



HUAWEI ME909s Series LTE Mini PCIe Module

Hardware Guide

Issue 07

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About This Document

Revision History

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01	2015-08-25		Creation
02	2016-09-07	2.2	Updated Table 2-1 Features
		2.3	Updated Circuit Block Diagram
		3.7.2	Updated Figure 3-11 Connections of the USIM_DET pin
		3.7.3	Updated Circuit Recommended for the USIM Card Interface
		4.2	Updated Operating Frequencies
		4.5.3	Updated Antenna Requirements
		5.4.2	Updated Table 5-5 Averaged standby DC power consumption of ME909s-821 Mini PCIe module and Table 5-6 Averaged standby DC power consumption of ME909s-120 Mini PCIe module
		5.5	Updated Table 5-11 Test conditions and results of the reliability of the ME909s Mini PCIe module
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Document Version	Date	Chapter	Descriptions
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		7.2	Added ME909s-821a Product Certifications

Scope

ME909s-821
ME909s-120
ME909s-821a



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1 Introduction

This document describes the hardware application interfaces and air interfaces provided by HUAWEI ME909s Series (ME909s-821 and ME909s-120 ME909s-821a) LTE Mini PCIe Module (hereinafter referred to as the ME909s Mini PCIe module).

This document helps hardware engineer to understand the interface specifications, electrical features and related product information of the ME909s Mini PCIe module.



2 Overall Description

2.1 About This Chapter

This chapter gives a general description of the ME909s Mini PCIe module and provides:

- Function Overview
- Circuit Block Diagram

2.2 Function Overview

Table 2-1 Features

Feature	Description
Physical Dimensions	ME909s-821 • Dimensions (L × W × H): 51 mm × 30.4 mm × 3.57 mm • Weight: about 10.46 g ME909s-120 • Dimensions (L × W × H): 51 mm × 30.4 mm × 3.52 mm • Weight: about 10.46 g ME909s-821a • Dimensions (L × W × H): 51 mm × 30.4 mm × 3.57 mm • Weight: about 10.46 g
Operating Bands	ME909s-821 • FDD LTE: Band 1, Band 3, Band 8, all bands with diversity • TDD LTE: Band 38, Band 39, Band 40, Band 41, all bands with diversity • DC-HSPA+/HSPA+/HSPA/UMTS: Band 1, Band 5, Band 8, Band 9, all bands with diversity • TD-SCDMA: Band 34, Band 39 • GSM/GPRS/EDGE: 1800 MHz/900 MHz



Feature	Description
	ME909s-120 • FDD LTE: Band 1, Band 2, Band 3, Band 4, Band 5, Band 7, Band 8, Band 20, all bands with diversity • WCDMA/HSDPA/HSUPA/HSPA+: Band 1, Band 2, Band 5, Band 8, all bands with diversity • GSM/GPRS/EDGE: 850 MHz/900 MHz/1800 MHz/1900 MHz
	ME909s-821a • FDD LTE: Band 1, Band 3, Band 5, Band 8, all bands with diversity • TDD LTE: Band 38, Band 39, Band 40, Band 41, all bands with diversity • DC-HSPA+/HSPA+/HSPA/UMTS: Band 1, Band 5, Band 8, Band 9, all bands with diversity • TD-SCDMA: Band 34, Band 39 GSM/GPRS/EDGE: 1800 MHz/900 MHz
Operating Temperature	Normal operating temperature: –20°C to +60°C Extended operating temperature ^[1] : –40°C to +85°C
Storage Temperature	–40°C to +85°C
Humidity	RH5% to RH95%
Power Voltage	DC 3.2 V–4.2 V (typical value is 3.8 V)
AT Commands	See the <i>HUAWEI ME909s Series LTE Module AT Command Interface Specification</i> .
Application Interface (52-pin Mini PCIe interface)	One standard USIM card (Class B and Class C) interface
	Audio interface: PCM interface
	USB 2.0 (High Speed)
	UART interface: 4-wire UART x 1
	WAKE#
	WAKEUP_IN
	USIM_DET
	LED_WWAN#: Active-low LED signal indicating the state of the module
Antenna connector	• WWAN MAIN antenna connector x 1 • WWAN AUX antenna connector x 1



Feature	Description
Data Services	ME909s-821 GPRS: UL 85.6 kbit/s; DL 85.6 kbit/s EDGE: UL 236.8 kbit/s; DL 236.8 kbit/s WCDMA CS: UL 64 kbit/s; DL 64 kbit/s WCDMA PS: UL 384 kbit/s; DL 384 kbit/s HSPA+: UL 5.76 Mbit/s; DL 21.6 Mbit/s DC-HSPA+: UL 5.76 Mbit/s; DL 42 Mbit/s TD-HSPA: UL 2.2 Mbit/s; DL 2.8 Mbit/s TD-SCDMA PS: UL 384 kbit/s; DL 2.8 Mbit/s LTE FDD: UL 50 Mbit/s; DL 150 Mbit/s @20M BW cat4 LTE TDD: UL 10 Mbit/s; DL 112 Mbit/s @20M BW cat4 (Uplink-downlink configuration 2, 1:3) ME909s-120 GPRS: UL 85.6 kbit/s; DL 85.6 kbit/s EDGE: UL 236.8 kbit/s; DL 236.8 kbit/s WCDMA CS: UL 64 kbit/s; DL 64 kbit/s WCDMA PS: UL 384 kbit/s; DL 384 kbit/s HSPA+: UL 5.76 Mbit/s; DL 21.6 Mbit/s DC-HSPA+: UL 5.76 Mbit/s; DL 42 Mbit/s LTE FDD: UL 50 Mbit/s; DL 150 Mbit/s @20M BW cat4 ME909s-821a GPRS: UL 85.6 kbit/s; DL 85.6 kbit/s EDGE: UL 236.8 kbit/s; DL 236.8 kbit/s WCDMA CS: UL 64 kbit/s; DL 64 kbit/s WCDMA PS: UL 384 kbit/s; DL 384 kbit/s HSPA+: UL 5.76 Mbit/s; DL 21.6 Mbit/s DC-HSPA+: UL 5.76 Mbit/s; DL 42 Mbit/s TD-HSPA: UL 2.2 Mbit/s; DL 2.8 Mbit/s TD-SCDMA PS: UL 384 kbit/s; DL 2.8 Mbit/s LTE FDD: UL 50 Mbit/s; DL 150 Mbit/s @20M BW cat4 LTE TDD: UL 10 Mbit/s; DL 112 Mbit/s @20M BW cat4 (Uplink-downlink configuration 2, 1:3)
Operating Systems	Android 2.x/3.x/4.x Linux (Kernel 2.6.29 or later) Windows 7/8/8.1/10 Windows CE 5.0/6.0/7.0



 NOTE

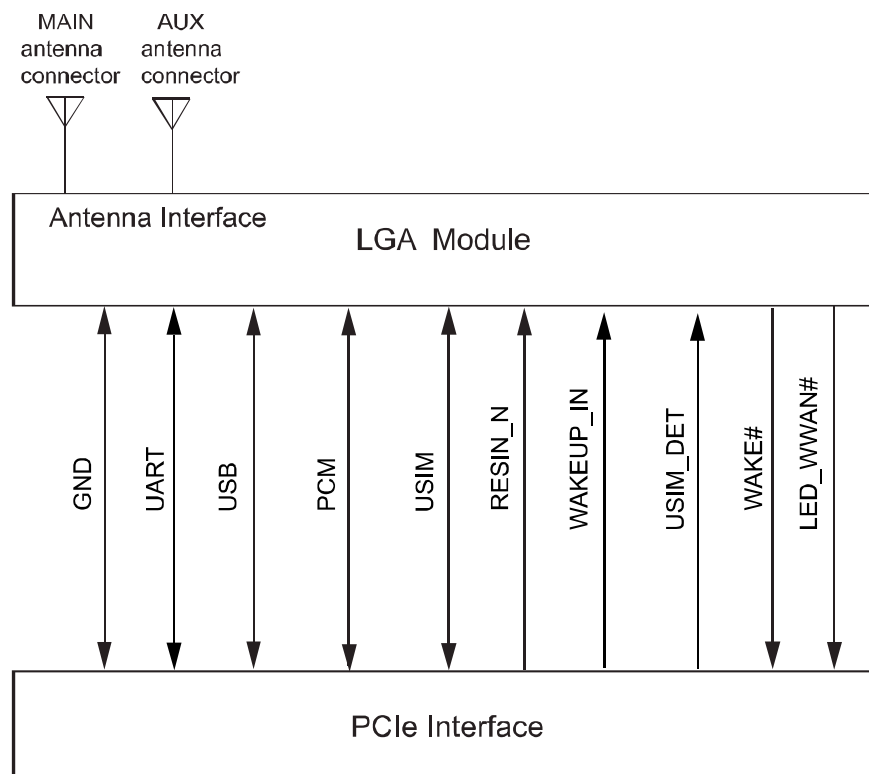
- [1]: When the ME909s Mini PCIe module works in the range from -40°C to -20°C or $+60^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, **NOT** all their RF performances comply with 3GPP specifications.
- The thermal design must be implemented according to the chapter 6.6 . If not, the overheat protection mechanism will be triggered due to overheated Mini PCIe module and the network connection will be terminated.

2.3 Circuit Block Diagram

The module is developed based on Huawei's Balong Hi6921M platform. Figure 2-1 shows the circuit block diagram of the ME909s Mini PCIe Adapter. The major functional units of the Mini PCIe Adapter contain the following parts:

- LGA Module
- Control Signals
- Antenna Connectors

Figure 2-1 Circuit block diagram of the ME909s Mini PCIe module





3

Description of the Application Interfaces

3.1 About This Chapter

This chapter mainly describes the external application interfaces of the ME909s Mini PCIe module, including:

- Mini PCIe Interface
- Power Interface
- Signal Control Interface
- UART Interface
- USB Interface
- USIM Card Interface
- Audio Interface
- NC Pins
- Reserved Pins

3.2 Mini PCIe Interface

The ME909s Mini PCIe module uses a Mini PCIe interface as its external interface. For details about the module and dimensions, see 6.2 Dimensions.



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

Figure 3-1 Sequence of Mini PCIe interface

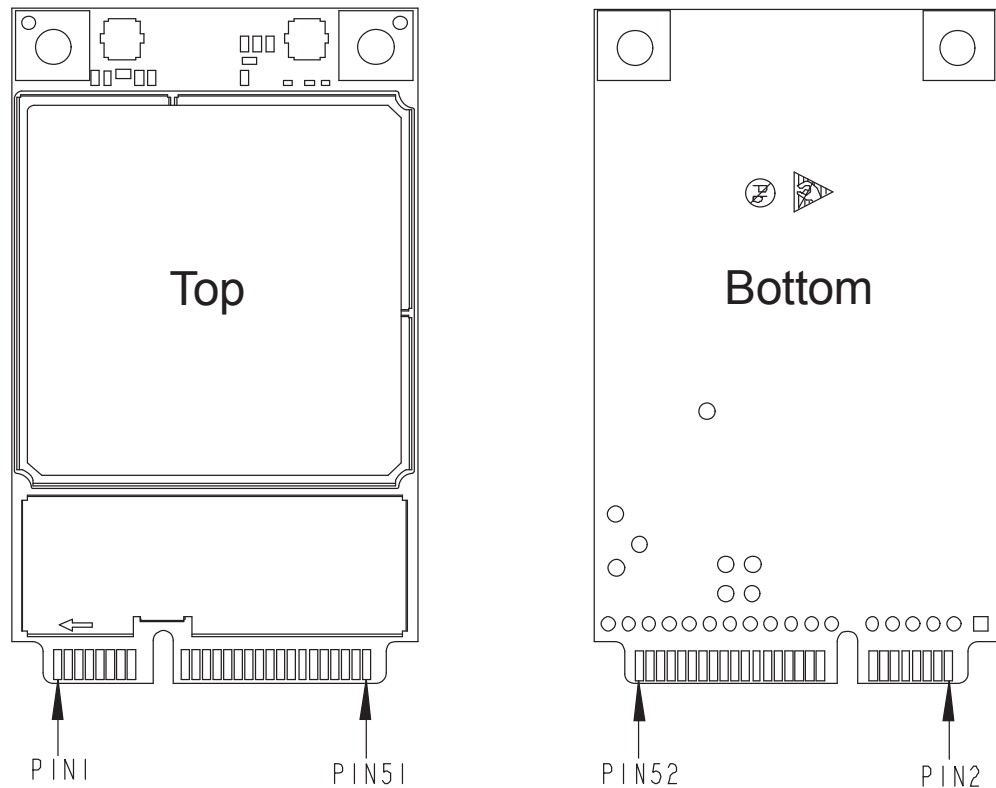


Table 3-1 shows the pin definitions of the Mini PCIe Interface.

Table 3-1 Pin definitions of the Mini PCIe Interface

Pin No.	Pin Name		Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comment
	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	-	0.45	-
2	3.3Vaux	VCC_3V3	PI	3.8 V DC supply input	-	3.2	3.8	4.2	-
3	COEX1	UART_CTS	I	UART Clear to Send	V_{IH}	1.17	1.8	1.98	-
					V_{IL}	-0.3	-	0.63	-



Pin No.	Pin Name		Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comment
	Mini PCI Express Standard Description	HUAWEI Pin Description							
4	GND	GND	-	Ground	-	-	-	-	-
5	COEX2	UART_RTS	O	UART request to send	V _{OH}	1.35	1.8	1.98	-
					V _{OL}	0	-	0.45	-
6	1.5 V	NC	-	Not connected	-	-	-	-	-
7	CLKREQ#	WAKEUP_IN	I	Sleep authorization signal. H: Sleep mode is disabled. L: Sleep mode is enabled (default value).	V _{IH}	1.17	1.8	1.98	-
					V _{IL}	-0.3	-	0.63	-
8	UIM_PWR	USIM_PWR	PO	Power supply for USIM card	-	1.75	1.8	1.98	USIM_PWR =1.8 V
					-	2.75	3.0	3.3	USIM_PWR =3.0 V
9	GND	GND	-	Ground	-	-	-	-	-
10	UIM_DATA	USIM_DATA	I/O	USIM card data	V _{IH}	0.65 x USIM_PWR	-	3.30	USIM_PWR =1.8 V or 3.0 V
					V _{IL}	0	-	0.25 x USIM_PWR	
					V _{OH}	0.7 x USIM_PWR	-	3.3	
					V _{OL}	0	-	0.2 x USIM_PWR	
11	REFCLK-	NC	-	Not connected	-	-	-	-	-



Pin No.	Pin Name		Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comment
	Mini PCI Express Standard Description	HUAWEI Pin Description							
12	UIM_CLK	USIM_CLK	O	USIM card clock	V _{OH}	0.7 x USIM_PWR	-	3.3	USIM_PWR = 1.8 V or 3.0 V
					V _{OL}	0	-	0.2 x USIM_PWR	
13	REFCLK+	NC	-	Not connected	-	-	-	-	-
14	UIM_RESET	USIM_RESET	O	USIM card reset	V _{OH}	0.7 x USIM_PWR	-	3.3	USIM_PWR = 1.8 V or 3.0 V
					V _{OL}	0	-	0.2 x USIM_PWR	
15	GND	GND	-	Ground	-	-	-	-	-
16	UIM_Vpp	NC	-	Not connected	-	-	-	-	-
17	Reserved	UART_RX	I	UART receive data input	V _{IH}	1.17	1.8	1.98	-
					V _{IL}	-0.3	-	0.63	-
18	GND	GND	-	Ground	-	-	-	-	-
19	Reserved	UART_TX	O	UART transmit output	V _{OH}	1.35	1.8	1.98	-
					V _{OL}	0	-	0.45	-
20	W_DISABLE#	Reserved	-	Reserved	-	-	-	-	-
21	GND	GND	-	Ground	-	-	-	-	-
22	PERST#	RESIN_N	I	Reset module Active-low	V _{IL}	0	0	0.18	The signal is internally pulled up.
					V _{IH}	1.62	1.8	1.98	
23	PERn0	NC	-	Not connected	-	-	-	-	-
24	3.3Vaux	VCC_3V3	PI	3.8 V DC supply input	-	3.2	3.8	4.2	-
25	PERp0	NC	-	Not connected	-	-	-	-	-



Pin No.	Pin Name		Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comment
	Mini PCI Express Standard Description	HUAWEI Pin Description							
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	PI	3.8 V DC supply input	-	3.2	3.8	4.2	-
40	GND	GND	-	Ground	-	-	-	-	-
41	3.3Vaux	VCC_3V3	PI	3.8 V DC supply input	-	3.2	3.8	4.2	-
42	LED_WWA N#	LED_WWA N#	O	Mode indicator current sink Drive strength: 10 mA	-	-	-	-	-
43	GND	GND	-	Ground	-	-	-	-	-
44	LED_WLAN #	USIM_DET	I	USIM hot swap detection pin. When it is High, USIM is present. When it is Low, USIM is absent.	V _{IH}	1.62	1.8	1.98	The signal is internally pulled up. Keep USIM_DET floating, if it is not used.
					V _{IL}	0	-	0.18	
45	Reserved	PCM_CLK	O	PCM interface clock	V _{OL}	-0.3	0	0.45	-
					V _{OH}	1.35	1.8	1.98	-



Pin No.	Pin Name		Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comment
	Mini PCI Express Standard Description	HUAWEI Pin Description							
46	LED_WPAN #	NC	-	Not connected	-	-	-	-	-
47	Reserved	PCM_DOUT	O	PCM I/F data output	V _{OL}	-0.3	0	0.45	-
					V _{OH}	1.35	1.8	1.98	-
48	1.5 V	NC	-	Not connected	-	-	-	-	-
49	Reserved	PCM_DIN	I	PCM I/F data input	V _{IL}	-0.3	0	0.63	-
					V _{IH}	1.17	1.8	1.98	-
50	GND	GND	-	Ground	-	-	-	-	-
51	Reserved	PCM_SYNC	O	PCM interface sync	V _{OL}	-0.3	0	0.45	-
					V _{OH}	1.35	1.8	1.98	-
52	3.3Vaux	VCC_3V3	PI	3.8 V DC supply input	-	3.2	3.8	4.2	-



NOTE

- **P** indicates power pins; **I** indicates pins for digital signal input; **O** indicates pins for digital signal output. **PO** indicates power output pins; **PI** indicates power input pins.
- **V_{IL}** indicates Low-level Input voltage; **V_{IH}** indicates High-level Input voltage; **V_{OL}** indicates Low-level Output voltage; **V_{OH}** indicates High-level Output voltage.
- The **NC** (Not Connected) pins are floating and there are no signal connected to these pins.
- 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 Interface

3.3.1 Power Sources and Grounds

For the Mini PCIe Adapter, +3.3Vaux is the only voltage supply that is available.

Table 3-2 Power and ground specifications

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)
2, 24, 39, 41 and 52	VCC_3V3	PI	3.8 V DC supply input	-	3.2	3.8	4.2



Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)
4, 9, 15, 18, 21, 26, 27, 29, 34, 35, 37, 40, 43, and 50	GND	-	Ground	-	-	-	-



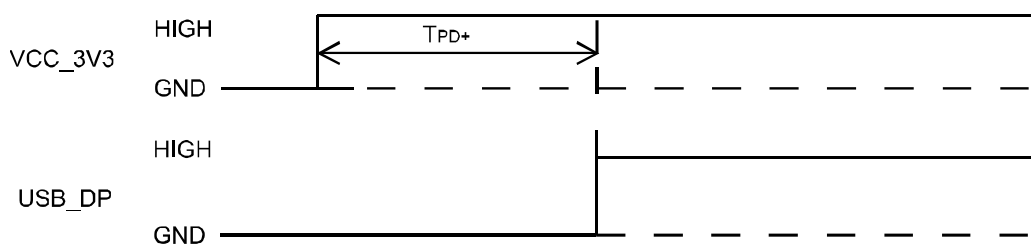
NOTE

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.

3.3.2 Power Supply Time Sequence

Power on Sequence

Figure 3-2 Power on timing sequence



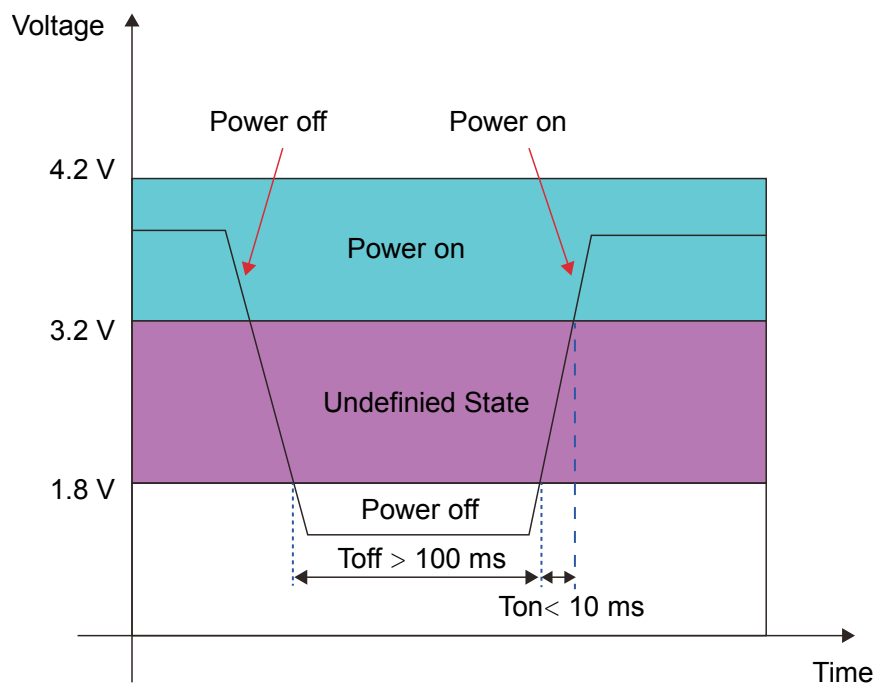
Parameter	Remarks	Time (Nominal value)	Unit
T_{PD+}	Power Valid to USB D+ high	5.5	s

Power off Sequence

Cutting off the VCC_3V3 power supply will power off the module.



Figure 3-3 Power supply time sequence for power cycling



Parameter	Remarks	Time	Unit
T_{off}	Power off time	>100	ms
T_{on}	Power on time	<10	ms



NOTE

The rising time of VCC_3V3 should be 100 μs at least.

3.4 Signal Control Interface

3.4.1 Overview

The signal control part of the interface in the ME909s Mini PCIe module consists of the following:

- WAKE# signal
- WAKEUP_IN signal
- RESIN_N signal
- LED_WWAN# signal

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



Table 3-3 Definitions of the pins on the signal control interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comment
1	WAKE#	O	Open collector active low signal. This signal is used to wake up the host.	V_{OL}	0	-	0.45	-
7	WAKEUP_IN	I	Sleep authorization signal. H: Sleep mode is disabled. L: Sleep mode is enabled (default value).	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	-0.3	-	0.63	-
22	RESIN_N	I	Reset module Active-low	V_{IL}	0	0	0.18	The signal is internally pulled up.
				V_{IH}	1.62	1.8	1.98	
42	LED_WWAN#	O	Mode indicator current sink Drive strength: 10 mA	-	-	-	-	-

3.4.2 WAKE# Signal

This signal is used for module to wake up the host. It is designed as an OC (Open Collector) 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 for 1s to wake up the host.

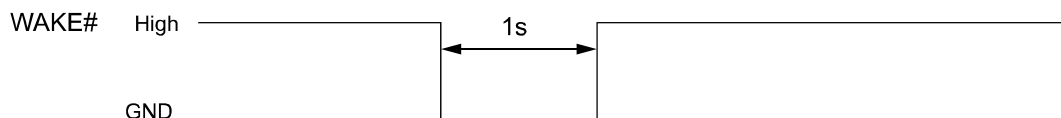
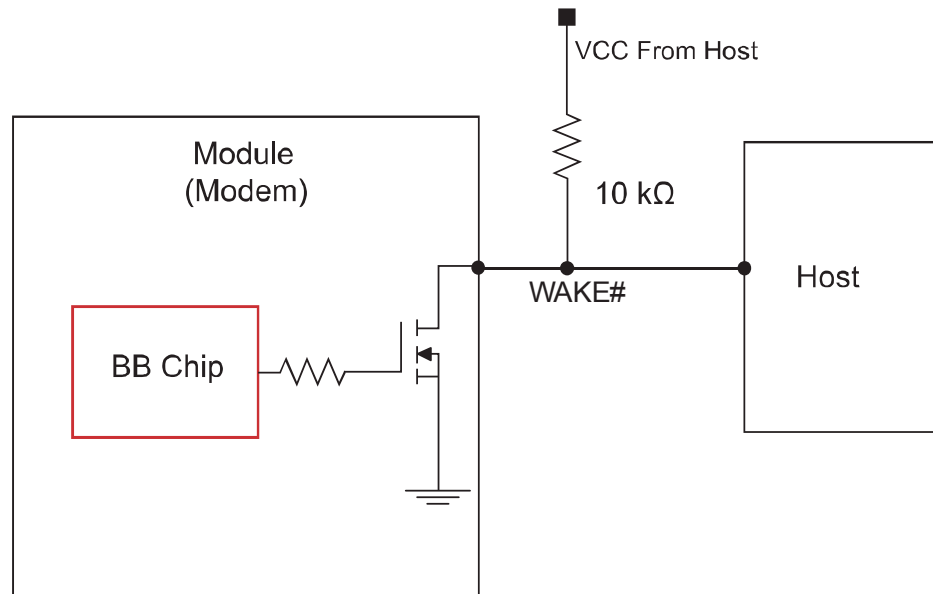




Figure 3-4 Connections of the WAKE# pin



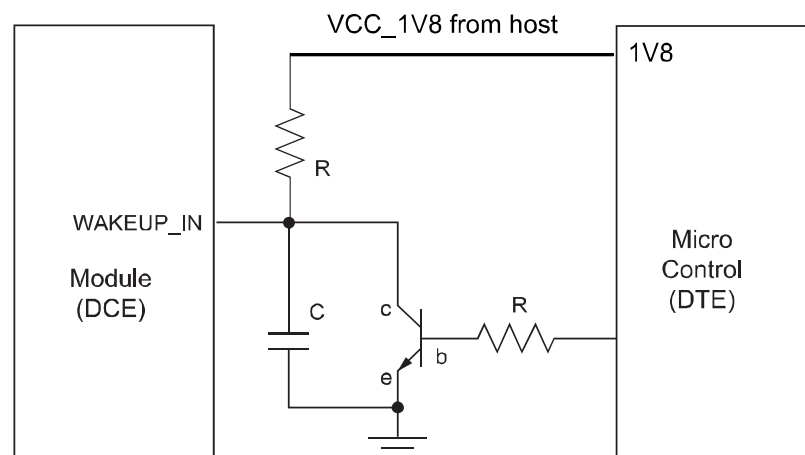
3.4.3 WAKEUP_IN Signal

WAKEUP_IN pin is the authorization signal of ME909s Mini PCIe module entering sleep mode. If this pin is not connected, it will keep in low level by default.

Table 3-3 shows the definition of the WAKEUP_IN signal.

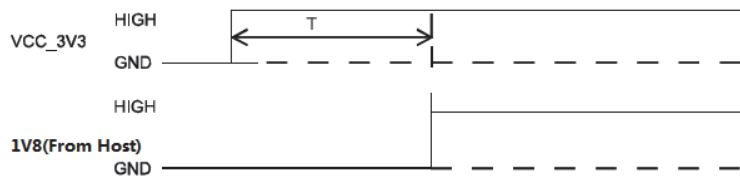
The module cannot enter sleep mode when this pin is pulled up (1.8 V), and the module should be waked up when the pin is pulled up.

Figure 3-5 Connections of the WAKEUP_IN pin



NOTE

Make sure the module is powered on and then pull up the pin to 1.8V after the VCC_3V3 is stable for 1s.



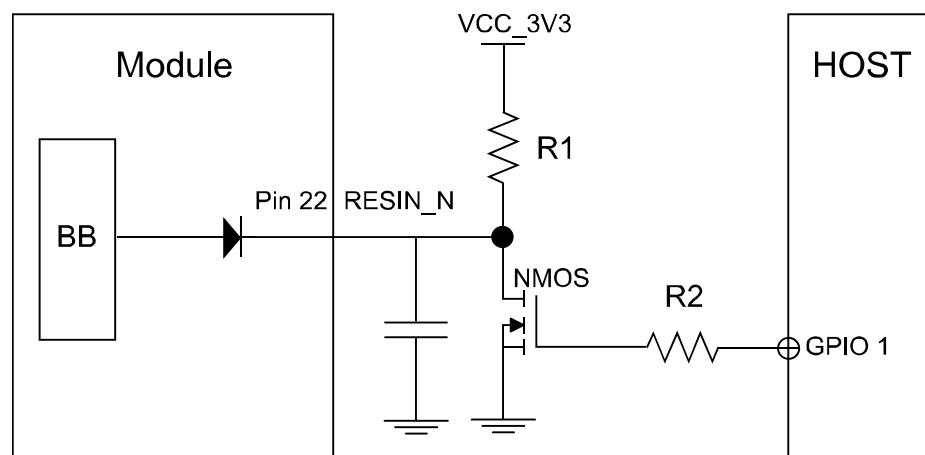
Parameter	Remarks	Time (Nominal value)	Unit
T	1V8 (From Host) Valid to high	1	s

3.4.4 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 3.8 V is applied and it is active-low.

Figure 3-6 Connections of the RESIN_N pin



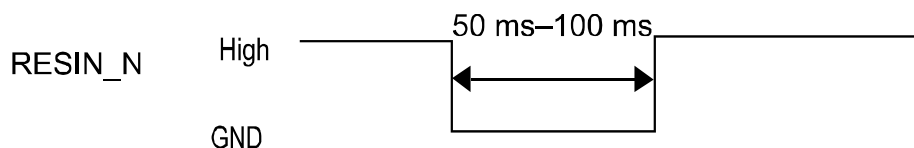


CAUTION

- As the RESIN_N signal is relatively sensitive, it is recommended that you install a 10 nF to 0.1 μ F 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 ME909s Mini PCIe module supports hardware reset function. If the software of the ME909s Mini PCIe module stops responding, you can reset the hardware through the RESIN_N signal as shown in Figure 3-7. 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 3-7 Reset pulse timing



NOTE

The RESIN_N pin is optional, which can be not connected. If the module is frequently powered on and off or restart during the using, it may cause damage and reduce its service life. Follow the advices below if you encounter any of the following issues:

- If the network search failed but the module can communicate with the host, do not use Power pulse or external reset, but run the AT command to control the module's network search. Perform a query at intervals. For example, perform the first query after 0.5 minute; the second query after 1 minute, the third query after 2 minutes. You may adjust the interval based on your experience. If it's not urgent, wait for a longer time before you perform a query again.

Perform the following operations: When the serial port can response, disable the RF by the AT command to the module, wait for 5.5 seconds and restore the standard mode, and the module will start to search the network again and complete network registration.

- Module identification errors (including unresponsive AT command). Do not frequently restart the module or power on/off the device. You may use reset (or power on the module once again) to restart the module once, and check if the module's communication works properly. If the issue persists, wait for 90 seconds and start the module again.

If your questions or issues are not covered in this file, contact and consult the FAE.



3.4.5 LED_WWAN# Signal

ME909s Mini PCIe module provides an LED_WWAN# signal to indicate the work status.

This function is disabled by default, it is controlled by AT^LEDCTRL. For details about the command, please refer to *HUAWEI ME909s Series LTE Module AT Command Interface Specification*.

Table 3-4 State of the LED_WWAN# pin

No.	Operating Status	LED_WWAN#
1	No service or 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

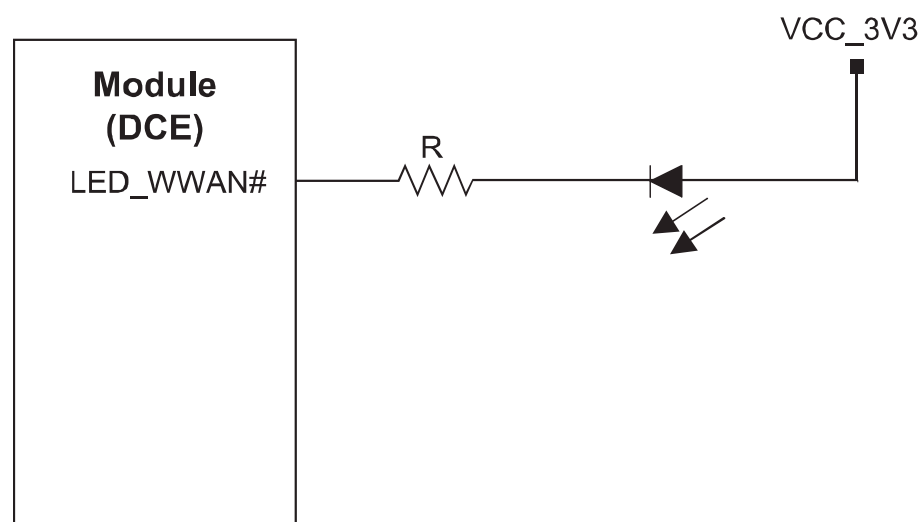


NOTE

The voltage level of the LED_WWAN# pin is controlled by AT^LEDCTRL. Its states are as listed in Table 3-4 only when the indicator is turned on and runs Huawei's default blinking scheme.

Figure 3-8 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. The mode indicator (LED_WWAN#) is current sink. Drive strength: 10 mA.

Figure 3-8 Driving circuit





3.5 UART Interface

3.5.1 Overview

The ME909s Mini PCIe module provides the UART (4-wire UART) interface for one asynchronous communication channel. As the UART interface supports signal control through standard modem handshake, AT commands are entered and serial communication is performed through the UART interface. The UART have 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
- UART supports baud rate: 300 bit/s, 600 bit/s, 1200 bit/s, 2400 bit/s, 4800 bit/s, 9600 bit/s, 19200 bit/s, 38400 bit/s, 57600 bit/s, 115200 bit/s (default), 230400 bit/s, 1000000 bit/s, 3000000 bit/s
- Baud rate auto adaptive change is supported. AP must choose one default Baud rate to communicate with module in the beginning.

Table 3-5 lists the UART interface signals.

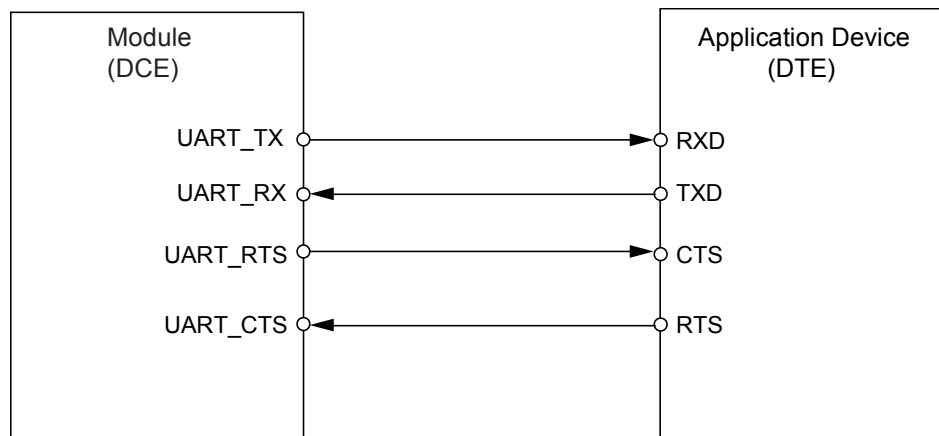
Table 3-5 UART interface signals

Pin No.	Pin Description	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)
3	UART_CTS	I	UART clear to send	V _{IH}	1.17	1.8	1.98
				V _{IL}	−0.3	-	0.63
5	UART_RTS	O	UART request to send	V _{OH}	1.35	1.8	1.98
				V _{OL}	0	-	0.45
17	UART_RX	I	UART receive data input	V _{IH}	1.17	1.8	1.98
				V _{IL}	−0.3	-	0.63
19	UART_TX	O	UART transmit output	V _{OH}	1.35	1.8	1.98
				V _{OL}	0	-	0.45



3.5.2 Circuit Recommended for the UART Interface

Figure 3-9 Connection of the UART interface in the ME909s Mini PCIe module (DCE) with the host (DTE)



NOTE

- The UART cannot wake up the module from the sleep status, and you can pull up the WAKEUP_IN signal for 1s instead.
- The level of RS-232 transceivers must match that of the ME909s Mini PCIe module.

3.6 USB Interface

The ME909s Mini PCIe module is compliant with USB 2.0 protocol. The USB interface is powered directly from the VCC_3V3 supply. The USB input/output lines are compatible with the USB 2.0 signal specifications. Figure 3-10 shows the circuit of the USB interface.

Table 3-6 Definition of the USB interface

PinNo.	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 ME909s Mini PCIe USB signal, please refer to the chapter 7.3.2 of *Universal Serial Bus Specification 2.0*.



Figure 3-10 Recommended circuit of USB interface



3.7 USIM Card Interface

3.7.1 Overview

The ME909s Mini PCIe module provides a USIM card interface complying with the ISO 7816-3 standard and supports both Class B and Class C USIM cards.

Table 3-7 USIM card interface signals

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)	Comment
14	USIM_RESET	O	USIM card reset	V _{OH}	0.7 x USIM_PWR	-	3.3	USIM_PWR =1.8 V or 3.0 V
				V _{OL}	0	-	0.2 x USIM_PWR	
12	USIM_CLK	O	USIM card clock	V _{OH}	0.7 x USIM_PWR	-	3.3	USIM_PWR =1.8 V or 3.0 V
				V _{OL}	0	-	0.2 x USIM_PWR	
10	USIM_DATA	I/O	USIM card data	V _{IH}	0.65 x USIM_PWR	-	3.3	USIM_PWR =1.8 V or 3.0 V
				V _{IL}	0	-	0.25 x USIM_PWR	



Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)	Comment
				V _{OH}	0.7 x USIM_PWR	-	3.3	
				V _{OL}	0	-	0.2 x USIM_PWR	
8	USIM_PWR	PO	Power supply for USIM card.	-	1.75	1.8	1.98	USIM_PWR =1.8 V
				-	2.75	2.85	3.3	USIM_PWR =3.0 V
44	USIM_DET	I	USIM hot swap detection pin. When it is High, USIM is present. When it is Low, USIM is absent.	V _{IH}	1.62	1.8	1.98	The module is pulled up inside. Keep USIM_DET floating, if it is not used.
				V _{IL}	0	-	0.18	

3.7.2 USIM_DET Pin

ME909s Mini PCIe module supports USIM hot swap function.

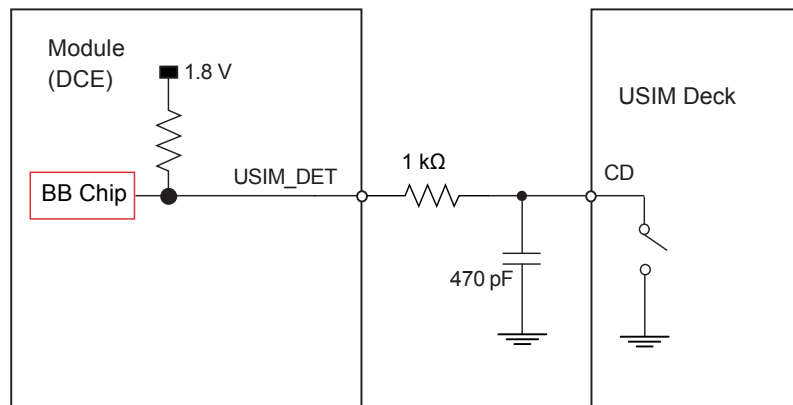
ME909s Mini PCIe module provides an input pin (USIM_DET) to detect whether the USIM card is present or not. This pin is a level trigger pin, and it is internally pulled up. If customers do not use the USIM hot swap function, keep USIM_DET floating.

Table 3-8 Function of the USIM_DET pin

No.	USIM_DET	Function
1	High level	USIM card insertion. If the USIM card is present, USIM_DET should be High.
2	Low level	USIM card removal. If the USIM card is absent, USIM_DET should be Low.



Figure 3-11 Connections of the USIM_DET pin



If USIM card is absent, the CD connects to Ground.
If USIM card is present, the CD is open.

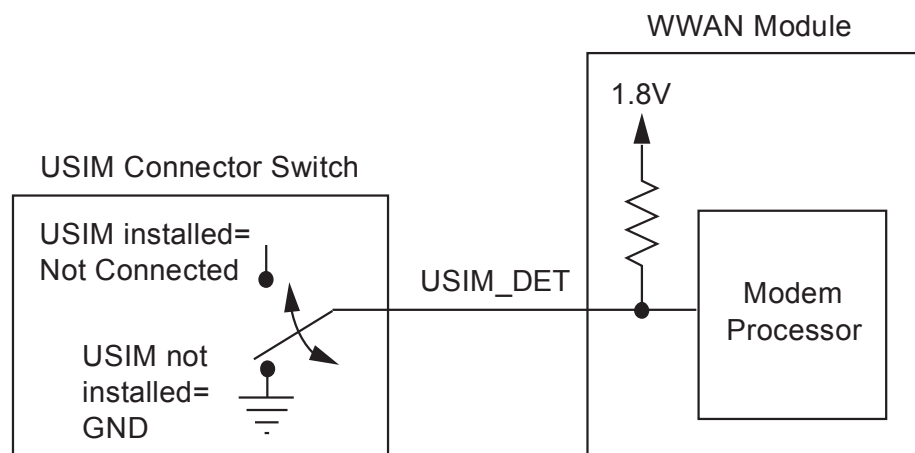
CD is a pin detecting of USIM in the USIM socket, in normal, there will be a detect pin in the USIM socket.



CAUTION

- The normal USIM connector should be employed. The logic of USIM_DET is shown as Figure 3-12 . High represents that USIM is inserted; Low represents that USIM is removed.
- When USIM is inserted (hot), USIM_DET will change from Low to High;
- When USIM is removed (hot), USIM_DET will change from High to Low;
- The module will detect the level of USIM_DET to support the hot swap.

Figure 3-12 Logic of USIM_DET



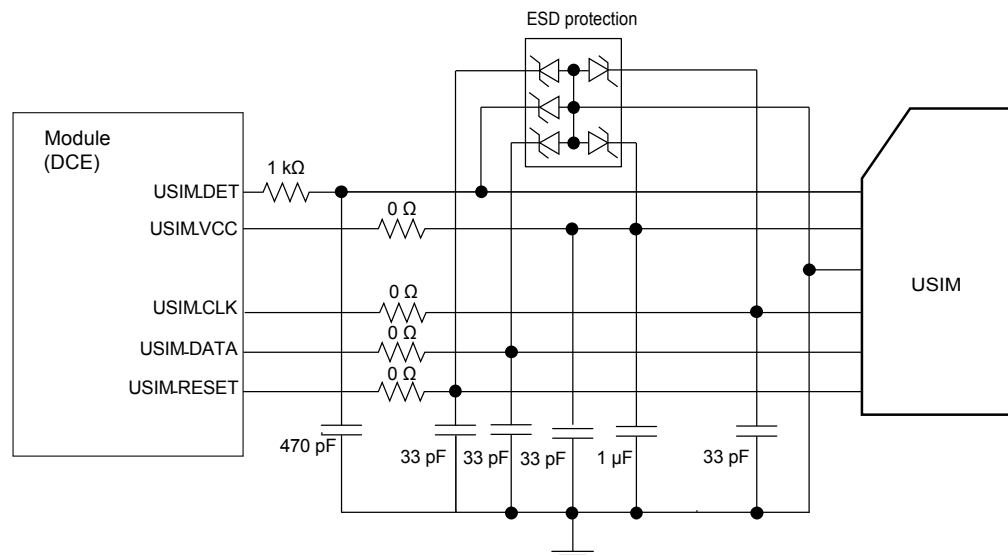


3.7.3 Circuit Recommended for the USIM Card Interface

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

Figure 3-13 shows the circuit of the USIM card interface.

Figure 3-13 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 USIM_CLK and USIM_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 33 pF capacitor and 1 μF capacitor are placed between the USIM_PWR and Ground pins in a parallel manner (If USIM_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 USIM_DATA and Ground pins, the USIM_RESET and Ground pins, and the USIM_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 V_{rwm} 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.



- It is not recommended that pull the USIM_DATA pin up during design as a 15000 Ω resistor is used to connect the USIM_DATA pin to the USIM_PWR.
- It is recommended to place a 1 k Ω resistor in series on the USIM_DET interface for ESD protection if USIM_DET is used.

3.8 Audio Interface

The ME909s Mini PCIe module provides one PCM digital audio interface. Table 3-9 lists the signals on the digital audio interface.

Table 3-9 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 interface clock	V _{OL}	-0.3	0	0.45
				V _{OH}	1.35	1.8	1.98
47	PCM_DOUT	O	PCM I/F data output	V _{OL}	-0.3	0	0.45
				V _{OH}	1.35	1.8	1.98
49	PCM_DIN	I	PCM I/F data input	V _{IL}	-0.3	0	0.63
				V _{IH}	1.17	1.8	1.98
51	PCM_SYNC	O	PCM interface sync	V _{OL}	-0.3	0	0.45
				V _{OH}	1.35	1.8	1.98

The ME909s Mini PCIe module interface enables communication with an external codec to support linear format.



Figure 3-14 Circuit diagram of the interface of the PCM (ME909s Mini PCIe module is used as PCM master)

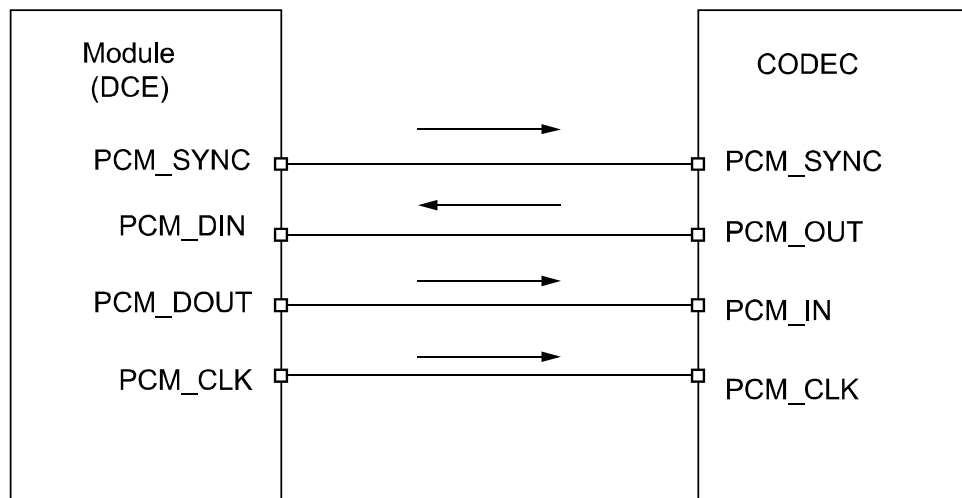
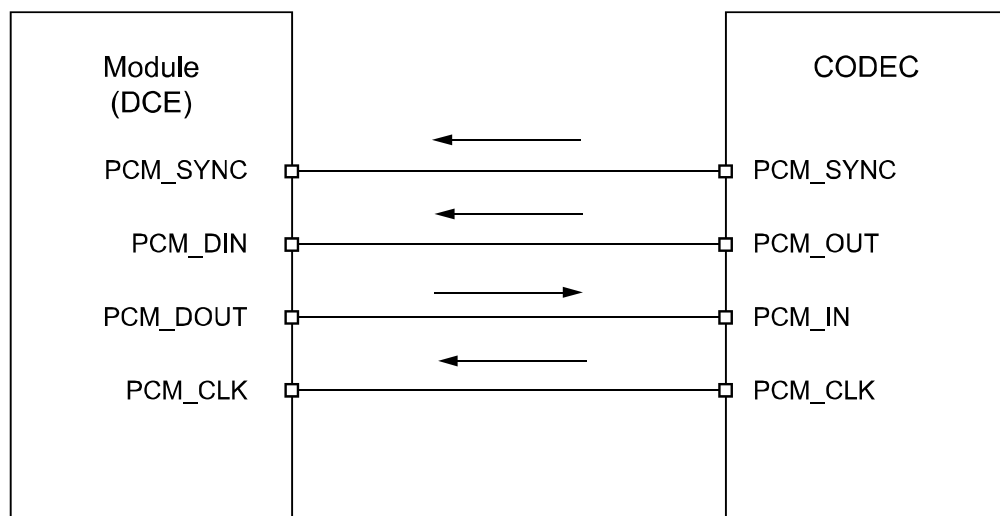


Figure 3-15 Circuit diagram of the interface of the PCM (ME909s Mini PCIe module is used as PCM slave)



NOTE

- The signal level of CODEC must match that of the module.
- ME909s Mini PCIe module supports both master and slave mode.
- PCM_SYNC: Output when PCM is in master mode; Input when PCM is in slave mode.
- PCM_CLK: Output when PCM is in master mode; Input when PCM is in slave mode.
- It is recommended that a TVS be used on the related interface, to prevent electrostatic discharge and protect integrated circuit (IC) components.



3.9 NC Pins

The ME909s Mini PCIe module has some NC pins. All of NC pins should not be connected. Please keep these pins open.

Table 3-10 NC pins

Pin No.	Pin Name	Pad Type	Description	Min. (V)	Typ. (V)	Max. (V)
6, 11, 13, 16, 23, 25, 28, 30–33, 46 and 48	NC	-	Not connected	-	-	-

3.10 Reserved Pins

The ME909s Mini PCIe module provides some reserved pins. All reserved pins cannot be used by the customer.

Table 3-11 Reserved pin

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)
20	Reserved	-	Reserved	-	-	-	-



4 RF Specifications

4.1 About This Chapter

This chapter describes the RF specifications of the ME909s Mini PCIe module, including:

- Operating Frequencies
- Conducted RF Measurement
- Conducted Rx Sensitivity and Tx Power
- Antenna Design Requirements
- Suggestions about LTE and 2.4 GHz Wi-Fi Co-existence

4.2 Operating Frequencies

Table 4-1 to Table 4-3 show the RF bands supported by the ME909s Mini PCIe module.

Table 4-1 RF bands of the ME909s-821 Mini PCIe module

Operating Band	Tx	Rx
UMTS Band 1	1920 MHz–1980 MHz	2110 MHz–2170 MHz
UMTS Band 5	824 MHz–849 MHz	869 MHz–894 MHz
UMTS Band 8	880 MHz–915 MHz	925 MHz–960 MHz
UMTS Band 9	1749.9 MHz–1784.9 MHz	1844.9 MHz–1879.9 MHz
GSM 900	880 MHz–915 MHz	925 MHz–960 MHz
GSM 1800	1710 MHz–1785 MHz	1805 MHz–1880 MHz
LTE Band 1	1920 MHz–1980 MHz	2110 MHz–2170 MHz
LTE Band 3	1710 MHz–1785 MHz	1805 MHz–1880 MHz
LTE Band 8	880 MHz–915 MHz	925 MHz–960 MHz



Operating Band	Tx	Rx
LTE Band 38	2570 MHz–2620 MHz	2570 MHz–2620 MHz
LTE Band 39	1880 MHz–1920 MHz	1880 MHz–1920 MHz
LTE Band 40 ^[1]	2300 MHz–2400 MHz	2300 MHz–2400 MHz
LTE Band 41 ^[2]	2496 MHz–2690 MHz	2496 MHz–2690 MHz
TD-SCDMA Band 34	2010 MHz–2025 MHz	2010 MHz–2025 MHz
TD-SCDMA Band 39	1880 MHz–1920 MHz	1880 MHz–1920 MHz

 NOTE

- [1]: The module may not meet the RF performance requirements at frequency 2390–2400 MHz in the LTE B40 band.
- [2]: The module may not meet the RF performance requirements at frequency 2496–2555 MHz or 2655–2690 MHz in the LTE B41 band.

Table 4-2 RF bands of the ME909s-120 Mini PCIe module

Operating Band	Tx	Rx
UMTS Band 1	1920 MHz–1980 MHz	2110 MHz–2170 MHz
UMTS Band 2	1850 MHz–1910 MHz	1930 MHz–1990 MHz
UMTS Band 5	824 MHz–849 MHz	869 MHz–894 MHz
UMTS Band 8	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	1710 MHz–1785 MHz	1805 MHz–1880 MHz
GSM 1900	1850 MHz–1910 MHz	1930 MHz–1990 MHz
LTE Band 1	1920 MHz–1980 MHz	2110 MHz–2170 MHz
LTE Band 2	1850 MHz–1910 MHz	1930 MHz–1990 MHz
LTE Band 3	1710 MHz–1785 MHz	1805 MHz–1880 MHz
LTE Band 4	1710 MHz–1755 MHz	2110 MHz–2155 MHz
LTE Band 5	824 MHz–849 MHz	869 MHz–894 MHz
LTE Band 7	2500 MHz–2570 MHz	2620 MHz–2690 MHz
LTE Band 8	880 MHz–915 MHz	925 MHz–960 MHz
LTE Band 20	832 MHz–862 MHz	791 MHz–821 MHz



Table 4-3 RF bands of the ME909s-821a Mini PCIe module

Operating Band	Tx	Rx
UMTS Band 1	1920 MHz–1980 MHz	2110 MHz–2170 MHz
UMTS Band 5	824 MHz–849 MHz	869 MHz–894 MHz
UMTS Band 8	880 MHz–915 MHz	925 MHz–960 MHz
UMTS Band 9	1749.9 MHz–1784.9 MHz	1844.9 MHz–1879.9 MHz
GSM 900	880 MHz–915 MHz	925 MHz–960 MHz
GSM 1800	1710 MHz–1785 MHz	1805 MHz–1880 MHz
LTE Band 1	1920 MHz–1980 MHz	2110 MHz–2170 MHz
LTE Band 3	1710 MHz–1785 MHz	1805 MHz–1880 MHz
LTE Band 5	824 MHz–849 MHz	869 MHz–894 MHz
LTE Band 8	880 MHz–915 MHz	925 MHz–960 MHz
LTE Band 38	2570 MHz–2620 MHz	2570 MHz–2620 MHz
LTE Band 39	1880 MHz–1920 MHz	1880 MHz–1920 MHz
LTE Band 40 ^[1]	2300 MHz–2400 MHz	2300 MHz–2400 MHz
LTE Band 41 ^[2]	2496 MHz–2690 MHz	2496 MHz–2690 MHz
TD-SCDMA Band 34	2010 MHz–2025 MHz	2010 MHz–2025 MHz
TD-SCDMA Band 39	1880 MHz–1920 MHz	1880 MHz–1920 MHz



NOTE

- [1]: The module may not meet the RF performance requirements at frequency 2390–2400 MHz in the LTE B40 band.
- [2]: The module may not meet the RF performance requirements at frequency 2496–2555 MHz or 2655–2690 MHz in the LTE B41 band.

4.3 Conducted RF Measurement

4.3.1 Test Environment

Test instrument	R&S CMU200, R&S CMW500, Agilent E5515C, Starpoint SP6010
Power supply	KEITHLEY 2306, Aglient66319D
RF cable for testing	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 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 ME909s Mini PCIe module. Table 4-4 to Table 4-5 list the typical tested values of the typical Rx sensitivity.

Table 4-4 ME909s-821 Mini PCIe module conducted Rx sensitivity

Band	Typical Value (Unit: dBm)	Note
GSM 900	-109	GMSK (BER < 2.43%)
	-109.5	8PSK (MCS5, BLER < 10%)
GSM 1800	-111	GMSK (BER < 2.43%)
	-110.5	8PSK (MCS5, BLER < 10%)
UMTS Band 1	-111	BER < 0.1%
UMTS Band 5	-111	BER < 0.1%
UMTS Band 8	-102.2	BER < 0.1%
UMTS Band 9	-102	BER < 0.1%
LTE Band 1	-102	FDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 3	-101	FDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 8	-102	FDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 38	-101	TDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 39	-100	TDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 40	-103.5	TDD QPSK throughput > 95%, 10 MHz Bandwidth



Band	Typical Value (Unit: dBm)	Note
LTE Band 41	-103.5	TDD QPSK throughput > 95%, 10 MHz Bandwidth
TD-SCMDA Band 34	-109	BER < 0.1%
TD-SCMDA Band 39	-109.5	BER < 0.1%

Table 4-5 ME909s-120 Mini PCIe module conducted Rx sensitivity

Band	Test Value (Unit: dBm)	Note
GSM 850	-108.5	BER Class II < 2.44%
GSM 900	-108.5	BER Class II < 2.44%
GSM 1800	-108	BER Class II < 2.44%
GSM 1900	-108.5	BER Class II < 2.44%
WCDMA Band 1	-110	BER < 0.1%
WCDMA Band 2	-111	BER < 0.1%
WCDMA Band 5	-110	BER < 0.1%
WCDMA Band 8	-111	BER < 0.1%
LTE Band 1	-102.2	Throughput ≥ 95%, 10 MHz Bandwidth
LTE Band 2	-101.6	Throughput ≥ 95%, 10 MHz Bandwidth
LTE Band 3	-102	Throughput ≥ 95%, 10 MHz Bandwidth
LTE Band 4	-102.2	Throughput ≥ 95%, 10 MHz Bandwidth
LTE Band 5	-101.1	Throughput ≥ 95%, 10 MHz Bandwidth
LTE Band 7	-101.1	Throughput ≥ 95%, 10 MHz Bandwidth
LTE Band 8	-102	Throughput ≥ 95%, 10 MHz Bandwidth
LTE Band 20	-102.2	Throughput ≥ 95%, 10 MHz Bandwidth

Table 4-6 ME909s-821a Mini PCIe module conducted Rx sensitivity

Band	Typical Value (Unit: dBm)	Note
GSM 900	-109	GMSK (BER < 2.43%)
	-109.5	8PSK (MCS5, BLER < 10%)
GSM 1800	-111	GMSK (BER < 2.43%)



Band	Typical Value (Unit: dBm)	Note
	-110.5	8PSK (MCS5, BLER < 10%)
UMTS Band 1	-111	BER < 0.1%
UMTS Band 5	-111	BER < 0.1%
UMTS Band 8	-102.2	BER < 0.1%
UMTS Band 9	-102	BER < 0.1%
LTE Band 1	-102	FDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 3	-101	FDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 5	-102	FDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 8	-102	FDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 38	-101	TDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 39	-100	TDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 40	-103.5	TDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 41	-103.5	TDD QPSK throughput > 95%, 10 MHz Bandwidth
TD-SCMDA Band 34	-109	BER < 0.1%
TD-SCMDA Band 39	-109.5	BER < 0.1%



NOTE

- The test values are the average of some test samples.
- LTE sensitivity is tested in SIMO (Main + AUX).

4.4.2 Conducted Transmit Power

The conducted transmit power is another indicator that measures the performance of ME909s Mini PCIe module. Table 4-7 and Table 4-8 list the typical tested values of the conducted transmit power.

Table 4-7 ME909s-821 Mini PCIe module conducted Tx power

Item		Typical Value (Unit: dBm)	Note (Unit: dB)
GSM 900	GMSK (1Tx Slot)	32.5	±1.5



Item		Typical Value (Unit: dBm)	Note (Unit: dB)
	8PSK (1Tx Slot)	27	±1.5
GSM 1800	GMSK (1Tx Slot)	29.5	±1.5
	8PSK (1Tx Slot)	26	±1.5
UMTS Band 1		23.5	±1.5
UMTS Band 5		23.5	±1.5
UMTS Band 8		23.5	±1.5
UMTS Band 9		23.5	±1.5
LTE Band 1		23	±2
LTE Band 3		23	±2
LTE Band 8		23	±2
LTE Band 38		23	±2
LTE Band 39		23	±2
LTE Band 40		23	±2
LTE Band 41		23	±2
TD-SCDMA Band 34		23.5	±1.5
TD-SCDMA Band 39		23.5	±1.5

Table 4-8 ME909s-120 Mini PCIe module conducted Tx power

Band		Typical Value (Unit: dBm)	Note (Unit: dB)
GSM 850	GMSK (1Tx Slot)	32.5	±1.5
	8PSK (1Tx Slot)	25.5	±1.5
GSM 900	GMSK (1Tx Slot)	32.5	±1.5
	8PSK (1Tx Slot)	25.5	±1.5
GSM 1800	GMSK (1Tx Slot)	29.5	±1.5
	8PSK (1Tx Slot)	25.5	±1.5
GSM 1900	GMSK (1Tx Slot)	29.5	±1.5
	8PSK (1Tx Slot)	25.5	±1.5
WCDMA Band 1		23.5	±1.5
WCDMA Band 2		23.5	±1.5
WCDMA Band 5		23.5	±1.5



Band	Typical Value (Unit: dBm)	Note (Unit: dB)
WCDMA Band 8	23.5	±1.5
LTE Band 1	22	±1.5
LTE Band 2	23	±2
LTE Band 3	22	±1.5
LTE Band 4	23	±2
LTE Band 5	23	±2
LTE Band 7	23	±2
LTE Band 8	23	±2
LTE Band 20	23	±2

Table 4-9 ME909s-821a Mini PCIe module conducted Tx power

Item		Typical Value (Unit: dBm)	Note (Unit: dB)
GSM 900	GMSK (1Tx Slot)	32.5	±1.5
	8PSK (1Tx Slot)	25.5	±1.5
GSM 1800	GMSK (1Tx Slot)	29.5	±1.5
	8PSK (1Tx Slot)	25.5	±1.5
UMTS Band 1		23.5	±1.5
UMTS Band 5		23.5	±1.5
UMTS Band 8		23.5	±1.5
UMTS Band 9		23.5	±1.5
LTE Band 1		22.5	±1.5
LTE Band 3		22	±1.5
LTE Band 5		23	±2
LTE Band 8		23	±2
LTE Band 38		23	±2
LTE Band 39		23	±2
LTE Band 40		23	±2
LTE Band 41		22.5	±2
TD-SCDMA Band 34		23.5	±1.5
TD-SCDMA Band 39		23.5	±1.5



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 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, U.FL-LP-088 made by HRS.

The following antenna efficiency (free space) is recommended for ME909s Mini PCIe 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 Ω). 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 ME909s Mini PCIe module:

- **S11 of the primary antenna: ≤ -6 dB**
- **S11 of the diversity antenna: ≤ -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 ME909s Mini PCIe 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 ME909s Mini PCIe 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: ≤ -12 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 ME909s Mini PCIe 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 (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 ME909s Mini PCIe module.

Primary/Diversity antenna: omnidirectional

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

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 ME909s Mini PCIe module:

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



ECC of the Antenna

ECC is short for Envelope Correlation Coefficient. It is the cross-correlation value of the complex patterns of the master and diversity antenna. It indicates how similar the magnitude and the phase patterns of the two antennas are. If two antennas have no similarity, the ECC should be zero. Actually, the less ECC, the better diversity performance.

The following ECC is recommended for ME909s Mini PCIe module.

- $ECC \leq 0.5$ (working frequency below 0.96 GHz)
- $ECC \leq 0.3$ (working frequency above 1.4 GHz)

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 (Total Isotropic Sensitivity)) 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 Antenna Requirements

The antenna for ME909s Mini PCIe module must fulfill the following requirements:

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 of primary antenna	ME909s-821 250 MHz in UMTS Band 1; LTE Band 1 170 MHz in GSM 1800; LTE Band 3 70 MHz in UMTS Band 5; 80 MHz in GSM 900; UMTS Band 8; LTE Band 8 130 MHz in UMTS Band 9 50 MHz in LTE Band 38



Antenna Requirements	
	40 MHz in LTE Band 39 100 MHz in LTE Band 40 194 MHz in LTE Band 41 15 MHz in TD-SCDMA Band 34 40 MHz in TD-SCDMA Band 39 ME909s-120 250 MHz in UMTS Band 1; LTE Band 1 140 MHz in GSM 1900; UMTS Band 2; LTE Band 2 170 MHz in GSM 1800; LTE Band 3 445 MHz in LTE Band 4 70 MHz in GSM 850; UMTS Band 5; LTE Band 5 190MHz in LTE Band 7 80 MHz in GSM 900; UMTS Band 8; LTE Band 8 71 MHz in LTE Band 20 ME909s-821a 250 MHz in UMTS Band 1; LTE Band 1 170 MHz in GSM 1800; LTE Band 3 70 MHz in UMTS Band 5; 80 MHz in GSM 900; UMTS Band 8; LTE Band 5, LTE Band 8 130 MHz in UMTS Band 9 50 MHz in LTE Band 38 40 MHz in LTE Band 39 100 MHz in LTE Band 40 194 MHz in LTE Band 41 15 MHz in TD-SCDMA Band 34 40 MHz in TD-SCDMA Band 39
Bandwidth of secondary antenna	ME909s-821 60 MHz in UMTS Band 1; LTE Band 1 75 MHz in LTE Band 3 25 MHz in UMTS Band 5 35 MHz in UMTS Band 8; Band8 30 MHz in UMTS Band 9 50 MHz in LTE Band 38 40 MHz in LTE Band 39 100 MHz in LTE Band 40 194 MHz in LTE Band 41 ME909s-120 60 MHz in UMTS Band 1; LTE Band 1

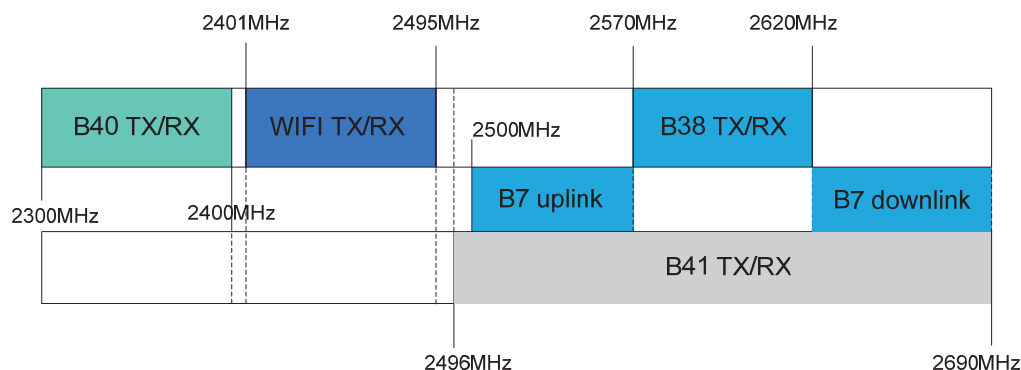


Antenna Requirements	
	60 MHz in UMTS Band 2; LTE Band 2 75 MHz in LTE Band 3 45 MHz in LTE Band 4 25 MHz in UMTS Band 5; LTE Band 5 70 MHz in LTE Band 7 35 MHz in UMTS Band 8; LTE Band 8 30 MHz in LTE Band 20 ME909s-821a 60 MHz in UMTS Band 1; LTE Band 1 75 MHz in LTE Band 3 25 MHz in UMTS Band 5 35 MHz in UMTS Band 8; LTE Band 5, Band8 30 MHz in UMTS Band 9 50 MHz in LTE Band 38 40 MHz in LTE Band 39 100 MHz in LTE Band 40 194 MHz in LTE Band 41
Gain	≤ 2.5 dBi
Impedance	50 Ω
VSWR absolute max	≤ 3:1
VSWR recommended	≤ 2:1

4.6 Suggestions about LTE and 2.4 GHz Wi-Fi Co-existence

4.6.1 Theory Analysis

The band gap between LTE Band 38/40/41 and Wi-Fi (2.4 G) is very narrow just as shown as below.



The two systems interfere with each other because of nonl inear characteristic of LTE Band 38/40/41 and Wi-Fi transmitter. The main impacts are as follows:

1. LTE Band transmitter spurious in Wi-Fi Band impacts on the sensitivity of Wi-Fi receiver.
2. LTE Band output power can block Wi-Fi receiver.
3. Wi-Fi transmitter spurious in LTE Band impacts on the sensitivity of LTE Bands.
4. Wi-Fi output power can block LTE Band receiver.

According to the theoretical analysis, in order to achieve the co-existence between Wi-Fi and LTE, the rejection between Wi-Fi and LTE Band 41 or Band 40 needs to be over 60 dB. (The analysis is based on the Wi-Fi chip Broadcom BCM432XX, the co-existence design depends on the customer's Wi-Fi chipset specification.)



NOTE

In fact, the current devices cannot meet this requirement, so we need to increase the isolation between antennas and disable some channels.

4.6.2 Suggestions about the Interference

These risks have been taken into consideration in the design of the ME909s Mini PCIe module. The system design also should be paid attention:

1. It is recommended that the system should be added Wi-Fi SAW filter to guarantee good attenuation in the LTE transmit Band (including Band 38, Band 40, Band 41), otherwise, LTE Band output power will block Wi-Fi receiver.
2. The good isolation between LTE antenna and Wi-Fi antenna is more than 25 dB.
3. Two ways above can help to make the isolation to be 60 dB. If they are still not enough, some channels may need to be disabled.



5 Electrical and Reliability Features

5.1 About This Chapter

This chapter describes the electrical and reliability features of the interfaces in the ME909s Mini PCIe module, including:

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

5.2 Absolute Ratings



WARNING

Table 5-1 lists the absolute ratings for the ME909s Mini PCIe module. Using the module beyond these conditions may result in permanent damage to the module.

Table 5-1 Absolute ratings for the ME909s Mini PCIe module

Symbol	Specification	Min.	Max.	Unit
VCC_3V3	External power voltage	−0.3	4.5	V

5.3 Operating and Storage Temperatures

Table 5-2 lists the operating and storage temperatures for the ME909s Mini PCIe module.



Table 5-2 Operating and storage temperatures for the ME909s Mini PCIe module

Specification	Min.	Max.	Unit
Normal working temperatures	–20	+60	°C
Extended temperatures ^[1]	–40	+85	°C
Ambient temperature for storage	–40	+85	°C



NOTE

- [1]: When the module works at –40°C to –20°C and +60°C to +85°C, **NOT** all its RF performances comply with 3GPP specifications.
- The thermal design must be implemented according to the chapter 6.6 Thermal Design Guide. If not, the overheat protection mechanism will be triggered due to overheated Mini PCIe and the network connection will be terminated.

5.4 Power Supply Features

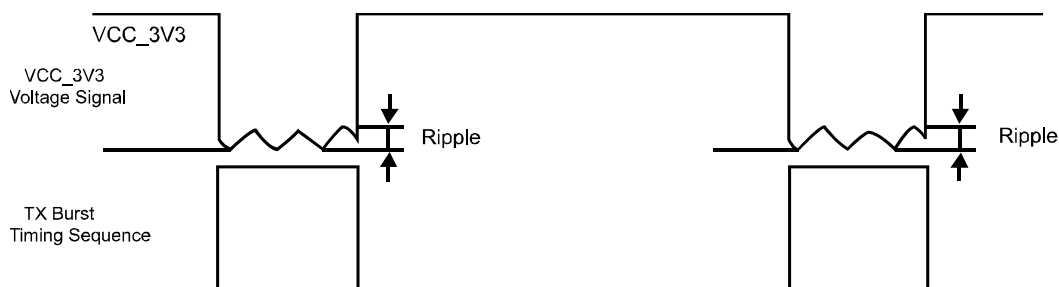
5.4.1 Input Power Supply

Table 5-3 lists the requirements for input power of the ME909s Mini PCIe module.

Table 5-3 Requirements for input power for the ME909s Mini PCIe module

Parameter	Min.	Typ.	Max.	Ripple	Unit
VCC_3V3	3.2	3.8	4.2	0.05	V

Figure 5-1 Power Supply During Burst Emission



NOTE

The VCC_3V3 minimum value must be guaranteed during the burst (with 3 A Peak in GSM 1 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 5-4 Requirements for input current of the ME909s Mini PCIe module

Power	Peak (GSM 1 slot)	Normal (WCDMA)	Normal (LTE 23 dbm)
VCC_3V3	3000 mA	800 mA	800 mA

5.4.2 Power Consumption

The power consumptions of ME909s Mini PCIe module in different scenarios are respectively listed in Table 5-5 to Table 5-12 .

The power consumption listed in this section is tested when the power supply of the ME909s Mini PCIe module is 3.8 V, and all of test values are measured at room temperature.

Table 5-5 Averaged standby DC power consumption of ME909s-821 Mini PCIe module

Description		Bands	Test Value (Unit: mA)	Notes/Configuration
			Typical	
Sleep	LTE	LTE bands	2.0	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in suspend.
	TD-SCDMA	TD-SCDMA bands	2.7	Module is powered up. DRX cycle=7 (1.28s) Module is registered on the network. USB is in suspend.
	HSPA+/WCDMA	UMTS bands	1.5	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in suspend.
	GPRS/EDGE	GSM bands	1.9	Module is powered up. MFRMS=5 (1.175s) Module is registered on the network. USB is in suspend.



Description		Bands	Test Value (Unit: mA)	Notes/Configuration
			Typical	
Idle	LTE	LTE bands	49	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in active.
	TD-SCDMA	TD-SCDMA bands	53	Module is powered up. DRX cycle=7 (1.28s) Module is registered on the network. USB is in active.
	HSPA+/WCDMA	UMTS bands	52	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	GSM bands	52	Module is powered up. MFRMS=5 (1.175s) Module is registered on the network, no data is transmitted. USB is in active.

Table 5-6 Averaged standby DC power consumption of ME909s-120 Mini PCIe module

Description		Bands	Test Value (Unit: mA)	Notes/Configuration
			Typical	
Sleep	LTE	LTE bands	2.2	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in suspend.
	HSPA+/WCDMA	UMTS bands	1.5	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in suspend.



Description		Bands	Test Value (Unit: mA)	Notes/Configuration
			Typical	
	GPRS/EDGE	GSM bands	2.3	Module is powered up. MFRMS=5 (1.175s) Module is registered on the network. USB is in suspend.
Idle	LTE	LTE bands	51	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in active.
	HSPA+/WCDMA	UMTS bands	55	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	GSM bands	56	Module is powered up. MFRMS=5 (1.175s) Module is registered on the network, no data is transmitted. USB is in active.

Table 5-7 Averaged standby DC power consumption of ME909s-821a Mini PCIe module

Description		Bands	Test Value (Unit: mA)	Notes/Configuration
			Typical	
Sleep	LTE	LTE bands	2.6	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in suspend.
	TD-SCDMA	TD-SCDMA bands	2.7	Module is powered up. DRX cycle=7 (1.28s) Module is registered on the network. USB is in suspend.



Description		Bands	Test Value (Unit: mA)	Notes/Configuration
			Typical	
	HSPA+/WCDMA	UMTS bands	1.5	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in suspend.
	GPRS/EDGE	GSM bands	2.7	Module is powered up. MFRMS=5 (1.175s) Module is registered on the network. USB is in suspend.
Idle	LTE	LTE bands	49	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in active.
	TD-SCDMA	TD-SCDMA bands	53	Module is powered up. DRX cycle=7 (1.28s) Module is registered on the network. USB is in active.
	HSPA+/WCDMA	UMTS bands	56	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	GSM bands	56	Module is powered up. MFRMS=5 (1.175s) Module is registered on the network, no data is transmitted. USB is in active.

Table 5-8 Averaged Data Transmission DC power consumption of ME909s-821 Mini PCIe module (HSPA/WCDMA/TD-SCDMA/LTE)

Description	Band	Test Value	Units	Power (Unit: dBm)
WCDMA	Band 1 (IMT2100)	226	mA	0 dBm Tx Power
		308		10 dBm Tx Power



Description	Band	Test Value	Units	Power (Unit: dBm)
	Band 9 (J1700)	830		23.5 dBm Tx Power
		220	mA	0 dBm Tx Power
		257		10 dBm Tx Power
		511		23.5 dBm Tx Power
	Band 5 (850 MHz)	220	mA	0 dBm Tx Power
		257		10 dBm Tx Power
		511		23.5 dBm Tx Power
	Band 8 (900 MHz)	221	mA	0 dBm Tx Power
		258		10 dBm Tx Power
		541		23.5 dBm Tx Power
HSDPA	Band 1 (IMT2100)	186	mA	0 dBm Tx Power
		227		10 dBm Tx Power
		533		23.5 dBm Tx Power
	Band 9 (J1700)	237	mA	0 dBm Tx Power
		340		10 dBm Tx Power
		817		23.5 dBm Tx Power
	Band 5 (850 MHz)	227	mA	0 dBm Tx Power
		259		10 dBm Tx Power
		497		23.5 dBm Tx Power
	Band 8 (900 MHz)	229	mA	0dBm Tx Power
		270		10 dBm Tx Power
		522		23.5 dBm Tx Power
FDD LTE	Band 1	265	mA	0 dBm Tx Power
		326		10 dBm Tx Power
		657		23 dBm Tx Power
	Band 3	267	mA	0 dBm Tx Power
		344		10 dBm Tx Power
		853		23 dBm Tx Power
	Band 8	272	mA	0 dBm Tx Power



Description	Band	Test Value	Units	Power (Unit: dBm)
TDD LTE		306		10 dBm Tx Power
		523		23 dBm Tx Power
	Band 38	197	mA	0 dBm Tx Power
		233		10 dBm Tx Power
		365		23 dBm Tx Power
	Band 39	186	mA	0 dBm Tx Power
		212		10 dBm Tx Power
		277		23 dBm Tx Power
	Band 40	198	mA	0 dBm Tx Power
		247		10 dBm Tx Power
		474		23 dBm Tx Power
	Band 41	197	mA	0 dBm Tx Power
		237		10 dBm Tx Power
		362		23 dBm Tx Power
TD-SCDMA	Band 34	87	mA	0 dBm Tx Power
		97		10 dBm Tx Power
		136		23 dBm Tx Power
	Band 39	87	mA	0 dBm Tx Power
		96		10 dBm Tx Power
		127		23 dBm Tx Power

Table 5-9 Averaged Data Transmission DC power consumption of ME909s-120 (WCDMA/HSDPA/LTE)

Description	Band	Test Value (Unit: mA)	Power (Unit: dBm)
WCDMA	Band 1 (IMT 2100)	207	0 dBm Tx Power
		264	10 dBm Tx Power
		795	23.5 dBm Tx Power



Description	Band	Test Value (Unit: mA)	Power (Unit: dBm)
	Band 2 (PCS 1900)	205	0 dBm Tx Power
		263	10 dBm Tx Power
		774	23.5 dBm Tx Power
	Band 5 (850 MHz)	197	0 dBm Tx Power
		243	10 dBm Tx Power
		710	23.5 dBm Tx Power
	Band 8 (900 MHz)	198	0 dBm Tx Power
		248	10 dBm Tx Power
		755	23.5 dBm Tx Power
HSDPA	Band 1 (IMT2100)	218	0 dBm Tx Power
		256	10 dBm Tx Power
		680	23.5 dBm Tx Power
	Band 2 (PCS 1900)	216	0 dBm Tx Power
		249	10 dBm Tx Power
		687	23.5 dBm Tx Power
	Band 5 (850 MHz)	208	0 dBm Tx Power
		245	10 dBm Tx Power
		623	23.5 dBm Tx Power
	Band 8 (900 MHz)	213	0 dBm Tx Power
		258	10 dBm Tx Power
		641	23.5 dBm Tx Power
LTE	Band 1	320	0 dBm Tx Power
		425	10 dBm Tx Power
		796	22 dBm Tx Power
	Band 2	306	0 dBm Tx Power
		412	10 dBm Tx Power
		794	23 dBm Tx Power
	Band 3	319	0 dBm Tx Power



Description	Band	Test Value (Unit: mA)	Power (Unit: dBm)
		431	10 dBm Tx Power
		756	22 dBm Tx Power
	Band 4	320	0 dBm Tx Power
		431	10 dBm Tx Power
		793	23 dBm Tx Power
	Band 5	295	0 dBm Tx Power
		372	10 dBm Tx Power
		720	23 dBm Tx Power
	Band 7	317	0 dBm Tx Power
		399	10 dBm Tx Power
		846	23 dBm Tx Power
	Band 8	299	0 dBm Tx Power
		380	10 dBm Tx Power
		762	23 dBm Tx Power
	Band 20	302	0 dBm Tx Power
		385	10 dBm Tx Power
		679	23 dBm Tx Power

Table 5-10 Averaged Data Transmission DC power consumption of ME909s-821a Mini PCIe module (HSPA/WCDMA/TD-SCDMA/LTE)

Description	Band	Test Value	Units	Power (Unit: dBm)
WCDMA	Band 1 (IMT2100)	226	mA	0 dBm Tx Power
		308		10 dBm Tx Power
		830		23.5 dBm Tx Power
	Band 9 (J1700)	260	mA	0 dBm Tx Power
		330		10 dBm Tx Power
		728		23.5 dBm Tx Power
	Band 5	230	mA	0 dBm Tx Power



Description	Band	Test Value	Units	Power (Unit: dBm)
	(850 MHz)	283		10 dBm Tx Power
		596		23.5 dBm Tx Power
	Band 8 (900 MHz)	233	mA	0 dBm Tx Power
		289		10 dBm Tx Power
		636		23.5 dBm Tx Power
HSDPA	Band 1 (IMT2100)	226	mA	0 dBm Tx Power
		269		10 dBm Tx Power
		722		23.5 dBm Tx Power
	Band 9 (J1700)	299	mA	0 dBm Tx Power
		501		10 dBm Tx Power
		817		23.5 dBm Tx Power
	Band 5 (850 MHz)	247	mA	0 dBm Tx Power
		306		10 dBm Tx Power
		631		23.5 dBm Tx Power
	Band 8 (900 MHz)	248	mA	0dBm Tx Power
		314		10 dBm Tx Power
		663		23.5 dBm Tx Power
FDD LTE	Band 1	326	mA	0 dBm Tx Power
		383		10 dBm Tx Power
		796		22.5 dBm Tx Power
	Band 3	324	mA	0 dBm Tx Power
		402		10 dBm Tx Power
		853		22 dBm Tx Power
	Band 5	305	mA	0 dBm Tx Power
		348		10 dBm Tx Power
		658		23 dBm Tx Power
	Band 8	308	mA	0 dBm Tx Power
		365		10 dBm Tx Power
		675		23 dBm Tx Power



Description	Band	Test Value	Units	Power (Unit: dBm)
TDD LTE	Band 38	216	mA	0 dBm Tx Power
		254		10 dBm Tx Power
		422		23 dBm Tx Power
	Band 39	214	mA	0 dBm Tx Power
		259		10 dBm Tx Power
		353		23 dBm Tx Power
	Band 40	218	mA	0 dBm Tx Power
		259		10 dBm Tx Power
		474		23 dBm Tx Power
	Band 41	220	mA	0 dBm Tx Power
		258		10 dBm Tx Power
		429		22.5 dBm Tx Power
TD-SCDMA	Band 34	98	mA	0 dBm Tx Power
		114		10 dBm Tx Power
		160		23 dBm Tx Power
	Band 39	98	mA	0 dBm Tx Power
		113		10 dBm Tx Power
		153		23 dBm Tx Power

Table 5-11 Averaged Data Transmission DC power consumption of ME909s-821 Mini PCIe module (GPRS/EDGE)

Description	Test Value (Unit: mA)	PCL	Configuration
	Typical		
GPRS 900	294	5	1 Up/1 Down
	431		2 Up/1 Down
	595		4 Up/1 Down
	157	10	1 Up/1 Down
	241		2 Up/1 Down



Description	Test Value (Unit: mA)	PCL	Configuration
	Typical		
GPRS 1800	415	0	4 Up/1 Down
	190		1 Up/1 Down
	276		2 Up/1 Down
	381	10	4 Up/1 Down
	100		1 Up/1 Down
	127		2 Up/1 Down
	184		4 Up/1 Down
EDGE 900	196	8	1 Up/1 Down
	272		2 Up/1 Down
	368		4 Up/1 Down
	109	15	1 Up/1 Down
	145		2 Up/1 Down
	221		4 Up/1 Down
EDGE 1800	153	2	1 Up/1 Down
	206		2 Up/1 Down
	276		4 Up/1 Down
	99	10	1 Up/1 Down
	125		2 Up/1 Down
	180		4 Up/1 Down

Table 5-12 Averaged Data Transmission DC power consumption of ME909s-120 Mini PCIe module (GPRS/EDGE)

Description	Test Value (Unit: mA)	PCL	Configuration
	Typical		
GPRS 850	337	5	1 Up/1 Down
	508		2 Up/1 Down
	704		4 Up/1 Down
	209	10	1 Up/1 Down
	339		2 Up/1 Down



Description	Test Value (Unit: mA)	PCL	Configuration
	Typical		
	583		4 Up/1 Down
GPRS 900	319	5	1 Up/1 Down
	473		2 Up/1 Down
	668		4 Up/1 Down
	202	10	1 Up/1 Down
	320		2 Up/1 Down
	551		4 Up/1 Down
GPRS 1800	224	0	1 Up/1 Down
	315		2 Up/1 Down
	442		4 Up/1 Down
	132	10	1 Up/1 Down
	179		2 Up/1 Down
	278		4 Up/1 Down
GPRS 1900	232	0	1 Up/1 Down
	328		2 Up/1 Down
	469		4 Up/1 Down
	133	10	1 Up/1 Down
	180		2 Up/1 Down
	280		4 Up/1 Down
EDGE 850	222	8	1 Up/1 Down
	321		2 Up/1 Down
	493		4 Up/1 Down
	175	15	1 Up/1 Down
	267		2 Up/1 Down
	458		4 Up/1 Down
EDGE 900	214	8	1 Up/1 Down
	310		2 Up/1 Down
	489		4 Up/1 Down
	176	15	1 Up/1 Down



Description	Test Value (Unit: mA)	PCL	Configuration
	Typical		
	267		2 Up/1 Down
	477		4 Up/1 Down
EDGE 1800	292	2	1 Up/1 Down
	326		2 Up/1 Down
	388		4 Up/1 Down
	239		4 Up/1 Down
	247	10	1 Up/1 Down
	346		2 Up/1 Down
EDGE 1900	185	2	4 Up/1 Down
	260		1 Up/1 Down
	377		2 Up/1 Down
	150		4 Up/1 Down
	210	10	1 Up/1 Down
	347		2 Up/1 Down

Table 5-13 Averaged Data Transmission DC power consumption of ME909s-821a Mini PCIe module (GPRS/EDGE)

Description	Test Value (Unit: mA)	PCL	Configuration
	Typical		
GPRS 900	331	5	1 Up/1 Down
	478		2 Up/1 Down
	638		4 Up/1 Down
	177		4 Up/1 Down
	270	10	1 Up/1 Down
	453		2 Up/1 Down
GPRS 1800	221	0	4 Up/1 Down
	341		1 Up/1 Down
	476		2 Up/1 Down
	135		4 Up/1 Down
	186	10	1 Up/1 Down



Description	Test Value (Unit: mA)	PCL	Configuration
	Typical		
EDGE 900	294	8	4 Up/1 Down
	222		1 Up/1 Down
	321		2 Up/1 Down
	490	15	4 Up/1 Down
	173		1 Up/1 Down
	263		2 Up/1 Down
	446		4 Up/1 Down
EDGE 1800	220	2	1 Up/1 Down
	338		2 Up/1 Down
	474		4 Up/1 Down
	135	10	1 Up/1 Down
	186		2 Up/1 Down
	295		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.
- LTE test condition: 10/20 MHz bandwidth, QPSK (Quadrature Phase Shift Keying), 1 RB when testing max. Tx power and full RB when testing 0 dBm or 10 dBm.
- Test condition: For Max. Tx. power, see 4.4.2 Conducted Transmit Power, which are listed in Table 4-7 and Table 4-8 ; for Max. data throughput, see 2.2 Function Overview, which are listed in Table 2-1 .

5.5 Reliability Features

Table 5-14 lists the test conditions and results of the reliability of the ME909s Mini PCIe module.

Table 5-14 Test conditions and results of the reliability of the ME909s Mini PCIe module

Item		Test Condition	Standard	Sample size	Results
Stress	Low-temperature storage	• Temperature: -40°C • 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



Item		Test Condition	Standard	Sample size	Results
	High-temperature storage	• Temperature: 85°C • 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: -40°C • 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: 85°C • 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
	Temperature cycle operating	• High temperature: 85°C • Low temperature: -40°C • Operation mode: working with service connected • Test duration: 30 cycles; 1 h+1 h/cycle	JESD22-A105-B	3pcs/group	Visual inspection: OK Function test: OK RF specification: OK
	Damp heat cycling	• High temperature: 55°C • Low temperature: 25°C • 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: -40°C • High temperature: 85°C • Temperature change interval: < 20s • Operation mode: no power • Test duration: 100 cycles; 15 Min+15 Min/cycle	JESD22-A106-B	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	Salty fog test	• Temperature: 35°C • Density of the NaCl solution: 5%±1% • Operation mode: no power, no package • Test duration: Spraying interval: 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: 0.5oct/min • Operation mode: working with service connected • Test duration: 3 axial directions. 2 h for each axial direction	JESD22-B103-B	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	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.	JESD-B104-C	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok



Item		Test Condition	Standard	Sample size	Results
	Drop test	1.0 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: 75°C - Operation mode: working with service connected - Test duration: 168 h, 336 h, 500 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: 85°C - Humidity: 85% - Operation mode: powered on and no working - Test duration: 168 h, 336 h, 500 h for inspection point	JESD22-A110-B	50 pcs/group	Visual inspection: ok Function test: ok RF specification: ok Cross section: ok
	Temperature cycle	- High temperature: 85°C - Low temperature: -40°C - Temperature change slope: 6°C/min - Operation mode: no power - Test duration: 168 h, 336 h, 500 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)	2 kV (Class 1B) - Operation mode: no power	JESD22-A114-D	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok



Item		Test Condition	Standard	Sample size	Results
	ESD with DVK (or embedded in the host)	• Contact and Air discharges: 10 positive and 10 negative applied • 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					

5.6 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 to avoid shaking, and the distance between the capacitor and the related pin should be less than 100 mil.
- A TVS should be added to the module power supply. It is recommended that the TVS's Clamping Voltage (V_{CL}) be smaller than 12 V and Peak Pulse Power (P_{PP}) at least 100 W.
- 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 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 $4\ \Omega$. 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 ME909s Mini PCIe module does not include any protection against overvoltage.



6 Mechanical Specifications

6.1 About This Chapter

This chapter mainly describes mechanical specifications of ME909s Mini PCIe module, including:

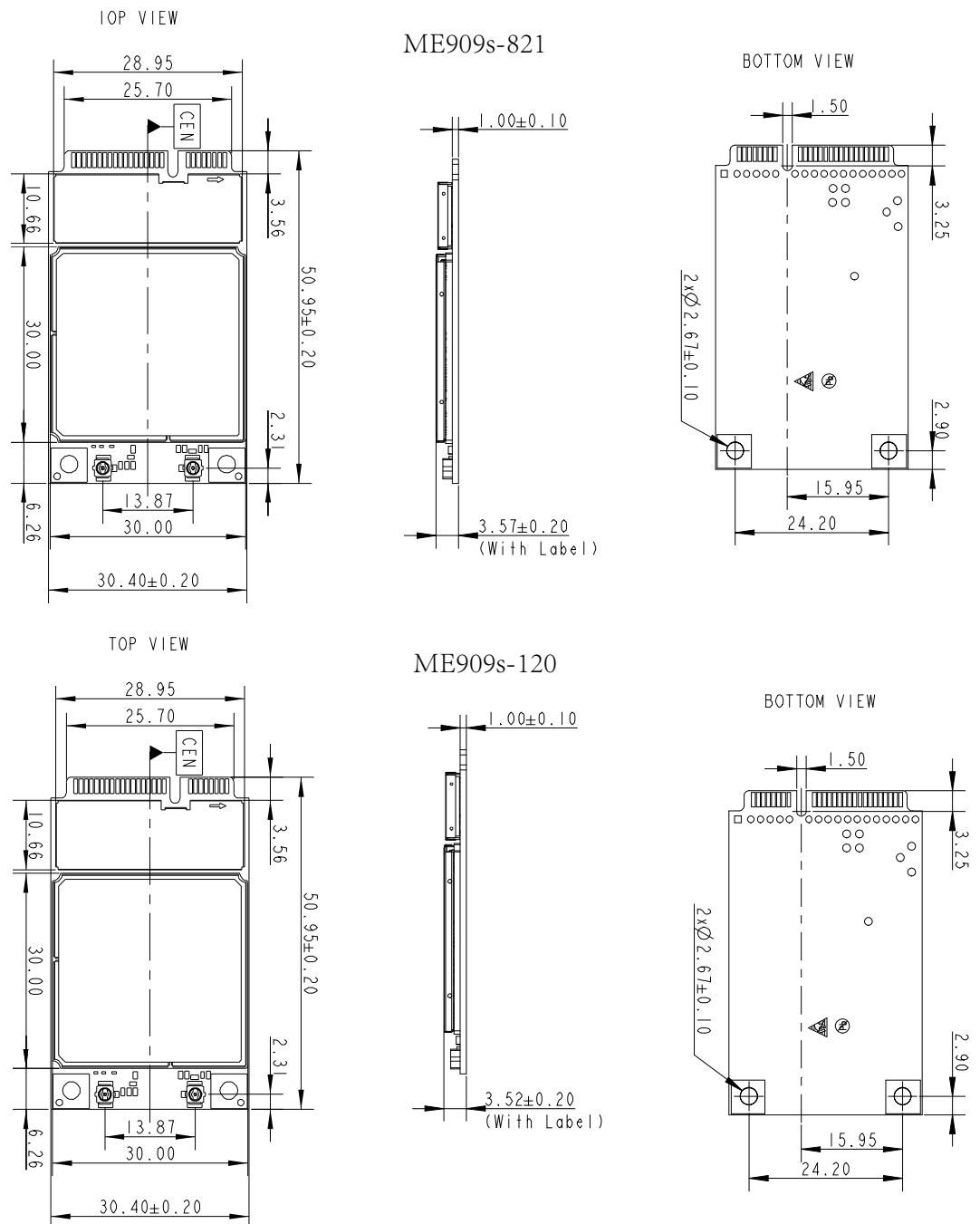
- Dimensions
- Packaging
- Specification Selection for Fasteners
- Antenna Plug
- Thermal Design Guide

6.2 Dimensions

Figure 6-1 shows the dimensions in detail.



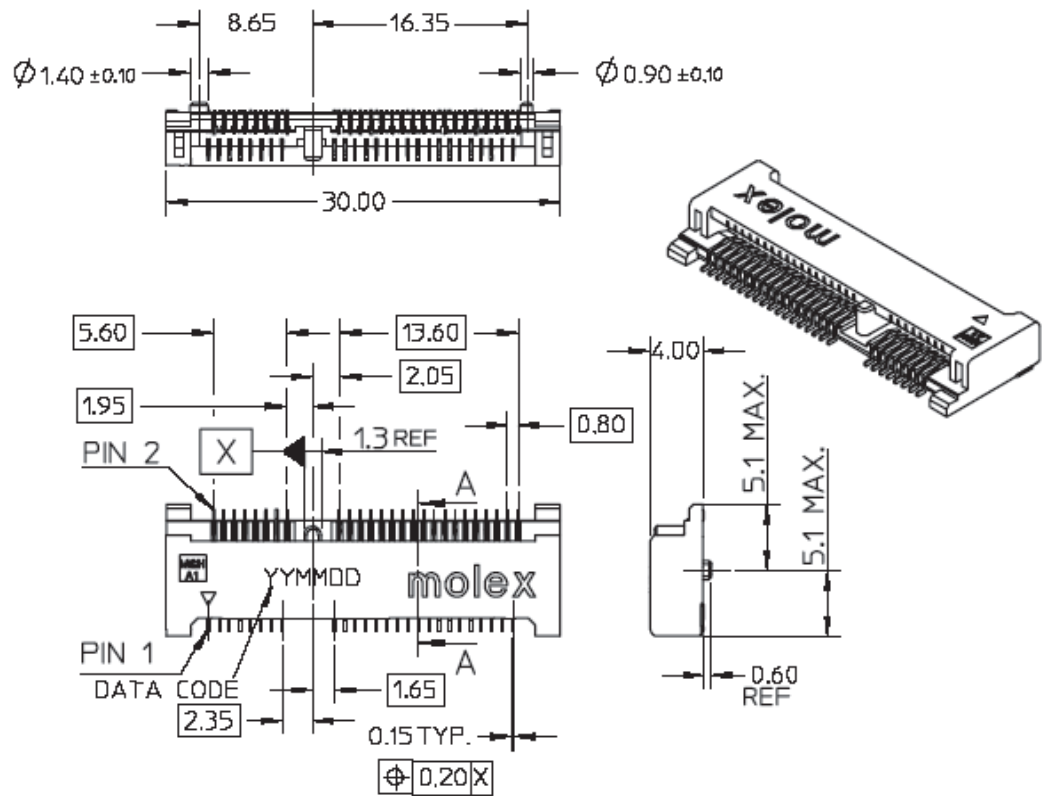
Figure 6-1 Dimensions (Unit: mm)



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 2.0*. 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 (Unit: mm)

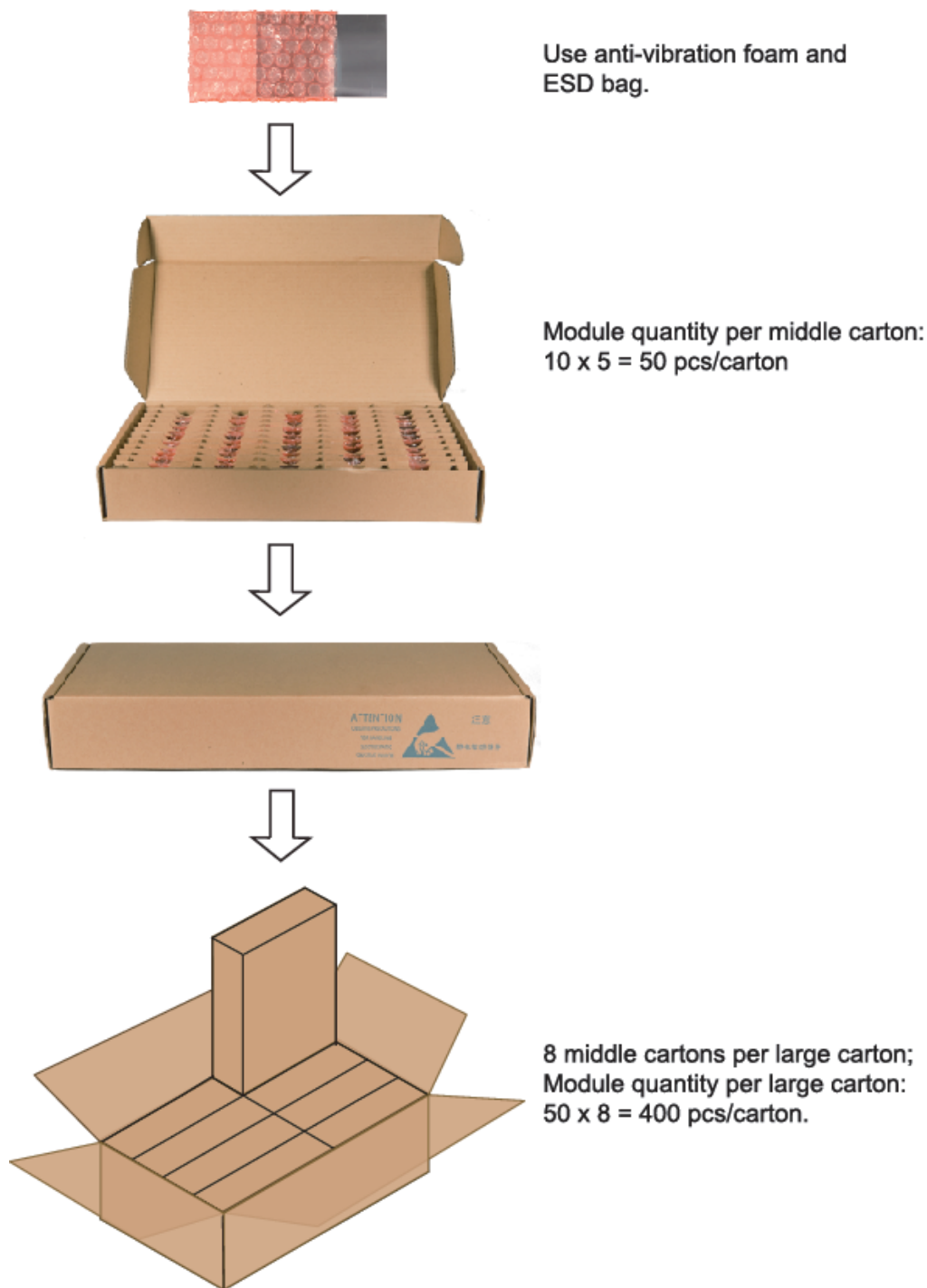


6.3 Packaging

HUAWEI Mini PCIe module uses anti-vibration foam and ESD bag into cartons.



Figure 6-3 The packaging



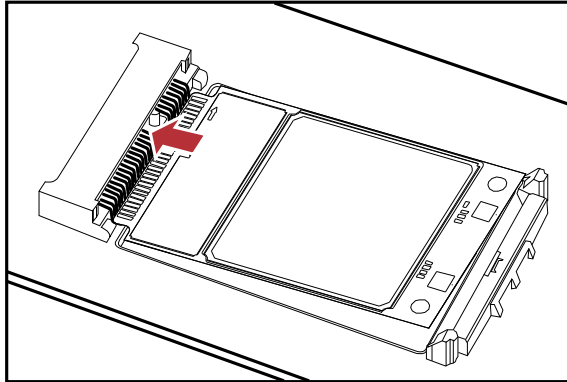


6.4 Specification Selection for Fasteners

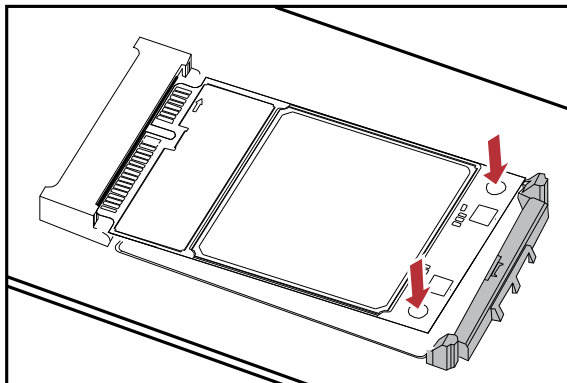
6.4.1 Installing the Mini PCIe Adapter on the Main Board

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

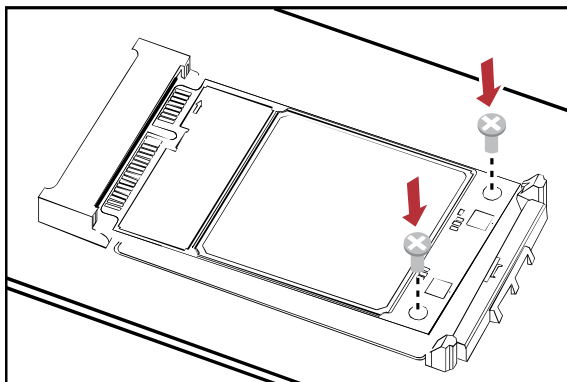
Step 1 Insert the Mini PCIe Adapter into the Mini PCI Express connector on the main board.



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

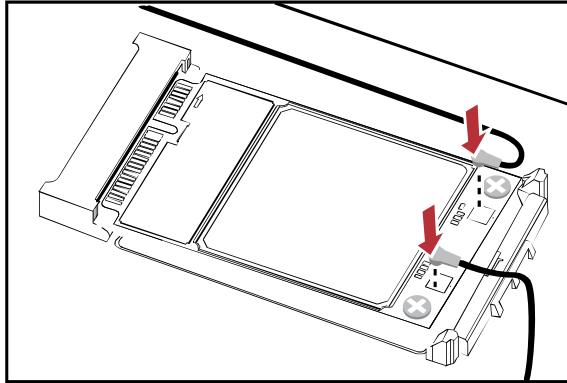


Step 3 Use a screwdriver to fix the Mini PCIe Adapter on the main board with two screws provided in the Mini PCIe Adapter packing box.





- 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.

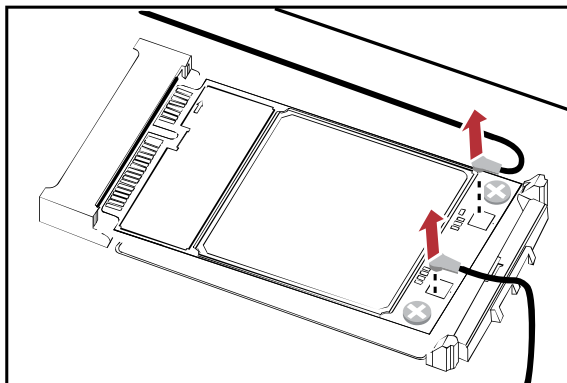


NOTE

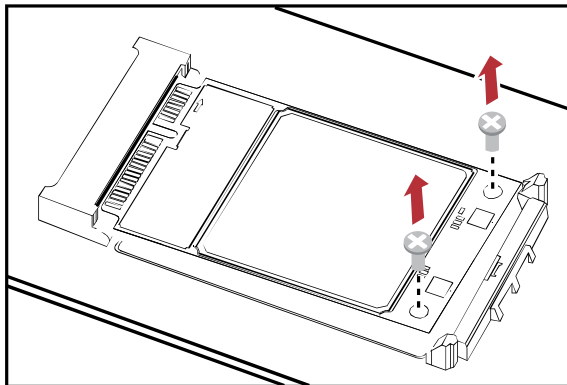
- Insert the antenna connectors vertically into the antenna interfaces of the Mini PCIe Adapter.
- Do not press or squeeze the antenna cable or damage the connectors. Otherwise, the wireless performance of the Mini PCIe Adapter may be reduced or the Mini PCIe Adapter cannot work normally.
- Ensure that 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.
- The module could not be installed or removed when the host is powered on. Otherwise, it may result in permanent damage to the module.

6.4.2 Removing the Mini PCIe Adapter from the Main Board

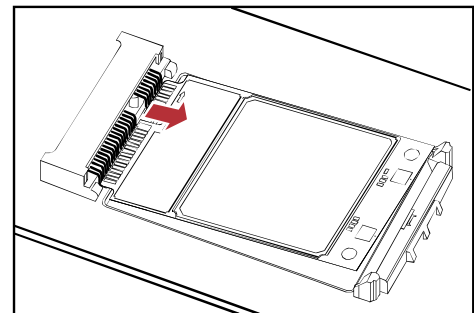
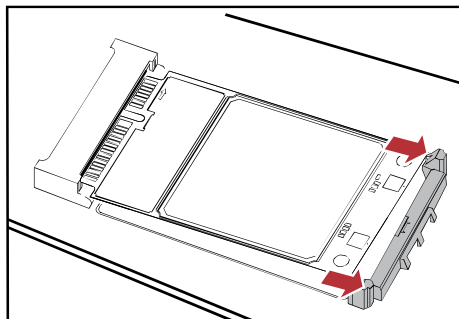
- Step 1 Disconnect the antenna cables from the Mini PCIe Adapter. You can lift the connectors using a small screwdriver.



- Step 2 Remove the two screws with the screwdriver.

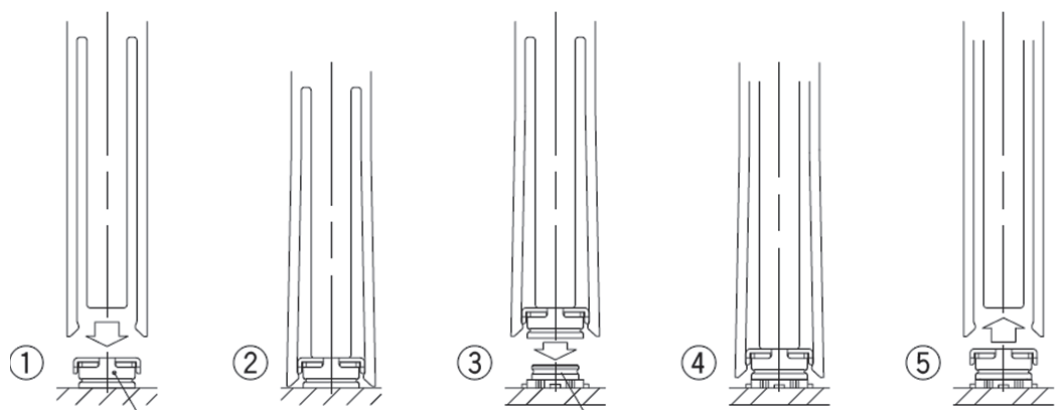


Step 3 Slide backwards the two clips to release the Mini PCIe Adapter from the slot. Then, lift up the Mini PCIe Adapter.



6.5 Antenna Plug

Figure 6-4 Mating the plug

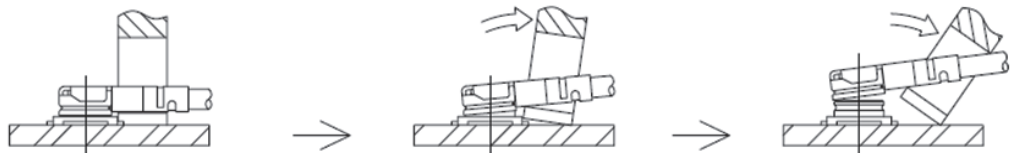


1. Align the mating tool or the mating end of the tool over the plug end of the cable assembly.
2. Firmly place the tool over the plug until it is secured in the tool.



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 6-5 Unmating the plug

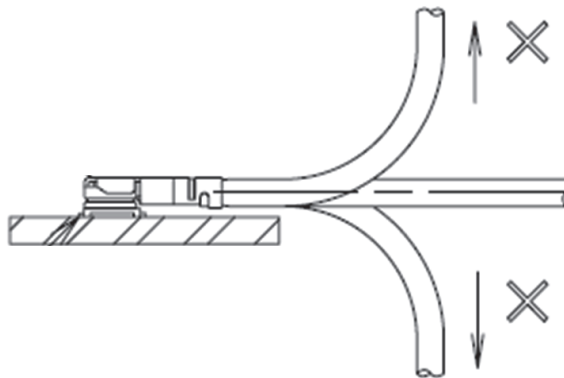


NOTE

- 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 not to apply any pull forces after the bending of the cable, as described in Figure 6-6 .

Figure 6-6 Do not apply any pull forces after the bending of the cable



6.6 Thermal Design Guide

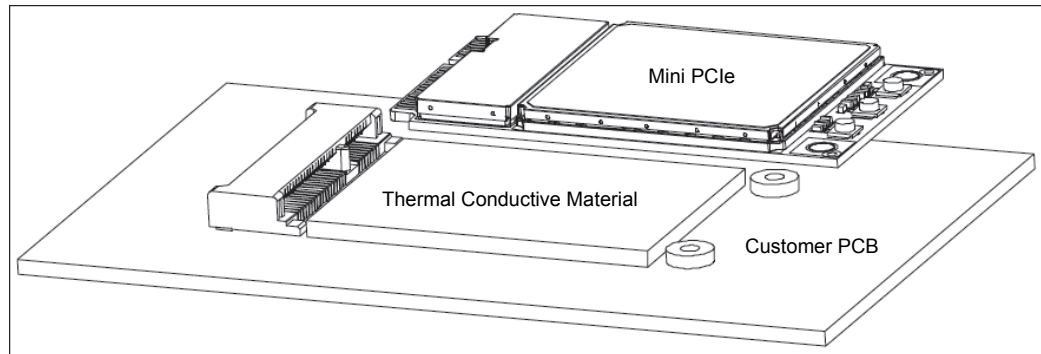
When using in the network, the ME909s Mini PCIe module (Mini PCIe) has high power consumption. To improve the module reliability and stability, focus on the thermal design of the device to speed up heat dissipation.

Take the following heat dissipation measures:

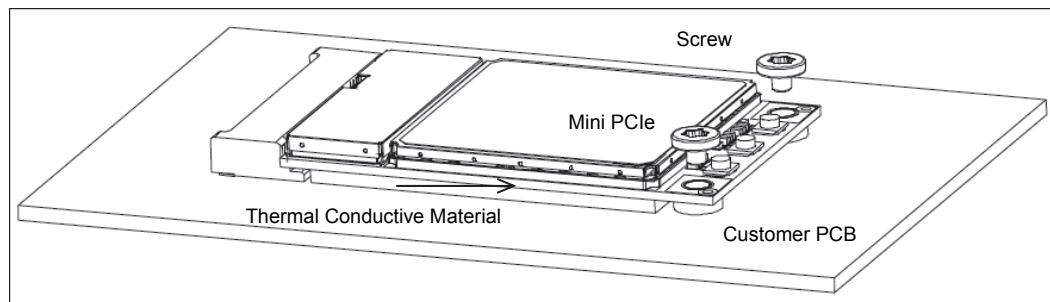
- Do not hollow out the customer PCB.
- Attach the thermal conductive material between the Mini PCIe and the customer PCB. The recommended thermal conductivity of the thermal conductive material



is 1.0 W/m-k or higher (recommended manufacturers: Laird and Bergquist). The dimensions (W x D) of the thermal conductive material are 38 mm x 28 mm (1.50 in. x 1.10 in.), and its height depends on the height of the Mini PCIe connector you use and the method for installing the Mini PCIe. When deciding the height of the thermal conductive material, you are advised to obey the following rule: After the Mini PCIe is fastened to the customer PCB, the compression amount of the thermal conductive material accounts for 15% to 30% of the thermal conductive material size. For example, if you use a connector shown in the following figure and install the Mini PCIe like this, the recommended height of the thermal conductive material is 1.8 mm (0.07 in.).



- On the customer PCB, reserve two metal screw holes, which are connected to the PCB ground plane. When installing the Mini PCIe, use two metal screws to fasten the Mini PCIe to the customer PCB. See the following figure.



- Ensure that the air flow around the Mini PCIe is sufficient.
- Try not to place any component in the Mini PCIe's projection region on the customer PCB. Do not place components with 1.5 W or higher power consumption or heat sensitive components (such as crystals) near the Mini PCIe.
- Use a large customer PCB. The recommended size (W x D) is 70 mm x 70 mm (2.76 in. x 2.76 in.).
- If the thermal conductive material is attached between the Mini PCIe and the customer PCB, then the heat dissipation performance will be better for multilayer PCB.
- Apply copper to the region for attaching the thermal conductive material to the customer PCB. Try to use the continuous ground plane design on the customer PCB, and each ground plane must be connected through holes. Therefore, reserve holes as many as possible.



NOTE

If you do not take the preceding heat dissipation measures, the overheat protection mechanism is triggered due to overheated Mini PCIe and the network connection is terminated when the Mini PCIe keeps working in enclosed space with a 70°C temperature and a big current for a period of time. You can resume the network connection only after the temperature drops.



7

Certifications

7.1 About This Chapter

This chapter gives a general description of certifications of ME909s Mini PCIe module.

7.2 Certifications



NOTE

Table 7-1 shows certifications the ME909s Mini PCIe module have been implemented. For more demands, please contact us for more details about this information.

Table 7-1 Product Certifications

Certification	Model name		
	ME909s-821	ME909s-120	ME909s-821a
CE	-	√	-
CCC	√	-	√
RoHS	√	√	√
WEEE	√	√	√
CTA	√	-	√
SRRC	√	-	√



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 EU Regulatory Conformance

Statement

Hereby, Huawei Technologies Co., Ltd. declares that this device is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.

The most recent, effective version of the DoC (Declaration of Conformity) can be viewed at <http://consumer.huawei.com/certification>.

This device may be operated in all member states of the EU.



Observe national and local regulations where the device is used.

This device may be restricted for use, depending on the local network.

Frequency Bands and Power

(a) Frequency bands in which the radio equipment operates: Some bands may not be available in all countries or all areas. Please contact the local carrier for more details.

(b) Maximum radio-frequency power transmitted in the frequency bands in which the radio equipment operates: The maximum power for all bands is less than the highest limit value specified in the related Harmonized Standard.

The frequency bands and transmitting power (radiated and/or conducted) nominal limits applicable to this radio equipment are as follows: GSM 900: 37 dBm, GSM 1800: 34 dBm, WCDMA 900/2100: 25.7 dBm, LTE Band 1/3/7/8/20: 25.7 dBm.

Software Information

Software updates will be released by the manufacturer to fix bugs or enhance functions after the product has been released. All software versions released by the manufacturer have been verified and are still compliant with the related rules.

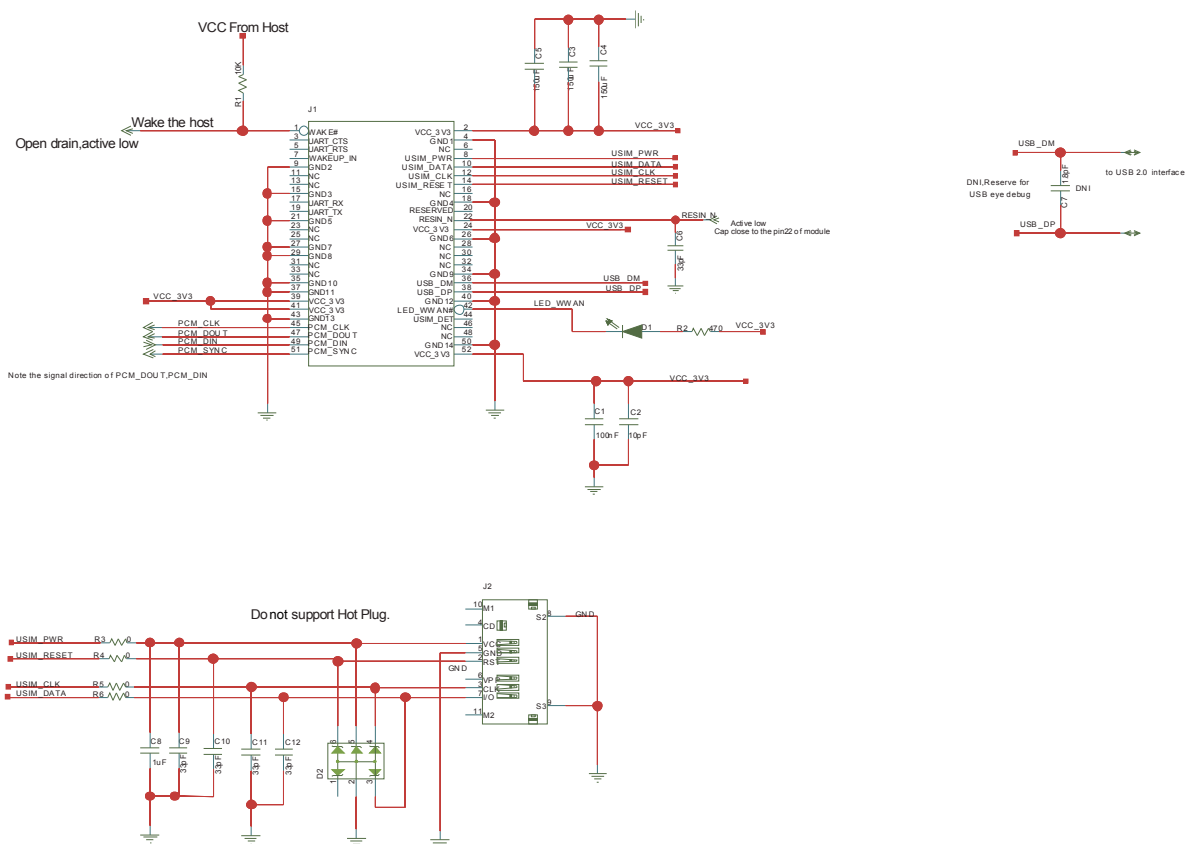
All RF parameters (for example, frequency range and output power) are not accessible to the user, and cannot be changed by the user.

For the most recent information about accessories and software, please see the DoC (Declaration of Conformity) at <http://consumer.huawei.com/certification>.



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Appendix A Circuit of Typical Interface





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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
OC	Open collector
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