



Draft

HUAWEI MU709s-2 HSPA+ Mini PCIe Module

## Hardware Guide

Issue 0.1

Date 2014-06-03

**Copyright © Huawei Technologies Co., Ltd. 2014. All rights reserved.**

No part of this manual may be reproduced or transmitted in any form or by any means without prior written consent of Huawei Technologies Co., Ltd. and its affiliates ("Huawei").

The product described in this manual may include copyrighted software of Huawei and possible licensors. Customers shall not in any manner reproduce, distribute, modify, decompile, disassemble, decrypt, extract, reverse engineer, lease, assign, or sublicense the said software, unless such restrictions are prohibited by applicable laws or such actions are approved by respective copyright holders.

## **Trademarks and Permissions**



HUAWEI, HUAWEI, and



are trademarks or registered trademarks of Huawei Technologies Co., Ltd.

Other trademarks, product, service and company names mentioned may be 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 therefore 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 which you purchase.

Huawei reserves the right to change or modify any information or specifications contained in this manual without prior notice and without any liability.

## **DISCLAIMER**

ALL 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 EVENT SHALL HUAWEI BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, OR LOSS OF PROFITS, BUSINESS, REVENUE, DATA, GOODWILL SAVINGS OR ANTICIPATED SAVINGS REGARDLESS OF WHETHER SUCH LOSSES ARE FORSEEABLE OR NOT.

THE MAXIMUM LIABILITY (THIS LIMITATION SHALL NOT APPLY TO LIABILITY FOR PERSONAL INJURY TO THE EXTENT APPLICABLE LAW PROHIBITS SUCH A LIMITATION) OF HUAWEI ARISING FROM THE USE OF THE PRODUCT DESCRIBED IN THIS MANUAL SHALL BE LIMITED TO THE AMOUNT PAID BY CUSTOMERS FOR THE PURCHASE OF THIS PRODUCT.

## **Import and Export Regulations**

Customers shall comply with all applicable export or import laws and regulations and be responsible to 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.

## **Privacy Policy**

To better understand how we protect your personal information, please see the privacy policy at <http://consumer.huawei.com/privacy-policy>



---

## About This Document

---

### Revision History

Document Version	Date	Chapter	Descriptions
0.1	2014-06-03		This is a draft version, and some chapters are still with "TBD".

Draft



# Contents

<b>1 Introduction</b>	<b>7</b>
<b>2 Overall Description</b>	<b>8</b>
2.1 About This Chapter	8
2.2 Function Overview	8
2.3 Circuit Block Diagram	9
<b>3 Description of the Application Interfaces</b>	<b>10</b>
3.1 About This Chapter	10
3.2 Mini PCIe Interface	10
3.3 Power Sources and Grounds	14
3.4 Power Supply Time Sequence	15
3.5 WAKE# Signal	16
3.6 RESIN_N Signal	17
3.7 W_DISABLE# Signal	18
3.8 LED_WWAN# Signal	18
3.9 USB Interface	19
3.10 USIM Card Interface	20
3.10.1 Overview	20
3.10.2 Circuit Recommended for the USIM Card Interface	20
3.11 Audio Interface	21
3.12 UART Interface	23
3.13 RF Antenna Connector	23
3.14 NC Pins	24
<b>4 RF Specifications</b>	<b>25</b>
4.1 About This Chapter	25
4.2 Operating Frequencies	25
4.3 Conducted RF Measurement	26
4.3.1 Test Environment	26
4.3.2 Test Standards	26
4.4 Conducted Rx Sensitivity and Tx Power	26
4.4.1 Conducted Receive Sensitivity	26
4.4.2 Conducted Transmit Power	27
4.5 Antenna Design Requirements	27



4.5.1 Antenna Design Indicators.....	27
4.5.2 Interference .....	30
4.5.3 GSM/WCDMA Antenna Requirements.....	30
<b>5 Electrical and Reliability Features .....</b>	<b>31</b>
5.1 About This Chapter.....	31
5.2 Absolute Ratings .....	31
5.3 Operating and Storage Temperatures .....	32
5.4 Electrical Features of USIM .....	32
5.5 Power Supply Features .....	32
5.5.1 Input Power Supply .....	32
5.5.2 Power Consumption .....	33
5.6 Reliability Features.....	37
5.7 EMC and ESD Features.....	40
<b>6 Mechanical Specifications.....</b>	<b>43</b>
6.1 About This Chapter.....	43
6.2 Dimensions and Interfaces.....	43
6.3 Dimensions of the Mini PCI Express Connector .....	44
6.4 Specification Selection for Fasteners .....	45
6.4.1 Installing the Mini PCIe Adapter on the Main Board.....	45
6.4.2 Removing the Mini PCIe Adapter from the Main Board .....	47
6.5 Label.....	48
<b>7 Certifications.....</b>	<b>49</b>
7.1 About This Chapter.....	49
7.2 Certifications.....	49
<b>8 Safety Information.....</b>	<b>50</b>
8.1 Interference .....	50
8.2 Medical Device .....	50
8.3 Area with Inflammables and Explosives.....	50
8.4 Traffic Security.....	51
8.5 Airline Security.....	51
8.6 Safety of Children.....	51
8.7 Environment Protection .....	51
8.8 WEEE Approval.....	51
8.9 RoHS Approval.....	51
8.10 Laws and Regulations Observance .....	52
8.11 Care and Maintenance .....	52
8.12 Emergency Call.....	52
8.13 Regulatory Information.....	52
8.13.1 CE Approval (European Union) .....	52
8.13.2 FCC Statement.....	53



---

9 Appendix A Circuit of Typical Interface.....	54
10 Appendix B Acronyms and Abbreviations.....	55

Draft



# 1 Introduction

---

This document describes the hardware application interfaces and air interfaces provided by MU709s-2 Mini PCIe Module (hereinafter referred to as the MU709s-2 module).

This document helps hardware engineer to understand the interface specifications, electrical features and related product information of the MU709s-2 module.

Draft

# 2 Overall Description

## 2.1 About This Chapter

This chapter gives a general description of the MU709s-2 module and provides:

- Function Overview
- Circuit Block Diagram

## 2.2 Function Overview

**Table 2-1** Features

Feature	Description
Physical Dimensions	Dimensions (L x W x H): 51 mm x 30.4 mm x 3.3 mm Weight: about 12 g
Operating Temperature	-40°C to +70°C
Storage Temperature	-40°C to +85°C
Power Voltage	DC 3.0 V–3.6 V (typical value is 3.3 V)
Application Interface (52-pin Mini PCIe interface)	One standard USIM card (Class B and Class C)
	Audio interface: PCM interface
	USB 2.0 (High Speed)
	UART(2-wire, up to 920kbps)
	RESIN_N: Reset module
	WAKE#: Wake up signal
	W_DISABLE# Signal (the software version is planning)

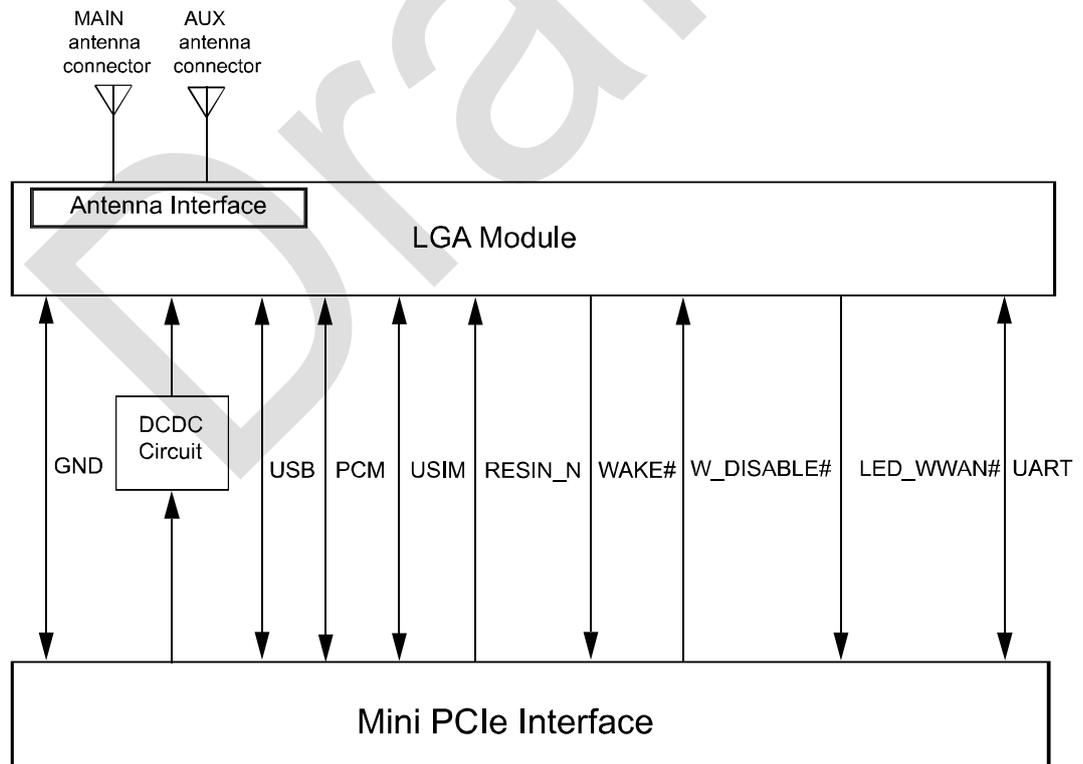
Feature	Description
	LED_WWAN#: Active-low LED signal indicating the state of the module
Antenna connector	WWAN MAIN antenna connector x1 WWAN AUX antenna connector x1

## 2.3 Circuit Block Diagram

Figure 2-1 shows the circuit block diagram of the MU709s-2 Mini PCIe Adapter. The major functional unit of the Mini PCIe Adapter contains the following parts:

- DCDC Circuit
- LGA Module
- Control signals
- Antenna Connectors

**Figure 2-1** Circuit block diagram of the MU709s-2 module



# 3 Description of the Application Interfaces

---

## 3.1 About This Chapter

This chapter mainly describes the external application interfaces of the MU709s-2 module, including:

- Mini PCIe Interface
- Power Sources and Grounds
- Power Supply Time Sequence
- WAKE# Signal
- RESIN\_N Signal
- W\_DISABLE# Signal
- LED\_WWAN# Signal
- USB Interface
- USIM Card Interface
- Audio Interface
- UART Interface
- RF Antenna Connector
- NC Pins

## 3.2 Mini PCIe Interface

The MU709s-2 module uses a Mini PCIe interface as its external interface. For details about the module and dimensions, see "Dimensions and Interfaces".

Figure 3-1 shows the sequence of pins on the interface of the Mini PCIe Adapter.

**Figure 3-1** Sequence of Mini PCIe interface

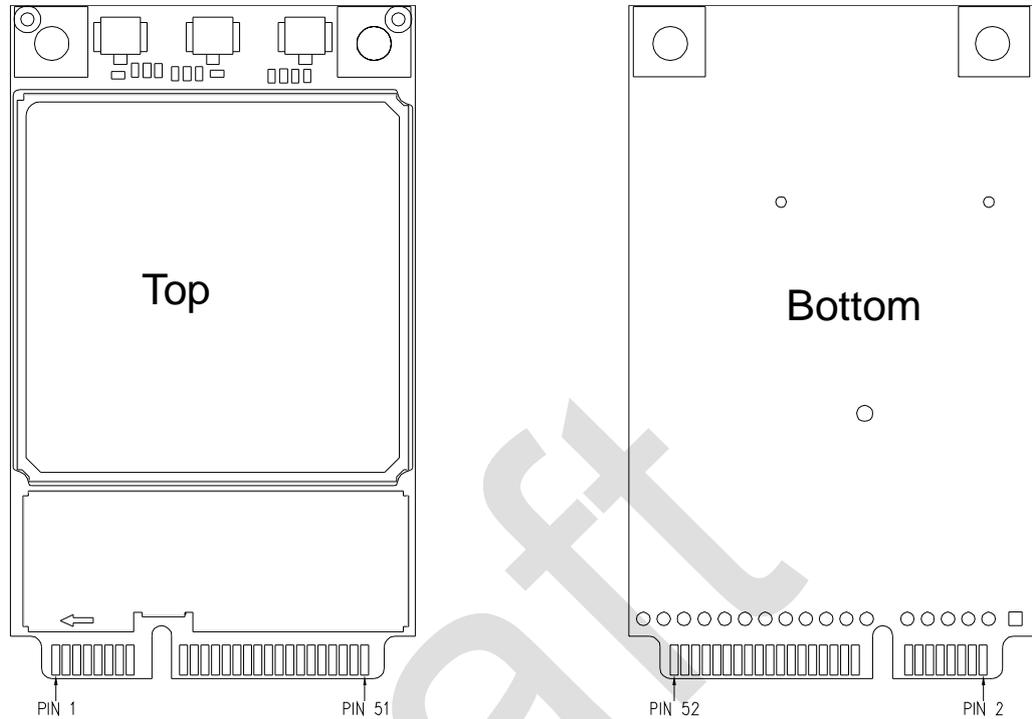


Table 3-1 shows the pin definitions of the Mini PCIe Interface.

**Table 3-1** Pin definitions of the Mini PCIe Interface

PIN No.	Pin Name		Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)
	Mini PCI Express Standard Description	HUAWEI Pin Description						
1	WAKE#	WAKE#	O	Open collector active low signal. This signal is used to wake up the host.	$V_{OL}$	-0.3		0.45
2	3.3Vaux	VCC_3V3	P	3.3 V DC supply input.		3.0	3.3	3.6
3	COEX1	NC	-	Not connected		-	-	-
4	GND	GND	-	Ground		-	-	-
5	COEX2	NC	-	Not connected		-	-	-
6	1.5 V	NC	-	Not connected		-	-	-



PIN No.	Pin Name		Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)
	Mini PCI Express Standard Description	HUAWEI Pin Description						
7	CLKREQ#	NC	-	Not connected		-	-	-
8	UIM_PWR	UIM_PWR	PO	Power source for the external USIM card	Class C	-0.3	1.8	1.98
					Class B	-0.3	2.85	3.3
9	GND	GND	-	Ground		-	-	-
10	UIM_DATA	UIM_DATA	I/O	External USIM data signal		-	1.8/2.85	-
11	REFCLK-	NC	-	Not connected		-	-	-
12	UIM_CLK	UIM_CLK	O	External USIM clock signal		-	1.8/2.85	-
13	REFCLK+	NC	-	Not connected		-	-	-
14	UIM_RESET	UIM_RESET	O	External USIM reset signal		-	1.8/2.85	-
15	GND	GND	-	Ground		-	-	-
16	UIM_Vpp	NC	-	Not connected		-	-	-
17	Reserved	UART_RX	I	UART receive	V <sub>IH</sub>	1.17	1.8	2.1
					V <sub>IL</sub>	-0.3	0	0.63
18	GND	GND	-	Ground		-	-	-
19	Reserved	UART_TX	O	UART transmit	V <sub>OH</sub>	1.35	1.8	2.1
					V <sub>OL</sub>	-0.3	0	0.45
20	W_DISABLE#	W_DISABLE#	I	The W_DISABLE# signal is an active low signal that when asserted (driven low) by the system shall disable radio operation. The software version is planning.	V <sub>IL</sub>	-0.3	0	0.3
					V <sub>IH</sub>	1.17	1.8	2.1
21	GND	GND	-	Ground		-	-	-
22	PERST#	RESIN_N	I	Reset module	V <sub>IH</sub>	-0.3	0	0.3



PIN No.	Pin Name		Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)
	Mini PCI Express Standard Description	HUAWEI Pin Description						
				Active-low	$V_{IL}$	1.17	3.6	3.6
23	PERn0	NC	-	Not connected		-	-	-
24	3.3Vaux	VCC_3V3	P	3.3 V DC supply input.		3.0	3.3	3.6
25	PERp0	NC	-	Not connected		-	-	-
26	GND	GND	-	Ground		-	-	-
27	GND	GND	-	Ground		-	-	-
28	1.5 V	NC	-	Not connected		-	-	-
29	GND	GND	-	Ground		-	-	-
30	SMB_CLK	NC	-	Not connected		-	-	-
31	PETn0	NC	-	Not connected		-	-	-
32	SMB_DATA	NC	-	Not connected		-	-	-
33	PETp0	NC	-	Not connected		-	-	-
34	GND	GND	-	Ground		-	-	-
35	GND	GND	-	Ground		-	-	-
36	USB_D-	USB_DM	I/O	USB signal D-		-	-	-
37	GND	GND	-	Ground		-	-	-
38	USB_D+	USB_DP	I/O	USB signal D+		-	-	-
39	3.3Vaux	VCC_3V3	P	3.3 V DC supply input.		3.0	3.3	3.6
40	GND	GND	-	Ground		-	-	-
41	3.3Vaux	VCC_3V3	P	3.3 V DC supply input.		3.0	3.3	3.6
42	LED_WWAN#	LED_WWAN#	O	Active-low LED signal indicating the state of the card.	$V_{OL}$	-0.3		0.45
43	GND	GND	-	Ground		-	-	-
44	LED_WLAN#	NC	-	Not connected		-	-	-
45	Reserved	PCM_CLK	O	PCM interface	$V_{OH}$	1.35	1.8	2.1

PIN No.	Pin Name		Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)
	Mini PCI Express Standard Description	HUAWEI Pin Description						
				clock	V <sub>OL</sub>	-0.3	0	0.45
46	LED_WPAN #	NC	-	Not connected		-	-	-
47	Reserved	PCM_DOUT	O	PCM I/F data output	V <sub>OH</sub>	1.35	1.8	2.1
					V <sub>OL</sub>	-0.3	0	0.45
48	1.5 V	NC	-	Not connected		-	-	-
49	Reserved	PCM_DIN	I	PCM I/F data input	V <sub>IH</sub>	1.17	1.8	2.1
					V <sub>IL</sub>	-0.3	0	0.63
50	GND	GND	-	Ground		-	-	-
51	Reserved	PCM_SYNC	O	PCM interface sync	V <sub>OH</sub>	1.35	1.8	2.1
					V <sub>OL</sub>	-0.3	0	0.45
52	3.3Vaux	VCC_3V3	P	3.3 V DC supply input.		3.0	3.3	3.6

 **NOTE**

- **P** indicates power pins; **PO** indicates output power pins; **I** indicates pins for digital signal input; **O** indicates pins for digital signal output. **AI** indicates pins for analog signal input.
- The **NC** (Not Connected) pins are floating and there are no signal connected to these pins. Yet some of these pins may be used in MU509, MC509, MU609 and ME909 module, therefore, before you deal with these pins, please refer to the corresponding hardware guide.
- The **Reserved** pins are internally connected to the module. Therefore, these pins should not be used, otherwise they may cause problems. Please contact with us for more details about this information.

### 3.3 Power Sources and Grounds

The PCIe Mini Card provides two power sources: one is 3.3 Vaux (+3.3 Vaux) and the other is 1.5 V (+1.5 V). For the PCIe Adapter, however, +3.3 Vaux is the only voltage supply that is available. The input voltage is 3.3 V±9%, as specified by [PCI Express Mini CEM Specifications 1.2](#).

**Table 3-2** Power and ground specifications

Pin Name	Pin No.	Min.(V)	Typ.(V)	Max.(V)
VCC_3V3	2, 24, 39, 41 and 52	3.0	3.3	3.6
GND	4, 9, 15, 18, 21, 26, 27, 29, 34, 35, 37, 40, 43, and 50	-		



**NOTE**

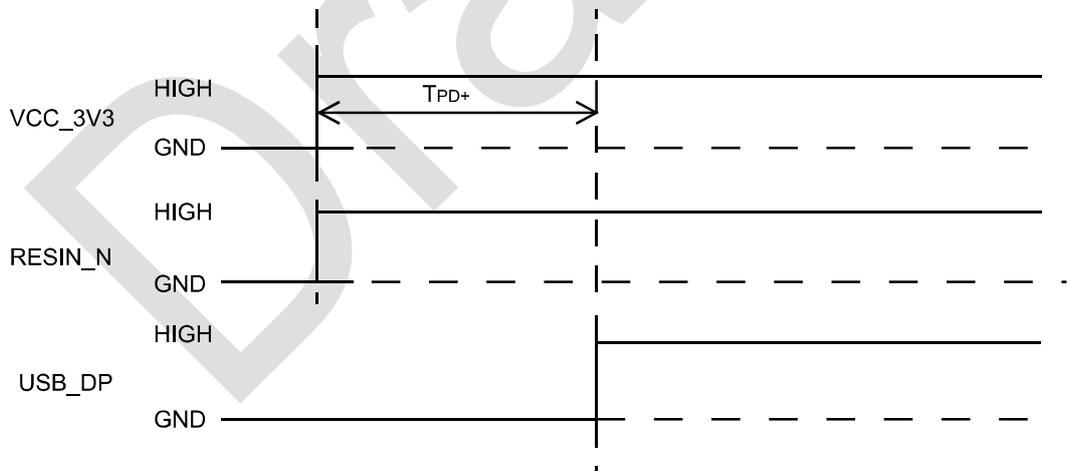
To minimize the RF radiation through the power lines, it is suggested to add ceramic capacitors of 10 pF and 100 nF in the power lines beside the Mini PCIe connector on the host side.

## 3.4 Power Supply Time Sequence

### Power on sequence

Do not toggle RESIN\_N pin during the power on sequence. Pulling RESIN\_N pin low will extend time for module startup.

**Figure 3-2** Power on timing sequence

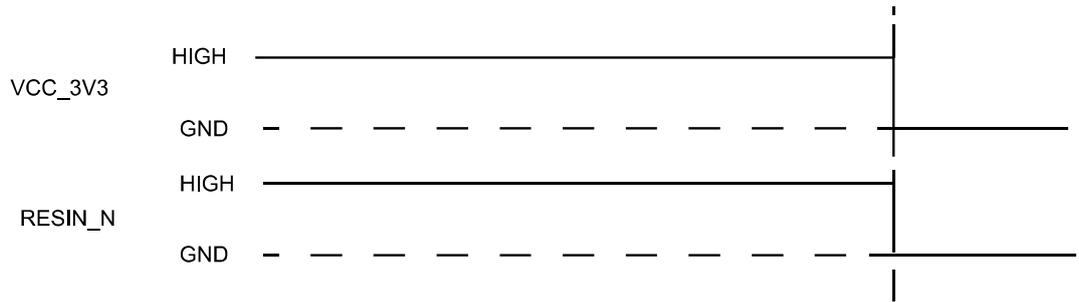


Parameter	Remarks	Time (Nominal value)	Unit
T <sub>PD+</sub>	Power Valid to USB D+ high	3.0–5.0	s

### Power off Sequence

Cutting off the 3.3 V power supply will power off the module.

**Figure 3-3** Power off timing sequence

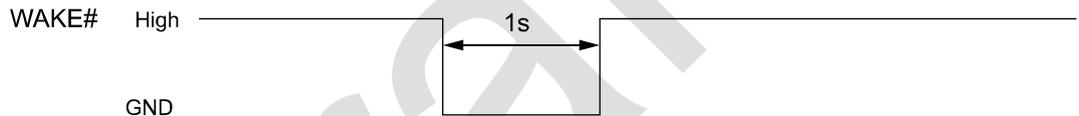


### 3.5 WAKE# Signal

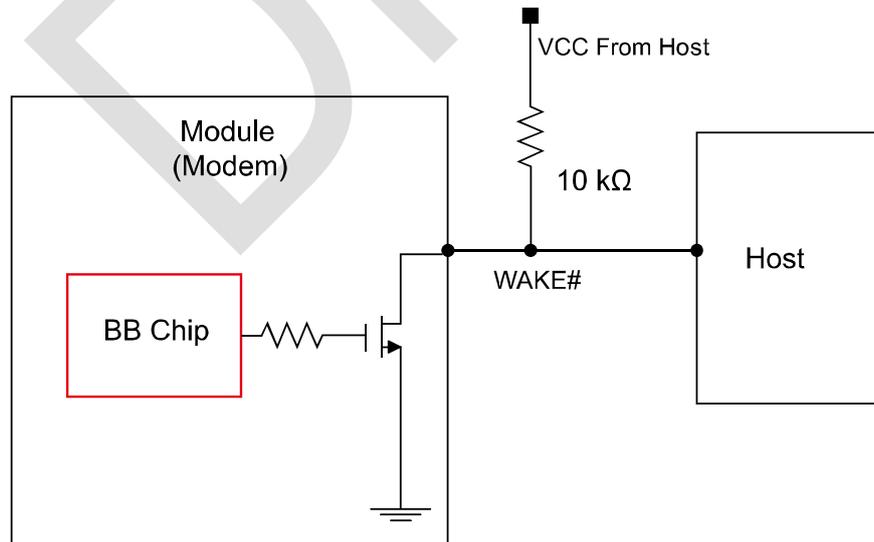
WAKE# pin (signal that the module uses to wake up the host) supports software control.

This signal is used for 3G module to wake up the host. It is designed as an OC gate, so it should be pulled up by the host and it is active-low.

When the module wakes up the host, the WAKE# pin will output low-level-voltage to wake the host.



**Figure 3-4** Connections of the WAKE# pin

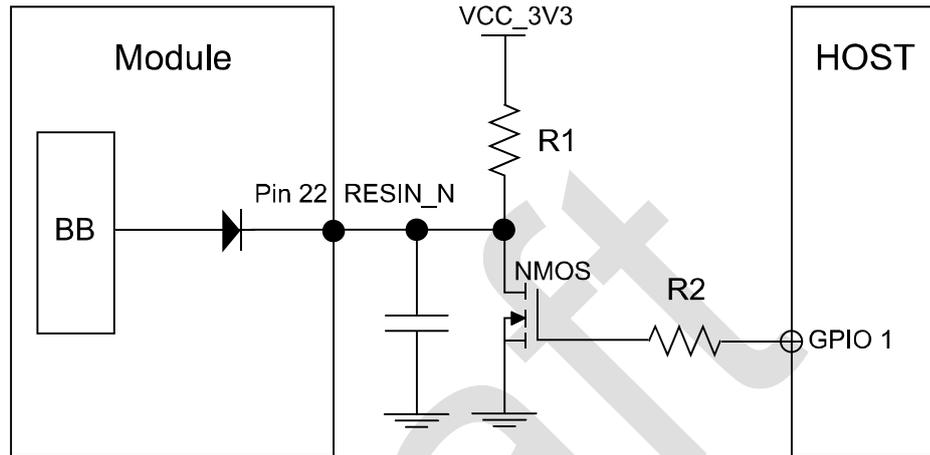


## 3.6 RESIN\_N Signal

The RESIN\_N pin is used to reset the module's system. When the module software stops responding, the RESIN\_N pin can be pulled down to reset the module hardware.

The RESIN\_N signal is internally pulled up to 1.8 V, which is automatically on when 3.3 V is applied and it is active-low.

**Figure 3-5** Connections of the RESIN\_N pin

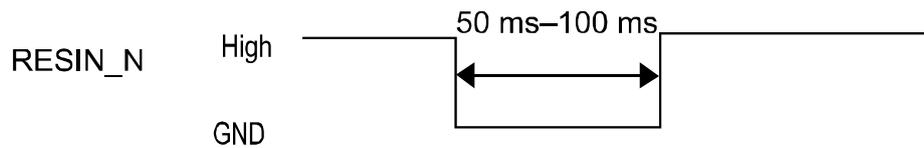


### CAUTION

- As the RESIN\_N signal are relatively sensitive, it is recommended that you install a 10 nF–0.1 μF capacitor near the RESIN\_N pin of the interface for filtering. In addition, when you design a circuit on the PCB of the interface board, it is recommended that the circuit length should not exceed 20 mm and that the circuit should be kept at a distance of 2.54 mm (100 mil) at least from the PCB edge. Furthermore, you need to wrap the area adjacent to the signal wire with a ground wire. Otherwise, the module may be reset due to interference.
- The maximum Forward Voltage Drop of the diode used in the module is 0.6 V. So when the host wants to reset the module, the low-level-voltage in the RESIN\_N pin should below 50 mV.

The MU709s-2 module supports hardware reset function. If the software of the MU709s-2 module stops responding, you can reset the hardware through the RESIN\_N signal as shown in Figure 3-6 . When a low-level pulse is supplied through the RESIN\_N pin, the hardware will be reset. After the hardware is reset, the software starts powering on the module and reports relevant information according to the actual settings. For example, the AT command automatically reports ^SYSSTART.

**Figure 3-6** Reset pulse timing



**NOTE**

- The RESIN\_N pin must not be pulled down for more than 1s.
- The RESIN\_N pin is optional, which can be not connected.

### 3.7 W\_DISABLE# Signal

The W\_DISABLE# signal is provided to allow users to disable wireless communications of the module.

The software version is planning.

### 3.8 LED\_WWAN# Signal

MU709s-2 provides a LED\_WWAN# signal to indicate the work status.

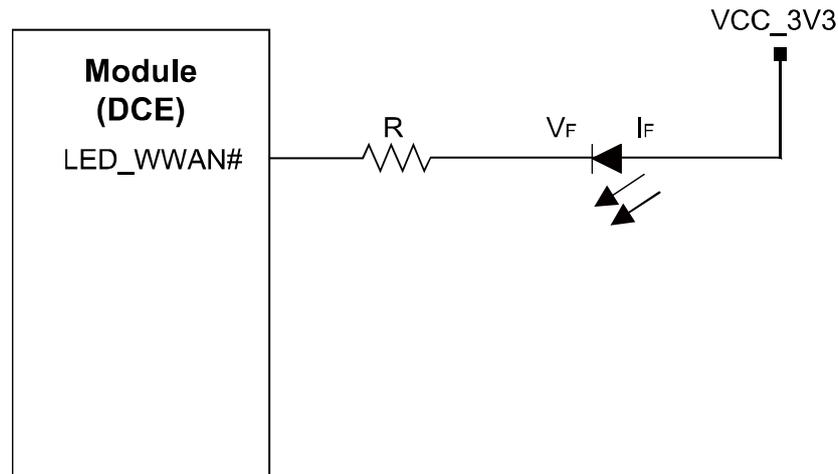
**Table 3-3** State of the LED\_WWAN# pin

No.	Operating Status	LED_WWAN#
1	No service/Restricted service	Outputs: low(0.1s)-high (0.1s)-low (0.1s)-high (1.7s) 2s cycle
2	Register to the network	Outputs: low (0.1s)-high (1.9s) 2s cycle
3	Dial-up successfully	Outputs: low

### External Circuits

Figure 3-7 shows the recommended circuits of the LED\_WWAN# pin. According to LED feature, you can adjust the LED brightness by adjusting the resistance of resistor R.

**Figure 3-7** Driving circuit



### 3.9 USB Interface

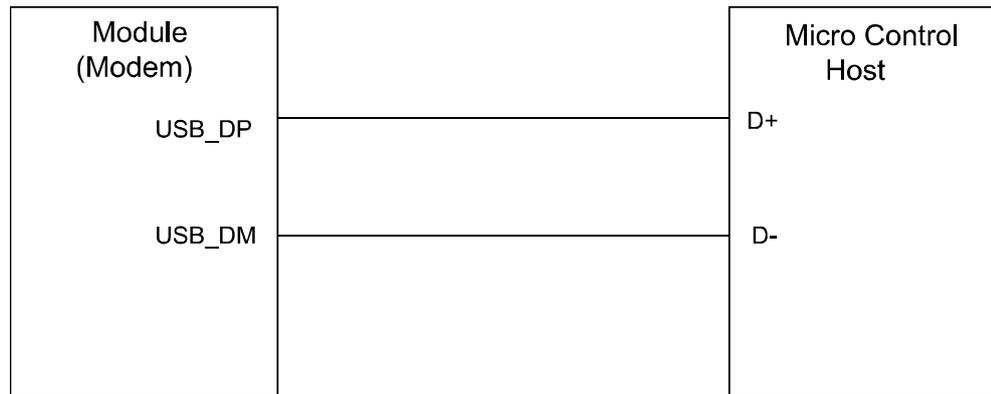
The MU709s-2 module is compliant with USB 2.0 protocol. The USB interface is powered directly from the VBAT supply. The USB input/output lines are compatible with the USB 2.0 signal specifications. Figure 3-8 shows the circuit of the USB interface.

**Table 3-4** Definition of the USB interface

PIN No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)
36	USB_DM	I/O	USB signal D-	-	-	-	-
38	USB_DP	I/O	USB signal D+	-	-	-	-

According to USB protocol, for bus timing or electrical characteristics of MU709s-2 USB signal, please refer to the chapter 7.3.2 of [Universal Serial Bus Specification 1.2](#).

**Figure 3-8** Recommended circuit of USB interface



## 3.10 USIM Card Interface

### 3.10.1 Overview

The MU709s-2 module provides a USIM card interface complying with the ISO 7816-3 standard and supports both Class B and Class C USIM cards.

**Table 3-5** USIM card interface signals

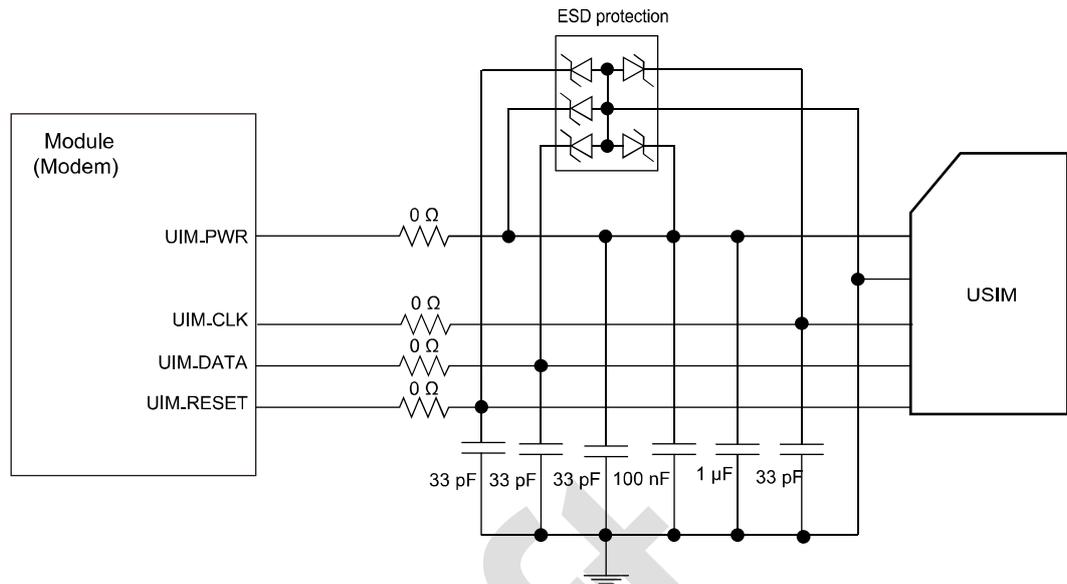
PIN No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)
14	UIM_RESET	O	External USIM reset signal		-	1.8/2.85	-
12	UIM_CLK	O	External USIM clock signal		-	1.8/2.85	-
10	UIM_DATA	I/O	External USIM data signal		-	1.8/2.85	-
8	UIM_PWR	PO	Power source for the external USIM card	Class C	-0.3	1.8	1.98
				Class B	-0.3	2.85	3.3

### 3.10.2 Circuit Recommended for the USIM Card Interface

As the Mini PCIe Adapter is not equipped with an USIM socket, you need to place an USIM socket on the user interface board.

Figure 3-9 shows the circuit of the USIM card interface.

**Figure 3-9** Circuit of the USIM card interface



 **CAUTION**

- To meet the requirements of 3GPP TS 51.010-1 protocols and electromagnetic compatibility (EMC) authentication, the USIM socket should be placed near the PCIe interface (it is recommended that the PCB circuit connects the PCIe 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 UIM\_CLK and UIM\_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 PCIe Adapter.
- A 100 nF capacitor and 1 μF capacitor are placed between the UIM\_PWR and GND pins in a parallel manner (If UIM\_PWR circuit is too long, that the larger capacitance such as 4.7 μF can be employed if necessary). Three 33 pF capacitors are placed between the UIM\_DATA and Ground pins, the UIM\_RESET and Ground pins, and the UIM\_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. The TVS diode with Vrwm of 5 V and junction capacitance less than 10 pF must 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 PCIe Adapter.

### 3.11 Audio Interface

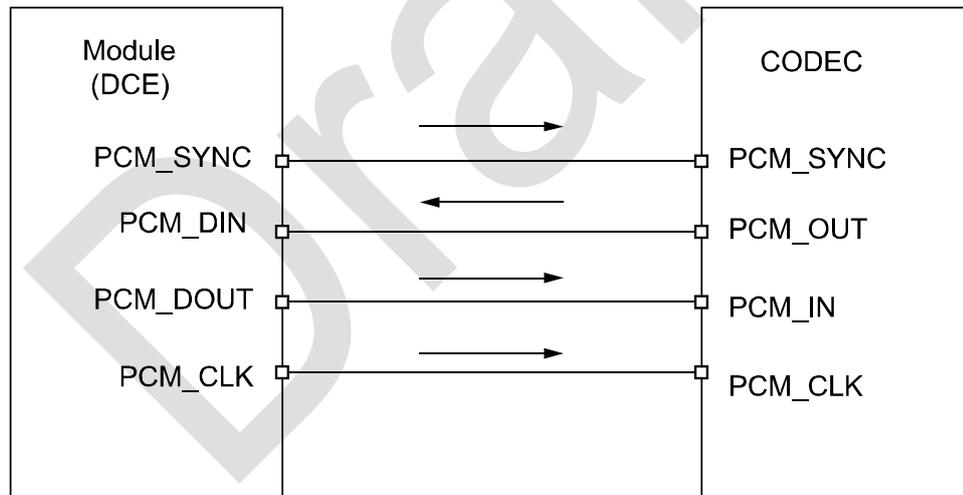
The MU709s-2 module provides one PCM digital audio interface. Table 3-6 lists the signals on the digital audio interface.

**Table 3-6** Signals on the digital audio interface

PIN No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)
45	PCM_CLK	O	PCM clock	-	-0.3	1.8	2.1
47	PCM_DOUT	O	PCM I/F data output	V <sub>OH</sub>	1.35	1.8	2.1
				V <sub>OL</sub>	-0.3	0	0.45
49	PCM_DIN	I	PCM I/F data input	V <sub>IH</sub>	1.17	1.8	2.1
				V <sub>IL</sub>	-0.3	0	0.63
51	PCM_SYNC	O	PCM interface sync	V <sub>OH</sub>	1.35	1.8	2.1
				V <sub>OL</sub>	-0.3	0	0.45

The MU709s-2 module interface enables communication with an external codec to support linear format.

**Figure 3-10** Circuit diagram of the interface of the PCM (MU709s-2 module is used as PCM master)



**NOTE**

- PCM\_SYNC: Output when PCM is in master mode;
- PCM\_CLK: Output when PCM is in master mode;
- The PCM function of MU709s-2 only supports master mode;
- It is recommended that a TVS be used on the related interface, to prevent electrostatic discharge and protect integrated circuit (IC) components.

## 3.12 UART Interface

The MU709s-2 module provides one UART interface (2-wire). Table 3-7 lists the signals of the UART interface. The UART has the following features:

- Full-duplex
- 7-bit or 8-bit data
- 1-bit or 2-bit stop bit
- Odd parity check, even parity check, or non-check
- Baud rate clock generated by the system clock
- Direct memory access (DMA) transmission
- Supported baud rate: 9600 bit/s, 19200 bit/s, 38400 bit/s, 57600 bit/s, 115200 bit/s(default), 230400 bit/s, 460800 bit/s and 921600 bit/s

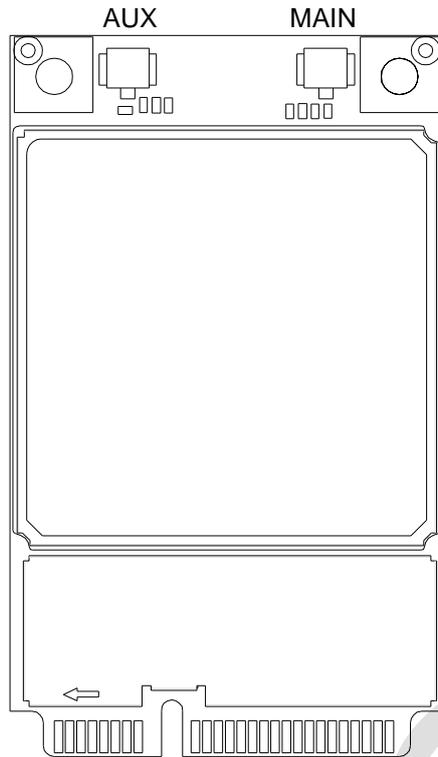
**Table 3-7** Signals of UART interface

PIN No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)
17	UART_RX	I	UART receive	$V_{IH}$	1.17	1.8	2.1
				$V_{IL}$	-0.3	0	0.63
19	UART_TX	O	UART transmit	$V_{OH}$	1.35	1.8	2.1
				$V_{OL}$	-0.3	0	0.45

## 3.13 RF Antenna Connector

The MU709s-2 module provides two antenna connectors (MAIN and AUX) for connecting the external antennas.

**Figure 3-11** RF antenna connectors



The antenna connectors must be used with coaxial cables with characteristic impedance of 50  $\Omega$ .

### 3.14 NC Pins

The MU709s-2 module has 17 NC pins. All of NC pins should not be connected. Please keep these pins open.

**Table 3-8** NC pins

Pin No.	Pin Name	I/O	Description
3, 5-7, 11, 13, 16, 23, 25, 28, 30-33, 44, 46, 48	NC	-	Not connected, please keep open.

# 4 RF Specifications

## 4.1 About This Chapter

This chapter describes the RF specifications of the MU709s-2 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 the MU709s-2 module.

**Table 4-1** RF bands

Operating Band	Tx	Rx
UMTS Band I	1920 MHz–1980 MHz	2110 MHz–2170 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

## 4.3 Conducted RF Measurement

### 4.3.1 Test Environment

<b>Test instrument</b>	R&S CMU200
<b>Power supply</b>	KEITHLEY 2306
<b>RF cable for testing</b>	L08-C014-350 of DRAKA COMTEQ or Rosenberger Cable length: 29 cm

**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 MU709s-2 module. The conducted receive sensitivity refers to the weakest signal that the module at the antenna port can receive. The BER must meet the 3GPP protocol requirements in the case of the minimum signal.

Table 4-2 lists the typical tested values of the MU709s-2 module.

**Table 4-2** MU709s-2 module conducted Rx sensitivity (Unit: dBm)

Band	Typical value	Note
GSM 850	-110	BER Class II < 2.44%
GSM 900	-110	BER Class II < 2.44%
DCS 1800	-109	BER Class II < 2.44%
PCS 1900	-109	BER Class II < 2.44%
WCDMA B1 Main Rx	-111	BER < 0.1%
WCDMA B8 Main Rx	-112	BER < 0.1%

**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 MU709s-2 module. The conducted transmit power refers to the maximum power that the module tested at the antenna connector can transmit. According to the 3GPP protocol, the required transmit power varies with the power class.

Table 4-3 lists the typical tested values of the MU709s-2 module.

**Table 4-3** MU709s-2 module conducted Tx power (unit: dBm)

Band	Typical value	Note
GSM 850	32.5	-1/+1.5 dB
GSM 900	32.5	-1/+1.5 dB
DCS 1800	29.5	-1/+1.5 dB
PCS 1900	29.5	-1/+1.5 dB
WCDMA B1	23.5	-1/+1.5 dB
WCDMA B8	23.5	-1/+1.5 dB

## 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 connector of PCIe Adapter 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 is as low as possible, for example, MXHP32HP1000 made by Murata or equivalent.

The following antenna efficiency (free space) is recommended for MU709s-2 module to ensure high radio performance of the module:

- **Efficiency of the primary antenna:  $\geq 40\%$  (below 960 MHz);  $\geq 50\%$  (over 1710 MHz)**

- **Efficiency of the diversity antenna:  $\geq$  half of the efficiency of the primary antenna in receiving band**

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 ( $50 \Omega$ ). 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 value is recommended for the antenna of MU709s-2 module:

- **S11 of the primary antenna:  $\leq -6$  dB**
- **S11 of the diversity antenna:  $\leq -6$  dB**

In addition, S11 is less important than the efficiency, and S11 has weak correlation to 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 MU709s-2 module 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 MU709s-2 module. 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:  $\leq -12$  dB**
- **Isolation between the primary antenna and the Wi-Fi antenna:  $\leq -15$  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 MU709s-2 module.

## 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 ( $\theta$  and  $\varphi$ ), 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 MU709s-2 module.

### Primary/Diversity antenna: omnidirectional

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

## 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.

## 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 MU709s-2 module. **Gain of the primary/diversity antenna  $\leq 2.5$  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 Antenna Requirements

The antenna for MU709s-2 module must fulfill the following requirements:

GSM/WCDMA 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 80 MHz in WCDMA900 (35MHz for diversity antenna) 250 MHz in WCDMA2100 (60MHz for diversity antenna)
Gain	≤ 2.5 dBi
Impedance	50 Ω
VSWR absolute max	≤ 3:1
VSWR recommended	≤ 2:1

# 5 Electrical and Reliability Features

## 5.1 About This Chapter

This chapter describes the electrical and reliability features of the interfaces in the MU709s-2 module, including:

- Absolute Ratings
- Operating and Storage Temperatures
- Electrical Features of USIM
- Power Supply Features
- Reliability Features
- EMC and ESD Features

## 5.2 Absolute Ratings



### WARNING

Table 5-1 lists the absolute ratings for the MU709s-2 module. Using the module beyond these conditions may result in permanent damage to the module.

**Table 5-1** Absolute ratings for the MU709s-2 module

Symbol	Specification	Min.	Max.	Unit
VCC_3V3	External power voltage	-0.3	4.0	V
VI	Digital input voltage	-0.3	2.1	V

## 5.3 Operating and Storage Temperatures

Table 5-2 lists the operating and storage temperatures for the MU709s-2 module.

**Table 5-2** Operating and storage temperatures for the MU709s-2 module

Specification	Min.	Max.	Unit
Normal working temperatures <sup>[1]</sup>	-40	+70	°C
Ambient temperature for storage	-40	+85	°C

 **NOTE**

[1]: When the MU709s-2 module works at this temperature, all its RF indexes comply with the 3GPP TS 45.005 and 3GPP TS 34.121-1 specifications.

## 5.4 Electrical Features of USIM

**Table 5-3** Electrical features of digital pins in the I/O supply domain of the USIM Interface

Parameter	Description	Min.	Max.	Notes	Unit
V <sub>IH</sub>	High-level input voltage	0.7 x V <sub>DDP_USIM</sub>	3.3	V <sub>DDP_USIM</sub> = 1.8 or 2.85	V
V <sub>IL</sub>	Low-level input voltage	0	0.2 x V <sub>DDP_USIM</sub>	V <sub>DDP_USIM</sub> = 1.8 or 2.85	V
V <sub>OH</sub>	High-level output voltage	0.7 x V <sub>DDP_USIM</sub>	3.3	V <sub>DDP_USIM</sub> = 1.8 or 2.85	V
V <sub>OL</sub>	Low-level output voltage	0	0.2 x V <sub>DDP_USIM</sub>	V <sub>DDP_USIM</sub> = 1.8 or 2.85	V

## 5.5 Power Supply Features

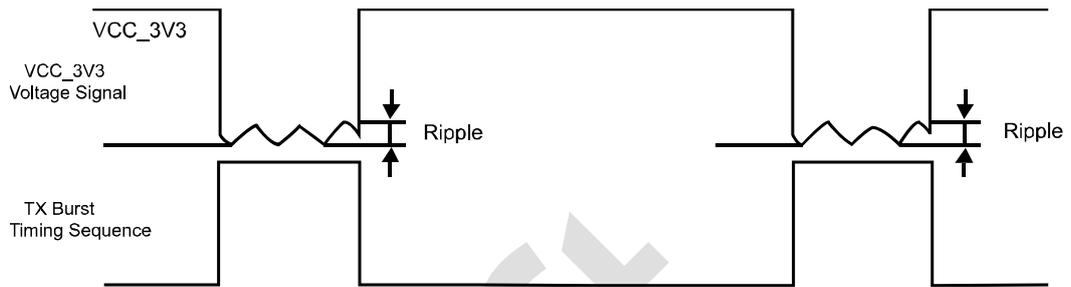
### 5.5.1 Input Power Supply

Table 5-4 lists the requirements for input power of the MU709s-2 module.

**Table 5-4** Requirements for input power for the MU709s-2 module

Parameter	Min.	Typ.	Max.	Ripple	Unit
VCC_3V3	3.0	3.3	3.6	0.05	V

**Figure 5-1** Power Supply During Burst Emission



**NOTE**

The VCC\_3V3 minimum value must be guaranteed during the burst (with 2.7 A Peak in GSM 2 slot mode). So a low-dropout (LDO) regulator or switch power with current output of more than 3.5 A is strongly recommended for external power supply.

**Table 5-5** Requirements for input current of the MU709s-2 module

Power	Module	Peak (GSM 2 slot)	Normal (WCDMA)
VCC_3V3	MU709s-2	2750 mA	1100 mA

## 5.5.2 Power Consumption

The power consumptions of MU709s-2 module in different scenarios are respectively listed in Table 5-6 to Table 5-8 .

The power consumption listed in this section is tested when the power supply of the MU709s-2 module is 3.3 V, and all of test values are measured at room temperature.

**Table 5-6** Averaged standby DC power consumption of MU709s-2 module

Description		Bands	Test Value (mA)	Notes/Configuration
			Typical	
Sleep	HSPA+/WCDMA (sleep)	UMTS bands	TBD	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in suspend.

	GPRS/EDGE (sleep)	GSM bands	TBD	Module is powered up. MFRMS=5 (1.175s) Module is registered on the network. USB is in suspend.
	Radio Off (sleep)	All bands	TBD	Module is powered up. RF is disabled USB is in suspend.
Idle	HSPA+/WCDMA (idle)	UMTS bands	TBD	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network, no data is transmitted. USB is in active.
	GPRS/EDGE (idle)	GSM bands	TBD	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	TBD	Module is powered up. RF is disabled. USB is in active.

**Table 5-7** Averaged Data Transmission DC power consumption of MU709s-2 module (HSPA/WCDMA)

Description	Band	Test Value (mA)	Power (dBm)
		Typical	
WCDMA	Band I (IMT2100)	TBD	0 dBm Tx Power
		TBD	10 dBm Tx Power
		TBD	23.5 dBm Tx Power
	Band VIII (900 MHz)	TBD	0 dBm Tx Power
		TBD	10 dBm Tx Power
		TBD	23.5dBm Tx Power
HSDPA	Band I (IMT2100)	TBD	0 dBm Tx Power
		TBD	10 dBm Tx Power
		TBD	23.5 dBm Tx Power
	Band VIII	TBD	0 dBm Tx Power



Description	Band	Test Value (mA)	Power (dBm)
		Typical	
	(900 MHz)	TBD	10 dBm Tx Power
		TBD	23.5 dBm Tx Power

**Table 5-8** Averaged DC power consumption of MU709s-2 module(GPRS/EDGE)

Description	Test Value (mA)	PCL	Configuration
	Typical		
GPRS850	TBD	5	1 Up/1 Down
	TBD		2 Up/1 Down
	TBD		4 Up/1 Down
	TBD	10	1 Up/1 Down
	TBD		2 Up/1 Down
	TBD		4 Up/1 Down
GPRS900	TBD	5	1 Up/1 Down
	TBD		2 Up/1 Down
	TBD		4 Up/1 Down
	TBD	10	1 Up/1 Down
	TBD		2 Up/1 Down
	TBD		4 Up/1 Down
GPRS1800	TBD	0	1 Up/1 Down
	TBD		2 Up/1 Down
	TBD		4 Up/1 Down
	TBD	10	1 Up/1 Down
	TBD		2 Up/1 Down
	TBD		4 Up/1 Down
GPRS1900	TBD	0	1 Up/1 Down
	TBD		2 Up/1 Down
	TBD		4 Up/1 Down
	TBD	10	1 Up/1 Down
	TBD		2 Up/1 Down



Description	Test Value (mA)	PCL	Configuration
	Typical		
	TBD		4 Up/1 Down
EDGE850	TBD	8	1 Up/1 Down
	TBD		2 Up/1 Down
	TBD		4 Up/1 Down
	TBD	15	1 Up/1 Down
	TBD		2 Up/1 Down
	TBD		4 Up/1 Down
EDGE900	TBD	8	1 Up/1 Down
	TBD		2 Up/1 Down
	TBD		4 Up/1 Down
	TBD	15	1 Up/1 Down
	TBD		2 Up/1 Down
	TBD		4 Up/1 Down
EDGE1800	TBD	2	1 Up/1 Down
	TBD		2 Up/1 Down
	TBD		4 Up/1 Down
	TBD	10	1 Up/1 Down
	TBD		2 Up/1 Down
	TBD		4 Up/1 Down
EDGE1900	TBD	2	1 Up/1 Down
	TBD		2 Up/1 Down
	TBD		4 Up/1 Down
	TBD	10	1 Up/1 Down
	TBD		2 Up/1 Down
	TBD		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, which are listed in Table 4-3 ; for Max. data throughput, see 2.2 Function Overview, which are listed in Table 2-1 .

## 5.6 Reliability Features

Table 5-9 lists the test conditions and results of the reliability of the MU709s-2 module.

**Table 5-9** Test conditions and results of the reliability of the MU709s-2 module

Item		Test Condition	Standard	Sample size	Results
Stress	Low-temperature storage	<ul style="list-style-type: none"> <li>• Temperature: -40°C</li> <li>• Operation mode: no power, no package</li> <li>• Test duration: 24 h</li> </ul>	JESD22-A119-C	3 pcs/group	Visual inspection: TBD Function test: TBD RF specification: TBD
	High-temperature storage	<ul style="list-style-type: none"> <li>• Temperature: 85°C</li> <li>• Operation mode: no power, no package</li> <li>• Test duration: 24 h</li> </ul>	JESD22-A103-C	3 pcs/group	Visual inspection: TBD Function test: TBD RF specification: TBD
	Low-temperature operating	<ul style="list-style-type: none"> <li>• Temperature: -30°C</li> <li>• Operation mode: working with service connected</li> <li>• Test duration: 24 h</li> </ul>	IEC60068-2-1	3 pcs/group	Visual inspection: TBD Function test: TBD RF specification: TBD
	High-temperature operating	<ul style="list-style-type: none"> <li>• Temperature: 70°C</li> <li>• Operation mode: working with service connected</li> <li>• Test duration: 24 h</li> </ul>	JESD22-A108-C	3 pcs/group	Visual inspection: TBD Function test: TBD RF specification: TBD
	Damp heat cycling	<ul style="list-style-type: none"> <li>• High temperature: 55°C</li> <li>• Low temperature: 25°C</li> <li>• Humidity: 95%±3%</li> <li>• Operation mode: working with service connected</li> <li>• Test duration: 6 cycles; 12 h+12 h/cycle</li> </ul>	JESD 22-A101-B	3 pcs/group	Visual inspection: TBD Function test: TBD RF specification: TBD



Item		Test Condition	Standard	Sample size	Results
	Thermal shock	<ul style="list-style-type: none"><li>• Low temperature: -40°</li><li>• High temperature: 85°C</li><li>• Temperature change interval: &lt; 20s</li><li>• Operation mode: no power</li><li>• Test duration: 100 cycles; 15 Min+15 Min/cycle</li></ul>	JESD22-A106-B	3 pcs/group	Visual inspection: TBD Function test: TBD RF specification: TBD
	Salty fog test	<ul style="list-style-type: none"><li>• Temperature: 35°C</li><li>• Density of the NaCl solution: 5%±1%</li><li>• Operation mode: no power, no package</li><li>• Test duration: Spraying interval: 8 h Exposing period after removing the salty fog environment: 16 h</li></ul>	JESD22-A107-B	3 pcs/group	Visual inspection: TBD Function test: TBD RF specification: TBD
	Sine vibration	<ul style="list-style-type: none"><li>• Frequency range: 5 Hz to 200 Hz</li><li>• Acceleration: 1 Grms</li><li>• Frequency scan rate: 0.5oct/min</li><li>• Operation mode: working with service connected</li><li>• Test duration: 3 axial directions. 2 h for each axial direction</li><li>• Operation mode: working with service connected</li></ul>	JESD22-B103-B	3 pcs/group	Visual inspection: TBD Function test: TBD RF specification: TBD



Item		Test Condition	Standard	Sample size	Results
	Shock test	<ul style="list-style-type: none"> <li>• Half-sine wave shock</li> <li>• Peak acceleration: 30 Grms</li> <li>• Shock duration: 11 ms</li> <li>• Operation mode: working with service connected</li> <li>• Test duration: 6 axial directions. 3 shocks for each axial direction.</li> <li>• Operation mode: working with service connected</li> </ul>	JESD-B1 04-C	3 pcs/group	Visual inspection: TBD Function test: TBD RF specification: TBD
	Drop test	<ul style="list-style-type: none"> <li>• 0.8 m in height. Drop the module on the marble terrace with one surface facing downwards. Six surfaces should be tested.</li> <li>• Operation mode: no power, no package</li> </ul>	IEC60068 -2-32	3 pcs/group	Visual inspection: TBD Function test: TBD RF specification: TBD
Life	Low-temperature storage	<ul style="list-style-type: none"> <li>• Temperature: -40°C</li> <li>• Operation mode: no power, no package</li> <li>• Test duration: 24 h</li> </ul>	JESD22-A119-C	3 pcs/group	Visual inspection: TBD Function test: TBD RF specification: TBD
	High temperature operating life	<ul style="list-style-type: none"> <li>• Temperature: 70°C</li> <li>• Operation mode: working with service connected</li> <li>• Test duration: 168 h, 336 h, 500 h for inspection point</li> </ul>	JESD22-A108-B	50 pcs/group	Visual inspection: TBD Function test: TBD RF specification: TBD
	High temperature & high humidity	<ul style="list-style-type: none"> <li>• High temperature: 85°C</li> <li>• Humidity: 85%</li> <li>• Operation mode: powered on and no working</li> <li>• Test duration: 168 h, 336 h, 500 h for inspection point</li> </ul>	JESD22-A110-B	50 pcs/group	Visual inspection: TBD Function test: TBD RF specification: TBD Cross section: TBD

Item		Test Condition	Standard	Sample size	Results
	Temperature cycle	<ul style="list-style-type: none"> <li>High temperature: 85°C</li> <li>Low temperature: -40°C</li> <li>Temperature change slope: 6°C/min</li> <li>Operation mode: no power</li> <li>Test duration: 168 h, 336 h, 500 h for inspection point</li> </ul>	JESD22-A104-C	50 pcs/group	Visual inspection: TBD Function test: TBD RF specification: TBD Cross section: TBD
ESD	HBM (Human Body Model)	<ul style="list-style-type: none"> <li>1 kV (Class 1B)</li> <li>Operation mode: no power</li> </ul>	JESD22-A114-D	3 pcs/group	Visual inspection: TBD Function test: TBD RF specification: TBD
	ESD with DVK (or embedded in the host)	<ul style="list-style-type: none"> <li>Contact and Air discharges: 10 positive and 10 negative applied</li> <li>Contact Voltage: ±2 kV, ±4 kV</li> <li>Air Voltage : ±2 kV, ±4 kV, ±8 kV</li> <li>Operation mode: working with service connected</li> </ul>	IEC 61000-4-2	2 pcs	Visual inspection: TBD Function test: TBD RF specification: TBD
 <b>NOTE</b> 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, 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 adjustment 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 USIM interface for ESD protection. The parasitic capacitance of TVS on USIM signal should be less than 10 pF.

- Resistors in parallel and a 10 nF capacitor should be added on RESIN\_N 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  $1 \times 10^4 \Omega$  while less than  $1 \times 10^9 \Omega$ .
- The EPA must have a sound ground system without loose ground wires, and the ground resistance must be less than 4  $\Omega$ .
- 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  $\Omega$ . The surface resistance and system resistance of the ESD pad must be less than  $1 \times 10^9 \Omega$ .
- 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  $\Omega$
  - $1 \times 10^5 \Omega \leq$  Soft ground resistance <  $1 \times 10^9 \Omega$
  - $1 \times 10^5 \Omega \leq$  ICT fixture soft ground resistance <  $1 \times 10^{11} \Omega$
  - The electronic screwdriver and electronic soldering iron can be easily oxidized. Their ground resistance must be less than 20  $\Omega$ .
- 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**

HUAWEI ME709s-2p module does not include any protection against overvoltage.

Draft

# 6 Mechanical Specifications

---

## 6.1 About This Chapter

This chapter mainly describes mechanical specifications of MU709s-2 module, including:

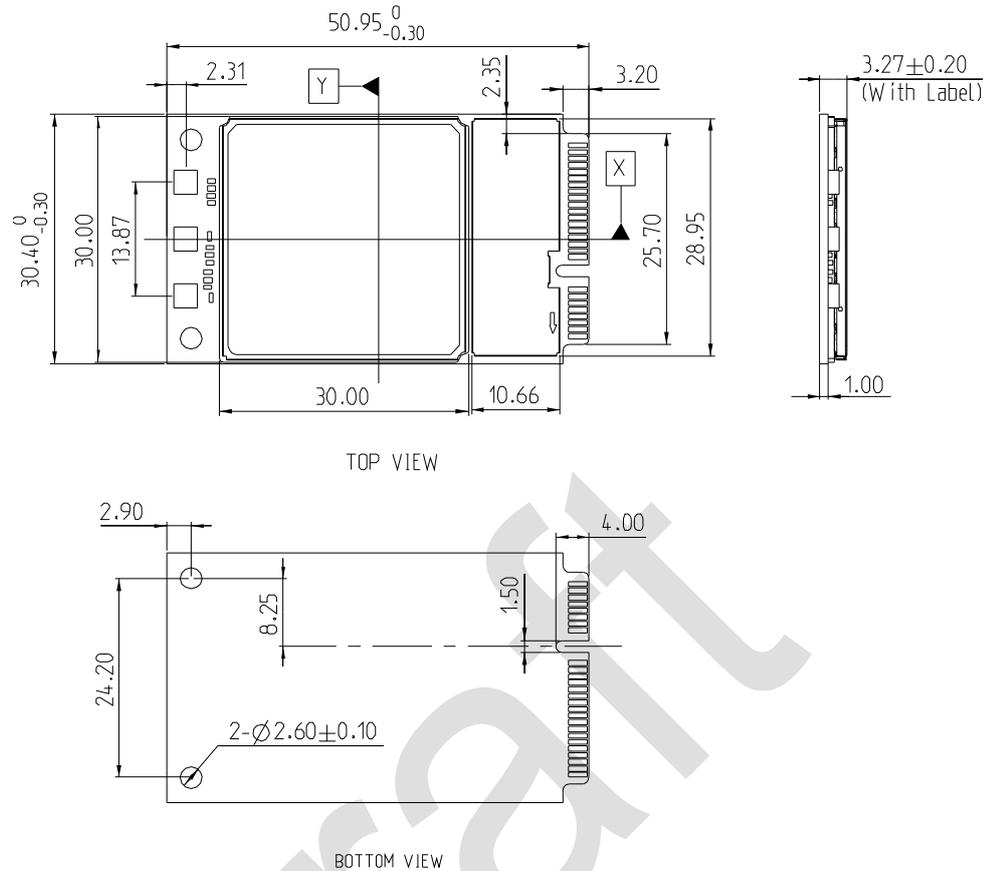
- Dimensions and Interfaces
- Dimensions of the Mini PCI Express Connector
- Specification Selection for Fasteners
- Label

## 6.2 Dimensions and Interfaces

The dimensions of the MU709s-2 module are 51 mm (length) × 30.4 mm (width) × 3.3 mm (height). Figure 6-1 shows the dimensions of MU709s-2 module in detail.

Figure 6-1 shows the appearance of the interfaces on the MU709s-2 module.

**Figure 6-1** Dimensions of the MU709s-2 module

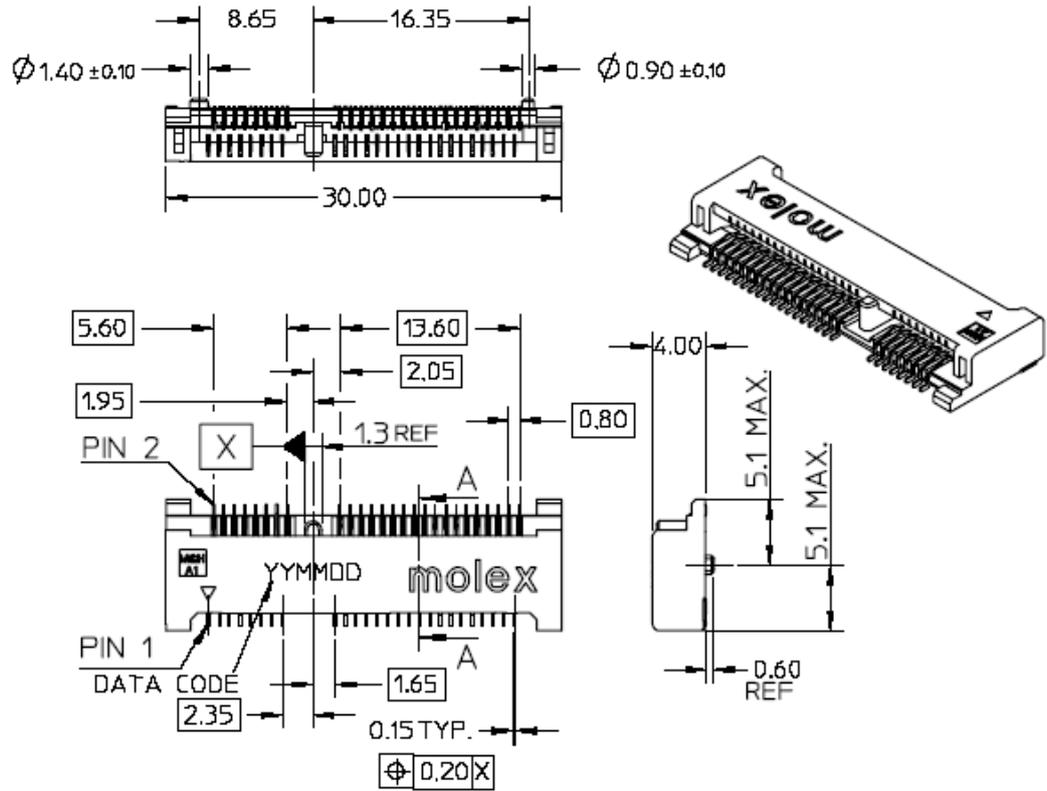


## 6.3 Dimensions of the Mini PCI Express Connector

The Mini PCIe Adapter adopts a standard Mini PCI Express connector that has 52 pins and complies with the [PCI Express Mini Card Electromechanical Specification Revision 1.2](#).

Figure 6-2 shows a 52-pin Mini PCI Express connector (take the Molex 67910002 as an example).

**Figure 6-2** Dimensions of the Mini PCI Express connector

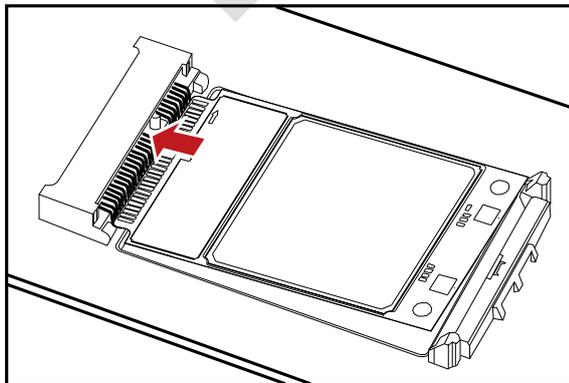


## 6.4 Specification Selection for Fasteners

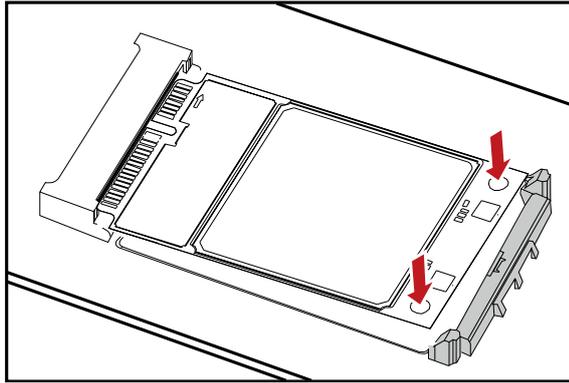
### 6.4.1 Installing the Mini PCIe Adapter on the Main Board

To install the Mini PCIe Adapter on the main board, do the following:

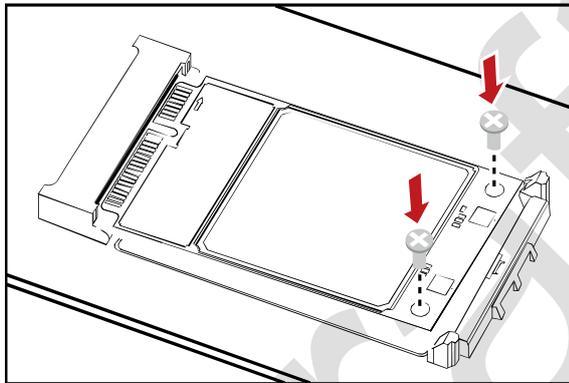
- Step 1 Insert the Mini PCIe Adapter into the Mini PCI Express connector on the main board.



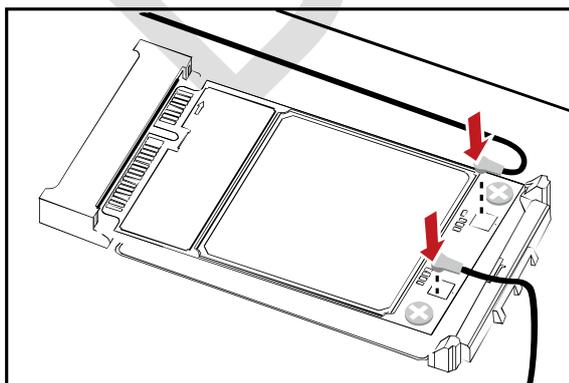
- Step 2 Press downwards to fix the Mini PCIe Adapter in the module slot.



Step 3 Use a screwdriver to fix the Mini PCIe Adapter on the main board with two screws provided in the Mini PCIe Adapter packing box.



Step 4 Insert the connector of the main antenna into the MAIN antenna interface (M) of the Mini PCIe Adapter according to the indication on the label of the Mini PCIe Adapter. Insert the connector of the auxiliary antenna into the AUX antenna interface (A) of the Mini PCIe Adapter of the Mini PCIe Adapter in the same way.

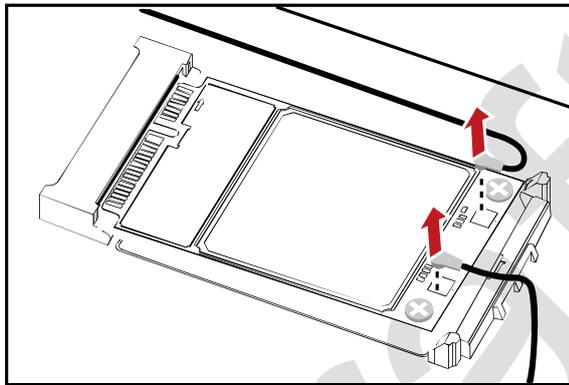


 **NOTE**

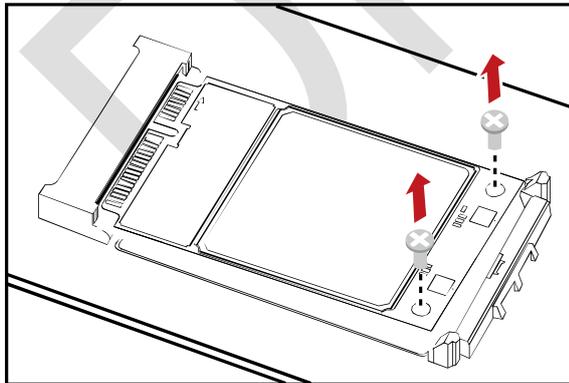
- Insert the antenna connectors vertically into the antenna interfaces of the Mini PCIe Adapter.
- Do not press or squeeze the antenna cable or damage the connectors. Otherwise, the wireless performance of the Mini PCIe Adapter may be reduced or the Mini PCIe Adapter cannot work normally.
- Ensure that the antenna cables are routed through the channel in the frame of the PC and do not lay the cables across the raised edges of the frame.

## 6.4.2 Removing the Mini PCIe Adapter from the Main Board

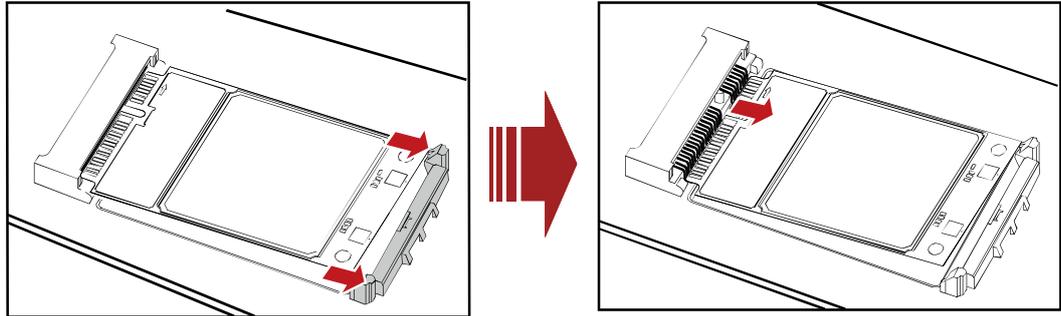
Step 1 Disconnect the antenna cables from the Mini PCIe Adapter. You can lift the connectors using a small screwdriver.



Step 2 Remove the two screws with the screwdriver.



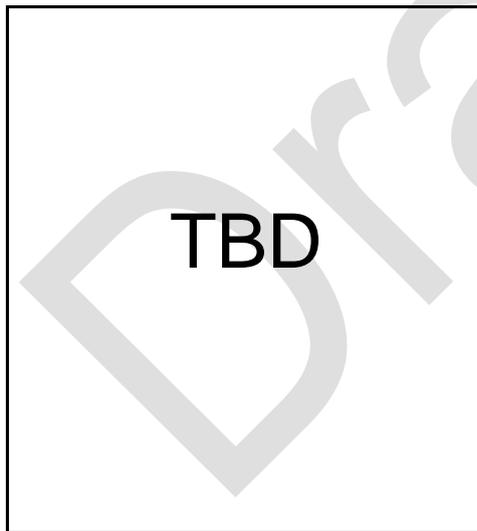
- Step 3 Slide backwards the two clips to release the Mini PCIe Adapter from the slot. Then, lift up the Mini PCIe Adapter.



## 6.5 Label

The label is made from fade-resistant, and is able to endure the high temperature of 149°C.

**Figure 6-3** MU709s-2 general label



**NOTE**

The picture mentioned above is only for reference.

# 7 Certifications

## 7.1 About This Chapter

This chapter gives a general description of certifications of MU709s-2 module.

## 7.2 Certifications

**NOTE**

Table 7-1 shows certifications the MU709s-2 module will be implemented. For more demands, please contact us for more details about this information.

**Table 7-1** Product Certifications

Certification	Model name
	MU709s-2
CE	On-going
CCC	On-going
GCF	On-going
RoHS	On-going
WEEE	On-going

# 8 Safety Information

---

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

## 8.1 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.

## 8.2 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.

## 8.3 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

## 8.4 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.

## 8.5 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.

## 8.6 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.

## 8.7 Environment Protection

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

## 8.8 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).

## 8.9 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).

## 8.10 Laws and Regulations Observance

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

## 8.11 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 abnormality 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.

## 8.12 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.

## 8.13 Regulatory Information

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

### 8.13.1 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).

## 8.13.2 FCC Statement

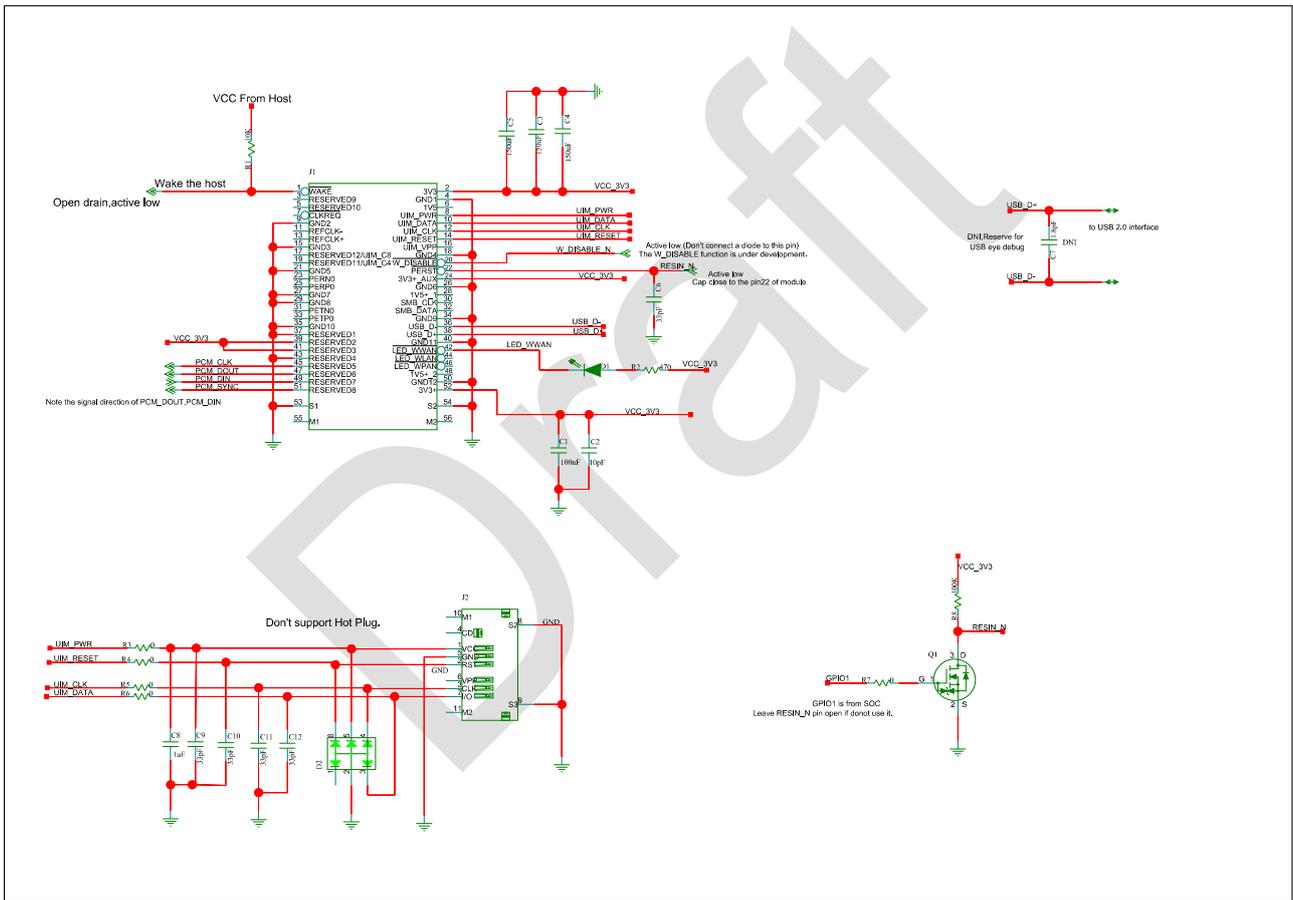
Federal Communications Commission Notice (United States): Before a wireless device model is available for sale to the public, it must be tested and certified to the FCC that it does not exceed the limit established by the government-adopted requirement for safe exposure.

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.

Draft

# 9 Appendix A Circuit of Typical Interface



# 10

## Appendix B Acronyms and Abbreviations

---

Acronym or Abbreviation	Expansion
3GPP	Third Generation Partnership Project
AUX	Auxiliary
CCC	China Compulsory Certification
CE	European Conformity
CS	Coding Scheme
CSD	Circuit Switched Data
DC	Direct Current
EDGE	Enhanced Data Rate for GSM Evolution
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
EU	European Union
FCC	Federal Communications Commission
GPIO	General-purpose I/O
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
HSDPA	High-Speed Downlink Packet Access
HSPA	High Speed Packet Access
HSUPA	High Speed Up-link Packet Access
ISO	International Standards Organization
LDO	Low-Dropout



Acronym or Abbreviation	Expansion
LED	Light-Emitting Diode
MCP	Multi-chip Package
PCB	Printed Circuit Board
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
WEEE	Waste Electrical and Electronic Equipment

Draft