ZTEWelink

Welink your smart

Hardware Development Guide of Module Product

MF206A

Version 2.5, 2015-06-18

ZTE

Legal Information

By receiving the document from Shenzhen ZTEWelink Technology Co., Ltd (shortly referred to as ZTEWelink), you are deemed to have agreed to the following terms. If you don't agree to the following terms, please stop using the document.

The product meets the design requirements of environmental protection and personal security. The storage, use or disposal of products should abide by the product manual, relevant contract or the laws and regulations of relevant country.

ZTEWelink reserves the right to make modifications on the product described in this document without prior notice, and keeps the right to revise or retrieve the document any time.

If you have any question about the manual, please consult the company or its distributors promptly.

Revision History

Version	Date	Description
1.0	2010-11-18	Initial version
2.0	2011-3-15	Chapter 1: 1. Add the application range and compilation purpose Chapter 2: 1. Update Table2-1 2. Add the introduction of baseband function and radio frequency; add the frame structure Chapter 3: 1. Add the definition of PIN I/O parameter, and provide the description of PINs 2. Add the feature of interface PWL Chapter 4: 1. Add the chapter Chapter 5: 1. Update the RF sourced index and source less index Chapter 6: 1. Update the testing standard and testing environment Chapter 7: 1. Add the chapter Chapter 8: 1. Add the chapter
2.1	2013-03-26	1. Modify the logo of cover and page footer 2. Modify Legal Information 3. Modify some errors in the Table 2-2 of Working Frequency Band 4. Update the Table 1-1 of Supported Document List 5. Modify the chapter of 7.7 of Recommended Upgrade Methods 6. Modify the Figure 7-1 of Main Antenna RF Connector Interface to erase the IMEI in picture 7. Modify the test result in Table 6-6 8. Modify the name of Table 5-1 to sourceless
	2013-05-31	9. Release as Version 2.1
2.2	2013-12-09	1. Modify the Figure 2-2. 2. Add the contact information

Version	Date	Description
		3. Update Document Format
2.3	2013-12-30	1. Add the profile dimensions of RF antenna console 2. Modify part 7.3 of RF Circuit Design
2.4	2014-06-30	1. Update the legal information 2. Add the NOTE in chapter 1.2 3. Update Table 1-1 of Reference Document List 4. Update Table 2-1 of Major Technical Parameters 5. Update Table 3-1 of PIN Parameters 6. Add Table 3–3 of The Mandatory Pins of Module 7. Update Figure 3-3 of SD Typical Application Circuit 8. Modify chapter 3.10 of Power-on/Power-off & Reset Signal 9. Update Figure 3-16 of Reference Circuit of Status Indicator 10. Modify chapter 4.2 of Working Current 11. Move the chapter 4.2 and 4.3 of Power-on/Power-off Flow in the former document to chapter 3.10 12. Modify Index of RF under UMTS & GPRS/GSM/EDGE Mode in chapter 5.1 and 5.2 13. Add the NOTE in chapter 6.3 14. Add Figure 9-1 of Recommended PCB Wielding Panel Design 15. Modify Figure 5–1 of Main Antenna RF Connector Interface 16. Modify chapter 10.2 of Furnace Temperature Curve 17. Add chapter 11 of Safety Information 18. Add the chapter 10.3 of Package System
2.5	2015-06-15	1. Add the description of Suspend and Resume of module in chapter 3.10 &3.7 2. Update the figures of module

Contact Information

Post	9/F, Tower A, Hans Innovation Mansion, North Ring Rd., No.9018, Hi-Tech Industrial Park, Nanshan District, Shenzhen. P.R.China
Web	www.ztewelink.com
Phone	+86-755-26902600
E-Mail	ztewelink@zte.com.cn

Note: Consult our website for up-to-date product descriptions, documentation, application notes, firmware upgrades, troubleshooting tips, and press releases

Besides, ZTEWelink provides various technical support ways to the customers, such as support by phone, website, instant messaging, E-mail and on-site.

Contents

Figures

Tables

1 About This Document

1.1 Application Range

This document is applicable as the hardware development guide of MF206A WCDMA module products. The user can design the product according to the requirement and guidance in this document. It is only applicable for the hardware application and development of MF206A WCDMA module products.

1.2 Purpose

This document provides the hardware solutions and development fundamentals for a product with the ZTEWelink module. By reading this document, the user can have an overall knowledge of MF206A and a clear understanding of the technical parameters. With this document, the user can successfully fulfill the application and development of wireless 3G Internet product or equipment.

Besides the product features and technical parameters, this document also provides the product reliability tests and related testing standards, service function implementation flow, RF performance indexes and a guide on the design of user circuits, to provide the user with a complete design reference.

NOTE:

To ensure the module manufacturing and welding quality, do as the chapter 10 of Manufacturing Guide in this document. The force on the squeegee should be adjusted so as to produce a clean stencil surface on a single pass and ensure the module soldering quality

---

1.3 Supported & Reference Document List

Besides the hardware development document, ZTEWelink also provides the board operation guide, software development guide and upgrading plan guide of MF206A. Table 1–1 is the list of supported documents.

Table 1–1 Reference Document List

NO.	Document Name
1	ZTEWelink LGA Type Ⅱ Module Dev Board User Guide.pdf
2	ZTEWelink Software Development Guide of Module Products.pdf
3	AT Commands reference guide for ZTEWelink WCDMA Modules.pdf
4	ZTEWelink SMT & Baking User Guide of Module Products.pdf

1.4 Abbreviations

Table 1–2 is a list of abbreviations involved in this document, as well as the English full names.

Table 1–2 Abbreviation List

Abbreviations	Full Name
AP	Another name of DTE
BER	Bit Error Rate
DL	Downlink
DPCH	Dedicated Physical Channel
ESD	Electro-Static discharge
ECT	Electric Connector Technology CO.,LTD
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
I/O	Input/output
LED	Light Emitting Diode
PWL	Power Level
SIM	Subscriber Identification Module
SMT	Surface Mount Technology
SPI	Serial Peripheral Interface
UMTS	Universal Mobile Telecommunication System
WCDMA	Wideband Code Division Multi Access

2 Product Overview

MF206A is a wireless Internet module with LGA interface. A rich set of internet protocols and abundant functions extend the applicability of the module to a wide range of M2M applications such as metering, tracking systems, security solutions, routers, wireless POS, mobile computing devices, PDAs, tablet PC and so on. The features of module are described as below.

1. It can support UMTS 850(900)/1900/2100MHz frequency band, and GSM/GPRS/EDGE 850/900/1800/1900MHz frequency band.
2. It can provide high-speed data access service under the mobile environment.
3. It provides the SPI interface, I2C interface, (U)SIM card interface (3.0V/1.8V), USB2.0 interface, UART interface, SD2.0 interface, power-on/power-off, and resetting.

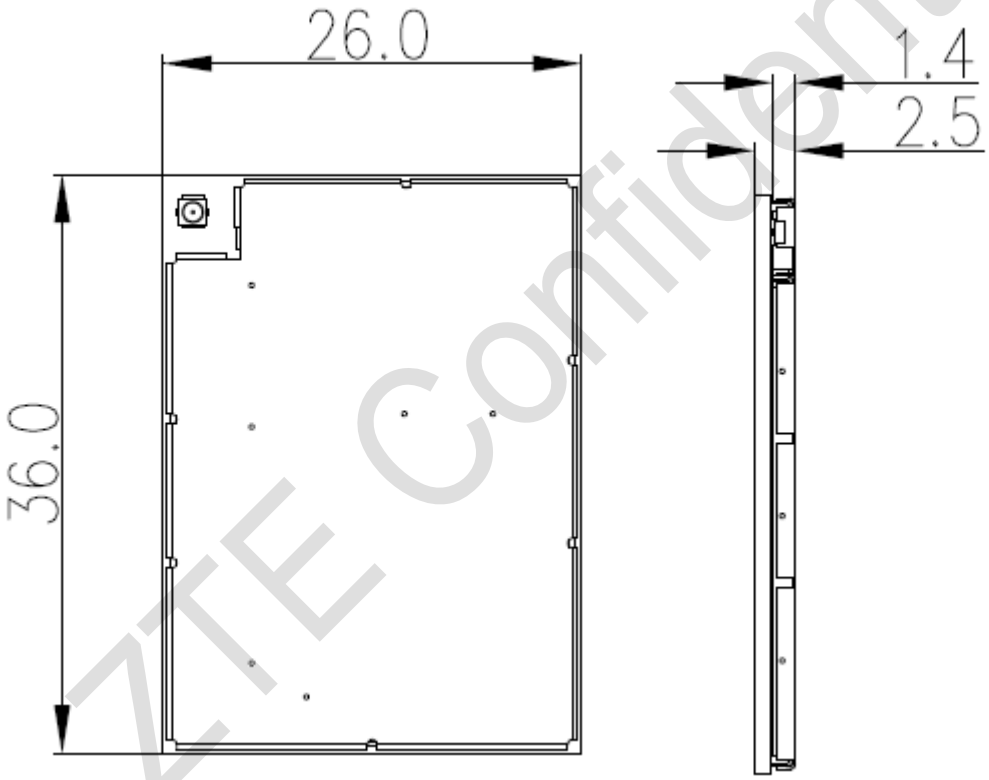
Figure 2–1 Product Illustration

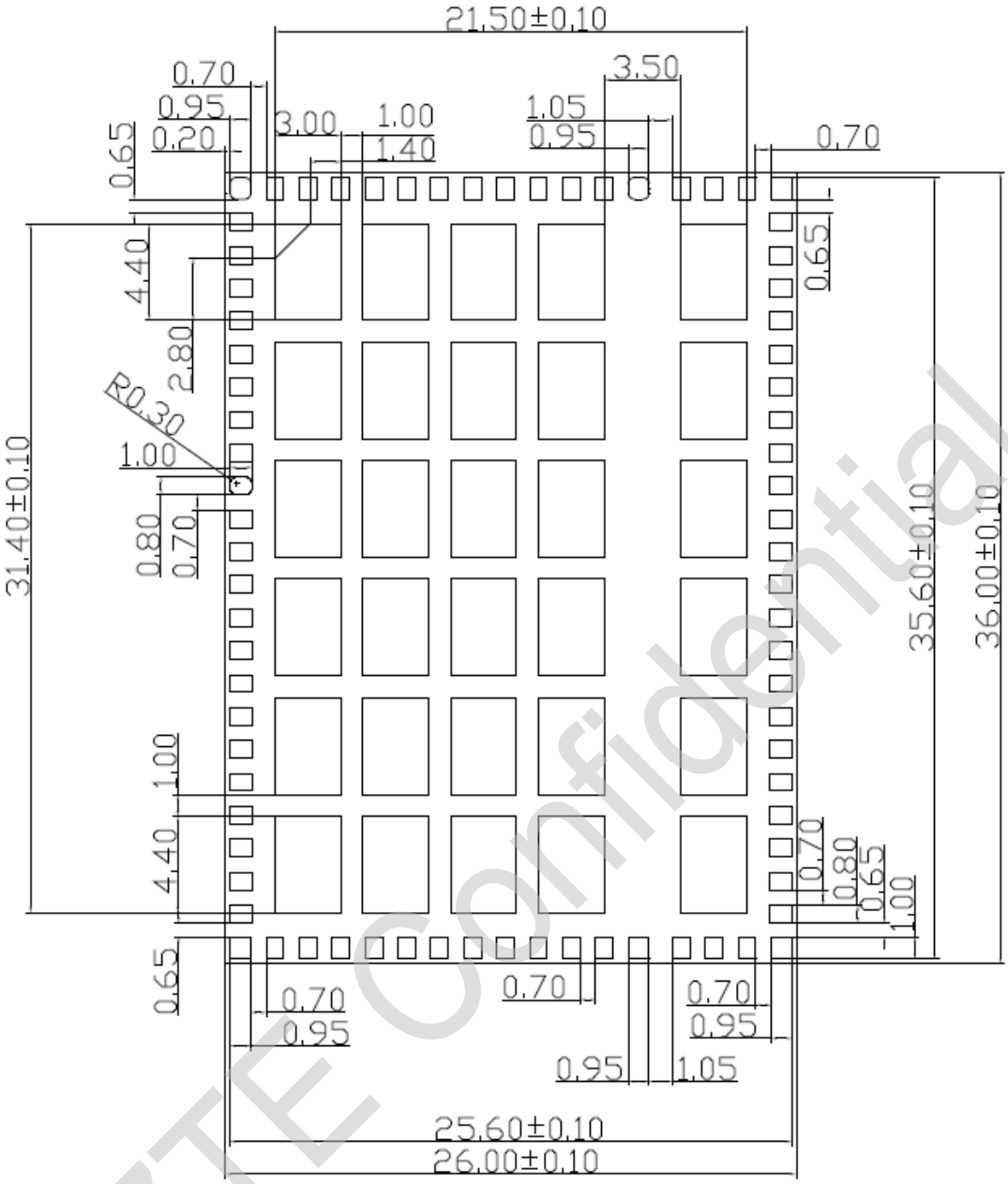
Note: The figures above are just for reference.

2.1 Mechanic Features

MF206A is a 108-pin LGA encapsulation module. Except for the signal PIN, there are many dedicated heat-dissipation ground wielding panel to improve the grounding performance, mechanical strength and heat-dissipation performance. There are altogether 30 heat-dissipation ground wielding panels, evenly distributed at the bottom of PCB. The dimensions of 108-pin LGA encapsulation are 26*36mm, and the height is 2.5+/-0.2mm. The location of PIN 1 is identified by the ground wielding panel with an inclination at the bottom, and its angle orientates to the top welding panel of the corresponding module. Figure 2–2 is a figure about the dimensions of module, and the unit of dimensions is mm.

Figure 2–2 Module Dimensions





(Top View)

2.2 Technical Parameters

The major features of module can be described from the aspects of mechanic feature, base band, radio frequency, technical standard and environment feature. Table 2-1 is a list of the major technical parameters and features supported by module.

Table 2–1 Major Technical Parameters

Name	Item	Specifications	
Mechanical Feature	Dimensions	36mm * 26mm * (2.5+/-0.2)mm	
	Weight	About 5.5g	
	Encapsulation type	LGA package(108 Pin)	
Baseband	Processor architecture	ARM 9 architecture	
	(U)SIM/SIM	Standard 6 PIN SIM card interface Support 3V SIM card and 1.8V SIM card	
	Memory	32MByte NAND Flash/128MByte DDR	
	USB interface	USB 2.0 HIGH SPEED, the data transfer rate can reach up to 480 Mbps. Can be used for AT command communication, data transmission, GNSS NMEA output, software debug and firmware upgrade	
	UART interface	Used for AT command, data transmission or Diag service And can be switch by the command of +UART	
	Maximum power consumption	2.2W note1	
	Power Supply	The range of voltage supply is 3. 4V-4.2V, and the typical value is3.8V	
	Working current note2	Peak current	≤2A (3.8V)
		Average normal working current	≤500mA (3.8V)
		Average normal working current (without services)	≤75mA
		Standby current	≤5mA (3.8V)
RF	GSM band	EDGE/GPRS/GSM Quad-band: GSM850, EGSM900, DCS1800, PCS1900.	
	UMTS band	UMTS: 2100/1900/850(900)MHz	
	RxDiv band	NA note3	
	Max. Transmitter Power	UMTS2100/1900/850(900): Power Class 3 (+24 +1/-3dBm) GSM/GPRS 850MHz/900MHz: Power Class 4 (+33±2dBm) GSM/GPRS 1800MHz/1900MHz: Power Class 1 (+30±2dBm) EDGE 850MHz/900MHz: Power Class E2 (+27±3dBm) EDGE 1800MHz/1900MHz: Power Class E2 (+26 -4/+3dBm)	
	Receiving sensitivity	WCDMA2100: ≤-106.7dBm WCDMA1900/850: ≤-104.7dBm	

Name	Item	Specifications
		WCDMA900: ≤-103.7dBm GSM850/900/1800/1900: ≤-102dBm
	Main antenna interface	Support
	Receive diversity (GPS) antenna interface	Support the GPS wielding panel interface, don't support the diversity antenna interface .We don't provide the antenna, and the antenna is provided by the third party.
Technical Standard	Data rate	GSM CS: UL 9.6kbps/DL 9.6kbps GPRS: Multi-slot Class 10 EDGE: Multi-slot Class 12 WCDMA CS: UL 64kbps/DL 64kbps WCDMA PS: UL 384kbps/DL 384kbps HSDPA: DL 3.6Mbps
	GPRS type	Class B
	3GPP protocol	R99,R5
	Other protocols	Support embedded TCP /UDP protocols Support PPP protocol Support the protocols PAP (Password Authentication Protocol) and CHAP (Challenge Handshake Authentication Protocol) usually used for PPP connections.
	Operating system	Windows XP (SP2 and later)
		Windows Vista
		Windows 7
		WinCE5.0/6.0 (X86 and ARM)
		Linux
		Android 2.x / 4.x
Environment Feature note4	Normal Working Temperature	-30 to 75 °C
	Storage Temperature	-45 to 90 °C
	Humidity	5%~ 95%
Application	RAS dialup	Support
	GPS/AGPS	Support
	SMS	Support Text and PDU mode. Point to point MO and MT. SMS Status Report & SMS centre address setting

Name	Item	Specifications
		Management of SMS: read, write, send, receive, delete, storage status, SMS list, new SMS alert
	Network locking	Support
	SIM READER	Support
	AT Commands	Compliant with 3GPP TS 27.007, 27.005 and ZTEWelink AT commands.
	Upgrading	Support, the time of upgrading is less than 12min.

NOTE:

1: Test condition: The maximum power consumption of the module refers to the average value measured under the maximum transmission power;

2: In the working current, the peak current, average normal working current, average normal working current (without services) are all the maximum value measured under the maximum power consumption. The standby current refers to the current under the SLEEP mode

3: NA means unrelated.

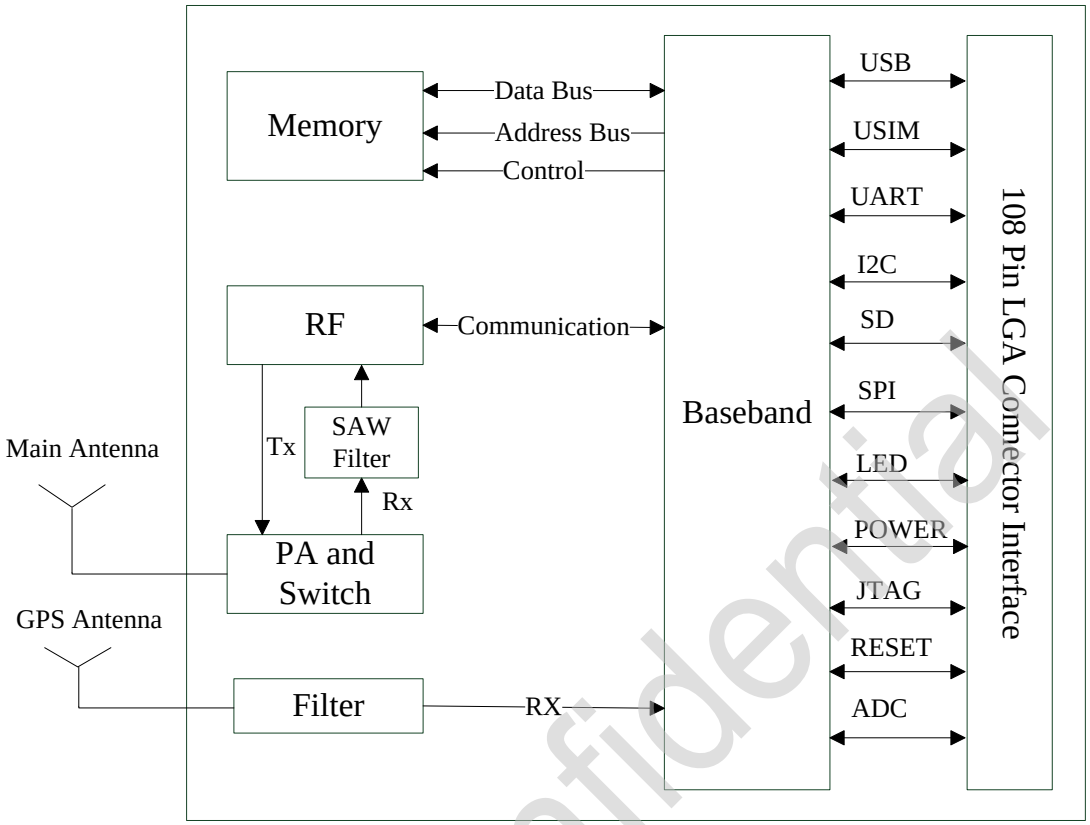
4: Using the module beyond these conditions may result in permanent damage to the module.

2.3 Function Overview

2.3.1 Baseband Function

The baseband part of module mainly includes the following signal groups: USB signal, (U)SIM card signal, wakeup signal, working status indicator signal, UART signal, SD interface signal, I2C interface signal, module power-on/resetting signal, SPI, main antenna interface, GPS antenna interface and power-supply interface. Figure 2–3 is a diagram of the system connection structure.

Figure 2–3 System Connection Structure



2.3.2 Radio Frequency Function

The radio frequency function of module can be viewed from the aspect of over-the-air wireless bearer network, frequency band, whether the receive diversity feature is supported, and the GPS function.

1. Support UMTS 850(900)/1900/2100MHz;
2. Support GSM/EDGE/GPRS 850/900/1800/1900 MHz;
3. Support GPS/AGPS;

The working frequency band of module is as shown in Table 2–2.

Table 2–2 Working Frequency Band

Working Frequency Band	Uplink Frequency Band	Downlink Frequency Band
UMTS850	824 MHz — 849 MHz	869 MHz — 894 MHz
UMTS900	880 MHz — 915 MHz	925 MHz — 960 MHz

UMTS1900	1850 MHz — 1910 MHz	1930 MHz — 1990 MHz
UMTS2100	1920 MHz — 1980 MHz	2110 MHz — 2170 MHz
GSM850	824 MHz — 849MHz	869 MHz — 894 MHz
GSM900	890 MHz — 915MHz	935 MHz — 960MHz
GSM1800	1710 MHz — 1785MHz	1805 MHz — 1880MHz
GSM1900	1850 MHz — 1910MHz	1930 MHz — 1990MHz

3 Interfaces

3.1 Definition of PINs

3.1.1 Definition of PIN I/O Parameters

The definition of module I/O parameter is as shown in Table 3–1.

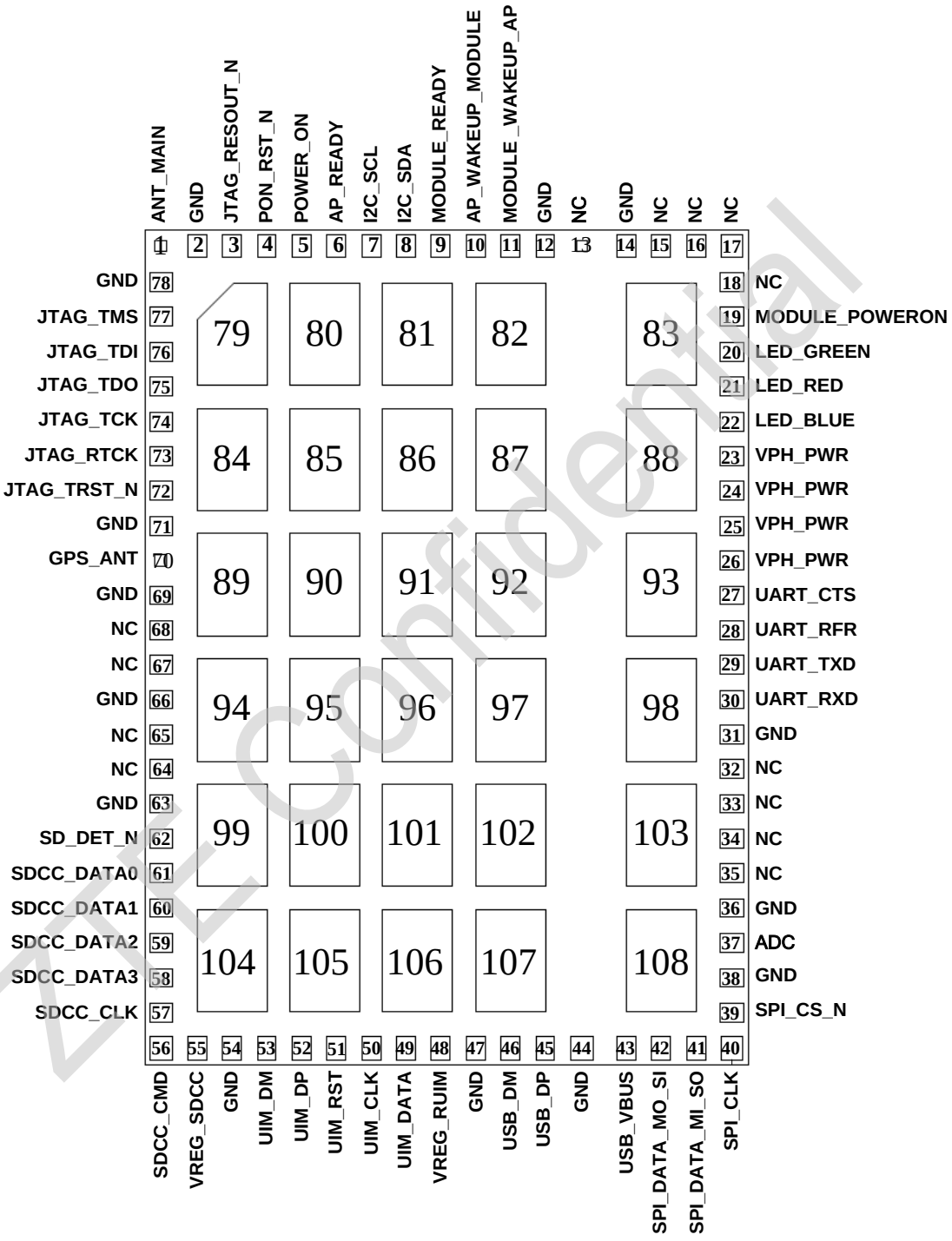
Table 3–1 PIN Parameters

PIN Attribute	Description
DI	Digital Input Pin
DO	Digital Output Pin
AI	Analog Input Pin
AO	Analog Output Pin
B	Two-way digital port, CMOS input
Z	High-resistance output
P1	PIN group 1, the power supply voltage is VDD_P1
P2	PIN group 2, the power supply voltage is VDD_P2
PU	PIN internal pull-up
PD	PIN internal pull-down

3.1.2 PIN Configuration Diagram

The PIN sequence of interfaces on module is defined as shown in Figure 3–1.

Figure 3–1 PIN Configuration Diagram



(Top View)

3.1.3 PIN Description

Table 3–2 PIN Interface Definition

PIN	Signal Definition	Voltage	I/O	PIN Attribute	PU/PD	Remark
1	ANT_MAIN	--	AI/ AO	Main antenna feedback point(50 ohm)	--	
2	GND	--	--	Ground	--	
3	JTAG_RESOUT_N	P1	DI	JTAG reset LGA module	--	
4	PON_RST_N	P1	DI	Reset the module	--	Pull-up to 1.8V internally. Active low.
5	POWER_ON	P1	DI	Turn on/off the module.	PU	Pull-up to 1.8V internally.
6	AP_READY	P1	DI	Module queries AP sleep status	--	
7	I2C_SCL	P1	B	I2C serial clock	--	
8	I2C_SDA	P1	B	I2C serial data	--	
9	MODULE_READY	P1	DO	AP queries Module sleep status	--	
10	AP_WAKEUP_MODULE	P1	DI	AP wakes up Module	--	Low-power level wakeup. To make the module standby, the AP needs to raise up this low signal.
11	MODULE _WAKEUP_AP	P1	DO	Module wakes up AP	--	
12	GND	--	--	--	--	
13	NC	--	--	--	--	--
14	GND	--	--	--	--	
15	NC	--	--	--	--	--
16	NC	--	--	--	--	--
17	NC	--	--	--	--	--
18	NC	--	--	--	--	--
19	MODULE_POWERON	P1	DO	MODULE power-on status indicator	--	
20	LED_GREEN	P1	AO	Signal indicator interface	--	high-current driver.

PIN	Signal Definition	Voltage	I/O	PIN Attribute	PU/PD	Remark
21	LED_RED	P1	AO	Signal indicator interface	--	high-current driver.
22	LED_BLUE	P1	AO	Signal indicator interface	--	high-current driver.
23	VPH_PWR	Vmax = 4.2V Vmin = 3.4V Vnorm = 3.8V	AI	Power supply	--	It must be able to provide sufficient current in a transmitting burst which typically rises to 2.0A.
24	VPH_PWR				--	
25	VPH_PWR				--	
26	VPH_PWR				--	
27	UART_CTS	P1	DI(HV)	UART clear to send signal	--	--
28	UART_RFR	P1	DO	UART ready for receive signal	--	--
29	UART_TXD	P1	DO	UART transmit data output	--	--
30	UART_RXD	P1	DI	UART receive data input	--	--
31	GND	--	--	Ground	--	--
32	NC	--	--	--	--	--
33	NC	--	--	--	--	--
34	NC	--	--	--	--	--
35	NC	--	--	--	--	--
36	GND	--	--	Ground	--	--
37	ADC	--	AI	Analog / Digital converter input	--	--
38	GND	--	--	Ground	--	--
39	SPI_CS_N	P1	DO	SPI interface channel signal	--	--
40	SPI_CLK	P1	DO	SPI clock signal	--	--
41	SPI_DATA_MI_SO	P1	B	SPI data IO signal	--	--
42	SPI_DATA_MO_SI	P1	B	SPI data IO signal	--	--
43	USB_VBUS	--	AI	Power sense for the internal USB	--	Pay attention to the power-on sequence of

PIN	Signal Definition	Voltage	I/O	PIN Attribute	PU/PD	Remark
				transceiver		VPH_PWR
44	GND	--	--	Ground	--	--
45	USB_DP	--	AI/ AO	USB differential data (+)	--	Require differential impedance of 90Ω.
46	USB_DM	--	AI/ AO	USB differential data (-)	--	Require differential impedance of 90Ω.
47	GND	--	--	Ground	--	--
48	VREG_RUIM	P1/ P2	AO	Power supply for USIM card.	--	--
49	UIM_DATA	P1/ P2	B	Data signal of USIM card.	--	--
50	UIM_CLK	P1/ P2	DO	Clock signal of USIM card.	--	--
51	UIM_RST	P1/ P2	DO	Reset signal of USIM card.	--	--
52	UIM_DP	P1/ P2	AI/ AO	Data plus line	--	--
53	UIM_DM	P1/ P2	AI/ AO	Data minus line	--	--
54	GND	--	--	Ground	--	--
55	VREG_SDCC	P2	AO	Power supply for SD card.	--	--
56	SDCC_CMD	P2	B	SD card control signal	HV	--
57	SDCC_CLK	P2	DO	SD card clock signal	--	--
58	SDCC_DATA3	P2	B	SD card data signal	--	--
59	SDCC_DATA2	P2	B	SD card data signal	--	--
60	SDCC_DATA1	P2	B	SD card data signal	--	--
61	SDCC_DATA0	P2	B	SD card data signal	--	--
62	SD_DET_N	--	--	NC	--	Reserved
63	GND	--	--	Ground	--	--
64	NC	--	--	--	--	--
65	NC	--	--	--	--	--
66	GND	--	--	Ground	--	--
67	NC	--	--	--	--	--

PIN	Signal Definition	Voltage	I/O	PIN Attribute	PU/PD	Remark
68	NC	--	--	--	--	--
69	GND	--	--	Ground	--	--
70	GPS_ANT	--	--	GPS antenna	--	--
71	GND	--	--	Ground	--	--
72	JTAG_TRST_N	P1	DI	JTAG reset	PD	--
73	JTAG_RTCK	P1	DO	JTAG return clock	--	--
74	JTAG_TCK	P1	DI	JTAG clock input	-PU	--
75	JTAG_TDO	P1	Z	JTAG test data output	--	--
76	JTAG_TDI	P1	DI	JTAG test data input	PU	--
77	JTAG_TMS	P1	DI	JTAG test mode select	PU	--
78	GND	--	--	Ground	--	--
79.-108.	GND	--	--	Heat-dissipation welder	--	--

NOTE:

"NC" indicates Not Connected internal. That is, there is no connection inside the module. P1 and P2 refer to the power-supply signal level group 1 and 2.

If not used, almost all pins should be left disconnected. The only exceptions are the following pins as shown in the Table 3-3 below:

Table 3–3 Mandatory Pins of Module

PIN	Signal Definition	Remark
1	ANT_MAIN	
5	POWER_ON	Pull-up to 1.8V internally.
23	VPH_PWR	It must be able to provide sufficient current in a transmitting burst which typically rises to 2.0A.
43	USB_VBUS	
45	USB_DP	Require differential impedance of 90Ω.
46	USB_DM	Require differential impedance of 90Ω.
48	VREG_RUIM	
49	UIM_DATA	

50	UIM_CLK	
51	UIM_RST	
2/12/14/31/36/38/44/47/54/63/66/69/71/78	GND	
79.-108.	GND	

3.2 Working Condition

Table 3–4 Working Condition

Signal	Description	Min	Typical	Max	Unit
VPH_PWR	Main power supply of the module	3.4	3.8	4.2	V
USB_VBUS	Power supply PIN of USB PHY	3.3	5	5.25	V
ADC	Analog input	0	--	2.2	V
VDD_P1	Voltage of PIN group P1	1.65	1.8	1.95	V
VDD_P2	Voltage of PIN group P2	2.7	2.85	3	V

NOTE:

1. The typical voltage refers to the default I/O voltage of P1 and P2 PIN group. It is required that the external input PIN provides this voltage.

2. The voltage design of external circuit interfaces should match that of the module PINs.

3. When VPH_PWR works within the voltage range, it can reach good whole-set performance. If it is lower than the minimum value, the whole-set performance will be affected, or the module cannot work normally. If it is higher than the maximum value, the module might be damaged

3.3 Feature of Digital Power Level

Table 3–5 Power Level Range of Digital Signal

Parameter	Description	Min	Max	Unit
VIH	High level of input voltage	0.65*VDD_PX	VDD_PX+0.3	V
VIL	Low level of input voltage	-0.3	0.35* VDD_PX	V
VOH	High level of output voltage	VDD_PX-0.45	VDD_PX	V
VOL	Low level of output voltage	0	0.45	V

3.4 Power Interface

3.4.1 Description of Power PINs

Power VPH_PWR signal (PIN No: 23-26). This is the positive signal of 3.8V power supply.

GND signal (PIN No: 2/12/14/31/36/38/44/47/54/63/66/69/71/78). This is the power ground and signal ground of module, which needs to be connected to the ground on the system board. If the GND signal is not connected completely, the performance of module will be affected. Besides, there are altogether 30 heat-dissipation wielding panel with PIN No. 79-108.

3.4.2 Requirement of Power Supply

The power supply is recommended to be within the range of 3.4~4.2V. If the network is in poor situation, the antenna will transmit at the maximum power, and the transient maximum peak current under 2G mode can reach as high as 2A. So the power supply capacity for peak current needs to be above 2.5A, and the average current needs to be above 2A.

NOTE:

More details about the designing of power supply please refer to Chapter 4 of Power Interface Design Guideline of this document.

3.5 (U)SIM Card Interface

3.5.1 Description of PINs

Module baseband processor integrates the (U)SIM card interface in compliance with ISO 7816-3 standards, and supports to automatically detect 3.0V/1.8V (U)SIM cards. The signals on SIM card interface is as shown in Table 3-6.;

Table 3–6 Definition & Description of (U)SIM Card Signal Group

PIN No.	Pin Name	Signal Definition	Signal Description
48	VREG_RSIM	Power supply for USIM card.	Output range: 1.5-3.0V
49	UIM_RST	Reset signal of USIM card.	UIM card reset signal, output from the module
50	UIM_DATA	Data signal of USIM card.	--
51	UIM_CLK	Clock signal of USIM card.	--
52	UIM_DP	Data cable	USIM card data signal, applied on a large-capacity SIM card
53	UIM_DM	Data cable	USIM card data signal, applied on a large-capacity SIM card

3.5.2 Electric Feature

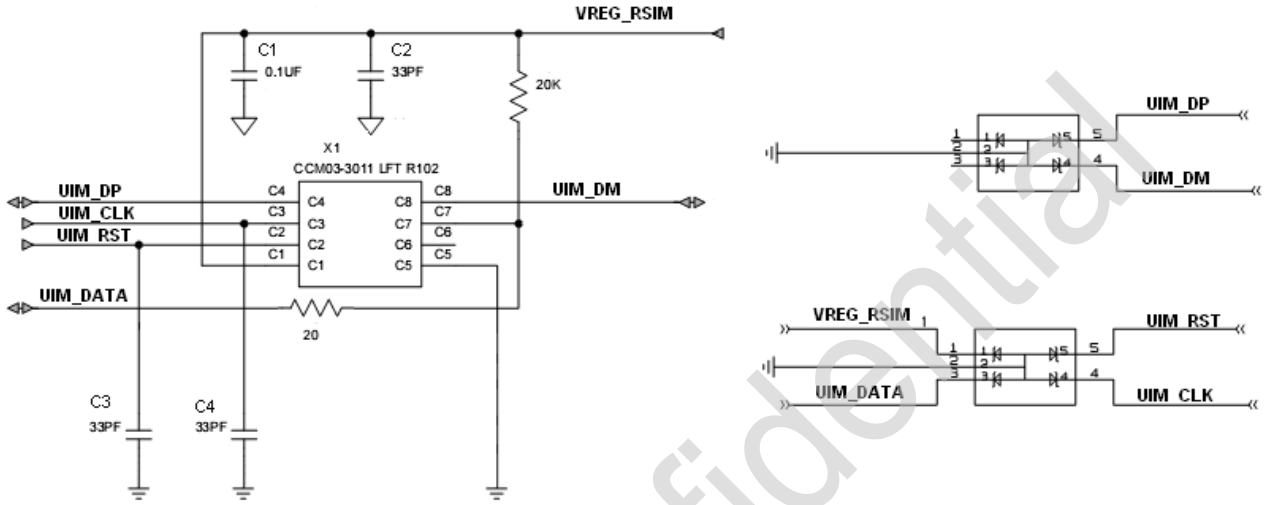
On the line close to the (U)SIM card console, be sure to add the ESD circuit protection during the design.

To comply with the requirements of 3GPP TS 51.010-1 and EMC authentication, it is recommended to place (U)SIM card console close to the (U)SIM card interface, to prevent the wiring from being too long, which might seriously distort the waveform and thus affect the signal integrity. It is recommended to make the grounding protection for UIM_CLK and UIM_DATA signal wiring. Cascade one 0.1μ F and 33pF capacitor between VREG_RSIM and GND, and cascade a 33pF capacitor between UIM_CLK, UIM_RST and GND, to filter out the interference by RF signals. It is recommended to cascade a 20ohm resistance on UIM_DATA cable.

3.5.3 Application of (U)SIM Card Interface

The following Figure 3-2 shows the reference design of the USIM card.

Figure 3–2 (U)SIM Card Signal Connection Circuit



3.6 SD Card Interface

3.6.1 Description of PINs

The SD card interface of module is the storage card based on FLASH, embedded with 4-bit and 1-bit SD controller, supporting SD and Mini SD cards. Its PIN signals are as shown in Table 3-7.

Table 3–7 Definition of SD Card Signal Interface

PIN No.	Pin Name	Signal Definition	Signal Description
61	SDCC_DATA0	SD card data cable PIN	SD card data cable
60	SDCC_DATA1	SD card data cable PIN	
59	SDCC_DATA2	SD card data cable PIN	
58	SDCC_DATA3	SD card data cable PIN	
57	SDCC_CLK	SD card clock cable PIN	SD control clock output can reach up to 20MHz
56	SDCC_CMD	SD card control PIN	--

55	VREG_MMC	SD card power	3V

3.6.2 Electric Feature

SDCC_CLK: Clock signal, host2device, default is 0~25MHz.

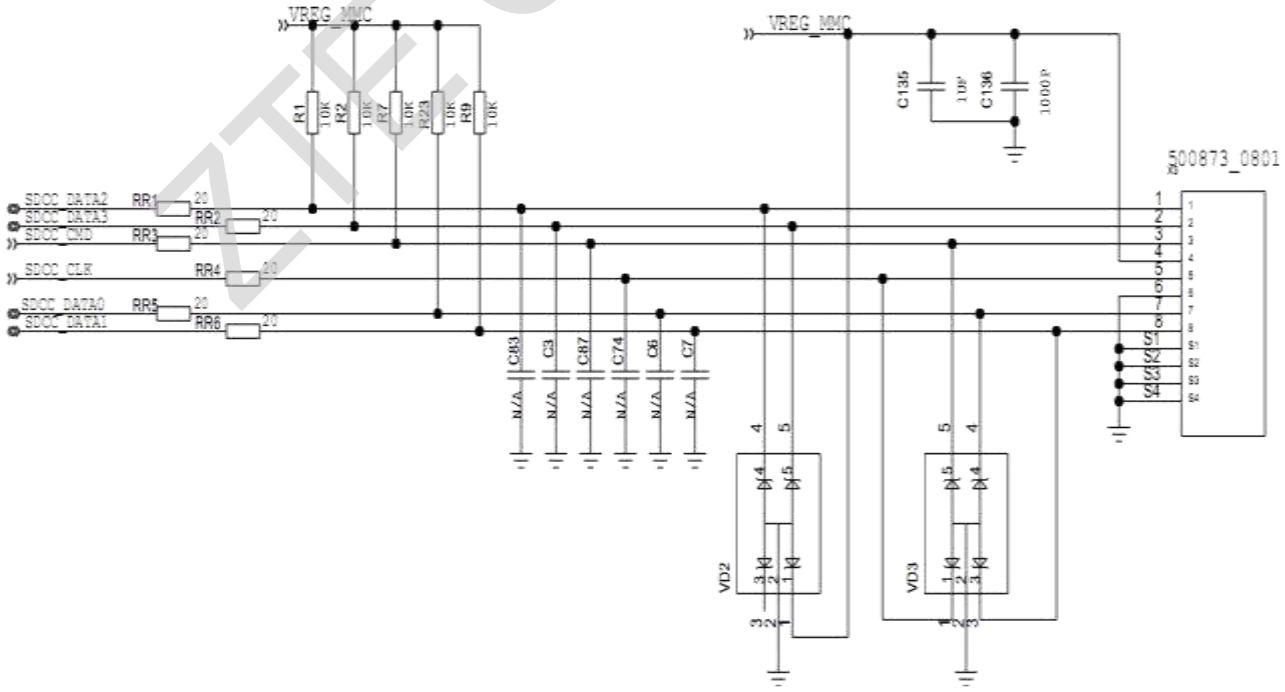
SDCC_CMD: Command/response, two-way: the command can be sent from the host to a single card/all cards, the response is sent from a single card/all cards to the host.

SDCC_DATA[3..0]: Data cable, two-way, default is 0~12.5MB/sec.

3.6.3 Application of SD Card Interface

Figure 3–3 is the reference design diagram for the SD interface. The detection of SD card adopts the polling mode of DATA3 signal cable to judge whether T card is inserted or not.

Figure 3–3 SD Typical Application Circuit



3.7 USB2.0 Interface

3.7.1 Description of PINs

MF206A has the high-speed USB2.0 interface, which supports both the full-speed mode and the high-speed mode. The main processor (AP) is connected with the module via the USB interface to transmit data.

3.7.2 Electric Feature

The USB interface complies with the USB2.0 specifications and the electric features. USB_DP, USB_DM are wired strictly according to the differential mode, and the length difference between the two cables should be restricted within 1mm.

NOTE:

NOTE: If the users of module need the wakeup and sleep function, and your AP side connects with the module through USB interface, the AP side needs to support USB suspend and resume to realize this function.

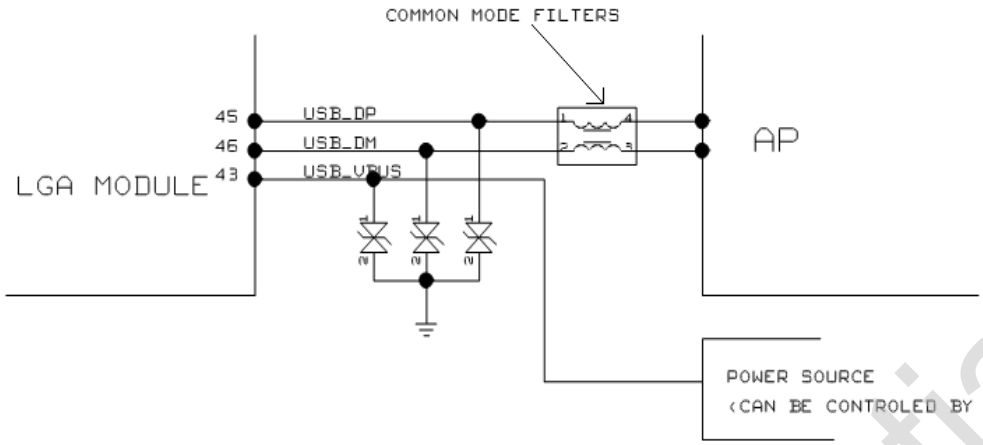
The differential impedance should be controlled within 90ohm.

It is recommended to connect to a high-speed common-mode echo filter on the USB differential signal wire. If the cable is exposed to the external environment, it is suggested to add an ESD protection device. The power capacity of the ESD protection device should be kept within 1.5pF.

3.7.3 Application of USB Interface

The USB bus is mainly used in data transmission, software upgrading and modular program detection. Figure 3–4 shows a reference circuit design.

Figure 3–4 USB Typical Circuit Application



3.8 SPI (Serial Peripheral Interface) Bus Interface

3.8.1 Description of PINs

The definition of SPI interface signaling is defined as shown in Table 3-8.

Table 3–8 Definition of SPI Signal

PIN No.	Pin Name	I/O Type	Signal Description
39	SPI_ CS_N	O	SPI segment
40	SPI_ CLK	O	SPI clock
41	SPI_MISO_DATA	B	Main input, slave output
42	SPI_MOSI_DATA	B	Main input, slave output

3.8.2 Electric Feature

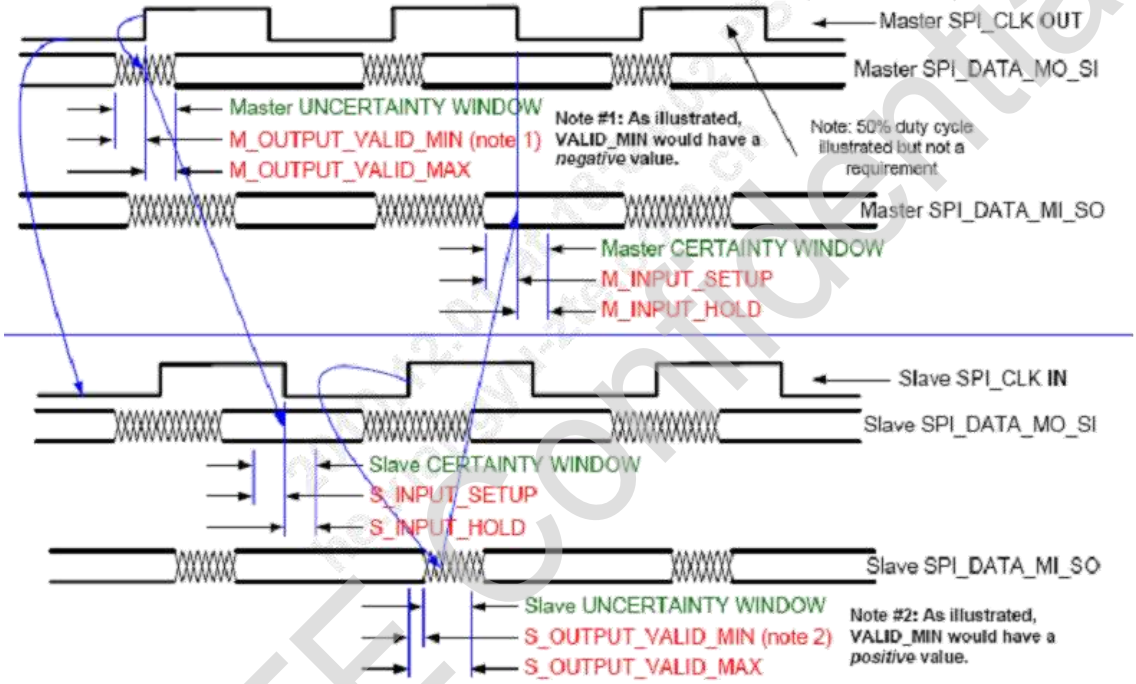
The SPI bus is configured as the master equipment, and there are three modes for SPI:

Running mode: Basic running mode.

Waiting mode: The waiting mode of SPI is a configurable low-power mode, enabled by the byte of the control registered. In the waiting mode, if the waiting byte is cleared, SPI works under the similar running mode. However, if SPI waits for the position byte, SPI clock stops and enters the low-power status.

Stop mode: Under the stop mode, SPI is not available, so the power consumption is reduced. If SPI is configured as the master equipment, any transmission process will be stopped, but it can enter the running mode when the waiting mode stops. Figure 3–5 is the SPI bus sequence chart.

Figure 3–5 SPI Bus Sequence Chart



3.9 I2C Bus

3.9.1 Description of PINs

I2C is the two-wire bus for the communication between ICs, which supports any IC process (NMOS, CMOS, dual-polarity). The two signal wires, serial data (SDA) and serial clock (SCL), can transmit information between the connected equipment. Each equipment is identified by the unique address (such as the micro controller, storage, LCD driver, audio DAC or keyboard interface). Due to the different functions of the equipment, it can be used as both the sender and the receiver.

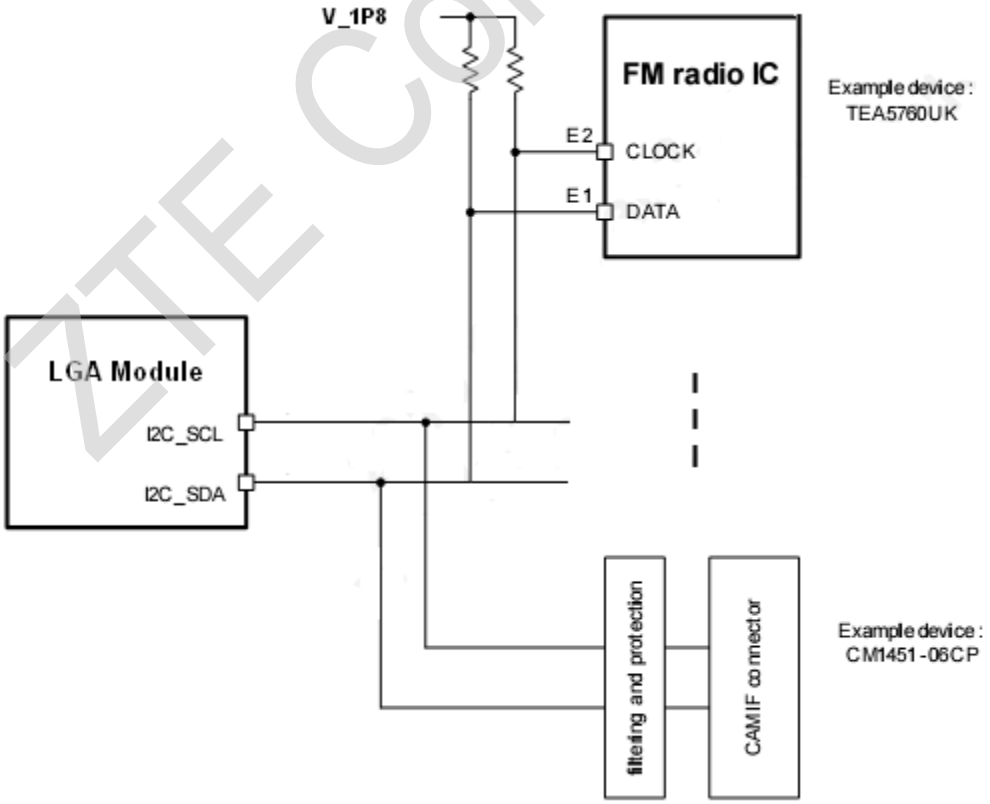
3.9.2 Electric Feature

The I2C interface has the following features:

1. The two-wire bus is used for the communication between ICs.
2. It supports any external equipment of any manufacturing technology (1.8V).
3. It supports the external functions, such as the image sensor, micro controller, FM radio chip, LCD chip, audio DAC and keyboard interface.

The I2C interface has two working modes with different transmission ratios: standard mode with a speed as high as 100kbps; high-speed mode with a speed as high as 400kbps. Figure 3–6 is the I2C reference circuit design diagram.

Figure 3–6 I2C Reference Circuit Diagram



3.10 UART Interface

3.10.1 Description of PINs

Module provides a circuit of serial communication interface UART, which complies with the RS-232 interface protocol, and supports the 4-wires serial bus interface or 2-wires serial interface. Via the UART interface, the module can perform the serial communication and AT instruction interaction with the external.

This UART port supports the programmable data width, programmable data stop digit and programmable odd/even checksum, and has an independent TX and RX FIFOs (512 bytes for each). For the normal UART application (non-Bluetooth), the maximum baud rate is 230400bps, the 4Mbps high baud rate is only used on Bluetooth 2.0 application, and the default baud rate is 115200bps. The PINs are defined as shown in Table 3-9.

Table 3–9 Definition of UART Signal

PIN No.	Pin Name	Signal Definition	Signal Description
27	UART1_CTS	UART clear to send signal	UART power level is 1.8V.
28	UART1_RFR	UART ready for receive signal	
29	UART1_TXD	UART transmit data output	
30	UART1_RXD	UART receive data input	

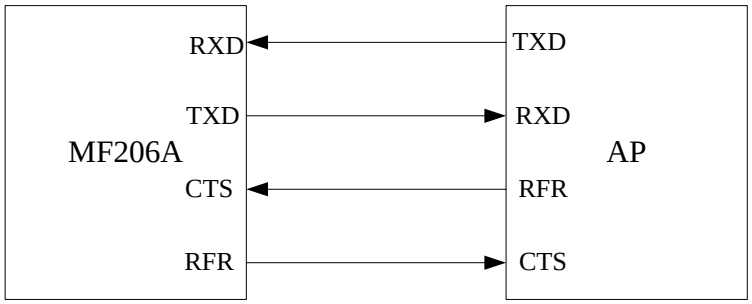
NOTE:

If the users of module need the wakeup and sleep function, and you AP side connects with the module through UART interface, you need to connect the PIN10&PIN11 (AP_WAKEUP_MODULE, MODULE_WAKEUP_AP) to the AP side to realize this function. The details of this two pin you can refer to chapter 3.13.

3.10.2 Electric Feature

During the software interconnection process, there is a method of capturing logs, and it is recommended that this interface be kept during the design and the testing point be reserved. If the module is used together with the application processor, and the PWL matches with 1.8V, the 4-wires connection mode is as shown in Figure 3–7. The 4-wires or 2-wires mode can be used for connection. The module interface PWL is 1.8V. If it does not match the PWL of AP interface, it is recommended to add the PWL conversion circuit.

Figure 3–7 Module Serial Port & AP Application Processor



3.11 JTAG (Joint Test Action Group) Interface

3.11.1 Description of PINs

The JTAG interface complies with the ANSI/ICEEE Std. 1149.1-1990 standard, and the interface is defined as shown in Table 3-10.

Table 3–10 Definition of JTAG Signal

PIN No.	Pin Name	I/O Type	Signal Description
3	JTAG_RESOUT_N	DI	LGA reset
72	JTAG_TRST_N	DI-PD	JTAG reset
73	JTAG_RTCK	DO	JTAG return clock
74	JTAG_TCK	DI-PU	JTAG clock input
75	JTAG_TDO	Z	JTAG test data output
76	JTAG_TDI	DI-PU	JTAG test data input
77	JTAG_TMS	DI-PU	JTAG test mode select
78	GND	--	Grounding

3.11.2 Application of JTAG Interface

On the system board, you need to reserve the testing point or interface of the related JTAG signal, so as to solve the un-repairable fault of LGA module due to emergencies such as downloading interruption.

3.12 Power-on/Power-off & Reset Signal

3.12.1 Description of PINs

To turn on the module the pad POWER_ON must be tied low for at least 0.05 seconds and then released.

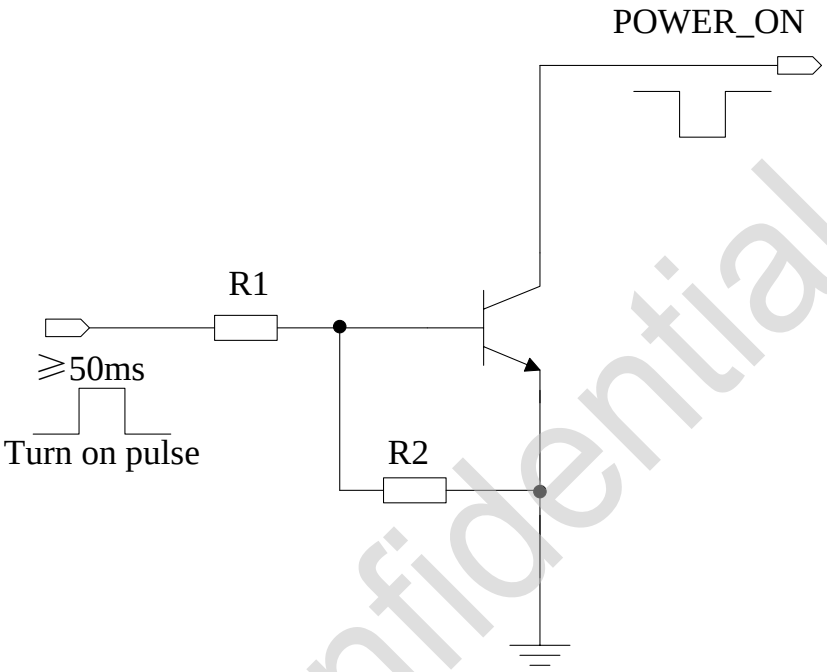
To turn off the module the pad POWER_ON must be tied low for at least 5 seconds and then released.

A simple circuit to do it is as shown in the following Figure 3-9.

NOTE:

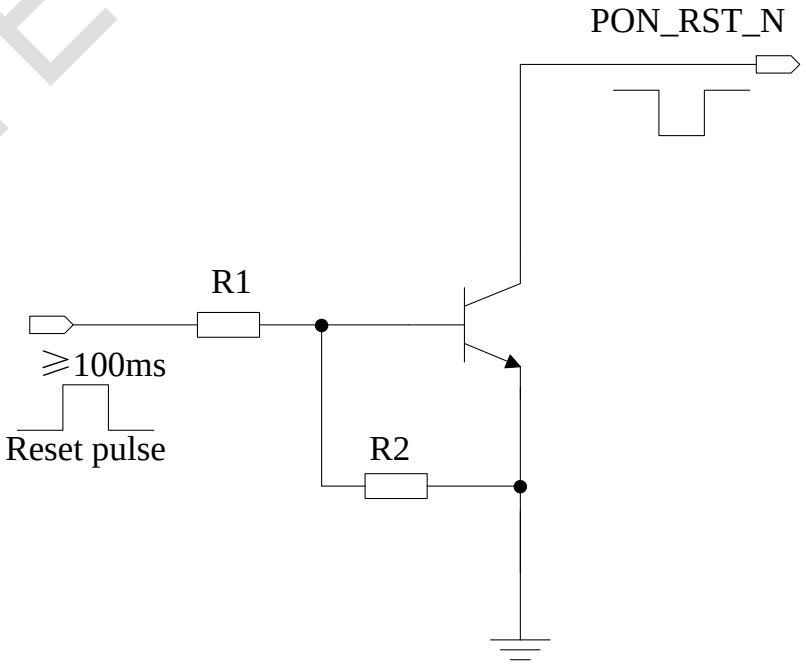
The resistors R1 and R2 in Figure 3-9 and Figure 3-1 are only the recommended value and they may different according to the users transistor selection.

Figure 3–8 Turn on the Module Using Driving Circuit



You can reset the module by driving the PON_RST_N to a low level voltage for more than 100ms and then releasing. A simple circuit to do it is as shown in the following Figure 3-10.

Figure 3–9 Resetting the Module Using Driving Circuit



3.12.2 Power-on/Power-off Flow

To guarantee the user can power on and power off stably, you can refer to the power-on sequence chart as shown in Figure 3-11 and the power-off sequence chart as shown in Figure 3-12. Table 3-11 shows the power-on and resetting time, which needs to be paid attention to during the module power-on process.

1. Once VPH_PWR is powered on, the POWER_ON signal will be synchronized and be established as the high PWL.
2. After VPH_PWR is established normally, the interval between it to the POWER_ON signal cannot be too short. Refer to T2 parameter. ZTEWelink recommends that VPH_PWR adopt the power-off plan that does not disconnect the power supply.
3. The power-on startup time takes the lower level of POWER_ON as the starting point, and POWER_ON needs to be released after being kept on the low PWL for a period.
4. SUB_VBUS is the USB PHY power supply. It is not recommended to be established before VPH_PWR.

During the process of establishing the module PINs, pay attention to the following items:

1. To power off by the POWER_ON signal, the T4 period needs to be designed as required.
2. After VPH_PWR and USB_VBUS are powered off, it is recommended not to disconnect the power supply.

Figure 3–10 Power-on Sequence Chart of Module

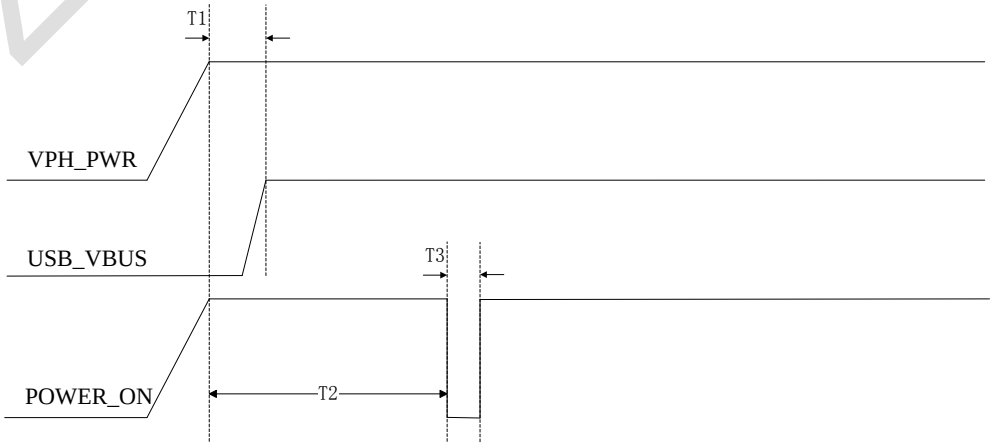


Figure 3–11 Power-off Sequence Chart of Module

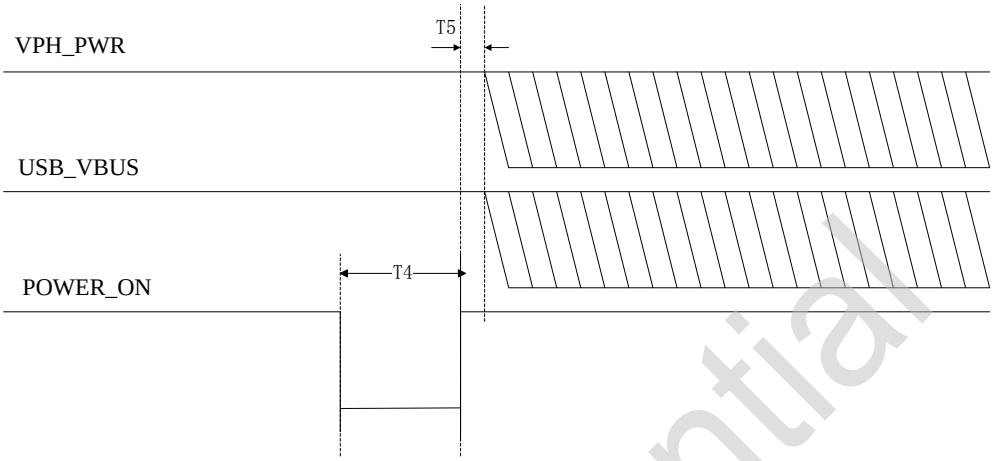


Table 3–11 Power-on/Power-off Time

Parameter	Description	Min	Typical	Max	Unit
T1	From powering on VPH_PWR to establishing USB_VBUS	0	0.5	1	second
T2	From powering on VPH_PWR to Power-on taking effect	1	1.5	--	second
T3	The period that the Power-on signal for power on operation is kept on the low PWL	0.05	0.1	--	second
T4	The period that the Power-on signal for power off operation is kept on the low PWL	4	5	--	second
T5	From the releasing the Power-on button for power off operation to the power off of VPH_PWR and USB_VBUS	1	2	--	second

3.12.3 Resetting Flow

The PON_RST_N reset signal of module is the increasing resetting, so it is reset after decreasing this PIN by 100ms. Figure 3-13 is the module resetting flow. Figure 3-14 is the timing of resetting module.

Figure 3–12 Module Resetting Flow

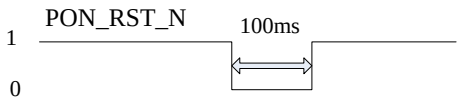
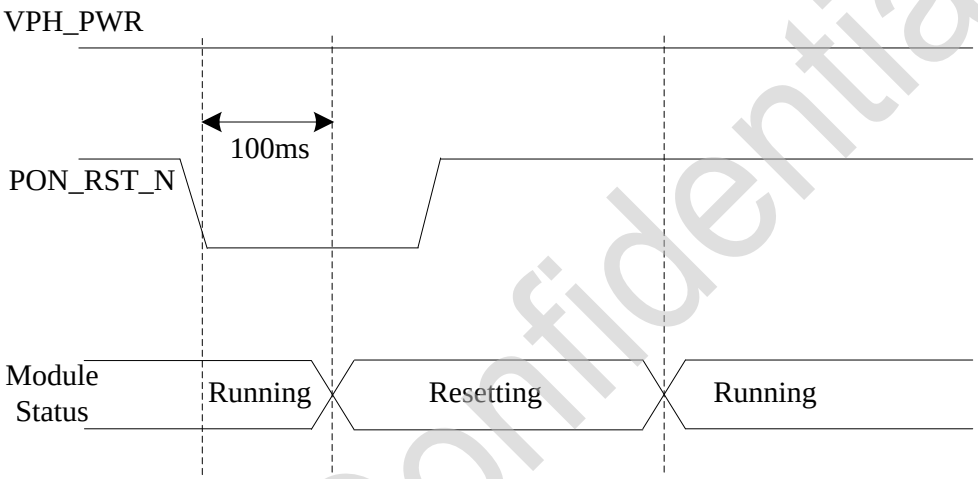


Figure 3–13 Timing of Resetting Module



3.13 Interactive Application Interface

3.13.1 Description of PINs

Table 3-12 mainly describes the interfaces interacting with the application processor, including the following three types of interfaces: querying, wakeup and status indication.

Table 3–12 Interactive Application Interface

PIN No.	Pin Name	I/O Type	Signal Description
6	AP_READY	DI	Module querying AP sleep status
9	MODULE_READY	DO	AP querying Module sleep status
10	AP_WAKEUP_MODULE	DI	AP wakeup Module
11	MODULE_WAKEUP_AP	DO	Module wakeup AP
19	MODULE_POWERON	DO	MODULE power-on status indication

3.13.2 Interface Application

The module provides 5 handshake signals for the communication with the application processor (AP). By MODULE_POWERON, AP can query whether LGA is powered on and is working normally. By MODULE_READY, AP queries whether the LGA module has entered the sleep status, wakes up the module under the sleep status by AP_WAKEUP _MODULE. In the same way, when AP is in the sleep status, the LGA module can query the AP status by AP_READY, and wakes up AP by MODULE _WAKEUP_AP.

AP_READY: Indicates that the AP server is sleep: the high PWL indicates the sleep status, and the low PWL indicates the wakeup status.

MODULE_READY: Indicates that the module is sleep: the high PWL indicates the sleep status, and the low PWL indicates the wakeup status.

AP_WAKEUP_MODULE: After the module has entered the sleep status, the AP server can wake up the module by the low PWL control; if it's always on the low PWL, the module cannot enter the sleep status. After the AP server enters the high PWL, the module enters the sleep status.

MODULE_WAKEUP_AP: After the AP server has entered the sleep status, the module can lower down this signal to wake up the AP server. After the module has queried that the server sleep indicator AP_READY is low, it resets this signal to high.

MODULE_POWERON: After the module is powered on, this signal is set to high, and kept until the system is restarted or powered down. Low signal indicates that the server is not powered on, during the power-on process or is being restarted.

3.14 LED Indicator Interface

3.14.1 Description of PINs

Table 3–13 Definition of LED PIN Signal

PIN	Signal Name	I/O Type	Function
20.	LED_GREEN	AO	Module signal indicator interface
21.	LED_RED	AO	Module signal indicator interface
22.	LED_BLUE	AO	Module signal indicator interface

3.14.2 Interface Application

The LGA module has three PINs to control the LED indicator, which is used to indicate the network connection status. The different modes of status indicator flashing indicate different network statuses. All the three PINs use the current sink type of current source for control, which connects to the negative end of LED and connects to VPH_PWR externally, to directly drive LED. Figure 3-16 is the reference circuit design diagram.

The flashing of indicator is controlled by the switch of RF, and the LED PIN indicates the control signal to the external. The indicator status of network is as defined in Table 3-14. If the RF control is not needed, the AP server can design the status of control indicator by itself.

Figure 3–14 Reference Circuit of Status Indicator

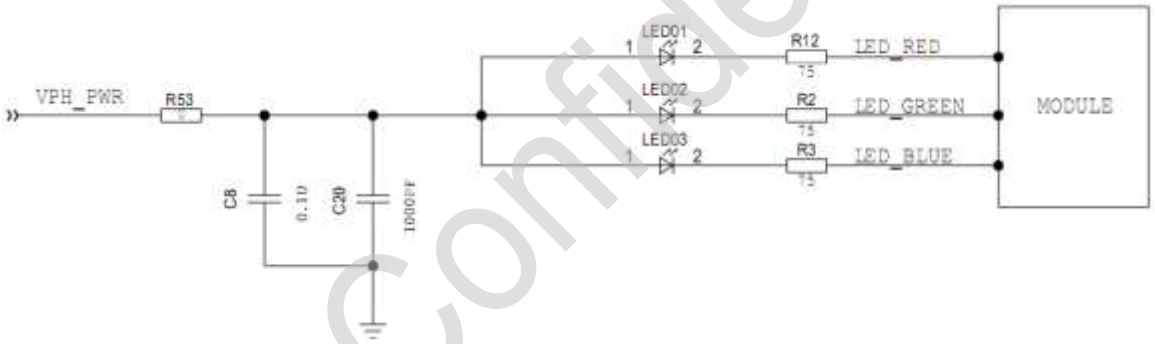


Table 3–14 Definition of Indicator Status

Indicator Status	Module Working Status
RED indicator always on	Not registered to the network
GREEN indicator always on	Have been registered to 2G network
GREEN indicator flashing	Have been registered to 2G network, and there is data service as well.
BLUE indicator always on	Have been registered to 3G network
BLUE indicator flashing	Have been registered to 3G network, and there is data service as well.

4 Power Interface Design Guideline

This chapter provides the power supply requirements, general design rules and Power-on/Power-off/Reset flow of modules. Users can design the power supply of module to achieve stable and well working performance according to this document.

4.1 General Design Rules

When the ZTEWelink module is used for different external applications, pay special attention to the design for the power supply.

In the process of peripheral circuit designing, users of this Module product should ensure that the external power supply circuit is capable of providing sufficient power supply capacity firstly, and control the supply range between 3.4V~4.2V strictly. If the value above module voltage range, it will lead the main chip burned, while below module voltage range, it will affect the RF circuit's work or cause shutdown and restart occurred. For the design of high-speed USB signal lines, it requires to control the differential impedance at 90ohm. The voltage design of external circuit interfaces should match that of the module PINs, and the detailed value can be got in Table 3-2. The module product has a good RF indicator; customers can refer to the Chapter 5 of Antenna Design Guide of Module Product in the process of antenna circuit designing. Otherwise it will affect the whole RF performance.

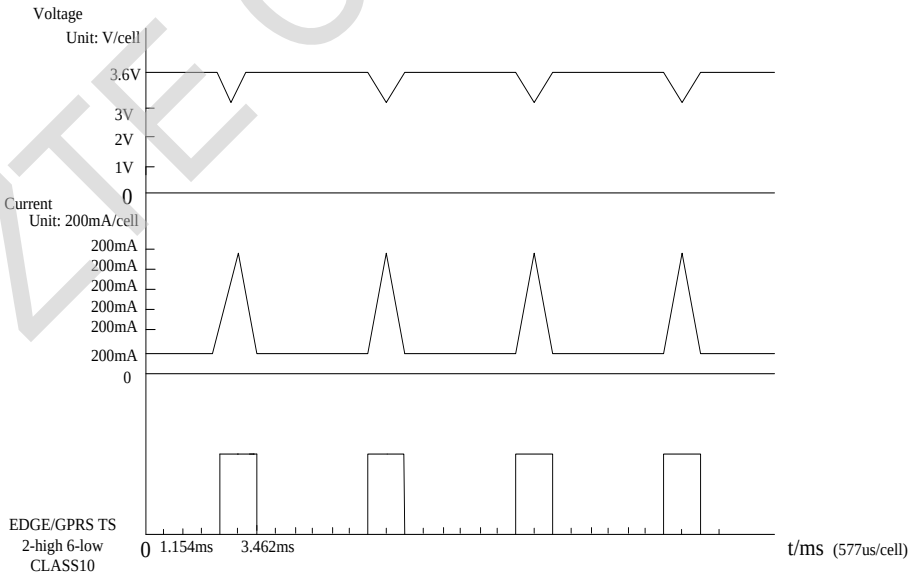
4.2 Power Supply Requirement

The power supply of ZTEWelink LGA Type module is usually recommended to be within the range of 3.4~4.2V. According to the requirement of mobile terminal device, the power supply voltage of module is 3.8V under normal working condition.

In poor situation of the network, the antenna will transmit at the maximum power, and the transient maximum peak current can reach as high as 2A. So the power supply capacity of system board needs to be above 2.5A to satisfy the requirement of module peak current; and the average current on the system side needs to be above 2.0A. Meanwhile, consider the voltage drop of power supply on the side of main board. If the network is in a poor situation or under 2G, the module peak current will be great, Therefore the power supply has to be designed in order to withstand with these current peaks without big voltage drops; this means that both the electrical design and the board layout must be designed for this current flow. If the layout of the PCB is not well designed a strong noise floor is generated on the ground and the supply; and exceptions such as restart of the module may occur.

The peak current of ZTEWelink module under the GSM BURST mode is different due to the differences in actual network environments. And its transient current under different powers will be various as well. The greater the power is, the greater the transient current is. The network quality also directly affects the work current of the module. If the network is in well situation, the peak work current on the module will be small. But if the network is in poor situation, its peak current will be great as shown in Figure 4-1. When ZTEWelink module works under the EDGE/GPRS Time Slot (2-high 6-low) and CLASS 10, if the module works under the 2-high work Time Slot, it requires greater current, and the voltage drop will occur accordingly.

Figure 4–1 Power Supply Current and Voltage Change under EDGE/GPRS

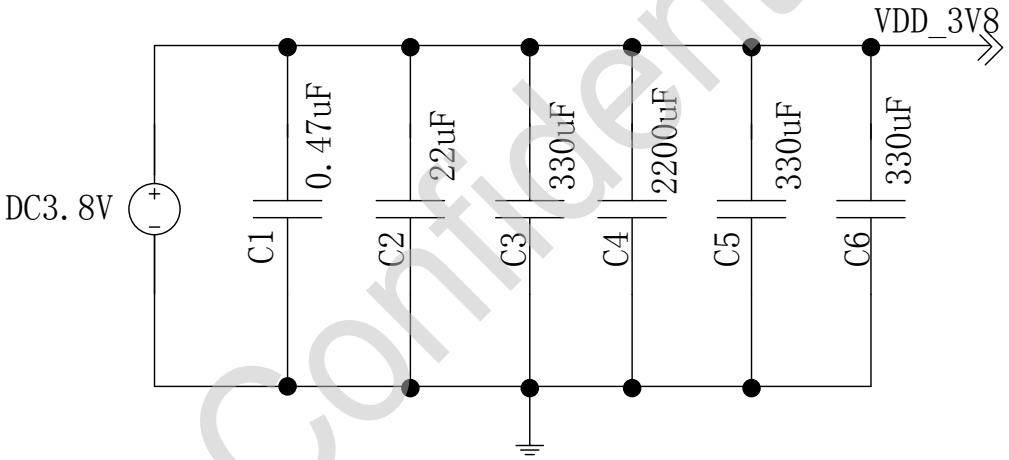


4.3 Circuit Requirements of Power Supply Output

Requirement：

- The power supply capacity of system board needs to be above 2.5A to satisfy the requirement of module peak current;
- The average current on the system side needs to be above 2.0A.
- When designing the PCB line, the power cable on the system board should be thick enough, and should form a good reflux with the ground.
- In the power supply circuit design, the user needs to add the large storage capacitor on the kilo level, to guarantee the transient power supply capability, and to prevent the module from resetting and shutting down caused by voltage fluctuation.

Figure 4–2 Add storage capacitor to Module power supply terminal



Add storage capacitor to Module power supply terminal to ensure the system instantaneous power capacity

4.4 Recommended Power Reference Circuit

Option one:

Use DC\DC switching power supply and large storage capacitor on the kilo level to ensure the normal operation of the RF power amplifier to withstand these current peaks without big voltage drops.

Advantage:

Can provide well transient current under 2G weak signal environment to satisfy modules requirements, to prevent device from shutdown and Ports re-enumeration as a consequence of the supply voltage drop.

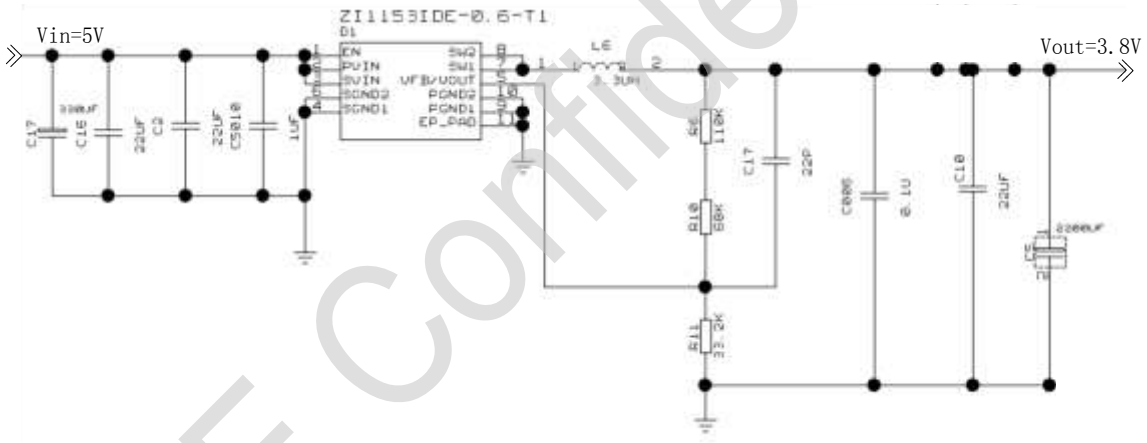
The over-current capability requirement of DC/DC switching power supply need to be above 3A, for example,ZI1153, AAT2138 and so on.

Input voltage range of ZI1153 is: 2.5～5.5V，output voltage range of ZI1153 is from 0.6V to VIN(input voltage).

Input voltage range of AAT2138is: 2.7～5.5V，output voltage range of AAT2138 is from 3.3～5.5V.

As shown in the Figure below, use DC/DC switching power supply ZI1153 as the buck chip. Place a tantalum capacitor of 330μ F at the input of the chip. Place a 2200μ F capacitor or place several 330μ F tantalum capacitors in parallel. This circuit fully meets the module power requirements. (If the user's PCB size is limited, the output of buck chip can place three more 330μ F tantalum capacitors of which the total capacity is more than 1000μ F)

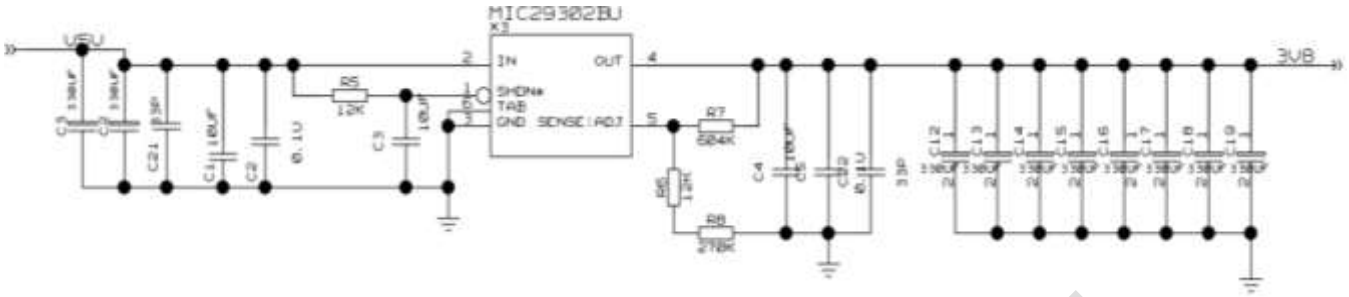
Figure 4–3 DC/DC Switching Power Supply



Option two:

Use LDO as the buck chip. The over-current capability of LDO is above 3A. As the poor transient response of linear regulator, large capacitors should be placed at the input and output of LDO. The output of LDO, place a capacitors above 2000μ F. The reference power supply circuit design with LDO is as shown in Figure below.

Figure 4–4 LDO Power Supply



4.5 PCB Layout Guideline of Power Supply

As seen on the electrical design guidelines the power supply shall have a low ESR capacitor on the output to cut the current peaks and a protection diode on the input to protect the supply from spikes and polarity inversion. The placement of these components is crucial for the correct working of the circuitry. A misplaced component can be useless or can even decrease the power supply performances. The users of ZTEWelink modules should do as the following guidelines in the process of power supply PCB line designing:

The use of a good common ground plane is suggested.

The placement of the power supply on the board should be done in such a way to guarantee that the high current return paths in the ground plane are not overlapped to any noise sensitive circuitry as the microphone amplifier/buffer or earphone amplifier.

The power supply input cables should be kept separate from noise sensitive lines such as microphone/earphone/RF cables.

The Bypass low ESR capacitor must be placed close to the ZTEWelink module power input pads, or in the case the power supply is a switching type it can be placed close to the inductor to cut the ripple provided the PCB trace from the capacitor to the module is wide enough to ensure a dropless connection even during the 2.5A current peaks.

The protection diode must be placed close to the input connector where the power source is drained.

The PCB traces from the input connector to the power regulator IC must be wide enough to ensure no voltage drops occur when the 2.5A current peaks are absorbed. Note that this is not made in order to save power loss but especially to avoid the voltage drops on the power line at the current peaks frequency that will reflect on all the

components connected to that supply, introducing the noise floor at the burst base frequency. For this reason while a voltage drop of 300-400 mV may be acceptable from the power loss point of view, the same voltage drop may not be acceptable from the noise point of view. If your application doesn't have audio interface but only uses the data feature of the ZTEWelink module, then this noise is not so disturbing and power supply layout design can be more forgiving.

The PCB traces to the ZTEWelink module and the Bypass capacitor must be wide enough to ensure no significant voltage drops occur when the 2.5A current peaks are absorbed. This is for the same reason as previous point. Try to keep this trace as short as possible.

The PCB traces connecting the Switching output to the inductor and the switching diode must be kept as short as possible by placing the inductor and the diode very close to the power switching IC (only for switching power supply). This is done in order to reduce the radiated field (noise) at the switching frequency (100-500 kHz usually).

5 RF Antenna Design Guide

The antenna connection and board layout design are the most important aspect in the full product design as they strongly affect the product overall performances, hence read carefully and follow the requirements and the guidelines for a proper design.

5.1 Antenna Types

Antenna types and modes are different according to the different ID designs and circuit layout designs of the product itself. You can choose the antenna type and mode according to the estimation result by antenna engineers.

1. For PAD products, because the product itself has low sections, usually printed antennas are used as the antenna mode (the antenna wiring is printed on a thin PCB board), and IFA plus parasitic units or monopole plus parasitic units are used as the antenna type.

2. For CPE products, because most products of this type have a large size, the available space for antennas is also relative large. Thus, this type of products usually adopts the mode of PC racks plus FPC antennas or PC racks plus bullet antennas. IFA plus parasitic units or monopole plus parasitic units are used as the antenna type.

3. If the product supports external antenna, then switch between the external antenna and internal antenna must be using mechanical switches instead of electronic switches.

5.2 Antenna RF Cable and RF Connector

5.2.1 RF Connector

There are two interfaces on the RF antenna of module: main antenna interface, and GPS antenna. The main antenna supports two access modes of RF signal: by LGA wielding panel mode and by RF connector mode. The GPS antenna only supports the access mode of LGA wielding panel. Figure 5-1 is the main antenna connector

interface, and Figure 5-2 is the Interface of Main Antenna and GPS Antenna Welding Pad. Figure 5-3 shows the main antenna RF connector. Currently, ZTEWelink module adopts the ECT818000157 RF connector testing console from ECT Company.

Figure 5–1 Main Antenna RF Connector Interface

Figure 5–2 Interface of Main Antenna and GPS Antenna Welding Pad

Figure 5–3 RF Interface Testing Console

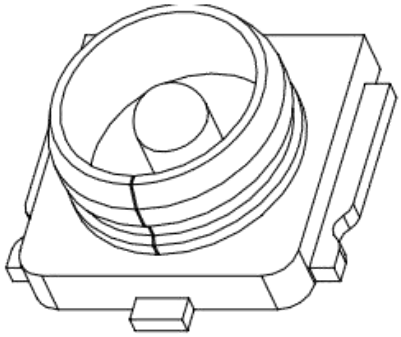
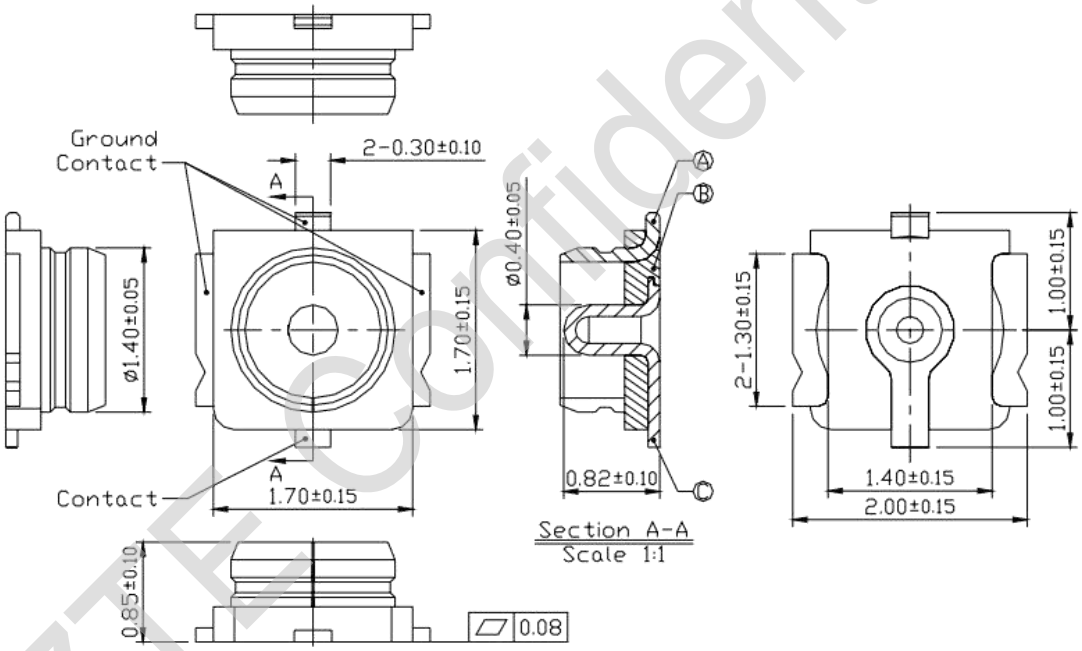


Figure 5–4 Profile Dimensions of RF antenna console



If the main antenna is access by the RF connector, the using of corresponding cables of RF interface are recommended. When this connection mode is adopted, the RF antenna connector can be directly inserted to the RF testing console of the module, so it saves the connection between the RF port and the antenna interface.

If the main antenna is accessed by the LGA wielding panel, the RF main antenna wield pane of the module itself needs to be connected to the antenna interface on main board via the wield pane and micro stripline or stripline. The micro stripline or stripline is designed according to the 50ohm impedance, and the dual-L model matching circuit is reserved.

RF interface on ZTEWelink module is ECT818000157. Because this type of RF interfaces requires RF cables with smaller diameters and larger consumptions, it is usually recommended not to directly connect RF connectors of antenna RF cables with RF interfaces on the module, and it is recommended to convert them into

common interfaces by conversion circuits, such as ECT818000071 of I-PEX and U.FL-R-SMT-1(80) of HIROSE.

The design of GPS antenna is consistent with the main antenna, and its efficiency index is allowed to be 3dB lower. The separation degree between the main antenna and the diversity antenna is required to be greater than 12dB.

5.2.2 RF Cable

If the diameter of RF cables used by the antenna is different, its consumption is also different. During the 2G/3G/LTE communication, usually RF cables with a diameter of 1.37mm or 1.13mm are adopted. It is recommended to select the RF coaxial cable with a diameter of 1.37mm because it has less consumption. There are many manufacturers of RF cables, such as GBE in Taiwan, Shenyu and Yuanda in China mainland, SUMITOMO and Shin Din in Japan. All of these manufacturers provide RF cables of more than two specifications. The following tables describe RF cables of several specifications.

The Standard Value of cable (RF137XR4 of GBE, RF-1.37 of Shenyu, 0.8DS-PBM(1.35) of SUMITOMO) consumption is shown as Table 5-1 below (Unit: dB/m):

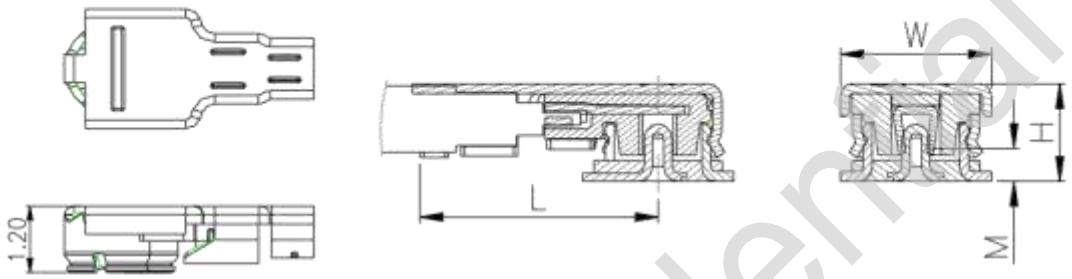
Table 5–1 The Cable Consumption

Frequency	RF137XR4 of GBE	RF-1.37 of Shenyu	0.8DS-PBM(1.35)
0.4GHz	1.0	--	--
0.8GHz	1.5	--	--
1.0GHz	1.6	≤1.7	≤1.5
1.5GHz	2.0	--	--
2.0GHz	2.3	≤2.5	≤2.2
2.4GHz	--	--	≤2.6
3.0GHz	2.9	≤3	≤2.8
4.0GHz	--	≤3.5	≤3.4
5.0GHz	--	≤4	≤3.8
5.2GHz	4.0	--	--
5.8GHz	4.2	--	--
6.0GHz	4.3	≤4.5	≤4.3

Because RF cables used by the antenna inevitably introduce certain loss, it is necessary to consider the wiring length of RF cables during the design of module position and antenna position. It is recommended to control the length within the loss range of 0.5 dB (HF). During the wiring design of antenna RF cables, avoid right angle, pressed and wearing.

The recommended receptacles Mode of ECT 818000157 is ECT 818000160 as shown below:

Figure 5–5 Recommended Receptacles Mode for module



Mating Dimension (mm)				
Item	L	H	W	M
DIA=0.81mm Coaxial Cable Assembly	2.95±0.2	1.5±0.1	2.1±0.2	0.5±0.20

5.3 Design of Antenna

5.3.1 Preliminary Antenna Evaluation

The antenna is a sensitive device and its performance is greatly affected by external environments. The radiation performance of the antenna is affected by the mainboard dimensions, antenna position, occupied space size of the antenna, and the grounding of surrounding components of the antenna. Besides, the fixed assembly of the antenna, the wiring of RF cables on the antenna, and the fixed position of the antenna all affect the radiation performance of the antenna too. Thus, during the preliminary design phase of an antenna, it is critical that antenna engineers, RF engineers, baseband engineers, structure engineers, and ID engineers work together to make an estimation for both 2D and 3D design.

The antenna interface should have an impedance of 50Ω.

5.3.2 Suggested Antenna Location

During the design of the board with ZTEWelink module, the placement of components should be placed properly, and keep the line length as short as possible, thus leading to lowest power losses possible.

Usually, the antenna position is designed according product features and antenna shall not be installed inside metal cases. For example, for Internet laptops and PAD products, the ideal position of antennas is on the top left corner or top right corner of the LCD, which is relatively far from the mainboard, so the electromagnetic interference is relatively small. Besides, because it is far from human bodies, it is easy to satisfy SAR indexes. For PAD products or Internet laptops, the ideal position is where hands rarely touch, so the impact from hand holding is the minimum.

The above example only considers the antenna position area in a specific scenario. For the specific position, it is critical to determine with antenna engineers, RF engineers, baseband engineers, structure engineers, and ID engineers during the 2D/3D estimation phase according to the specific product. Antenna shall be installed also according to antenna manufacturer instructions.

5.3.3 Suggested Antenna Occupancy Space

For different product types, because their frequency bands are different, required occupation space of the antenna is also different. For the specific antenna space, it is critical to estimate it with antenna engineers, RF engineers, baseband engineers, structure engineers, and ID engineers during the 2D/3D estimation phase. Taking the PAD product with a dimension of 95 mm * 125 mm (length * width) as an example, if the antenna should cover 824-960 MHz and 1710-2170 MHz, it is recommended to reserve the following antenna space: if the printed antenna mode is adopted, the reserved space should be above 75mm*10mm (length*width); if the antenna mode of PC rack plus FPC or PC rack plus spring is adopted, the reserved space should be above 70mm*10mm*3mm (length*width*height).

5.3.4 Matching Circuit of Antenna

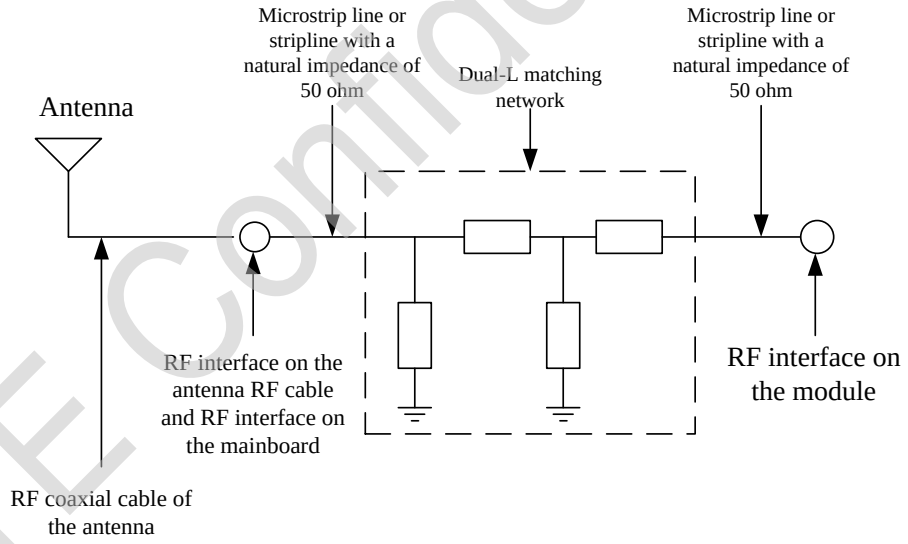
For all products with ZTEWelink module, the antenna is basically connected to the module through RF cables and RF connectors. This section describes two situations.

1. If the RF terminal connector of the module does not match the RF cables used by the antenna, or the direct connection between the RF antenna mated connector of RF cables and the RF port of the module is

restricted by the height, a circuit is required between them for transition. During the design of transit circuits on the mainboard, the natural impedance of the microstrip line or stripline between the RF port of the module and the RF port on the mainboard connected to the antenna is designed to be 50 ohm, and a dual-L matching circuit is reserved, as shown in Figure 5-6. Use a zero-ohm resistor on the cascading position between them.

2. If the RF connector used by the RF cable can be directly connected to the RF terminal on the module, and the height falls within the limited range, the circuit transition between the RF port on the module and the antenna interface can be saved, and the RF connected used by the RF cable of the antenna can be directly connected to the RF terminal of the module.

Figure 5–6 Transition Circuit



5.3.5 Type of Antenna RF Cable & RF Connector

The antenna RF connection cable usually adopts GBE(TW) and Shenyu (Mainland), or Japanese Somitomo and Shin Din. The antenna RF cable usually adopts a line width of 1.37mm. The antenna RF connector usually adopts Japanese IPX, or HRS, while the price of the latter is higher.

5.4 Recommended Antenna Manufacturers

Many domestic antenna manufacturers in China can design proper matched antennas according to specific products. This section recommends several antenna manufacturers with strong integrative strength in the mobile terminal industry, which have powerful hardware resources and software resources, experienced antenna design engineers, and advanced antenna test systems (including antenna Passive test, Passive OTA test, and SAR test) to satisfy various customer requirements.

1. Ethertronics at Shanghai
2. Skycross at Shanghai
3. Laird at Beijing
4. Sherbed at Suzhou
5. Yaodeng Electronic Communication Technology (kunshan) Co., Ltd.

5.5 PCB line guidelines

The users of ZTEWelink modules should do as the following guidelines in the process of RF PCB line design:

1. Make sure that the transmission line's characteristic impedance is 50ohm ;
2. Keep line on the PCB as short as possible, since the antenna line loss shall be less than around 0,3 dB;
3. Line geometry should have uniform characteristics, constant cross section, avoid meanders and abrupt curves;
4. If a Ground plane is required in line geometry, that plane has to be continuous and sufficiently extended, so the geometry can be as similar as possible to the related canonical model;
5. It is wise to surround (on both sides) the PCB transmission line with Ground, avoid having other signal tracks facing directly the antenna line track.
6. Keep, if possible, at least one layer of the PCB used only for the Ground plane; If possible, use this layer as reference Ground plane for the transmission line;
7. Avoid crossing any un-shielded transmission line footprint with other signal tracks on different layers;

8. The ground surrounding the antenna line on PCB has to be strictly connected to the main Ground Plane by means of via holes (once per 2mm at least), placed close to the ground edges facing line track;

9. Place EM noisy devices as far as possible from modules antenna line;

10. Keep the antenna line far away from the module power supply lines;

11. If EM noisy devices are present on the PCB hosting the ZTEWelink module, such as fast switching ICs, take care of the shielding of the antenna line by burying it inside the layers of PCB and surround it with Ground planes, or shield it with a metal frame cover.

5.6 Suggestions for EMC & ESD Design

5.6.1 EMC Design Requirements

During the design of the whole device, the user needs to fully consider the EMC problem caused by the signal integrity and power integrity.

1. During the product design, it is better to separate the module from the mainboard PCB, instead of installing the module on the ground of the mainboard. If they cannot be separated, the module should be far from modules and components that might generate EMI, such as chip and memory, power interface, and data cable interface.

2. Because the mainboard of PAD, CPE, and Internet laptops does not have a shielding cover, as that of mobile terminals, to shield most circuits to avoid overflow of electromagnetic interference, you can spray conductive paint on the surface on non-antenna areas within the structural components above and below the mainboard, and the conductive paint should be connected to the ground on the mainboard by several points to shield electromagnetic interference.

3. Besides, data cables of the LCD and the camera might introduce interference signals, which affect the receiving performance of the antenna. Thus, it is necessary to wrap conductive cloth around the two data cables and connected them to the ground.

4. RF cables of the antenna should be far from modules and components that might generate EMI, such as chip and memory, power interface, and data cable interface. The wiring of RF cables should be close to the ground of the mainboard.

5. During the layout and wiring of peripheral circuits, for the wiring of power and signal cables, keep a distance of 2 times of the line width, so as to effectively reduce the coupling between signals and keep a clean reflux path for the signal.

6. During the design of peripheral power circuits, the de-coupled capacitor should be placed closed to the module power PIN, the high-frequency high-speed circuit and the sensitive circuit should be placed far away from the border of PCB. They should better be separated during layout, so as to reduce the interference between them and protect the sensitive signal.

7. For the circuit or device on the side of system board that might interfere with the module, it should be shielded during design.

5.6.2 ESD Design Requirements

MF206A is embedded on the side of system board, so the user needs to make the ESD protection during design. For the key input/output signal interface, such as the (U)SIM card signal interface, the ESD device should be placed closely for protection. Besides, on the side of main board, the user should reasonably design the structure and PCB layout, guarantee that the metallic shielding shell is fully grounded, so as to leave a smooth discharge channel for ESD.

5.7 Antenna Indexes

The module supports the AGPS/GPS function, so the system equipment needs to add the GPS antenna. The design of GPS antenna is consistent with that of the main antenna, and its efficiency index can be 3dB lower. The separation degree between the main antenna and the diversity antenna is required to be greater than 12dB. The antenna index is divided into the Inactive index and Active index. The Inactive index includes S11, efficiency, gains, orientation diagram and polarity, which can be used as the parameter measuring the performance of the antenna itself. The Active index is also called the OTA index, including TRP (all-round radiation power), TIS (all-round receiving sensitivity), radiation orientation diagram, which is an important index measuring the radiation performance of the whole set (including the antenna, module, main board).

5.7.1 Passive Indexes

Different products have different requirements for antenna performance. The following table describes wireless indexes for PAD products as a reference to users, but the radiation performance of the antenna is finally determined by Active indexes.

Table 5–2 Passive Indexes of Main Antennas on PAD Products

Frequency	824-960MHz	1710-2170MHz
VSWR	<3.5:1	<3.5:1
Maximum gains	>0dBi	>0dBi
Average gains	>-3.5dBi	>-3.5dBi
Efficiency	>40%	>40%

5.7.2 Active Indexes

Active indexes are important indexes measuring the radiation performance of the whole mobile phone (including the antenna, module, and mainboard), thus they determine the final radiation performance of the terminal product. However, different products have different Active indexes, and different carries have different requirements for Active indexes as well. Thus, antenna engineers, RF engineers, baseband engineers, structure engineers, and ID engineers should work together to estimate the performance of the board during the project preliminary phase according to the Active indexes. There is no universal international standard for mobile terminal products, so mobile terminals are all designed according to the carrier requirements. Table 5-3 describes the requirement of Active indexes by ZTEWelink for Mobile Terminal Devices as a reference to users.

Table 5–3 ZTEWelink Indexes for Mobile Terminal Devices

Mode	Band	TRP(dBm)	TIS(dBm)
		Free space	Free space
GSM	GSM850MHz	28	-104
	GSM900MHz	28	-104
	GSM1800MHz	26	-102
	GSM1900MHz	26	-102
WCDMA	Band I	19	-106
	Band II	19	-104.5
	Band V	19	-104.5
	Band VIII	19	-104.5

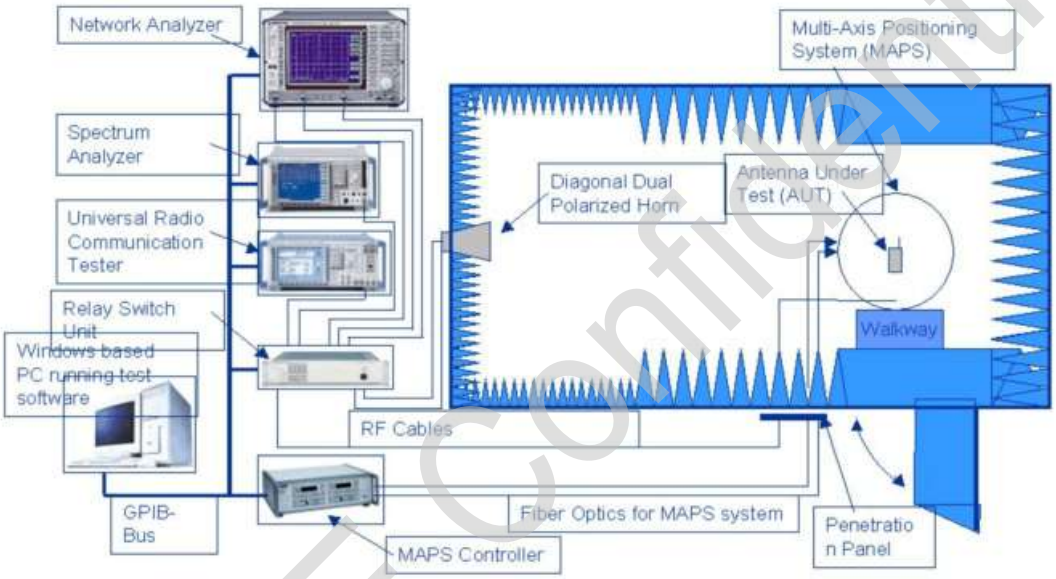
The Active indexes of diversity antennas are determined by the performance of diversity antennas.

5.7.3 Test Methods for Whole-Set Antenna OTA

Figure 5-7 is the diagram of OTA test system of CTIA. The system is mainly composed of test chamber, high-precision positioning system and its controller, Windows based PC running test software and RF test instruments with automatic test program. The main RF instruments are integrated RF test equipment, Spectrum Analyzer, Network Analyzer.

The radio equipments, Relay Switch Unit and PC with automatic test software are communicated via GPIB interface.

Figure 5–7 The OTA test system of CTIA



6 Electric Feature

6.1 Power Supply

The external power supply must be connected to VPH_PWR signals and must fulfill the following requirements:

The input voltage range of module is DC 3.4V~4.2V, and the typical value is 3.8V as shown in Table6-1.

Table 6–1 Input Voltage

Parameter	Min	Typical	Max
Input voltage	3.4V	3.8V	4.2V

6.2 Working Current

The working current range of module is as shown in Table 6-2 to Table 6-4. The IDLE mode indicates the power consumption of the module when there is no service but the module is interactive with network. The table also provides the working current range under GSM and WCMA mode when there is data service.

Table 6–2 Averaged standby DC power consumption

Mode	Bands	Test value (mA)	Remark
/WCDMA	Band I (IMT2100)	2.3	Standby mode
	Band II (PCS1900)	2.3	
	Band V (850M)	2.4	
GSM/GPRS/EDGE	GPRS 1900	5.4	Standby mode
	GPRS 1800	5.4	
	GPRS 900	5.6	
	GPRS 850	5.9	
Note: assumes USB bus is fully suspended during measurements. Under different environments, the testing results might be slightly different. Take the actual situation as the reference.			

Table 6–3 Averaged idle mode DC power consumption

Mode	Bands	Test value (mA)	Remark
UMTS	Band I (IMT2100)	68	Idle mode
	Band II (PCS1900)	60	
	Band V (850M)	59	
GPRS	GPRS1900	51	Idle mode
	GPRS1800	46	
	GPRS900	24	
	GPRS850	21	
EDGE	EDGE1900	39	Idle mode
	EDGE1800	23	
	EDGE900	47	
	EDGE850	41	
Note: The IDLE mode indicates the power consumption of the module when there is no service. But the module is interactiving with the network such as network registration, and USB is active. The above values are the average of some test samples. Under different environments, the testing results might be slightly different. Take the actual situation as the reference.			

Table 6–4 Averaged DC power consumption in working state

Mode	Bands	Test value (mA)	Remark
UMTS	Band I (IMT2100)	468	Acquired under the maximum transmission power
	Band II (PCS1900)	475	
	Band V (850M)	376	
GPRS	GPRS1900	287	Acquired under the maximum transmission power
	GPRS1800	275	
	GPRS900	352	
	GPRS850	363	
EDGE	EDGE1900	208	Acquired under the maximum transmission power
	EDGE1800	202	
	EDGE900	210	

	EDGE850	215	
Note: The above average current is acquired under the maximum transmission power. Under different environments, the testing results might be slightly different. Take the actual situation as the reference.			

NOTE:

The above average current is acquired under the maximum transmission power. Under different environments, the testing results might be slightly different. Take the actual situation as the reference.

7 Technical Index of Radio Frequency

Test Environment:

- Test instrument: Agilent 8960
- Power supply: Agilent 66319D
- RF cable for testing
- Cable length: About 15 cm
- Compensation for WCDMA 850 MHz or WCDMA 900 MHz: 0.6 dB
- Compensation for WCDMA 2100 MHz or WCDMA 1900 MHz: 0.8 dB

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.

7.1 Index of RF under UMTS Mode

7.1.1 UMTS (WCDMA)

The RF index should be tested strictly in accordance with the related testing specifications of 3GPP. The RF indexes of UMTS2100/1900/850 should satisfy the requirements of 3GPP TS 34.121 protocol.

7.1.2 Acquiring Radio Frequency Index

The testing of radio frequency index should strictly follow the specified testing specifications of 3GPP. In particular, when carrying out the acceptance test of related indexes, make sure to perform the test in a well-shielded environment.

7.1.3 Maximum Transmission Power

Under the normal testing environment, the maximum transmission power of UMTS2100/1900/850(900) should satisfy the requirements in Table 7-1.

Table 7–1 Maximum Transmission Power

Operating Band	level	3GPP Protocol Claim (dBm)	Test value
UMTS850	Class 3	+24dBm +1/-3dBm	22.4dBm
UMTS1900	Class 3	+24dBm +1/-3dBm	22.3dBm
UMTS2100	Class 3	+24dBm +1/-3dBm	22.3dBm

7.1.4 Receiving Sensibility

The receiving sensitivity is a key parameter that indicates the receiver performance of module. The receiving sensitivity is the weakest signal that the module at the antenna port can receive. At the same time the BER (Bit Error Rate) must meet the 3GPP TS 34.121protocol requirements in case of the minimum signal. The test value of UMTS2100/1900/850(900) receiving sensibility is shown in the Table 7-2.

Table 7–2 Reference Table of Receiving Sensitivity

Operating Band	Unit	3GPP Protocol Claim	Test value
UMTS850	dBm/3.84 MHz	≤-104.7dBm	-109dBm
UMTS1900	dBm/3.84 MHz	≤-104.7dBm	-109dBm
UMTS2100	dBm/3.84 MHz	≤-106.7dBm	-110dBm

7.1.5 Spurious Emission Index

The spurious emission index of UMTS2100/1900/850(900) should comply with the requirements in 3GPP TS 34.121 protocol, as illustrated below. And the test result of module in UMTS mode meets the requirement in Table 7-3.

Table 7–3 Spurious Emission Index

Frequency Band	Resolution Bandwidth	Minimum Requirement
9 kHz ≤ f < 150 kHz	1 kHz	-36 dBm
150 kHz ≤ f < 30 MHz	10 kHz	-36 dBm
30 MHz ≤ f < 1000 MHz	100 kHz	-36 dBm
1 GHz ≤ f < 12.75 GHz	1 MHz	-30 dBm

7.2 Index of RF under GPRS/GSM/EDGE Mode

The RF indexes of GSM/GPRS/EDGE850/900/1800/1900 should satisfy the requirements of 3GPP TS 05.05 protocol.

7.2.1 Output Transmission Power

The maximum output transmission power of GSM850/900/1800/1900 (GMSK/8PSK) should comply with the requirements of 3GPP TS 05.05 4.1 protocol, as shown in Table 7-4 indicates the power level of each frequency band.

Table 7–4 Output Transmission Power of GSM850/900/1800/1900 (GMSK)

Operating Band	Power level	3GPP Protocol Claim (dBm)	Test value
GSM850	Class 4	+33dBm±2dBm	32.0dBm
GSM900	Class 4	+33dBm±2dBm	32.0dBm
GSM1800	Class 1	+30dBm ±2dBm	29.0dBm
GSM1900	Class 1	+30dBm ±2dBm	29.0dBm

7.2.2 Receiving Sensibility

The receiving sensitivity is a key parameter that indicates the receiver performance of module. The receiving sensitivity is the weakest signal that the module at the antenna port can receive. At the same time the BER (Bit Error Rate) must meet the 3GPP TS 05.05 6.2 protocol requirements in case of the minimum signal. The test value of GSM850/900/1800/1900 receiving sensibility is shown in the Table 7-5.

Table 7–5 Reference Table of Receiving Sensitivity

Operating Band	Unit	3GPP Protocol Claim	Test value
GSM850	dBm/3.84 MHz	≤-102dBm	-108dBm
GSM900	dBm/3.84 MHz	≤-102dBm	-108dBm
GSM1800	dBm/3.84 MHz	≤-102dBm	-107dBm
GSM1900	dBm/3.84 MHz	≤-102dBm	-107dBm

7.2.3 Spurious Emission Index

The spurious emission index of GSM850/900/1800/1900 (GMSK) should comply with the requirements of 3GPP TS 4.3.2.1 protocol, as shown in the table below.

The power measured in bandwidth of 9kHz to 1GHz shall be no more than -36 dBm.

The power measured in bandwidth of 1GHz to 12.75GHz shall be no more than -30dBm.

And the test result of module in GPRS/GSM/EDGE mode meets the requirement above.

8 Related Test & Test Standard

8.1 Testing Reference

The related tests of module comply with the IEC standard, including the equipment running under high/low temperature, storage under high/low temperature, temperature shock and EMC. Table 8-1 is the list of testing standard, which includes the related testing standards.

Table 8–1 Testing Standard

Test Standard	Document Reference
IEC6006826	Environmental testing-Part2.6:Test FC: Sinusoidal Vibration
IEC60068234	Basic environment testing procedures part2.
IEC60068264	Environmental testing-part2-64: Test FH: vibration, broadband random and guidance.
IEC60068214	Environmental testing-part 2-14: Test N:change of temperature.
IEC60068229	Basic environmental testing procedures-part2: Test EB and guidance.
IEC6006822	Environmental testing-part2-2:Test B:dry heat
IEC6006821	Environment testing-part2-1: Test A: cold.
GB/T 15844.2	MS telecommunication RF wireless phone-set environment requirement & experimental method – part 4: Strict level of experimental condition
GB/T 2423.17	Basic environment experiment of electronic products-Experiment Ka: Salt mist experiment method
GB/T 2423.5	Basic environment experiment of electronic products-Part2:Experiment method Try Ea & Introduction: Shock
GB/T 2423.11	Basic environment experiment of electronic products-Part2:Experiment method Try Fd: Broad frequency band random vibration (General requirement)
TIA/EIA 603 3.3.5	TIA Standard-part3-5:Shock Stability

NOTE:

1. IECL International Electro technical Commission;

2. GB/T: Recommended national standard

8.2 Description of Testing Environment

The working temperature range of module is divided into the normal working temperature range and the extreme working temperature range. Under the normal working temperature range, the testing result of RF complies with the requirements of 3GPP specifications, and its function is normal. Under the extreme temperature range, the RF index basically complies with the 3GPP specifications, and the quality of data communication is affected to a certain extent, but its normal function is not affected. The module has passed the EMC test. Table 8-2 is the requirement for the testing environment, and Table 8-3 lists out the instruments and devices that might be used during the test.

WARNING:

Table 6-2 lists the extreme working conditions for the module. Using the module beyond these conditions may result in permanent damage to the module.

Table 8–2 Testing Environment

Working Condition	Min Temperature	Max Temperature	Remark
Normal working condition	-30 ℃	75 ℃	All the indexes are good.
Extreme working condition	-40 ℃	85 ℃	Some indexes become poorer.
Storage	-45 ℃	90 ℃	Storage environment of module

Table 8–3 Testing Instrument & Device

Testing Item	Instrument & Device
RF test	Comprehensive testing device
	RF cable
	Tower antenna
	Microwave darkroom
High/Low-temperature running & storage test	High/Low-temperature experimental box
Temperature shock test	Temperature shock experimental box
Vibration test	Vibration console

8.3 Reliability Testing Environment

The reliability test includes the vibration test, high/low-temperature running, high/low-temperature storage and temperature shock experiment test. Refer to Table 8-4 for the specific parameters.

Table 8–4 Reliability Features

Test Item	Test Condition	Test Standard
Random vibration	Frequency range: 5-20Hz, PSD:1.0m2/s3 Frequency range: 20-200Hz, -3dB/oct 3 axis, 1 hour for each axis	IEC 68-2-6
Temperature shock	Low temperature: -40 ℃ ±2 ℃ High temperature: +80 ℃ ±2 ℃ Temperature changing period: less than 30seconds Test duration: 2 hours Cycle: 10	IEC 68-2-14 Na
High-temperature running	Normal high temperature: 75 ℃ Extreme high temperature: 85 ℃ Duration: 24 hours	ZTE standard
Low-temperature running	Normal low temperature: -30 ℃ Extreme low temperature: -40 ℃ Duration: 24 hours	ZTE standard

High temperature & high humidity	Temperature: +60 ℃ Humidity: 95% Duration: 48 hours	ZTE standard
High temperature storage:	Temperature: 90 ℃ Duration: 24 hours	IEC 68-2-1 Ab
Low temperature storage:	Temperature: -45 ℃ Duration: 24 hours	IEC 68-2-2 Bb

NOTE:

When the module works at the normal temperature, all its RF indexes comply with the 3GPP specifications.

When the module works at extreme temperature, certain RF indexes do not comply with the 3GPP specifications.

8.4 Reliability Testing Result

Table 8–5 Temperature Testing Result Under Windless Environment

Mode	Temperature	Voltage	Transmission Power	Duration	Testing Result
GPRS Class 10	+25℃	(3.8±10%)V	Max	≥1hour	Pass
EDGE Class 12	+25℃	(3.8±10%)V	Max	≥1 hour	Pass
WCDMA	+25℃	(3.8±10%)V	Max	≥1 hour	Pass

Table 8–6 High/Low-temperature Running & Storage Testing Result

Test Item	Test Condition & Standard	Test Content	Test Result
Random vibration	Refer to Table 8-4	RF test & function test	Pass
Temperature shock	Refer to Table 8-4	RF test & function test	Pass
Low-temperature working	Refer to Table 8-4	RF test & function test	Pass
High-temperature working	Refer to Table 8-4	RF test & function test	Pass
Extreme low-temperature working	Refer to Table 8-4	RF test & function test	Pass

Extreme high-temperature working	Refer to Table 8-4	RF test & function test	Pass
Low-temperature storage	Refer to Table 8-4	RF test & function test	Pass
High-temperature storage	Refer to Table 8-4	RF test & function test	Pass

9 Design Guide

This chapter provides the general design guide for module, used as a reference for the user during the design process, so that the product can reach better performance.

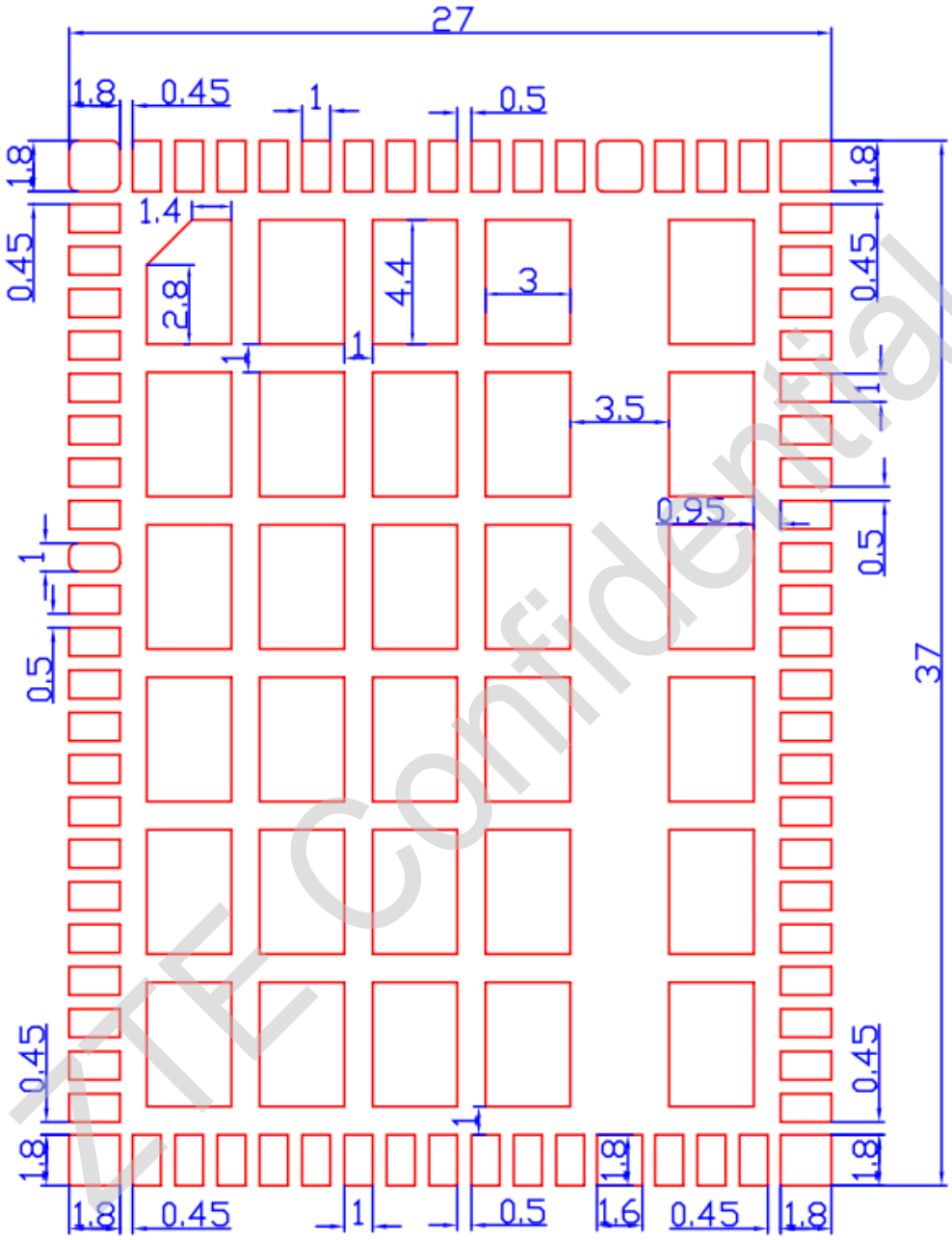
9.1 General Design Rule & Requirement

When the user is designing the peripheral circuits of module, he needs to first guarantee that the external circuit has the sufficient power supply capability, and the USB of high-speed signal cable is required to have 90ohm differential resistance. For the common signal interface, it is required to design according to ZTEWelink requirements, which needs to comply with the power level of interface signal, so as to prevent the impedance from damaging the module. The RF index of this product itself is good, and the user needs to design the antenna circuit of the main board and make the corresponding impedance control. Otherwise, the RF index of the whole set will be affected.

9.2 Suggestions for PCB Wielding Panel Design

When the user is designing the encapsulation wielding panel on main board, the 30 heat wielding panels in the center are recommended to be designed according to the dimensions as described in Figure 9-1. The surrounding 78 wielding panels should be extended by more than 0.3mm, and the other three sides of the wielding panel are extended by 0.05mm. For the right angles of wielding panels for the main antenna PIN1 and GPS antenna PIN70, they are recommended to be rounded into a round angel with a radius of 0.3mm. In this way, it is convenient for the import of interference and the radiation of RF signal. The Recommended PCB Wielding Panel Design is shown in Figure 9-1 (Unit:mm).

Figure 9–1 Recommended PCB Wielding Panel Design



9.3 Suggestions for Heat-dissipation Design

The module will dissipate heat during the working process, and might also be affected by other high-temperature devices. The heat dissipation is taken into full consideration during the product design, as 30 heat wielding

panels are reserved in the center of the module. During the connection with the system board, make sure that these wielding panes are grounded well, which is greatly helpful to heat conductivity and heat balance, and is greatly beneficial to the electric performance of the whole set as well.

NOTE:

1. Keep this product away from heat-dissipation devices with high power, to prevent the temperature of the module from being too high.

2. Do not put the module close to the large heat-dissipation devices, such as CPU or bridge. The high temperature will affect the RF performance.

9.4 Recommended Product Upgrading Plan

It's recommended to use the one-click software upgrade tool to upgrade through the USB port provided by ZTEWelink in the Windows system. If the customer wants to upgrade the module in other operation systems, ZTEWelink provides the corresponding reliable tools as well.

10 Manufacturing Guide

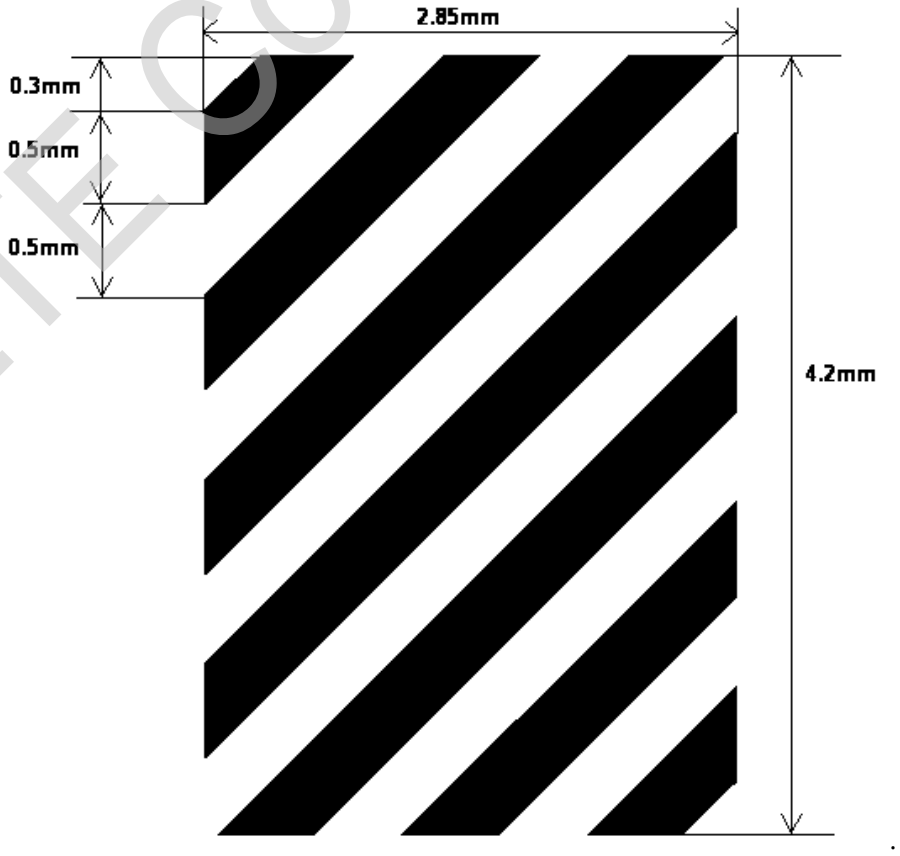
10.1 Design of Steel Mesh

During the design of steel mesh, note:

1. When manufacturing the steel mesh of thermal pad on the bottom of the module, narrow the mouth of the steel mesh of the original size, so as to reduce the risk of shortcut between the module thermal and the peripheral PINs. This method is effective.

2. It is recommended to design to the mouth of steel mesh on the thermal pad wielding panel to the lattice form. Figure 10-1 shows the recommended pattern for the steel mesh.

Figure 10–1 Recommended Pattern of Steel Mesh on Wielding panel



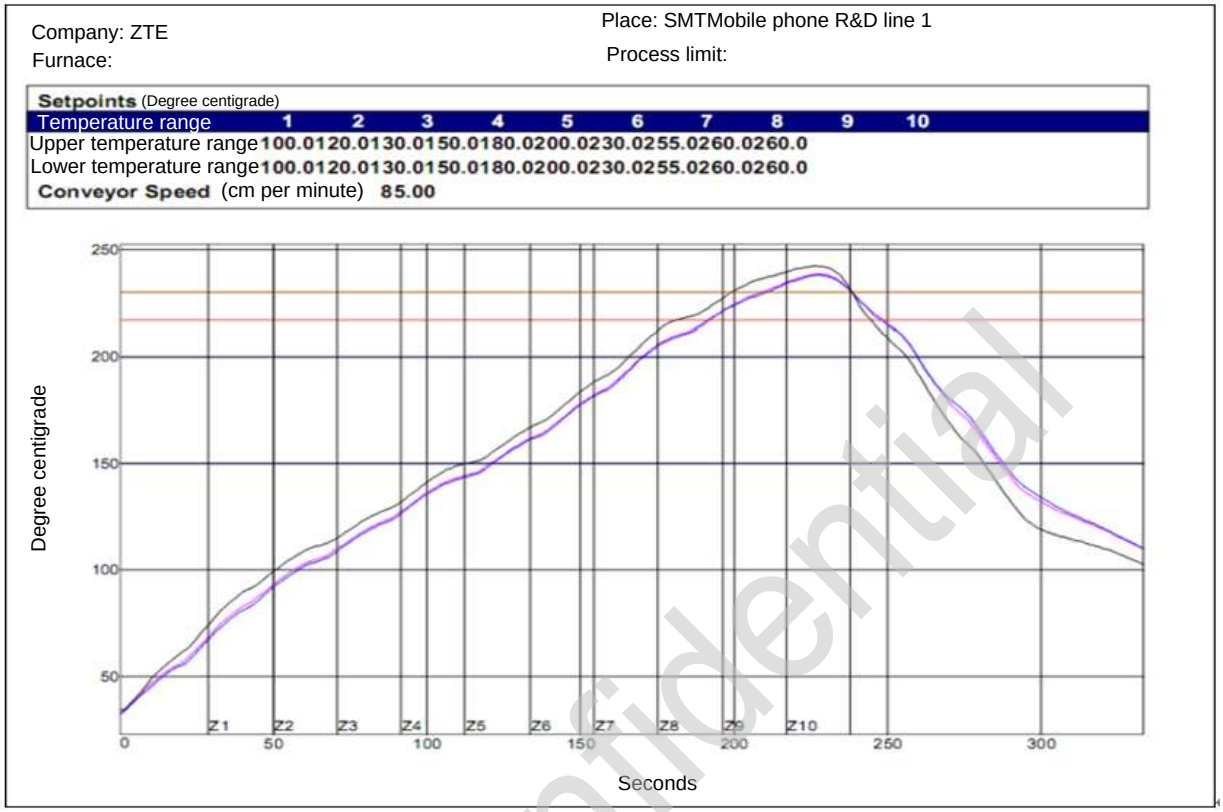
10.2 Furnace Temperature Curve

The furnace temperature curve greatly affects the wielding quality and the material status, so it needs to be paid great attention to. The temperature increasing speed cannot be too fast, with the increase speed from the room temperature to 150℃ less than 3℃/second. At the same time, if the temperature is above 217℃, the duration should be kept within 70 seconds, while the interim value 55 seconds is ideal. Otherwise, the great temperature shock will make certain devices ineffective, causing the quality to decrease and the maintenance difficulty to increase. At the same, keep the precise maximum temperature to be below 245℃, as certain materials (such as the crystal) might crack under the high temperature and won't vibrate any more, so the product function is affected. Refer to Table 10-1 for the detailed requirements setting of furnace temperature curve, refer to Figure 10-2 for the furnace temperature curve and the testing result.

Table 10–1 Curve Temperature Curve Parameter Setting

Lead-free Curve Temperature Curve		
Phase	Temperature	Duration
Pre-heat	Temperature is increased from room temperature to 150℃	Temperature increasing ratio <3℃/second
Temperature keeping	150℃~200℃	40~110 seconds
Wielding	Greater than 217℃	40~70 seconds
	Above 230℃	15~45 seconds
	Peak temperature	MAX: 245℃
		MIN: 230℃

Figure 10–2 Furnace Temperature Curve Reference Diagram



PWI= 74%	Maximum temperature ascending slope		Maximum temperature descending slope		Preheat time 150200C		Time of the reflow temperature or above271C		Upper limit		Total time	/230C
Module edge point	1.3	-34%	-1.9	55%	49.6	-72%	57.4	16%	238.7	16%	29.5	-3%
Module bottom	1.3	-35%	-1.8	60%	49.1	-74%	56.2	8%	238.1	8%	28.2	-12%
Chip	1.4	-29%	-2.1	46%	52.7	-64%	63.6	57%	242.5	66%	39.6	64%
Temperature difference	0.1		0.3		3.6		7.4		4.3		11.4	

Process limit

Butter of antimony: Define Your Own Spec

Statistic name	Lower limit	Upper limit	Unit
Maximum temperature ascending slope (target: 2.0) (Time distance = 20 seconds)	0.0	3.0	Degree per second
Maximum temperature descending slope (Time distance = 20 seconds)	-5.0	-1.0	Degree per second
Preheat time 150200C	40	110	Seconds
Time of the reflow temperature or above271C	40	70	Seconds
Maximum temperature	230	245	Degree centigrade
Time of the temperature above 230C	15	45	Seconds

NOTE:

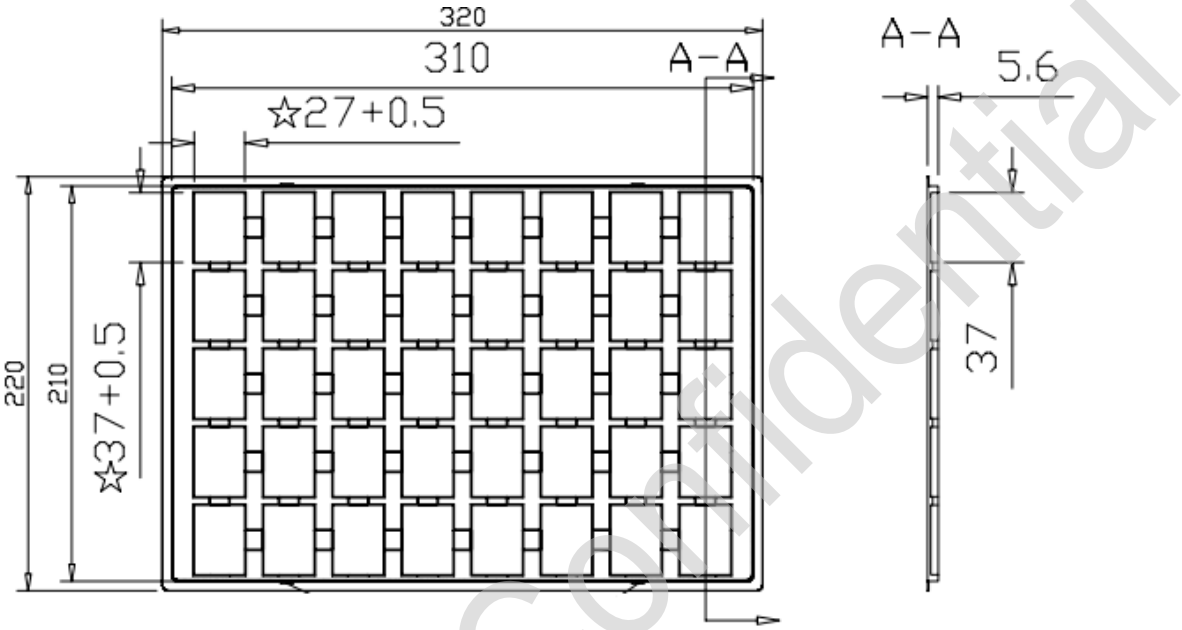
More Guide Information about SMT & Baking about the Manufacturing process, please refer to the document named SMT & Baking User Guide of ZTEWelink LGA Module Products.pdf

10.3 Package System

The modules are packaged on trays of 40 pieces each. These trays can be used in SMT processes for pick & place handling.

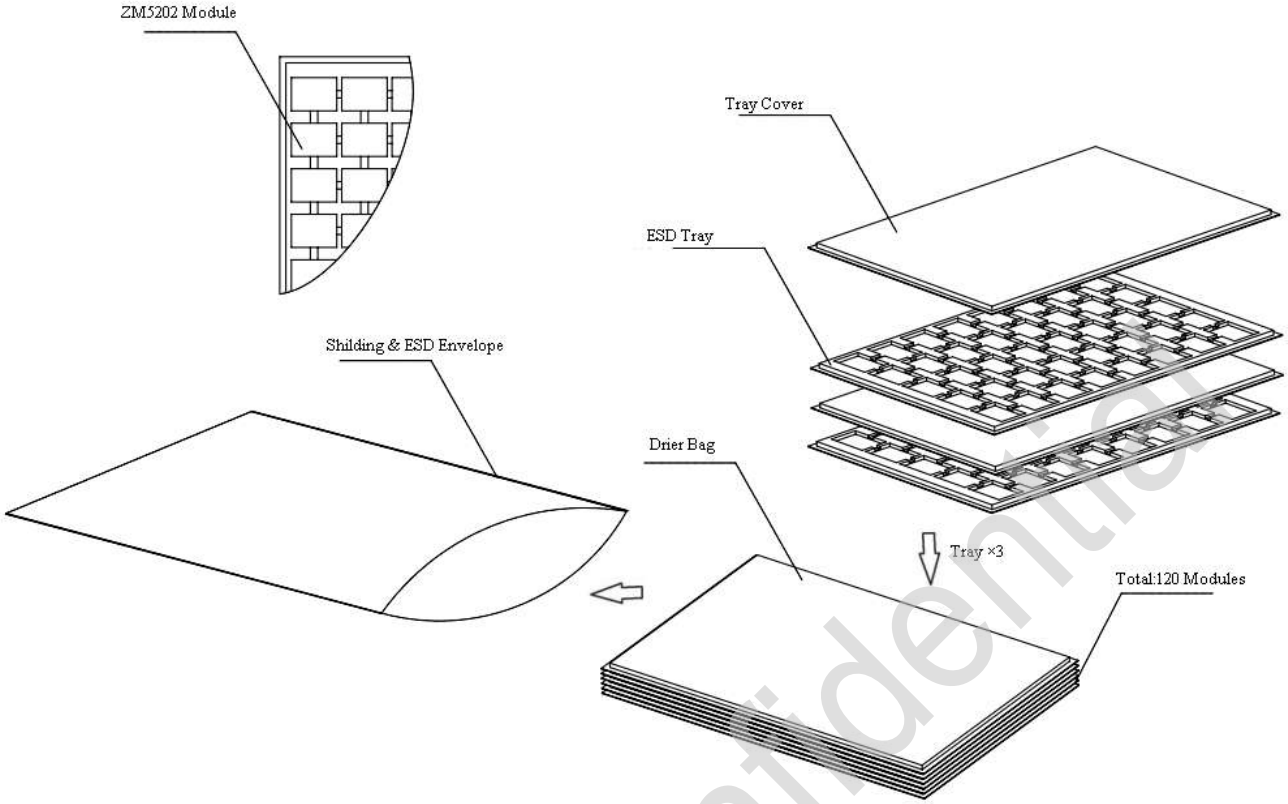
The dimensions tolerance of tray is between 1mm except the dimensions with ☆ in the Figure below (and the unit of dimensions is mm):

Figure 10–3 The dimensions of Package tray



The package process of modules is shown as the Figure below:

Figure 10–4 Package process of modules



11 Safety Information

The following safety precautions must be observed during all phases of the operation, such as usage, service or repair of any cellular terminal incorporating module. Manufacturers of the cellular terminal should send the following safety information to users, operating personnel and to incorporate these guidelines into all manuals supplied with the product.

The use of this product may be dangerous and has to be avoided in the following areas:

- Where it can interfere with other electronic devices in environments such as hospitals, aircrafts, airports, etc, switch off before boarding an aircraft. Make sure the cellular terminal is switched off in these areas. The operation of wireless appliances in the hospitals, aircrafts and airports are forbidden to prevent interference with communication systems.
- Areas with potentially explosive atmospheres including fuelling areas, below decks on boats, fuel or chemical transfer or storage facilities, areas where the air contains chemicals or particles such as gasoline stations, oil refineries, etc make sure that wireless devices are turned off.

It's the responsibility of users to enforce other country regulations and the specific environment regulations. And ZTEWelink does not take on any liability for customer failure to comply with these precautions.

Federal Communication Commission Interference 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.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or

television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution:

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

This device is intended only for OEM integrators under the following conditions:

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and the maximum antenna gain allowed for use with this device is 5 dBi.
2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must

be labeled in a visible area with the following: “Contains FCC ID: Q78-ZTEMF206A”. The grantee's FCC ID can be used only when all FCC compliance requirements are met.

Manual Information To the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user’s manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.