Air795U

Hardware Design Manual

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Modify the record:

version number	edit a record	dates	author
V1.0.0	newly built	2023-7-24	Chengong
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directory (on computer hard drive)

1. preface

Air795U is an LTE Cat 1 wireless communication module designed based on Zircon Spreadtrum UIS8910DM platform. Aiming at overseas market, it supports multiple 4G frequency bands and covers most of overseas countries. It supports GSM/FDD-LTE/TDD-LTE 4G long-distance wireless transmission technology, WiFi Scan and WiFi positioning, VoLTE, Audio, etc. In addition, the module provides universal interfaces such as USB/UART/SPI/I2C/SDIO, etc. to satisfy the secondary development requirements of IoT industry.

The following figure shows the functional block diagram of the Air795U module:

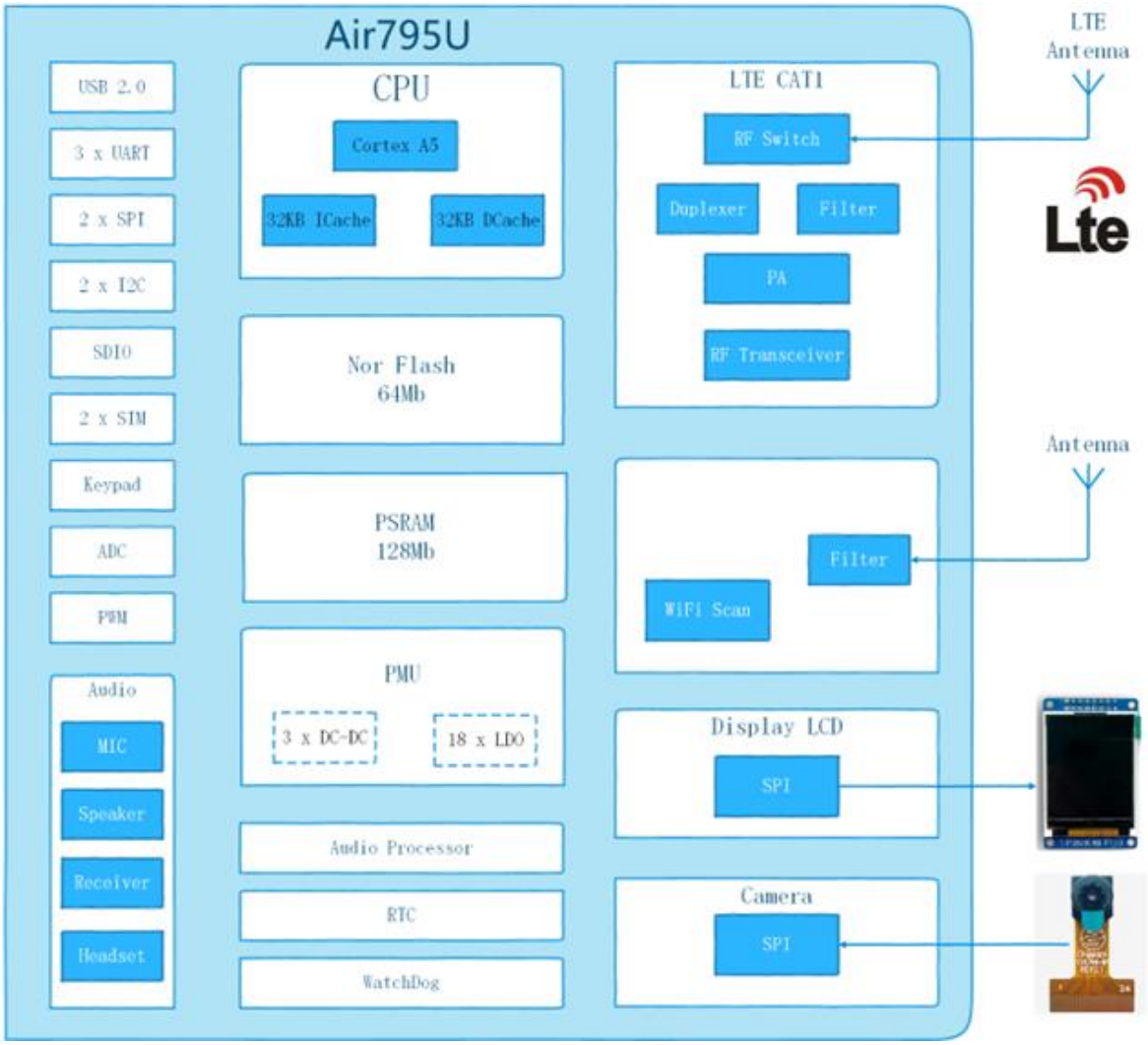


Chart1 : Functional Block Diagram

2. a roundup

2.1 Model information

Tables1 : List of Module Models

model number	Air795U
LTE-FDD	B1/B2/B3/B4/B5/B8/B12/B13/B17/B20/B25/B26/B28/B66
LTE-TDD	B38/B41
GSM	850/900/1800/1900
VOLTE	adjuvant
speech simulation	adjuvant
Module Size	25X29MM
seal inside	LGA
shore	globally

2.2 Main performance

Tables2 : Module Key Performance

diagnostic property	clarification
CPU	♦ Cortex A5 @ 500MHz ♦ 32KB ICache and 32KB DCache
Flash	♦ Nor Flash 64Mb
RAM	♦ PSRAM 128Mb
Supported Frequency Bands	♦ LTE-FDD: B1/B2/B3/B4/B5/B8/B12/B13/B17/B20/B25/B26/B28/B66 ♦ LTE-TDD: B38/B41 ♦ GSM: 850/900/1800/1900
firing power	♦ LTE-FDD: Class3 (23dBm+-2dB) ♦ LTE-TDD: Class3 (23dBm+1/-3dB)
electricity supply	♦ VBAT 3.3V ~ 4.3V, 3.8V typical
LTE Features	♦ Maximum support for non-CA CAT1 ♦ Support VOLTE ♦ Support 1.4~20MHz RF bandwidth ♦ LTE-FDD: Maximum uplink rate 5Mbps, maximum downlink rate 10Mbps ♦ LTE-TDD: uplink and downlink configuration1 Maximum uplink rate 4Mbps, maximum downlink rate 6Mbps ♦ LTE-TDD: uplink and downlink configurations2 Maximum uplink rate 2Mbps, maximum downlink rate 8Mbps
network protocol characteristic	♦ TCP/UDP/PPP/FTP/HTTP/NITZ/CMUX/NDIS/NTP/HTTPS/PING/FTPS/FILE/MQTT is supported.
USIM card interface	♦ USIM/SIM card support: 1.8V and 3V ♦ Dual SIM single standby support
USB port	♦ Supports USB 2.0 High speed (Slave mode only), data transfer rate up to 480Mbps. ♦ For AT commands, data transfer, software debugging, software upgrades ♦ USB Virtual Serial Driver: Support USB driver under Windows 7/8.1/10, Linux 2.6.x/3.x/4.1, Android 4.x/5.x/6.x/7.x and other operating systems.

serial port (computing)	MAIN_UART: ♦ Universal serial port for AT commands and data transfer ♦ Maximum baud rate 921600bps, default baud rate adaptive 9600-115200bps ♦ Supports hardware flow control (RTS/CTS) AUX_UART: ♦ Used for RF calibration and also for communicating with internal Bluetooth. UART3: ♦ Universal Serial Port HOST UART: ♦ Used to output debugging information ZSP UART: ♦ Used to output debugging information
SPI Camera	♦ adjuvant
SPI LCD	♦ adjuvant
I2C	♦ adjuvant
SDIO	♦ adjuvant
Audio	♦ Supports two analogue inputs ♦ Supports three analogue outputs
keypads	♦ Support 6*6 scanning keyboard
RTC	♦ support sth.
WatchDog	♦ support sth.
Antenna Interface	♦ One LTE antenna connector
temperature range	♦ Normal operating temperature: 25° C ♦ Extreme operating temperature: -20° C to +45° C
RoHS	♦ All devices are fully RoHS compliant
physical property	♦ Size: 25mm*29mm*2.3mm ♦ Weight: approx. 2.6g
seal inside	♦ 126 pins, see pin diagram for actual available pins

3. application interface

The following sections describe in detail the functions of each Air795U interface

3.1. Pin Description

Chart2 : Air795U Pin Arrangement Diagram (Front View)

Tables3 : Pin Descriptions

power supply

pin name	pin number	IO	descriptions	Electrical Characteristics	note
VBAT_BB	33,32	PI	Module Baseband Mains	VBAT=3.3V~4.3	External connection to VBAT_RF is required.
VBAT_RF	52,53	PI	Mode RF mains	VBAT=3.3V~4.3	Power supply capacity to meet instantaneous current greater than 1.5A
VDD_EXT	29	DO	Fixed output 1.8V	VDD_EXT=1.8V Imax= 100mA	If you don't need to keep it suspended
GND	3, 31, 47,48, 50, 54, 55, 58, 59, 61, 62, 67-74, 79-82, 89-92, 100-102		reference point		

control pin

pin name	pin number	IO	descriptions	Electrical Characteristics	note
PWRKEY	15	DI	Switch Control Pin, Low Active		
RESET_N	17	DI	Module reset input, low pulse is valid, the module is in hardware shutdown state after reset		If you don't use it, it hangs in the air.

BOOT	75	DI	Download mode control pin, pull up to VDD_EXT before power on, the module will force into USB download mode	Be sure to reserve a test site

indicator pin

pin name	pin number	IO	descriptions	Electrical Characteristics	note
STAUS	20	DO	Indicates module operating status		If you don't use it, it hangs in the air.
NET_STATUS	21	DO	Indicates network status		If you don't use it, it hangs in the air.

USB port

pin name	pin number	IO	descriptions	Electrical Characteristics	note
VBUS	8	AI	USB plug-in wake-up	Recommended not to exceed 5.5V	Internal Resistor Voltage Divider
USB_DP	9	IO	USB2.0 Data Differential Signal		90 Ohm differential master control
USB_DM	10	IO	USB2.0 Data Differential Signal		90 Ohm differential master control

USIM interface

pin name	pin number	IO	descriptions	Electrical Characteristics	note

SIM1_RST	44	DO	USIM1 card interface reset signal	1.8V/3.3V
SIM1_CLK	46	DO	USIM1 card interface clock signal	1.8V/3.3V
SIM1_DAT	45	IO	USIM1 card for data signals	1.8V/3.3V
SIM1_VDD	43	PO	USIM1 card to power signal	1.8V/3.3V
SIM1_DET	42	DI	USIM1 card interface presence detection	1.8V/3.3V
SIM2_RST	85	DO	USIM2 card interface reset signal	1.8V/3.3V
SIM2_CLK	84	DO	USIM2 card interface clock signal	1.8V/3.3V
SIM2_DAT	86	IO	USIM2 card for data signals	1.8V/3.3V
SIM2_VDD	87	PO	USIM2 card to power signal	1.8V/3.3V

serial port (computing)

pin name	pin number	IO	descriptions	Electrical Characteristics	note
MAIN_TXD	35	DO	Main Serial Port Data Transmission	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
MAIN_RXD	34	DI	Main serial port data reception	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
MAIN_CTS	36	DO	DTE Clear Transmit	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
MAIN_RTS	37	DI	DTE request sent	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
MAIN_DCD	38	DO	UART output carrier detection	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
MAIN_DTR	30	DI	Main serial port data terminal ready, ground active, wake module from hibernation	VDD= 1.8V VIH= 0.7*VDD	If you don't use it, it hangs in the air.

				VIL=0.2* VDD	
MAIN_RI	39	DO	Main serial port data ringing signal	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
AUX_TXD	27	DO	Extended Serial Data Transmission	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
AUX_RXD	28	DI	Extended serial data reception	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
DBG_TXD	23	DO	Debugging Serial Digital Transmission	DC Level:VDD_EXT	Can only be used to monitor debugging information
DBG_RXD	22	DI	Debugging Serial Inputs	DC Level:VDD_EXT	Can only be used to monitor debugging information

I2C interface*

pin name	pin number	IO	descriptions	Electrical Characteristics	note
I2C_SCL	40	OD	I2C Interface Clock Signal		External pull-up required
I2C_SDA	41	OD	I2C interface data signals		External pull-up required

External pull-up required

Digital voice interface*

pin name	pin number	IO	descriptions	Electrical Characteristics	note
I2S_LRCK	4	DI	I2S digital voice interface left and right channel control signals	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
I2S_BCK	5	DO	I2S digital voice interface bit clock signal	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
I2S_DIN	6	DI	I2S digital voice interface input signal	DC Level:VDD_EXT	If you don't use it, it hangs in the air.

I2S_OUT	7	DO	I2S digital voice interface output signal	DC Level:VDD_EXT	If you don't use it, it hangs in the air.

Antenna Interface

pin name	pin number	IO	descriptions	Electrical Characteristics	note
LTE_ANT	60		4G LTE RF Antenna Interface		It is recommended to reserve Π-shaped antenna to match, and the alignment needs 50 ohm impedance matching.
ANT_ WIFI	56		wifi positioning RF antenna interface		It is recommended to reserve Π-shaped antenna to match, and the alignment needs 50 ohm impedance matching.
ANT_GNSS	49		GNSS satellite positioning RF antenna interface		50 ohm impedance matching required for alignment

SPI interface*

pin name	pin number	IO	descriptions	Electrical Characteristics	note
SPI_CLK	26	DO	SPI Clock	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
SPI_CS	25	DO	SPI Chip Select	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
SPI_DIN	88	DI	SPI Data Input	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
SPI_DOUT	64	DO	SPI Data Output	DC Level:VDD_EXT	If you don't use it, it hangs in the air.

Analogue-to-digital ADC interface*

pin name	pin number	IO	descriptions	Electrical Characteristics	note
ADC0	24	AI	Analogue-to-digital ADC Channel 0	Range 0~1.4V	External resistor divider required if over range
ADC1	2	AI	Analogue-to-digital ADC Channel 1	Range 0~1.4V	External resistor divider required if over range

analogue voice interface

pin name	pin number	IO	descriptions	Electrical Characteristics	note
MIC_N	119	AI	MIC differential input (-)		If you don't use it, it hangs in the air.
MIC_P	126	AI	MIC differential input (+)		If you don't use it, it hangs in the air.
MICBIAS	120	PO	MIC bias voltage supply		If you don't use it, it hangs in the air.
SPK_P	121	AO	Analogue voice output differential signal (+)		
SPK_N	122	AO	Analogue voice output differential signal (-)		

Other IO ports

pin name	pin number	IO	descriptions	Electrical Characteristics	note

W_DISABLE# *	18	DI	Flight Mode Control	Duplicate ZSP_UART_TXD serial port for debugging purpose.
AP_READY*	19	DI	AP master working status indication	
PSM_IND*	1	DO	PSM mode status indication	
PSM_EINT*	96	DI	PSM interrupt indication	
RESERVED	11-14, 16, 51, 57, 63, 65, 66, 76-78, 83, 93-95, 97-99, 103-111, 113-118,123 123-125		Reserve GPIO	Stay in the air.
1PPS*	112		GPS	

***Note: *Functionality under development**

Tables4 : IO Parameter Definitions

typology	descriptions
IO	Input/Output
DI	Digital Input
DO	Digital Output
PI	Power Input

PO	Power Output
AI	Analog Input
AO	Analog Output
OD	Open Drain Output

3.2. operating mode

The following table briefly describes the various operating modes mentioned in the next chapters.

Tables5 Table 5: Modes of operation

paradigm	functionality	
proper functioning	SLEEP	The module automatically enters sleep mode when it has no tasks to perform. In sleep mode, the power consumption of the module is reduced to a very low level, but the module is still able to send and receive data, SMS and incoming calls.
	IDLE	The software is functioning normally. The module registers on the network with no data, voice or SMS interaction.
	TALK/Data	The connection works properly. There is data or voice or SMS interaction. In this mode, the module power consumption depends on the strength of the ambient signal, the dynamic DTX control and the RF operating frequency.
shutdown mode	In this mode, the PMU stops supplying power to the baseband and RF, the software stops working, the serial port is not available, but the VBAT pin is still energised.	
Minimum function mode (holding supply voltage)	AT+CFUN=0 Allows you to set the module to least-function mode. In this mode, neither the RF nor the SIM card works, but the serial port can still be accessed	
flight mode	AT+CFUN=4 allows you to set the module to flight mode, in which the module RF does not work.	

For specific power consumption data, please consult 5.4 Power Consumption section.

3.3. power supply

pin name	pin number	IO	descriptions	Electrical Characteristics	note
VBAT_BB	33,32	PI	Module Baseband Mains	VBAT=3.3V~4.3	External connection to VBAT_RF is required.
VBAT_RF	52,53	PI	Mode RF mains	VBAT=3.3V~4.3	Power supply capacity to meet instantaneous current greater than 1.5A

3.3.1. Modular Power Supply Operating Characteristics

Power supply design is an important part of module application design. Since LTE RF operates at maximum transmit power with a continuous operating current of about 700mA, the power supply must be able to provide sufficient current, otherwise it may cause the supply voltage to drop or even the module to power down and restart directly.

3.3.2. Reduced voltage drop

Module power supply VBAT voltage input range of 3.3V ~ 4.3V, but the module in the RF transmitter usually produces a power supply voltage drop phenomenon in the VBAT power supply, this is due to the power supply or the impedance on the alignment path, generally difficult to avoid. Therefore, special attention should be paid to the module's power supply design, in the VBAT input, it is recommended that a low ESR (ESR = 0.7Ω) of 100uF tantalum capacitors in parallel, as well as 100nF, 33pF, 10pF filter capacitors, the VBAT input reference circuit shown in Figure 4. It is also recommended that the PCB alignment of the VBAT be as short as possible and wide enough to reduce the equivalent impedance of the VBAT alignment to ensure that there is no large voltage drop under high current at maximum transmit power. It is recommended that the width of the VBAT alignment should be not less than 1mm, and the longer the alignment, the wider the line width.

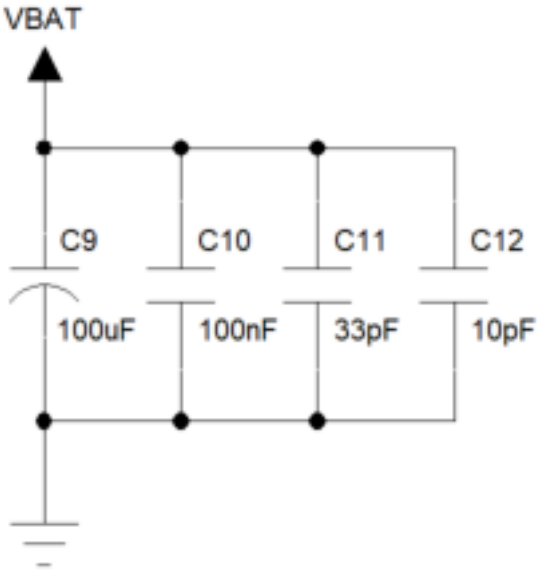


Chart3 : VBAT Input Reference Circuit

3.3.3. Power Supply Reference Circuit

The power supply design is critical to the power supply of the module, and it is important to select a power supply that is capable of supplying at least 1A of current. If the voltage difference between the input voltage and the module's supply voltage is less than 2V, it is recommended that an LDO be used as the power supply. If the voltage difference between input and output is greater than 2V, a switching power converter is recommended to improve power conversion efficiency.

LDO power supply:

The following figure shows a reference design for a 5V supply, using a Micrel LDO, model MIC29302WU. It has an output voltage of 4.16V and a peak load current of 3A. To ensure the stability of the output power supply, it is

recommended that a regulator be reserved at the output and placed close to the VBAT pin of the module. It is recommended to choose a regulator with a reverse breakdown voltage of 5.1V and a power dissipation of 1W or more.

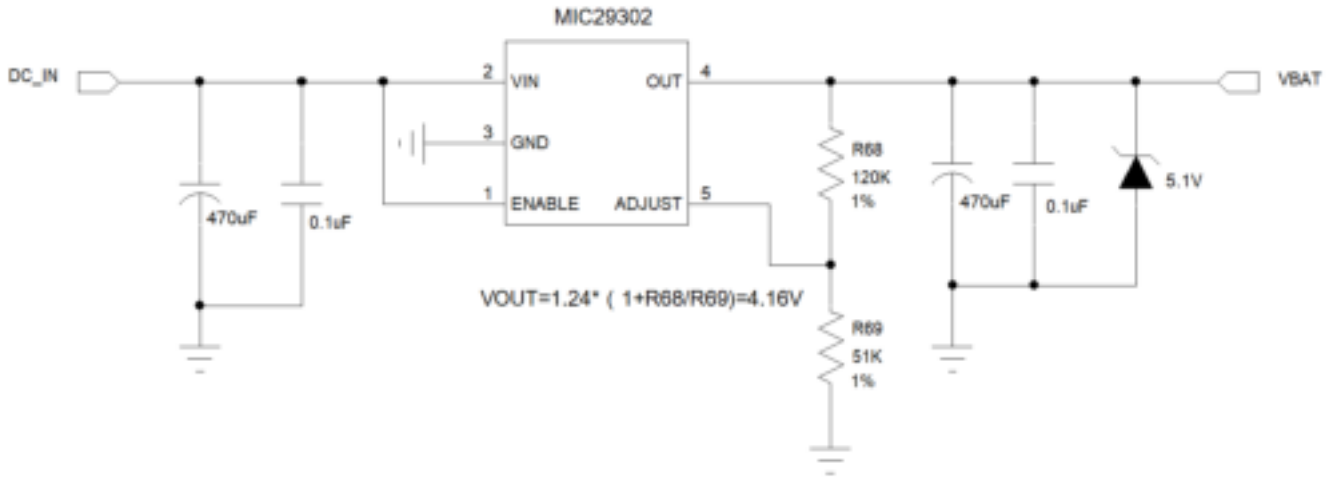


Chart4 : Power Input Reference Design

DC-DC powered:

The following figure shows the reference design of a DC-DC switching power supply, using the JW5033S switching power supply chip from JWT, which has a maximum output current of 2A and an input voltage range of 3.7V~18V. Note that the selection of C25 should be based on the input voltage to select the appropriate withstand voltage value.

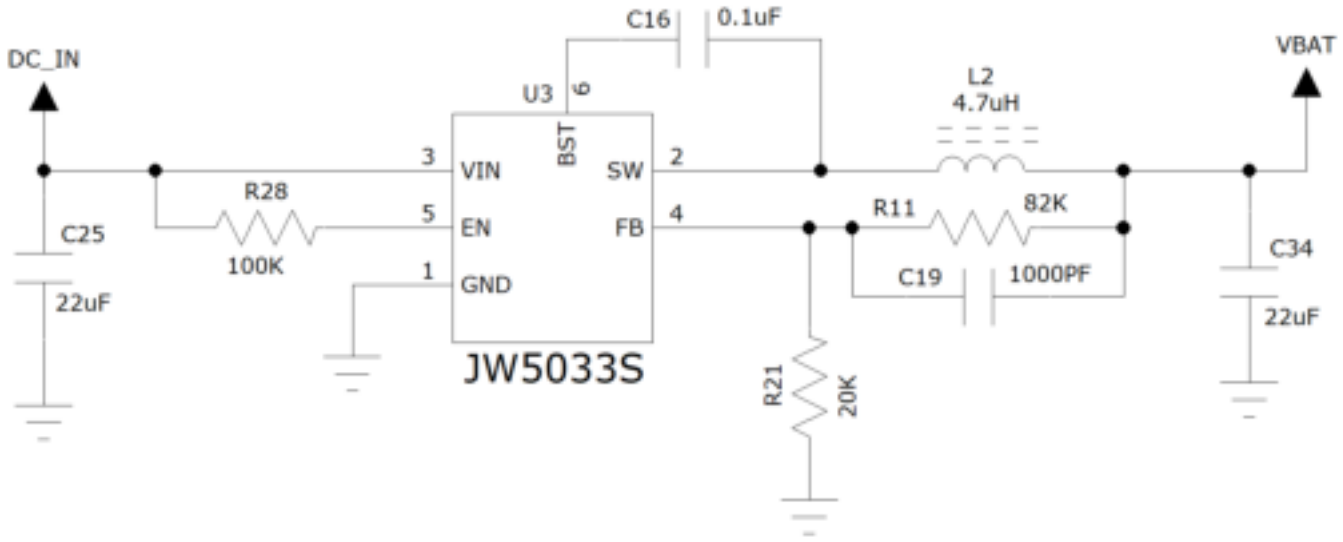


Figure 6: DCDC Power Supply Input Reference Design

Due to the DC-DC chip on the layout and alignment requirements, in order to simplify the design, you can also use the JW5033S power supply module introduced by Hopu: Air5033S to supply power to the 4G module, only need to add two filter capacitors, the reference circuit is as follows:

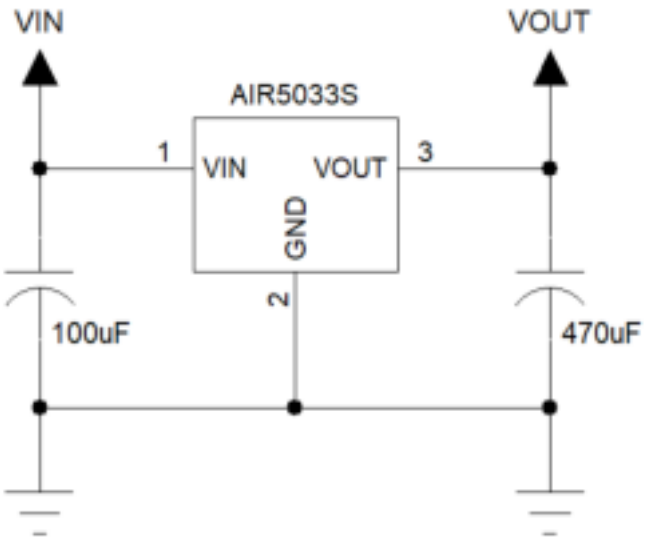


Figure 6: Air5033S Power Supply Input Reference Design

3.4. switching mode

3.4.1. begin shooting a film or TV show

pin name	pin number	IO	descriptions	Electrical Characteristics	note
PWRKEY	15	DI	Switch Control Pin, Low Active		

The A795U can be triggered to power on after the VBAT is powered up in the following three ways:

1. Pull PWRKEY down by more than 1.2 seconds.
2. Supply power to the VBUS pin to trigger charging on (not supported by AT firmware)
3. RTC Timed Power On (not supported by AT firmware)

3.4.1.1 PWRKEY pin on

After VBAT is powered on, the module can be started through the PWRKEY pin, after pulling the PWRKEY pin down for more than 1.2 seconds, the module will enter into the power-on process, and the software will detect the voltage of the VBAT pin, if the voltage of the VBAT pin is greater than the power-on voltage set by the software (3.1V), it will continue to power on the module until the power-on of the system is completed; otherwise, the power-

on action will be halted, and the system will be switched off, and the system will be switched off. The PWRKEY pin can be released after successful power-on. You can judge whether the module is powered on or not by detecting the level of VDD_EXT pin. It is recommended to use the open set driver circuit to control the PWRKEY pin. The following figure shows the reference circuit:

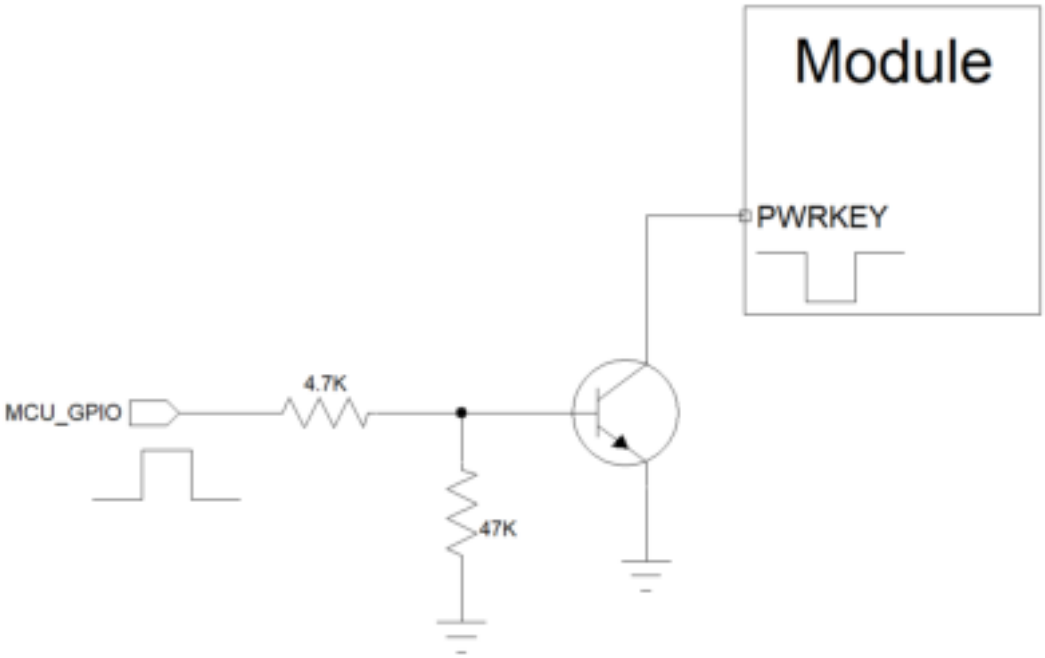


Chart5 : Open Set Driver Reference Power-Up Circuit

Another way to control the PWRKEY pin is to use a pushbutton switch directly. A TVS tube needs to be placed near the button for ESD protection. The figure below shows the reference circuit:

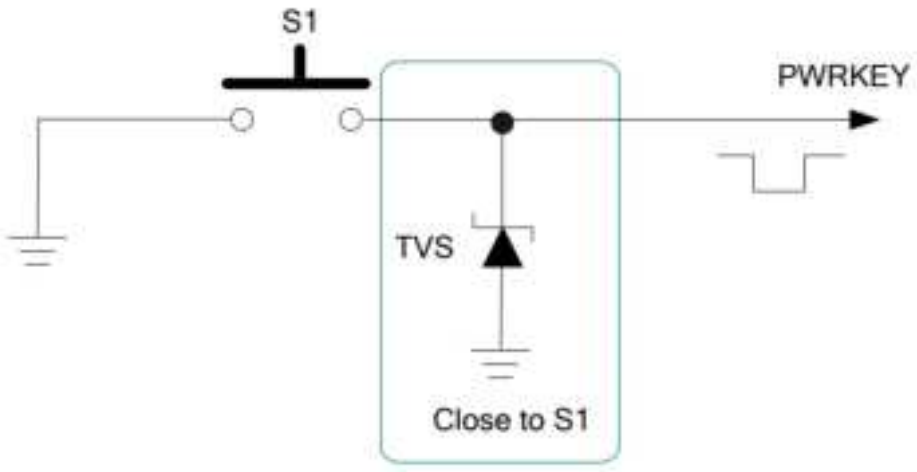
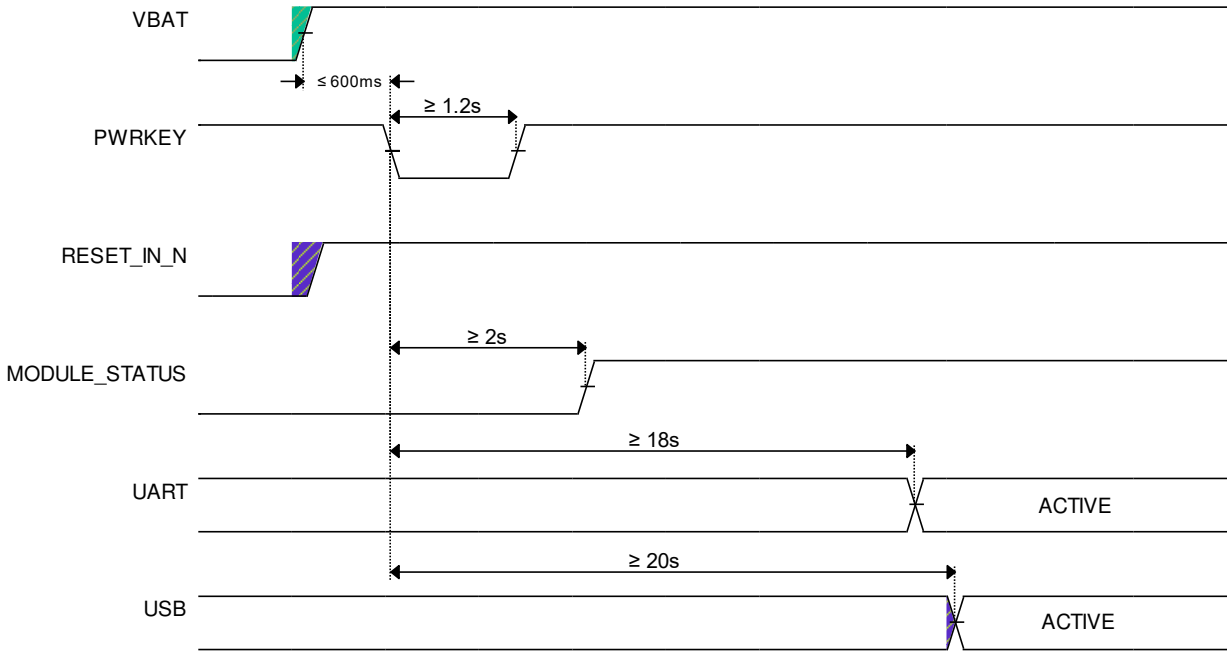


Chart6 : Key On Reference Circuit

Button on timing diagram:



3.4.1.2 Power-up and start-up

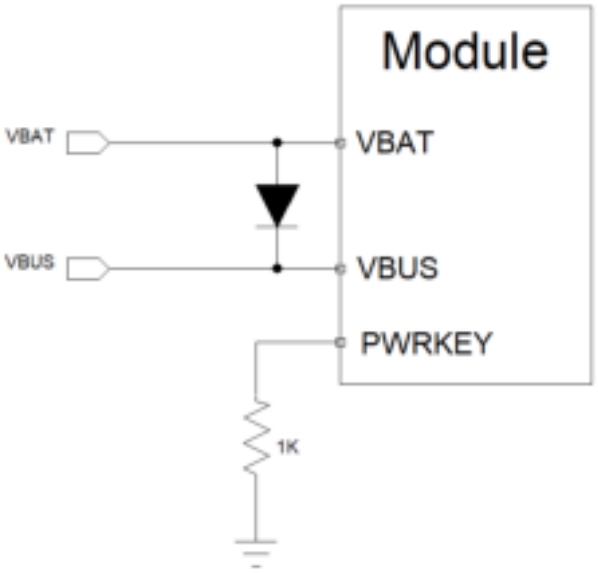
The power-on auto power-on function can be achieved by grounding the PWRKEY of the module directly. Note that in power-on mode, the module cannot be switched off, as long as the voltage at the VBAT pin is greater than the power-on voltage, even if the software calls the power-off interface, the module will still be switched on again. In addition, in this mode, in order to successfully power on the VBAT pin voltage should still be greater than the power-on voltage set by the software (3.1V), if it does not meet, the module will be shut down, and there will be repeated switching on and off.

For application scenarios powered by lithium batteries or other rechargeable batteries, it is recommended to give priority to the key-on method.

If you want to power on, besides pulling PWRKEY low, you must also connect the VBUS pin to the charger to trigger charging and power on, or add a Schottky diode between VBUS and VBAT to trigger charging and power on, or else, after the Li-Ion battery is over-discharged resulting in the module shutting down at a low voltage, when the Li-Ion battery is re-charged, because the voltage is still unstable, and the module will only detect the interruption of PWRKEY pulling low once, it will result in probabilistic failure to power on. The module will detect only one PWRKEY pull-down interrupt, which will lead to probable failure to power on.

Adding this Schottky diode increases the standby current by about 0.6mA.

The reference circuit is as follows:



3.4.2. finish shooting a film

The following ways are available to close the module:

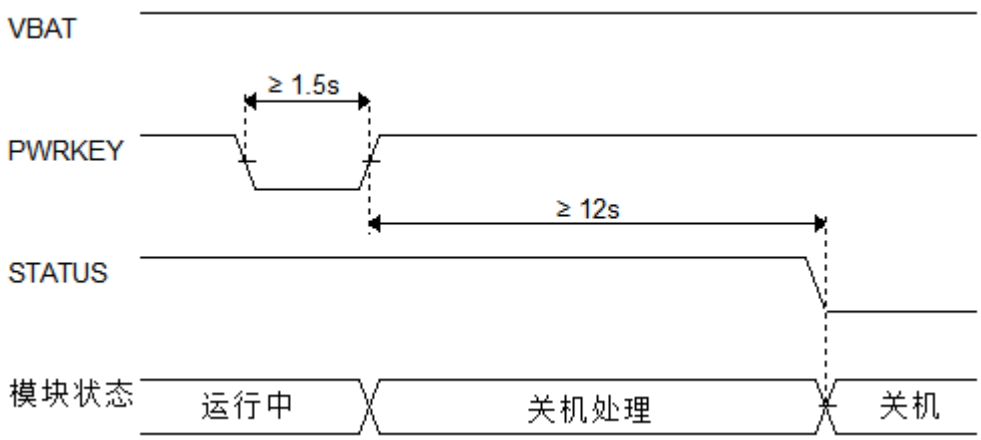
- Normal shutdown: shutdown using PWRKEY pin
- Normal shutdown: shutdown by AT command AT+CPOWD
- Low Voltage Auto Shutdown: The module shuts down when it detects low voltage, and the threshold value of low voltage can be set by AT instruction AT+CBC;

3.4.2.1 PWRKEY pin shutdown

The module performs a shutdown action when the PWRKEY pin is pulled low for more than 1.5s.

During the shutdown process, the module needs to log out of the network, the logout time is related to the current network status, which has been measured to take about 2s~12s, so it is recommended to extend the 12s before powering off or restarting to ensure that the software saves the important data before completely powering off.

The timing diagram is shown below:



3.4.2.2 Low voltage auto shutdown

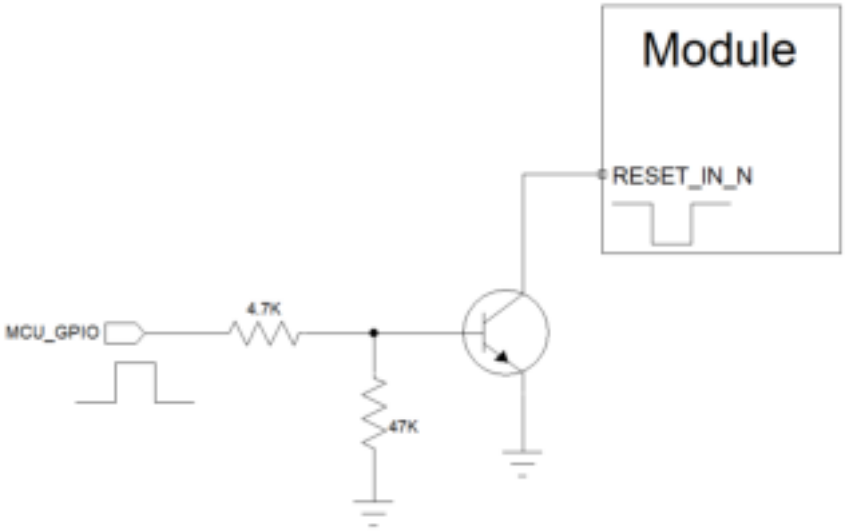
When the voltage of VBAT pin is lower than the shutdown voltage set by the software (default setting 3.1V), the software will perform shutdown action to shut down the module in order to prevent all kinds of abnormality under the operation of low-voltage state.

3.4.3 Reset

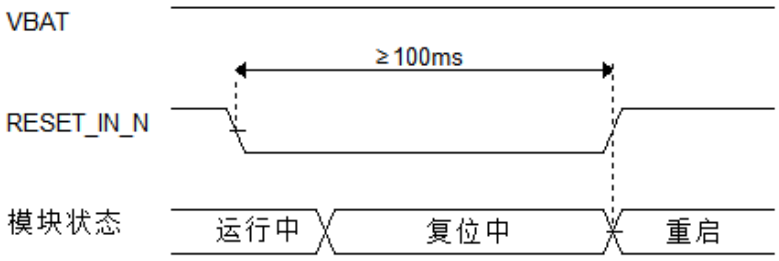
pin name	pin number	IO	descriptions	Electrical Characteristics	note
RESET_N	17	DI	Module reset input, low pulse is valid, the module is in hardware shutdown state after reset		If you don't use it, it hangs in the air.

The RESET_IN_N pin can be used to reset the module. Pulling down the RESET_IN_N pin for more than 100ms can reset the module. The RESET_IN_N signal is sensitive to interference, so it is recommended that the wiring on the module interface board be as short as possible and be ground-protected.

Reference Circuit:



Timing diagram.



Remarks:

1. The reset function is recommended for use only after AT+CPOWD and PWRKEY shutdown failures.

3.5. serial port (computing)

The module provides three general-purpose asynchronous transceivers: the main serial port UART, the extended serial port AUX_UART, and the debug serial port HOST UART.

3.5.1. MAIN_UART

Tables6 : MAIN_UART Pin Definitions

pin name	pin number	IO	descriptions	Electrical Characteristics	note
MAIN_TXD	35	DO	Main Serial Port Data Transmission	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
MAIN_RXD	34	DI	Main serial port data reception	DC Level:VDD_EXT	If you don't use it, it hangs in the air.

MAIN_CTS	36	DO	DTE Clear Transmit	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
MAIN_RTS	37	DI	DTE request sent	DC Level:VDD_EXT	If you don't use it, it hangs in the air.

For the Luat development method, MAIN_UART can be used as a general-purpose serial port to connect to other serial devices.

For AT development mode, MAIN_UART is used for AT command communication.MAIN_UART supports fixed baud rate and adaptive baud rate. MAIN_UART supports fixed baud rate and adaptive baud rate, the adaptive baud rate support range is 9600bps to 115200bps.

By default, the hardware flow control of the module is turned off. When the client needs hardware flow control, pins **RTS,CTS** must be connected to the client, **AT** command **"AT+IFC=2,2"** can be used to turn on the hardware flow control, **AT** command **"AT+IFC=0,0"** can be used to turn off the flow control. Please refer to "AirM2M Wireless Module AT Command Manual" for details.

The features of MAIN_UART are as follows:

- Includes data lines TXD and RXD, and hardware flow control lines RTS and CTS.
- 8 data bits, no parity, one stop bit.
- Hardware flow control is turned off by default.
- Used for AT command transmission, digital transmission, etc.
- Support baud rate as follows:
  1200,2400,4800,9600,14400,19200,28800,38400,57600,115200,230400,460800,921600bps
- AT command version By default the module is adaptive baud rate (AT+IPR=0), in adaptive baud rate mode, the initialisation message (starting with "RDY") will not be sent back to the master after power up. After the module is powered on for 2-3 seconds, AT command can be sent to the module. The master must first send an "AT" character to the module to train the baud rate of the master, and then the module will report the initialisation information, indicating that the training is successful. Users can send an "AT+IPR=x :&W" command to the module (x is the baud rate, for example, 9600), the function of this command is to set a fixed baud rate and save it, after these configurations are completed, every time the module is powered on, it will automatically return the initialisation information of the URC by the serial port (beginning with "RDY"). "RDY").

The following conditions of use need to be noted for better use of the Adaptive Baud Rate function:

Synchronisation between **the module and the host computer**:

If the adaptive baud rate function is enabled, when the module is powered on, it is better to wait for 2~3 seconds before sending the "AT" character. When the module reports power-on initialisation information, it indicates that the baud rate training is successful and synchronisation with the host computer is completed.

In adaptive baud rate mode, the master must first be synchronised if it requires power-up information. Otherwise the power-up initialisation information will not be reported.

Adaptive baud rate operation configuration:

- Serial port configured with 8 data bits, no parity bits, 1 stop bit (factory configuration)
- Only the string "AT" can train the baud rate when the module is switched on. ("at", "At" or "aT" are not recognised.)
- After successful baud rate training, AT commands can be recognised in upper case, lower case or a combination of upper and lower case.
- Switching to adaptive baud rate mode while in fixed baud rate mode is not recommended.
- In adaptive baud rate mode, switching to software multiplexing mode is not recommended.

3.5.2. AUX_UART

Tables7 : AUX_UART Pin Definitions

pin name	pin number	IO	descriptions	Electrical Characteristics	note
AUX_TXD	27	DO	Extended Serial Data Transmission	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
AUX_RXD	28	DI	Extended serial data reception	DC Level:VDD_EXT	If you don't use it, it hangs in the air.

AUX_UART can be used for RF calibration, and AUX_UART is also used to communicate with the internal Bluetooth, if the Bluetooth function is used, AUX_UART can not be used for other purposes.

Note: AUX_UART will automatically print a log after power on, baud rate 921600, this log can not be turned off by modifying the software, it is recommended to give priority to using MAIN_UART and UART3.

AUX_UART prints the following Log:

```
RDA8910m Boot_ROM V1.0-17b887ec
 HW_CFG: 36
 SW_CFG: 0
 SE_CFG: 0
 check flash img
 checking.....
 Security Disabled
 Check uImage Done
 Run ...
```

3.5.3. DBG_UART

pin name	pin number	IO	descriptions	Electrical Characteristics	note
DBG_TXD	23	DO	Debugging Serial Digital Transmission	DC Level:VDD_EXT	Can only be used to monitor debugging information
DBG_RXD	22	DI	Debugging Serial Inputs	DC Level:VDD_EXT	Can only be used to monitor debugging information

DBG_UART is used to output AP trace when software debugging, it is recommended to reserve test points.

3.5.4. Serial Connection Method

Serial port connection is more flexible, the following are three commonly used connection methods.

Please refer to the following connection method for the 3-wire serial port:

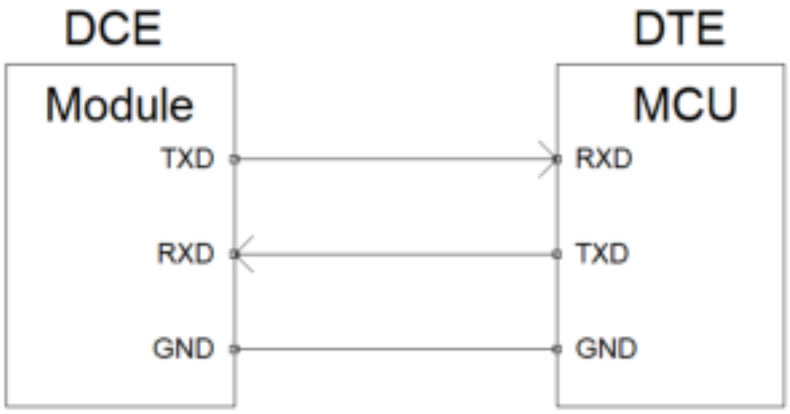


Chart7 : Diagram of the three-wire connection of the serial port

For serial port connection with flow control, please refer to the following circuit connection. This connection can improve the reliability of large data volume transmission and prevent data loss.

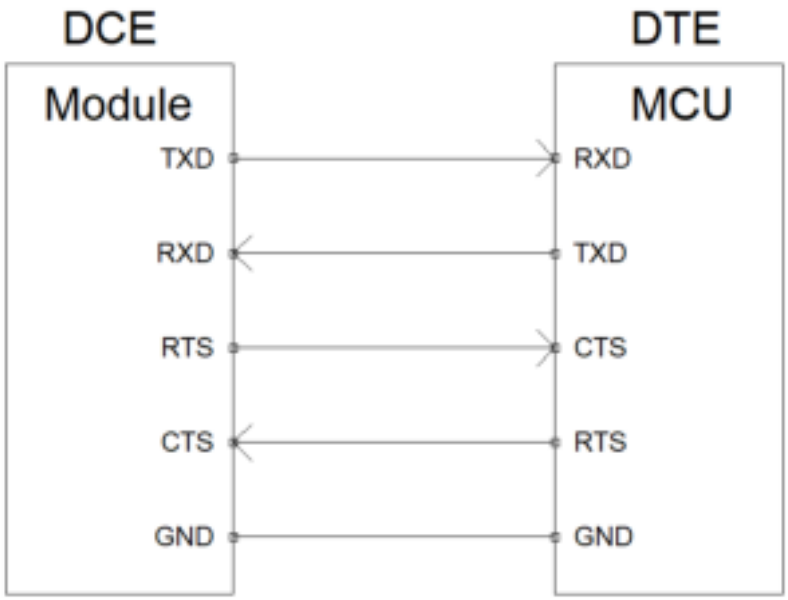
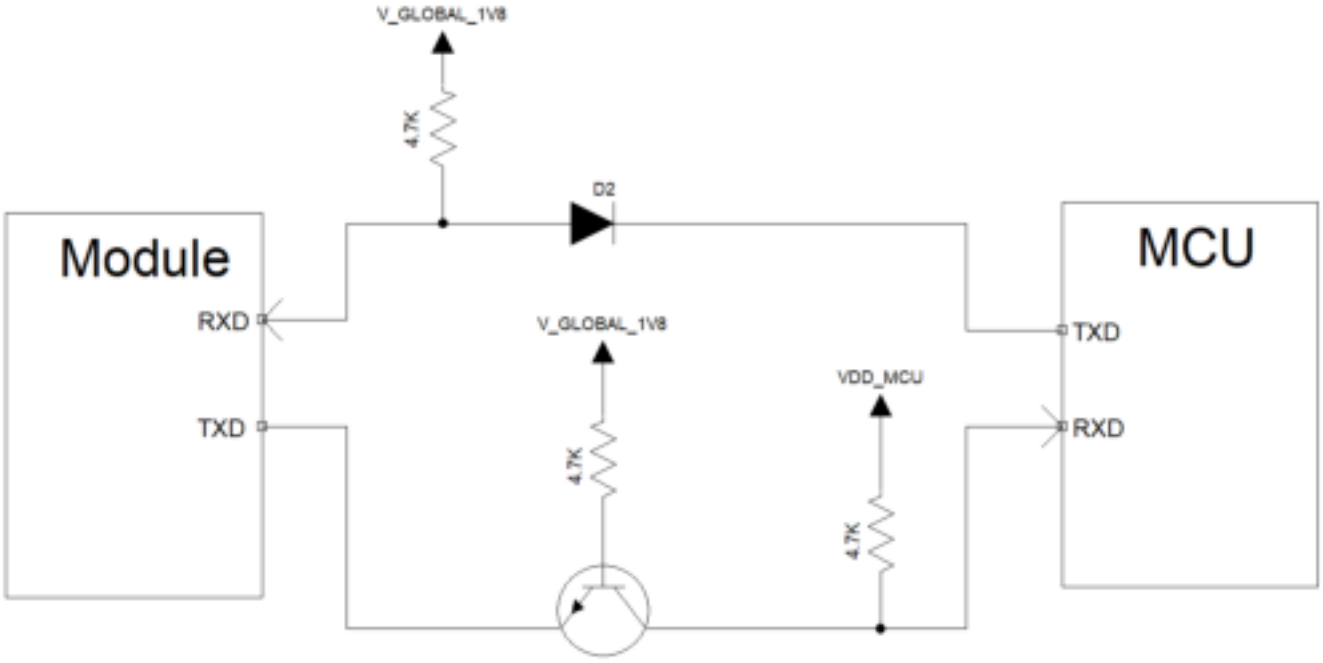


Chart8 : Diagram of serial port connection with flow control

3.5.5. Serial Voltage Conversion

The serial port levels of the A795U module are all 1.8V, so if you want to communicate with a 3.3V/5V MCU or other serial peripherals, you must add a level conversion circuit:

The level shifting reference circuit is as follows:



Note that this level shifter circuit is not suitable for applications with baud rates higher than 460800 bps;

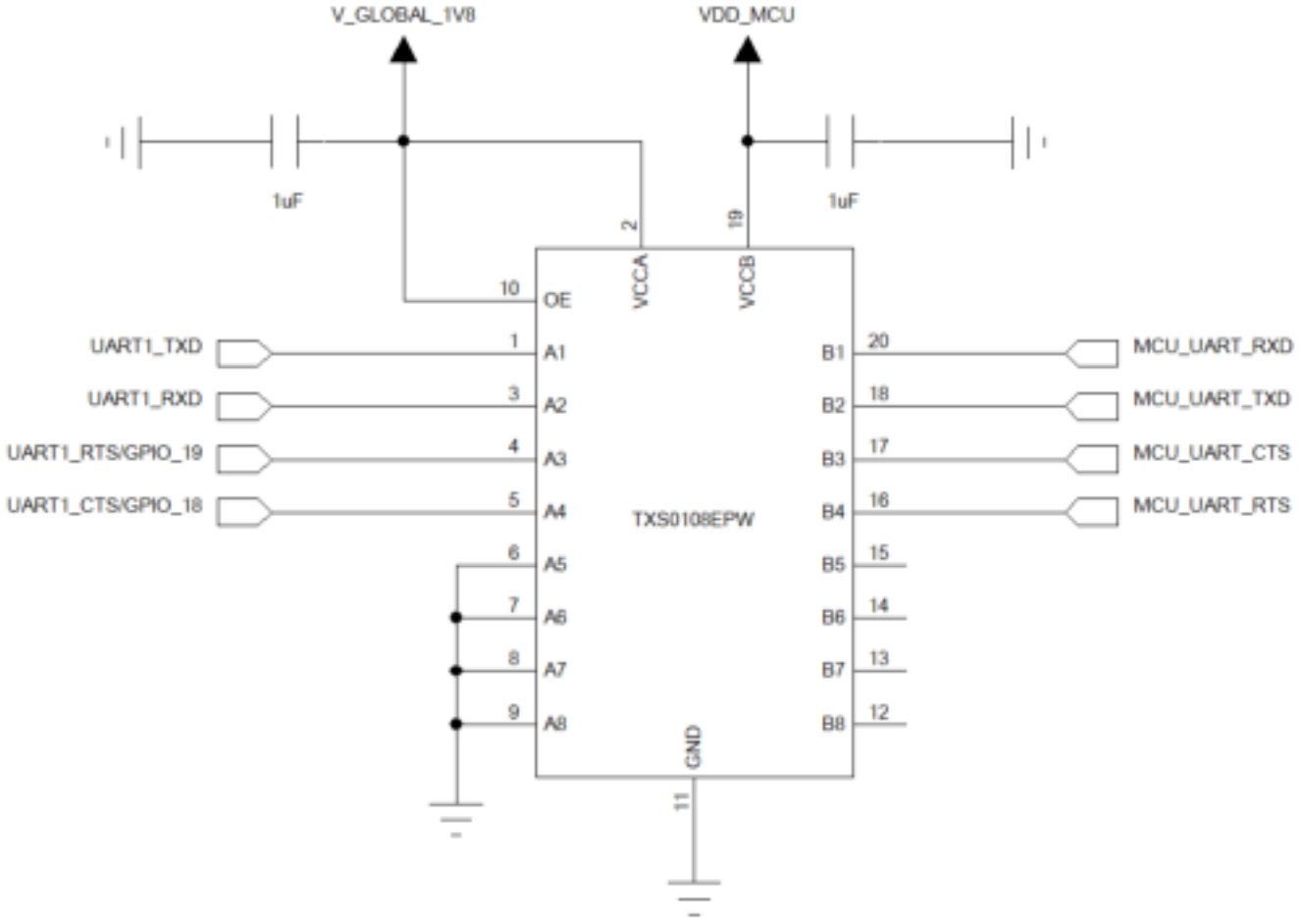
In the figure, VDD_EXT is the I/O reference voltage for module output. vdd_MCU is the I/O reference voltage for client.

D2 A Schottky diode with a low on-state voltage drop must be used.

Recommended models for Schottky diodes and NPN transistors are listed below:

Material Name	model number	company	descriptions
Schottky diode	RB521S-30	Jiangsu Changdian	Schottky Diode;30V;200mA;SOD523;1.6*0.8*0.6mm
	PSB521S-30	Shanghai WiseCrystal	Schottky Diode;30V;200mA;SOD523;1.6*0.8*0.6mm
	LRB521S-30T1G	LRC	Schottky Diode;30V;200mA;SOD523;1.6*0.8*0.6mm
	PSBD521S-30	Prisemi	Schottky Diode;30V;200mA;SOD523;1.6*0.8*0.6mm
NPN Triode	MMBT3904	Jiangsu Changdian	Transistor;NPN;40V;200mA;SOT23;1.1mm;ROHS
	MMBT3904	Shanghai WiseCrystal	Transistor;NPN;40V;200mA;SOT23;1.1mm;ROHS
	LMBT3904LT1G	LRC	Transistor;NPN;40V;200mA;SOT23;1.1mm;ROHS

For applications with baud rates higher than 460800bps, voltage conversion can be achieved by adding an external level conversion chip with the following reference circuit:



The level converter chip used in this circuit is TI's TXS0108E, an 8-bit bi-directional voltage level converter for open drain and push-pull applications, with maximum support rate:

Push-Pull: 110Mbps

Open leakage: 1.2Mbps

3.6. USB port

The A795U's USB is compliant with the USB 2.0 specification and supports high-speed (480Mbps), full-speed (12Mbps) modes and low-speed (1.2Mbps) modes.The USB interface can be used for AT command transfer, data transfer, software debugging and software upgrades.

Tables8 : USB Pin Definitions

pin name	pin number	IO	descriptions	Electrical Characteristics	note
VBUS	8	AI	USB plug-in wake-up	Recommended not to exceed 5.5V	Internal Resistor Voltage Divider
USB_DP	9	IO	USB2.0 Data Differential Signal		90 Ohm differential master control

USB_DM	10	IO	USB2.0 Data Differential Signal	90 Ohm differential master control

The USB interface reference design circuit is as follows:

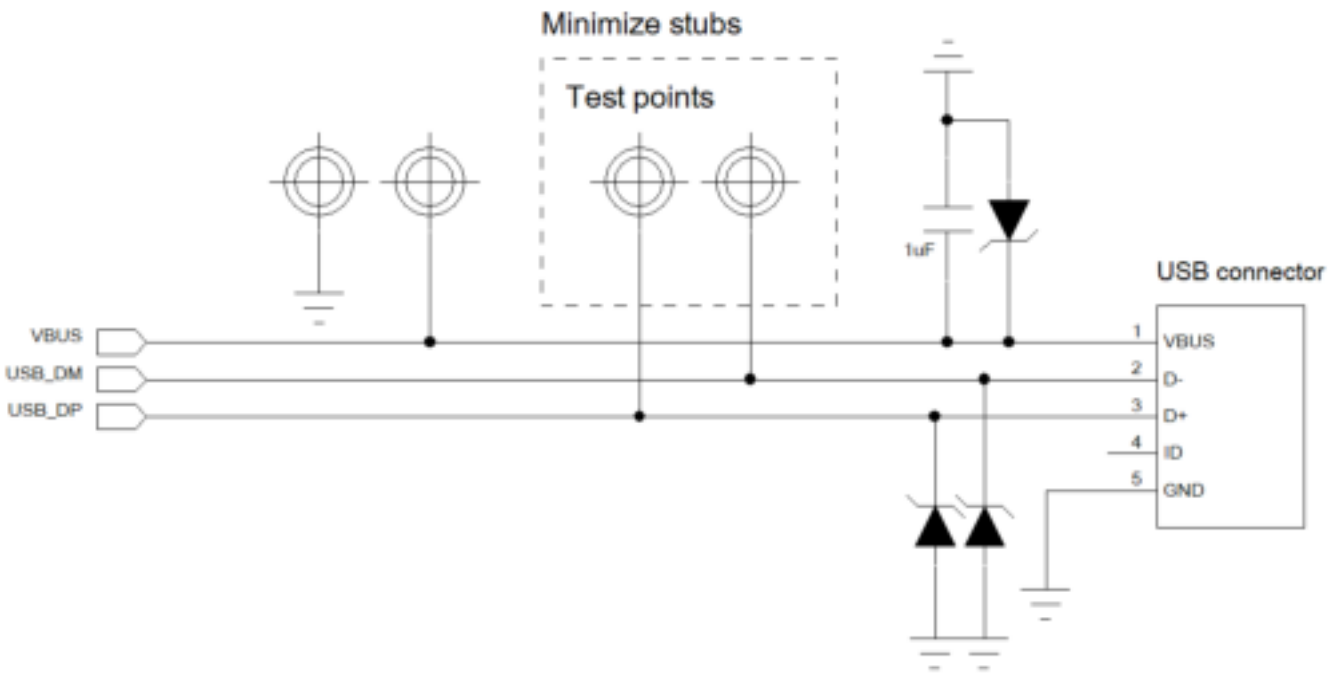


Chart9 : USB Interface Reference Design

The notes are as follows:

1. USB alignment needs to be strictly controlled by differential lines to be parallel and equal length;
2. The impedance of the USB alignment needs to be controlled to a differential 90 ohms;
3. It is necessary to reduce the stubs of the USB alignment as much as possible to reduce signal reflection; the test point of the USB signal is best placed directly on the alignment to reduce stubs;
4. Minimise the number of cross-holes for USB routing;
5. Near the USB connector or test point to add TVS protection tube, due to the high rate of USB, need to pay attention to the selection of TVS tube, to ensure that the selection of TVS protection tube parasitic capacitance of less than 1pF
6. VBUS as USB insertion detection, must be connected to the USB power supply or external power supply, otherwise USB can not be detected, VBUS detection voltage should be greater than 3.3V

3.7. USB download mode

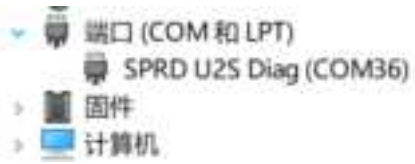
pin name	pin number	IO	descriptions	Electrical Characteristics	note
BOOT	75	DI	Download mode control pin, pull up to VDD_EXT before power on, the module will force into USB download mode		Be sure to reserve a test site
VDD_EXT	29	DO	Fixed output 1.8V	VDD_EXT=1.8V Imax= 100mA	If you don't need to keep it suspended

There are two ways for the A795U module to enter USB download mode:

1. Before booting, pull BOOT/up to VDD_EXT
2. Before powering up, pull BOOT/up to an external 1.8V level

It is recommended to reserve test points for BOOT and VDD_EXT for easy downloading and debugging.

The module will enumerate the ports shown below when it enters USB download mode:



After entering the debug mode, you will not be able to boot normally, so please do not pull up the BOOT to VDD_EXT for normal booting.

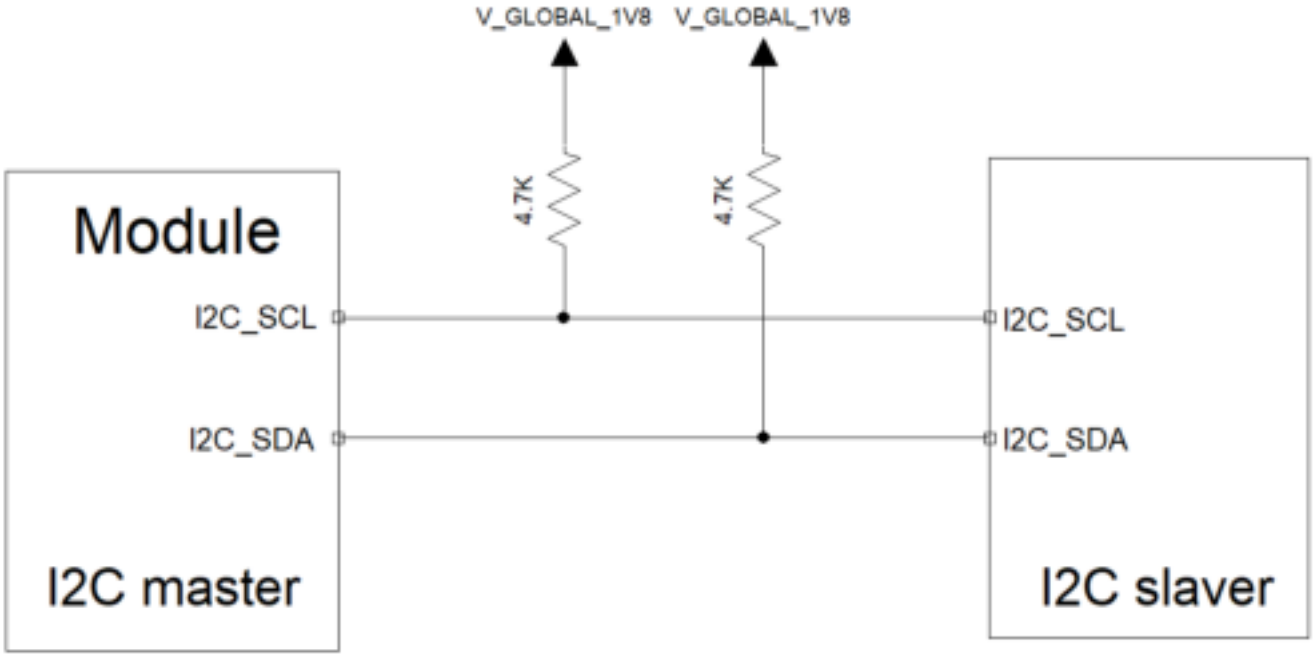
3.8. I2C

pin name	pin number	IO	descriptions	Electrical Characteristics	note
I2C_SCL	40	OD	I2C Interface Clock Signal		External pull-up required
I2C_SDA	41	OD	I2C interface data signals		External pull-up required

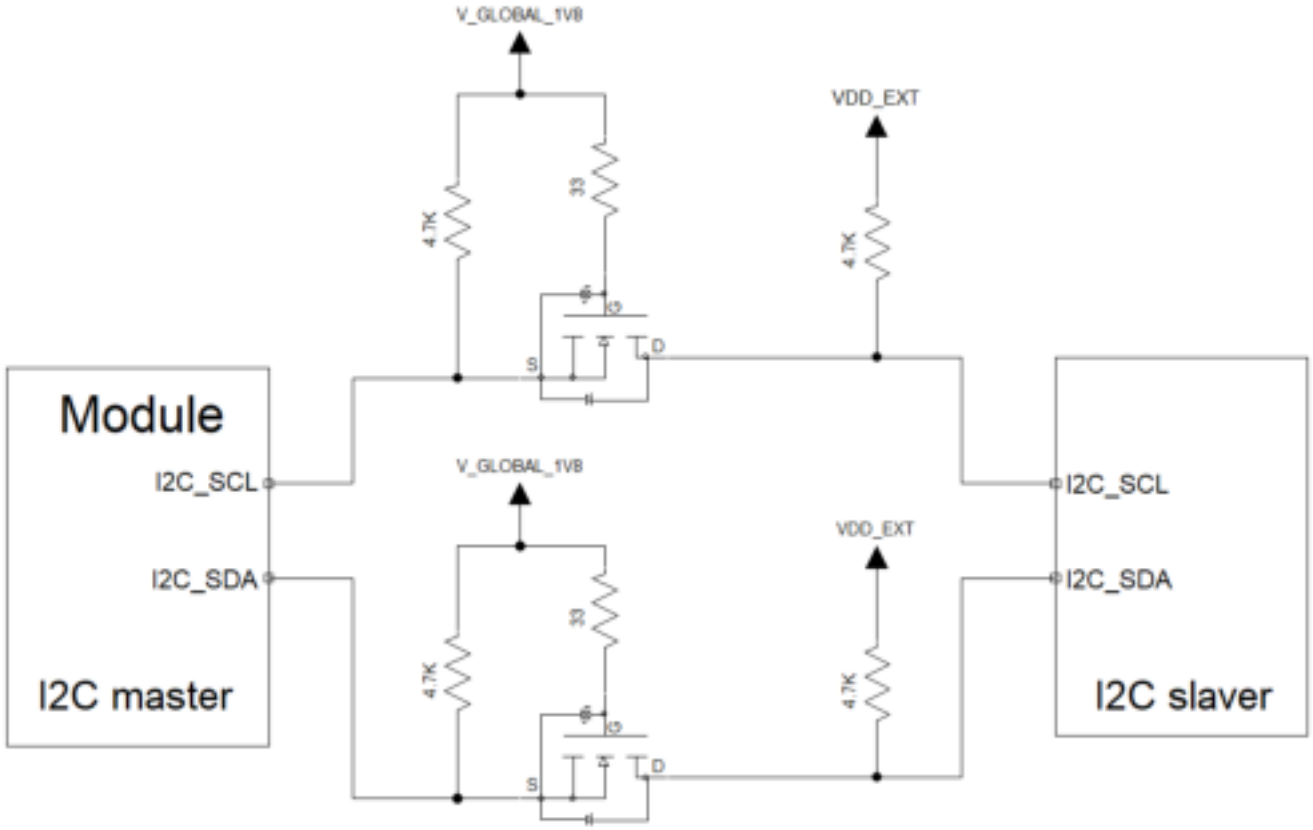
The A795U can support two I2C interfaces:

- Compatible with Philips I2C standard protocols
- Fast mode (400Kbps) and Slow mode (100Kbps) are supported.
- Only master mode is supported, not slaver mode.
- Software configurable internal pull-up resistor, 1.8K or 20K.
- Theoretically supports up to 127 slave devices

The reference circuit for I2C is as follows:



The I2C interface voltage of A795U is 1.8V, if you want to connect 3.3V/5V I2C device, you need to add level conversion circuit, the reference circuit is as follows:



VDD_EXT is the reference voltage for the module I2C. vdd_ext is the reference voltage for the I2C device.

NMOS tubes for level conversion must be selected with a junction capacitance of less than 50pF, and the recommended models are as follows:

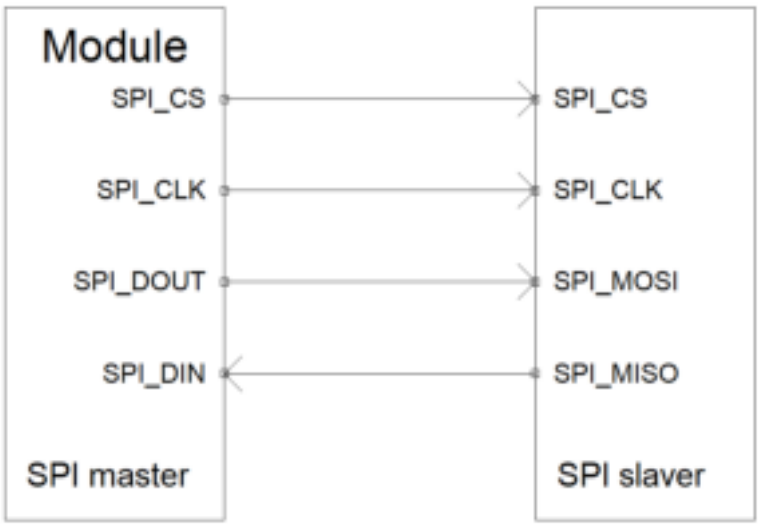
Material Name	model number	company	descriptions
NMOS	BSS138	Jiangsu Changdian	N-Channel,50V,0.22A,SOT-23,ROHS
	BSS138	UMW (Youtai Semiconductor)	N-Channel,50V,0.3A,SOT-23,ROHS

3.9. Standard SPI

pin name	pin number	IO	descriptions	Electrical Characteristics	note
SPI_CLK	26	DO	SPI Clock	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
SPI_CS	25	DO	SPI Chip Select	DC Level:VDD_EXT	If you don't use it, it hangs in the air.

SPI_DIN	88	DI	SPI Data Input	DC Level:VDD_EXT	If you don't use it, it hangs in the air.
SPI_DOUT	64	DO	SPI Data Output	DC Level:VDD_EXT	If you don't use it, it hangs in the air.

The SPI of A795U only supports master mode, the reference circuit is as follows:

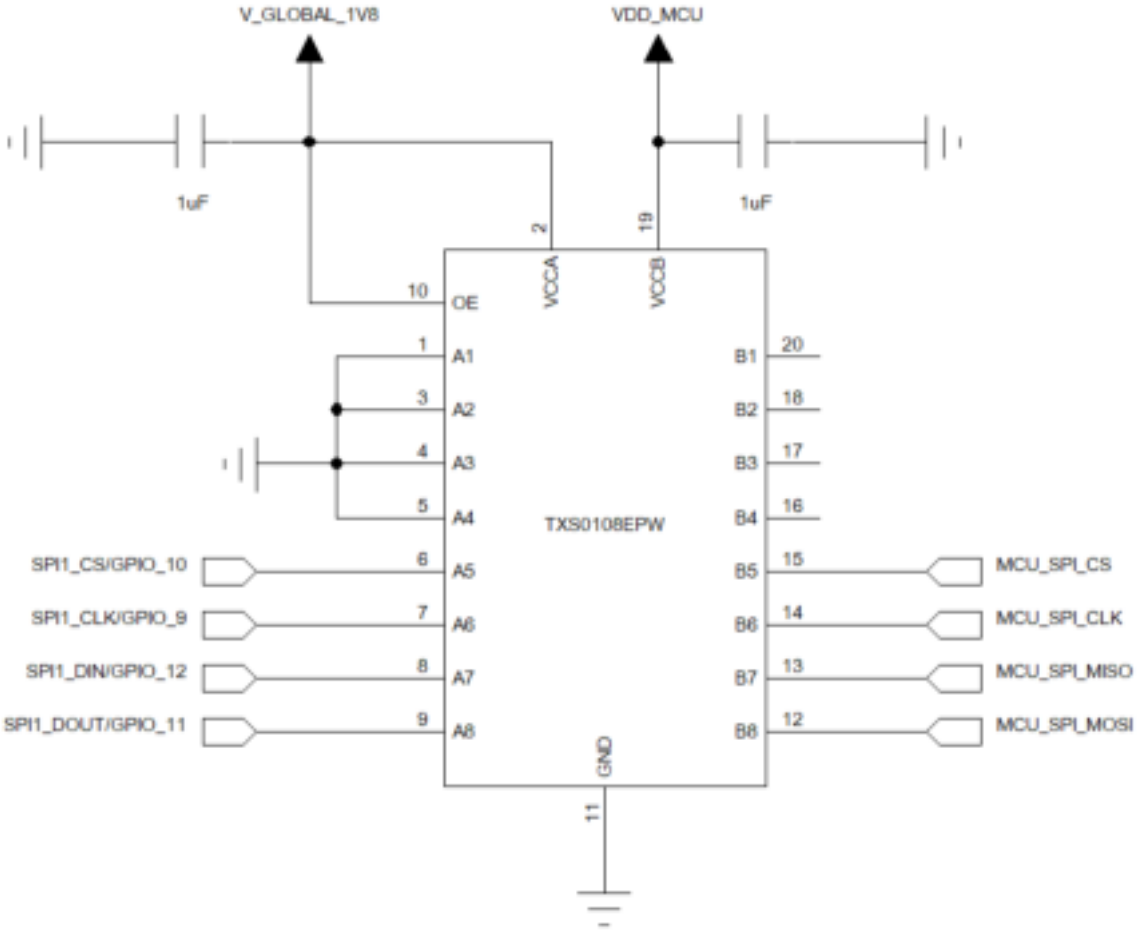


The SPI interface voltage of A795U is 1.8V, if you need external 3.3V/5V peripherals, you need to add a level converter chip, and we recommend TI's TXS0108E, an 8-bit bi-directional voltage level converter for open drain and push-pull applications, with maximum support rate:

Push-Pull: 110Mbps

Open leakage: 1.2Mbps

The SPI level conversion reference circuit is as follows:



3.10. SIM card interface

The SIM card interface supports ETSI and IMT-2000 card specifications and 1.8V and 3.0V USIM cards.

Supports dual SIM single standby.

3.10.1. SIM interface

The following table describes the pin definitions for the SIM interface.

Tables9 : SIM Card Interface Pin Definitions

pin name	pin number	IO	descriptions	Electrical Characteristics	note
SIM1_RST	44	DO	USIM1 card interface reset signal	1.8V/3.3V	
SIM1_CLK	46	DO	USIM1 card interface clock signal	1.8V/3.3V	
SIM1_DAT	45	IO	USIM1 card for data signals	1.8V/3.3V	
SIM1_VDD	43	PO	USIM1 card to power signal	1.8V/3.3V	

SIM1_DET	42	DI	USIM1 card interface presence detection	1.8V/3.3V
SIM2_RST	85	DO	USIM2 card interface reset signal	1.8V/3.3V
SIM2_CLK	84	DO	USIM2 card interface clock signal	1.8V/3.3V
SIM2_DAT	86	IO	USIM2 card for data signals	1.8V/3.3V
SIM2_VDD	87	PO	USIM2 card to power signal	1.8V/3.3V

3.10.2. SIM1 and SIM2 card switching logic

The A795U supports dual SIM1 and SIM2 single standby;

After the module is switched on, it will firstly query whether there is a SIM card inserted in the SIM1 interface, if the SIM card is detected on the SIM1 interface, it will read the card information of the SIM1 interface to connect to the network; if the SIM card is not detected on the SIM1 interface, it will then go to the SIM2 interface to detect whether there is a SIM card on the SIM2 interface; if it detects the SIM card on the SIM2 interface, it will read the SIM2 interface card information to connect to the network; if no SIM card is detected on the SIM2 interface either, it will report an error that no SIM card has been inserted;

If SIM cards are inserted into both SIM1 and SIM2 interfaces, the SIM card on the SIM1 interface will be used by default, and it can also be switched by the command AT+SIMCROSS;

SIM interface reference circuit

The following figure shows the reference circuit for the SIM interface, using a 6pin SIM card holder.

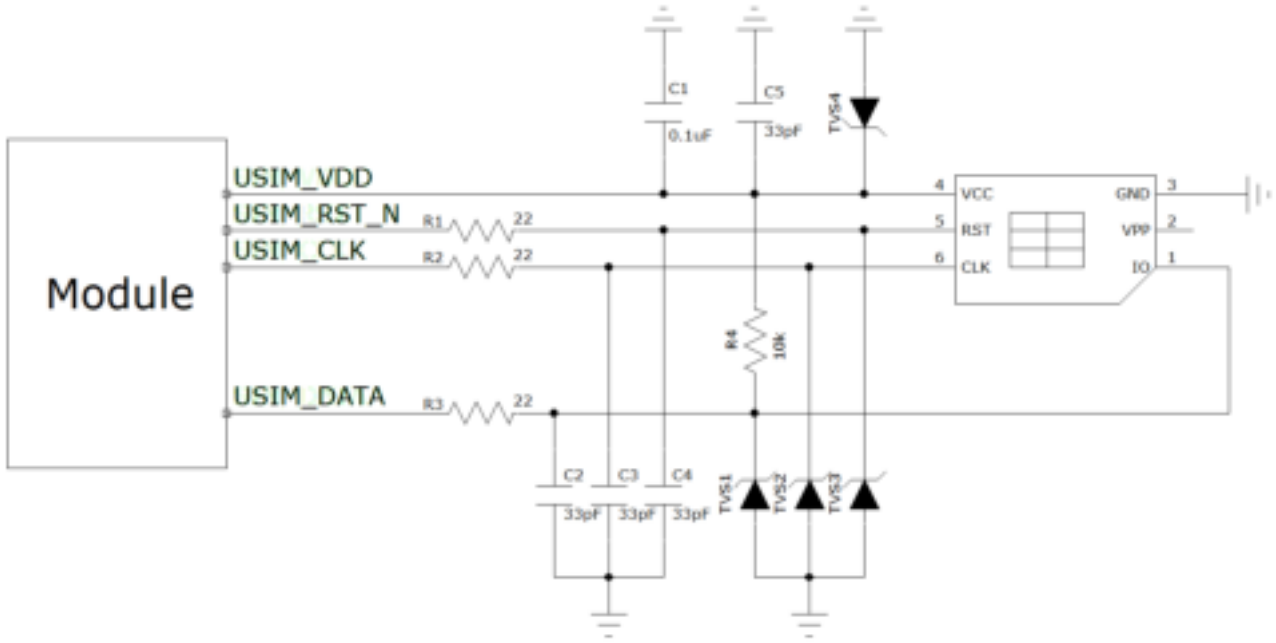


Chart10 : Reference Circuit Diagram for Using 6pin SIM Card Holder (SIM)

If sim card presence detection is required, the recommended circuit is as follows.

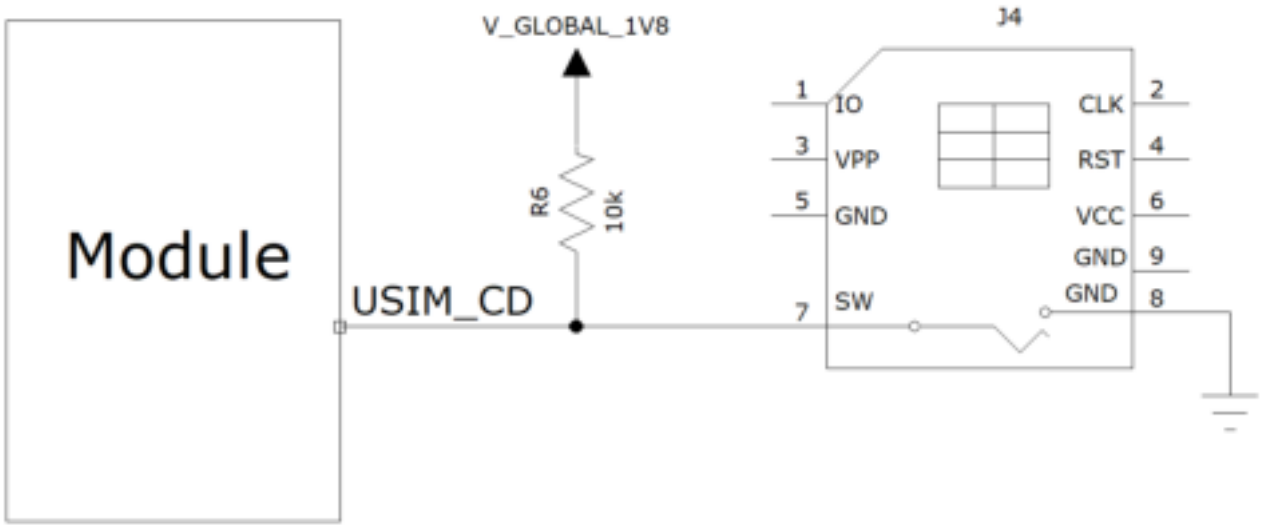


Chart 11 : Reference Circuit Diagram for SIM Card Holder with PIN Detection

In the circuit design of the SIM card interface, the following design principles are recommended in the circuit design in order to ensure good functional performance of the SIM card and not to be damaged:

1. SIM card holder and module distance from the pendulum can not be too far, the closer the better, try to ensure that the SIM card signal cable wiring does not exceed 20cm.
2. SIM card signal wiring is routed away from RF lines and VBAT power lines.
3. In order to prevent possible crosstalk of the USIM_CLK signal to the USIM_DATA signal, do not route the two too close together, and add ground shielding between the two alignments. And ground protection is also required for the USIM_RST signal.
4. To ensure good ESD protection, it is recommended to add TVS tubes and place them close to the SIM card holder. The parasitic capacitance of the selected ESD device should not be greater than 50pF. 22 ohm resistors can also be connected in series between the module and the SIM card to suppress stray EMI and enhance ESD protection. the peripheral circuits of the SIM card must be placed as close as possible to the SIM card holder.

3.11. audio interface

The module provides one analogue audio input channel and one analogue output channel, supporting functions such as call, recording and playback.

3.11.1. Protection against TDD noise and other noise

It is recommended to use an electret microphone with built-in RF filtering dual capacitors (e.g. 10pF and 33pF) for the microphone of the handheld joystick and handsfree, to filter the RF interference from the source of the interference, which will improve the coupled TDD noise to a great extent.The 33pF capacitor is used to filter out the high-frequency interference when the module operates at the frequency of 900MHz. Without this capacitor, it is possible to hear TDD noise during a call. The 10pF capacitor is also used to filter out high frequency interference when operating at 1800MHz. It should be noted that since the resonance point of the capacitor depends greatly on the material of the capacitor as well as the manufacturing process, it is necessary to consult with the supplier of the

capacitor when selecting the capacitor to choose the most suitable capacitance value to filter out high frequency noise.

The RF filter capacitors on the PCB board should be placed as close as possible to the audio device or audio interface, and the alignment should be as short as possible, going through the filter capacitors first and then to other points.

Position the antenna as far away from the audio components and audio alignment as possible to reduce radiated interference, the power alignment and audio alignment should not be parallel, and the power cable should be as far away from the audio cable as possible.

Differential audio alignments must follow the Layout rules for differential signals.

3.11.2. microphone connector

pin name	pin number	IO	descriptions	Electrical Characteristics	note
MIC_N	119	AI	MIC differential input (-)		If you don't use it, it hangs in the air.
MIC_P	126	AI	MIC differential input (+)		If you don't use it, it hangs in the air.
MICBIAS	120	PO	MIC bias voltage supply		If you don't use it, it hangs in the air.

The reference circuit is shown below:

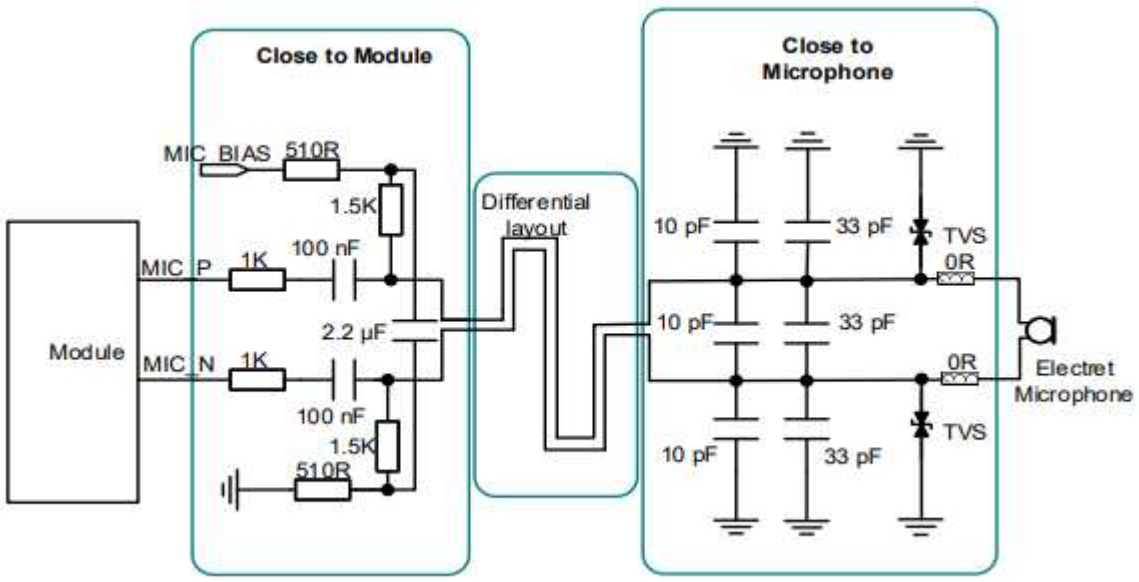


Chart12 : AIN Microphone Channel Interface Circuit

3.11.3. speaker output connector

pin name	pin number	IO	descriptions	Electrical Characteristics	note
SPK_P	121	AO	Analogue voice output differential signal (+)		
SPK_N	122	AO	Analogue voice output differential signal (-)		

The speaker output channel can directly drive an 8 ohm speaker with the following reference circuit:

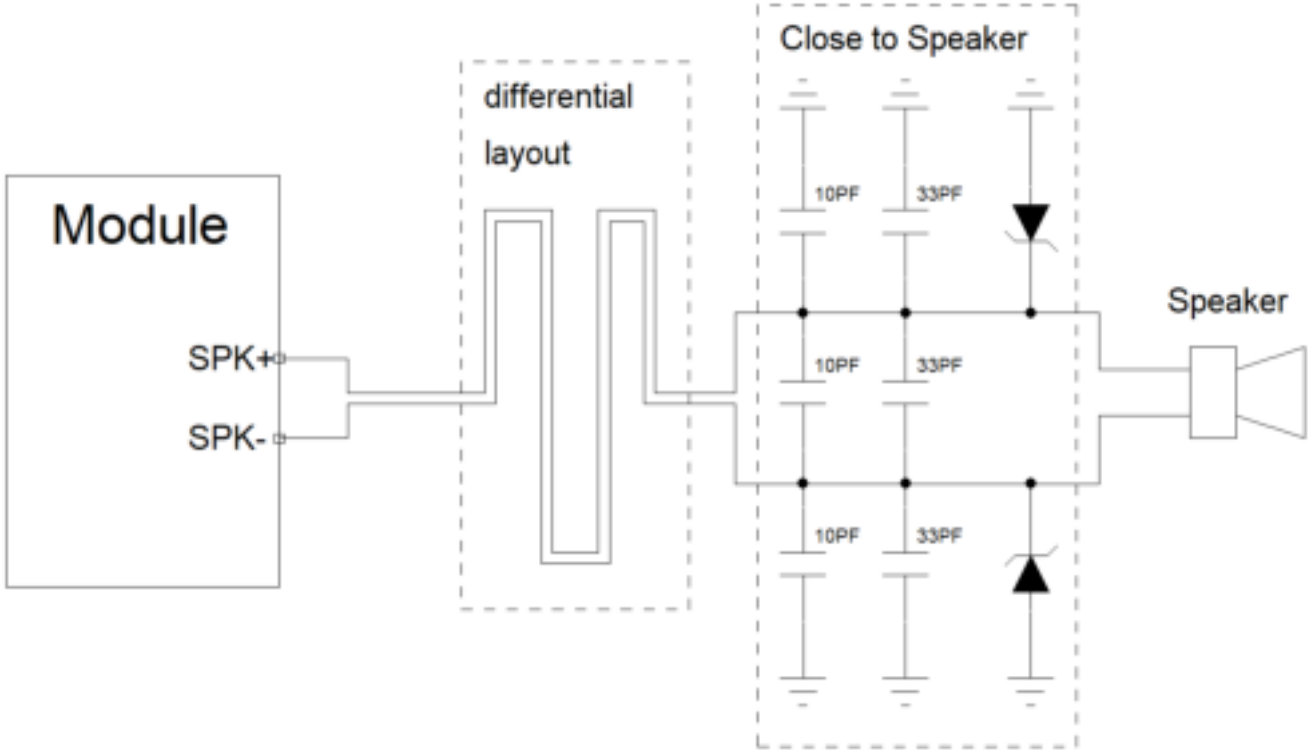


Chart13 : Horn Output Reference Line

- Speaker's alignment needs to be in differential form, parallel and equal length;
- Speaker recommends a wire width of 0.5mm or more;
- The built-in audio PA of the module can be configured as Class-AB mode or Class-D mode, when working in Class-D mode, the Speaker alignment is particularly big interference to the outside world, so pay attention to stay away from the sensitive signal lines when Layout;
- The 10pF and 33pF filter capacitors need to be placed close to the speaker;
- It is recommended to reserve the TVS protection tube and place it close to the speaker;
- If the output power of the built-in PA is not large enough, you can add an audio amplifier, note that you must choose an audio amplifier that supports differential inputs, and configure the module's built-in PA operating mode as Class-AB.

Tables10 Horn Output Performance Parameters (Class-AB Mode), Test Conditions: 25°C, VBAT=4.2V

parametric	prerequisite	minimum value	typical value	maximum values	unit (of measure)
Full-scale output voltage	0 dB gain, 8Ω load	5	6		Vpp
Output power	0 dB gain, 8Ω load THD+N=0.1%	300	500		mW
	0 dB gain, 8Ω load THD+N=1 per cent	400	600		mW
	0 dB gain, 8Ω load THD+N=10 per cent	600	900		mW
SNR	0 dB gain, 8 Ω load, 0 dB gain, 8 Ω load, 0 dB gain, 8 Ω load, 0 dB gain Po=200mW	90	100		dB
THD	0 dB gain, 8 Ω load, 0 dB gain, 8 Ω load, 0 dB gain, 8 Ω load, 0 dB gain Po=200mW		0.01 per cent	0.02 per cent	dB
Idle noise	0 dB gain, 8Ω load		17	20	uV

Tables11 Speaker Output Performance Parameters (Class-D Mode), Test Conditions: 25°C, VBAT=4.2V

parametric	prerequisite	minimum value	typical value	maximum values	unit (of measure)
Full-scale output voltage	0 dB gain, 8Ω load	7	8		Vpp
Output power	0 dB gain, 8Ω load THD+N=0.1%	350	500		mW
	0 dB gain, 8Ω load THD+N=1 per cent	600	800		mW
	0 dB gain, 8Ω load THD+N=10 per cent	700	900		mW
SNR	0 dB gain, 8 Ω load, 0 dB gain, 8 Ω load, 0 dB gain, 8 Ω load, 0 dB gain	90	98		dB

	Po=300mW				
THD	0 dB gain, 8 Ω load, 0 dB gain, 8 Ω load, 0 dB gain, 8 Ω load, 0 dB gain Po=300mW		0.02 per cent	0.1%	dB
Idle noise	0 dB gain, 8Ω load		25	30	uV

3.12. ADC

A795U Supports two ADC inputs

pin name	pin number	IO	descriptions	Electrical Characteristics	note
ADC0	24	AI	Analogue-to-digital ADC Channel 0	Range 0~1.4V	External resistor is required for over-range
ADC1	2	AI	Analogue-to-digital ADC Channel 1	Range 0~1.4V	External resistor divider required if over range

Tables12 : ADC Performance

parameters	prerequisite	minimum value	typical value	maximum values	unit (of measure)
resolution (of a photo)			11		bits
Input Voltage Range	Input scale ratio=1:1	0		1.25	V
	Input scale ratio=1.92:1	0		2.4	V
	Input scale ratio=2.56:1	0		3.2	V
	Input scale ratio=4:1	0	VBAT	5	V
accurate	Input scale ratio=1:1		10		mV
	Input scale ratio=4:1 input 3.6~4.2V		20		mV
conversion time			50		us

Attention:

1. Do not connect any input voltage to the ADC connector when the VBAT is not powered.
2. The limiting input voltage of the ADC is 5V;
3. The default range set by the software is 0-VBAT, if the input voltage exceeds VBAT, it will result in a large error in the value acquired by the ADC;
4. The accuracy of the ADC can be adjusted by setting different ranges in software;

3.13. Function Pins

3.13.1. MAIN_RI

pin name	pin number	IO	descriptions	Electrical Characteristics	note
MAIN_DTR	39	DO	Main serial port data ringing signal	DC Level:VDD_EXT	If you don't use it, it hangs in the air.

Tables13 : MAIN_RI Signal Action

state of affairs	MAIN_RI answer
pragmatic	high level
voice call	goes low, after that: （1） Goes high when call is established （2） Using the AT command ATH hangs up the voice and MAIN_RI goes high （3） Caller hangs up, MAIN_RI first goes high, then pulls low for 120ms, receives auto-reply URC message "NO CARRIER", then goes high again after that （4） Goes high when a text message is received
data transmission	goes low, after that: 2. Goes high when a data connection is established 3. Use the AT command ATH to hang up the data connection, MAIN_RI goes high 4. Caller hangs up, MAIN_RI first goes high, then pulls low for 120ms, receives auto-reply URC message "NO CARRIER", then goes high again after that 5. Goes high when a text message is received
text messaging	When a new SMS is received, MAIN_RI goes low for 120ms and goes high again
URC	Certain URC messages can trigger MAIN_RI to pull down for 120ms.

If the module is used as the calling party, MAIN_RI will remain high, except when a URC message or SMS is received. And when the module is used as the called party, the timing of MAIN_RI is shown below:

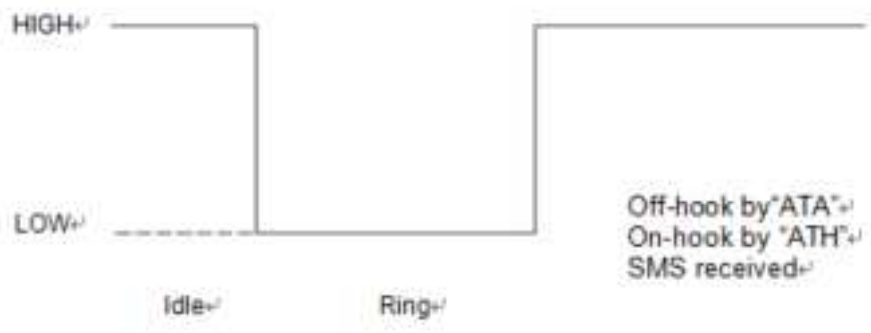


Chart14 : Module used as called party MAIN_RI timing for voice calls

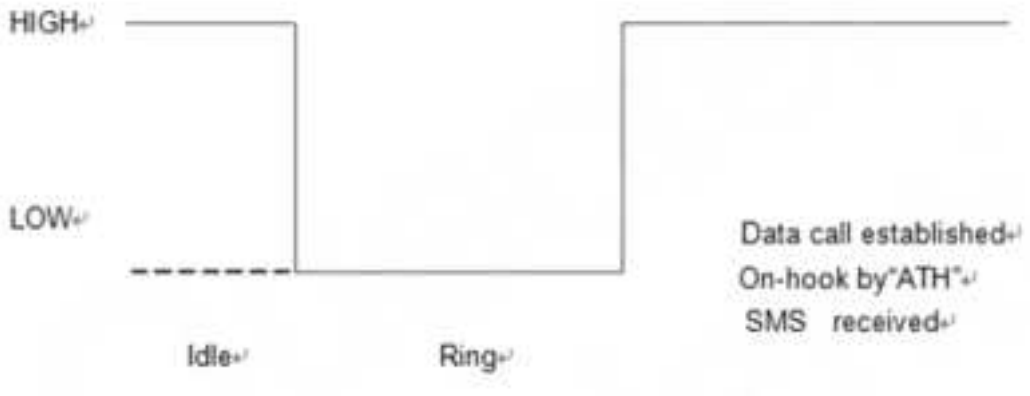


Chart15 : Module used as called party MAIN_RI timing for data calls

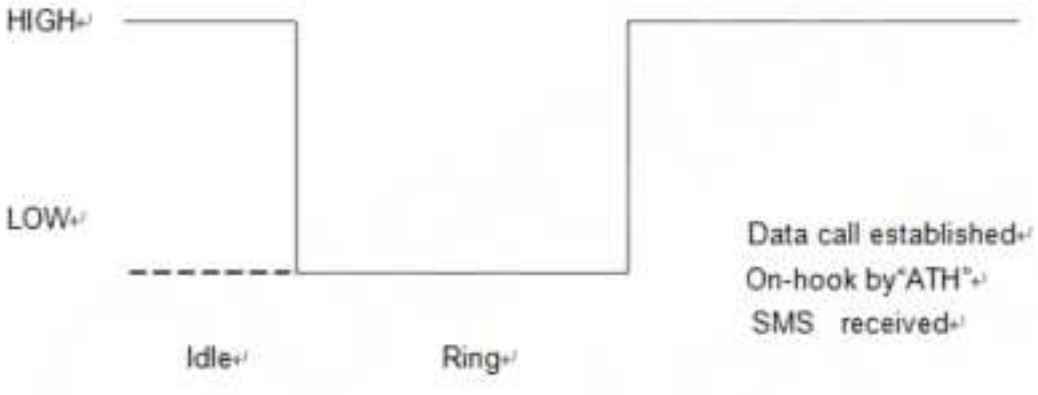


Chart16 : MAIN_RI Timing for Module Calls

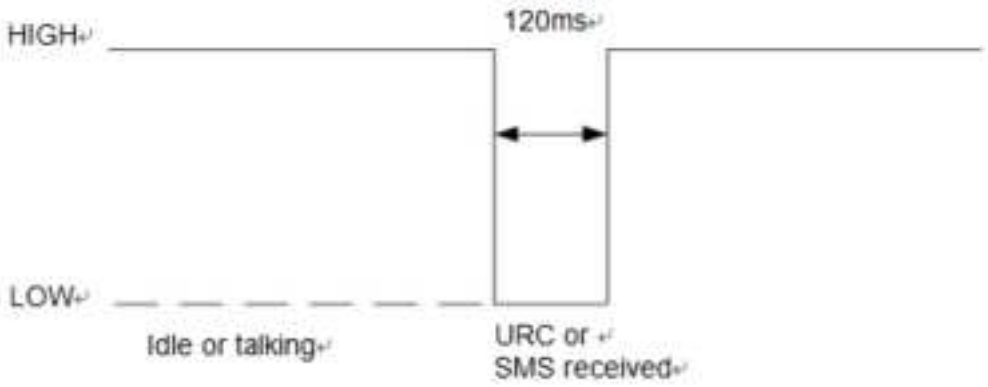


Chart17 : MAIN_RI timing when receiving URC messages or SMS messages

3.13.2. MAIN_DTR

pin name	pin number	IO	descriptions	Electrical Characteristics	note
MAIN_DTR	30	DI	Main serial port data terminal ready, ground active, wake module from hibernation	VDD= 1.8V VIH= 0.7*VDD VIL=0.2* VDD	If you don't use it, it hangs in the air.

The module supports two sleep modes:

Sleep mode 1: send AT+CSCLK=1 to control whether the module goes to sleep or not by MAIN_DTR pin level

Sleep mode 2: send AT+CSCLK=2, the module automatically enters sleep after the serial port has been idle for a period of time

For details, refer to 3.20.2 Sleep mode

3.13.3. Status Indicator

The A795U uses one pin to indicate the power-on state and two pin signals to indicate the state of the network. The following two tables describe the pin definitions and the logic level changes for different network states, respectively:

Tables14 : Network Indication Pin Definitions

pin name	pin number	IO	descriptions	Electrical Characteristics	note
STAUS	20	DO	Indicates module operating status		If you don't use it, it hangs in the air.
NET_STATUS	21	DO	Indicates network status		If you don't use it, it hangs in the air.

Tables15 : Indicates the operating status of the network pins

state of affairs	Pin operating status	network state
STATUS	your (honorific)	Register to LTE network
	lower (one's head)	the rest
NET_STATUS	Lights up for 0.2	search network status
	1.8 seconds on, 0.2	pragmatic

	Lights up for 0.125 seconds, goes out for 0.125 seconds	data transmission status Note: This status indication is limited to PPP dialling success or AT command active activation of PDP success and RNDIS networking success.

The indicator reference circuit is shown below:

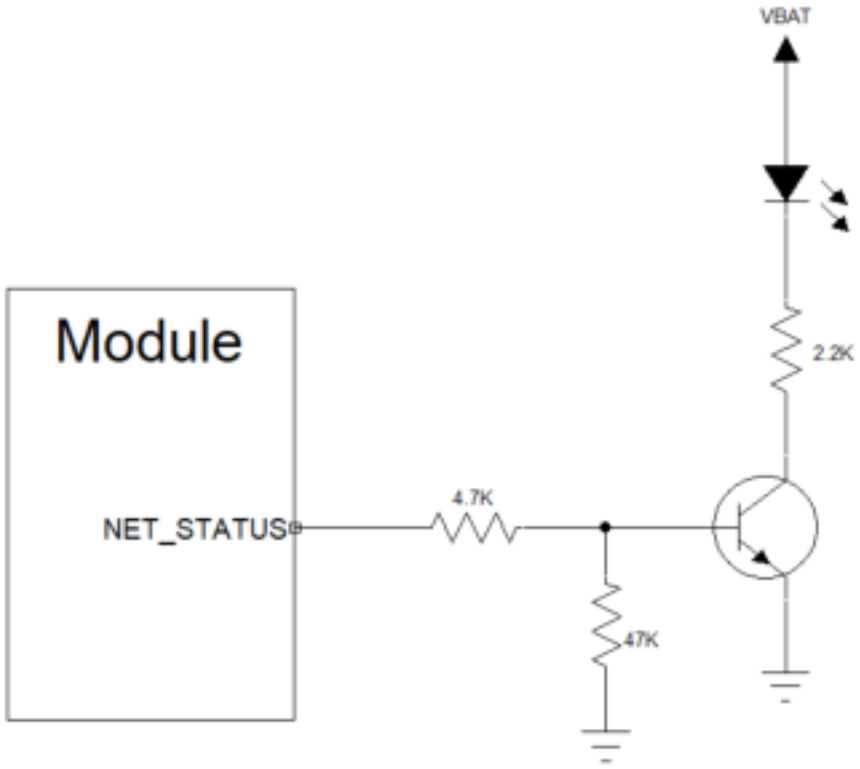


Chart18 : Indicator Light Reference Circuit

3.14. power saving feature

Depending on the system requirements, there are two ways to put the module into a low power state. For the AT version, the "AT+CFUN" command can be used to put the module into the least functional state.

For specific power consumption data, please consult 5.4 Power Consumption section.

3.14.1. Minimum Function Mode/Flight Mode

Minimum function mode can reduce the module function to minimum, this mode can be set by sending "AT+CFUN=<fun>" command. The <fun> parameter can be selected from 0, 1, 4.

- 0: Minimum function (disable RF and SIM card);
- 1: Full function (default);
- 4: Disable the RF send and receive function;

If you use "AT+CFUN=0" to set the module to least functional mode, the functions of the RF section and SIM section will be switched off. The serial port is still valid, but the AT commands related to the RF section and SIM card section are not available.

If you use "AT+CFUN=4" to set the module, the RF part of the function will be disabled, while the serial port is still valid. All AT commands related to the RF part are not available.

After the module is set by "AT+CFUN=0" or "AT+CFUN=4", it can be set to return to the full-function state by "AT+CFUN=1" command. state.

3.14.2. Sleep mode (slow clock mode)

For the LUAT version, the module starts auto sleep control by default on power up, and will automatically enter sleep mode when the system is idle, which can be woken up by timer, IO interrupt, network message interrupt, alarm interrupt etc.

For the standard AT version, the control method for sleep mode is as follows:

3.20.2.1 Serial port applications

Two sleep modes are supported under serial applications:

- Sleep Mode 1: Controls whether the module goes to sleep or not via MAIN_DTR pin level
- Sleep mode 2: the module automatically goes to sleep after the serial port has been idle for a period of time

3.20.2.1.1 Sleep mode 1

Opening conditions:

Send AT command AT+CSCLK=1

The module goes to sleep:

Controlling the MAIN_DTR pin to pull high, the module will enter sleep mode 1

The module exits sleep:

Pull down the MAIN_DTR pin for more than 50ms, the module will exit the sleep mode can accept the AT instruction

Software function of the module in sleep mode 1:

Doesn't respond to AT commands but receives data/SMS/incoming calls with URC reporting

How to wake up the HOST when the module receives data/SMS/incoming calls while the HOST is sleeping:

MAIN_RI Signal

3.20.2.1.2 Sleep mode 2

Opening conditions:

Send AT command AT+CSLCK=2

The module goes to sleep:

The serial port is idle for more than the time configured by AT+WAKETIM (default 5s), the module automatically enters sleep mode 2

The module exits sleep:

The serial port continuously sends AT until the module responds then it exits sleep mode 2

Software function of the module in sleep mode 2:

Doesn't respond to AT commands but receives data/SMS/incoming calls with URC reporting

How to wake up the HOST when the module receives data/SMS/incoming calls while the HOST is sleeping:

MAIN_RI signal

3.20.2.2 USB applications

Opening conditions:

USB HOST must support USB suspend/resume.

The module goes to sleep:

HOST initiates USB suspend

The module exits sleep:

HOST initiates USB resume

How to wake up the HOST when the module receives data/SMS/incoming calls while the HOST is sleeping:

MAIN_RI signal

3.15. Mode switching summary

Tables16 : Summary of mode switching

current mode	Next mode		
	finish shooting a film	normal mode	sleep mode
finish shooting a	/	Booting with PWRKEY	/
normal mode	Using the PWRKEY pin, or VBAT voltage below the shutdown voltage	/	Software call sleep interface, AT version does not do the action of 30s automatic hibernation

sleep mode	Using the PWRKEY pin, or VBAT voltage below the shutdown voltage	GPIO pin interrupt, timer, receive SMS or network data	/

For specific power consumption data, please consult 5.4 Power Consumption section.

4. RF interface

The antenna interface pins are defined below:

Tables17 : RF_ANT Pin Definitions

pin name	pin number	IO	descriptions	Electrical Characteristics	note
LTE_ANT	60		4G LTE RF Antenna Interface		It is recommended to reserve ∏-shaped antenna to match, and the alignment needs 50 ohm impedance matching.
ANT_WIFI	56		wifi positioning RF antenna interface		It is recommended to reserve ∏-shaped antenna to match, and the alignment needs 50 ohm impedance matching.

4.1. RF reference circuit

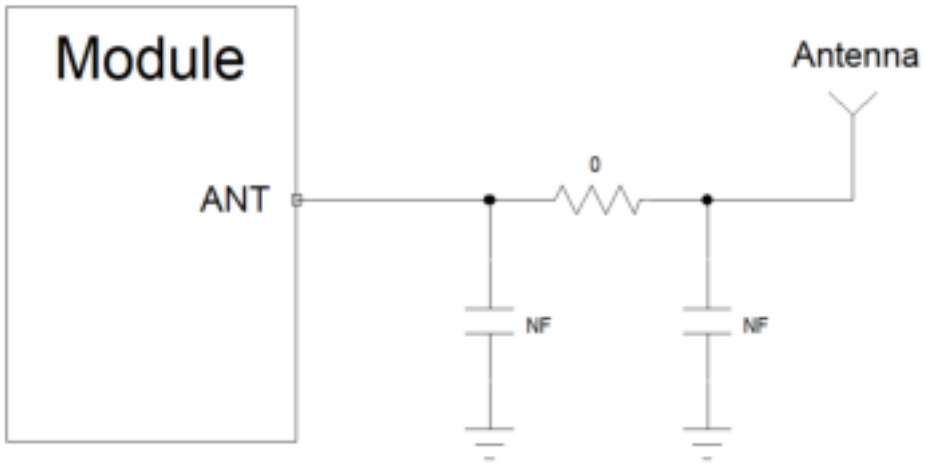


Chart19 : RF Reference Circuit

Attention:

- The RF traces connected to the module RF antenna pads must be microstrip or other types of RF traces with an impedance of about 50 ohms.
- Reserve the ∏-type matching circuit near the antenna, the two capacitors are not patched by default, and the resistor is patched with 0 ohm by default, and the matching circuit will be patched with the actual debugging after the antenna factory debugs the antenna;

- Luat module impedance line and antenna design recommendations: https://doc.openluat.com/article/2430

4.2. RF Output Power

Tables18 : RF Conducted Power

(radio) band	greatest	minimal
b1/b2/b3/b4/b5/b8/b12/b13/b17/b20/b25/b26/b28/b66	23dBm +-2dB	<-44dBm
LTE TDD B34/38/B39/B41	23dBm +-2dB	<-42dBm
GSM 850/900/1800/1900	33dBm +-2dB	

4.3. RF conduction sensitivity

Tables19 : RF Conductivity Sensitivity

(radio) band	receiver sensitivity
LTE FDD B1 (10M)	< -99dBm
LTE FDD B3 (10M)	< -99dBm
LTE FDD B5 (10M)	< -100dBm
LTE FDD B8 (10M)	< -99dBm
LTE TDD B34 (10M)	< -99dBm
LTE TDD B38 (10M)	< -99dBm
LTE TDD B39 (10M)	< -99dBm
LTE TDD B41 (10M)	< -99dBm

4.4. operating frequency

3GPP frequency band	sending	reception (of transmitted signal)	unit (of measure)
LTE-FDD B1	1920~1980	2110~2170	MHz
LTE-FDD B3	1710~1785	1805~1880	MHz
LTE-FDD B5	824~849	869~894	MHz
LTE-FDD B8	880~915	925~960	MHz
LTE-TDD B34	2010~2025	2010~2025	MHz
LTE-TDD B38	2570~2620	2570~2620	MHz
LTE-TDD B39	1880-1920	1880-1920	MHz
LTE-TDD B41	2555~2655	2555~2655	MHz

4.5. Recommended RF Soldering Methods

If the RF connector connecting the external antenna is connected to the module by soldering, please be sure to pay attention to the stripping method of the connecting wires and the soldering method, especially the ground should be soldered sufficiently, please follow the correct soldering method in the following figure to avoid the increase of the wire loss caused by the poor soldering.

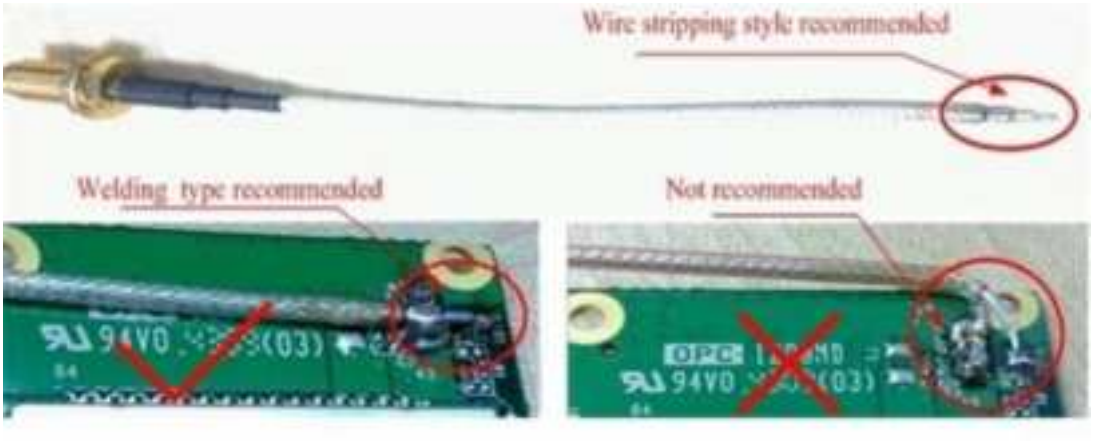


Chart20 : Recommendations for RF Welding Methods

5. Electrical Characteristics, Reliability, RF Characteristics

5.1. absolute maximum

The following table shows the maximum withstand values for the power supply voltage and current for the digital and analogue pins of the module.

Tables20 : Absolute Maximum

parameters	minimal	greatest	unit (of measure)
V_{BAT}	-0.3	4.7	V
VBUS	-0.3	5.5	V
Power supply peak current	0	1	A
Power supply average current (TDMA one frame time)	0	0.7	A
Voltage at digital pins	-0.3	VDDIO+0.3	V
Voltage at analogue pin (ADC)	-0.3	4.7	V

5.2. Recommended working conditions

Tables21 : Recommended Conditions of Employment

parameters	minimal	quintessential	greatest	unit (of measure)
V_{BAT}	3.3	3.8	4.3	V
VBUS	3.3	5.0	5.25	V

5.3. operating temperature

Tables22 : Operating Temperature

temp	lowest	quintessential	supreme	unit (of measure)
normal working temperature	-35	25	75	℃

Limit working temperature	-40~-35		75~85	℃
Storage temperature	-45		90	℃

5.4. power wastage

5.4.1. Module operating current

Test equipment: IMRT R&S CMW500, programme controlled power supply Agilent 66319D

Test conditions: VBAT=3.8V, ambient temperature 25℃, insert white card, connect CMW500 synthesizer

parameters	test condition		minimal	quintessential	greatest	unit (of measure)
I_{VBAT}	leakage current	First time on the power.		30		uA
		Power on and off (RTC off)		2		uA
		Power on and off (RTC working properly)		220		uA
	Standby Current	LTE-TDD Pagingcycle=128		TBD		mA
		LTE-FDD Pagingcycle=128		TBD		mA
	Flight Mode AT+CFUN=4			TBD		mA
	LTE-FDD B1 CH300 BW=10M	TX power = 23dbm		TBD		mA
		TX power = -42dbm		TBD		mA
	LTE-FDD B3 CH1575 BW=10M	TX power = 23dbm		TBD		mA
		TX power = -42dbm		TBD		mA
	LTE-FDD B5 CH2525 BW=10M	TX power = 23dbm		TBD		mA
		TX power = -42dbm		TBD		mA
	LTE-FDD B8 CH3625 BW=10M	TX power = 23dbm		TBD		mA
		TX power = -42dbm		TBD		mA
	LTE-TDD B34 CH36275 BW=10M	TX power = 23dbm		TBD		mA
		TX power = -42dbm		TBD		mA
	LTE-TDD B38	TX power = 23dbm		TBD		mA

	CH38000 BW=10M	TX power = -42dbm		TBD		mA
	LTE-TDD B39 CH38450 BW=10M	TX power = 23dbm		TBD		mA
		TX power = -42dbm		TBD		mA
	LTE-TDD B41 CH40620 BW=10M	TX power = 23dbm		TBD		mA
		TX power = -42dbm		TBD		mA

5.4.2. Real network simulation of long connection power consumption

Test Instrument: Programmable Power Supply Agilent 66319D

Test conditions: VBAT=3.8V, ambient temperature 25° C

Insert mobile SIM card, real network registration band: B41

Real network signal strength (CESQ): 72

parameters	test condition	quintessential	unit (of measure)
I_{VBAT}	TCP connection, auto sleep, 1 minute heartbeat interval (default configuration)	TBD	mA
I_{VBAT}	TCP connection, auto-sleep, 5 minute heartbeat interval (default configuration)	TBD	mA
I_{VBAT}	TCP connection, auto-sleep, 1 minute heartbeat interval (ultra-low power AT*RTIME=1)	TBD	mA
I_{VBAT}	TCP connection, auto-sleep, 5 minute heartbeat interval (ultra-low power AT*RTIME=1)	TBD	mA

Insert Unicom SIM card, real network registration band: B1

Real network signal strength (CESQ): 60

parameters	test condition	quintessential	unit (of measure)
I_{VBAT}	TCP connection, auto-sleep, 1 minute heartbeat interval (default configuration)	TBD	mA
I_{VBAT}	TCP connection, auto-sleep, 5 minute heartbeat interval (default configuration)	TBD	mA
I_{VBAT}	TCP connection, auto-sleep, 1 minute heartbeat interval (ultra-low power AT*RTIME=1)	TBD	mA
I_{VBAT}	TCP connection, auto-sleep, 5 minute heartbeat interval (ultra-low power AT*RTIME=1)	TBD	mA

Insert Telecom SIM card, real network registration band: B1

Real network signal strength (CESQ): 62

parameters	test condition	quintessential	unit (of measure)
I_{VBAT}	TCP connection, auto-sleep, 1 minute heartbeat interval (default configuration)	TBD	mA
I_{VBAT}	TCP connection, auto-sleep, 5 minute heartbeat interval (default configuration)	TBD	mA
I_{VBAT}	TCP connection, auto-sleep, 1 minute heartbeat interval (ultra-low power AT*RTIME=1)	TBD	mA
I_{VBAT}	TCP connection, auto-sleep, 5 minute heartbeat interval (ultra-low power AT*RTIME=1)	TBD	mA

Attention:

As this is a real network test, network signal strength, registration band, server response time will have a greater impact on the value of the test, therefore, this data is for reference only.

5.5. electrostatic protection

In the module application, due to human body static electricity, microelectronics between the charged friction and other static electricity, through a variety of ways to discharge to the module, may cause some damage to the module, so the ESD protection must pay attention to, no matter in the production and assembly, testing, R & D and other processes, especially in the design of the product should be taken to prevent ESD protection measures. Such as circuit design at the interface or vulnerable to ESD points to increase ESD protection, production with anti-ESD gloves and so on.

The following table shows the ESD withstand voltage of the module's key PIN pins.

Tables23 ESD performance parameters (temperature: 25°C, humidity: 45%)

pin name	contact discharge	air discharge
VBAT,GND	±5KV	±10KV
LTE_ANT	±5KV	±10KV
Others	±0.5KV	±1KV

6. Module Dimension Drawing

This section describes the mechanical dimensions of the module and the recommended package size for customer designs using the module.

6.1. Module External Dimensions

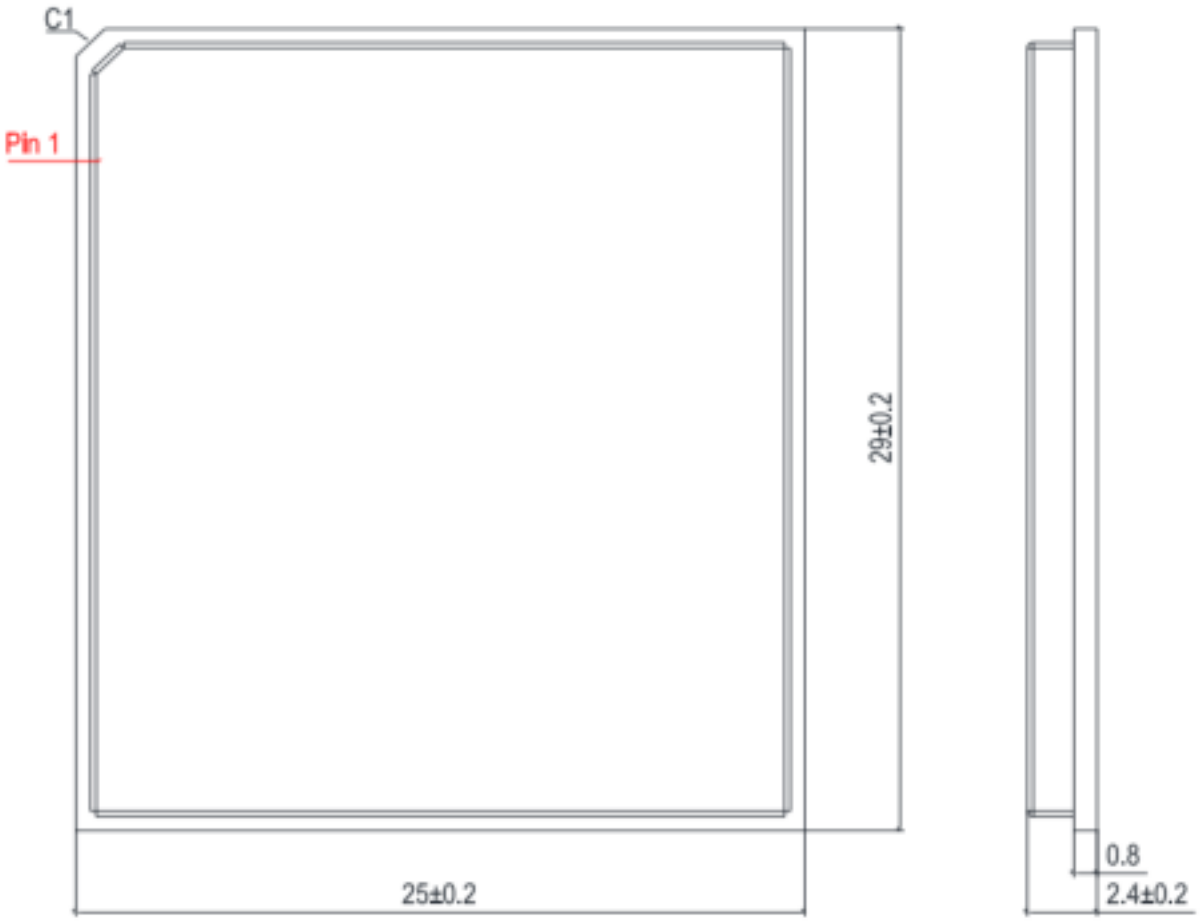


Chart21 : Dimensional drawing of A795U (in mm)

6.2. Recommended PCB Packages

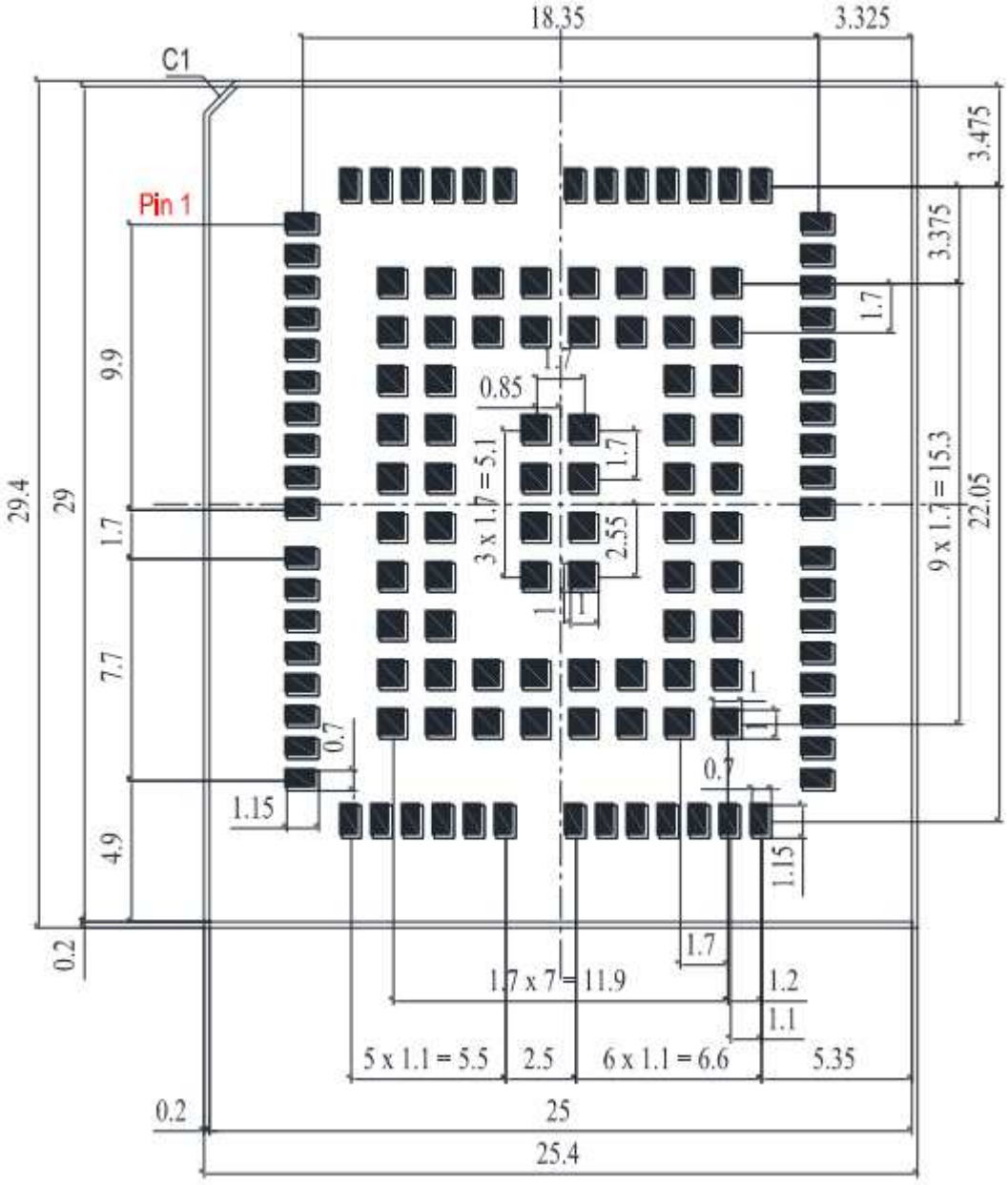


Chart22 : Front view, A795U PCB package (in mm)

Attention:

1. The spacing between modules and other components on the **PCB** is recommended to be at least **3mm;**
2. Please visit: https://doc.openluat.com/wiki/21?wiki_page_id=2055 to get the schematic PCB package library for the module.

7. Storage and production

7.1. stockpile

The A795U is shipped in vacuum sealed bags. Storage of the module is subject to the following conditions:

Modules can be stored in vacuum sealed bags for up to 12 months at ambient temperatures below 40 degrees Celsius and air humidity of less than 90%.

When the vacuum sealed bag is opened, the module can be directly reflowed or other high temperature processes if the following conditions are met:

- Module ambient temperature is less than 30 degrees Celsius, air humidity is less than 60 per cent, and the factory completes the patch in less than 72 hours.
- Air humidity less than 10 per cent

If the module is in the following conditions, it needs to be baked before placement:

- Humidity indicator card shows humidity greater than 10% when the ambient temperature is 23 degrees Celsius (5 degrees Celsius fluctuation allowed).
- When the vacuum-sealed bag is opened, the module ambient temperature is less than 30 degrees Celsius and the air humidity is less than 60 per cent, but the factory fails to complete the patch in less than 72 hours
- Module storage air humidity greater than 10% when vacuum sealed bag is opened

If the modules need to be baked, bake them at 125 degrees Celsius (allowing for fluctuations of 5 degrees Celsius up or down) for 48 hours.

NOTE: The module packaging cannot withstand such high temperatures, remove module packaging before baking the module. If only a short baking time is required, please refer to **IPC/JEDECJ-STD-033** specification.

7.2. Production welding

Use the printing squeegee to print solder paste on the stencil, so that the solder paste through the opening of the stencil leakage printed on the PCB, the strength of the printing squeegee needs to be adjusted appropriately, in order to ensure the quality of the module printing paste, the thickness of the stencil corresponding to the part of the pad of the A795U module should be 0.2mm.

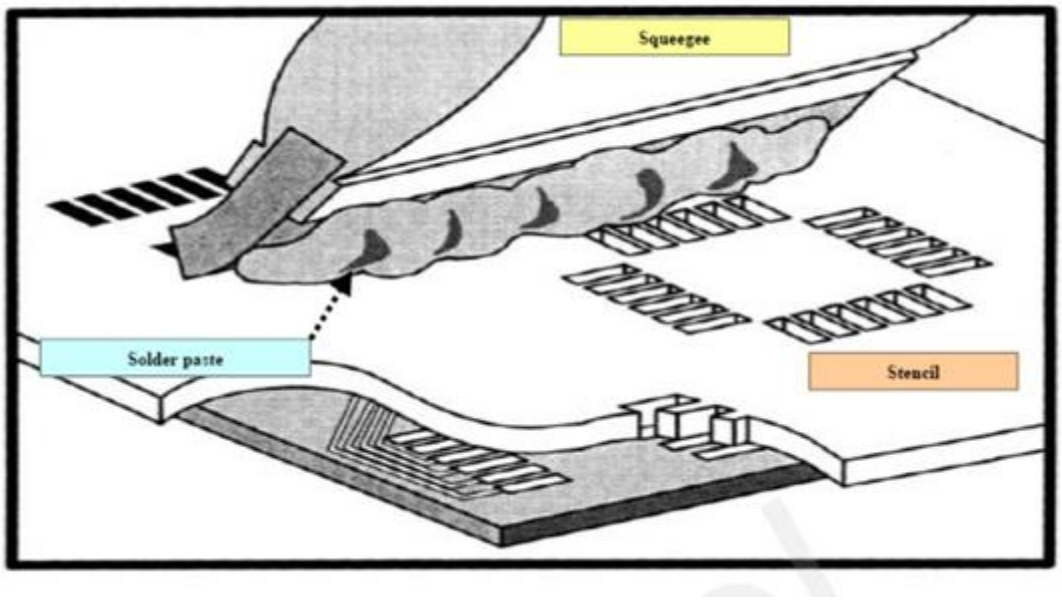


Chart23 : Printing Paste Chart

In order to avoid repeated heat damage to the module, it is recommended that customers reflow the first side of the PCB board before attaching the module. The recommended oven temperature profile is shown below:

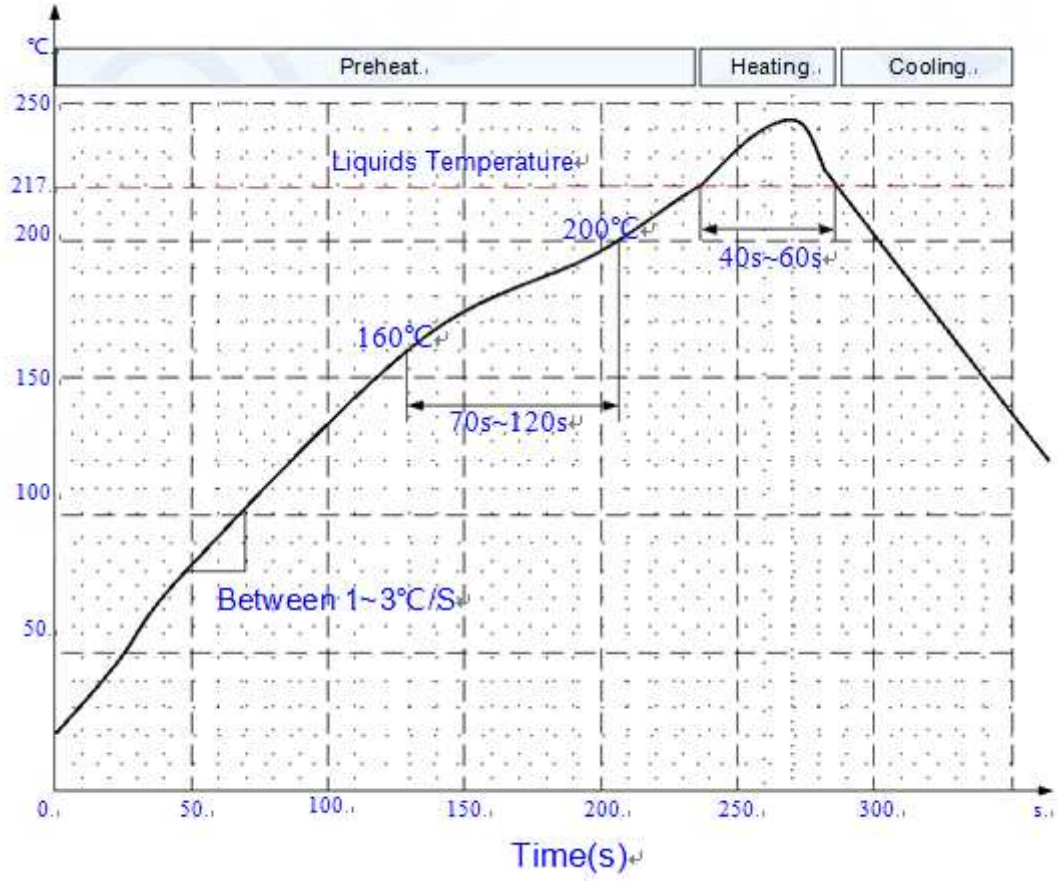


Chart24 : Furnace Temperature Curve

FCC Statement

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursua nt to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful inte rference in a residential installation. This equipment generates uses and can radiate radio frequency energy a nd, if not installed and used in accordance with the instructions, may cause harmful interference to radio com munications. 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 turn ing the equipment off and on, the user is encouraged to try to correct the interference by one or more 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 important announcement Important Note:

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 and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. Country Code selection feature to be disabled for products marketed to the US/Canada.

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

- The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- The transmitter module may not be co-located with any other transmitter or antenna,

As long as the two conditions above are met, further transmitter testing 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 cannot 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 cannot 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

The final end product must be labeled in a visible area with the following"

Contains FCC ID: **2AEGG-AIR795U** "

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.

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01r01

2.2 List of applicable FCC rules

CFR 47 FCC PART 15 SUBPART C has been investigated. It is applicable to the modular transmitter

2.3 Specific operational use conditions

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.

2.4 Limited module procedures

Not applicable

2.5 Trace antenna designs

Not applicable

2.6 RF exposure considerations

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.

2.7 Antennas

This radio transmitter **FCC ID:2AEGG-AIR795U** has been approved by Federal Communications Commission to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Antenna No.	Model No. of antenna:	Type of antenna:	Gain of the antenna (max.)	Frequency range:
GSM/LTE Antenna	/	PIFA Antenna	2.21dBi (max.) For E-UTRA Band 2 2.09dBi (max.) For E-UTRA Band 4 0.78dBi (max.) For E-UTRA Band 5 0.61dBi (max.) For E-UTRA Band 12 0.56dBi (max.) For E-UTRA Band 13 0.61dBi (max.) For E-UTRA Band 17 2.21dBi (max.) For E-UTRA Band 25 0.71dBi (max.) For E-UTRA Band 26 2.77dBi (max.) For E-UTRA Band 38 2.79dBi (max.) For E-UTRA Band 41 2.09dBi (max.) For E-UTRA Band 66	1710-1755MHz 1850-1910MHz 1710-1755MHz 824-849MHz 699-716MHz 777-787MHz 704-716MHz 1850-1915MHz 814-849MHz 2570-2620MHz 2496-2690MHz 1710-1780MHz

2.8 Label and compliance information

The final end product must be labeled in a visible area with the following" Contains **FCC ID:2AEGG-AIR795U**".

2.9 Information on test modes and additional testing requirements

Host manufacturer is strongly recommended to confirm compliance with FCC requirements for the transmitter when the module is installed in the host.

2.10 Additional testing, Part 15 Subpart B disclaimer

Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15 B.

2.11 Note EMI Considerations

Host manufacture is recommended to use D04 Module Integration Guide recommending as "best practice" RF design engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties.

2.12 How to make changes

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system. According to the KDB 996369 D02 Q&A Q12, that a host manufacture only needs to do an evaluation (i.e., no C2PC required when no emission exceeds the limit of any individual device (including unintentional radiators) as a composite. The host manufacturer must fix any failure.