



HUAWEI MG323-B GSM LCC Module

Hardware Guide

Issue 04

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About This Document

History

Version	Date	Chapter	Descriptions
03	2012-04-12		Creation
04	2012-07-02	6.4	Revised Figure 6-1 Dimensions of the MG323-B module (unit: mm)
		6.5.1	Revised Figure 6-2 PCB pad design (Top View)
		6.6	Revised 6.6 Stencil Design



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1 Introduction

This document describes the hardware application interfaces and air interfaces that are provided when the Huawei MG323-B GSM LCC module (hereinafter referred to as the MG323-B module) is used.

This document helps you to understand the interface specifications, electrical features, and related product information of the MG323-B module.

2 Overall Description

2.1 About This Chapter

This chapter gives a general description of the MG323-B module and provides:

- Function Overview
- Application Block Diagram
- Circuit Block Diagram

2.2 Function Overview

Table 2-1 Feature

Feature	Description
Working bands	GSM/GPRS: 850 MHz/900 MHz/1800 MHz/1900 MHz
Maximum transmission power	GSM850 Class 4 (2 W)
	GSM900 Class 4 (2 W)
	GSM1800 Class 1 (1 W)
	GSM1900 Class 1 (1 W)
Receiver sensitivity	< -107 dBm
Working temperature	Normal working temperature: -20°C to +70°C
	Extreme working temperatures: -30°C to -20°C and +70°C to +75°C
Ambient temperature for storage	-40°C to +85°C
Power voltage	3.3 V to 4.2 V (3.8 V is recommended.)



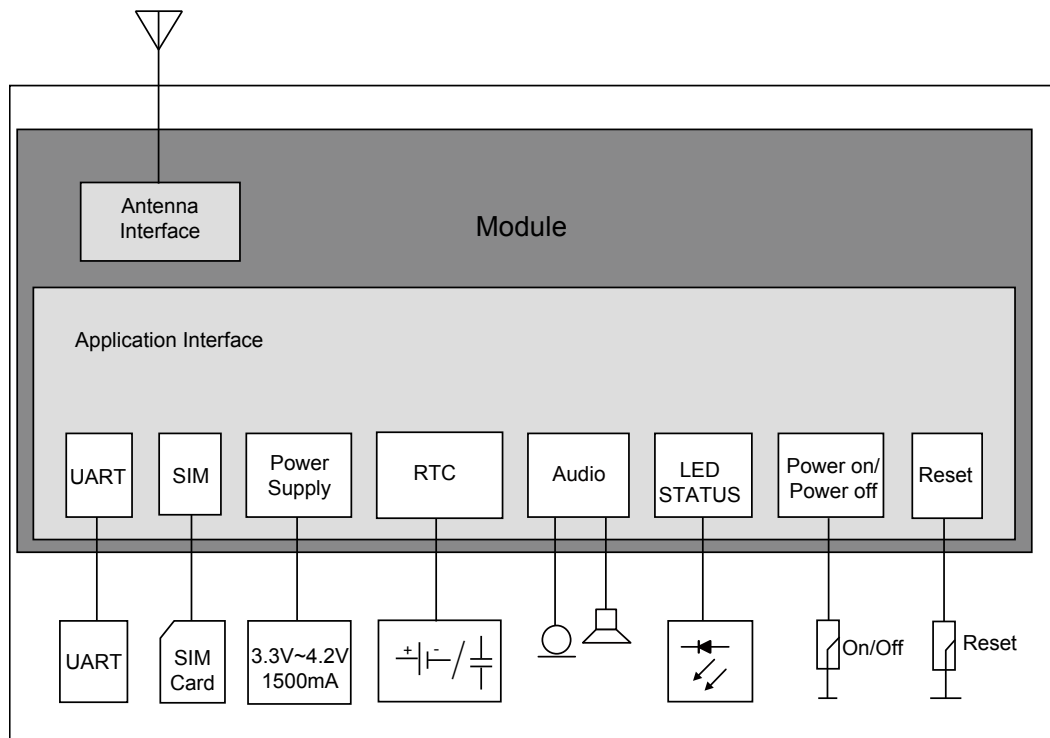
Feature	Description		
Power consumption (current)	Power-off current: 50 μ A		
	Average standby current	MFRMS=2	I < 3.0 mA
		MFRMS=5	I < 3.0mA
		MFRMS=9	I < 3.0 mA
GPRS Class 10 (maximum): I _{typical} =460 mA			
Protocols	GSM/GPRS Phase2/2+		
AT commands	See the HUAWEI MG323-B GSM LCC Module AT Command Interface Specification .		
Application interface (68-pin LCC interfaces)	UART 1 (supporting 8-wire UART) and UART 0 (supporting 2-wire UART)		
	One standard Subscriber Identity Module (SIM) card interface (3 V or 1.8 V)		
	Interfaces for two analog audio channels		
	Power Interface		
	Network status light-emitting diode (LED) control interface		
Antenna interface	Antenna pad		
Voice services	Two analog voice channels		
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		
GPRS	GPRS CLASS 10		
	Encoding schemes: CS 1, CS 2, CS 3, and CS 4		
	Maximum downlink transmission rate: 85.6 kbps		
	Maximum uplink transmission rate: 42.8 kbps		
	Packet Broadcast Control Channel (PBCCH)		
	Embedded with TCP/IP protocols, supporting multiple links		
Circuit Switched Data (CSD) data services	CSD data services at the maximum rate of 9.6 kbit/s		
Physical features	<ul style="list-style-type: none">• Dimensions (L × W × H): 24 mm X 24 mm X 2.95 mm• Weight: <3.5 g		

Feature	Description
Certification information	Restriction of the use of certain Hazardous Substances (RoHS) European Conformity (CE) China Compulsory Certification (CCC) GSM Certification Forum (GCF)

2.3 Application Block Diagram

Figure 2-1 shows the application block diagram of the MG323-B module.

Figure 2-1 Application block diagram of the MG323-B module



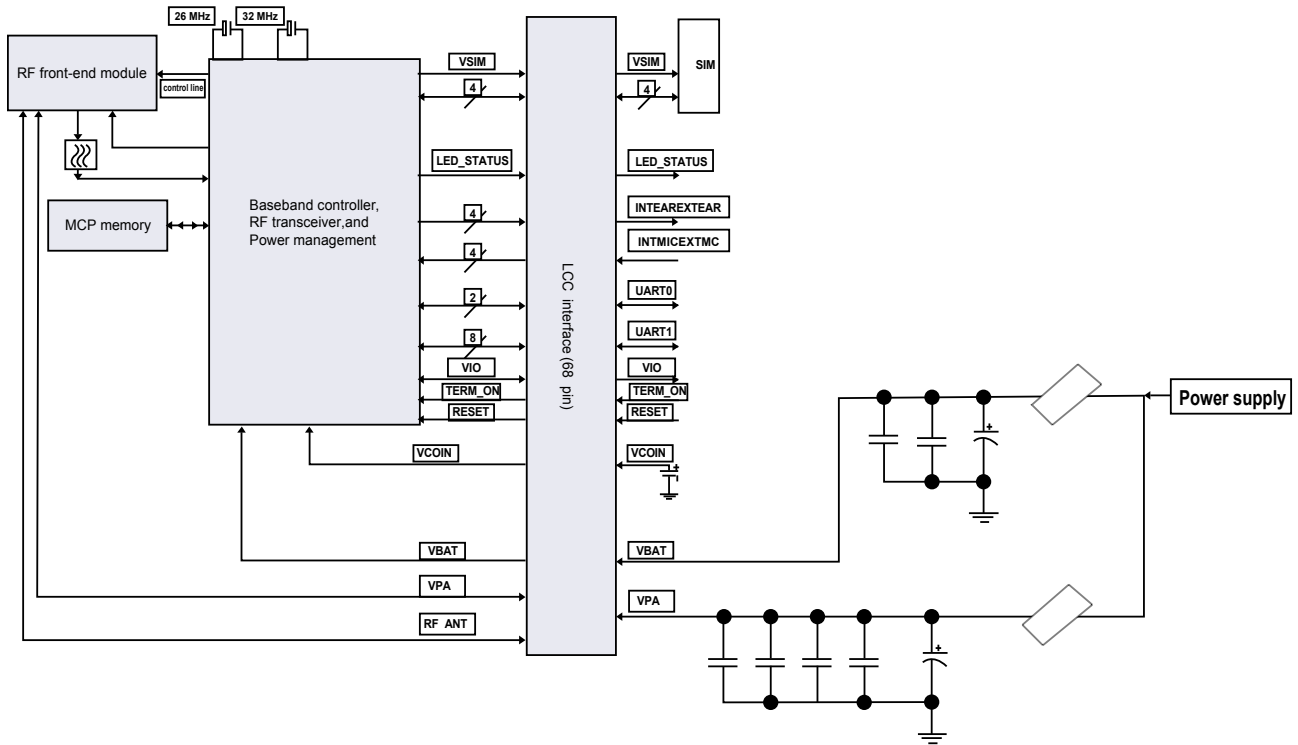
2.4 Circuit Block Diagram

The circuit block diagram and major functional units of the MG323-B module contain the following parts:

- GSM baseband controller
- Power management
- Multi-chip package (MCP) memory
- Radio frequency (RF) transceiver

- 26 MHz reference clock
- RF front-end modules
- Receive filter

Figure 2-2 Circuit block diagram of the MG323-B module



3 Description of the Application Interfaces

3.1 About This Chapter

This chapter mainly describes the external application interfaces of the MG323-B module, including:

- LCC Interface
- Power Interface
- Signal Control Interface
- UART 0 Interface
- UART 1 Interface
- SIM Card Interface
- Audio Interface
- RF Antenna Interface
- NC Interfaces

3.2 LCC Interface

The MG323-B module uses a 68-pin LCC as its external interface. For details about the model and dimensions of the LCC, see "6.4 Dimensions of the Module."

Table 3-1 shows the definitions of pins on the LCC signal interface of the MG323-B module.

Table 3-1 Definitions of pins on the LCC interface

Pin No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
1	GND	-	-	Ground	-	-	-
2	GND	-	-	Ground	-	-	-
3	GND	-	-	Ground	-	-	-
4	RF_ANT	-	-	RF antenna interface	-	-	-



Pin No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
5	GND	-	-	Ground	-	-	-
6	GND	-	-	Ground	-	-	-
7	VPA	-	P	Power supply for PA	3.3	3.8	4.2
8	VPA	-	P	Power supply for PA	3.3	3.8	4.2
9	GND	-	-	Ground	-	-	-
10	NC	-	-	Not connected, please keep this pin open	-	-	-
11	LED_STATUS	-	O	network status indicating	-0.4	2.8	3.2
12	NC	-	-	Not connected, please keep this pin open	-	-	-
13	NC	-	-	Not connected, please keep this pin open	-	-	-
14	NC	-	-	Not connected, please keep this pin open	-	-	-
15	NC	-	-	Not connected, please keep this pin open	-	-	-
16	NC	-	-	Not connected, please keep this pin open	-	-	-
17	NC	-	-	Not connected, please keep this pin open	-	-	-
18	NC	-	-	Not connected, please keep this pin open	-	-	-
19	NC	-	-	Not connected, please keep this pin open	-	-	-
20	VIO	-	P	external power output	2.7	2.8	2.95
21	VBAT	-	P	Power supply for baseband	3.3	3.8	4.2
22	VBAT	-	P	Power supply for baseband	3.3	3.8	4.2
23	GND	-	-	Ground	-	-	-
24	UART1_DCD	-	O	The second group of DCE data carrier detect	-0.4	2.8	3.2
25	URAT1_RING	-	O	The second group of DCE ring indicator	-0.4	2.8	3.2



Pin No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
26	UART1_DSR	-	O	The second group of DCE data set ready	-0.4	2.8	3.2
27	UART1_DTR	-	I	The second group of DCE data terminal ready	-0.4	2.8	3.2
28	UART1_TD	-	I	The second group of DCE receive data	-0.4	2.85	3.25
29	UART1_RD	-	O	The second group of DCE transmit data	-0.4	2.85	3.25
30	UART1_CTS	-	O	The second group of DCE clear to send	-0.4	2.85	3.25
31	UART1_RTS	-	I	The second group of DCE request to send	-0.4	2.85	3.25
32	GND	-	-	Ground	-	-	-
33	EXTEAR_N	-	AO	Negative pole of the output of headset speaker	-	-	-
34	EXTEAR_P	-	AO	Positive pole of the output of headset speaker	-	-	-
35	INTMIC_P	-	AI	Positive pole of the input of headset microphone	-	-	-
36	INTMIC_N	-	AI	Negative pole of the input of headset microphone	-	-	-
37	INTEAR_N	-	AO	Negative pole of the output of headset speaker	-	-	-
38	INTEAR_P	-	AO	Positive pole of the output of headset speaker	-	-	-
39	EXTMIC_P	-	AI	Positive pole of the input of headset microphone	-	-	-
40	EXTMIC_N	-	AI	Negative pole of the input of headset microphone	-	-	-
41	GND	-	-	Ground	-	-	-



Pin No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
42	VCOIN	-	P	Standby power input of the RTC	2	3	3.15
43	GND	-	-	Ground	-	-	-
44	NC	-	-	Not connected, please keep this pin open	-	-	-
45	GND	-	-	Ground	-	-	-
46	UART0_RD	-	O	The first group of DCE transmit data	-0.4	2.85	3.25
47	UART0_TD	-	I	The first group of DCE receive data	-0.4	2.85	3.25
48	NC	-	-	Not connected, please keep this pin open	-	-	-
49	NC	-	-	Not connected, please keep this pin open	-	-	-
50	NC	-	-	Not connected, please keep this pin open	-	-	-
51	NC	-	-	Not connected, please keep this pin open	-	-	-
52	NC	-	-	Not connected, please keep this pin open	-	-	-
53	NC	-	-	Not connected, please keep this pin open	-	-	-
54	GND	-	-	Ground	-	-	-
55	SIM_CLK	-	O	Clock signal of the SIM card	-0.4	1.80/2.90	2.2/3.3
56	SIM_DATA	-	I/O	Data signal of the SIM card	-0.4	1.80/2.90	2.2/3.3
57	SIM_RST	-	O	Reset signal of the SIM card	-0.4	1.80/2.90	2.2/3.3
58	VSIM	-	P	Power supply of the SIM card	1.65/2.75	1.80/2.90	1.95/3.00
59	NC	-	-	Not connected, please keep this pin open	-	-	-
60	GND	-	-	Ground	-	-	-
61	NC	-	-	Not connected, please keep this pin open	-	-	-

Pin No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
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	GND	-	-	Ground	-	-	-
66	NC	-	-	Not connected, please keep this pin open	-	-	-
67	RESET	-	I	Hardware reset	-0.4	2.8	3.2
68	TERM_ON	-	I	Power on/power off control	-	Internal pulled up	-

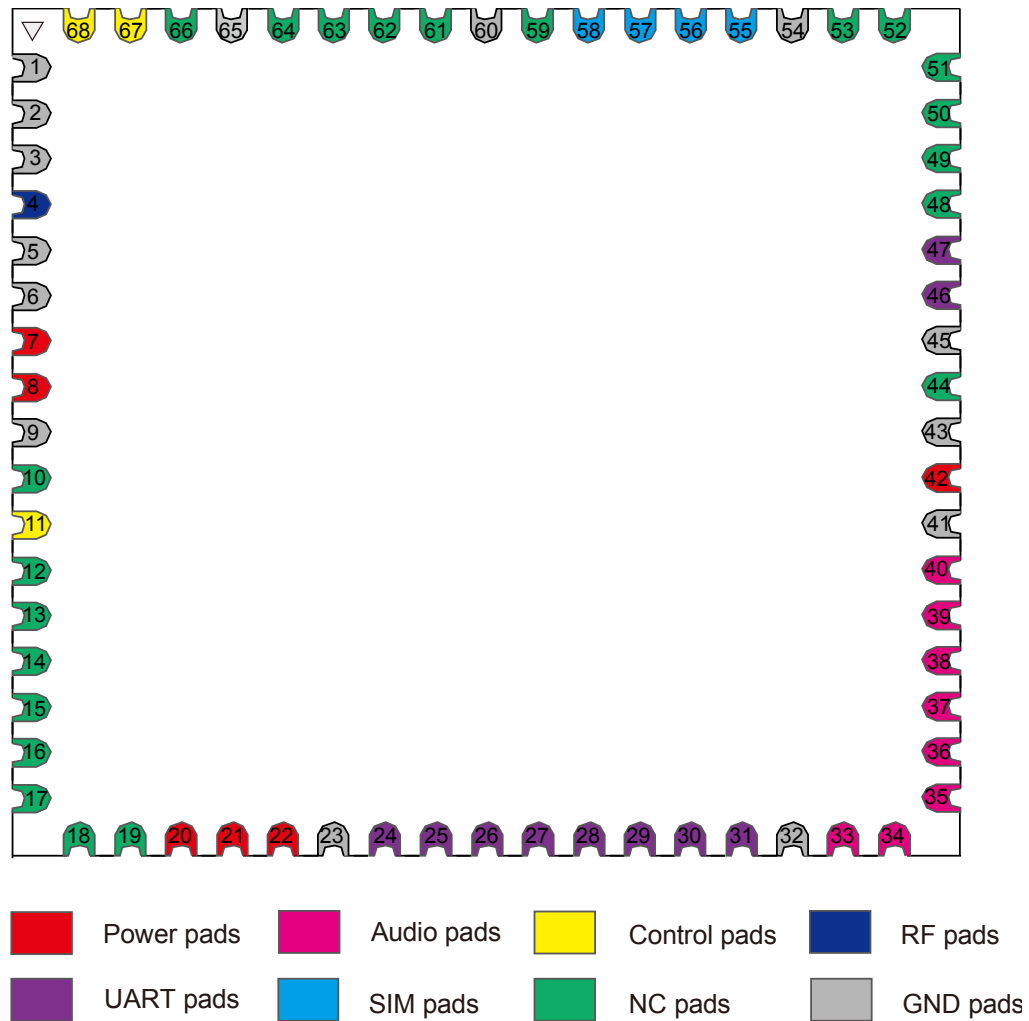


NOTE

- For detailed information about the pins of MG323-B module, please see Table 5-3 . Electrical features of application interfaces
- **P** indicates power pins; **I** indicates pins for digital signal input; **O** indicates pins for digital signal output; **AI** indicates pins for analog signal input; **AO** indicates pins for analog 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.

Figure 3-1 shows the sequence of pins on the 68-pin LCC signal interface of the MG323-B module.

Figure 3-1 The sequence of pins on the 68-pin signal interface of the MG323-B module (top view).



3.3 Power Interface

3.3.1 Overview

The power supply part of the LCC interface of the MG323-B module contains:

- VBAT interface for the baseband power supply
- VPA interface for the PA power supply
- VCOIN interface for the standby power supply of the real-time clock (RTC)
- VIO interface for external 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
21, 22	VBAT	P	Pins for baseband power voltage input
7, 8	VPA	P	Pins for PA power voltage input
1, 2, 3, 5, 6, 9, 23, 32, 41, 43, 45, 54, 60, 65	GND	-	GND
42	VCOIN	P	Pin for power input of the RTC
20	VIO	P	Pin for 2.8V power output

3.3.2 VBAT and VPA Interface

When the MG323-B module works normally, power is supplied through the VBAT and VPA pins and the voltage ranges from 3.3 V to 4.2 V (the typical value is 3.8 V). The 68-pin LCC module provides two VBAT pins, two VPA pins and fourteen GND pins. To ensure that the MG323-B module works normally, all the pins must be connected.

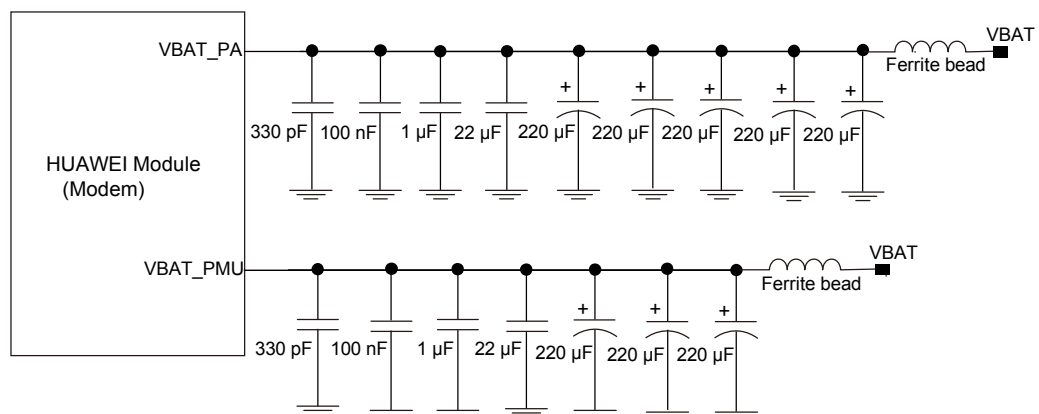
When the MG323-B module is used for different applications, special attention should be paid to the design of the power supply. When the MG323-B module transmits at the maximum power, the transient peak current may reach 2.0 A. In this case, the VPA voltage drops. Make sure that the voltage does not decrease below 3.3 V in any case. Otherwise, exceptions such as reset of the MG323-B module may occur.

A low-dropout (LDO) regulator or switch-mode power supply with load current larger than 2 A is recommended. At least three 220 μ F capacitors should be installed to VBAT pins. And the trace of the power supply should be as short and wide as possible.

It is recommended to employ a ferrite bead in series on VBAT and VPA to improve the EMI performance. And the rated current of the ferrite bead is required at least 2 A.

Figure 3-2 shows the recommended power circuit of MG323-B module.

Figure 3-2 Recommended power circuit of MG323-B module



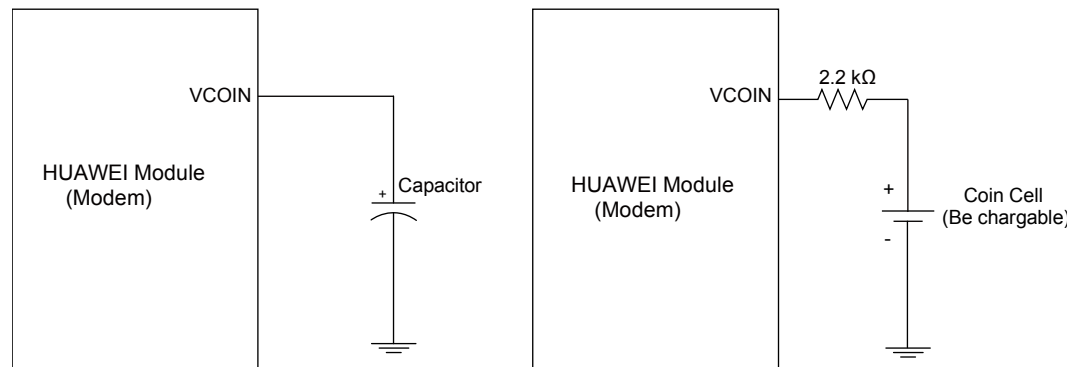
3.3.3 VCOIN Interface

VCOIN is an interface for standby power input of the RTC in the MG323-B module. If the VBAT interface is ready for power supply, it on priority supplies the RTC with power. If the VBAT interface is not ready, the VCOIN interface provides standby power input for the RTC. In this case, the MG323-B module needs 5 μ A to maintain the RTC function.

You can use an external battery to supply power through the VCOIN interface. The recommended voltage is 3 V. You can also use an external capacitor if you do not use a battery. The capacitance determines the duration of the RTC when the VBAT interface is not ready.

The MG323-B module supports charging external standby batteries. When the VBAT voltage is 3.8 V, the charging current is about 0.6 mA (typical value). Figure 3-3 shows two types of circuits for your reference.

Figure 3-3 VCOIN interface circuit



3.3.4 VIO Interface

Through the VIO interface, the MG323-B module can supply 2.8 V power externally with an output current of 10 mA (typical value) for external level conversion or other applications.

If the MG323-B module is in Sleep mode, the VIO interface is in the low power consumption state (< 500 μ A). If the MG323-B module is in Power Down mode, the VIO is in the disabled state. If VIO pin is not in use, disconnect the pin and make sure it is not grounded.

3.4 Signal Control Interface

3.4.1 Overview

The signal control part of the LCC interface in the MG323-B module consists of:

- Power-on/off (TERM_ON) pin
- Hardware reset (RESET) pin
- Network status (LED_STATUS) pin

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

Table 3-3 Pins on the signal control interface

Pin No.	Signal Name	I/O	Description
68	TERM_ON	I	Pin for controlling power-on and power-off
67	RESET	I	Pin for resetting the hardware
11	LED_STATUS	O	Pin for network status LED

3.4.2 Input Signal Control Pins

The MG323-B module implements power-on and power-off and resets the hardware through the input signal control pins.

The TERM_ON pin is used to implement power-on and power-off. If the TERM_ON pin is pulled down for 1 second to 2 seconds, the module is powered on; if the TERM_ON pin is pulled down for 1 second to 2 seconds 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 at least 10 ms to reset the hardware.

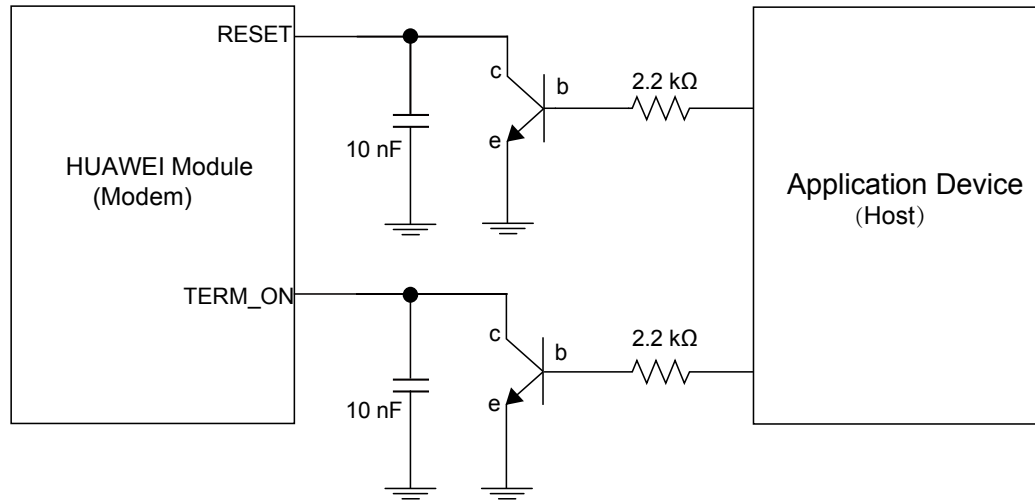


CAUTION

As the RESET and TERM_ON signals are relatively sensitive, it is recommended that you install a 10 nF capacitor near the RESET and TERM_ON pins of the LCC 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 20 mm and that the circuit be kept at a distance of 2.54 mm (100 mil) at least from the PCB edge. Furthermore, you need to wrap the area adjacent to the signal wire with a ground wire. Otherwise, the module may be reset due to interference.

Figure 3-4 shows the connections of the TERM_ON and RESET pins.

Figure 3-4 Connections of the TERM_ON and RESET pins



Power-On/Off Time Sequence

The power-on, power-off, and reset control parts of the LCC interface of the MG323-B module includes power-on/power-off interface signal (TERM_ON) and the hardware reset interface signal (RESET). Table 3-3 lists the definitions of the interface pins.



WARNING

- Make sure that the MG323-B module is powered on at the voltage and working temperature in the recommended range. Otherwise, the module may get damaged or work improperly.
- External application interfaces must be powered on after the module is powered on.

You can power on the MG323-B module through the TERM_ON interface. The software will report relevant information according to the actual settings after the module is powered on. For example, the AT command automatically reports `^SYSSTART[1]`. In this case, the external VIO interface is enabled and supplies 2.8 V power.

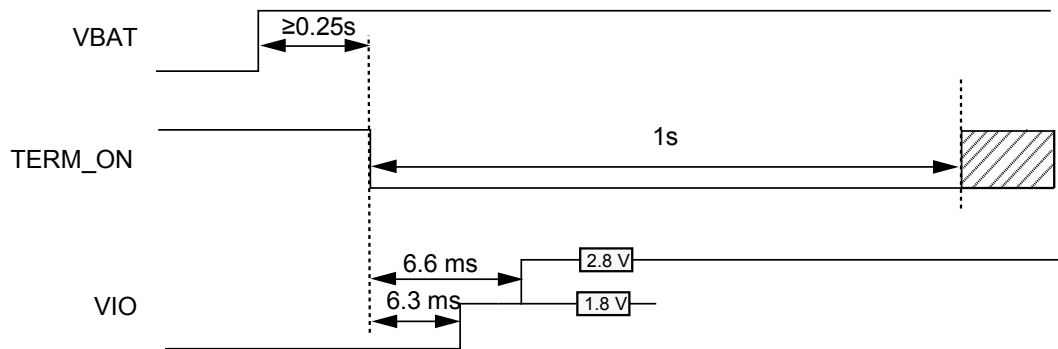


NOTE

[1] For specific setting information about the power-on/power-off software, see the [HUAWEI MG323-B GSM LCC Module AT Command Interface Specification](#).

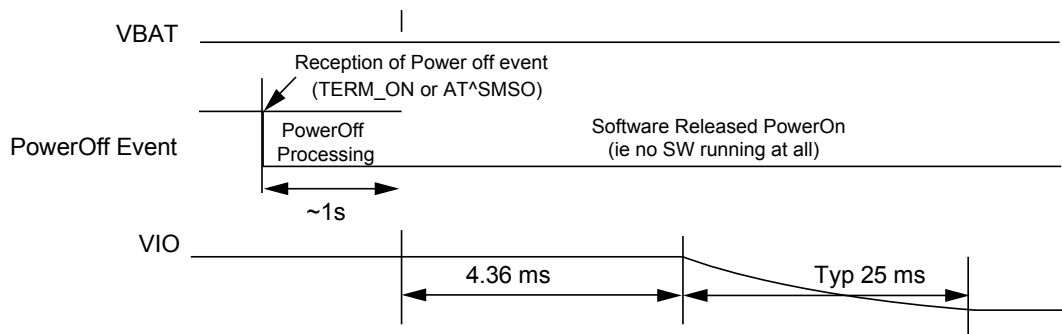
Figure 3-5 shows the power-on time sequence. The module will be power-on after pull up VBAT pin at least 0.25s and then pull down TERM_ON pin at least 1s.

Figure 3-5 Power-on time sequence



The MG323-B module supports power-off through the TERM_ON interface or the **AT^SMSO** command. Figure 3-6 shows the power-off time sequence.

Figure 3-6 Power-off time sequence



 **NOTE**

- The processing of the power-off event depends on the normal stop time of the file system in the MG323-B module. The processing varies with the capacity of the file system.
- It's recommended to turn off the module before stopping power supply.

RESET

The MG323-B module supports hardware reset function. If the software of the MG323-B module stops responding, you can reset the hardware through the RESET 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**. In this case, the external VIO interface is enabled and supplies 2.8 V power.

3.4.3 Output Signal Control Pin

The MG323-B module provides a network status LED pin LED_STATUS. The pulse signal output through this pin controls the status LED on the user interface board to display the network status.

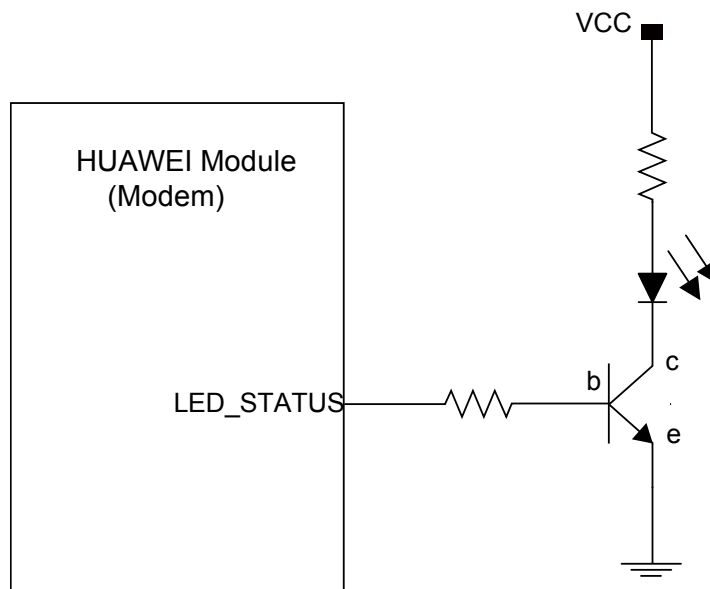
Different blinking modes of the status LED indicate different network status. Table 3-4 describes the status of the LED_STATUS pin.

Table 3-4 Status of the LED_STATUS pin

Working or Network Status	Output Status of the LED_STATUS Pin
Sleep mode	A low-level signal is output continuously.
Network-searching or non-network status (including the case when the SIM card is not inserted and the case when the PIN number is unblocked)	An output signal of high-level continues for 0.1s in a period of 1s.
Registered with a 2G network	An output signal of high-level continues for 0.1s in a period of 3s.
GPRS data service	An output signal of high-level continues for 0.1s in a period of 0.125s.
Voice call	A high-level signal is output continuously.

In practical application, the LED_STATUS pin cannot be directly used to drive the status LED. The LED_STATUS pin needs to be used with a transistor. To select a suitable current-limiting resistor for the LED, check the actual voltage drop and rated current of the LED. Figure 3-7 shows the driving circuit.

Figure 3-7 Driving circuit



3.5 UART 0 Interface

The MG323-B module provides a 2-wire UART 0 interface for debugging. It's recommended to reserve test points for these two pins.

Table 3-5 UART 0 interface signals (named by the reference of DTE)

Pin No.	Signal Name	Description	Feature	I/O	Direction
46	UART 0_RD	The first group of DCE transmit data	The data terminal equipment (DTE) receives serial data.	O	DCE→DTE
47	UART 0_TD	The first group of DCE receive data	The DTE transmits serial data.	I	DTE→DCE

3.6 UART 1 Interface

3.6.1 Overview

The MG323-B module provides the RS-232 UART 1 (8-wire UART) interface for one asynchronous communication channel. As the UART 1 interface supports signal control through standard modem handshake, AT commands are entered and serial communication is performed through the UART 1 interface. The UART 1 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 (115.2 kbit/s by default)
- Self-adapted baud rate ranging from 1200 bit/s to 115.2 kbit/s

Table 3-6 lists the UART1 interface signals.

Table 3-6 UART1 interface signals (named by the reference of DTE)

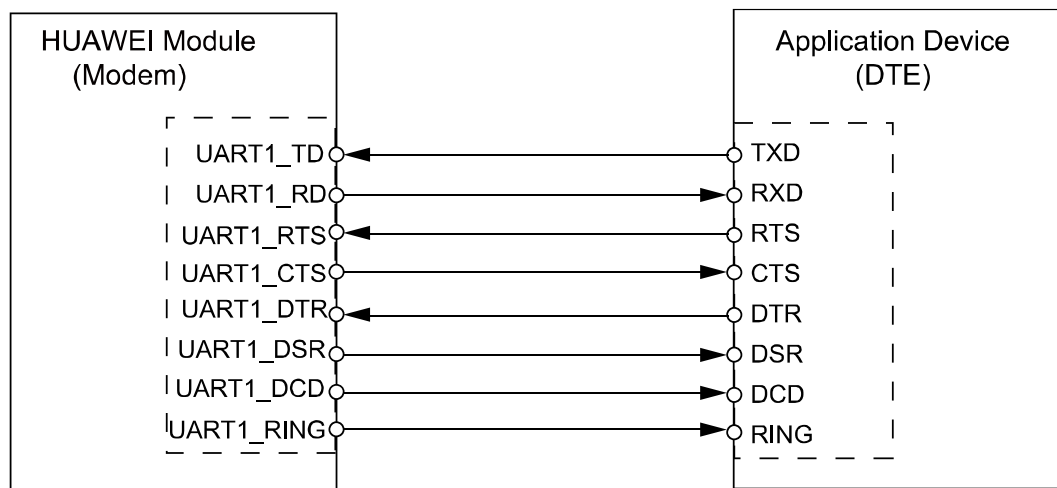
Pin No.	Signal Name	Description	Feature	I/O	Direction
29	UART 1_RD	The second group of DCE transmit data	The data terminal equipment (DTE) receives serial data.	O	DCE→DTE

Pin No.	Signal Name	Description	Feature	I/O	Direction
28	UART 1_TD	The second group of DCE receive data	The DTE transmits serial data.	I	DTE→DCE
24	UART 1_DCD	The second group of DCE data carrier detect	A data link is set up.	O	DCE→DTE
25	UART 1_RING	The second group of DCE ring indicator	The DCE notifies the DTE of a remote call.	O	DCE→DTE
26	UART 1_DSR	The second group of DCE data set ready	The DCE is ready.	O	DCE→DTE
27	UART 1_DTR	The second group of DCE data terminal ready	The DTE is ready.	I	DTE→DCE
30	UART 1_CTS	The second group of DCE clear to send	The DCE has switched to the data receiving mode.	O	DCE→DTE
31	UART 1_RTS	The second group of DCE request to send	The DCE requests the DTE to send data.	I	DTE→DCE

3.6.2 Circuit Recommended for the UART1 Interface

Figure 3-8 shows the connection of the UART1 interface in the MG323-B module (DCE) with the host (DTE).

Figure 3-8 Connection of the UART1 interface in the MG323-B module (DCE) with the host (DTE)

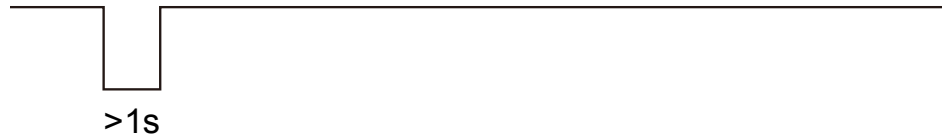


The RS-232 chip can be used to connect the MG323-B GSM module to the RS-232-C interface. In this connection, the transistor-transistor logic (TTL) level and the Electronic Industries Association (EIA) level are converted mutually. For example, it is

recommended that you use the MAX3232 chip with a 2-wire serial port and the SP3238 or MAX3238 chip with an 8-wire serial port.

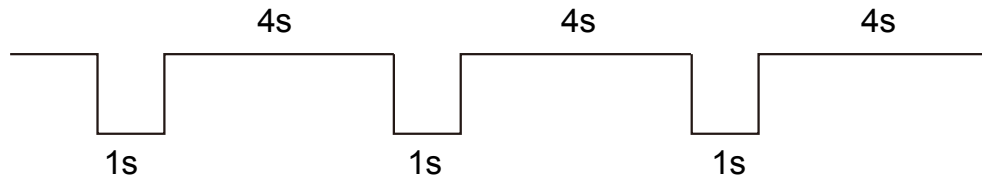
When an MG323-B module receives an SM (Short Message), a low-level signal is output through the RING (pin 25) for less than 1s, as shown in Figure 3-9 .

Figure 3-9 The signal through the RING after the MG323-B receives an SM



When an MG323-B Module receives a voice call, a periodical low level signal for 1s and a high level signal for 4s are output by RING, as shown in Figure 3-10 .

Figure 3-10 The signal through the /RING after the MG323-B receives a voice call



NOTE

For detailed application of the MG323-B UART 1 interface, see [HUAWEI Module UART Serial Port Design Guide](#).

3.7 SIM Card Interface

3.7.1 Overview

The MG323-B module provides a SIM card interface complying with the ISO 7816-3 standard and supports automatic detection of a 3.0 V SIM card or a 1.8 V SIM card. Table 3-7 lists the SIM card interface signals.

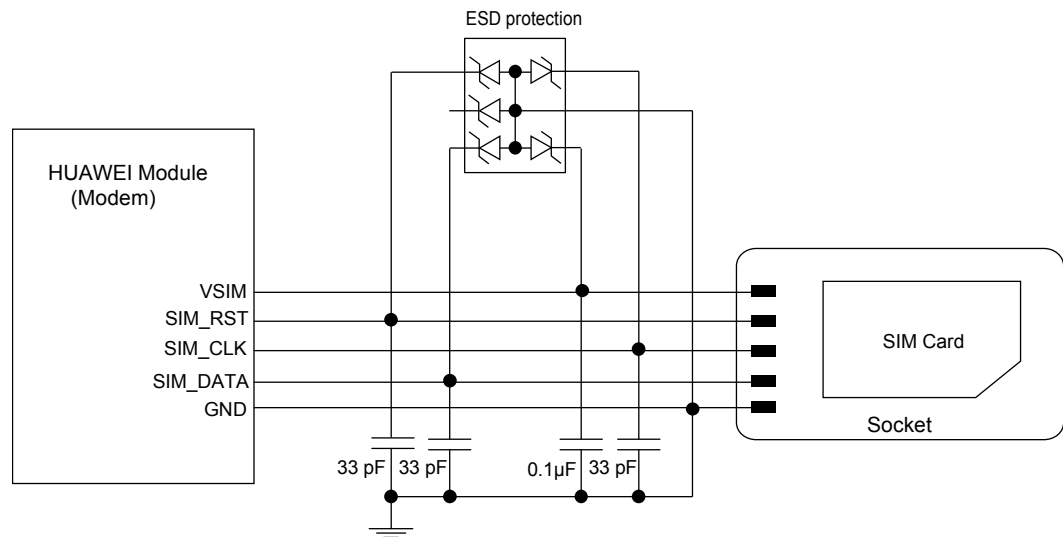
Table 3-7 SIM card interface signals

Pin No.	Signal Name	I/O	Description
55	SIM_CLK	O	Clock signal of the SIM card
58	VSIM	P	Power supply of the SIM card
56	SIM_DATA	I/O	Data signal of the SIM card
57	SIM_RST	O	Reset signal of the SIM card

3.7.2 Circuit Recommended for the SIM Card Interface

As the MG323-B module is not equipped with a SIM card socket, you need to place a SIM card socket on the user interface board. The SIM card signals are transmitted outwards through the 68-pin LCC connector interface. Figure 3-11 shows the circuit of the SIM card interface.

Figure 3-11 Circuit of the SIM card interface



CAUTION

- To meet the requirements of 3GPP TS 51.010-1 protocols and electromagnetic compatibility (EMC) authentication, the SIM card socket should be placed near the LCC interface (it is recommended that the PCB circuit connecting the LCC interface and the SIM card socket not exceed 100 mm), because a long circuit may lead to wave distortion, thus affecting signal quality.
- It is recommended that you wrap the area adjacent to the SIM_CLK and SIM_DATA signal wires with a ground wire. The GND pin of the SIM card socket and the GND pin of the SIM card must be well connected to the power GND pin supplying power to the MG323-B module.
- A 0.1 μF capacitor or a 0.22 μF capacitor is placed between the VSIM and GND pins in parallel. Three 33 pF capacitors are placed between the SIM_DATA and GND pins, the SIM_RST and GND pins, and the SIM_CLK and GND pins in parallel to filter interference from RF signals.
- You do not need to pull the SIM_DATA pin up during design as a 15 kΩ resistor is used to connect the SIM_DATA pin to the VSIM pin.

3.7.3 ESD Protection for the SIM Card Interface

It is recommended that you take electrostatic discharge (ESD) protection measures near the SIM card socket. Figure 3-11 shows ESD protection circuit of the SIM card, in which the transient voltage suppressor (TVS) diode is placed as near as possible

to the SIM card socket, and the GND pin of the ESD protection component is well connected to the power GND pin that supplies power to the MG323-B module.

3.8 Audio Interface

3.8.1 Overview

The MG323-B module provides two types of audio interfaces: one is for handsets, the other is for headsets. The audio interfaces of the MG323-B module support input from handset microphones and headset microphones, and provide output that supports 32 Ω handsets and 16 Ω headsets. Differential signal lines are recommended for the microphone interface and the speaker interface. Single-ended signal lines are not recommended. The reception gain can be adjusted by using software. A microphone with an equivalent load of 2.2 k Ω is recommended, because both the pull-up resistor and the pull-down resistor of the two types of differential signal lines for the microphone are 1 k Ω .

Table 3-8 Definitions of the pins on the audio interface

Pin No.	Signal Name	I/O	Description
33	EXTEAR_N	AO	Negative pole of the output of headset speaker
34	EXTEAR_P	AO	Positive pole of the output of headset speaker
35	INTMIC_P	AI	Positive pole of the input of handset microphone
36	INTMIC_N	AI	Negative pole of the input of handset microphone
37	INTEAR_N	AO	Negative pole of the output of handset speaker
38	INTEAR_P	AO	Positive pole of the output of handset speaker
39	EXTMIC_P	AI	Positive pole of the input of headset microphone
40	EXTMIC_N	AI	Negative pole of the input of headset microphone

3.8.2 Speaker Interface

The MG323-B module provides two types of audio interfaces that respectively support 32 Ω handsets and 16 Ω headsets. 33 pF capacitors are added for filtering radio frequency interference. Differential signal lines are recommended for the speaker interface. Consider the drive capability of the module when using a speaker with greater power.

Figure 3-12 External circuit for 32 Ω handsets/16 Ω headsets

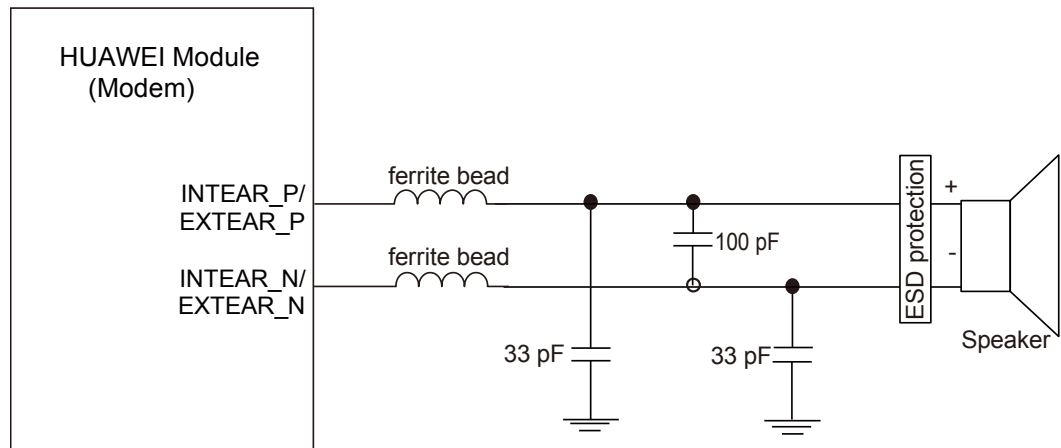


Table 3-9 Required speaker power for 32 Ω handsets/16 Ω headsets

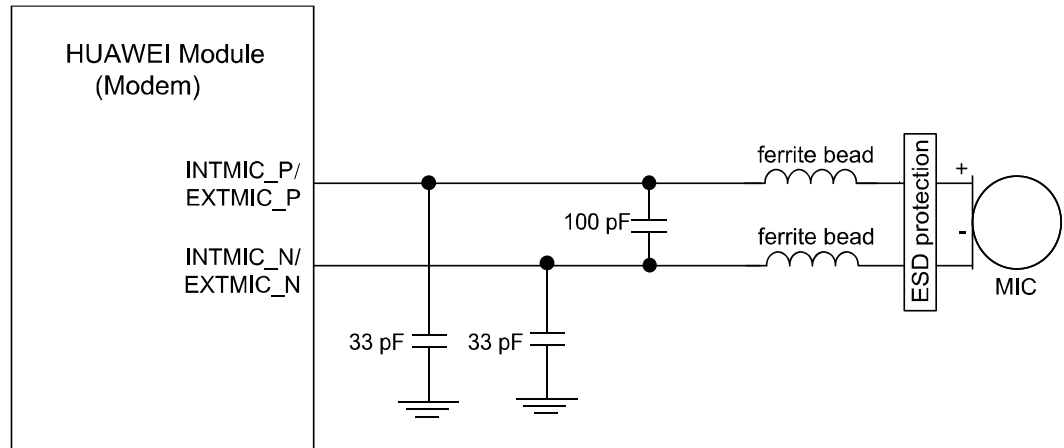
Speaker Load	Total Harmonic Distortion	Power (Typical)
32 Ω (handset)	THD < 0.1%	91 mW
32 Ω (handset)	THD < 1%	96 mW
16 Ω (headset)	THD < 0.1%	127 mW
16 Ω (headset)	THD < 1%	144 mW

The specifications listed in Table 3-9 are based on the specified working temperature of the module.

3.8.3 Microphone Interface

A microphone with an equivalent load of 2.2 kΩ is recommended, because both the pull-up resistor and the pull-down resistor of the two types of differential signal lines for the microphone are 1 kΩ. It is recommended that ESD components and 33 pF capacitors be added to the interface to reduce radio frequency interference.

Figure 3-13 External circuit for the microphone interface



Total Harmonic Distortion	Internal Settings of the Module	Supported Input from Microphones
THD < 1%	F = 1 kHz, pre-amp gain = 20 dB, PGA gain = 14 dB	15.4 mV (typical)
THD < 5%	F = 1 kHz, pre-amp gain = 0 dB, PGA gain = 0 dB	740 mV (typical)

The specifications listed in the preceding table are based on the ambient temperature ranging from -30°C to $+75^{\circ}\text{C}$ when the module is working.

THD (Total Harmonic Distortion) is a measurement of harmonic wave that generated by the audio equipment. Generally, the THD of high quality equipment is very low, but not all. Many diode equipments' THD is very high, while transistor equipment must have low THD.



CAUTION

It is recommended that ESD components be added to the external circuit of the audio interface to protect the module.

3.9 RF Antenna Interface

The MG323-B module provides an RF antenna interface for connecting an external antenna. Through the RF_ANT pad, the antenna interface is routed to the DTE.

Table 3-10 Signals of RF Antenna interface

Pin No.	Signal Name	I/O	Description
4	RF_ANT	-	RF main antenna interface

3.10 NC Interfaces

The MG323-B module has 22 NC pins. All of NC interfaces should not be connected. Please keep these pins open.

Table 3-11 Signals of NC interface

Pin No.	Signal Name	I/O	Description
10, 12, 13, 14, 15, 16, 17, 18, 19, 44, 48, 49, 50, 51, 52, 53, 59, 61, 62, 63, 64, 66	NC	-	Not connected, please keep open.

4 RF specifications

4.1 About This Chapter

This chapter describes the RF specifications of the MG323-B module, including:

- Antenna Installation Guidelines
- Operating Frequencies
- Conducted RF Measurement
- Conducted Rx Sensitivity and Tx Power
- Antenna Design Requirements
- ESD Protection for the Antenna Interface

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 to Antenna manufacturer instructions.

4.3 Operating Frequencies

Table 4-1 shows the RF bands supported by MG323-B.

Table 4-1 RF bands

Operating Band	Tx	Rx
GSM 850	824 MHz–849 MHz	869 MHz–894 MHz
GSM 900	880 MHz–915 MHz	925 MHz–960 MHz
GSM 1800(DCS)	1710 MHz–1785 MHz	1805 MHz–1880 MHz

Operating Band	Tx	Rx
GSM 1900(PCS)	1850 MHz–1910 MHz	1930 MHz–1990 MHz

4.4 Conducted RF Measurement

4.4.1 Test Environment

Test instrument	R&S CMU200、Agilent E5515C
Power supply	Keithley 2303、Agilent 66319
RF cable for testing	Rosenberger Precision Microwave Cable



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 3GPP test standards relating to 2G. 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 MG323-B. 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 4-2 lists the required minimum values, and the **Test Value** column lists the tested values of MG323-B.

Table 4-2 MG323-B conducted Rx sensitivity (Unit: dBm)

Item		3GPP Protocol Claim (dBm)	MG323-B Test Value (dBm)		
			Min.	Typ.	Max.
GSM850	GMSK (BER < 2.43%)	< -102	-	-108.5	-
GSM900	GMSK (BER < 2.43%)	< -102	-	-108.5	-

Item		3GPP Protocol Claim (dBm)	MG323-B Test Value (dBm)		
			Min.	Typ.	Max.
GSM1800	GMSK (BER < 2.43%)	< -102	-	-108	-
GSM1900	GMSK (BER < 2.43%)	< -102	-	-108	-



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 MG323-B. The conducted transmit power refers to the maximum power that the module tested at the antenna port can transmit. According to the 3GPP protocol, the required transmit power varies with the power class.

Table 4-3 lists the required ranges of the conducted transmit power of MG323-B. The tested values listed in the Test Value column must range from the minimum power to the maximum power.

Table 4-3 MG323-B conducted Tx power (Unit: dBm)

Item		3GPP Protocol Claim (dBm)	MG323-B Test Value (dBm)		
			Min.	Typ.	Max.
GSM850	GMSK(1Tx Slot)	31–35	31	32.5	35
GSM900	GMSK(1Tx Slot)	31–35	31	32.5	35
GSM1800	GMSK(1Tx Slot)	28–32	28	29.5	32
GSM1900	GMSK(1Tx Slot)	28–32	28	29.5	32

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 MG323-B 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 MG323-B to ensure high radio performance of the module: **Efficiency of the master antenna > 50% (-4 dB)**, 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 Ω). S11 shows the resonance feature and impedance bandwidth of an antenna. Voltage standing wave ratio (VSWR) is another expression of S11. S11 relates to the antenna efficiency. S11 can be measured with a vector analyzer.

The following S11 values are recommended for the antenna of MG323-B: **S11 of the master antenna < -6 dB**

Polarization

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

The linear polarization is recommended for the antenna of MG323-B.

Radiation Pattern

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

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

The following radiation patterns are recommended for the antenna of MG323-B.
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 MG323-B. **Gain of the master antenna ≤ 2.5 dBi**

 **NOTE**

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

The antenna for MG323-B must fulfill the following requirements:

GSM Antenna Requirements	
Frequency range	Depending on frequency band(s) provided by the network operator, the customer must use the most suitable antenna for that/those band(s)
Bandwidth	70 MHz in GSM850 80 MHz in GSM900 170 MHz in DCS 140 MHz in PCS
Gain	Gain < 3 dBi
Impedance	50 ohm
Input power	> 33 dBm (2 W) peak power in GSM
VSWR absolute max	≤ 5:1
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 20 cm 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 380 MHz to 6 GHz. The test items are described as follows:

Passive Tests

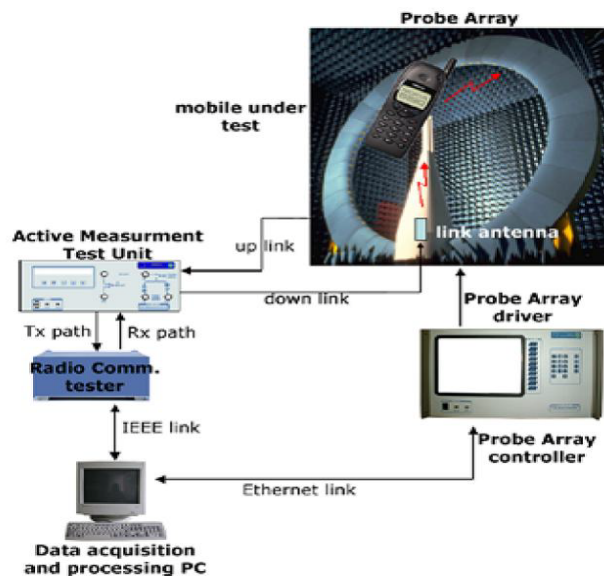
- Antenna efficiency
- Gain
- Pattern shape
- Envelope correlation coefficient

Active Tests

- **TRP:** GSM, WCDMA, 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



4.7 ESD Protection for the Antenna Interface

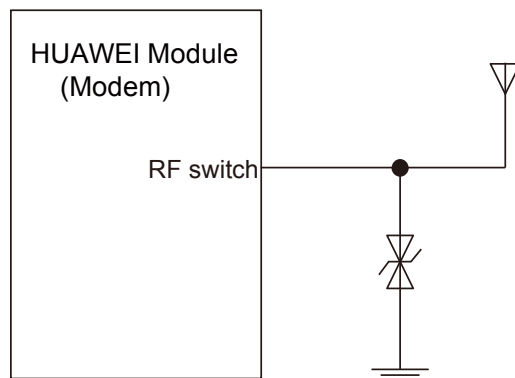


WARNING

In practical application, pay attention to the ESD protection for the antenna interface of the MG323-B module. Incorrect operation may result in permanent damage to the RF components.

Figure 4-2 shows the ESD protection circuit recommended for the antenna interface.

Figure 4-2 ESD protection circuit recommended for the antenna interface



CAUTION

It is recommended that you pay attention to the junction capacitance of the TVS diode when you choose the model of the TVS diode. Ensure that the junction capacitance of the TVS diode is lower than 1 pF.

5 Electrical and Reliability Features

5.1 About This Chapter

This chapter describes the electrical and reliability features of the interfaces in the MG323-B module, including:

- Extreme Working Conditions
- Working and Storage Temperatures and Humidity
- Electrical Features of Application Interfaces
- Power Supply Features
- Reliability Features
- ESD Features

5.2 Extreme Working Conditions



WARNING

Table 5-1 lists the extreme working conditions for the MG323-B module. Using the MG323-B module beyond these conditions may result in permanent damage to the module.

Table 5-1 Extreme working conditions for the MG323-B module

Symbol	Specification	Minimum Value	Maximum Value	Unit
V _{BAT}	External power voltage	-0.4	6.0	V
V _{COIN}	Input voltage of standby power for the RTC	2.0	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 MG323-B module.

Table 5-2 Working and storage temperatures and humidity for the MG323-B module

Specification	Minimum Value	Maximum Value	Unit
Normal working temperatures [1]	-20	+70	°C
Extreme working temperatures [2]	-30 to -20	+70 to +75	°C
Ambient temperature for storage	-40	+85	°C
Moisture	5	95	%



NOTE

[1]: When the MG323-B module works at this temperature, all its RF indexes comply with the 3GPP TS 45.005 specifications.

[2]: When the MG323-B module works at this temperature, certain RF indexes do not comply with the 3GPP TS 45.005 specifications.

5.4 Electrical Features of Application Interfaces

Table 5-3 lists electrical features (typical values) measured when no external device is connected to the MG323 module through the 68-pin LCC interface.

Table 5-3 Electrical features of application interfaces

Function	Signal Name	I/O	Waveform and Level	Remarks
Power supply interface	VBAT	P	$V_I = 3.30\text{ V to }4.20\text{ V}$ $V_{I\text{typical}} = 3.80\text{ V}$	Pin 21 and 22 are power supply pins used for the MG323-B module's baseband.
	VPA	P	$V_I = 3.30\text{ V to }4.20\text{ V}$ $V_{I\text{typical}} = 3.80\text{ V}$	Pin 7 and 8 are power supply pins used for the MG323-B module's PA. When the module transmits signals at the maximum power, the transient current can reach about 2 A, which may result in VPA voltage drop. The VPA power voltage for the MG323-B module should not be lower than 3.3 V.
	GND	-	-	Pins 1, 2, 3, 5, 6, 9, 23, 32, 41, 43, 45, 54, 60 and 65 are power GND pins.



Function	Signal Name	I/O	Waveform and Level	Remarks
External power voltage interface	VIO	P	$V_{omin}=2.70\text{ V}$ $V_{otypical}=2.80\text{ V}$ $V_{omax}=2.95\text{ V}$ $I_{omax}=10.00\text{ mA}$	<p>Pin 20 is a pin for supplying external devices with power from the MG323-B module. Ensure that the external peaks and burst do not damage the VIO interface.</p> <p>If the MG323-B module is in Sleep mode, the VIO pin is in the enabled low consumption state (< 500 uA). If the MG323-B module is in Power Down mode, the VIO pin is in the disabled state.</p> <p>This pin can be left floating if it is not used.</p>
Interface for standby power input of the RTC	VCOIN	P	$V_{omax}=3.00\text{ V}$ $V_{lmin}=2.00\text{ V}$ $V_{ltypical}=3.00\text{ V}$ $V_{lmax}=3.15\text{ V}$ $I_{ltypical}=5.00\text{ }\mu\text{A}$ at $\text{VBAT}=0\text{ V}$	<p>Pin 42 is a pin for standby power input of the RTC. When the VBAT is not ready for power supply, the RTC can be supplied with power through an external coin battery or capacitor.</p> <p>This pin can be left floating if it is not used.</p>
Power pin	TERM_ON	I	$V_{lmax}=0.40\text{ V}$ The signal can be detected when low level keeps effective for one second or more.	<p>Pin 68 is a pin for powering on the module. Low level is effective.</p>
Reset pin	RESET	I	$V_{lmax}=0.40\text{ V}$ The signal can be detected when low level keeps effective for 10 milliseconds or more.	<p>Pin 67 is a pin for restarting the module. Low level is effective.</p> <p>This pin can be left floating if it is not used.</p>
Signal of the network status LED	LED_STATU S	O	$V_{oHmin}=2.70\text{ V}$	<p>Pin 11 is a pin for controlling the network status LED.</p> <p>This pin can be left floating if it is not used.</p>
SIM card interface (assuming the voltage is 3.0 V)	SIM_RST	O		Reset signal of the SIM card
	SIM_DATA	I/O		Data signal of the SIM card
	SIM_CLK	O		Clock signal of the SIM card
	VSIM	P	$V_{oHmax}=3.00\text{ V}$ $V_{otypical}=2.90\text{ V}$ $V_{oHmin}=2.75\text{ V}$	Power voltage of the SIM card
	GND			



Function	Signal Name	I/O	Waveform and Level	Remarks
SIM card interface (assuming the voltage is 1.8 V)	SIM_RST			Reset signal of the SIM card
	SIM_DATA			Data signal of the SIM card
	SIM_CLK			Clock signal of the SIM card
	VSIM		$V_{oHmax}=1.95\text{ V}$ $V_{oTypical}=1.80\text{ V}$ $V_{oHmin}=1.65\text{ V}$	Power voltage of the SIM card
	GND			GND of the SIM card
UART1 communication interface	UART1_RD	O	$V_{oLmax}=0.10\text{ V}$ $V_{oHmin}=2.70\text{ V}$	This interface can be used to transmit AT commands and data.
	UART1_TD	I		
	UART1_RING	O	$V_{iLmax}=0.40\text{ V}$ $V_{iHmin}=2.40\text{ V}$ $V_{iHmax}=3.30\text{ V}$	
	UART1_DSR	O		
	UART1_RTS	I		
	UART1_DTR	I		
	UART1_CTS	O		
	UART1_DCD	O		
Analog audio interface	EXTMIC_N	AI		Negative pole of the input of headset microphone
	EXTMIC_P	AI		Positive pole of the input of headset microphone
	INTMIC_P	AI		Positive pole of the input of handset microphone
	INTMIC_N	AI		Negative pole of the input of handset microphone
	EXTEAR_N	AO		Negative pole of the output of headset speaker
	EXTEAR_P	AO		Positive pole of the output of headset speaker
	INTEAR_P	AO		Positive pole of the output of handset speaker
	INTEAR_N	AO		Negative pole of the output of handset speaker
NC pin	NC			Pin 10, 12, 13, 14, 15, 16, 17, 18, 19, 44, 48, 49, 50, 51, 52, 53, 59, 61, 62, 63, 64 and 66 are internal pins. These pins need to be left floating when they are used.

**NOTE**

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

5.5 Power Supply Features

5.5.1 Input Power Supply

Table 5-4 lists the requirements for input power of the MG323-B module.

Table 5-4 Requirements for input power of the MG323-B module

Parameter	Minimum Value	Typical Value	Maximum Value	Unit
V _{BAT}	3.3	3.8	4.2	V
V _{COIN}	2	3	3.15	V

5.5.2 Working Current

Table 5-5 lists the working current of the MG323-B module.

Table 5-5 Working current of the MG323-B module

Working Mode	Maximum Value	Unit
Power-off mode	50	μA
Standby mode	MFRMS=2, I<3.0	mA
	MFRMS=5, I<3.0	mA
	MFRMS=9, I<3.0	mA
GPRS mode	460	mA

5.6 Reliability Features

Table 5-6 lists the test conditions and results of the mechanical reliability of the MG323-B module.

Table 5-6 Test conditions and results of the mechanical reliability of the MG323-B module

Item	Test Condition	Standard
Low-temperature storage	Temperature: $-40^{\circ}\text{C}\pm 2^{\circ}\text{C}$ Test duration: 24 h	IEC60068
High-temperature storage	Temperature: $85^{\circ}\text{C}\pm 2^{\circ}\text{C}$ Test duration: 24 h	IEC60068
Low-temperature working	Temperature: $-30^{\circ}\text{C}\pm 2^{\circ}\text{C}$ Test duration: 24 h	IEC60068
High-temperature working	Temperature: $75^{\circ}\text{C}\pm 2^{\circ}\text{C}$ Test duration: 24 h	IEC60068
Damp heat cycling	High temperature: $55^{\circ}\text{C}\pm 2^{\circ}\text{C}$ Low temperature: $25^{\circ}\text{C}\pm 2^{\circ}\text{C}$ Humidity: 95% Repetition times: 4 Test duration: 12 h+12 h	IEC60068
Temperature shock	Low temperature: $-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ High temperature: $85^{\circ}\text{C}\pm 2^{\circ}\text{C}$ Temperature change interval: < 30s Test duration: 15 min Repetition times: 100	IEC60068
Condensation test	Temperature: $-40^{\circ}\text{C}\pm 2^{\circ}\text{C}$ Time for keeping condensed: 2 h Recovery temperature: $25^{\circ}\text{C}\pm 2^{\circ}\text{C}$ Recovery time: 5 min Repetition times: 6	IEC60068
Dust test	Dust density: 2 kg/m^3 Dust type: dry talcum powder Size requirement: < $75 \mu\text{m}$ Duration: 8 h	IEC60068
Salty fog test	Temperature: 35°C Density of the NaCl solution: $5\pm 1\%$ Spraying interval: 8 h Duration of exposing the module to the temperature of 35°C : 16 h	IEC60068
Sun exposure	Radiation strength: 1120 W/m^2 Duration: 20 h Repetition time: 3	IEC60068

Item	Test Condition	Standard
Sine vibration	Frequency range: 5 Hz to 200 Hz Acceleration: 10 m/s ² Frequency scan rate: 1 oct/min Test period: 3 axial directions. Five circles for each axial direction.	IEC60068
Shock test	Half-sine wave shock Peak acceleration: 300 m/s ² Shock duration: 11 ms Test period: 6 axial directions. One shock for each axial direction.	IEC60068
Clash test	Half-sine wave Peak acceleration: 180 m/s ² Pulse duration: 6 ms Repetition time: 6 directions. 1000 times for each direction.	IEC60068
Drop test	First case: 0.3 m in height. Drop the MG323-B module on the marble terrace with one surface facing downwards twice. Six surfaces should be tested. Second case: 0.8 m in height. Drop the MG323-B module on the marble terrace with one surface facing downwards twice. Six surfaces should be tested.	IEC60068

5.7 ESD Features

Table 5-7 lists the test results of the ESD performance of the MG323-B module according to the EN61000-4-2 standard.

Table 5-7 ESD performance

ESD Test Standard	Contact Discharge	Air Discharge
EN61000-4-2	±4 kV	±8 kV

6 Mechanical Specification

6.1 About This Chapter

This chapter describes the dimensions of the MG323-B module, including:

- Storage Requirement
- Moisture Sensitivity
- Dimensions of the Module
- Customer PCB Design
- Stencil Design
- Reflow Profile
- Label
- Packing System
- Specification of Rework

6.2 Storage Requirement

The module must be stored and sealed properly in vacuum package under a temperature below 40°C and the relative humidity less than 90% in order to ensure the weldability within 12 months.

6.3 Moisture Sensitivity

- The moisture sensitivity is level 3.
- After unpacking, the module must be assembled within 168 hours under the environmental conditions that the temperature is lower than 30°C and the relative humidity is less than 60%. If the preceding conditions cannot be met, the module needs to be baked according to the parameters specified in Table 6-1 .

Table 6-1 Baking parameters

Baking Temperature	Baking Condition	Baking Duration	Remarks
125±5°C	Relative humidity ≤ 60%	8 hours	

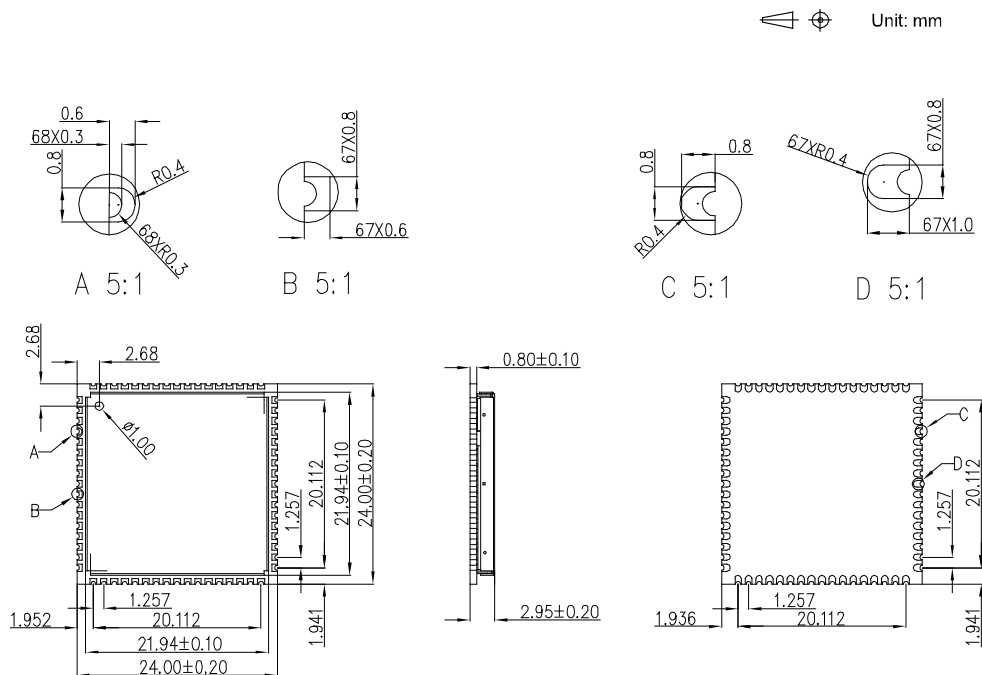
6.4 Dimensions of the Module

Dimensions (L x W x H): 24 mm ± 0.2 mm x 24.0 mm ± 0.2 mm x 2.95 mm ± 0.2 mm

Figure 6-1 shows the dimensions.

Weight: < 3.5 g

Figure 6-1 Dimensions of the MG323-B module (unit: mm)

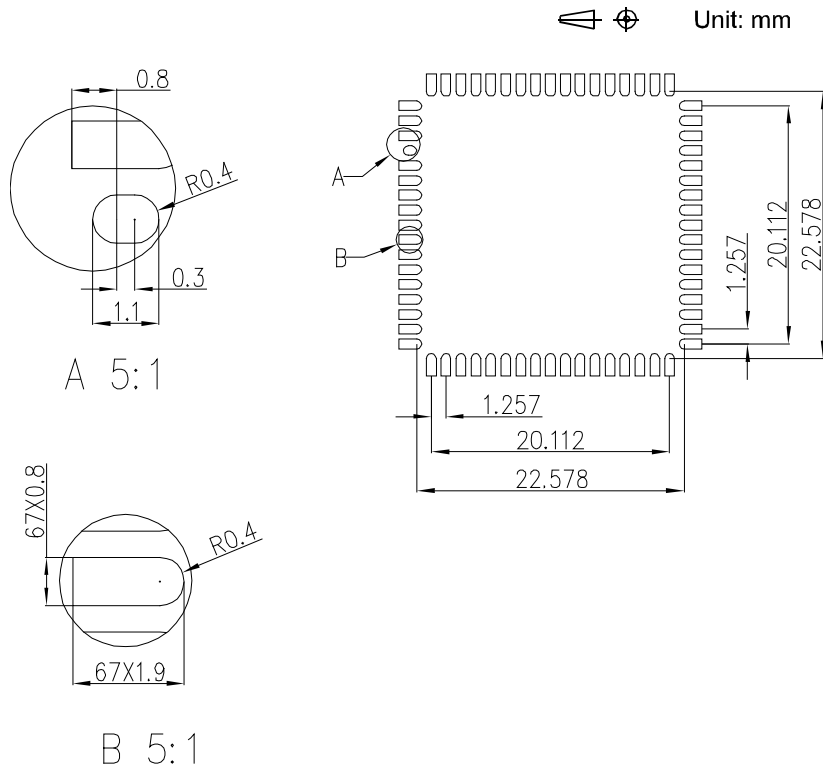


6.5 Customer PCB Design

6.5.1 Pad Design

To achieve assembly yields and solder joints of high reliability, it is recommended the customer PCB pad sizes. For details, see Figure 6-2 .

Figure 6-2 PCB pad design (Top View)



6.5.2 Solder Mask

The PCB pad design can be solder mask defined (SMD), or non-solder mask defined (NSMD). NSMD is recommended. In addition, the solder mask of the NSMD pad design is larger than the pad so the reliability of the solder joint can be improved.

The solder mask must be 100 μm to 150 μm larger than the pad, that is, the single side of the solder mask must be 50 μm to 75 μm larger than the pad. The specific size depends on the processing capability of the PCB manufacturer.

The area recommended be filled with twice solder mask.

6.5.3 PCB Surface Finish

The PCB surface finish recommended is Electroless Nickel, immersion Gold (ENIG). Organic Solderability Preservative (OSP) may also be used, ENIG preferred.

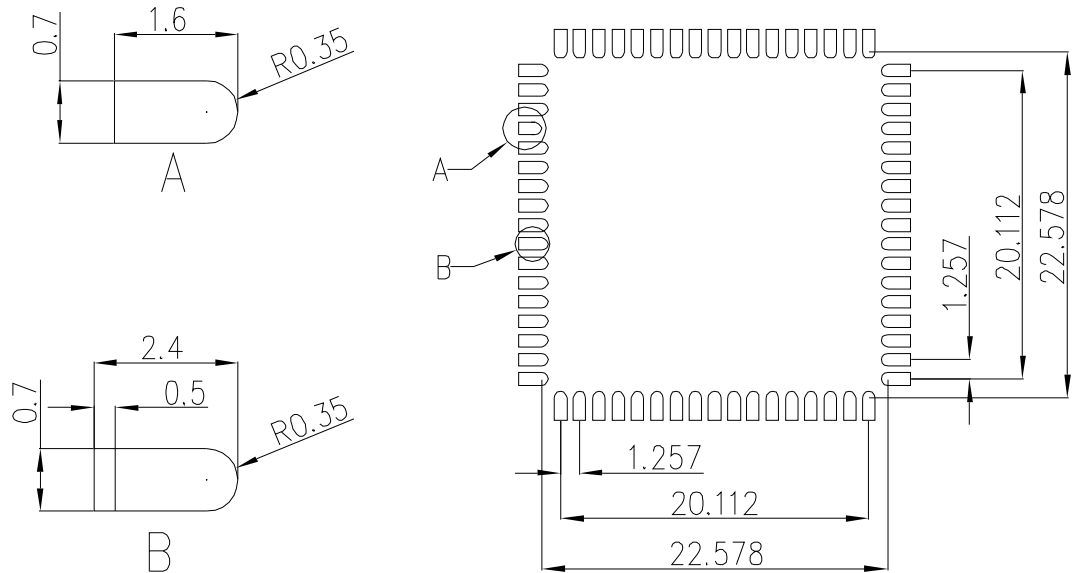
6.5.4 Requirements on PCB Layout

- It is recommended that the thickness of PCB is more than 1.0 mm to reduce the deformation caused by high temperature welding.
- Other devices must be located more than 3 mm (5 mm recommended) away from the LCC module. The minimum distance between the LCC module and the PCB edge is 1.5 mm.

When the PCB layout is double sided, it is recommended that the LCC module be placed on the second side for assembly.

6.6 Stencil Design

It is recommended that the stencil for the LCC module be 0.25 mm in thickness. For the stencil design, see the following figure:



6.7 Reflow Profile

For the soldering temperature of the LCC module, see the following figure:

Figure 6-3 Reflow profile

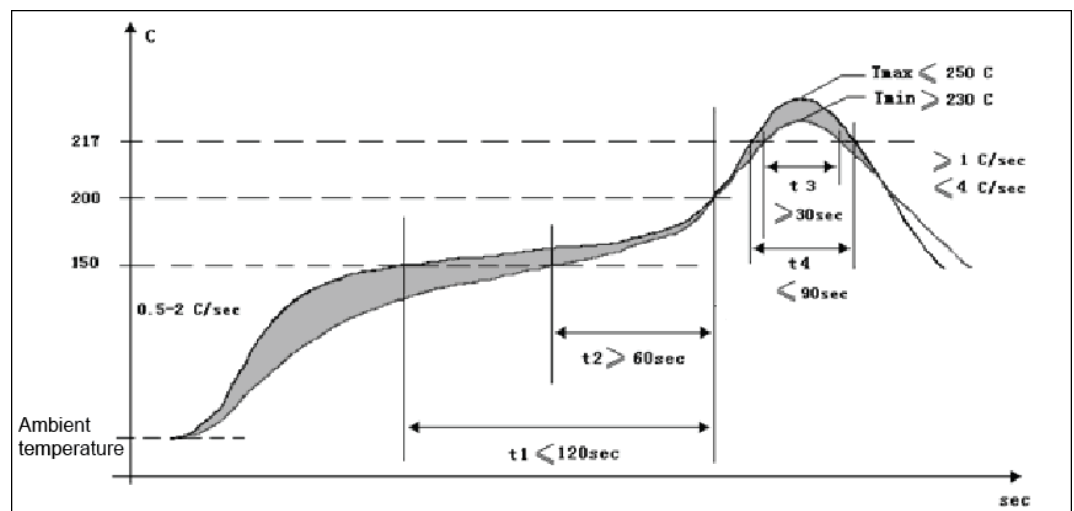


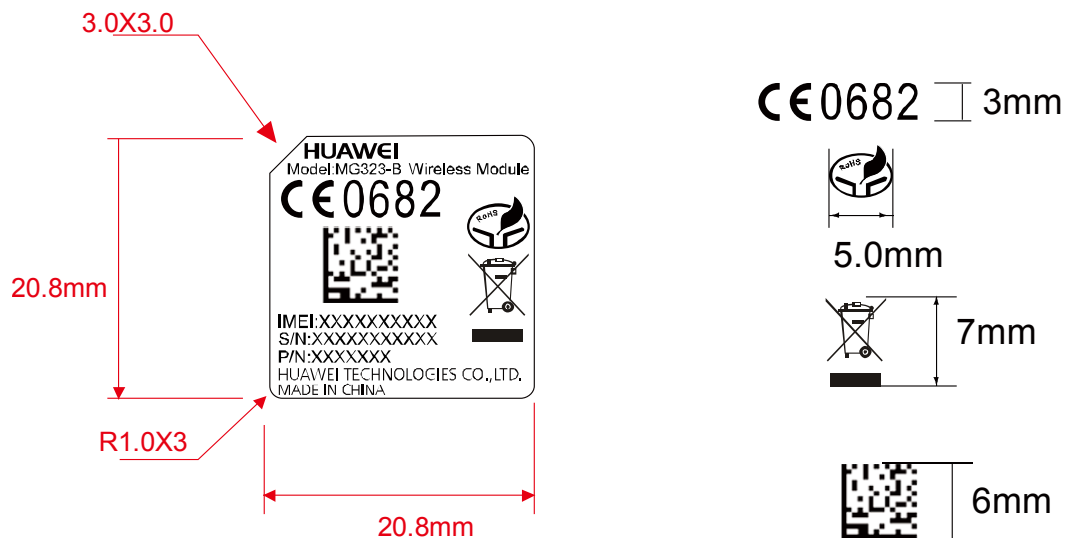
Table 6-2 Reflow parameters:

Temperature Zone	Time	Key Parameter
Preheat zone (40°C–150°C)	60s–120s	Heating rate:0.5°C /s–2°C /s
Soak zone (150°C–200°C)	(t1– t2) :60s–120s	Heating rate:<1.0°C /s
Reflow zone (>217°C)	(t3–t4) :30s–90s	Peak reflow temperature:230°C–250°C
Cooling zone	Cooling rate: 1°C /s≤Slope≤4°C /s	

6.8 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 6-4 MG323-B module's label

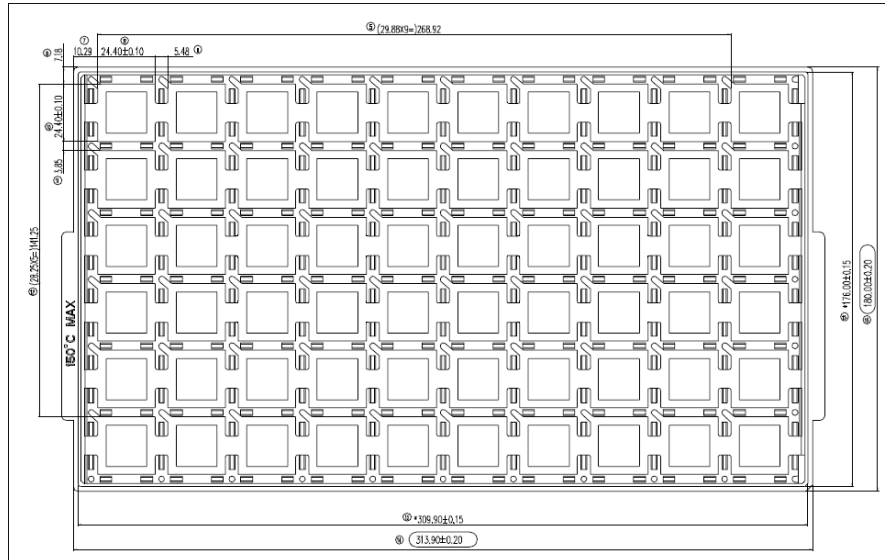


NOTE

- The picture mentioned above is only for reference.
- The silk-screen should be clear, without burrs, and dimension should be accurate.
- 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 to 40s and able to endure the high temperature of 260°C. And the color of the material of the nameplate can't change.

6.9 Packing System

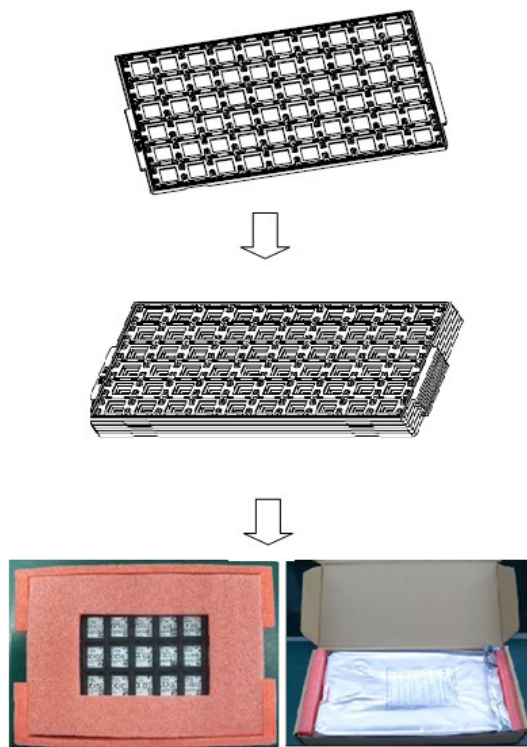
HUAWEI module uses five layers ESD pallet, anti-vibration foam and vacuum packing into cartons.



NOTE

- All materials used must meet eco-friendly requirements.
- According to the requirements and test methods specified in EIA 541, the surface resistance must range from $10,000 \Omega$ to $1000,000 \Omega$.
- Packaging materials must be resistant to temperature higher than or equal to 150°C .
- Triboelectricity must be lower than 100 V .

The following figures show the packaging.



Orient LCC modules in the specified direction.

Module quantity per tray $6 \times 10 = 60$ pcs/tray

6 trays/vacuum package. Do not place any modules on the tray at the top of each package.

Total quantity per package: $5 \times 60 = 300$ pcs/vacuum package.

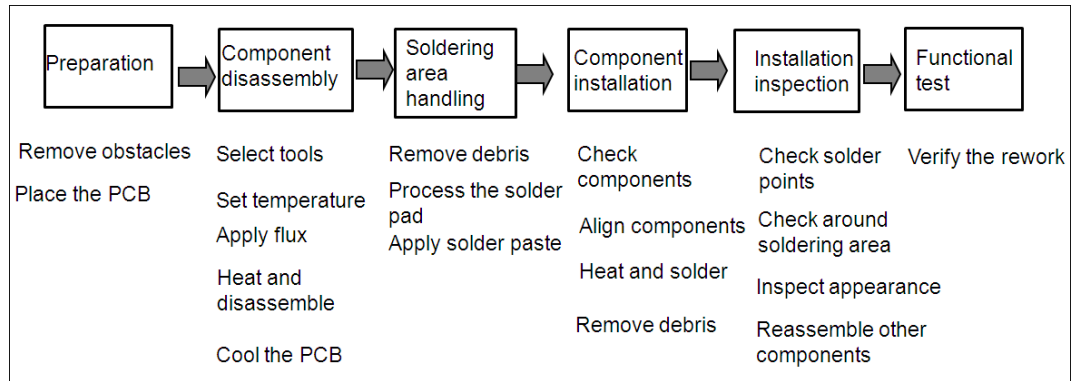
Use vacuum packages; one package per carton; module quantity per carton: $5 \times 60 = 300$ pcs/carton.

 **NOTE**

- A secondary SMT assembly will be conducted on the LCC modules. To keep LCC modules dry and ensure a quality secondary SMT assembly, use vacuum packing for the LCC modules in accordance with the packing standards for Moisture Sensitivity Level (MSL) 3 components.
- Include desiccant and humidity indicators in the packages. Attach the packages with labels indicating that the LCC modules contained in the packages are MSL 3 components.
- Packages must be made of ESD materials. Packages or containers must be attached with ESD labels.

6.10 Specification of Rework

6.10.1 Process of Rework



6.10.2 Preparations of Rework

- Remove barrier or devices that can't stand high temperature before rework.
- If the device to be reworked is beyond the storage period, bake the device according to Table 6-1 .

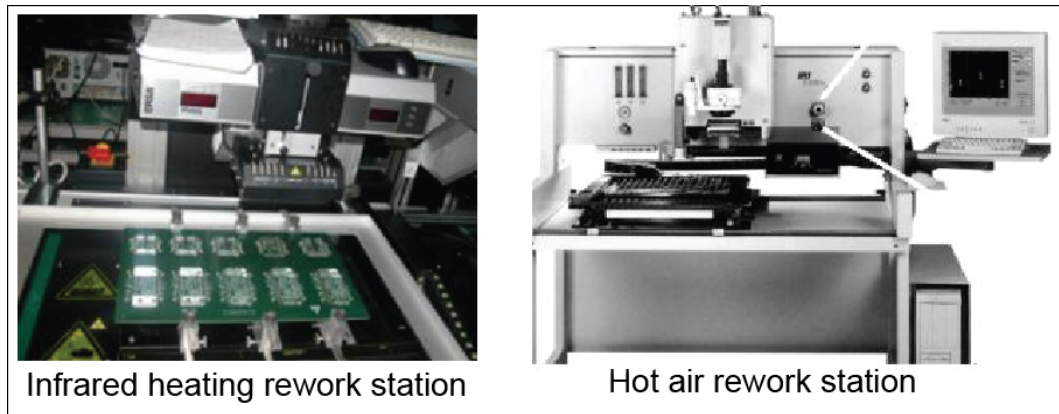
6.10.3 Removing of the Module

The solder is molten and reflowed through heating during the module removing process. The heating rate must be quick but controllable in order to melt all the solder joints simultaneously. Pay attention to protect the module, PCB, neighboring devices, and their solder joints against heating or mechanical damages.

NOTE

- The LCC module has many solder pads and the pads are large. Therefore, common soldering irons and heat guns cannot be used in the rework. Rework must be done using either infrared heating rework stations or hot air rework stations. Infrared heating rework stations are preferred, because they can heat components without touching them. In addition, infrared heating rework stations produce less solder debris and less impact on modules, while hot air rework stations may cause shift of other components not to be reworked.
- It is proposed that a special clamp is used to remove the module.

Figure 6-5 Equipment used for rework



6.10.4 Welding Area Treatment

- Step 1 Remove the old solder by using a soldering iron and solder braid that can wet the solder.
- Step 2 Clean the pad and remove the flux residuals.
- Step 3 Solder pre-filling: Before the module is installed on a board, apply some solder paste to the pad of the module by using the rework fixture and stencil or apply some solder paste to the pad on the PCB by using a rework stencil.



NOTE

It is recommended that a fixture and a mini-stencil be made to apply the solder paste in the rework.

6.10.5 Module Installation

Install the module precisely on the module and ensure the right installation direction of the module and the reliability of the electrical connection with the PCB. It is recommended that the module be preheated in order to ensure that the temperature of all parts to be soldered is uniform during the reflow process. The solder quickly reflows upon heating so the parts are soldered reliably. The solder joints undergo proper reflow duration at a preset temperature to form a favorable Intermetallic Compound (IMC).

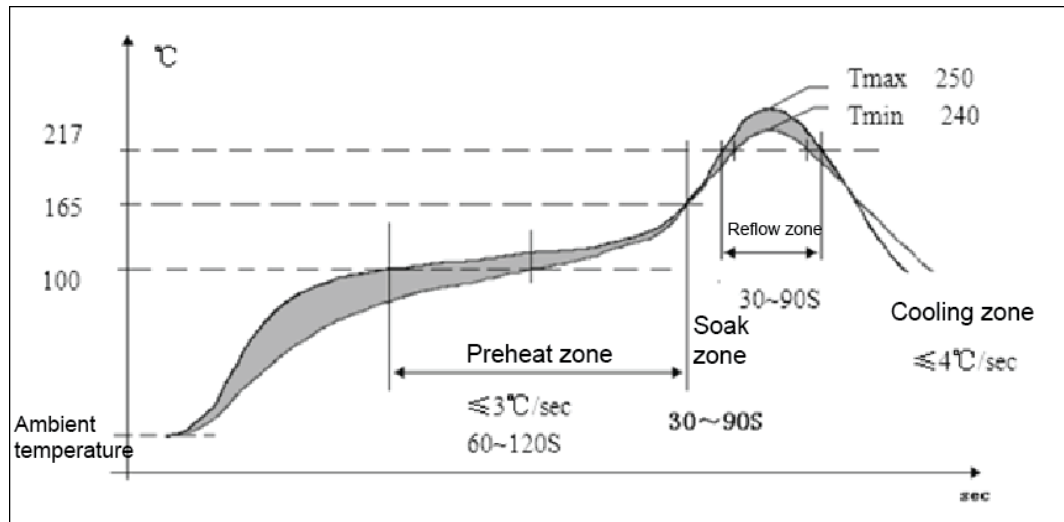


NOTE

- It is recommended that a special clamp be used to pick the module when the module is installed on the pad after applied with some solder.
- A special rework device must be used for the rework.

Temperature parameter of rework: for either the removing or welding of the module, the peak temperature between 240–250°C. The following parameters are recommended during the rework.

Figure 6-6 Temperature graph of rework



7 Certifications

7.1 About This Chapter

This chapter gives a general description of certifications:

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

7.2 Certifications

**NOTE**

The certification of MG323-B has not carried out; Table 7-1 shows certifications the MG323-B will be implemented. For more demands, please contact us for more details about this information.

Table 7-1 Product Certifications

Certification	Model name
	MG323-B
CE	√
FCC	-
CCC	√
NCC	-
A-TICK	-
Jate & Telec	-
IC number	-

Certification	Model name
	MG323-B
EU RoHS	√
JGPSSI	-
SGS RoHS	-
PVC-Free	-
GCF	√
PTCRB	-

7.3 Environmental Protection Certification and Test

7.3.1 RoHS

RoHS 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

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

7.3.2 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.

7.3.3 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.

7.3.4 Packaging

The packaging and packaging waste of the product is compliant with 2004/12/EC.

7.4 National Compulsory Certification

7.4.1 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.

7.4.2 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

7.4.3 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

7.4.4 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.

7.4.5 Certification Modes

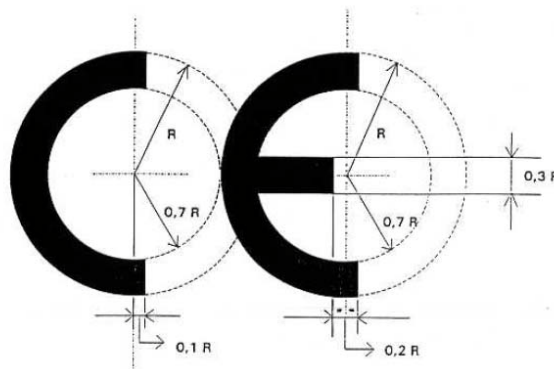
- DOC
By affixing a certification mark to a product, the manufacturer declares that the product is compliant with the relevant certification standards. For example, a manufacturer declares that its product complies with relevant EU directives if it affixes a CE mark to the product.
- NB certification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

7.4.6 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: XXXYYYYYYYYY

- **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.

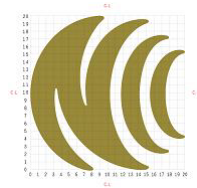
The following lists the controlled telecommunications equipment:

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

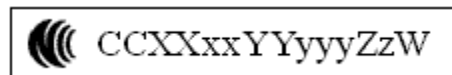
The DGT's *Technical Specifications for Low-Power Radio-Frequency Devices* specifies the frequencies that no low-power RF device or its principal wave should not use and control the radiation field strength of low-power RF devices.

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:



TELEC and JATE Certification (Japan)

- Telecom Engineer Center (TELEC)

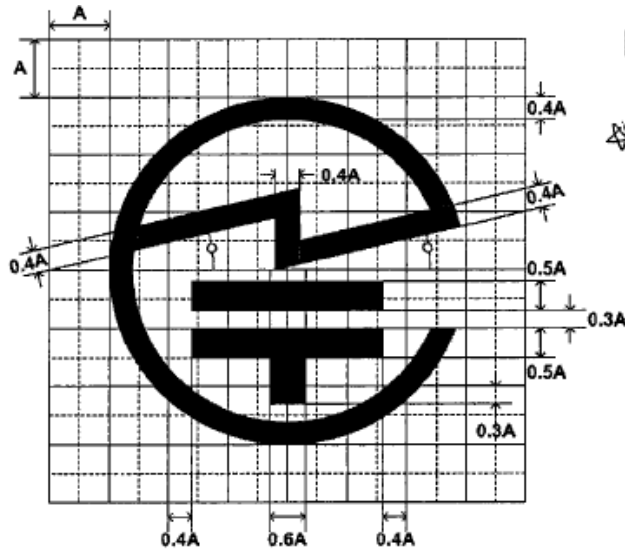
TELEC is a compulsory certification for radio products in Japan. The TELEC certification complies with Japanese Radio Law. The specific test regulations are stipulated in MIC Notice No.88 and are updated and maintained by the MIC. All wireless products require type approval (mainly for the RF part) by 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

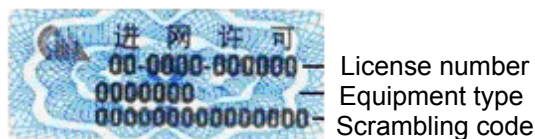
A network access license often is valid for three years. The *Telecommunications Administration Bureau, MII* is responsible for inspecting and approving telecommunications equipment and then issuing network access licenses according to the inspection results. Local telecommunication administration departments 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).

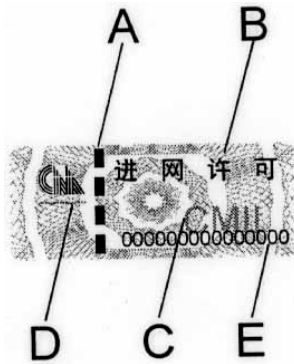
NAL marks should meet the following requirements:

- 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.



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 CMIIT 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.



7.4.7 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 20cm 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.

7.5 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.

7.5.1 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.

7.5.2 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.

7.5.3 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
- SIM/USIM 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 USIM card interface circuits are modified in the integrated equipment. For this reason, the antennas and the USIM 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.

- SIM/USIM test

USIM card interface circuits are re-designed in the integrated equipment, which may result in changes in the electrical features of the USIM card interface. For this reason, the USIM card interface circuits need to be re-tested. The SIM/USIM test aims to verify the overall performance of SIM/USIM 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 SIM/USIM 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
- SIM/USIM 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 USIM card interface circuits are modified in the integrated equipment. For this reason, the antennas and the USIM 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.

- SIM/USIM test

USIM card interface circuits are re-designed in the integrated equipment, which may result in changes in the electrical features of the USIM card interface. For this reason, the USIM card interface circuits need to be re-tested. The SIM/USIM test aims to verify the overall performance of SIM/USIM 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:

6. 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.

7. 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.

8. 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.

9. 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.

10. Perform overall-system certification.

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

11. 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 USIM test is the same for both the GCF certification and the PTCRB certification, the test organization needs to perform the USIM 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 abnormality of the wireless device or accessories.
- Do not dismantle the wireless device or accessories. Otherwise, the wireless device and accessories are not covered by the warranty.

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.



10 Appendix B Acronyms and Abbreviations

Acronym or Abbreviation	Expansion
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
EU	European Conformity
FCC	Federal Communications Commission
FDD-TDMA	Frequency Division Duplexing–time Division Multiple Access
GMSK	Gaussian Minimum Shift Keying
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
ISO	International Standards Organization
LCC	Leadless Chip Carrier
LDO	Low-Dropout
LED	Light-emitting Diode



Acronym or Abbreviation	Expansion
MCP	Multi-chip Package
PBCCH	Packet Broadcast Control Channel
PCB	Printed Circuit Board
PDU	Protocol Data Unit
RF	Radio Frequency
RoHS	Restriction of the Use of Certain Hazardous Substances
RTC	Real-time Clock
SIM	Subscriber Identity Module
THD	Total Harmonic Distortion
TTL	Transistor-transistor Logic
TVS	Transient Voltage Suppressor
UART	Universal Asynchronous Receiver-transmitter
VSWR	Voltage Standing Wave Ratio