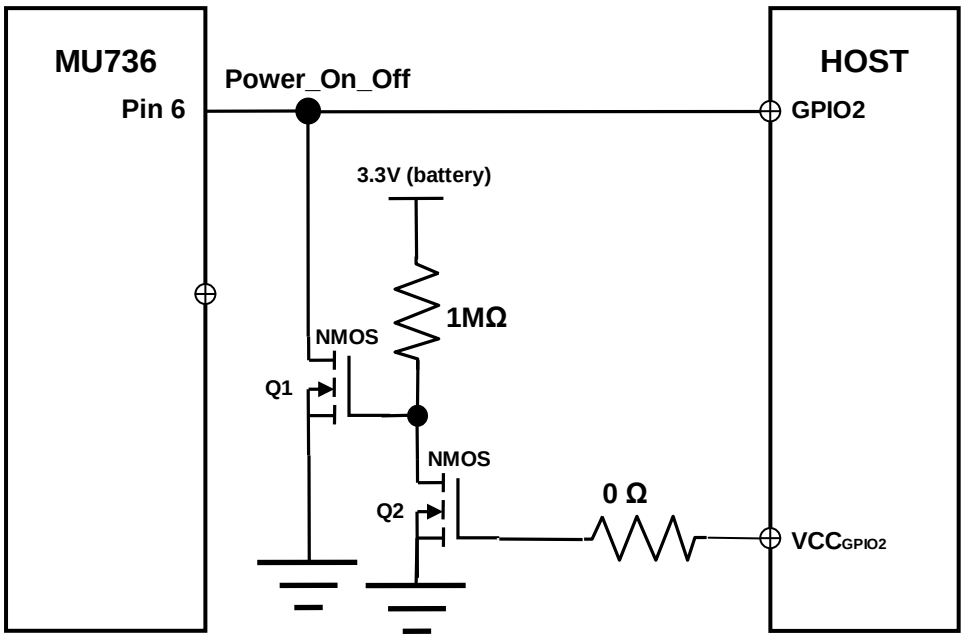
Keep Power_On_Off pin logic low for more than 500 ms to power off the module.

Figure 3-10 Recommended power off timing (connect to battery)



If there is limitation on the controlling GPIO to be programmable 500 ms, the hardware solution can be used, as shown in Figure 3-11 .

Figure 3-11 Power on off circuit (hardware solution)



VCC$_{GPIO2}$ is the power domain of the GPIO2.
When **VCC**$_{GPIO2}$ is **ON**, Q2 is on and Q1 is off. So the Pin6 is controlled by GPIO2 of host.
When **VCC**$_{GPIO2}$ is **Off**, Q2 is off and Q1 is on. So the Pin6 is pulled low, then the module is powered off.

3.4.3 RESET# Pins

The MU736 module can be reset through the RESET# pin asynchronous, active low. Whenever this pin is active, the module will immediately be placed in a Power On reset condition. Care should be taken for this pin unless there is a critical failure and all other methods of regaining control and/or communication with the WWAN sub-system have failed.

Pulling RESET# pin low for more than **20 ms** will reset the module.

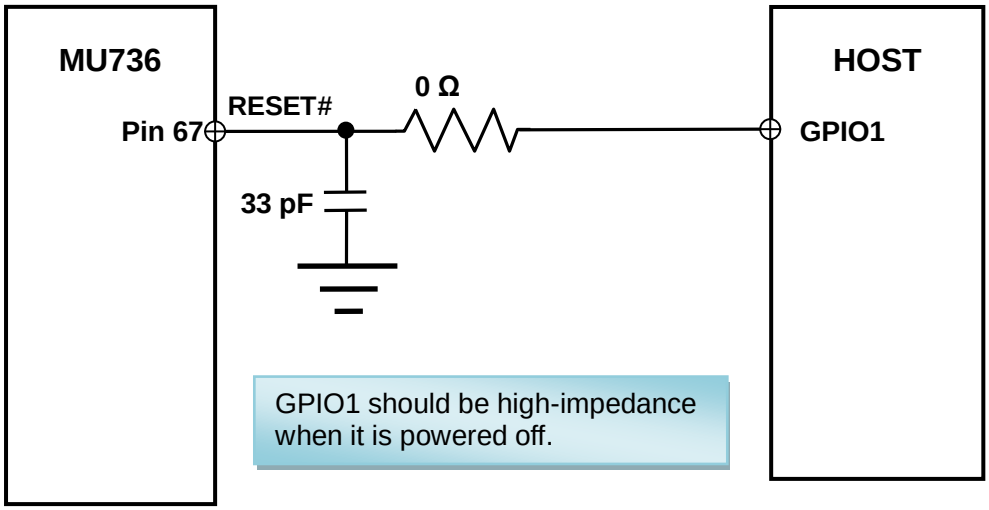
RESET# pin is optional, which cannot be connected. Pulling Power_On_Off pin low for more than 500 ms can work as a reset.

RESET# pin is internally pulled up to 1.8 V, which is automatically on when 3.3 V is applied even though Power_On_Off pin is low. Cautions should be taken on circuit design otherwise there may be back driving issue.

Option 1: Hardware circuit for RESET#

In this case, the GPIO is high-impedance when the module is powered off.

Figure 3-12 Hardware circuit for RESET# (Option 1)

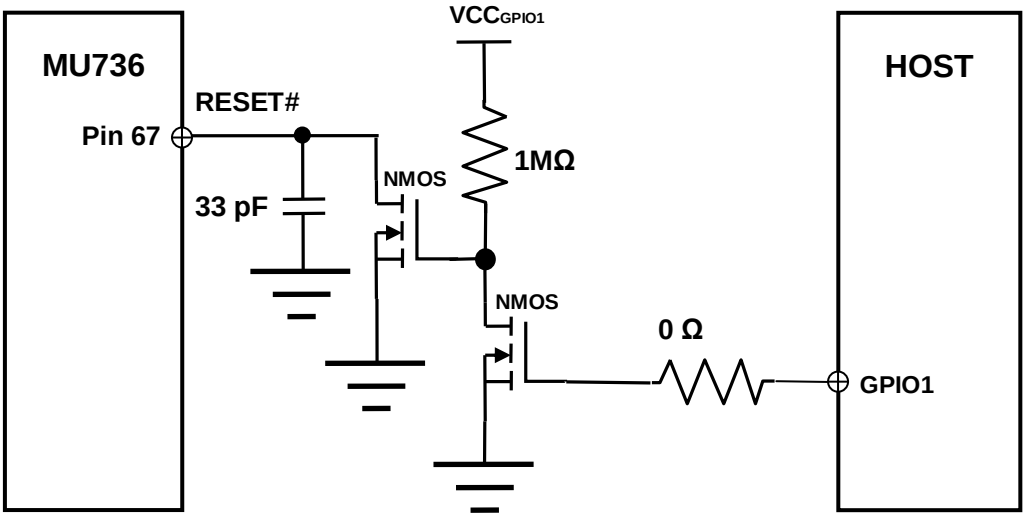


Option 2: Hardware circuit for RESET#

In this case, the GPIO is not high-impedance when It is powered off.

Use 2 NMOSFET so that the logic of RESET# pin and GPIO are the same.

Figure 3-13 Hardware circuit for RESET# (Option 2)

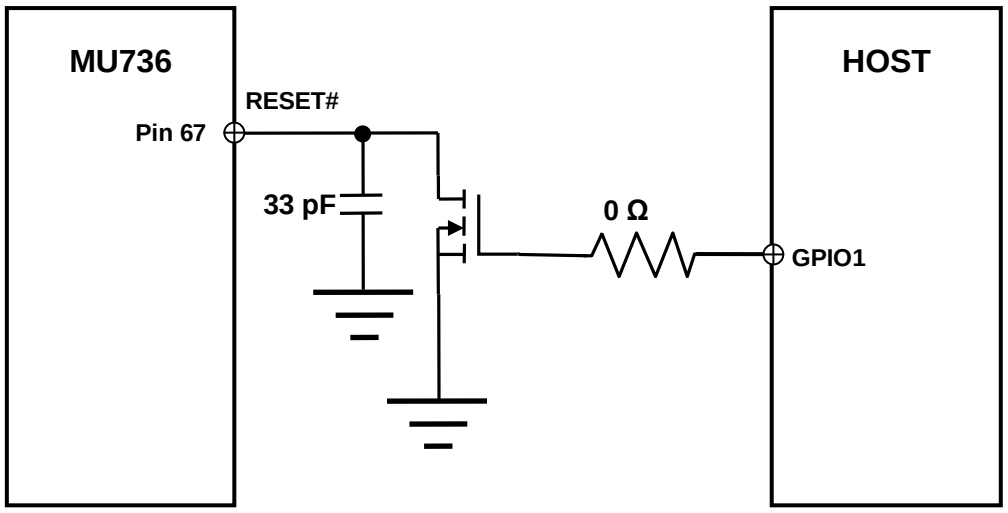


Option 3: Hardware circuit for RESET#

In this case, the GPIO is not high-impedance when the host is powered off.

Use only one NMOSFET, in this case the logic of RESET# pin and GPIO1 is reversed.

Figure 3-14 Hardware circuit for RESET# (Option 3)



CAUTION

- As the RESET# pin signal is relatively sensitive, it is recommended to install a 33 pF capacitor near to the M.2 pin.
- **Triggering the RESET# pin signal will lead to loss of all data in the module and the removal of system drivers. It will also disconnect the module from the network resulting in a call drop.**

3.4.4 LED# Pin

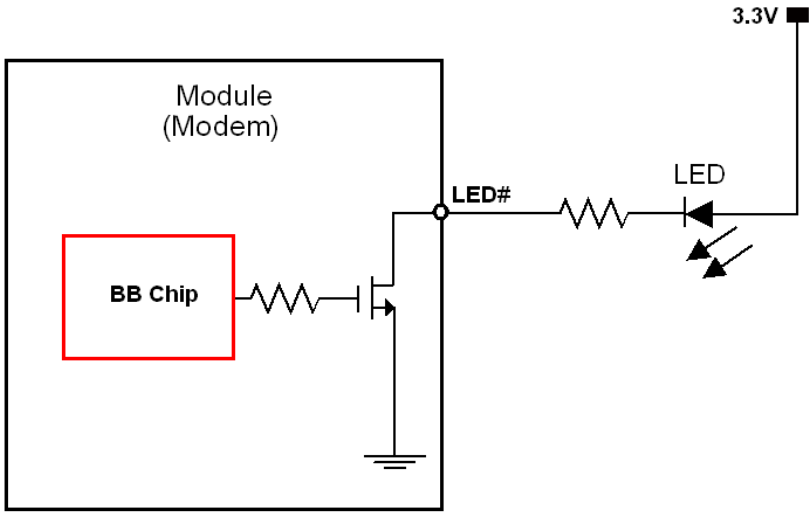
MU736 provides an open drain signal to indicate the RF status.

Table 3-5 State of the LED# pin

No.	Operating Status	LED#
1	RF function is turned on	Outputs Low
2	RF function is turned off	Outputs High

Figure 3-15 shows the recommended circuits of the LED# pin. The brightness of LED can be adjusted by adjusting the resistance of the series resistor.

Figure 3-15 Driving circuit



CAUTION

LED# pin output is different from HUAWEI MU733 module, because MU736 integrates a MOSFET inside.

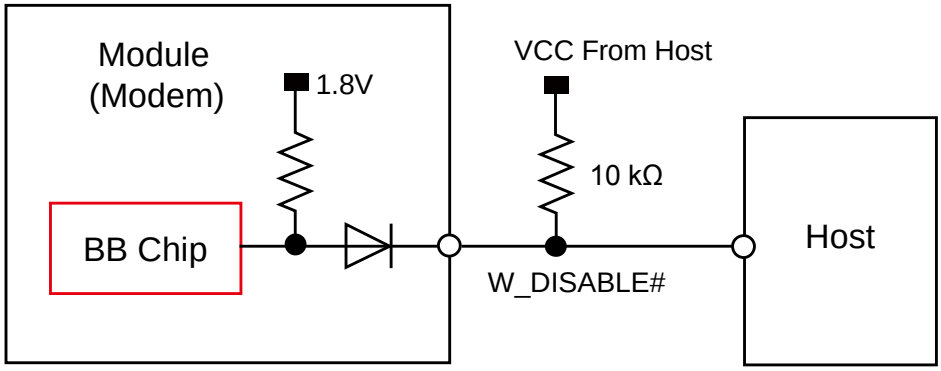
3.4.5 W_DISABLE# Pin

MU736 provides a hardware pin (W_DISABLE#) to enable/disable the radio function. This function also can be implemented by AT command.

Table 3-6 Function of the W_DISABLE# pin

No.	W_DISABLE#	Function
1	Low	WWAN function will be turned off.
2	High	WWAN function is determined by software AT command. Default enabled.
3	Floating	WWAN function is determined by software AT command. Default enabled.

Figure 3-16 Connections of the W_DISABLE# pin



CAUTION

It is recommended not to add a diode on the W_DISABLE# pin outside the MU736 module.

3.4.6 GPS_DISABLE# Pin

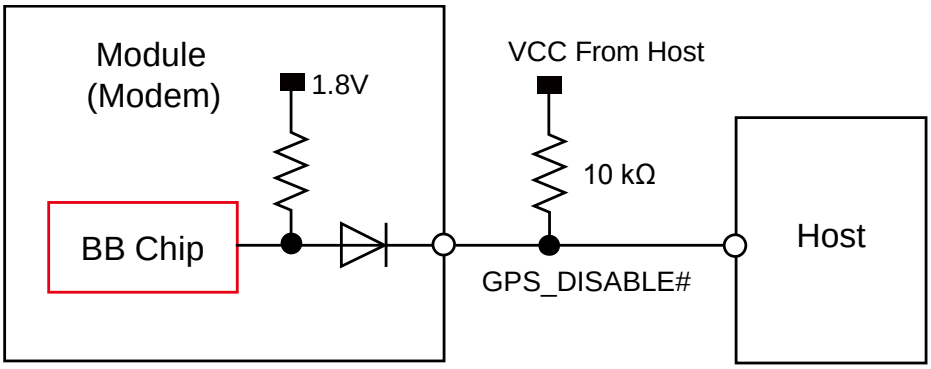
MU736 provides a hardware pin (GPS_DISABLE#) to enable/disable the GPS function.

Table 3-7 Function of the GPS_DISABLE# pin

No.	GPS_DISABLE#	Function
1	Low	GPS function is disabled.
2	High	GPS function is determined by software AT command. Default enabled.

No.	GPS_DISABLE#	Function
3	Floating	GPS function is determined by software AT command. Default enabled.

Figure 3-17 Connections of the GPS_DISABLE# pin



CAUTION

It is recommended not to add a diode on the GPS_DISABLE# pin outside the MU736 module.

3.4.7 Wake_On_WWAN# Pin

MU736 provides an open drain output Wake_On_WWAN# pin to wake host. It is low active.

Figure 3-18 Wave form of the Wake_On_WWAN# pin

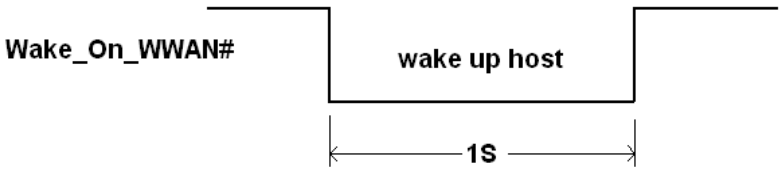
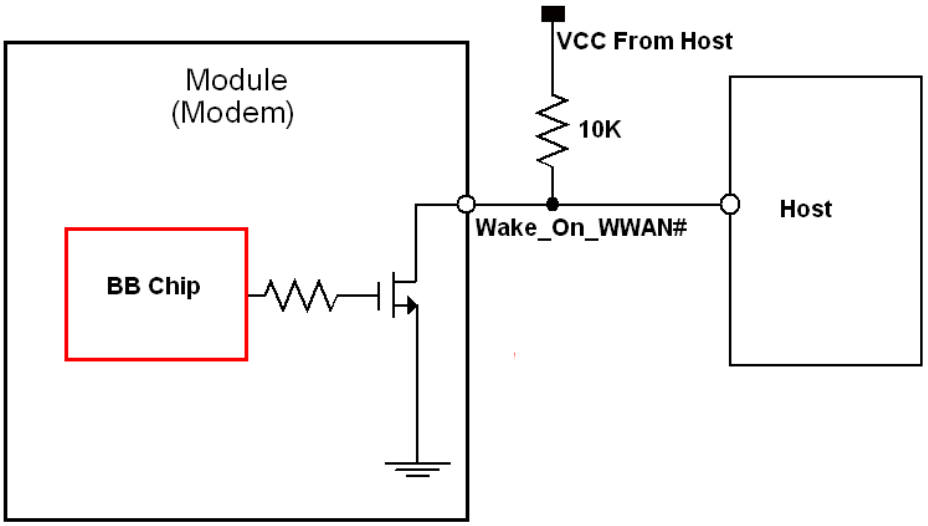


Figure 3-19 Connections of the Wake_On_WWAN# pin



3.4.8 BodySAR_N Pin

MU736 provides an input pin BodySAR_N for BodySAR detection.

It is pulled up internally and when it is pulled low by the proximity sensor output or controlling signal from host systems, the Tx power reduction actions will be triggered.

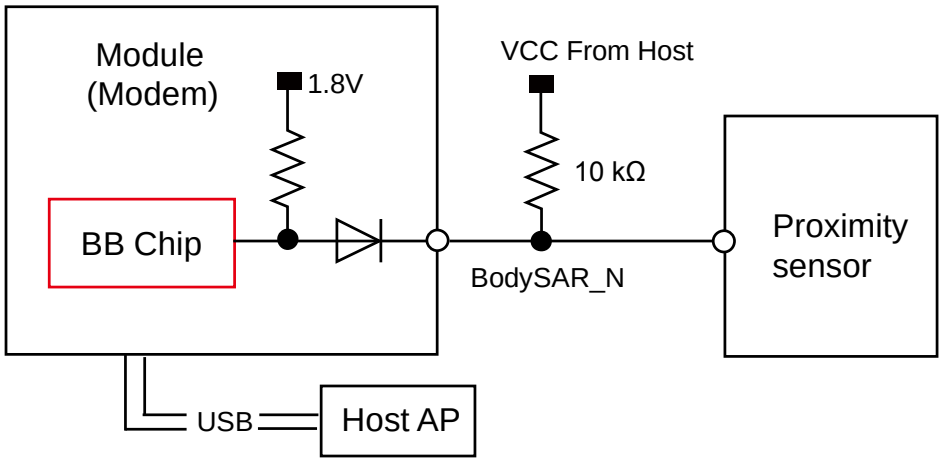
Table 3-8 Function of the BodySAR_N pin

No.	BodySAR_N	Function
1	Low	MAX TX power will be back off by setting through AT command
2	High	MAX TX power will **NOT** be backed off (default)
3	Floating	MAX TX power will **NOT** be backed off

If BodySAR_N pin is used to monitor the proximity sensor output, there are some essential preconditions for this hardware solution.

MU736 cannot provide any control signal for the proximity sensor. Any control or programming required by the proximity sensor should be handled by the host side.

Figure 3-20 Connections of the BodySAR_N pin



CAUTION

It is recommended not to add a diode on the BodySAR_N pin outside the MU736 module.

3.4.9 SIM_DET Pin

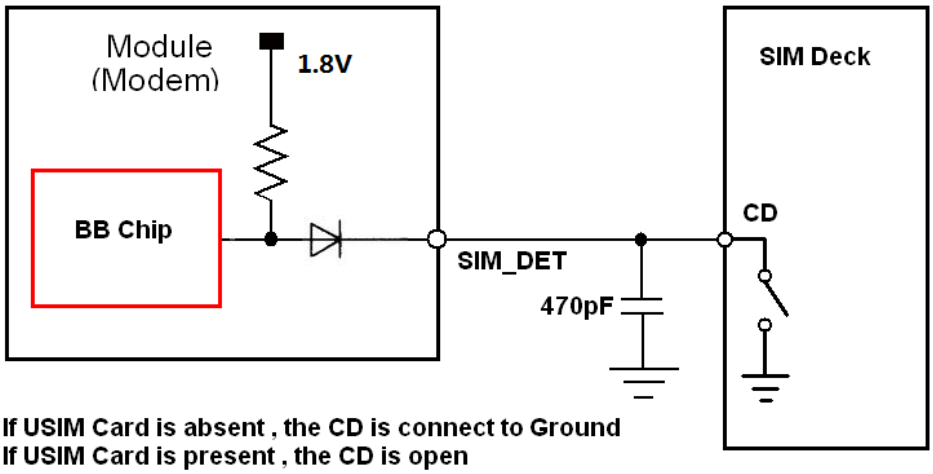
MU736 supports USIM Hot Swap function.

MU736 provides an input pin (SIM_DET) to detect whether the USIM card is present or not. This pin is an edge trigger pin.

Table 3-9 Function of the SIM_DET pin

No.	SIM_DET	Function
1	Rising edge	USIM Card insertion. If the USIM Card is present, SIM_DET pin should be high.
2	Falling edge	USIM Card removal. If the USIM Card is absent, SIM_DET pin should be low.

Figure 3-21 Connections of the SIM_DET pin

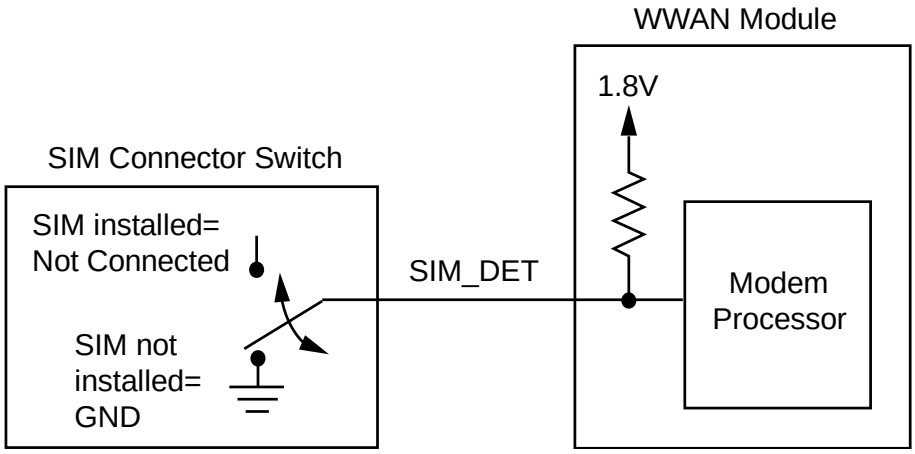


CD is a pin detecting USIM in the SIM Socket, normally, there will be a detect pin in the SIM Socket.

CAUTION

- The Normal SHORT SIM connector should be employed. The logic of SIM_DET pin is shown as Figure 3-22 . High represents that SIM is inserted; Low represents that SIM is removed.
- When SIM is inserted (hot), SIM_DET pin will change from Low to High;
- When SIM is removed (hot), SIM_DET pin will change from High to Low.
- MU736 will detect the rising or falling edge of SIM_DET to react the hot swap.

Figure 3-22 The logic of SIM_DET



3.5 USB Interface

The MU736 is compliant with USB 2.0 high speed protocol. The USB input/output lines are following USB 2.0 specifications. Definition of the USB interface:

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min.	Typ.	Max.
7	USB_D+	I/O	USB data signal D+	-	-	-
9	USB_D-	I/O	USB data signal D-	-	-	-

Figure 3-23 Recommended circuit of USB interface

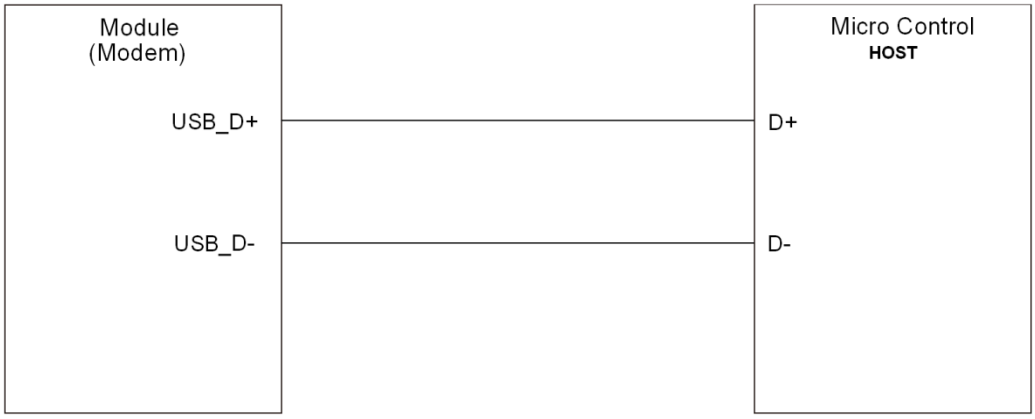
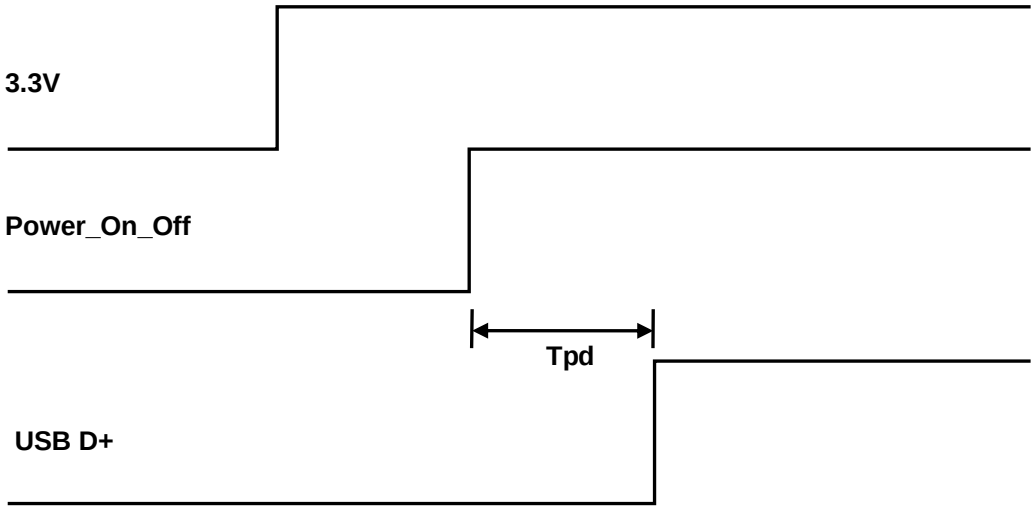


Figure 3-24 shows the timing sequence between 3.3 V and USB D+.

Figure 3-24 MU736 USB D+ and 3.3 V power on timing



Parameter	Remarks	Time(Nominal value)	Unit
T_{pd}	Power valid to USB D+ high	8	s

NOTE
The layout design of this circuit on the host board should comply with the USB 2.0 high speed protocol, with differential characteristic impedance of 90 Ω.

3.6 USIM Card Interface

3.6.1 Overview

The MU736 module provides a USIM card interface complying with the ISO 7816-3 standard and supports both 1.8 V and 3.0 V USIM cards.

Table 3-10 USIM card interface signals

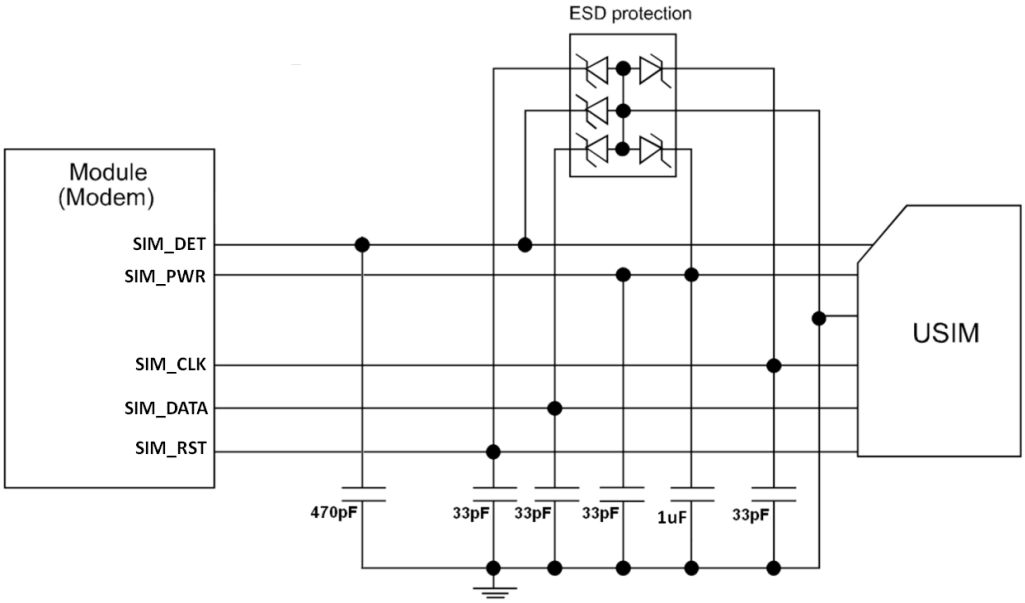
Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min.	Typ.	Max.
30	UIM_RESET	O	USIM Reset	–0.3	1.8/2.85	1.98/3.0
32	UIM_CLK	O	USIM clock	–0.3	1.8/2.85	1.98/3.0
34	UIM_DATA	IO	USIM DATA	–0.3	1.8/2.85	1.98/3.0
36	UIM_PWR	PO	USIM POWER	–0.3	1.8/2.85	1.98/3.0

3.6.2 Circuit Recommended for the USIM Card Interface

As the MU736 module is not equipped with an USIM socket, you need to place an USIM socket on the user interface board.

Figure 3-25 shows the circuit of the USIM card interface.

Figure 3-25 Circuit of the USIM card interface



CAUTION

- The ESD protection component should choose low capacitance. The capacitance of the component should be **less than 10 pF.**
- To meet the requirements of 3GPP TS 51.010-1 protocols and electromagnetic compatibility (EMC) authentication, the USIM socket should be placed near the M.2 interface (it is recommended that the PCB circuit connects the M.2 interface and the USIM socket does not exceed 100 mm), because a long circuit may lead to wave distortion, thus affecting signal quality.
- It is recommended that you wrap the area adjacent to the SIM_CLK and SIM_DATA signal wires with ground. The Ground pin of the USIM socket and the Ground pin of the USIM card must be well connected to the power Ground pin supplying power to the MU736 module.
- A 100 nF capacitor (0402 package is recommended so that larger capacitance such as 1μF can be employed if necessary) and a 33 pF capacitor are placed between the SIM_VCC and Ground pins in parallel. Three 33 pF capacitors are placed between the SIM_DATA and Ground pins, the SIM_RST and Ground pins, and the SIM_CLK and Ground pins in parallel to filter interference from RF signals.
- It is recommended to take electrostatic discharge (ESD) protection measures near the USIM card socket. Transient voltage suppressor diode should be placed as close as possible to the USIM socket, and the Ground pin of the ESD protection component is well connected to the power Ground pin that supplies power to the MU736 module.

3.7 Tunable Antenna Control

The module provides 4 tunable antenna control pins.

Table 3-11 List of ANTCTL pins

Pin No.	Pin Name	I/O	Description	DC Characteristics(V)		
				Min.	Typ.	Max.
59	ANTCTL0	O	Tunable antenna control signal bit 0. It is a push-pull type GPIO.	–0.3	1.8	2.1
61	ANTCTL1	O	Tunable antenna control signal bit 1. It is a push-pull type GPIO.	–0.3	1.8	2.1
63	ANTCTL2	O	Tunable antenna control signal bit 2. It is a push-pull type GPIO.	–0.3	1.8	2.1
65	ANTCTL3	O	Tunable antenna control signal bit 3. It is a push-pull type GPIO.	–0.3	1.8	2.1

3.8 Config Pins

The module provides 4 config pins. MU736 is configured as WWAN-SSIC 0.

Table 3-12 List of CONFIG pins

Pin No.	Pin Name	I/O	Description	DC Characteristics(V)		
				Min.	Typ.	Max.
1	CONFIG_3	O	Connected to GND internally	-	0	-
21	CONFIG_0	O	Not Connected internally	-	-	-
69	CONFIG_1	O	Connected to GND internally	-	0	-
75	CONFIG_2	O	Connected to GND internally	-	0	-

In the M.2 specification, the 4 pins are defined as Table 3-13 .

Table 3-13 List of Config pins

Config_0 (Pin 21)	Config_1 (Pin 69)	Config_2 (Pin 75)	Config_3 (Pin 1)	Module type and Main host interface	Port Configuration
Ground	Ground	Ground	Ground	SSD-SATA	N/A
Ground	NC	Ground	Ground	SSD-PCIe	N/A
NC	**Ground**	**Ground**	**Ground**	**WWAN-SSIC**	**0**
NC	NC	NC	NC	No Module present	N/A

The GPIO0~7 pins have configurable assignments. There are 4 possible functional pin out configurations. These 4 configurations are called Port Config0~3. In each Port Configuration each GPIO is defined as a specific functional pin. The GPIO pin assignment can see in Table 3-14 . MU736 supports Config0. But the audio function is not implemented in MU736.

Table 3-14 GPIO Pin Function Assignment per Port Configuration

GPIO Pin	Port Config0 (GNSS+Audio ver1)
GPIO_0 (Pin 40)	GNSS_SCL
GPIO_1 (Pin 42)	GNSS_SDA
GPIO_2 (Pin 44)	GNSS_I2C_IRQ
GPIO_3 (Pin 46)	SYSCLK
GPIO_4 (Pin 48)	TX_Blanking
GPIO_5 (Pin 20)	Audio_0 (not supported)
GPIO_6 (Pin 22)	Audio_1 (not supported)
GPIO_7 (Pin 24)	Audio_2 (not supported)

3.9 NC Pins

The module has some NC pins. All of NC pins are not connected in the module.

Table 3-15 List of NC pins

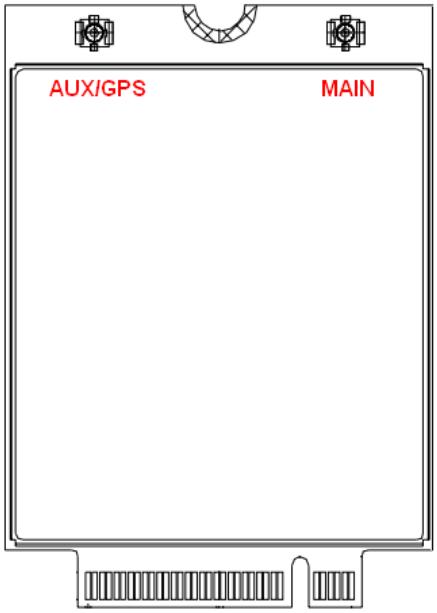
Pin No.	Pin Name	I/O	Description	DC Characteristics(V)		
				Min.	Typ.	Max.
28, 29, 31, 35, 37, 38, 41, 43, 47, 49, 50, 52, 53, 54, 55, 56, 58, 68	NC	-	Not Connected	-	-	-

3.10 RF Antenna Interface

3.10.1 RF Connector location

MU736 module provides 2 antenna connectors for connecting the external antennas.

Figure 3-26 RF antenna connectors



3.10.2 Coaxial RF Connector Guidelines

- The antenna interface must be used with coaxial cables with characteristic impedance of 50 Ω.
- The MU736 module supports the buckled RF connector antenna connection methods: buckled RF connector MM4829-2702RA4 by MURATA or other equivalent connectors

Figure 3-27 shows the RF connector dimensions.

Figure 3-27 RF connector dimensions

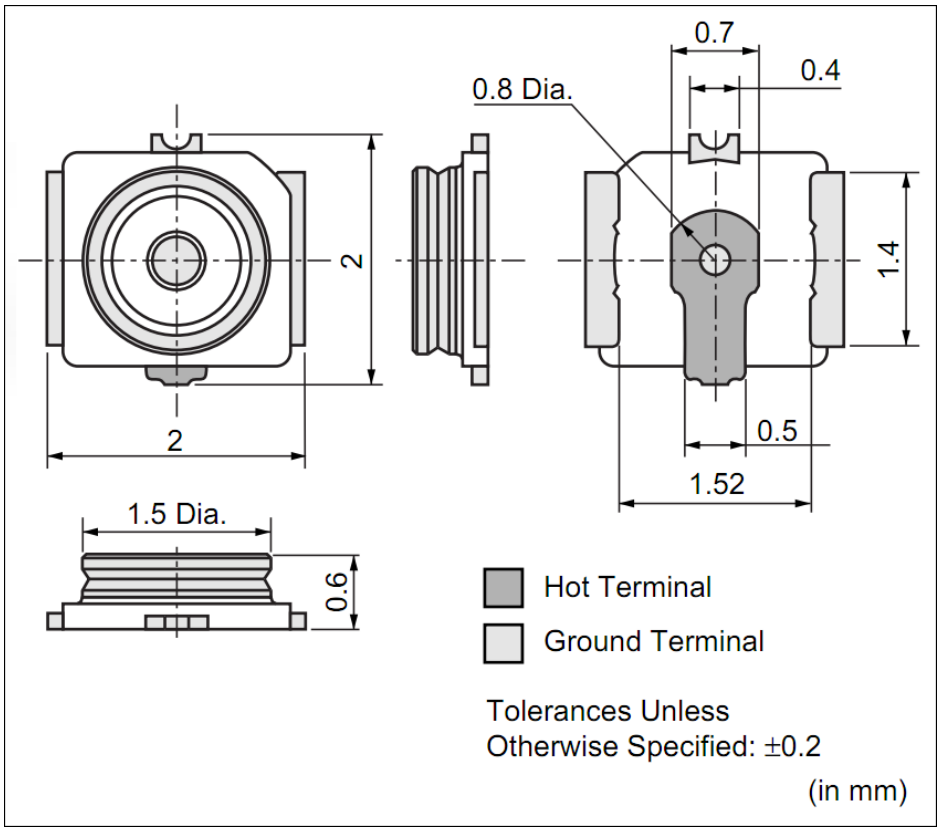


Table 3-16 The major specifications of the RF connector

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

There are two kinds of coaxial cables mating the RF connector in the MU736.

Figure 3-28 shows the specifications of 0.81 mm coaxial cable mating the recommended RF connector.

Figure 3-28 Specifications of 0.81 mm coaxial cable mating with the RF connector

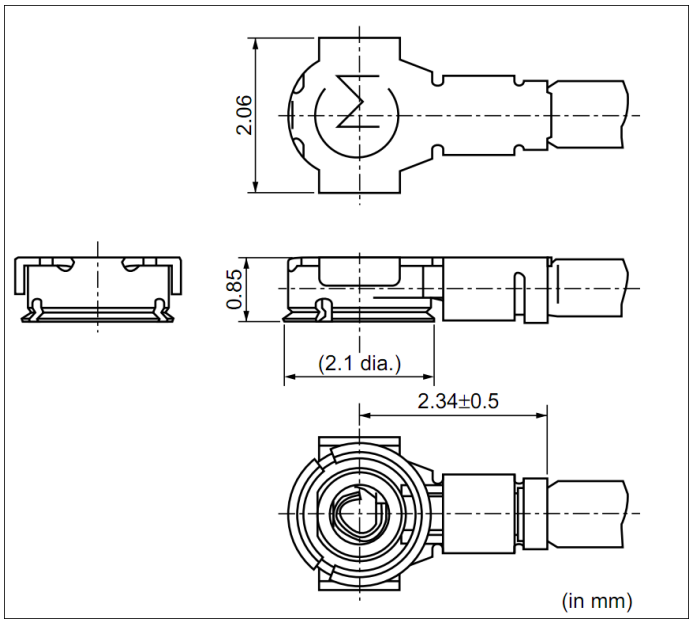


Figure 3-29 shows the connection between the RF connector and the 0.81 mm cable.

Figure 3-29 Connection between the RF connector and the 0.81 mm cable

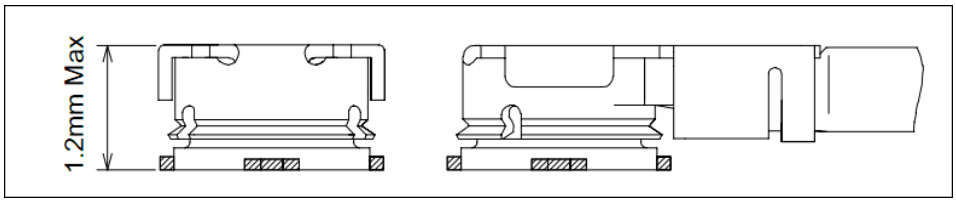


Figure 3-30 shows the specifications of 1.13 mm coaxial cable mating the recommended RF connector.

Figure 3-30 Specifications of 1.13 mm coaxial cable mating with the RF connector

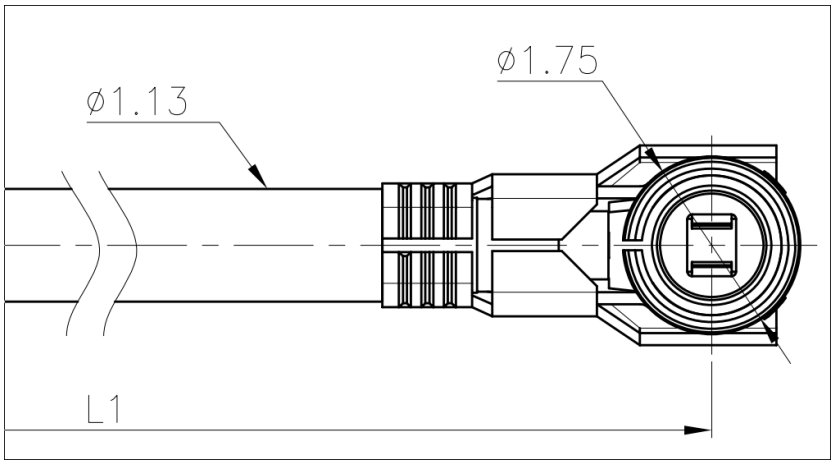
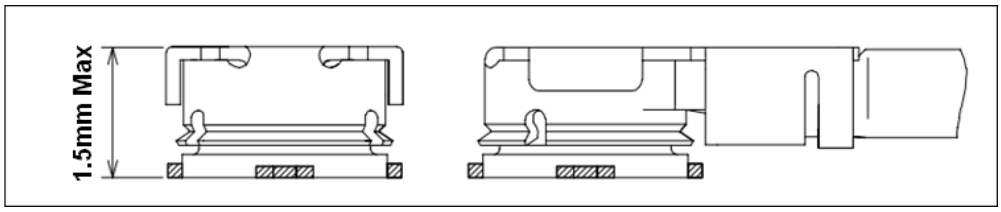


Figure 3-31 shows the connection between the RF connector and the 1.13 mm cable.

Figure 3-31 Connection between the RF connector and the 1.13 mm cable



4 RF Specifications

4.1 About This Chapter

This chapter describes the RF specifications of the MU736 module, including:

- Operating Frequencies
- Conducted RF Measurement
- Conducted Rx Sensitivity and Tx Power
- Antenna Design Requirements

4.2 Operating Frequencies

Table 4-1 shows the RF bands supported by MU736.

Table 4-1 RF bands

Operating Band	Tx	Rx
UMTS Band I	1920 MHz–1980 MHz	2110 MHz–2170 MHz
UMTS Band II	1850 MHz–1910 MHz	1930 MHz–1990 MHz
UMTS Band IV(AWS)	1710 MHz–1755 MHz	2110 MHz–2155 MHz
UMTS Band V	824 MHz–849 MHz	869 MHz–894 MHz
UMTS Band VIII	880 MHz–915 MHz	925 MHz–960 MHz
GSM 850	824 MHz–849 MHz	869 MHz–894 MHz
GSM 900	880 MHz–915 MHz	925 MHz–960 MHz
GSM 1800(DCS)	1710 MHz–1785 MHz	1805 MHz–1880 MHz
GSM 1900(PCS)	1850 MHz–1910 MHz	1930 MHz–1990 MHz
GPS	-	1574.42 MHz–1576.42 MHz

4.3 Conducted RF Measurement

4.3.1 Test Environment

Test instrument	R&S CMU200, Agilent E5515C, GSS6700
Power supply	Keithley 2303, Agilent 66319
RF cable for testing	Rosenberger Precision Microwave Cable
Murata coaxial cable	MXHP32HP1000

NOTE

- The compensation for different frequency bands relates to the cable and the test environment.
- The instrument compensation needs to be set according to the actual cable conditions.

4.3.2 Test Standards

Huawei modules meet 3GPP TS 51.010-1 and 3GPP TS 34.121-1 test standards. Each module passes strict tests at the factory and thus the quality of the modules is guaranteed.

4.4 Conducted Rx Sensitivity and Tx Power

4.4.1 Conducted Receive Sensitivity

The conducted receive sensitivity is a key parameter that indicates the receiver performance of MU736.

The **3GPP Protocol Claim** column in Table 4-2 lists the required minimum values, and the **Test Value** column lists the tested values of MU736.

Table 4-2 MU736 conducted Rx sensitivity (Unit: dBm)

Item		3GPP Protocol Claim (dBm)	MU736 Test Value (dBm)		
			Min.	Typ.	Max.
GSM850	GMSK (CS1, BLER < 10%)	< –102	-	-	–108
	8PSK (MCS5, BLER < 10%)	< –98	-	-	–101
GSM900	GMSK (CS1, BLER < 10%)	< –102	-	-	–108
	8PSK (MCS5, BLER < 10%)	< –98	-	-	–101

Item		3GPP Protocol Claim (dBm)	MU736 Test Value (dBm)		
			Min.	Typ.	Max.
GSM1800	GMSK (CS1, BLER < 10%)	< –102	-	-	–108
	8PSK (MCS5, BLER < 10%)	< –98	-	-	–101
GSM1900	GMSK (CS1, BLER < 10%)	< –102	-	-	–108
	8PSK (MCS5, BLER < 10%)	< –98	-	-	–101
Band I (BER < 0.1%)		< –106.7	-	-	–108
Band II (BER < 0.1%)		< –104.7	-	-	–108
Band IV (BER < 0.1%)		< –106.7	-	-	–108
Band VIII (BER < 0.1%)		< –103.7	-	-	–108
Band V (BER < 0.1%)		< –104.7	-	-	–108

Table 4-3 MU736 GPS specifications

TTFF	Cold start	43s@–130 dBm
	Warm start	43s@–130 dBm
	Hot Start	3s@–130 dBm
Sensitivity	Cold start	–144 dBm
	Tracking	–158 dBm

NOTE
The test values are the average of some test samples.

4.4.2 Conducted Transmit Power

The conducted transmit power is another indicator that measures the performance of MU736. The conducted transmit power refers to the maximum power that the module tested at the antenna port can transmit. According to the 3GPP protocol, the required transmit power varies with the power class.

Table 4-4 lists the required ranges of the conducted transmit power of MU736. The tested values listed in the Test Value column must range from the minimum power to the maximum power.

Table 4-4 MU736 conducted Tx power (Unit: dBm)

Item		3GPP Protocol Claim (dBm)	MU736 Test Value (dBm)		
			Min.	Typ.	Max.
GSM850	GMSK (1Tx Slot)	31 to 35	31.5	32.5	33.5
	8PSK (1Tx Slot)	24 to 30	26	27	28
GSM900	GMSK (1Tx Slot)	31 to 35	31.5	32.5	33.5
	8PSK (1Tx Slot)	24 to 30	26	27	28
GSM1800	GMSK (1Tx Slot)	28 to 32	28.5	29.5	30.5
	8PSK (1Tx Slot)	23 to 29	25	26	27
GSM1900	GMSK (1Tx Slot)	28 to 32	28.5	29.5	30.5
	8PSK (1Tx Slot)	23 to 29	25	26	27
Band I		21 to 25	22.5	23.5	24.5
Band II		21 to 25	22.5	23.5	24.5
Band IV		21 to 25	22.5	23.5	24.5
Band VIII		21 to 25	22.5	23.5	24.5
Band V		21 to 25	22.5	23.5	24.5

4.5 Antenna Design Requirements

4.5.1 Antenna Design Indicators

Antenna Efficiency

Antenna efficiency is the ratio of the input power to the radiated or received power of an antenna. The radiated power of an antenna is always lower than the input power due to the following antenna losses: return loss, material loss, and coupling loss. The efficiency of an antenna relates to its electrical dimensions. To be specific, the antenna efficiency increases with the electrical dimensions. In addition, the transmission cable from the antenna port of MU736 to the antenna is also part of the antenna. The cable loss increases with the cable length and the frequency. It is recommended that the cable loss be as low as possible, for example, U.FL-LP-088 made by HRS.

The following antenna efficiency (free space) is recommended for MU736 to ensure high radio performance of the module:

- Efficiency of the primary antenna: ≥ 40% (below 960 MHz); ≥ 50% (over 1710 MHz)
- Efficiency of the diversity antenna: ≥ half of the efficiency of the primary antenna in receiving band

- Efficiency of the GPS antenna: ≥ 50%

In addition, the efficiency should be tested with the transmission cable.

S11 or VSWR

S11 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 with a vector analyzer.

The following S11 values are recommended for the antenna of MU736:

- S11 of the primary antenna ≤ –6 dB
- S11 of the diversity antenna ≤ –6 dB
- S11 of the GPS antenna ≤ –10 dB

In addition, S11 is less important than the efficiency, and S11 has weak correlation to the wireless performance.

Isolation

For a wireless device with multiple antennas, the power of different antennas is coupled with each other. Antenna isolation is used to measure the power coupling. The power radiated by an antenna might be received by an adjacent antenna, which decreases the antenna radiation efficiency and affects the running of other devices. To avoid this problem, evaluate the antenna isolation as sufficiently as possible at the early stage of antenna design.

Antenna isolation depends on the following factors:

- Distance between antennas
- Antenna type
- Antenna direction

The primary antenna must be placed as near as possible to the MU736 to minimize the cable length. The diversity antenna needs to be installed perpendicularly to the primary antenna. The diversity antenna can be placed farther away from the MU736. Antenna isolation can be measured with a two-port vector network analyzer.

The following antenna isolation is recommended for the antennas on laptops:

- Isolation between the primary and diversity antennas ≤ –12 dB
- Isolation between the primary antenna and the GPS antenna ≤ –15 dB
- Isolation between the primary antenna and the Wi-Fi antenna ≤ –15 dB

Polarization

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

The linear polarization is recommended for the antenna of MU736.

Envelope Correlation Coefficient

The envelope correlation coefficient indicates the correlation between different antennas in a multi-antenna system (primary antenna, diversity antenna, and MIMO antenna). The correlation coefficient shows the similarity of radiation patterns, that is, amplitude and phase of the antennas. The ideal correlation coefficient of a diversity antenna system or a MIMO antenna system is 0. A small value of the envelope correlation coefficient between the primary antenna and the diversity antenna indicates a high diversity gain. The envelope correlation coefficient depends on the following factors:

- Distance between antennas
- Antenna type
- Antenna direction

The antenna correlation coefficient differs from the antenna isolation. Sufficient antenna isolation does not represent a satisfactory correlation coefficient. For this reason, the two indicators need to be evaluated separately.

For the antennas on laptops, the recommended envelope correlation coefficient between the primary antenna and the diversity antenna is smaller than 0.5.

Radiation Pattern

The radiation pattern of an antenna reflects the radiation features of the antenna in the remote field region. The radiation pattern of an antenna commonly describes the power or field strength of the radiated electromagnetic waves in various directions from the antenna. The power or field strength varies with the angular coordinates (θ and φ), but is independent of the radial coordinates.

The radiation pattern of half wave dipole antennas is omnidirectional in the horizontal plane, and the incident waves of base stations are often in the horizontal plane. For this reason, the receiving performance is optimal.

The following radiation patterns are recommended for the antenna of MU736:
Primary/Diversity/GPS/WIFI antenna: omnidirectional.

In addition, the diversity antenna’s pattern should be complementary with the primary antenna’s pattern.

Gain and Directivity

The radiation pattern of an antenna represents the field strength of the radiated electromagnetic waves in all directions, but not the power density that the antenna radiates in the specific direction. The directivity of an antenna, however, measures the power density that the antenna radiates.

Gain, as another important parameter of antennas, correlates closely to the directivity. The gain of an antenna takes both the directivity and the efficiency of the antenna into account. The appropriate antenna gain prolongs the service life of relevant batteries.

The following antenna gain is recommended for MU736:

- Gain of the primary antenna ≤ 2.5 dBi
- Gain of the diversity antenna ≤ 2.5 dBi

NOTE

- The antenna consists of the antenna body and the relevant RF transmission cable. Take the RF transmission cable into account when measuring any of the preceding antenna indicators.
- Huawei cooperates with various famous antenna suppliers who are able to make suggestions on antenna design, for example, Amphenol, Skycross, etc.

4.5.2 Interference

Besides the antenna performance, the interference on the user 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 user board, there are various interference sources, such as the LCD, CPU, audio circuits, and power supply. All the interference sources emit interference signals that affect the normal operation of the module. For example, the module sensitivity can be decreased due to interference signals. Therefore, during the design, you need to consider how to reduce the effects of interference sources on the module. You can take the following measures: Use an LCD with optimized performance; shield the LCD interference signals; shield the signal cable of the board; or design filter circuits.

Huawei is able to make technical suggestions on radio performance improvement of the module.

4.5.3 GSM/WCDMA/GPS Antenna Requirements

The antenna for MU736 must fulfill the following requirements:

GSM/WCDMA/GPS Antenna Requirements	
Frequency range	Depending on frequency band(s) provided by the network operator, the customer must use the most suitable antenna for that/those band(s)
Bandwidth	70 MHz in GSM850 80 MHz in GSM900 170 MHz in DCS 140 MHz in PCS 70 MHZ in WCDMA850 (25 MHz for diversity antenna) 80 MHz in WCDMA900 (35 MHz for diversity antenna) 445 MHz in WCDMA1700 (AWS) (45 MHz for diversity antenna) 140 MHz in WCDMA1900 (60 MHz for diversity antenna) 250 MHz in WCDMA2100 (60 MHz for diversity antenna) 2 MHz in GPS
Gain	≤ 2.5 dBi
Impedance	50 Ω
VSWR absolute max	≤ 3:1 (≤ 2:1 for GPS antenna)

GSM/WCDMA/GPS Antenna Requirements	
VSWR recommended	≤ 2:1 (≤ 1.5:1 for GPS antenna)

4.5.4 Radio Test Environment

The antenna efficiency, antenna gain, radiation pattern, total radiated power (TRP), and total isotropic sensitivity (TIS) can be tested in a microwave testing chamber.

Huawei has a complete set of OTA test environments (SATIMO microwave testing chambers and ETS microwave testing chambers). The testing chambers are certified by professional organizations and are applicable to testing at frequencies ranging from 380 MHz to 6 GHz. The test items are described as follows.

Passive Tests

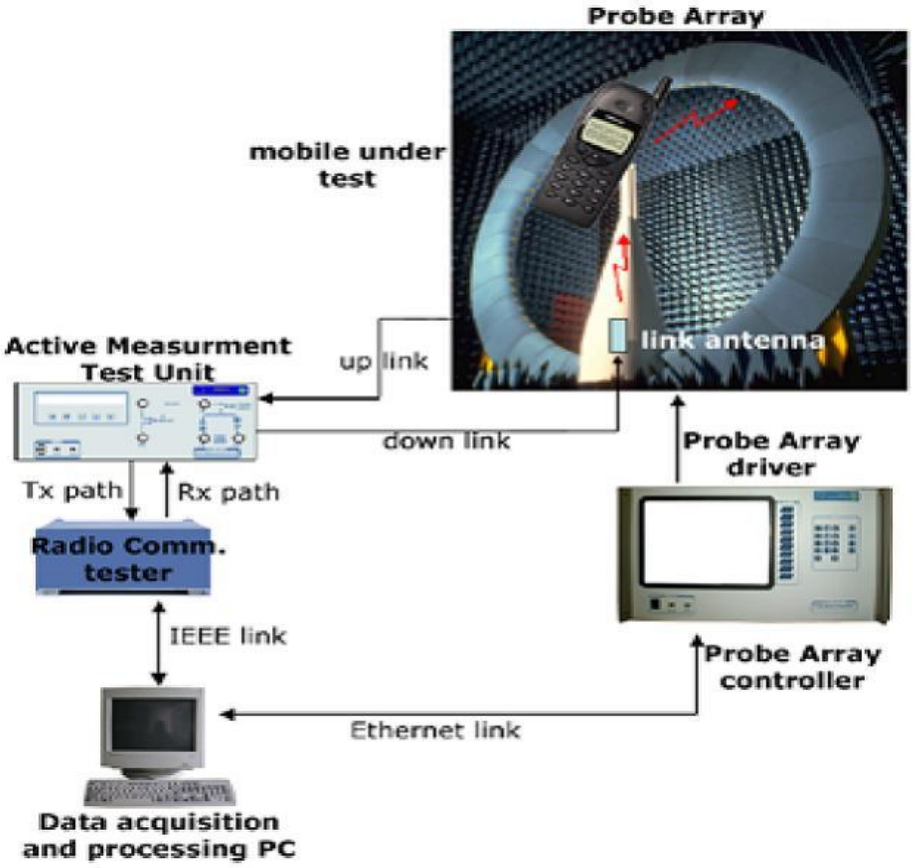
- Antenna efficiency
- Gain
- Pattern shape
- Envelope correlation coefficient

Active Tests

- **TRP**: GSM, WCDMA systems
- **TIS**: GSM, WCDMA systems

Figure 4-1 shows the SATIMO microwave testing chamber.

Figure 4-1 SATIMO microwave testing chamber



5 Electrical and Reliability Features

5.1 About This Chapter

This chapter describes the electrical and reliability features of the interfaces in the MU736 module, including:

- Absolute Ratings
- Operating and Storage Temperatures and Humidity
- Electrical Features of Application Interfaces
- Power Supply Features
- Reliability Features
- EMC and ESD Features

5.2 Absolute Ratings

WARNING

Table 5-1 lists the absolute ratings for the MU736 module. Using the MU736 module beyond these conditions may result in permanent damage to the module.

Table 5-1 Absolute ratings for the MU736 module

Symbol	Specification	Min.	Max.	Unit
3.3 V	External power voltage	–0.3	5.5	V

5.3 Operating and Storage Temperatures and Humidity

Table 5-2 lists the operating and storage temperatures and humidity for the MU736 module.

Table 5-2 operating and storage temperatures and humidity for the MU736 module

Specification	Min.	Max.	Unit
Normal working temperatures[1]	–10	+55	°C
Extended temperatures[2]	–20	+70	°C
Ambient temperature for storage	–40	+85	°C
Moisture	5	95	%

NOTE

[1]: When the MU736 module works at this temperature, all its RF indexes comply with the 3GPP TS 45.005 specifications.

[2]: When the MU736 module works at this temperature, **NOT** all its RF indexes comply with the 3GPP TS 45.005 specifications.

5.4 Electrical Features of Application Interfaces

Table 5-3 Electrical features of Digital Pins

Parameter	Description	Min.	Max.	Unit
BodySAR_N	V_{IH}	1.26	3.6	V
	V_{IL}	–0.2	0.3	V
RESET	V_{IH}	1.26	2.1	V
	V_{IL}	–0.2	0.3	V
Power_On_Off	V_{IH}	1.26	3.6	V
	V_{IL}	–0.2	0.3	V
W_DISABLE	V_{IH}	1.26	3.6	V
	V_{IL}	–0.2	0.3	V
GPS_DISABLE	V_{IH}	1.26	3.6	V
	V_{IL}	–0.2	0.3	V
SIM_DET	V_{IH}	1.26	2.1	V
	V_{IL}	–0.2	0.3	V

Table 5-4 Electrical features of Digital Pins in the I/O supply domain of the USIM Interface

Parameter	Description	Min.	Max.	Note	Unit
V_{IH}	High-level input voltage	0.7 x V_{DDP_USIM}	3.3	V_{DDP_USIM}=1.8 V or 2.9 V	V
V_{IL}	Low-level input voltage	0	0.2 x V_{DDP_USIM}	V_{DDP_USIM}=1.8 V or 2.9 V	V
V_{OH}	High-level output voltage	0.7 x V_{DDP_USIM}	3.3	V_{DDP_USIM}=1.8 V or 2.9 V, I_{OL}=–1.0 mA	V
V_{OL}	Low-level output voltage	0	0.2 x V_{DDP_USIM}	V_{DDP_USIM}=1.8 V or 2.9 V, I_{OL}=+1.0 mA	V
I_{leak}	Input/Output leakage current	-	±0.7	0.2V < V_{IN} < V_{IHmax}	μA

Table 5-5 Electrical features of Digital Pins of the ANT_TUNER Interface

Parameter	Description	Min.	Max.	Note	Unit
V_{OH}	High-level output voltage	1.26	2	-	V
V_{OL}	Low-level output voltage	0	0.15	-	V

5.5 Power Supply Features

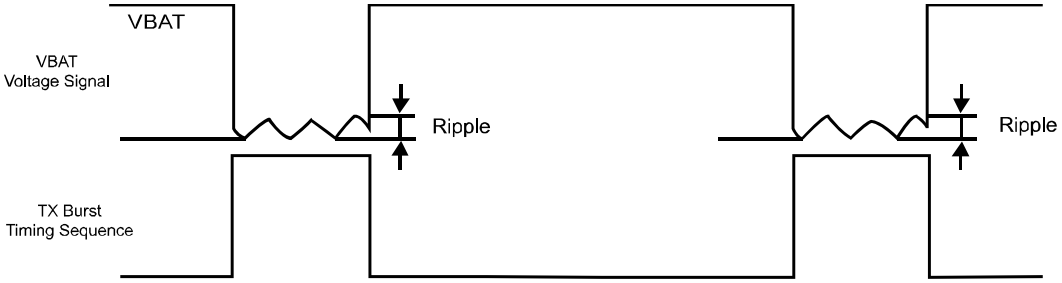
5.5.1 Input Power Supply

Table 5-6 lists the requirements for input power of the MU736 module.

Table 5-6 Requirements for input power for the MU736 module

Parameter	Min.	Typ.	Max.	Ripple	Unit
3.3 V	3.135	3.3	4.4	0.05	V

Figure 5-1 Power Supply During Burst Emission



NOTE
The minimum value of the power supply must be guaranteed during the burst (with 2. 5 A Peak in GPRS or EGPRS mode).

Table 5-7 Requirements for input current of the MU736 module

Power	Peak (Maximum)	Normal (Maximum)
3.3 V	2500 mA	1100 mA

5.5.2 Power Consumption

The power consumption of MU736 in different scenarios are respectively listed in Table 5-8 to Table 5-12 .

The power consumption listed in this section is tested when the power supply of MU736 module is normal voltage (3.3 V), and all of test values are measured at room temperature.

Table 5-8 Averaged power off DC power consumption of MU736

Description	Test Value (uA)	Notes/Configuration
	Typical	
Power off	50	Normal voltage (3.3 V) is ON and Power_On_Off pin is pulled low.

Table 5-9 Averaged standby DC power consumption of MU736 (WCDMA/HSDPA/GSM)

Description		Bands	Test Value (mA)	Notes/Configuration
			Typical	
Sleep	HSPA+/WCDMA (sleep)	UMTS bands	2.3	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in suspend.
	GPRS/EDGE (sleep)	GSM bands	2.3	Module is powered up. MFRMS=5 (1.175s) Module is registered on the network. USB is in suspend.
	Radio Off (sleep)	All bands	1.6	Module is powered up. RF is disabled. USB is in suspend.
Idle	HSPA+/WCDMA (idle)	UMTS bands	30	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network, and no data is transmitted. USB is in active.
	GPRS/EDGE (idle)	GSM bands	30	Module is powered up. MFRMS=5 (1.175s) Module is registered on the network. no data is transmitted. USB is in active.
	Radio Off (idle)	All bands	30	Module is powered up. RF is disabled. USB is in active.

Table 5-10 Averaged Data Transmission DC power consumption of MU736 (WCDMA/HSDPA)

Description	Band	Test Value (mA)	Notes/Configuration
		Typical	
WCDMA	Band I (IMT2100)	190	0 dBm Tx Power
		245	10 dBm Tx Power

Description	Band	Test Value (mA)	Notes/Configuration
		Typical	
		710	23.5 dBm Tx Power
	Band II (PCS 1900)	180	0 dBm Tx Power
		245	10 dBm Tx Power
		790	23.5 dBm Tx Power
	Band IV (AWS)	180	0 dBm Tx Power
		220	10 dBm Tx Power
		690	23.5 dBm Tx Power
	Band V (850 MHz)	180	0 dBm Tx Power
		220	10 dBm Tx Power
		680	23.5 dBm Tx Power
	Band VIII (900 MHz)	180	0 dBm Tx Power
		240	10 dBm Tx Power
		760	23.5 dBm Tx Power
HSDPA	Band I (IMT2100)	195	0 dBm Tx Power
		260	10 dBm Tx Power
		740	23.5 dBm Tx Power
	Band II (PCS 1900)	195	0 dBm Tx Power
		255	10 dBm Tx Power
		790	23.5 dBm Tx Power
	Band IV (AWS)	190	0 dBm Tx Power
		250	10 dBm Tx Power
		690	23.5 dBm Tx Power
	Band V (850 MHz)	195	0 dBm Tx Power
		245	10 dBm Tx Power
		690	23.5 dBm Tx Power
	Band VIII (900 MHz)	195	0 dBm Tx Power
		255	10 dBm Tx Power
		730	23.5 dBm Tx Power

Table 5-11 Averaged DC power consumption of MU736 (GPRS/EDGE)

Description	Test Value (mA)	PCL	Notes/Configuration
	Typical		
GPRS850	265	5	1 Up/1 Down
	385		2 Up/1 Down
	535		4 Up/1 Down
	145	10	1 Up/1 Down
	230		2 Up/1 Down
	380		4 Up/1 Down
GPRS900	270	5	1 Up/1 Down
	390		2 Up/1 Down
	550		4 Up/1 Down
	145	10	1 Up/1 Down
	230		2 Up/1 Down
	395		4 Up/1 Down
GPRS1800	175	0	1 Up/1 Down
	225		2 Up/1 Down
	265		4 Up/1 Down
	80	10	1 Up/1 Down
	105		2 Up/1 Down
	140		4 Up/1 Down
GPRS1900	185	0	1 Up/1 Down
	240		2 Up/1 Down
	280		4 Up/1 Down
	80	10	1 Up/1 Down
	105		2 Up/1 Down
	145		4 Up/1 Down
EDGE850	185	8	1 Up/1 Down
	280		2 Up/1 Down
	430		4 Up/1 Down
	100	15	1 Up/1 Down
	145		2 Up/1 Down

Description	Test Value (mA)	PCL	Notes/Configuration
	Typical		
	220		4 Up/1 Down
EDGE900	190	8	1 Up/1 Down
	295		2 Up/1 Down
	455		4 Up/1 Down
	100	15	1 Up/1 Down
	150		2 Up/1 Down
	230		4 Up/1 Down
EDGE1800	150	2	1 Up/1 Down
	240		2 Up/1 Down
	360		4 Up/1 Down
	100	10	1 Up/1 Down
	150		2 Up/1 Down
	230		4 Up/1 Down
EDGE1900	150	2	1 Up/1 Down
	230		2 Up/1 Down
	360		4 Up/1 Down
	100	10	1 Up/1 Down
	150		2 Up/1 Down
	230		4 Up/1 Down

NOTE

All power consumption test configuration can be referenced by GSM Association Official Document TS.09: Battery Life Measurement and Current Consumption Technique.

- Test condition: For Max Tx power ,see 4.4.2 Conducted Transmit Power, they are listed in Table 4-4 ; for Max data throughput, see 2.2 Function Overview, they are listed in Table 2-1 Features.

Table 5-12 Averaged GPS operation DC power consumption of MU736

Description	Test Value (mA)	Notes/Configuration
	Typical	
GPS fixing	100	RF is disabled;

Description	Test Value (mA)	Notes/Configuration
	Typical	
GPS tracking	100	USB is in active; The Rx power of GPS is –130 dBm.

5.6 Reliability Features

Table 5-13 lists the test conditions and results of the reliability of the MU736 module.

Table 5-13 Test conditions and results of the reliability of the MU736 module

Item		Test Condition	Standard	Sample size	Results
Stress	Low-temperature storage	Temperature: –40ºC Operation mode: no power, no package Test duration: 24 h	JESD22-A119-C	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	High-temperature storage	Temperature: 85ºC Operation mode: no power, no package Test duration: 24 h	JESD22-A103-C	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	Low-temperature operating	Temperature: –20ºC Operation mode: working with service connected Test duration: 24 h	IEC60068-2-1	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	High-temperature operating	Temperature: 70ºC Operation mode: working with service connected Test duration: 24 h	JESD22-A108-C	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	Damp heat cycling	High temperature: 55ºC Low temperature: 25ºC Humidity: 95%±3% Operation mode: working with service connected Test duration: 6 cycles; 12 h+12 h/cycle	JESD22-A101-B	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok

Item		Test Condition	Standard	Sample size	Results
	Thermal shock	Low temperature: –40º High temperature: 85ºC Temperature change interval: < 20s Operation mode: working with service connected Test duration: 100 cycles; 15 min+15 min/cycle	JESD22-A106-B	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
Stress	Salty fog test	Temperature: 35°C Density of the NaCl solution: 5%±1% Operation mode: no power, no package Test duration: Spraying period: 8 h Exposing period after removing the salty fog environment: 16 h	JESD22-A107-B	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	Sine vibration	Frequency range: 5 Hz to 200 Hz Acceleration: 1 Grms Frequency scan rate: 0.5 oct/min Operation mode: working with service connected Test duration: 3 axial directions. 2 h for each axial direction. Operation mode: working with service connected	JESD22-B103-B	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok

Item		Test Condition	Standard	Sample size	Results
	Shock test	Half-sine wave shock Peak acceleration: 30 Grms Shock duration: 11 ms Operation mode: working with service connected Test duration: 6 axial directions. 3 shocks for each axial direction. Operation mode: working with service connected	JESD-B104-C	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
Stress	Drop test	0.8 m in height. Drop the module on the marble terrace with one surface facing downwards, six surfaces should be tested. Operation mode: no power, no package	IEC60068-2-32	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
Life	High temperature operating life	Temperature: 70ºC Operation mode: working with service connected Test duration: 168 h, 336 h, 500 h, 1000 h for inspection point	JESD22-A108-B	50 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	High temperature & high humidity	High temperature: 85ºC Humidity: 85% Operation mode: powered on and no working Test duration: 168 h, 336 h, 500 h, 1000 h for inspection point	JESD22-A110-B	50 pcs/group	Visual inspection: ok Function test: ok RF specification: ok Cross section: ok

Item		Test Condition	Standard	Sample size	Results
	Temperature cycle	High temperature: 85ºC Low temperature: –40ºC Temperature change slope: 6ºC/min Operation mode: no power Test duration: 168 h, 336 h, 500 h, 1000 h for inspection point	JESD22-A104-C	50 pcs/group	Visual inspection: ok Function test: ok RF specification: ok Cross section: ok
ESD	HBM (Human Body Model)	1 kV (Class 1 B) Operation mode: no power	JESD22-A114-D	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	ESD with DVK (or embedded in the host)	Contact Voltage: ±2 kV, ±4 kV Air Voltage: ±2 kV, ±4 kV, ±8 kV Operation mode: working with service connected	IEC61000-4-2	2 pcs	Visual inspection: ok Function test: ok RF specification: ok
NOTE Groups ≥ 2					

5.7 EMC and ESD Features

The following are the EMC design comments:

- Attention should be paid to static control in the manufacture, assembly, packaging, handling, and storage process to reduce electrostatic damage to HUAWEI module.
- RSE (Radiated Spurious Emission) may exceed the limit defined by EN301489 if the antenna port is protected by TVS (Transient Voltage Suppressor), which is resolved by making some adjustments on RF match circuit.
- TVS should be added on the USB port for ESD protection, and the parasitic capacitance of TVS on D+/D- signal should be less than 2 pF. Common-mode inductor should be added in parallel on D+/D- signal.
- TVS should be added on the SIM interface for ESD protection. The parasitic capacitance of TVS on SIM signal should be less than 10 pF.
- Resistors in parallel and a 10 nF capacitor should be added on RESET# and Power_On_Off signal to avoid shaking, and the distance between the capacitor and the related pin should be less than 100 mil.

- PCB routing should be V-type rather than T-type for TVS.
- An integrated ground plane is necessary for EMC design.

The following are the requirements of ESD environment control:

- The electrostatic discharge protected area (EPA) must have an ESD floor whose surface resistance and system resistance are greater than 1×10^4 Ω while less than 1×10^9 Ω.
- The EPA must have a sound ground system without loose ground wires, and the ground resistance must be less than 4 Ω.
- The workbench for handling ESD sensitive components must be equipped with common ground points, the wrist strap jack, and ESD pad. The resistance between the jack and common ground point must be less than 4 Ω. The surface resistance and system resistance of the ESD pad must be less than 1×10^9 Ω.
- The EPA must use the ESD two-circuit wrist strap, and the wrist strap must be connected to the dedicated jack. The crocodile clip must not be connected to the ground.
- The ESD sensitive components, the processing equipment, test equipment, tools, and devices must be connected to the ground properly. The indexes are as follows:
  - Hard ground resistance < 4 Ω
  - 1×10^5 Ω ≤ Soft ground resistance < 1×10^9 Ω
  - 1×10^5 Ω ≤ ICT fixture soft ground resistance < 1×10^{11} Ω
  - The electronic screwdriver and electronic soldering iron can be easily oxidized. Their ground resistance must be less than 20 Ω.
- The parts of the equipment, devices, and tools that touch the ESD sensitive components and moving parts that are close to the ESD sensitive components must be made of ESD materials and have sound ground connection. The parts that are not made of ESD materials must be handled with ESD treatment, such as painting the ESD coating or ionization treatment (check that the friction voltage is less than 100 V).
- Key parts in the production equipment (parts that touch the ESD sensitive components or parts that are within 30 cm away from the ESD sensitive components), including the conveyor belt, conveyor chain, guide wheel, and SMT nozzle, must all be made of ESD materials and be connected to the ground properly (check that the friction voltage is less than 100 V).
- Engineers that touch IC chips, boards, modules, and other ESD sensitive components and assemblies must wear ESD wrist straps, ESD gloves, or ESD finger cots properly. Engineers that sit when handling the components must all wear ESD wrist straps.
- Noticeable ESD warning signs must be attached to the packages and placement areas of ESD sensitive components and assemblies.
- Boards and IC chips must not be stacked randomly or be placed with other ESD components.
- Effective shielding measures must be taken on the ESD sensitive materials that are transported or stored outside the EPA.

NOTE
The HUAWEI MU736 module does not include any protection against overvoltage.

6 Mechanical Specifications

6.1 About This Chapter

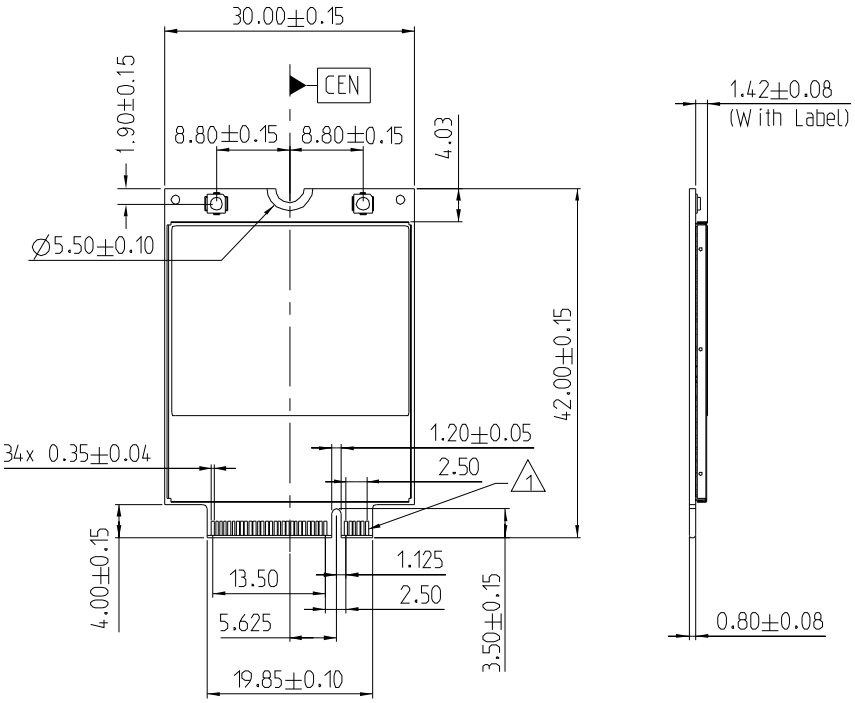
This chapter describes the following aspects of the MU736 module:

- Dimensions of MU736
- Label
- Packing System

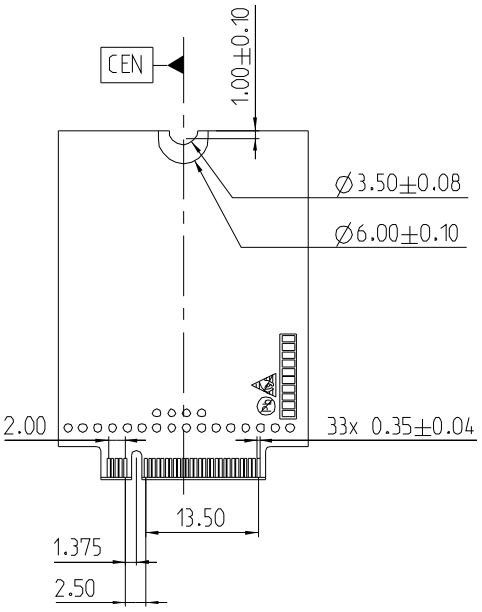
6.2 Dimensions of MU736

Figure 6-1 shows the dimensions of MU736 in details.

Figure 6-1 Dimensions of MU736



TOP VIEW



BOTTOM VIEW

6.3 Label

There are two labels on the MU736.

Figure 6-2 Dimensions of label (front label)

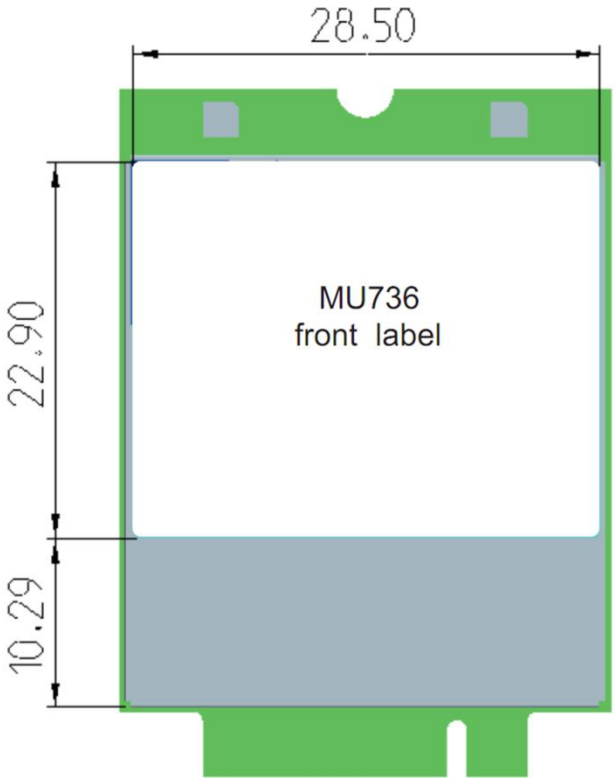
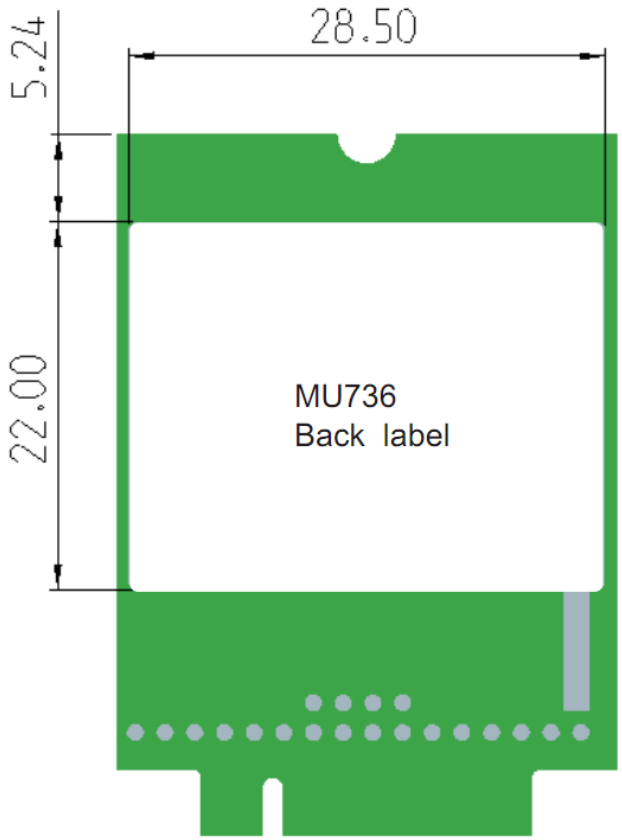


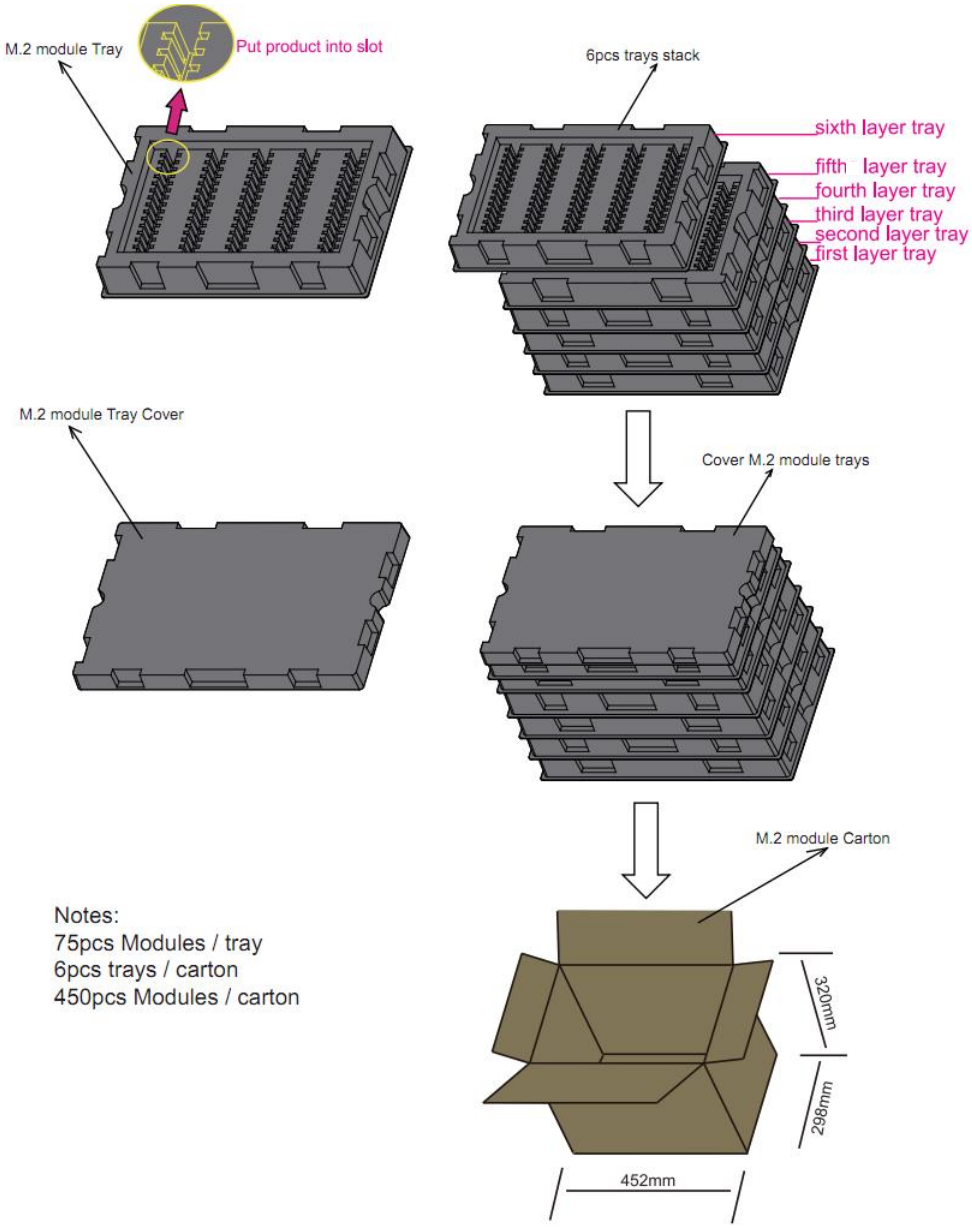
Figure 6-3 Dimensions of label (back label)



6.4 Packing System

HUAWEI M.2 module uses five layers ESD pallet, anti-vibration foam and vacuum packing into cartons.

Figure 6-4 Packet system



7 Installation

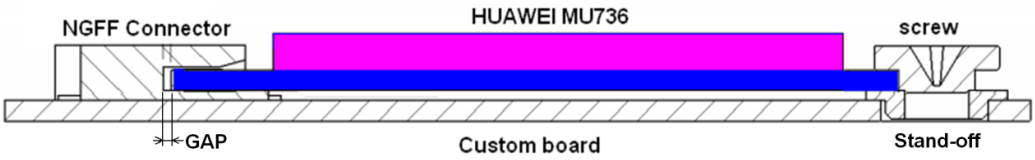
7.1 About This Chapter

This chapter describes the assembly of MU736, including:

- Connect MU736 to Board
- Antenna Plug

7.2 Connect MU736 to Board

Figure 7-1 Install MU736



It refers to M.2 specification.

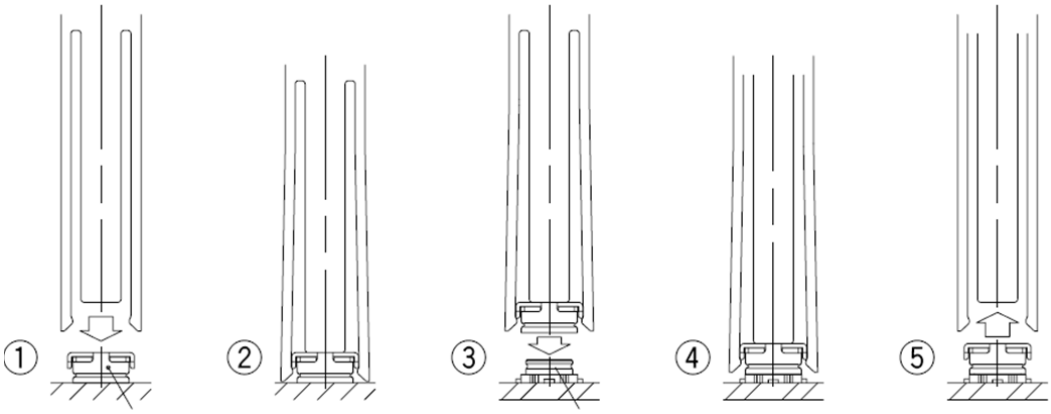
The module will need a mechanical retention at the end of the board. The module specifies a 5.5 mm Dia. keep out zone at the end for attaching a screw.

The module Stand-off and mounting screw also serve as part of the module Electrical Ground path. The Stand-off should be connected directly to the ground plane on the platform. So that when the module is mounted and the mounting screw is screwed on to hold the module in place, this will make the electrical ground connection from the module to the platform ground plane.

The stand-off must provide a Thermal Ground Path. The design requirements for thermal are a material with a minimum conductivity of 50 watts per meter Kelvin and surface area of 22 Sq mm.

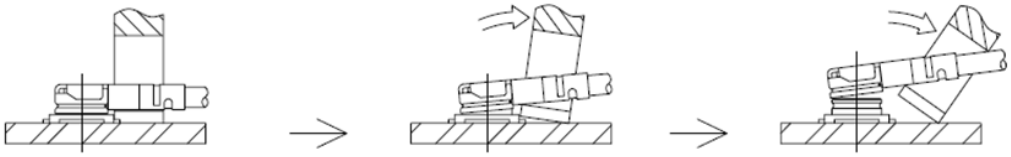
7.3 Antenna Plug

Figure 7-2 Mating the plug



1. Align the mating tool or the mating end of the tool over the plug end of the cable assembly.
2. Firmly place the tool over the plug until it is secured in the tool.
3. Place the plug cable assembly (held in the tool) over the corresponding receptacle.
4. Assure that the plug and receptacle are aligned press-down perpendicular to the mounting surface until both connectors are fully mated.
5. Remove the mating tool by pulling it up carefully.

Figure 7-3 Unmating the plug

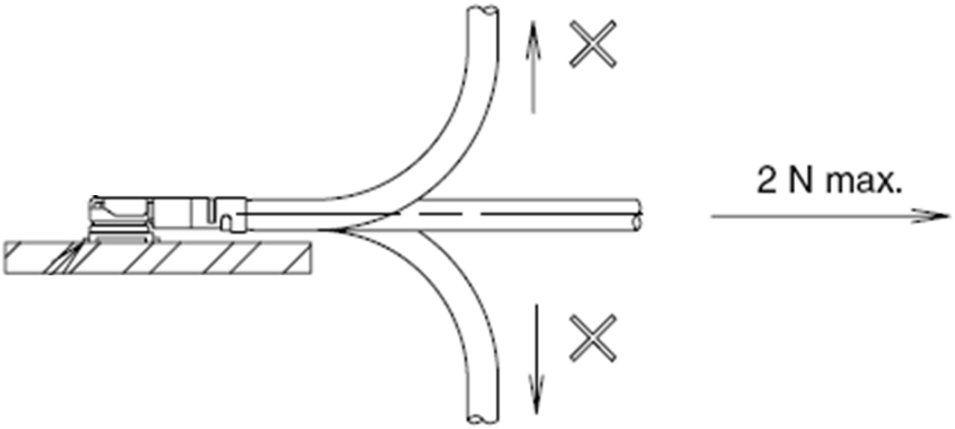


NOTE

- The extraction tool is recommended.
- Any attempt of unmating by pulling on the cable may result in damage and influence the mechanical / electrical performance.

It is recommended that not to apply any pull forces after the bending of the cable, as described in Figure 7-4 .

Figure 7-4 Do not apply any pull forces after the bending of the cable



8 Certifications

8.1 About This Chapter

This chapter gives a general description of certifications of MU736.

8.2 Certifications

NOTE
The certification of MU736 is testing now. Table 8-1 shows certifications the MU736 will be implemented. For more demands, please contact us for more details about this information.

Table 8-1 Product Certifications

Certification	Model name
	MU736
CE	√
FCC	√
CCC	√
NCC	√
A-TICK	√
Jate & Telec	√
IC	√
EU RoHS	√
JGPSSI	-
SGS RoHS	-

Certification	Model name
	MU736
PVC-Free	-
GCF	√
PTCRB	√
Halogen-free	√

9 Safety Information

Read the safety information carefully to ensure the correct and safe use of your wireless device. Applicable safety information must be observed.

9.1 Interference

Power off your wireless device if using the device is prohibited. Do not use the wireless device when it causes danger or interference with electric devices.

9.2 Medical Device

- Power off your wireless device and follow the rules and regulations set forth by the hospitals and health care facilities.
- Some wireless devices may affect the performance of the hearing aids. For any such problems, consult your service provider.
- Pacemaker manufacturers recommend that a minimum distance of 15 cm be maintained between the wireless device and a pacemaker to prevent potential interference with the pacemaker. If you are using an electronic medical device, consult the doctor or device manufacturer to confirm whether the radio wave affects the operation of this device.

9.3 Area with Inflammables and Explosives

To prevent explosions and fires in areas that are stored with inflammable and explosive devices, power off your wireless device and observe the rules. Areas stored with inflammables and explosives include but are not limited to the following:

- Gas station
- Fuel depot (such as the bunk below the deck of a ship)
- Container/Vehicle for storing or transporting fuels or chemical products
- Area where the air contains chemical substances and particles (such as granule, dust, or metal powder)
- Area indicated with the "Explosives" sign

- Area indicated with the "Power off bi-direction wireless equipment" sign
- Area where you are generally suggested to stop the engine of a vehicle

9.4 Traffic Security

- Observe local laws and regulations while using the wireless device. To prevent accidents, do not use your wireless device while driving.
- RF signals may affect electronic systems of motor vehicles. For more information, consult the vehicle manufacturer.
- In a motor vehicle, do not place the wireless device over the air bag or in the air bag deployment area. Otherwise, the wireless device may hurt you owing to the strong force when the air bag inflates.

9.5 Airline Security

Observe the rules and regulations of airline companies. When boarding or approaching a plane, power off your wireless device. Otherwise, the radio signal of the wireless device may interfere with the plane control signals.

9.6 Safety of Children

Do not allow children to use the wireless device without guidance. Small and sharp components of the wireless device may cause danger to children or cause suffocation if children swallow the components.

9.7 Environment Protection

Observe the local regulations regarding the disposal of your packaging materials, used wireless device and accessories, and promote their recycling.

9.8 WEEE Approval

The wireless device is in compliance with the essential requirements and other relevant provisions of the Waste Electrical and Electronic Equipment Directive 2012/19/EU (WEEE Directive).

9.9 RoHS Approval

The wireless device is in compliance with the restriction of the use of certain hazardous substances in electrical and electronic equipment Directive 2011/65/EU (RoHS Directive).

9.10 Laws and Regulations Observance

Observe laws and regulations when using your wireless device. Respect the privacy and legal rights of the others.

9.11 Care and Maintenance

It is normal that your wireless device gets hot when you use or charge it. Before you clean or maintain the wireless device, stop all applications and power off the wireless device.

- Use your wireless device and accessories with care and in clean environment. Keep the wireless device from a fire or a lit cigarette.
- Protect your wireless device and accessories from water and vapour and keep them dry.
- Do not drop, throw or bend your wireless device.
- Clean your wireless device with a piece of damp and soft antistatic cloth. Do not use any chemical agents (such as alcohol and benzene), chemical detergent, or powder to clean it.
- Do not leave your wireless device and accessories in a place with a considerably low or high temperature.
- Use only accessories of the wireless device approved by the manufacture. Contact the authorized service center for any abnormity of the wireless device or accessories.
- Do not dismantle the wireless device or accessories. Otherwise, the wireless device and accessories are not covered by the warranty.
- The device should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

9.12 Emergency Call

This wireless device functions through receiving and transmitting radio signals. Therefore, the connection cannot be guaranteed in all conditions. In an emergency, you should not rely solely on the wireless device for essential communications.

9.13 Regulatory Information

The following approvals and notices apply in specific regions as noted.

9.13.1 CE Approval (European Union)

The wireless device is approved to be used in the member states of the EU. The wireless device is in compliance with the essential requirements and other relevant provisions of the Radio and Telecommunications Terminal Equipment Directive 1999/5/EC (R&TTE Directive).

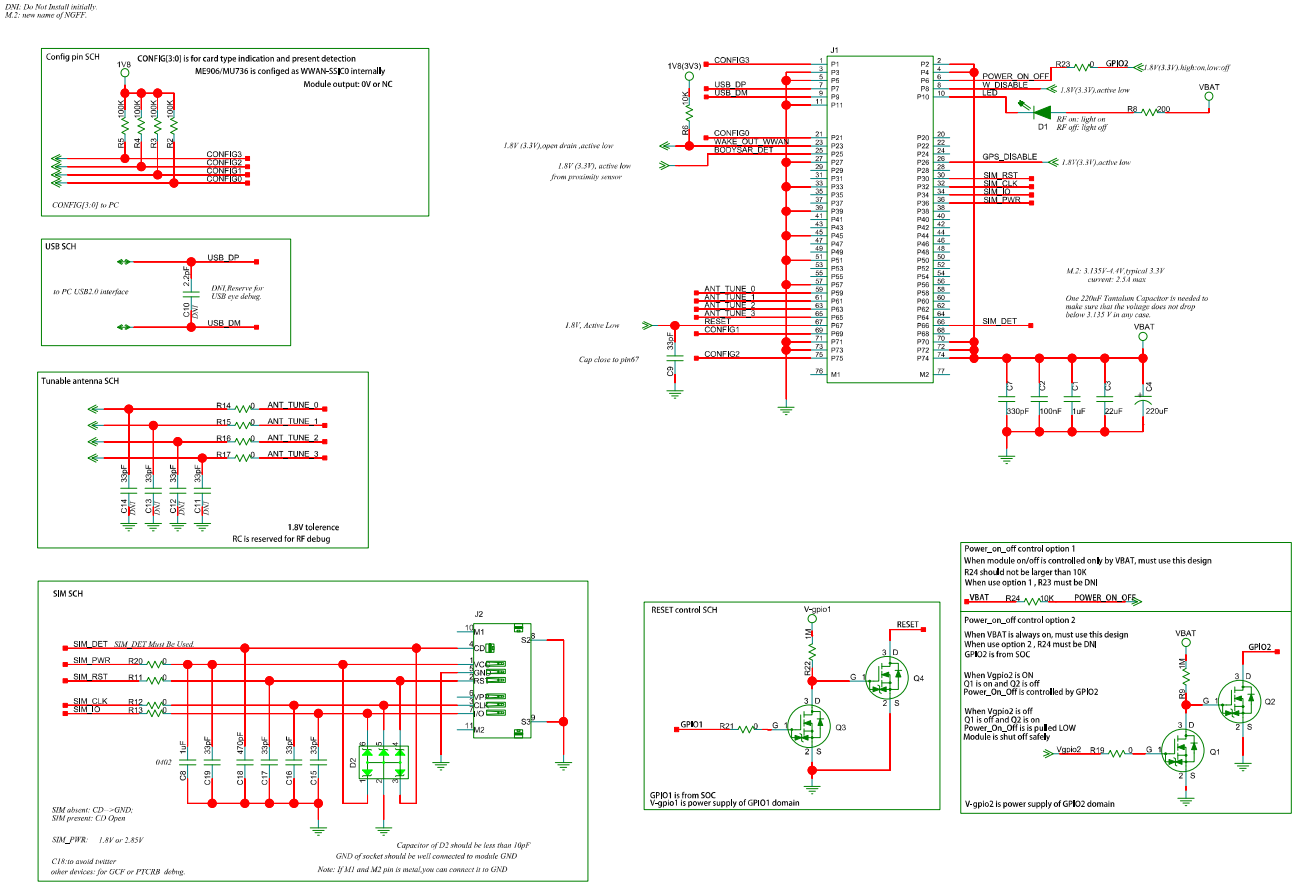
9.13.2 FCC Statement

Federal Communications Commission Notice (United States): Before a wireless device model is available for sale to the public, it must be tested and certified to the FCC that it does not exceed the limit established by the government-adopted requirement for safe exposure.

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.

Warning: Changes or modifications made to this equipment not expressly approved by HUAWEI may void the FCC authorization to operate this equipment.

10 Appendix A Circuit of Typical Interface



11 Appendix B Acronyms and Abbreviations

Acronym or Abbreviation	Expansion
AP	Application Process
CCC	China Compulsory Certification
CE	European Conformity
CS	Coding Scheme
CSD	Circuit Switched Data
DC	Direct Current
DMA	Direct Memory Access
DVK	Development Kit
EBU	External Bus Unit
EIA	Electronic Industries Association
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
EU	European Union
FCC	Federal Communications Commission
GMSK	Gaussian Minimum Shift Keying
GPIO	General-purpose I/O
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
HBM	Human Body Model
HSIC	High Speed Inter-Chip Interface

Acronym or Abbreviation	Expansion
HSDPA	High-Speed Downlink Packet Access
HSPA+	Enhanced High Speed Packet Access
HSUPA	High Speed Up-link Packet Access
ISO	International Standards Organization
LCP	Liquid Crystal Polyester
LDO	Low-Dropout
LED	Light-Emitting Diode
M.2	New Name for NGFF
MCP	Multi-chip Package
NGFF	Next Generation Form Factor
NTC	Negative Temperature Coefficient
PA	Power Amplifier
PBCCH	Packet Broadcast Control Channel
PCB	Printed Circuit Board
PDU	Protocol Data Unit
PMU	Power Management Unit
RF	Radio Frequency
RoHS	Restriction of the Use of Certain Hazardous Substances
TVS	Transient Voltage Suppressor
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
USIM	Universal Subscriber Identity Module
VSWR	Voltage Standing Wave Ratio
WCDMA	Wideband Code Division Multiple Access