HUAWEI MC509 CDMA LGA Module

Hardware Guide

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About This Document

History

Version	Date	Chapter	Descriptions
01	2011-04-08		Creation

Summary

This document provides information about the major functions, supported services, system architecture, and technical references of HUAWEI MC509 CDMA LGA Module.

- Packing System
- Certifications
- Environmental Protection Certification and Test
- National Compulsory Certification

The following table lists the contents of this document.

Chapter	Details
1 Introduction	Describes the short introduction of the product.
2 Overall Description	Describes the Function overview, Circuit Block Diagram and Application Block Diagram of the product.
3 Description of the Application Interfaces	Describes the external application interfaces of the product.
4 RF Specifications	Describes the RF specifications of the product.
5 Electrical and Reliability Features	Describes the electrical and reliability features of the interfaces in the product.
6 Mechanical Specifications	Describes the Dimensions, Label and Packing System of the product.
7 Certifications	Describes the certifications of the product.
8 Safety Information	Lists the safety information of using the product.
9 Appendix A Circuit of Typical Interfacesl	Lists the circuit of typical interface of the product.
10 Appendix B Acronyms and Abbreviations	Lists the acronyms and abbreviations mentioned in this document.

Content

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1 Introduction

This document describes the hardware application interfaces and air interfaces that are provided when the HUAWEI MC509 CDMA LGA Module (hereinafter referred to as the MC509 module) is used.

This document helps you to understand the interface specifications, electrical features, and related product information of the MC509 module. To facilitate its use in different fields, relevant development guide documents are also provided with the module, which can be obtained from the Huawei website.

Product name	RF Band	Bandwidth
MC509	CDMA/EVDO 1900/800 MHz	

- CDMA/EVDO 1900/800 MHz（Data only or Telematics）

MC509 model has two editions: Data only or Telematics. Data only does not support the voice function.

	Data only	Telematics
Analog voice input function	×	√
Analog voice output function	×	√
PCM voice function	×	√

2 Overall Description

2.1 About This Chapter

This chapter gives a general description of the MC509 module and provides:

- Function Overview
- Circuit Block Diagram
- Application Block Diagram

2.2 Function Overview

Table 2-1 Feature

Feature	Description
Physical Features	Dimensions (L × W × H): 30mm×30mm×2.6mm Weight about 5.5g
Working Bands	CDMA2000 1x, CDMA2000 EV-DO Rev 0, CDMA2000 EV-DO Rev A Supports BC0(800MHz band), BC1(1900MHz band) (Data only or Telematics)
Working Temperature	Normal working temperature: –20°C ~ +70°C
	Extreme working temperatures: –30°C ~ –20°C and +70°C ~ +75°C
Ambient Temperature for Storage	–40°C ~ 85°C
Power Voltage	3.3V ~ 4.2V (3.8V is recommended.)
AT Commands	See the *HUAWEI MC509 CDMA LGA Module AT Command Interface Specification*.

Feature	Description
Application Interface (145-pin LGA interface)	Universal Asynchronous Receiver-Transmitter (UART) Supporting 8-wire UART
	One standard user interface Module (UIM) card (3V or 1.8V)
	Audio (OPTION): (only telematics version supports this function) For detailed information about the working bands supported, see 错误！未找到引用源。. • 2×Micphone in • 1×Speaker out • 1×handset out • 1×PCM
	USB 2.0(full speed)
	Power on/off
	Reset
	Wakeup In
	Wakeup out (TBD)
	Light-emitting Diode (LED)
	Configurable General-purpose I/O (GPIO)
	RF pad
	Power
SMS	New message alert, text message receiving, and text message sending
	Management of text messages: read messages, delete messages, storage status, and message list
	Support for the Protocol Data Unit (PDU) mode
Data Services	CDMA2000 1X: UL/DL: 153.6kbps
	CDMA2000 1X/EVDO rev.0: UL 153.6kbps DL 2.4Mbps
	CDMA2000 1X/EVDO rev A: UL 1.8Mbps DL 3.1Mbps
Security	(TBD)
Internet Protocols	TCP/IP, UDP/IP, PPP protocol
Applications	(TBD)

Feature	Description
Certification Information	• Restriction of the use of certain Hazardous Substances (RoHS) • Federal Communications Commission (FCC) • China Compulsory Certification(CCC) • China Telecommunications Equipment Network Access Approval(CTA) • Waste Electrical and Electronic Equipment Directive(WEEE)

2.3 Circuit Block Diagram

Figure 2-1 shows the circuit block diagram of the MC509 module. The application block diagram and major functional units of the MC509 module contain the following parts:

- Qualcomm QSC chip
- Multi-chip package (MCP) memory
- RF Circuit

Figure 2-1 Circuit block diagram of the MC509 module
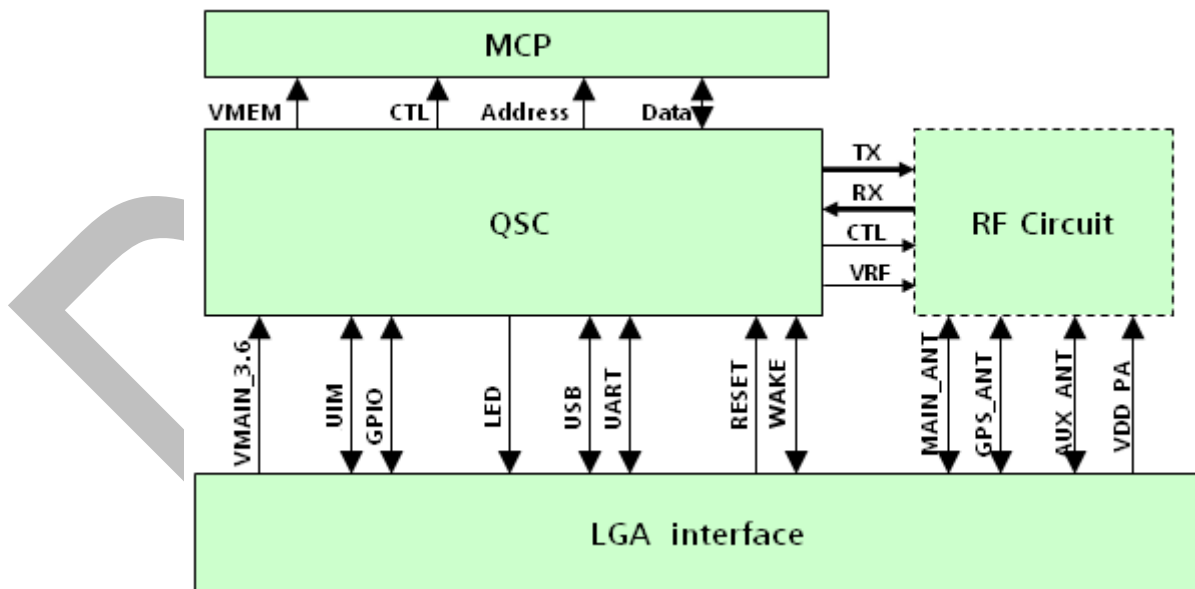
📖 **NOTE**

Only telematics version supports the audio function.

2.4 Application Block Diagram

Figure 2-2 Application block diagram of the MC509 module
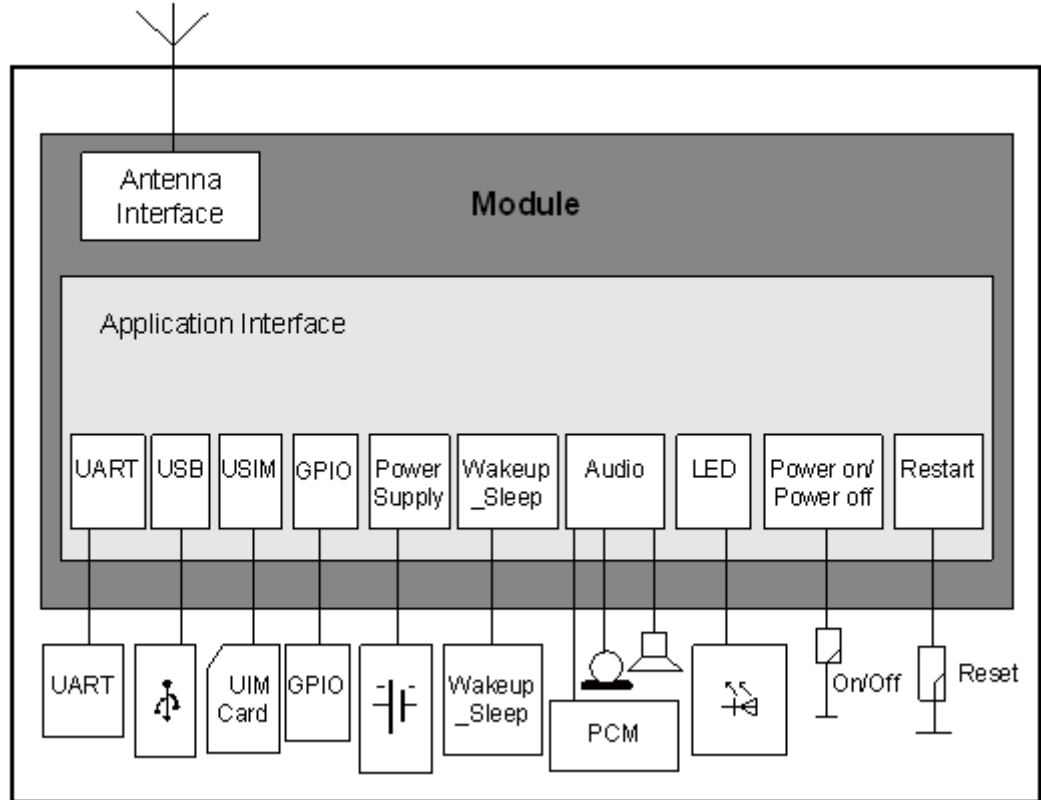
UART Interface： The module supports 3-line or 5-line or full serial port interface.

USB Interface： The USB interface supports USB 2.0 full speed standard.

UIM Interface： The UIM interface provides the interface for a UIM card. The UIM card can be inserted into the host side.

Power Supply： DC 3.8V is recommended.

Audio Interface： The module supports one speaker output, two microphone, one handset, one speaker and one PCM interface (only telematics version supports the audio function).

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3 Description of the Application Interfaces

3.1 About This Chapter

This chapter mainly describes the external application interfaces of the MC509 module, including:

- LGA Interface
- Power Interface
- Signal Control Interface
- UART Interface
- USB Interface
- UIM Card Interface
- Audio Interface
- General Purpose I/O Interface
- JTAG Interface
- RF Antenna Interface
- NC Pins

3.2 LGA Interface

The MC509 module uses a 145-pin LGA as its external interface. For details about the module and dimensions of the LGA, see "6.2 Dimensions and interfaces".

If DTE supports Huawei LGA module, such as module with system of CDMA, TD-SCDMA or HSPA +, you can refer to Huawei LGA Migration Guide to get the details.

Table 3-1 shows the definitions of pins on the 145-pin signal interface of the MC509 module.

Table 3-1 Definitions of pins on the LGA interface

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min	Typical	Max
1	NC	-	-	Not connected, please keep this pin open	-	-	-
2	NC	-	-	Not connected, please keep this pin open	-	-	-
3	NC	-	-	Not connected, please keep this pin open	-	-	-
4	NC	-	-	Not connected, please keep this pin open	-	-	-
5	PCM_SYNC	GPIO	I/O	PCM interface sync	-0.3	2.6	2.9
6	PCM_DIN	GPIO	I	PCM I/F data in	-0.3	2.6	2.9
7	PCM_DOUT	GPIO	O	PCM I/F data out	-0.3	2.6	2.9
8	PCM_CLK	GPIO	I/O	PCM interface clock	-0.3	2.6	2.9
9	NC	-	-	Not connected, please keep this pin open	-	-	-
10	NC	-	-	Not connected, please keep this pin open	-	-	-
11	WAKEUP_IN	GPIO	I	Host to wake up Module	-0.3	2.6	2.9
12	VBAT	-	P	Power supply input	3.3	3.8	4.2
13	VBAT	-	P	Power supply input	3.3	3.8	4.2
14	PS_HOLD	-	-	This input high to keep power on, low to shut down.	-	1.8	-
15	Reserved	-	-	-	-	-	-
16	NC	-	-	Not connected, please keep this pin open	-	-	-
17	NC	-	-	Not connected, please keep open	-	-	-
18	NC	-	-	Not connected, please keep this pin open	-	-	-
19	NC	-	-	Not connected, please keep this pin open	-	-	-
20	NC	-	-	Not connected, please keep this pin open	-	-	-

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min	Typical	Max
21	NC	-	-	Not connected, please keep this pin open	-	-	-
22	NC	-	-	Not connected, please keep this pin open	-	-	-
23	NC	-	-	Not connected, please keep this pin open	-	-	-
24	NC	-	-	Not connected, please keep this pin open	-	-	-
25	NC	-	-	Not connected, please keep this pin open	-	-	-
26	NC	-	-	Not connected, please keep this pin open	-	-	-
27	NC	-	-	Not connected, please keep this pin open	-	-	-
28	Reserved	-	-	-	-	-	-
29	Reserved	-	-	-	-	-	-
30	JTAG_TMS	-	I	JTAG Test mode select	-0.3	2.6	2.9
31	VCC_EXT2	-	P	2.6V POWER output	-	2.6	-
32	VCC_EXT1	-	P	1.8V POWER output	-	1.8	-
33	NC	-	-	Not connected, please keep this pin open	-	-	-
34	UIM_VCC	-	P	Power supply for UIM card	-0.3	1.8/2.85	2.1/3.15
35	VCOIN	-	P	Coin cell input	1.5	3.0	3.25
36	JTAG_TRST_N	-	I	JTAG reset	-0.3	2.6	2.9
37	NC	-	-	Not connected, please keep this pin open	-	-	-
38	MIC2_P	-	I	(Only telematics version supports audio function, Data only version does not support this function) Positive pole of the input of audio interface 2	-	-	-

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min	Typical	Max
39	MIC2_N	-	I	(Only telematics version supports audio function, Data only version does not support this function) Negative pole of the input of audio interface 2	-	-	-
40	MIC1_P	-	I	(Only telematics version supports audio function , Data only version does not support this function) Positive pole of the input of audio interface 1	-	-	-
41	MIC1_N	-	I	(Only telematics version supports audio function , Data only version does not support this function) Negative pole of the input of audio interface 1	-	-	-
42	JTAG_TCK	-	I	JTAG clock input	-0.3	2.6	2.9
43	Reserved	-	-	-	-	-	-
44	GPIO	-	I/O	General I/O pin. The function of these pins has not been defined	-0.3	2.6	2.9
45	W_DISABLE	-	I	Close wireless communications	-0.3	2.6	2.9
46	GPIO	-	I/O	General I/O pins. The function of these pins has not been defined	-0.3	2.6	2.9
47	NC	-	-	Not connected, please keep this pin open	-	-	-
48	GND	-	-	GND	-	-	-
49	GND	-	-	GND	-	-	-
50	GND	-	-	GND	-	-	-
51	GPIO	-	I/O	General I/O pins. The function of these pins has not been defined	-0.3	2.6	2.9
52	GND	-	-	GND	-	-	-
53	GND	-	-	GND	-	-	-
54	GND	-	-	GND	-	-	-

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min	Typical	Max
55	GPIO	-	I/O	General I/O pins. The function of these pins has not been defined	-0.3	2.6	2.9
56	GND	-	-	GND	-	-	-
57	GND	-	-	GND	-	-	-
58	GND	-	-	GND	-	-	-
59	GND	-	-	GND	-	-	-
60	NC	-	-	Not connected, please keep this pin open	-	-	-
61	NC	-	-	Not connected, please keep this pin open	-	-	-
62	NC	-	-	Not connected, please keep this pin open	-	-	-
63	NC	-	-	Not connected, please keep this pin open	-	-	-
64	NC	-	-	Not connected, please keep this pin open	-	-	-
65	NC	-	-	Not connected, please keep this pin open	-	-	-
66	NC	-	-	Not connected, please keep this pin open	-	-	-
67	NC	-	-	Not connected, please keep this pin open	-	-	-
68	NC	-	-	Not connected, please keep this pin open	-	-	-
69	NC	-	-	Not connected, please keep this pin open	-	-	-
70	NC	-	-	Not connected, please keep this pin open	-	-	-
71	WAKEUP_OUT	GPIO	O	Module to wake up the host	-0.3	2.6	2.9
72	JTAG_TDO	-	Z	JTAG test data output	-0.3	2.6	2.9
73	UART_DSR	GPIO	O	UART Data Set Ready	-0.3	2.6	2.9
74	UART_RTS	GPIO	O	UART Ready for receive	-0.3	2.6	2.9
75	UART_DCD	GPIO	O	UART Data Carrier Detect	-0.3	2.6	2.9
76	UART_TX	GPIO	O	UART transmit output	-0.3	2.6	2.9

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min	Typical	Max
77	UART_RING	GPIO	O	UART Ring Indicator	-0.3	2.6	2.9
78	UART_RX	GPIO	I	UART receive data input	-0.3	2.6	2.9
79	UART_DTR	GPIO	I	Data Terminal Ready	-0.3	2.6	2.9
80	UART_CTS	GPIO	I	UART Clear to Send	-0.3	2.6	2.9
81	POWER_ON_OFF	-	I	System power-on or power-off	-	Pulled up on chip	-
82	NC	-	-	Not connected, please keep this pin open	-	-	-
83	NC	-	-	Not connected, please keep this pin open	-	-	-
84	NC	-	-	Not connected, please keep this pin open	-	-	-
85	USB_DM	-	I/O	Full-speed USB D-	-	-	-
86	USB_DP	-	I/O	Full-speed USB D+	-	-	-
87	JTAG_TDI	-	I	JTAG test data input	-0.3	2.6	2.9
88	UIM_RESET	-	O	UIM reset	-0.3	1.8/2.85	2.1/3.15
89	UIM_DATA	-	I/O	UIM Data	-0.3	1.8/2.85	2.1/3.15
90	UIM_CLK	-	O	UIM Clock	-0.3	1.8/2.85	2.1/3.15
91	LED_STATUS	-	I	Status indicator SINK current source Driver strength: 10mA	-	-	-
92	NC	-	-	Not connected, please keep this pin open	-	-	-
93	JTAG_RTCK	-	I	JTAG return clock	-0.3	2.6	2.9
94	NC	-		Not connected, please keep this pin open	-	-	-
95	NC	-		Not connected, please keep this pin open	-	-	-

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min	Typical	Max
96	EAR_OUT_N	-	O	(Only telematics version supports audio function , Data only version does not support this function) Negative pole of the output of Earphone interface	-	-	-
97	EAR_OUT_P	-	O	(Only telematics version supports audio function , Data only version does not support this function) Positive pole of the output of Earphone interface	-	-	-
98	SPKR_OUT_P	-	O	(Only telematics version supports audio function, Data only version does not support this function) Positive pole of the output of speaker interface	-	-	-
99	SPKR_OUT_N	-	O	(Only telematics version supports audio function, Data only version does not support this function) Negative pole of the output of speaker interface	-	-	-
100	RESIN_N	-	I	Reset module.	-0.3	1.8	2.1
101	LED_MODE	-	I	Mode indicator SINK current source Driver strength: 10 mA	-	-	-
102	NC	-	-	Not connected, please keep this pin open	-	-	-
103	NC	-	-	Not connected, please keep this pin open	-	-	-
104	NC	-	-	Not connected, please keep this pin open	-	-	-
105	GPIO	-	I/O	General I/O pins. The function of these pins has not been defined.	-0.3	2.6	2.9
106	GND	-	-	GND	-	-	-
107	MAIN_ANT	-	-	RF main antenna interface	-	-	-

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min	Typical	Max
108	GND	-	-	GND	-	-	-
109	GPIO	-	I/O	General I/O pins. The function of these pins has not been defined	-0.3	2.6	2.9
110	GND	-	-	GND	-	-	-
111	GPS_ANT	-	-	RF GPS antenna interface	-	-	-
112	GND	-	-	GND	-	-	-
113	GPIO	-	I/O	General I/O pins. The function of these pins has not been defined	-0.3	2.6	2.9
114	GND	-	-	GND	-	-	-
115	AUX_ANT	-	-	RF divert antenna interface	-	-	-
116	GND	-	-	GND	-	-	-
117	NC	-	-	Not connected, please keep this pin open	-	-	-
118	NC	-	-	Not connected, please keep this pin open	-	-	-
119	NC	-	-	Not connected, please keep this pin open	-	-	-
120	NC	-	-	Not connected, please keep this pin open	-	-	-
121	GND	-	-	GND	-	-	-
122	GND	-	-	GND	-	-	-
123	GND	-	-	GND	-	-	-
124	GND	-	-	GND	-	-	-
125	GND	-	-	GND	-	-	-
126	GND	-	-	GND	-	-	-
127	GND	-	-	GND	-	-	-
128	GND	-	-	GND	-	-	-
129	GND	-	-	GND	-	-	-
130	GND	-	-	GND	-	-	-
131	GND	-	-	GND	-	-	-

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min	Typical	Max
132	GND	-	-	GND	-	-	-
133	GND	-	-	GND	-	-	-
134	GND	-	-	GND	-	-	-
135	GND	-	-	GND	-	-	-
136	GND	-	-	GND	-	-	-
137	GND	-	-	GND	-	-	-
138	GND	-	-	GND	-	-	-
139	GND	-	-	GND	-	-	-
140	GND	-	-	GND	-	-	-
141	GND	-	-	GND	-	-	-
142	GND	-	-	GND	-	-	-
143	GND	-	-	GND	-	-	-
144	GND	-	-	GND	-	-	-
145	GND	-	-	GND	-	-	-

📖 NOTE

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

- The **NC** (Not Connected) pins are internally connected to the module. Therefore, these pins should not be used, otherwise they may cause problems. Please contact us for more details about this information.

- When the MC509 module works on master mode, PCM_CLK and PCM_SYNC pins are in the output status

Figure 3-1 shows the sequence of pins on the 145-pin signal interface of the MC509 module.

Figure 3-1 Bottom view of sequence of LGA interface pins
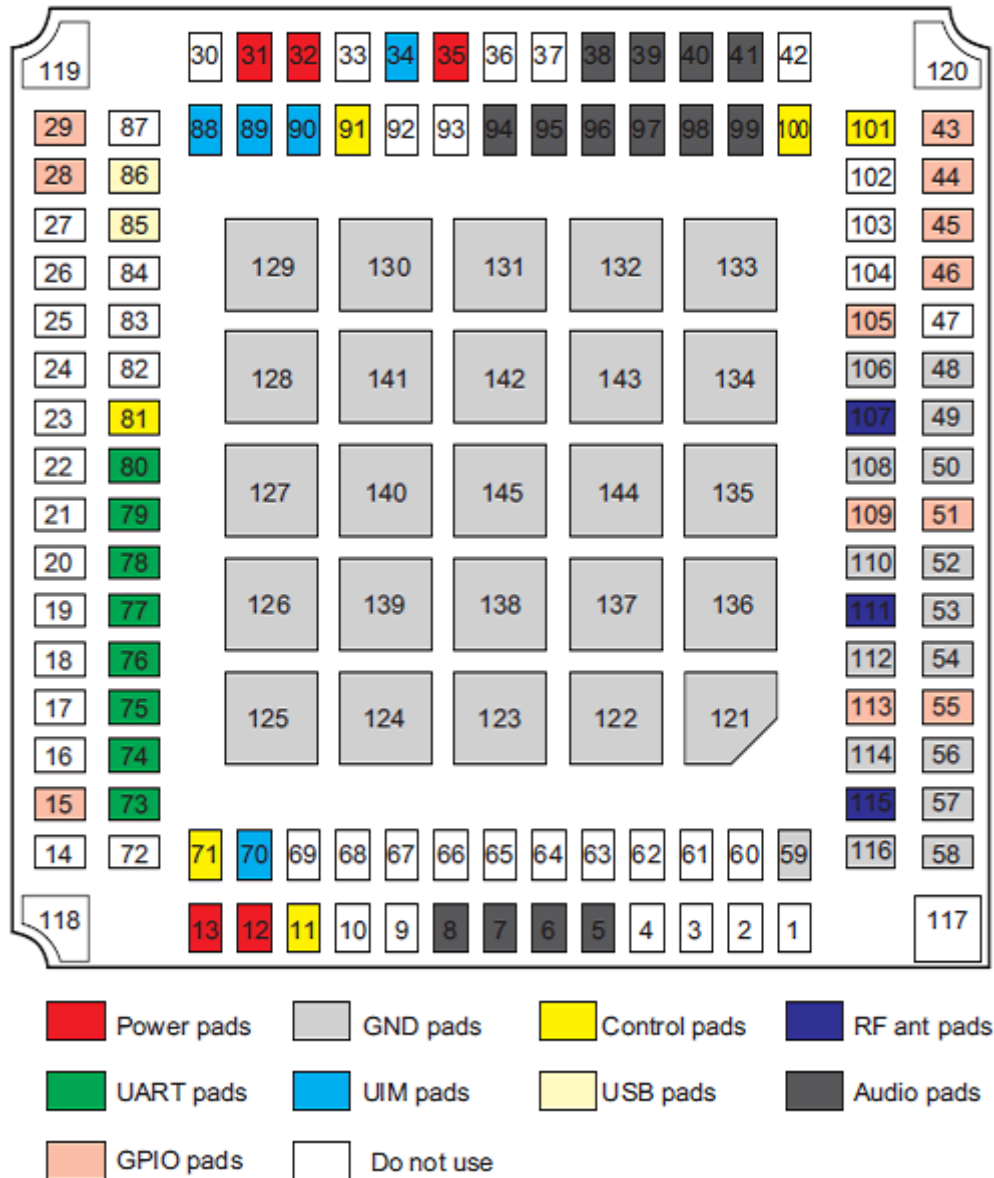
3.3 Power Interface

3.3.1 Overview

The power supply part of the MC509 module contains:

- VBAT PIN for the power supply
- VCOIN PIN for the standby power supply of the real-time clock (RTC)
- VCC_EXT1 PIN for external power output
- VCC_EXT2 PIN for external power output
- UIM_VCC PIN for UIM card power output

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

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

Pin No.	Signal Name	I/O	Description	DC Characteristics (V)		
				Min	Typical	Max
12, 13	VBAT	P	Pins for power voltage input	3.3	3.8	4.2
48, 49, 50, 52, 53, 54, 56, 57, 58, 59, 106, 108, 110, 112, 114, 116	GND	-	GND	-	-	-
35	VCOIN	P	Pin for standby power input of the RTC	1.5	3.0	3.25
32	VCC_EXT1	P	Pin for external power output	-	2.6	-
31	VCC_EXT2	P	Pin for external power output	-	1.8	-
34	UIM_VCC	P	Power supply for UIM card	-0.3	1.8/2.85	2.1/3.15
121~145	GND	-	Thermal Ground Pad	-	-	-

3.3.2 VBAT Interface

When the MC509 module works normally, power is supplied through the VBAT pins and the voltage ranges from 3.3V to 4.2V (typical value: 3.8V). The 145-pin LGA provides two VBAT pins and sixteen GND pins for external power input. To ensure that the MC509 module works normally, all the pins must be used efficiently.

When the MC509 module is used for different external applications, pay special attention to the design for the power supply. When the MC509 module transmits signals at the maximum power, the transient current may reach the transient peak value of about 1.5A due to the differences in actual network environments. In this case, the VBAT voltage drops. Make sure that the voltage does not decrease below 3.3V in any case. Otherwise, exceptions such as restart of the MC509 module may occur.

A low-dropout (LDO) regulator or switch power with current output of more than 1.5A is recommended for external power supply. Furthermore, a 220uF or above energy storage capacitor is connected in parallel at the power interface of the MC509 module.

📖 **NOTE**

For detailed information about power supply design and printed circuit board (PCB) design, see the *HUAWEI Module Power Supply Design Guide* and the *HUAWEI LGA Module PCB Interconnection Design Guide*

3.3.3 VCOIN Interface

VCOIN pin of MC509 module is used as backup power from the 3 V coin cell for SMPL, RTC, and 32 kHz crystal oscillator backup; a capacitor (rather than a coin cell) can be used if only SMPL is supported. Used as an analog output for coin cell or capacitor charging.

Sudden momentary power loss

If the monitored VBAT drops out-of-range (<3.3V nominal), the SMPL feature may initiate a power-on sequence without software intervention, and then VBAT returns in-range within a programmable interval of between 0.5 and 2.0 seconds. SMPL achieves immediate and automatic recovery from momentary power loss. A valid voltage on VCOIN is required to run the SMPL timer. If a capacitor is used instead of a coin, it must be connected between VCOIN and the ground. The capacitor must be charged to operate properly as the SMPL power source. The capacitor value depends on the SMPL timer setting.

Table 3-3 Keep-alive capacitor values vs.SMPL timer settings

SMPL timer setting	Capacitor value	Capacitor package
0.5 sec	1.5µF	0805
1.0 sec	3.3µF	0805
1.5 sec	4.7µF	0805
2.0 sec	6.8µF	1206

If the SMPL counter expires without VBAT returning to its valid range, the MC509 must undergo the normal power-on sequence whenever the VBAT is detected.

Real-time clock

If RTC is used, a manganese-lithium rechargeable battery is recommended, for example, the SII Micro Parts HB-414 and the Panasonic ML-series. Two sets of coin cell specifications are compared in Table 3-4 . When the MC509 is off, RTC and its oscillator source are still active, provided by a coin cell battery which is installed. This allows continued monitoring of RTC alarms programmed via software.

Table 3-4 Coin cell characteristics

Parameter	Specifications	
	HB-414	ML-series
Nominal voltage	3V	3V
Nominal capacity	0.3mAh	3.4mAh
Continuous standard load	5mA	10mA
Operating temperature	-20℃ ～ +60℃	-20℃ ～ +60℃
Diameter	4.8mm	6.8mm
Height	1.4mm	1.45mm
Weight	0.07g	0.17g

An interrupt is generated if the coin cell voltage drops too low (and the main battery is not present). If this interrupt occurs, the RTC might be corrupted. A different interrupt is generated if the crystal oscillator stops; this signifies that handset timing is no longer accurate. Again, the RTC is corrupted.

When the VBAT power supply of the MC509 is normal, the coin cell charging is powered from VBAT. The MC509 reads the coin cell voltage and monitors the charging. During normal operation, the VCOIN pin voltage will stay above 2.2V, even when the coin cell charger is turned off. Figure 3-2 shows the reference RTC circuit.

Figure 3-2 VCOIN interface circuit
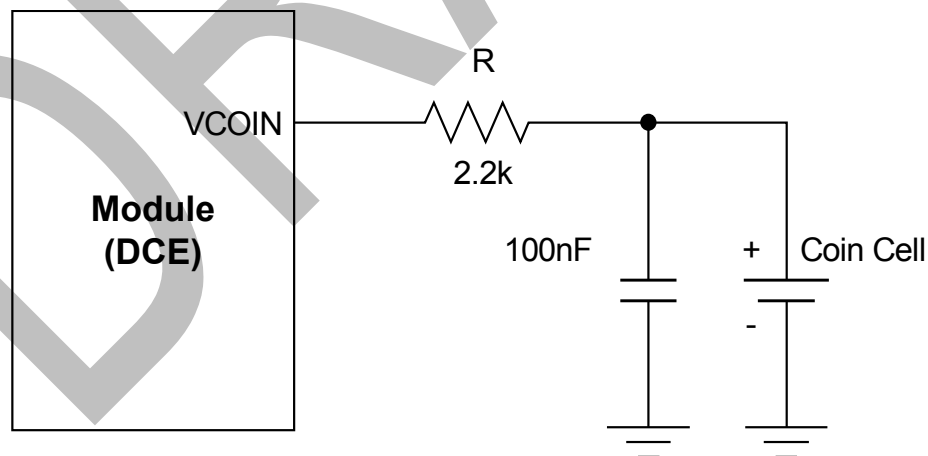
3.3.4 Output Power Supply Interface

Output Power Supply Interface includes VCC_EXT1 PIN, VCC_EXT2 PIN and UIM_VCC PIN.

Through the Output Power Supply interface, the MC509 module can supply 2.6V and 1.8V power externally with an output current of 20mA (typical value) for external level conversion or other applications.

If the MC509 module is in Sleep mode, the Output Power Supply interface is in the low power consumption state (< 500µA). If the MC509 module is in Power Down mode, the Output Power Supply is in the disabled state.

3.4 Signal Control Interface

3.4.1 Overview

The signal control part of the interface in the MC509 module consists of the following:

- Power-on/off (POWER_ON_OFF) pin
- Hardware reset (RESIN_N) pin
- Network status LED (LED_STATUS/LED_MODE) pin
- WAKEUP_IN Signal (WAKEUP_IN) pin
- WAKEUP_OUT Signal (TBD)

Table 3-5 lists the pins on the signal control interface.

Table 3-5 Pins on the signal control interface

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min	Typical	Max
81	POWER_ON_OFF	I	Pin for controlling power-on and power-off	-	Pulled up on chip	-
100	RESIN_N	I	Pin for resetting the hardware	-0.3	1.8	2.1
91	LED_STATUS	I	Pin for network status LED	-	-	-
101	LED_MODE	I	Pin for network mode LED	-	-	-
11	WAKEUP_IN	I	H: DTE wakeup MC509. L: DTE set MC509 to sleep mode.	-0.3	2.6	2.9
71	WAKEUP_OUT	O	H: MC509 wakeup DTE L: MC509 set DTE to sleep mode.	-0.3	2.6	2.9

 NOTE
It is recommended that use resistance of 0ohm in the DTE to isolate signals transmitted from above pins in Table 3-5

3.4.2 Input Signal Control Pins

The MC509 module implements power-on and power-off and resets the hardware through the input signal control pins.

The power-on, power-off, and reset control parts of the interface of the MC509 module include power-on/power-off interface signal (POWER_ON_OFF) and the hardware reset interface signal (RESIN_N).

The POWER_ON_OFF pin is used to implement power-on and power-off. If the POWER_ON_OFF pin is pulled down for at least 0.5s, the module is powered on; if the POWER_ON_OFF pin is pulled down for at least 2.5s again, the module is powered off.

The RESET pin is used to reset the hardware. When the software stops responding, the RESET pin can be pulled down for 100ms to reset the hardware.

 ⚠ CAUTION

As the RESET and POWER_ON_OFF signals are relatively sensitive, it is recommended that you install a 10nF capacitor near the RESET and POWER_ON_OFF pins 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 not exceed 20mm and that the circuit be kept at a distance of 2.54mm (100mil) 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.

Figure 3-3 shows the connections of the POWER_ON_OFF and RESIN_N pins.

Figure 3-3 Connections of the POWER_ON_OFF and RESIN_N pins
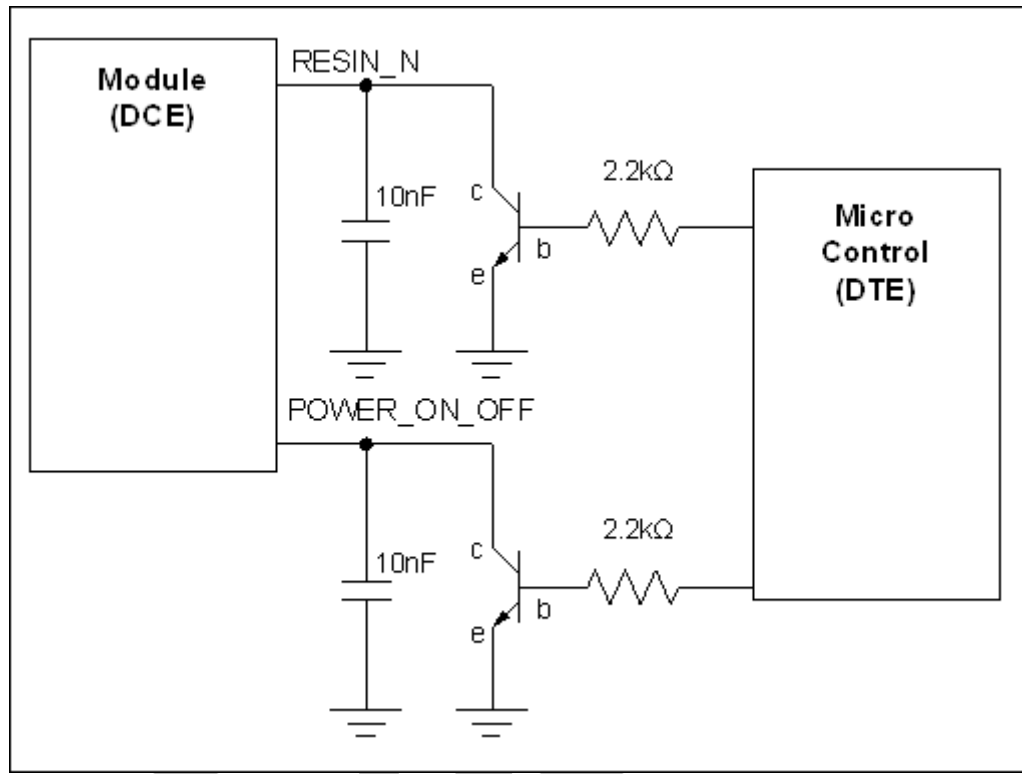
Power-On Time Sequence

After VBAT has been applied and is stable, the module will generate an on board power on reset signal and on the release of the reset, the module will boot up.

USB_DP will be pulled high when boot up completes, simultaneously the module starts to communicate with host via USB or UART. Figure 3-4 shows power on timing sequence.

During power on timing, please make sure the VBAT is stable.

Figure 3-4 Power on timing sequence
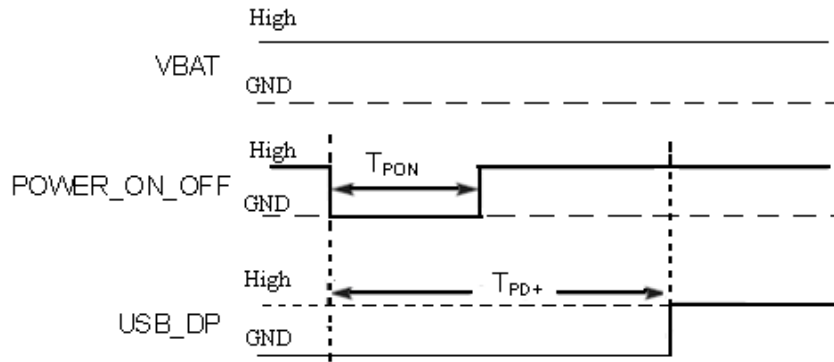
Table 3-6 Power on timing

Parameter	Comments	Time(Nominal values)	Units
T_{PON}	POWER_ON_OFF turn on time.	$0.5< T_{PON} <1$	sec
T_{PD+}	POWER_ON_OFF Valid to USB D+ high	4	sec

If the DTE needs to detect the PID/VID of module during the BIOS phase, the detection time should exceed the T_{PD+} time.

Figure 3-5 Power off timing
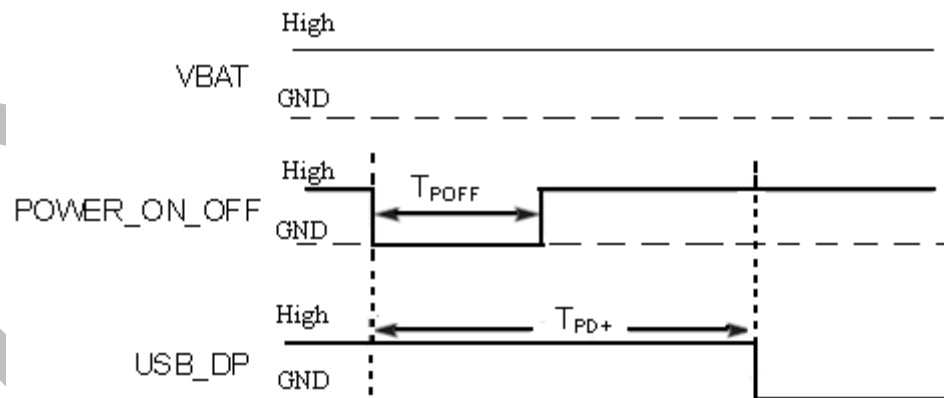

Table 3-7 Power off timing

Parameter	Comments	Time(Nominal values)	Units
T_{POFF}	POWER_ON_OFF turn off time.	$2.5< T_{POFF} <4$	sec
T_{PD+}	POWER_ON_OFF Valid to USB D+ high	4.6	sec

 NOTE

For detailed information about power supply design and printed circuit board (PCB) design, see the *HUAWEI LGA Module Power Supply Design Guide* and the *HUAWEI MC509 CDMA LGA Module PCB Interconnection Design Guide*.

RESIN_N

The MC509 module supports hardware reset function. If the software of the MC509 module stops responding, the MC509 module can be reset through the RESIN_N signal. 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**.

3.4.3 Output Signal Control Pin (TBD)

3.4.4 WAKEUP_IN Signal

The DTE controls the sleep and wakeup status of the MC509 module through the WAKEUP_ IN signal.

If there is no external WAKEUP_IN signal, the wireless module keeps in the wakeup status by default. After receiving the WAKEUP_ IN signal, the wireless module determines whether to enter the sleep mode according to the level status of the WAKEUP_IN signal.

Table 3-5 shows the definition of the WAKE_IN signal.

3.4.5 WAKEUP_OUT Signal

The WAKEUP_OUT signal is used to wake up the external system. Figure 3-6 shows the recommended schematic.

Figure 3-6 Connections of the WAKEUP_IN and WAKEUP_OUT pins
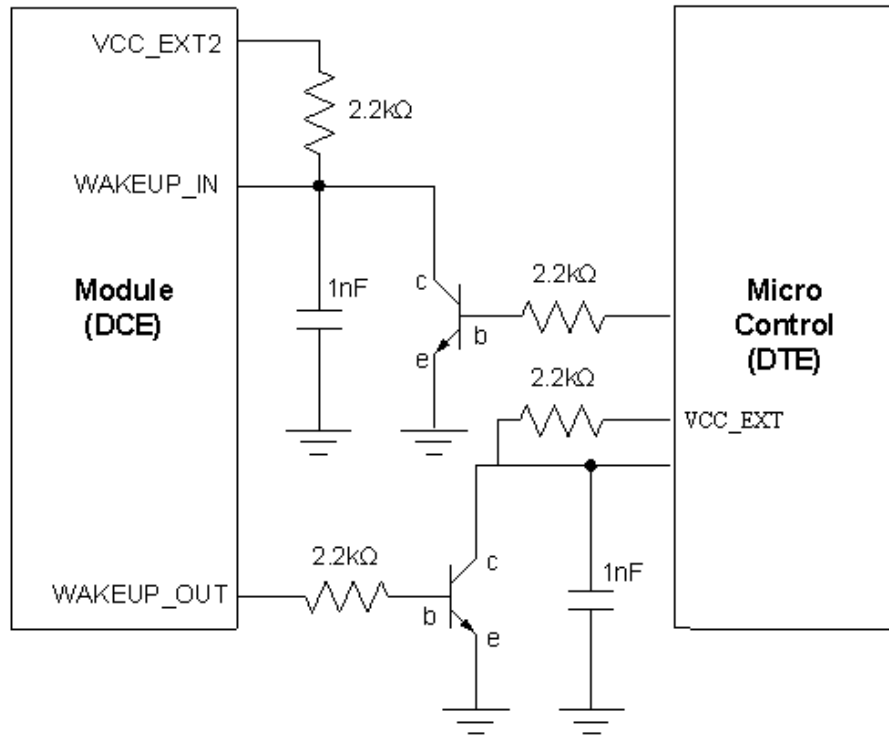
3.5 UART Interface

3.5.1 Overview

The MC509 module provides the RS-232 UART (9-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 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

- Baud rate ranging from 600 bit/s to 230400 bit/s (115200 bit/s by default)

- Self-adapted baud rate ranging from 1200 bit/s to 115200 bit/s

Table 3-8 lists the UART interface signals.

Table 3-8 UART interface signals

Pin No.	Pin Name	I/O	Description	Feature	DC Characteristics (V)		
					Min	Typical	Max
76	UART_TX	O	Data sending on the wireless module	The DTE receives serial data.	-0.3	2.6	2.9
78	UART_RX	I	Data receive end of the module	The DTE transmits serial data.	-0.3	2.6	2.9
77	UART_RING	O	Ringing indication on the wireless module	The DTE is notified of a remote call.	-0.3	2.6	2.9
74	UART_RTS	O	Data sending request on the wireless module	The DTE notifies the DCE of sending requests.	-0.3	2.6	2.9
79	UART_DTR	I	Data terminal ready on the wireless module	The DTE is ready.	-0.3	2.6	2.9
80	UART_CTS	I	Clearing to send on the wireless module	The DCE switches to the receiving mode.	-0.3	2.6	2.9
75	UART_DCD	O	Data carrier detection on the wireless module	Data links are connected.	-0.3	2.6	2.9
73	UART_DSR	O	Data ready on the wireless module	The DCE is ready.	-0.3	2.6	2.9

3.5.2 Circuit Recommended for the UART Interface

Figure 3-7 shows the connection of the UART interface in the MC509 module (DCE) with the host (DTE).

Figure 3-7 Connection of the UART interface in the MC509 module (DCE) with the host (DTE)
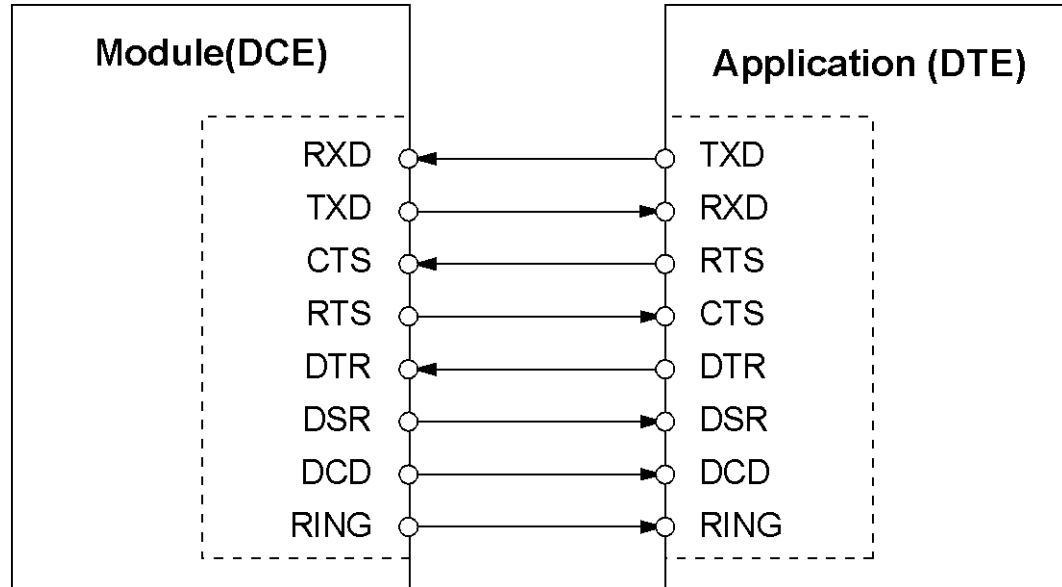
The RS-232 Transceivers can be used to connect the MC509 module to the RS-232-C interface. In this connection, the complementary metal oxide semiconductor (COMS) level and the Electronic Industries Association (EIA) level are converted mutually.

📖 **NOTE**

For detailed application of the MC509 UART interface, see the *HUAWEI LGA Module UART Design Guide*.

It is recommended that set the pins related to UART interface as test points on the DTE for debug.

3.6 USB Interface

The MC509 is compliant with USB 2.0 full speed protocol. The USB interface is powered directly from the 3.3 V supply. The USB input/output lines are compatible with the USB 2.0 3.3 V signal specifications. 0shows the circuit of the USB interface.

Table 3-9 USB interface signals

Pin No.	Pin Name	I/O	Description
86	USB_DP	I/O	USB data signal D+
85	USB_DM	I/O	USB data signal D-

📕 NOTE

The USB interface is powered directly from the 3.3 V supply. The USB input/output lines are compatible with the USB 2.0 3.3 V signal specifications.

Table 3-10 DC Electrical Characteristics of USB

VOHmin	VOLmax	VIHmin	VILmax
2.8V	0.3V	2V	0.8V

Figure 3-8 Recommended circuit of USB interface
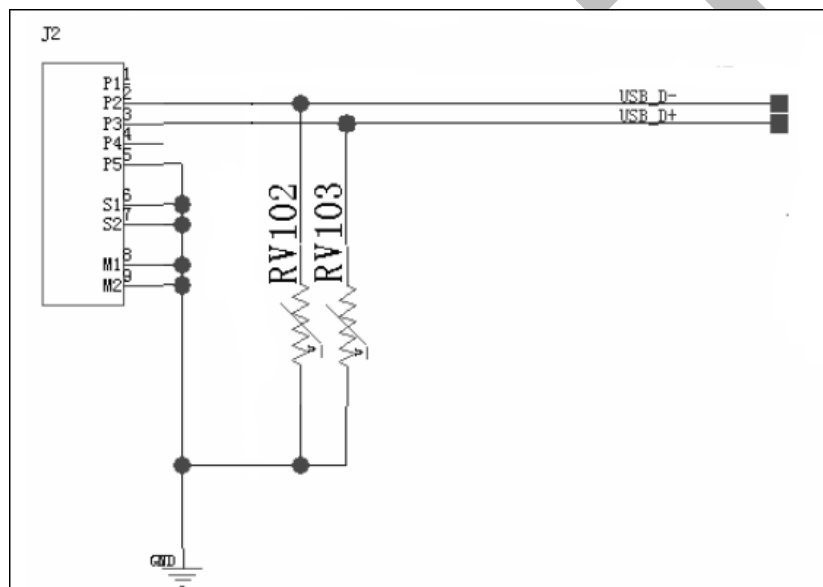
📕 NOTE

● Since the USB interface of MC509 module supports USB 2.0 full speed, the resistance "RV102 and RV103" in the 0must be Voltage Sensitive Resistor with small capacitance (ALVC18S02003 manufactured by AMOTECH or B72590T7900V60 manufactured by EPCOS is recommended.). In addition, The layout design of this circuit on the DTE board should comply with the USB 2.0 full speed protocol, with differential lining and impedance control to 90 ohm

● It is recommended that set USB D+ and USB D- pins as test points and then place these test points on the DTE for debug.

3.7 UIM Card Interface

3.7.1 Overview

The MC509 module provides a UIM card interface complying with the ISO 7816-3 standard and supports automatic detection of a 3.0V UIM card or a 1.8V UIM card. Table 3-11 lists the UIM card interface signals.

Table 3-11 UIM card interface signals

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min	Typical	Max
34	UIM_VCC	O	Power source for the external UIM.	-0.3	1.8/2.85	2.1/3.15
89	UIM_DATA	I/O	External UIM data signal.	-0.3	1.8/2.85	2.1/3.15
90	UIM_CLK	O	External UIM clock signal.	-0.3	1.8/2.85	2.1/3.15
88	UIM_RESET	O	External UIM reset signal.	-0.3	1.8/2.85	2.1/3.15

3.7.2 Circuit Recommended for the UIM Card Interface

As the MC509 module is not equipped with a UIM card socket, a UIM card socket need to be placed on the user interface board. The UIM card signals are transmitted outwards through the 145-pin LGA interface. Figure 3-9 shows the circuit of the UIM card interface.
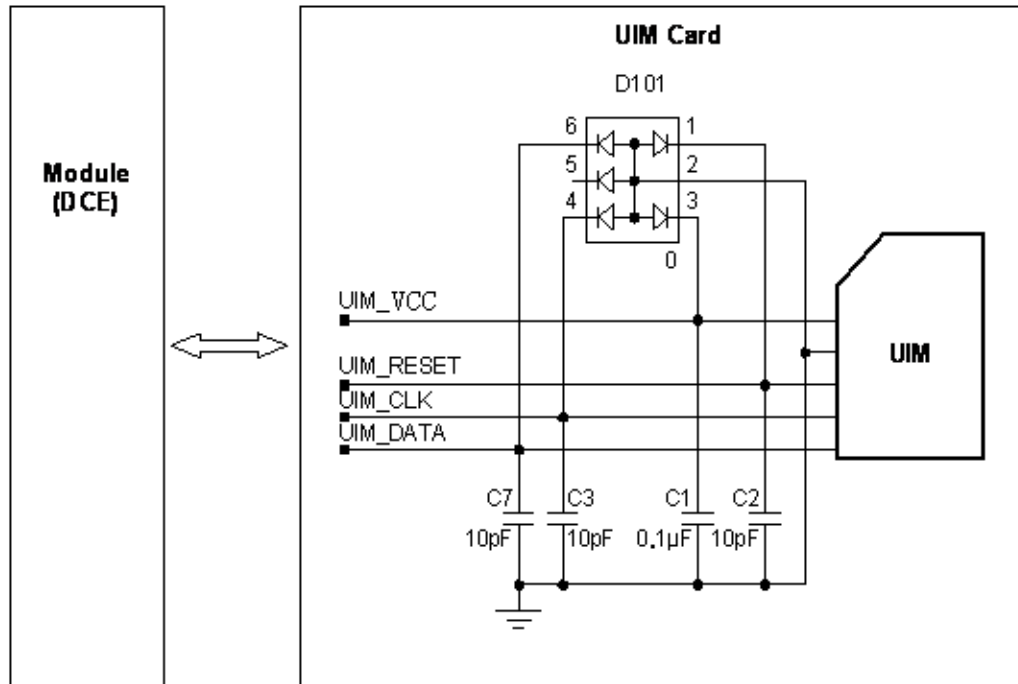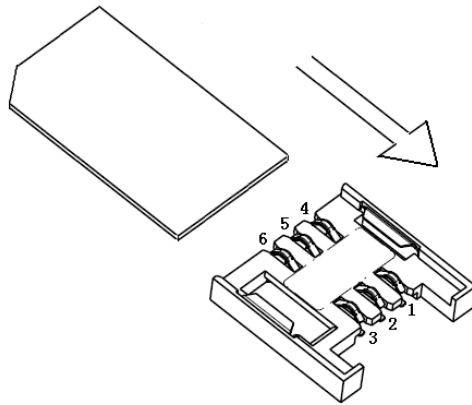
Figure 3-9 Circuit of the UIM card interface

Figure 3-10 Pin definition of UIM Socket

| pin1： | UIM_PWR |
pin2：	UIM_RESET
pin3：	UIM_CLK
pin4：	GND
pin5：	NULL
pin6：	UIM_DATA

⚠ **CAUTION**

- To meet the requirements of ETSI TS 102 230protocols and electromagnetic compatibility (EMC) authentication, the UIM card socket should be placed near the LGA interface (it is recommended that the PCB circuit connecting the LGA interface and the UIM card socket not exceed 100mm), because a long circuit may lead to wave distortion, thus affecting signal quality.

- It is recommended that the user should wrap the area adjacent to the UIM_CLK and UIM_DATA signal wires with a ground wire. The GND pin of the UIM card socket and the GND pin of the UIM card must be well connected to the power GND pin supplying power to the MC509 module.

- A 0.1μF capacitor is placed between the UIM_VCC and GND pins in a parallel manner. Three 10pF or 33pF capacitors are placed between the UIM_DATA and GND pins, the UIM_RST and GND pins, and the UIM_CLK and GND pins in parallel to filter interference from RF signals.

- It is not recommended that pull the UIM_DATA pin up during design as a 15000-ohm resistor is used to connect the UIM_DATA pin to the UIM_VCC.

3.7.3 ESD Protection for the UIM Card Interface

It is recommended to take electrostatic discharge (ESD) protection measures near the UIM card socket. Figure 3-11 shows ESD protection circuit of the UIM card, in which the transient voltage suppressor (TVS) diode is placed as close as possible to the UIM card socket, and the GND pin of the ESD protection component is well connected to the power GND pin that supplies power to the MC509 module.

Figure 3-11 ESD protection circuit on the UIM card
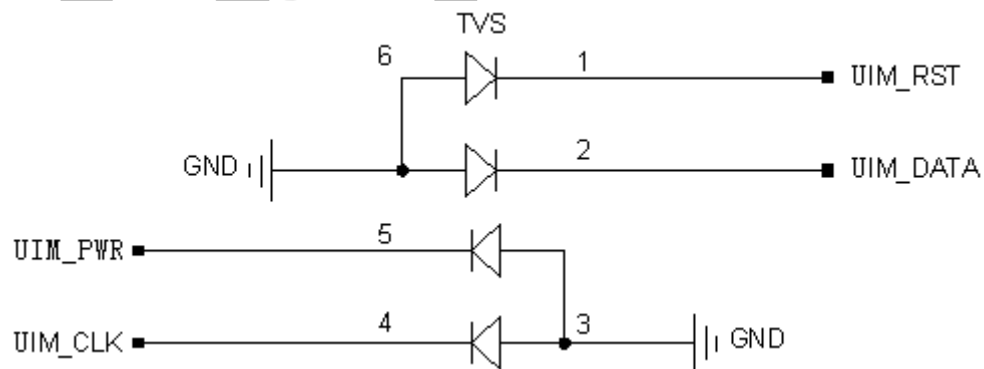
3.8 Audio Interface

3.8.1 Analogue Audio

The MC509 provides two audio I/O channels (Data only doesn't support the voice function).

The two audio I/O channels are completely different and thus have good performance of resisting RF interferences. The routes on the printed circuit board (PCB) should be placed in parallel with each other and should be short. The filter circuit on the two sides should be symmetric. The differential signals should be close to each other. The audio output signals in differential pairs and the audio input signals in differential pairs should be separated effectively through ground. In addition, the audio signals should be located away from the circuits of the power supply, RF, and antenna.

The first audio channel can be used for the handset without requiring any audio amplifier. The output power for the differential ear output is typically 350mW for a full-scale +3dBm sine wave into a 32-ohm speaker.

The second audio channel can be used for the hands-free without requiring any audio amplifier. The output pins are configured differently, with a rated output of 500 mW into an 8Ω speaker. Considerable current flows between the audio output pins and the speaker, and thus wide PCB traces are recommended (20mils).

MC509 provides 2.2V power source and 1mA of bias current internally for the microphones of both audio channels.

Figure 3-12 Circuit diagram of the interface of the first audio channel
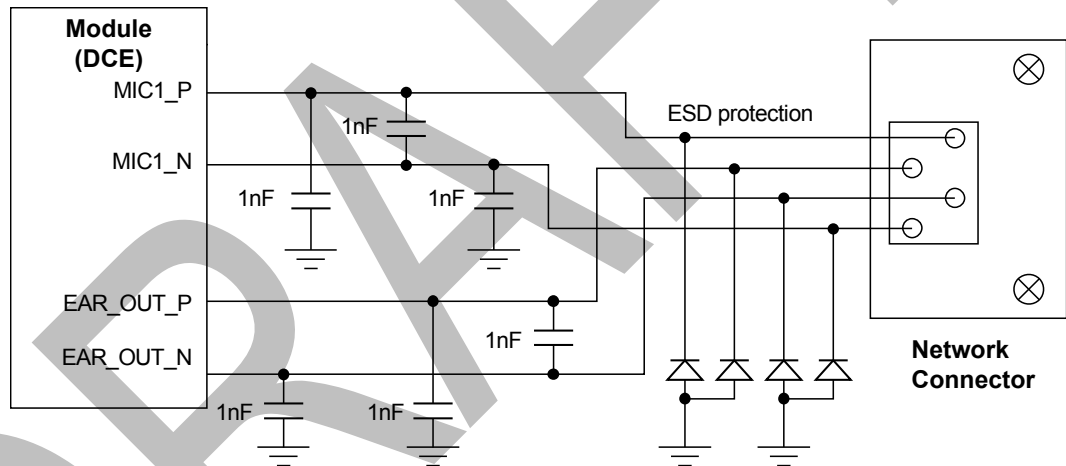
Figure 3-13 Circuit diagram of the interface of the second audio channel
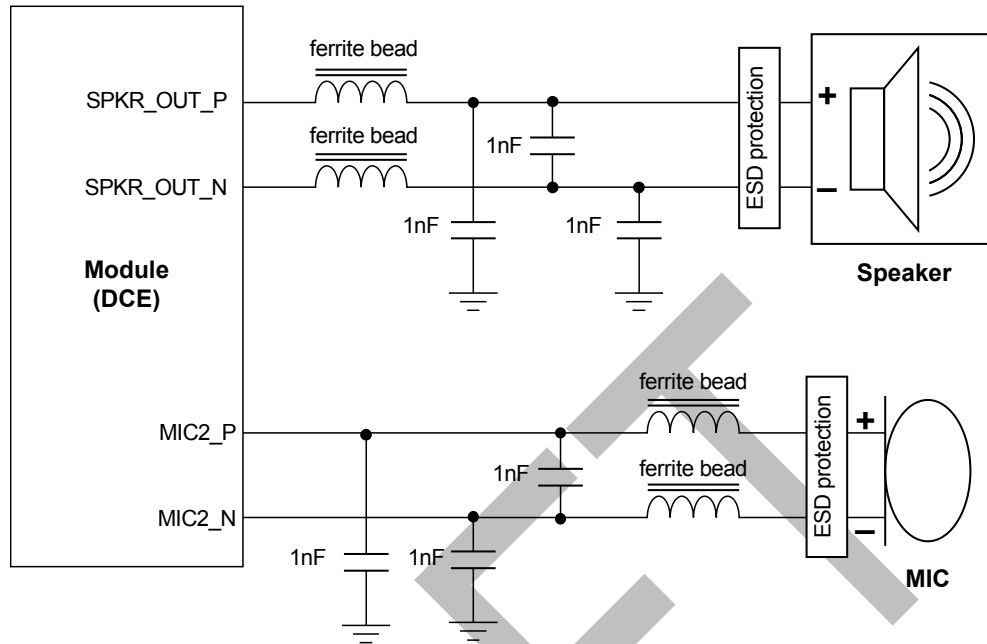
> **NOTE**
> - It is recommended that a TVS be used on the related interface, to prevent electrostatic discharge and protect integrated circuit (IC) components.
> - Data only does not support the voice function.

3.8.2 Digital Audio

The MC509 provides one digital audio channels (Data only doesn't support the voice function). Table 3-12 lists the signals on the digital audio interface.

Table 3-12 Signals on the digital audio interface

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min	Typical	Max
5	PCM_SYNC	O	PCM interface sync	-0.3	2.6	2.9
6	PCM_DIN	I	PCM I/F data in	-0.3	2.6	2.9
7	PCM_DOUT	O	PCM I/F data out	-0.3	2.6	2.9
8	PCM_CLK	O	PCM interface clock	-0.3	2.6	2.9

The MC509 PCM interface enables communication with an external codec to support linear and μ-law format. The PCM_SYNC runs at 8kHz with a 50% duty cycle.

Figure 3-14 Circuit diagram of the interface of the PCM (MC509 is used as PCM master)

📖 **NOTE**

- PCM_SYNC: Output when PCM master
- PCM_CLK: Output when PCM master
- It is recommended that a TVS be used on the related interface, to prevent electrostatic discharge and protect integrated circuit (IC) components.
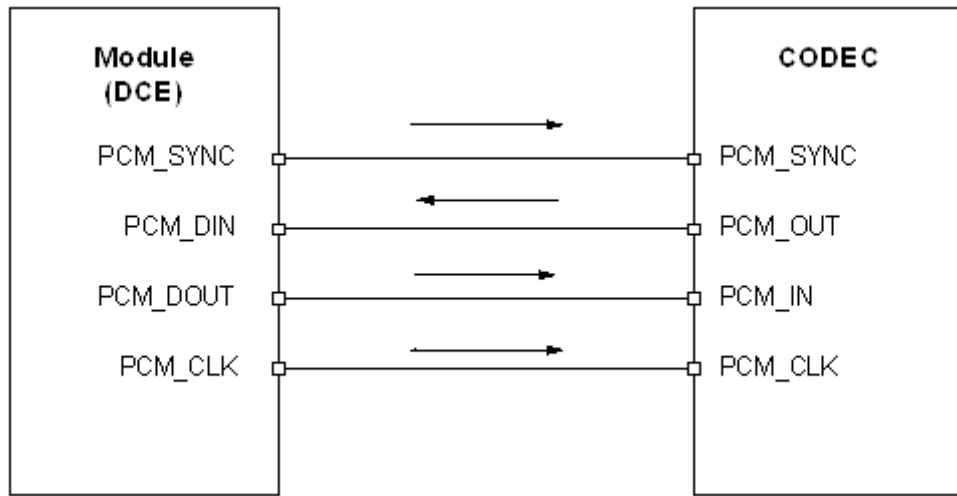- Data only edition does not support the voice function.

Primary Mode

On Primary mode MU509 provides a 16-bit linear or μ-law, with short-sync and 2.048MHz clock (on the PCM_CLOCK pin).

3.9 General Purpose I/O Interface

The LGA module provides seven channels GPIO pins for customers to applications of controlling signal. Customers can use AT command to control the state of logic levels of eight channels GPIO output signal. See the *HUAWEI MC509 CDMA LGA Module AT Command Interface Specification*.

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min	Type	Max
44，46，51，55，105，109，113,	GPIO	I/O	General I/O pins	-0.3	2.6	2.9

3.10 JTAG Interface

LGA MC509 module provides one JTAG interface (Joint Test Action Group). Set the pins in the following table as the test pins. And place the test points in the DTE for debug.

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min	Type	Max
31	VCC_EXT2	O	2.6V POWER output	-	2.6	-
100	RESIN_N	I	Reset module	-0.3	1.8	2.1
30	JTAG_TMS	I	JTAG Test mode select	-0.3	2.6	2.9
36	JTAG_TRST_N	I	JTAG reset.	-0.3	2.6	2.9
42	JTAG_TCK	I	JTAG clock input	-0.3	2.6	2.9
72	JTAG_TDO	Z	JTAG test data output	-0.3	2.6	2.9
87	JTAG_TDI	I	JTAG test data input	-0.3	2.6	2.9
93	JTAG_RTCK	O	JTAG return clock	-0.3	2.6	2.9
14	PS_HOLD		This input high to keep power on, low to shut down.	-	1.8	

📖 NOTE

It is recommended that set the 9 pins related to JTAG interface as test points on the DTE for tracing and debug.

3.11 RF Antenna Interface

MC509 module provides an RF ANT PAD for connecting an external antenna. Through the MAIN_ANT pad, the antenna interface is routed to the coaxial connector on the DTE (Impedance 50).The external antenna is connected to the module through the coaxial connector.

A matching location for the antenna must be reserved at the antenna port.

Table 3-13 Signals on RF Antenna interface

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min	Typical	Max
107	MAIN_ANT	-	RF main antenna interface	-	-	-
111	GPS_ANT	-	RF GPS antenna interface	-	-	-
115	AUX_ANT		RF divert antenna interface	-	-	-

3.12 NC Pins

The LGA module has 45 NC pins. All the NC interfaces should not be connected. Please keep this pin open.

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min	Typical	Max
1~4,9,10,16~27,33, 37, 47,60~70,82~84,92,94, 95, 102~104.117~120	NC	-	Not connected, please keep this pin open	-	-	-

4 RF Specifications

4.1 About This Chapter

This chapter describes the RF specifications of the MC509 module, including:

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

4.2 Antenna Installation Guidelines

- Install the antenna in a place covered by the signal.
- The Antenna must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.
- Antenna must not be installed inside metal cases.
- Antenna must be installed also according Antenna manufacturer instructions.

4.3 Operating Frequencies

错误！未找到引用源。 shows the RF bands supported by MC509 RF bands

Operating Band	Tx	Rx
CDMA 800 (BC0)	824MHz ~ 849MHz	869MHz ~ 894MHz
CDMA 1900 (BC1)	1850MHz ~ 1910MHz	1930MHz ~ 1990MHz

4.4 Conducted RF Measurement

4.4.1 Test Environment

Test instrument   Agilent 8960

Power supply   KEITHLEY 2306

RF cable for testing   L08-C014-350 of DRAKA COMTEQ or Rosenberger

Cable length: 29cm

Compensation for CDMA 850MHz:0.8dB

Compensation for CDMA 2100MHz:1dB

📖 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.

4.4.2 Test Standards

Huawei modules meet all 3GPP2 test standards relating to 3G. Each module passes strict tests at the factory and thus the quality of the modules is guaranteed.

4.5 Conducted Rx Sensitivity and Tx Power

4.5.1 Conducted Receive Sensitivity

The conducted receive sensitivity is a key parameter that indicates the receiver performance of MC509. 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.

The **3GPP Protocol Claim** column in Table 4-1 lists the required minimum values, and the **Test Value** column lists the tested values of MC509.

Table 4-1 MC509 conducted Rx sensitivity (Unit: dBm)

Item		3GPP2 Protocol Claim (dBm)	MC509 Test Value (dBm)		
			Min	Typical	Max
CDMA 800	1x(FER<0.5%)	< -104	-		-104
	EVDO(FER<0.5%)	< -105.5	-		-105.5
CDMA1900	1x(FER<0.5%)	< -104	-		-104
	EVDO(FER<0.5%)	< -105.5	-		-105.5

📖 **NOTE**

The test values are the average of some test samples.

4.5.2 Conducted Transmit Power

The conducted transmit power is another indicator that measures the performance of MC509. The conducted transmit power refers to the maximum power that the module tested at the antenna port can transmit. According to the 3GPP2 protocol, the required transmit power varies with the power class.

Table 4-2 lists the required ranges of the conducted transmit power of MC509. The tested values listed in the Test Value column must range from the minimum power to the maximum power.

Table 4-2 MC509 conducted Tx power (Unit: dBm)

Item	MC509 Test Value (dBm)		
	Min	**Typical**	**Max**
BC0(CDMA 800MHz)	23	24	26
BC1(CDMA 1900MHz)	23	24	26

4.6 Antenna Design Requirements

4.6.1 Antenna Design Indicators

Antenna Efficiency

Antenna efficiency is the ratio of the input power to the radiated or received power of an antenna. The radiated power of an antenna is always lower than the input power due to the following antenna losses: return loss, material loss, and coupling loss. The efficiency of an antenna relates to its electrical dimensions. To be specific, the antenna efficiency increases with the electrical dimensions. In addition, the transmission cable from the antenna port of MC509 to the antenna is also part of the antenna. The cable loss increases with the cable length and the frequency. It is recommended that the cable loss be as low as possible, for example, U.FL-LP-088 made by HRS.

The following antenna efficiency (free space) is recommended for MC509 to ensure high radio performance of the module: **Efficiency of the master antenna > 50% (– 4dB),** In addition, the efficiency should be tested with the transmission cable.

S11 or VSWR

S11 (return loss) indicates the degree to which the input impedance of an antenna matches the reference impedance (50-ohm). S11 shows the resonance feature and impedance bandwidth of an antenna. Voltage standing wave ratio (VSWR) is another

expression of S11. S11 relates to the antenna efficiency. S11 can be measured with a vector analyzer.

The following S11 values are recommended for the antenna of MC509: **S11 of the master antenna < –6dB**

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 MC509.

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 can be used for wireless terminals. 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 MC509: **Master antenna: omnidirectional**

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 MC509: **Gain of the master antenna ≤ 2.5dBi**

📖 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, Pulse, etc.

4.6.2 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.

4.6.3 CDMA Antenna Requirements

The antenna for MC509 must fulfill the following requirements:

CDMA 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	80MHz in CDMA800 140MHz in CDMA1900
Gain	Gain < 3dBi
Impedance	50-ohm
Input power	> 24dBm Average power in CDMA
VSWR absolute max	<= 10:1
VSWR recommended	<= 2:1

Furthermore if the device is developed for the US and/or Canada market, it must comply with the FCC and/or IC requirements:

This device is to be used only for mobile and fixed application. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. End-users must be provided with transmitter operation conditions for satisfying RF exposure compliance. OEM integrators must ensure that the end user has no manual instructions to remove or install the UC864-E/G/WD /WDU module. Antennas used for this OEM module must not exceed 3dBi gain for mobile and fixed operating configurations.

4.6.4 Radio Test Environment

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

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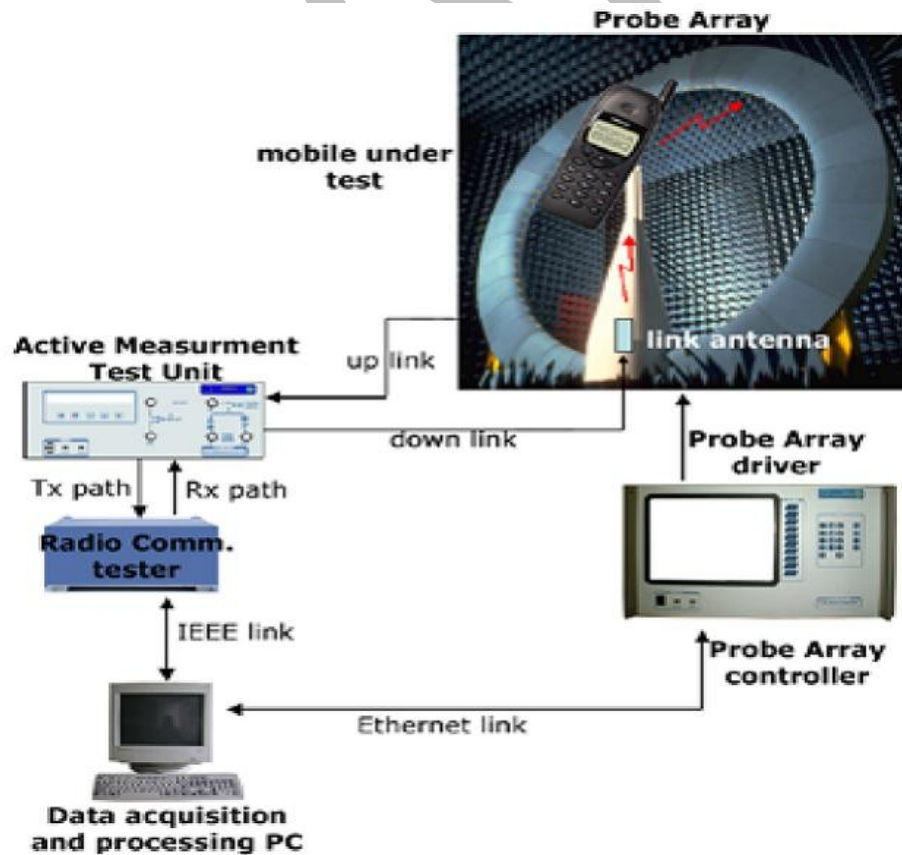
Passive Tests

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

Active Tests

- **TRP:** GSM, WCDMA, CDMA, TD-SCDMA, and LTE systems
- **TIS:** GSM, WCDMA, CDMA, TD-SCDMA, and LTE systems

Figure 4-1 shows the SATIMO microwave testing chamber.

Figure 4-1 SATIMO microwave testing chamber

5 Electrical and Reliability Features

5.1 About This Chapter

This chapter describes the electrical and reliability features of the interfaces in the MC509 module, including:

- Extreme Working Conditions
- Working and Storage Temperatures and Humidity
- Power Supply Features
- Reliability Features
- EMC and ESD Features

5.2 Extreme Working Conditions

⚠ **WARNING**

Table 5-1 lists the extreme working conditions for the MC509 module. Using the MC509 module beyond these conditions may result in permanent damage to the module.

Table 5-1 Extreme working conditions for the MC509 module

Symbol	Specification	Minimum Value	Maximum Value	Unit
VBAT	External power voltage	-0.5	5.0	V
VCOIN	Input voltage of standby power for the RTC	1.5	3.15	V
V_I	Data pin voltage	-0.4	3.3	V

5.3 Working and Storage Temperatures and Humidity

Table 5-2 lists the working and storage temperatures and humidity for the MC509 module.

Table 5-2 Working and storage temperatures and humidity for the MC509 module

Specification	Minimum Value	Maximum Value	Unit
Normal working temperatures [1]	TBD	TBD	°C
Extreme working temperatures [2]	TBD	TBD	°C
Ambient temperature for storage	TBD	TBD	°C
Moisture	TBD	TBD	%

📖 NOTE

[1]: When the MC509 module works at this temperature, all its RF indexes comply with the 3GPP2 C.S057D specifications.

[2]: When the MC509 module works at this temperature, certain RF indexes do not comply with the 3GPP2 C.S057D specifications.

5.4 Electrical Features of Application Interfaces

Table 5-3 lists electrical features (typical values).

Table 5-3 Electrical features of application interfaces

Parameter	Description	Minimum Value	Maximum Value	Unit
V_{IH}	High-level input voltage	0.65*VDD_PX	VDD_PX + 0.3	V
V_{IL}	Low-level input voltage	-0.3	0.35* VDD_PX	V
I_{leak}	Input leakage current	-0.2	0.2	µA
V_{OH}	High-level output voltage	VDD_PX – 0.45	VDD_PX	V
V_{OL}	Low-level output voltage	0	0.45	V
I_{OH}	High-level output current	1.5		mA

Parameter	Description	Minimum Value	Maximum Value	Unit
I_{OL}	Low-level output current		-1.5	mA

📖 **NOTE**

VDD_PX is 2.6V or 1.8V, about the voltage, please refer to Table 3-1 .

5.5 Power Supply Features

5.5.1 Input Power Supply

Table 5-4 lists the requirements for input power of the MC509 module.

Table 5-4 Requirements for input power of the MC509 module

Parameter	Minimum Value	Typical Value	Maximum Value	Ripple	Unit
VBAT	3.0	3.8	4.2	< 50mVpp (0Hz to 2.5GHz)	V
VCOIN	1.5	3.0	3.25	< 30mVpp	V

Figure 5-1 lists the Power Supply During Burst Emission
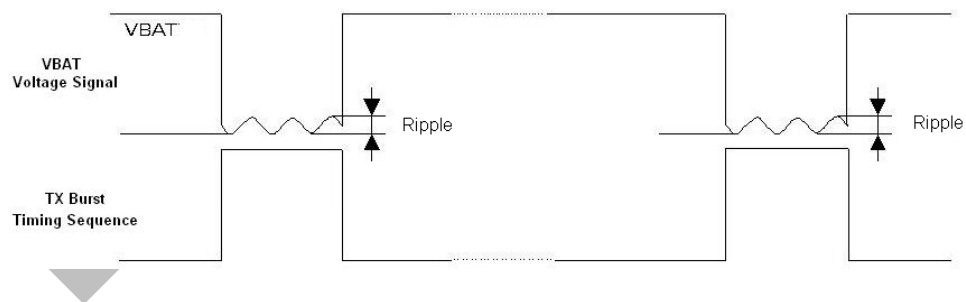
Figure 5-1 Power Supply During Burst Emission

Table 5-5 Requirements for input current of the MC509 module

Power	Peak (Maximum)	Normal (Maximum)
3.8V	<1500mA	<1000mA

5.5.2 Power Consumption

The power consumptions of MC509 in different scenarios are respectively listed in Table 5-6 .

The power consumption listed in this section is tested when the power supply of MC509 module is 3.8V. Typical values are measured at room temperature, and minimum and maximum values are measured over the entire operating temperature range.

Table 5-6 Averaged standby DC power consumption

Working mode		Max	Unit
Power off mode		TBD	µA
Standby mode	800M	TBD	mA
	1900M	TBD	mA
Data mode	800M	TBD	mA
	1900M	TBD	mA

NOTE

- Standby current consumption with Sleep mode deactivated-Idle(assumes USB bus is fully suspended during measurements)

- The above values are the average of some test samples.

5.6 Reliability Features

Table 5-7 lists the test conditions and results of the mechanical reliability of the MC509 module.

Table 5-7 Test conditions and results of the mechanical reliability of the MC509 module

Item	Test Condition	Standard
Low-temperature storage	Temperature: –40±2 ºC Test duration: 24h	IEC60068
High-temperature storage	Temperature: 85±2 ºC Test duration: 24h	IEC60068
Low-temperature working	Temperature: –30±2 ºC Test duration: 24h	IEC60068
High-temperature working	Temperature: 75±2 ºC Test duration: 24h	IEC60068

Item	Test Condition	Standard
Damp heat cycling	High temperature: 55±2 ºC Low temperature: 25±2 ºC Humidity: 95% Repetition times: 4 Test duration: 12h + 12h	IEC60068
Temperature shock	Low temperature: –40±2 ºC High temperature: 85±2 ºC Temperature change interval: < 30s Test duration: 15min Repetition times: 100	IEC60068
Salty fog test	Temperature: 35°C Density of the NaCl solution: 5±1 % Spraying interval: 8h Duration of exposing the module to the temperature of 35°C: 16h	IEC60068
Sine vibration	Frequency range: 5Hz to 200Hz Acceleration: 10m/s^2 Frequency scan rate: 1oct/min Test period: 3 axial directions. Five circles for each axial direction.	IEC60068
Shock test	Half-sine wave shock Peak acceleration: 300m/s^2 Shock duration: 11ms Test period: 6 axial directions. One shock for each axial direction.	IEC60068
Clash test	Half-sine wave Peak acceleration: 180m/s^2 Pulse duration: 6ms Repetition time: 6 directions. 1000 times for each direction.	IEC60068
Drop test	First case: 0.3m in height. Drop the MC509 module on the marble terrace with one surface facing downwards twice. Six surfaces should be tested. Second case: 0.8m in height. Drop the MC509 module on the marble terrace with one surface facing downwards twice. Six surfaces should be tested.	IEC60068

5.7 EMC and ESD Features

EMC tests have to be performed on the application as soon as possible to detect any potential problems.

When designing, special attention should be paid to the following:

- Possible harmful emissions radiated by the application to the RF receiver in the receiver band.

- ESD protection is mandatory on all signals which are externally accessible

- Typically, ESD protection is mandatory for the following:

    − UIM (if accessible from outside)

    − Serial link

    − USB

    − Audio

- Length of the UIM interface lines (preferably <10cm).

- EMC protection on audio input/output (filters against 900MHz emissions).

- Biasing of the microphone inputs.

- Ground plane: HUAWEI Wireless recommends a common ground plane for analog/digital/RF grounds.

- A metallic case or plastic casing with conductive paint is recommended, except for the area around the antenna.

📖 NOTE

The HUAWEI MC509 Module does not include any protection against over voltage.

6 Mechanical Specifications

6.1 About This Chapter

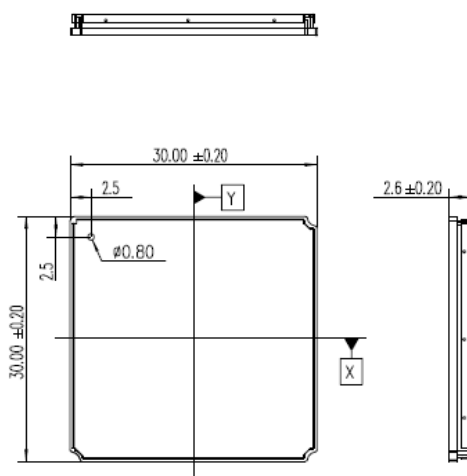This chapter describes the following aspects of the MC509 module:

- Dimensions and interfaces
- PCB Pad Design
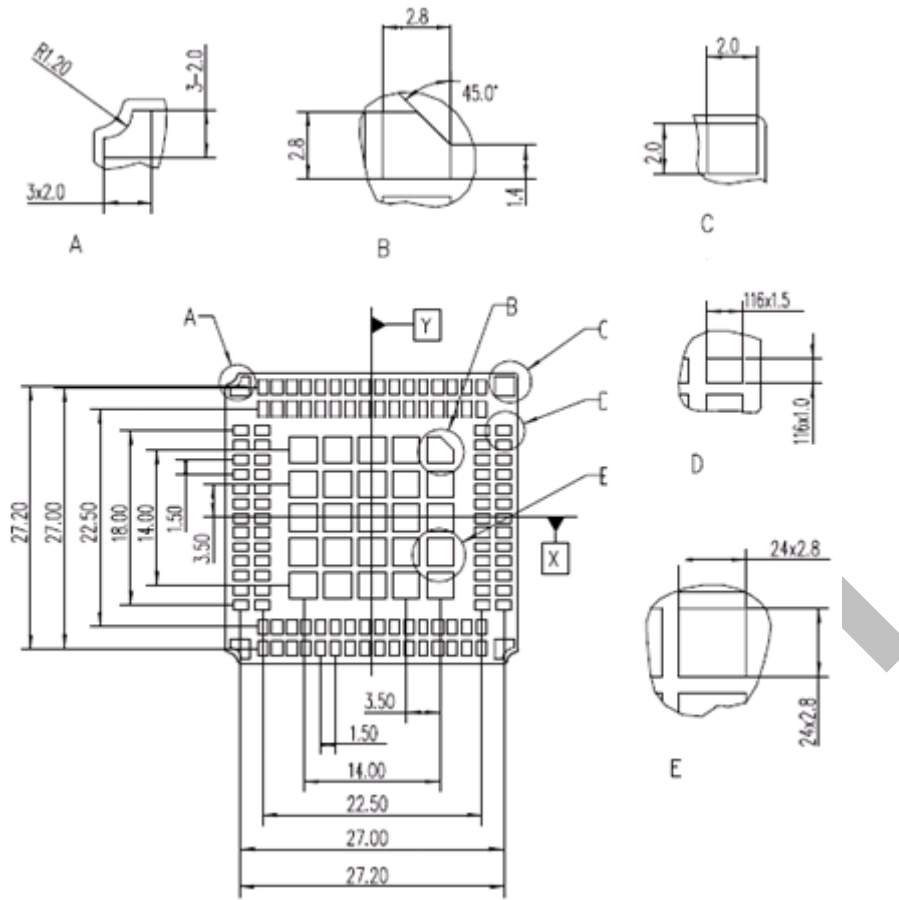- Label
- Packing System

6.2 Dimensions and interfaces

The dimension of MC509 is 30mm (length) × 30mm (width) × 2.6mm (height).

Figure 6-1 shows the dimensions of MC509 in details.

Figure 6-1 Dimensions of MC509

6.3 PCB Pad Design

To achieve assembly yields and solder joints of high reliability, it is recommended that the PCB pad size be designed as follows: the size of the pad in the middle region is the same as the pad size of the product package; other pads are 0.05 mm larger than the unilateral pad of the product package. For details, see Figure 6-2 .
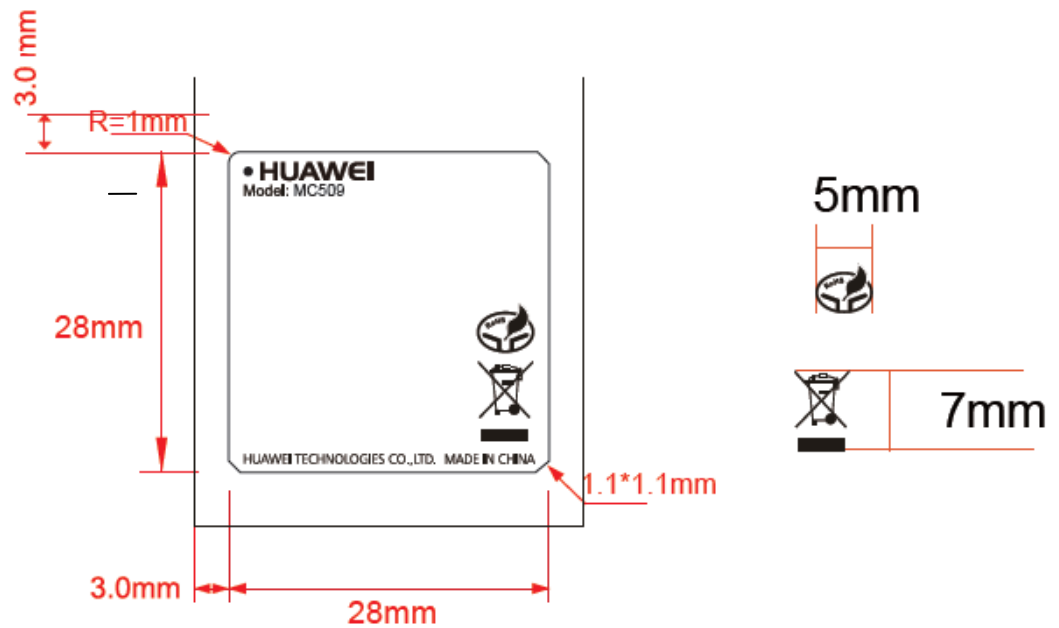
Figure 6-2 PCB pad design

LGA module customer PCB PADS recommendation
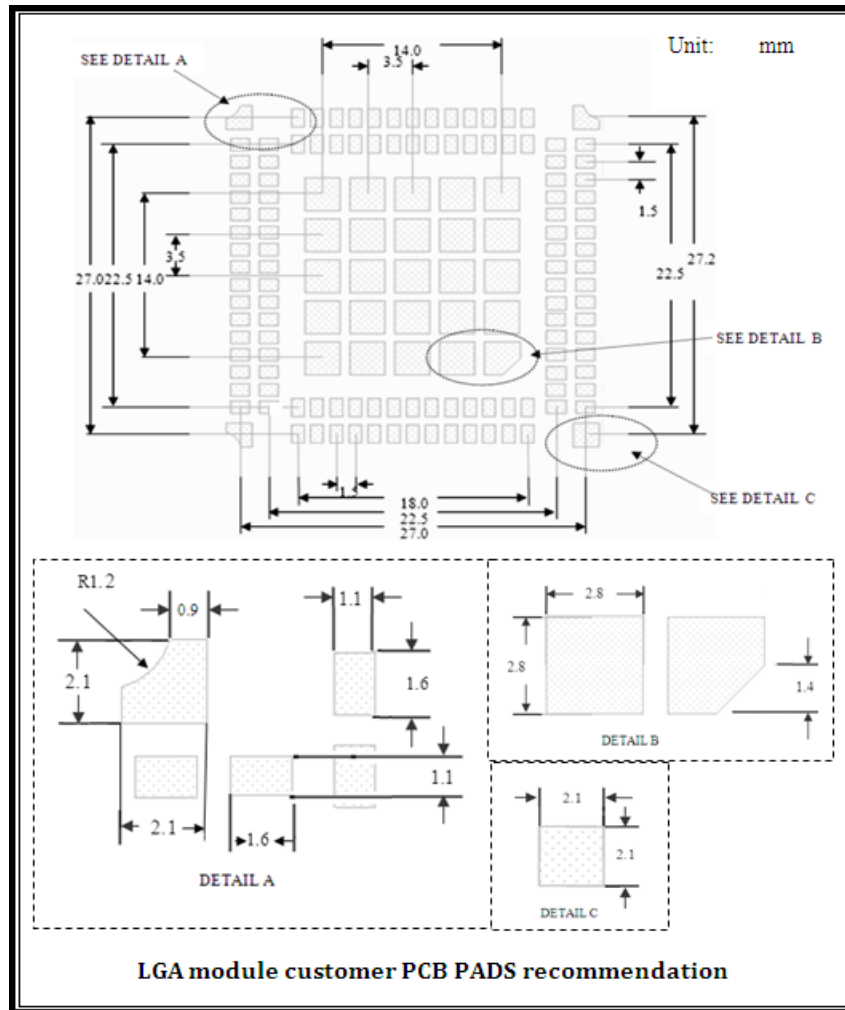
6.4 Label

The label is made from deformation-resistant, fade-resistant, and high-temperature-resistant material and is able to endure the high temperature of 260°C.

Figure 6-3 Nameplate

📖 **NOTE**

- The picture mentioned above is only for reference.
- Make the film according to the drawing.
- The silk-screen should be clear, without burrs, and dimension should be accurate.
- This nameplate should not be covered by the film.
- The material and surface finishing and coatings which used have to make satisfied with the EU WEEE and RoHS directives.
- The label must be heated up for 20s~40s and able to endure the high temperature of 260 °C. And the color of the material of the nameplate can't change.

6.5 Packing System

HUAWEI LGA module uses five layers ESD pallet, anti-vibration foam and vacuum packing into cartons. To get the details about the packing system, please refer to HUAWEI LGA Module Technical Guide for Assembly.

7 Certifications

7.1 About This Chapter

This chapter gives a general description of certifications:

- Environmental Protection Certification and Test
- National Compulsory Certification
- GCF and PTCRB

Table 7-1 Product Certifications

Certification	MC509
CE	
FCC	√
CCC	√
NCC	
A-TICK	
Jate&Telec	
IC	
EU RoHS	
JGPSSI	
SGS RoHS	
PVC-Free	
GCF	
PTCRB	
SUPL 1.0	

7.2 Environmental Protection Certification and Test

7.2.1 RoHS

RoSH stands for the restriction of the use of certain hazardous substances in electrical and electronic equipment.

The following table lists the substances restricted by the RoHS and upper thresholds of their density.

Restricted Substance	Density Threshold (ppm)
Cadmium (Cd)	100
Lead (Pb)	1000
Mercury (Hg)	1000
Hexavalent chromium (Cr6+)	1000
Polybrominated biphenyls (PBB)	1000
Polybrominated diphenyl ether (PBDE)	1000
The RoHS does not conflict with the following regulations: Battery directive Cadmium directive (91/338/EEC) Directive 2004/12/EC on packaging and packaging waste	

Declaration of Conformity (DOC): The product is declared as environment-friendly or as compliant with the environmental protection requirements after internal testing.

Notified body (NB) certification: The product passes the test arranged by a notified body (SGS), and the notified body issues the relevant certificate.

SGS RoHS Test

Tested object: homogeneous material (a material that cannot be mechanically disjoined into different materials) such as metal, plastic, glass, ceramics, solder, and coating

Test method: IEC62321 or equivalent test methods

The following describes the test methods in detail:

- XRF scanning

    The XRF scanning measurement can only analyze the calibration substances within its applicability scope. For chromium (Cr) and bromine (Br), the XRF scanning result shows only the total chromium and total bromine but not hexavalent chromium, PBB, or PBDE. If chromium or bromine is detected, you need to further test hexavalent chromium, PBB, and PBDE by using other test methods.

    The following table lists the required test results.

Element	Polymeric Material	Metallic Material	Electronic Component
Cd	$P \leqslant (70-3\sigma) < X < (130+3\sigma) \leqslant F$	$P \leqslant (70-3\sigma) < X < (130+3\sigma) \leqslant F$	$LOD \leqslant X < (250+3\sigma) \leqslant F$
Pb	$P \leqslant (700-3\sigma) < X < (1300+3\sigma) \leqslant F$	$P \leqslant (700-3\sigma) < X < (1300+3\sigma) \leqslant F$	$P \leqslant (500-3\sigma) < X < (1500+3\sigma) \leqslant F$
Hg	$P \leqslant (700-3\sigma) < X < (1300+3\sigma) \leqslant F$	$P \leqslant (700-3\sigma) < X < (1300+3\sigma) \leqslant F$	$P \leqslant (500-3\sigma) < X < (500+3\sigma) \leqslant F$
Br	$P \leqslant (300-3\sigma) < X$		$P \leqslant (250-3\sigma) < X$
Cr	$P \leqslant (700-3\sigma) < X$	$P \leqslant (700-3\sigma) < X$	$P \leqslant (500-3\sigma) < X$

- Chemical analysis
  - Use the ICP-AES, ICP-MS, and AAS to measure cadmium and lead in polymeric materials.
  - Use the CV-AAS, AFS, ICP-AES, and ICP-MS to measure mercury in polymeric materials, metals, and electronic components.
  - Test the chromized ferrous or non-ferrous metals by using the spot test method or boiling water extraction.
  - If the spot test fails to provide a definite result, you can perform boiling water extraction to further confirm the test result. If boiling water extraction shows the presence of hexavalent chromium, it is confirmed that the sample is coated with hexavalent chromium. Measure hexavalent chromium by using the colorimetric method.
  - Use a gas chromatograph (GC) or a mass spectrometer (MS) to measure PBB and PBDE in polymeric materials. Use a high pressure liquid chromatography (HPLC) or a UV detector to measure PBB and PBDE in polymeric materials.
  - The density of lead, mercury, hexavalent chromium, PBB, and PBDE needs to be lower than 1000 ppm. The density of cadmium needs to be lower than 100 ppm.

7.2.2 WEEE

WEEE stands for the Waste Electrical and Electronic Equipment Directive.

The WEEE mark is on the nameplate of the product. Huawei has concluded recycling agreements with four professional recycling companies in Europe. According to the agreements, the companies are responsible for recycling all Huawei waste equipment in Europe.

The WEEE Directive aims to reduce the amount of electrical and electronic equipment being produced and to encourage everyone to reuse, recycle and recover it.

The rate of recovery reaches 75% by an average weight per product. The reuse and recycling rate of components, materials, and substances reaches 65% by an average weight per product (the additional 10% is for energy recovery). Huawei Technical Support Department also declares the number and weight of the products delivered every year on the European Recycling Platform.

According to the European Recycling Platform and the agreements concluded between Huawei and the recycling companies in EU, the recycling companies

specified in the agreements are responsible for recycling the telecommunication products.

7.2.3 PVC-free

PVC-free products are free of polyvinyl chloride (PVC) that is harmful to human beings.

PVC is used to produce soft plastic products such as artificial leather, membrane, and cable sheaths, and hard plastic products such as plates, windows, doors, pipes, and valves.

PVC-free test mainly applies to printed circuit boards (PCBs) and surface mount technology (SMT) components.

A notified body must perform PVC-free tests (qualitative analysis and mixed tests) and then issue relevant test reports.

7.3 National Compulsory Certification

7.3.1 Product Certification

Product certification is the process of certifying that a certain product complies with the electromagnetic compatibility (EMC) safety and qualification requirements stipulated in relevant international, national, or industrial regulations and issuing relevant test report and certificate.

7.3.2 Importance of Product Certification

The possible violations of EMC rules are as follows:

- Use certification mark without authorization.
- Supply products without certification mark.
- Supply incompatible products or apply certification mark to incompatible products.
- Make incorrect declarations or no compatibility record is created or kept.

Possible penalties for violation of EMC rules are as follows:

- Sale forbidden
- Inventory seizure
- Compulsory callback
- Fine
- Being accused or put into prison

7.3.3 Product Certification Test Items

A product certification test consists of any or any combination of the following items:

- EMC

  Testing electromagnetic interference (EMI) and electromagnetic sensitivity
- Safety

Testing the product according to relevant safety regulations and ensuring that the product does no harm to users

- RF

  Measuring whether the radio transmitter meets relevant requirements

- Specific absorption rate (SAR)

  Measuring the RF energy absorbed by the body when an electronic product is used

7.3.4 Product Certification Classifications

Product certification is classified into compulsory certification and non-compulsory certification.

- Compulsory certification

  Many countries and regions define compulsory certification marks to facilitate market supervision of the commodity inspection organizations. For example, the Certification Europe (CE) mark, Federal Communications Commission (FCC) mark in U.S.A, and China Compulsory Certificate (CCC) mark are compulsory certification marks. Only the products with required compulsory certification marks can be sold in the relevant countries or regions.

- Non-compulsory certification

  Non-compulsory certification is also called voluntary certification. Compared with compulsory certification marks, the certification marks issued by independent certification bodies are more common in international trade. The PCS Type Certification Review Board (PTCRB) in America and the Global Certification Forum (GCF) in Europe are two typical examples of non-compulsory certification marks. Non-compulsory certification marks are issued by authorized non-governmental certification bodies based on the product liability laws in relevant countries and are recognized by the local governments. Compared with governmental bodies, non-governmental certification bodies are more professional with better test conditions and more positive certification measures. In addition, non-governmental certification bodies are under supervision of their authorizing administrations. For these reasons, the certification marks issued by non-governmental certification bodies are widely recognized in the market and are essential to international trade.

7.3.5 Certification Modes

- DOC

  By affixing a certification mark to a product, the manufacturer declares that the product is compliant with the relevant certification standards. For example, a manufacturer declares that its product complies with relevant EU directives if it affixes a CE mark to the product.

- NB certification

  By affixing a certification mark issued by an authorized certification body to a product, the manufacturer declares that the product passes the NB certification tests and complies with the relevant certification standards. The CE0682 mark issued by CETECOM, the UL mark issued by UL, and the GS mark issued by TUV Rheinland are three examples of NB certification marks.

  NB certification is used for Huawei modules in most cases.

7.3.6 Certification Types

CE Certification

According to the R&TTE Directive 1999/95/EC, all wireless equipment and telecommunications terminals sold in EU must meet all the stipulated health, safety, RF, and EMC requirements that provide for CE mark. Wireless equipment using frequency bands whose use is not harmonized throughout the EU should pass the certification test of a notified body. Notification should be given no less than four weeks in advance of the start of placing on the market and should provide information about the radio characteristics of the equipment (in particular frequency bands, channel spacing, type of modulation and RF-power) and the identification number of the notified body. The CE mark is a mandatory European mark. Any product placed on the single market in the European Economic Area should be affixed with a CE mark.
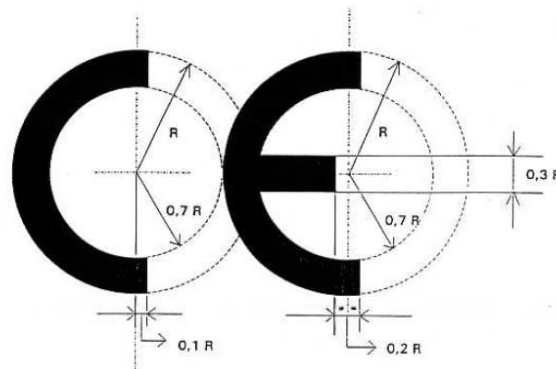
The CE mark of wireless equipment relates to the used frequency bands and the notified body. For this reason, the CE mark on the nameplate consists of letters C and E, the identification number of the notified body, and a ⓘ symbol.

FCC Certification

FCC stands for Federal Communications Commission.

The FCC, as an independent agency of the United States government, is charged with regulating interstate and international communications by radio, television, wire, satellite and cable.

FCC regulations, as part of federal laws, are divided into several parts.

Different parts define regulations for different products. A product, however, probably is required to meet the regulations in two or more parts.

All terminals should be certified by the FCC or TCB and granted with an FCC ID.

The FCC ID format is as follows: XXXYYYYYYYY

- **XXX** is the identification number of the applicant manufacturer (Huawei: QIS).
- **YYYYYYY** is the product number consisting of two to 14 digits.

An FCCID consists of capital letters in English, digits, and symbols - only. No other character is allowed.

For any Huawei product, the product model is used as the product number. For example, the FCC ID of the EM770W is QISEM770W.

NCC (DGT) Certification

According to *Telecommunications Act* and *Regulations on Inspection and Certification of Controlled Telecommunications Equipment* of Taiwan, no communication and electronic equipment can be manufactured or sold in Taiwan unless certified by the NCC (former DGT) with relevant certification marks.

The following lists the controlled telecommunications equipment:

- Radio transmitter
- Radio transceiver
- Radio receiver
- Radiated device
- Other radio sources

The DGT's *Technical Specifications for Low-Power Radio-Frequency Devices* specifies the frequencies that no low-power RF device or its principal wave should not use and control the radiation field strength of low-power RF devices.

Comply with the following rules when making DGT marks:

- Comply with the *Technical Specifications for Low-Power Radio-Frequency Devices* and the *Compliance Approval Regulations on Controlled Telecommunications Radio-Frequency Devices*.
- Affix or print marks of appropriate size on the equipment bodies because the dimensions are not specified.
- Affix or print the DGT mark on the minimal package if the equipment body is small to the mark.
- Attach the DGT mark to relevant products in compliant with relevant regulations. Ensure that the mark is legible in a single color.
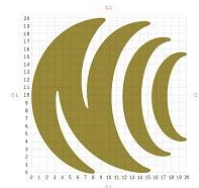
An example of the DGT mark:
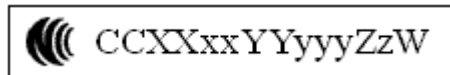
A-Tick Certification

The A-Tick is a compliance mark produced by the Australian Communications and Media Authority (ACMA) for telecommunications equipment. The A-Tick indicates that a product is compliant with the mandatory technical and safety standards specified by ACMA and can legally be connected to a telecommunications network in Australia.

All A-Tick certification test items should be performed in local labs in Australia. The test items are as follows:

- Safety test
- EMC test
- SAR test
- RF test

Some test requirements of the A-Tick certification are the same as those of the CE certification. For this reason, CE certification is accepted in Australia to avoid repeated tests.

The following frequency bands are allocated for mobile communication in Australia at present:

- 825–845 MHz and 870–890 MHz: The CDMA digital technical standards of North America are used.
- 890–915 MHz and 935–960 MHz: The GSM digital technical standards of Europe are used.
- 1710–1785 MHz and 1805–1880 MHz: The GSM digital technical standards of Europe are used.
- 1885–1980 MHz and 2110–2170 MHz: The 3G mobile communication technologies are to be used.

The A-tick mark is as follows:

N14036

TELEC and JATE Certification (Japan)

- Telecom Engineer Center (TELEC)

  TELEC is a compulsory certification for radio products in Japan. The TELEC certification complies with Japanese Radio Law. The specific test regulations are stipulated in MIC Notice No.88 and are updated and maintained by the MIC. All

wireless products require type approval (mainly for the RF part) by Japan Telecom before entering Japanese market.

- JATE

  JATE certification is mandatory for telecommunications equipment in Japan according to the Telecommunications Business Law. As specified in article 68 in the Telecommunications Business Law enforced in 1985, the Ministry of Public Management, Home Affairs, Posts and Telecommunications (MPHPT) has the right to designate qualified agencies for technical certification.

  The MPHPT designates the Japan Approvals Institute for Telecommunications Equipment (JATE) as the sole authorized agency for technical conditions certification (that is, JATE certification). The JATE provides technical conditions regulatory compliance certifications for telecommunications terminals. The certified equipment can legally be connected to public telecommunications networks without inspection of telecom carriers.

  All products certified by the JATE need to be affixed with certification mark shown in the following figure. Sequence numbers are used on the certification marks.
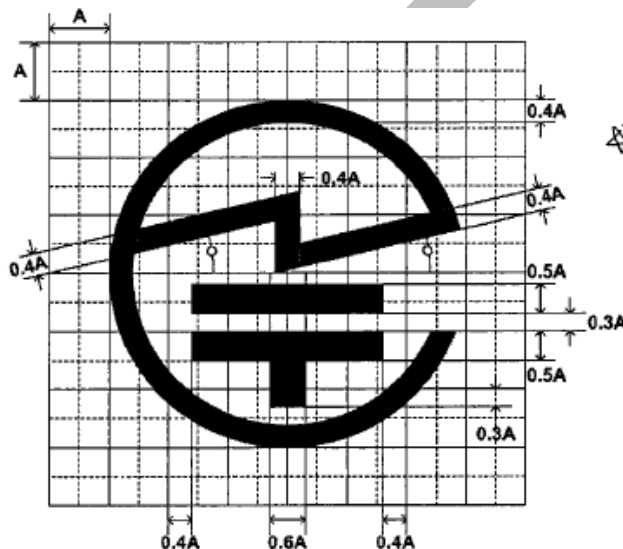
IC Certification (Canada)

IC stands for Industry Canada. As a department of the Government of Canada, the IC stipulates the inspection standards for analog and digital terminals, performs certifications of electrical and electronic products entering the Canadian market, and requires that all electronic products imported to Canada must pass EMC certification. The involved products include broadcast and TV equipment, IT equipment, wireless equipment, telecommunications equipment, and industrial, scientific, and medical (ISM) equipment. Similar to the FCC, the IC applies restrictions on electromagnetic interference only.

The complete IC certification or registration number is as follows:

IC: XXXXXX-YYYYYYYY

- XXXXXX

  XXXXXX is the company number issued by the IC (Huawei: 6369A).

- YYYYYYYY

    YYYYYYYY is the unique product number (UPN) consisting of up to eight capital letters in English and/or digits.

Chinese Certifications

- Network access licensing (NAL)

    The Ministry of Information Industry (MII, former Ministry of Posts and Telecommunications) applies NAL to telecommunications equipment. On January 1, 1999, with the enforcement of the *Administration of the Network Connection of Telecommunications Equipment Procedures* issued by the MII, all telecommunications equipment that access public or private telecommunications networks in China should obtain network access licenses issued by the MII. No telecommunications equipment can be connected to a public telecommunications network or be sold in China without a network access license.

    A network access license includes the following information:

    - License number
    - Applicant
    - Manufacturer
    - Equipment name
    - Equipment type
    - Place of manufacture
    - Remarks
    - Date of issue
    - Date of expiry

    A network access license often is valid for three years. The Telecommunications Administration Bureau, MII is responsible for inspecting and approving telecommunications equipment and then issuing network access licenses according to the inspection results. Local telecommunication administration departments are responsible for supervising and managing network access of telecommunications equipment in the local regions.

    The network access certification is called China Telecommunications Equipment Network Access Approval (TENAA or CTA) or China Telecommunications Equipment Network Access Licensing (NAL).

    NAL marks should meet the following requirements:

    - NAL marks are the quality compliance marks affixed to the telecommunications equipment that obtains network access licenses.
    - NAL marks are printed and issued by the MII.
    - NAL marks can be purchased for the equipment that obtains network access licenses.
    - NAL marks should be affixed firmly to the telecommunications equipment that obtains network access licenses.
    - Forging or illegally using NAL marks is forbidden. No NAL mark can be affixed to the telecommunications equipment that fails to obtain network access licenses or whose network access licenses expire.

    The following figure shows an example of NAL marks.

License number
Equipment type
Scrambling code

The following figure shows the anti-counterfeiting measures of NAL marks.
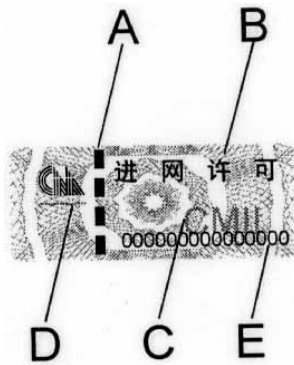
- A means the fluorescent anti-counterfeiting string inside the mark. The anti-counterfeiting string is visible under UV light and can be exposed with a knife.
- B means the anti-counterfeiting shading that supports anti-photography and anti-forgery.
- C means the invisible CMII fluorescent mark that is visible under UV light.
- D means the characters that use microform printing.
- E means the unique computer scrambling code that relates to the license number, equipment type, and sequence number. The scrambling code cannot be copied.

- Type approval

On July 24, 1995, the former State Radio Regulatory Committee (SRRC), the State Economic and Trade Commission (SETC), the General Administration of Customs (GAC), and the Ministry of Foreign Trade and Economic Cooperation (MFTEC) jointly issued the *Provisions on the Management of Import of Radio Transmission Equipment*. In April 1999, the Ministry of Industry and Information Technology of the People's Republic of China (MIIT) issued the *Notice of Strengthening Management of Radio Transmission Equipment*. As stipulated in the provisions and notice, manufacturers of all radio transmission equipment sold in China should possess the *China Radio Transmission Equipment Approval Certificate* issued by the SRRC and the relevant CMIIT ID should be affixed to the equipment nameplates.

Telecommunication equipment manufacturers should submit the *China Radio Transmission Equipment Approval Certificate* when applying for a network access license to the MIIT. In other words, completion of equipment type approval is one of the prerequisites for network access application.

The relevant CMIIT ID should be marked on the nameplate of Huawei radio terminals according to article 4 in the *Provisions on Management of Manufacture of Radio Transmission Equipment*.

The following shows an example of the CMIIT ID:

xxxxCPxxxx

xxxx before the letters **CP** is four Arabic numerals, indicating the year of issue of the certificate. **xxxx** following the letters **CP** is four Arabic numerals, indicating the sequence number of the certificate.

- CCC

  The China National Certification and Accreditation Administration of People's Republic of China (CNCA) is responsible for managing and organizing the CCC. The CCC mark is a compulsory safety mark for the products covered in the *List of the First Group of Products Being Required Compulsory Product Certification* when the products are sold on the Chinese market. No listed product can be imported, sold, or used in China without a CCC certificate issued by designated certification bodies or without a CCC mark.

  CCC marks are classified into standard and non-standard marks. Huawei products use non-standard CCC marks.
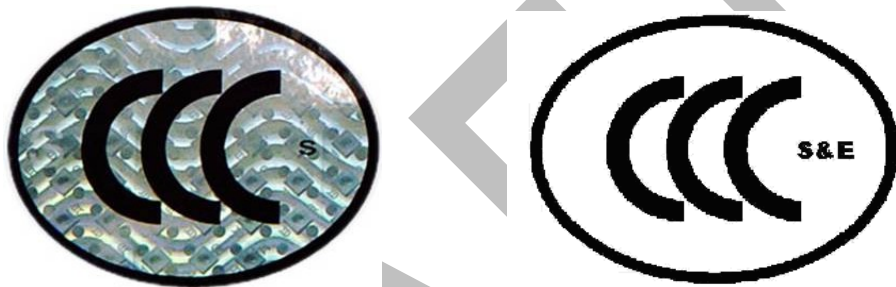
RoHS, REACH, JGPSSI, and Chinese Environmental Protection

- RoHS: the restriction of the use of certain hazardous substances in electrical and electronic equipment

  According to RoHS directive, all electrical and electronic products sold on the EU market should be free of the following six hazardous substances as of July 1, 2006:

  – lead

  – Mercury

  – Cadmium

  – Hexavalent chromium

  – PBB

  – PBDE

  The maximum permitted concentrations of the six substances are specified as follows:

  – The maximum permitted concentrations of lead, mercury, hexavalent chromium, PBB, and PBDE are 1000 ppm (0.1%) by weight of homogeneous material.

  – The maximum permitted concentration of cadmium is limited to 100 ppm (0.01%).

The EU does not specify any RoHS mark. Huawei, however, designs the preceding RoHS mark to distinguish between environment-friendly and environment-unfriendly products. For Huawei RoHS marks, any color is acceptable.

- REACH: Regulation (EC) No. 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)

  The REACH entered into force on June 1, 2007 and was implemented as of June 1, 2008.

  The REACH Regulation is a mandatory preventative regulation on all chemicals sold on the EU market.

  The REACH Regulation creates a large complex chemical management system that transfers the chemicals safety responsibility from the government to the industry. Manufacturers, importers, and downstream users are held responsible for the safety of the chemicals used in their products.

  The REACH Regulation specifies that a substance is regarded as hazardous until proven safe. The earlier EU chemical regulations, however, specifies that a substance is regarded as safe until proven hazardous.

- JGPSSI: Japan Green Procurement Survey Standardization Initiative

  The JGPSSI was established by some Japanese electrical and electronic enterprises in January 2001. Since its establishment, the JGPSSI has been researching on standardization of green procurement of electrical and electronic products. The JGPSSI issued and promoted guidelines for management of chemical substances in products in July 2003.

  The JGPSSI divides the management of chemicals into the following three processes:

  − Acquisition of content information for purchased materials (IN information): Obtain content information (IN information) for each substance/preparation and each article, and confirm the reliability of the content information.

  − Manufacture of products using those materials in a manufacturing process: Increase the reliability in the daily quality management activities, such as preventing the content of incorrect components and preventing contamination by substances/preparations or articles that contain prohibited substances.

  − Provision of content information for the products sold (OUT information): Improve reliability by providing content information (OUT information) for each substance/preparation or article.

- China Environmental protection: *Administrative Measures on the Control of Pollution Caused by Electronic Information Products* that is similar to EU's RoHS

– When designing and manufacturing electronic information products, the manufacturers should use materials, technologies, and processes that are easily recyclable and environment-friendly in accordance with the relevant industrial or national standards.

– All electronic information products sold on Chinese market should be marked with the names and contents of toxic and harmful substances and elements, safety period, and recyclability.

– The use of six hazardous substances is prohibited or limited in the products listed in the administrative catalogue for the control of pollution caused by electronic information products. The catalogue is not determined at present. It is estimated that the first catalogue is to be issued at the end of year 2009. Printers, telephones, and mobile phones might be listed in the catalogue.

– The control of toxic and harmful substances in electronic information products is covered in the CCC management.

– Six hazardous substances are prohibited, including lead, mercury, cadmium, hexavalent chromium, PBB, and PBDE. Other hazardous substances defined by China are also prohibited.

– No exemption clause is defined in the *Administrative Measures on the Control of Pollution Caused by Electronic Information Products*.

The *Marking for the Control of Pollution Caused by Electronic Information Products* (SJ/T11364-2006) issued on November 6, 2006 specifies that the mark should indicate whether the electronic information products contain any toxic or hazardous substances or elements, the safety period, and the recyclability of the products.

– The mark shown in the left figure is used by the products that are free of any toxic or hazardous substances or elements.

– The mark shown in the right figure is used by products that contain toxic or hazardous substances or elements. The user manuals of the products should indicate the names and contents of the toxic or hazardous substances or elements. The number in the middle of the mark indicates the safety period of the specific product. The safety period of a product will be determined in accordance with the *General Guidelines of Environment-Friendly Use Period of Electronic Information Products* to be issued.

7.3.7 Guide to Product Certification

CE Certification and FCC Certification

Huawei modules pass the RF, EMC, and safety specifications tests and obtain relevant certificates issued by notified certification bodies.

In the case of certification of the laptops installed with Huawei modules, the relevant test reports of Huawei modules can be directly used in accordance with the following rules:

- The conductivity test data in the Huawei RF test report can be directly used by the laptop manufacturer.
- The laptop manufacturer should determine whether the radio test data in Huawei RF test report can be used according to the antenna gain.
    - The radio test data in Huawei RF test report can be directly used if the antenna gain of the laptop is lower than that used in the certification test of Huawei modules.
    - The laptop manufacturer should test antennas of the laptops if the antenna gain of the laptop is higher than that used in the certification test of Huawei modules.
- The laptop manufacturer should test the compliance of the laptops with EMC and safety specifications.
- The SAR of the laptops needs to be tested only if the antennas of the laptops are within 20 cm of people.

IC Certification

Huawei applies for IC certificate to the relevant certification bodies by using an IC test report converted from the FCC test report.

NCC Certification

Huawei mails a sample module to the ADT of Taiwan. The ADT then performs relevant tests and issues an NCC certificate.

7.4 GCF and PTCRB

Conformance test and declaration are required for establishing that the GSM and WCDMA terminals to be sold in a region meet the requirements of the local carriers and networks.

Global Certification Forum (GCF) and PTCRB certifications are recognized in most regions all around the world. Most operators all round the world accept either certification as one of the market entry conditions.

7.4.1 GCF Certification

The GCF is an active partnership between European mobile device manufacturers and mobile network operators.

According to the R&TTE Directive 1999/95/EC issued in 2001, authorized test organizations or manufacturers should perform final conformance tests of GSM terminals in compliance with the GCF certification criteria (GCF-CC). Manufacturers then should prepare a DOC and take all responsibilities for quality of the equipment.

The GCF officially launched the 3G WCDMA certification program in February 2005.

The GCF plays an important role in protocol and application conformance testing. The GCF provides harmonized standards for conformance tests and defines a test

system approved by all members to ensure that the terminals meet network deployment requirements. All GCF members approve the terminals if the terminals are certified by the GCF. The GCF certifies both test cases and test systems. The GCF certification originates in Europe and now is accepted by mainstream operators in both Europe and Asia.

The GCF certification is a DOC of equipment manufacturers. Equipment manufacturers only need to perform the test items defined by the GCF and then submit a DOC on the GCF website. All GCF members can view the desired DOC on the GCF website.

The test system defined by the GCF requires thorough conformance tests of terminals. The test system consists of indoor and outdoor tests.

- Outdoor tests mean field testing of terminals in actual networks. Outdoor tests are often performed in the networks of large European operators.
- Indoor tests include protocol conformance testing and application conformance testing.
  - Protocol conformance testing aims to test terminals' conformance with 3GPP communication protocols, including GSM and WCDMA protocols.
  - Application conformance testing aims to test terminals' conformance with widely used applications such as browsers, SUPL, MMS, and VT.

    The OMA and the IMTC specify operation and interaction specifications of such upper-layer applications. Application conformance testing is based on the test standards defined by the OMA and the IMTC.

Terminals are not required to pass all the GCF tests. GCF tests are classified into the following types:

- Mandatory tests: Mandatory tests mean the tests that the terminals supporting the GSM or WCDMA system must pass. Mandatory tests cover the capabilities that a terminal must have when it supports communications in the relevant system (GSM or WCDMA).
- Optional tests: Optional tests refer to the tests that the terminals supporting a feature specified in the 3GPP protocol or the OMA or IMTC protocols must pass. If a manufacturer is unwilling to perform such tests for its terminals, the manufacturer should declare that the terminals do not support the related features and not claim that the terminals support the related features when releasing the terminals to the market.
- Unnecessary tests: The GCF does not require the terminals to pass all the tests specified by the 3GPP, OMA, or IMTC. The tests that are not relevant need not to be performed.

As the GCF test items need to be updated frequently to meet the requirements of new communication technologies, the GCF updates the GCF-CC version continuously. Usually the number of test items increases every time a new GCF-CC version is released and terminals are required to pass an increasingly large number of tests.

The current GCF-CC version is 3.35. The GCF updates the GCF-CC version every two or three months. The previous version is rendered obsolete 110 days after a new version is released. All terminal manufacturers need to pay attention to the 110-day rule because additional test items are required after the previous version becomes obsolete. All GCF members can view the latest GCF-CC version, the currently available version, and the validity period published on the GCF website.

7.4.2 PTCRB Certification

The PTCRB requirements are certification standards in North America.

The PTCRB was created in March 1997. GSM 850 MHz requirements were added to the PTCRB requirements in May 2001, which is an important development milestone in the history of standardization organizations in U.S.A. Similar to the GCF, the PTCRB comprises of operators and mainstream mobile phone manufacturers, and approved laboratories. The PTCRB was created by North American operators (Cingular, T-Mobile, and Rogers) and is applied to North America, Central America, and South America. The PTCRB certification is similar to the GCF certification, except that the PTCRB certification acts as the license for the UMTS terminals to be connected to American operators' networks. Only the PTCRB certified terminals are accepted by mainstream operators.

The PTCRB certification also differs from the GCF certification in the frequency bands because the frequency bands used in America differ from those in Europe. The PTCRB focuses on the GSM 850 MHz, GSM 1900 MHz, WCDMA FDD II, and WCDMA FDD V, while the GCF focuses on the GSM 900 MHz, GSM 1800 MHz, and WCDMA FDD I.

Different from the GCF certification, the PTCRB certification does not allow DOC. The entire certification process should be performed under the PTCRB's supervision and all the certification tests should be performed in the labs authorized by the PTCRB. A manufacturer who applies for the PTCRB certification needs to submit a test application to the PTCRB, and then the PTCRB will transfer the application to the test organization designated by the manufacturer. The test organization should perform the test and then submit the test report to the PTCRB for review. The PTCRB certification is completed if the PTCRB approves the test report. The PTCRB should also publish the certification on its website for viewing and querying by the PTCRB members.

The PTCRB certification is similar to the GCF certification in terms of test system. The only difference is that no field testing is performed in the case of the PTCRB certification. OTA tests are adopted to measure the antenna performance. The PTCRB test items and version are also updated continuously. Different from the GCF-CC version, only one PTCRB version is valid at any time. Each PTCRB version is valid for three months. Manufacturers are not allowed to apply for the previous version of PTCRB certification if a new version is released. For a terminal for which the manufacturer has applied for the previous version of PTCRB certification before the new version is released, the manufacturer needs not to apply for the new version if the PTCRB certification is completed within nine months.

7.4.3 Overall-System Certification

Both the test system and test items of the GCF certification are similar to those of the PTCRB certification. Both certifications test the declared capabilities of terminals based on the 3GPP test standards. The integrated equipment needs to pass relevant certification tests, even though the modules pass the conformance certification. The following describes the overall-system certification procedures in detail. The overall-system can be a notebook, a MID, a smartphone, etc.

Overall-System GCF Certification

Huawei modules pass the GCF certification before being released to the market. Huawei performs 2000 to 3000 test items for each type of modules. The major tests are as follows:

- Protocol conformance test
- RF conformance test
- UIM conformance test

The details about the certification tests are defined in the 3GPP test standards.

According to the GCF-CC, the test reports of modules can be used for the overall-system certification. The changed parts, however, need to be re-tested. Regarding the product structure, the antennas and UIM card interface circuits are modified in the integrated equipment. For this reason, the antennas and the UIM card interface circuits need to be re-tested in the overall-system certification.

- Field test

  The antenna performance-relevant field test is required due to changes in the antennas and to test the equipment's functions and its interoperability with networks on five networks run by different European operators. To be specific, the field test tests the basic functions of the UE on actual networks and determines whether the UE passes the testing according to the UE performance.

- UIM test

  UIM card interface circuits are re-designed in the integrated equipment, which may result in changes in the electrical features of the UIM card interface. For this reason, the UIM card interface circuits need to be re-tested. The UIM test aims to verify the overall performance of UIM interface with appropriate test instruments in accordance with the relevant 3GPP protocol requirements.

Huawei provides a test report of the product to be certified for the customers who require the GCF certification. The test report is issued by an organization designated for GCF certification. The test report covers the Protocol Implementation Conformance Statement (PICS) and the test information on the product. The PICS is a conformance statement of the product and a basis for GCF certification. The test information includes the performed test items and results of the product. The test organization can issue a certification report of the integrated equipment after performing the required field test and UIM test based on the test report provided by Huawei.

Terminal manufacturers who apply for the GCF certification of the terminals to be integrated with Huawei modules must accomplish the following tasks:

1. Register as a member of the GCF.

   The GCF certification is a DOC. Only GCF members can submit their DOC on the GCF website. Contact the GCF if you need to join the GCF. Proceed with the following steps if you are a GCF member.

2. Choose a test organization.

   The GCF does not designate its test organizations. All test organizations that meet the GCF test conditions can perform GCF tests. In this case, it is necessary for manufacturers to choose a well-recognized test organization that provides high quality and high efficiency services. The global test organizations 7layers, SGS, and CETCOM are recommended. The recommended test organizations have built various labs all around the world and work closely with

the GCF and the PTCRB. Therefore, the test organizations are able to provide high quality and high efficiency test services and are widely recognized by operators.

3. Discuss test details with the test organization.

   Provide the test organization with the test report of Huawei modules and the modifications of the integrated equipment. The test organization then can determine the detailed test items and determine the test schedule accordingly. With the detailed test items and schedule, terminal manufacturers can determine accurate plans of product development and marketing.

4. Perform overall-system certification.

   The integrated equipment can pass the over-all certification test easily if Huawei's design suggestions are complied with.

5. Obtain the test report and the DOC.

   The test report describes the details about the overall-system test that operators are concerned about. The GCF certification is completed upon uploading of the DOC to the GCF website.

Overall-System PTCRB Certification

Huawei modules pass the PTCRB certification before being released to the market. Huawei performs 2000 to 3000 test items for each type of modules. The major tests are as follows:

- Protocol conformance test
- RF conformance test
- UIM conformance test

The details about the certification tests are defined in the 3GPP test standards.

According to the PTCRB certification criteria, the test reports of modules can be used for the overall-system certification. The changed parts, however, need to be re-tested. Regarding the product structure, the antennas and UIM card interface circuits are modified in the integrated equipment. For this reason, the antennas and the UIM card interface circuits need to be re-tested in the overall-system certification.

- OTA test

   Different from the GCF certification, the PTCRB certification does not require field testing. The antenna performance is verified through OTA tests. OTA tests are defined by the CTIA for verifying antenna performance.

- UIM test

   UIM card interface circuits are re-designed in the integrated equipment, which may result in changes in the electrical features of the UIM card interface. For this reason, the UIM card interface circuits need to be re-tested. The UIM test aims to verify the overall performance of UIM interface with appropriate test instruments in accordance with the relevant 3GPP protocol requirements.

Similar to the GCF certification, the PTCRB certification requires a small number of test items for integrated equipment. In addition, the required test items are easy to perform with appropriate design suggestions. Huawei also provides customers with a PTCRB test report of the module. The test is a basis for the PTCRB certification of the equipment integrated with the module.

Terminal manufacturers who apply for the PTCRB certification of the terminals to be integrated with Huawei modules must accomplish the following tasks:

1. Register as a guest of the PTCRB.

    Different from the GCF, the PTCRB comprises of only operators. Terminal manufacturers can join the PTCRB only as guests. The terminal manufacturers who apply for the PTCRB certification have to register as PTCRB guests as they must submit the application on the PTCRB website.

2. Choose a test organization.

    The PTCRB requires only qualified test organization to perform PTCRB tests. In this case, it is necessary for manufacturers to choose a well-recognized test organization that provides high quality and high efficiency services. The global test organizations 7layers, SGS, and CETCOM are recommended. The recommended test organizations have built various labs all around the world and work closely with the GCF and the PTCRB. Therefore, the test organizations are able to provide high quality and high efficiency test services and are widely recognized by operators.

3. Discuss test details with the test organization.

    Provide the test organization with the test report of Huawei modules and the modifications of the integrated equipment. The test organization then can determine the detailed test items and determine the test schedule accordingly. With the detailed test items and schedule, terminal manufacturers can determine accurate plans of product development and marketing.

4. Submit an overall-system certification application on the PTCRB website and designate a test organization.

    Submit a test application on the PTCRB website, indicating the basic information of the terminal to be certified. The PTCRB then transfers the application to the designated test organization. Remember to pay the CTIA after you submit a test application. Unpaid applications are rejected even though all the required tests are performed.

5. Perform overall-system certification.

    The integrated equipment can pass the over-all certification test easily if Huawei's design suggestions are complied with.

6. Obtain the test report and submit relevant materials.

    The PTCRB test report is provided by the test organization. The terminal manufacturer, however, is required to provide the user manual and other necessary documents of the terminal to be certified on the PTCRB website before the PTCRB test application can be approved. In addition, the PTCRB submits all the materials to the CTIA for review on completion of all the PTCRB tests. The terminal is PTCRB certified on completion of the CTIA review.

GCF and PTCRB Certification

To launch a terminal in the global market, both the GCF certification and the PTCRB certification are required. In this case, the manufacturer does not need to conduct two end-to-end tests. As the UIM test is the same for both the GCF certification and the PTCRB certification, the test organization needs to perform the UIM test only once. This practice is recognized by both the GCF and the PTCRB. The cost, including time and expense, of overall-system certification is thus reduced.

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 2002/96/EC (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 2002/95/EC (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 abnormity of the wireless device or accessories.

- Do not dismantle the wireless device or accessories. Otherwise, the wireless device and accessories are not covered by the warranty.

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 Specific Absorption Rate (SAR)

Your wireless device is a radio transmitter and receiver. It is designed not to exceed the limits for exposure to radio waves recommended by international guidelines. These guidelines were developed by the independent scientific organization ICNIRP and include safety margins designed to assure the protection of all persons, regardless of age and health.

The guidelines use a unit of measurement known as the Specific Absorption Rate, or SAR. The SAR limit for wireless devices is 2.0 W/kg and the highest SAR value for this device when tested complied with this limit.

8.14 Regulatory Information

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

8.14.1 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).

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.

The SAR limit adopted by the USA and Canada is 1.6 watts/kilogram (W/kg) averaged over one gram of tissue. The highest SAR value reported to the FCC for this device type was compliant with this limit.

8.14.2 FCC Statement

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.
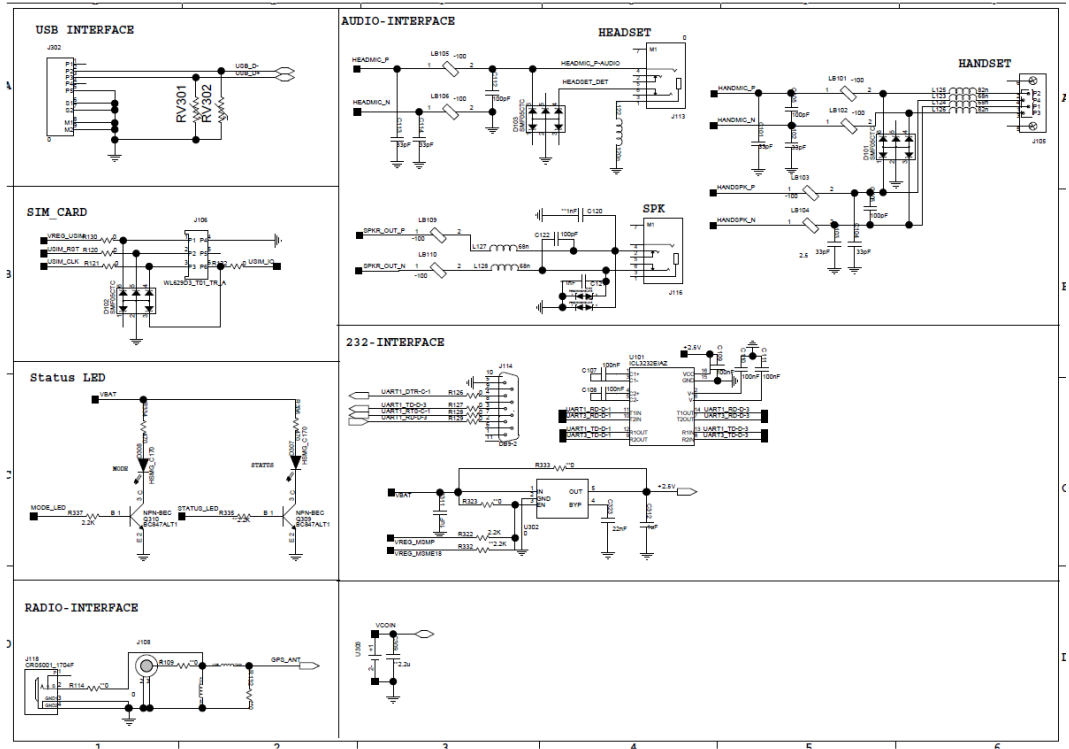
The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons.

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

9 Appendix A Circuit of Typical Interfaces
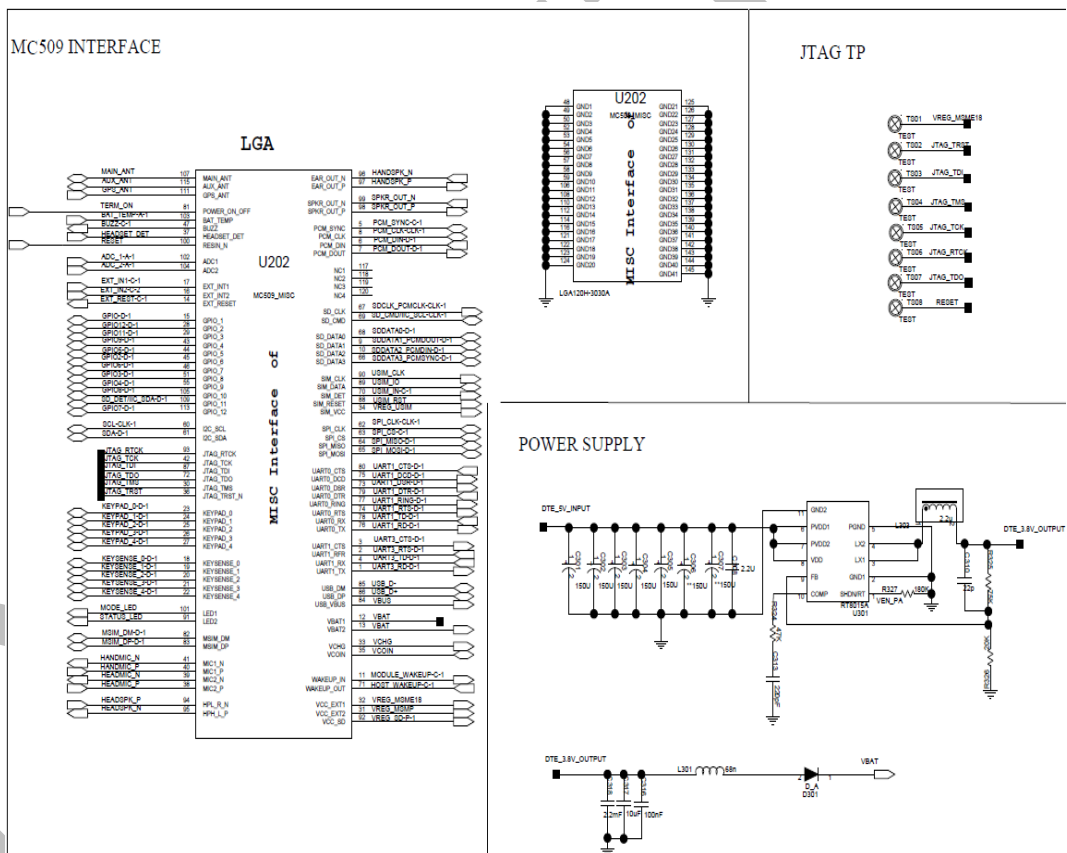
10 Appendix B Acronyms and Abbreviations

Acronym or Abbreviation	Expansion
BB	Baseband
CE	European Conformity
CS	Coding Scheme
CSD	Circuit Switched Data
DC	direct current
DCE	data circuit-terminating equipment
DMA	direct memory access
DTE	data terminal equipment
EIA	Electronic Industries Association
EMC	electromagnetic compatibility
ESD	electrostatic discharge
FCC	Federal Commnications Commission
ISO	International Standards Organization
LCP	liquid crystal polyester
LDO	low-dropout
LED	light-emitting diode
MCP	multi-chip package
NTC	negative temperature coefficient
PBCCH	Packet Broadcast Control Channel
PCB	printed circuit board

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Acronym or Abbreviation	Expansion
PDU	protocol data unit
RF	radio frequency
RoHS	Restriction of the use of certain Hazardous Substances
RTC	real-time clock
UIM	User interface module
TTL	transistor-transistor logic
TVS	transient voltage suppressor
VSWR	voltage standing wave ratio
ACLR	Adjacent channel leakage power radio
AMPS	Advanced mobile phone system
CDMA	Code-division multiple access
DCCH	Dedicated control channel
EACH	Enhanced access channel
EVRC	Enhanced variable rate coder
LNA	Low noise amplifier
LPF	Lowpass filter
NF	Noise figure
PCM	Pulse coded modulation
PCS	Personal communication system
PLL	Phase lock loop
RF	Radio frequncy
Rx	Receive
SCH	Supplemental channel
SYNCH	Sync channel
EVDO	Evolution data only

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