

F8L10C-00 Series Private Version Instruction Manual	Document Version	Density class
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F8L10C-00 Series LoRa Module Private Version

Instructions for use

This manual is applicable to the following models:

Model	Product Category
F8L10C-00LU	LoRa module domestic version with the IPEX head antenna interface
F8L10C-00LN	LoRa module domestic version, pin antenna interface
F8L10C-00HU	LoRa module foreign version, with the IPEX head antenna interface
F8L10C-00HN	LoRa module foreign version, pin antenna interface



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Chapter 1 Product Introduction

1.1 Overview

F8L10C-00 series LoRa data transmission module is the 1 embedded wireless data transmission module based on LoRa technology, using the LoRa network to provide users with wireless data transmission function, compatible with the FSK * modulation.

This product uses ultra-low power consumption LoRa integrated chip. The chip uses ASR advanced low power consumption radio frequency chip and 32-bit RISC MCU. MCU uses ARM Cortex M4, and the module supports LoRaWAN, private, CLAA, LinkWAN and other protocols.

The ultra-small size design of the product can be widely used in the M2M industry in the Internet of Things industry chain, such as smart grid, smart transportation, wireless water and gas heat meter reading, wireless automated data collection, industrial automation, smart buildings, fire protection, public safety, Environmental protection, meteorology, digital medical treatment, remote sensing survey, military, space exploration, agriculture, forestry, water affairs, coal mine, petrochemical and other fields.

1.2 Product Features

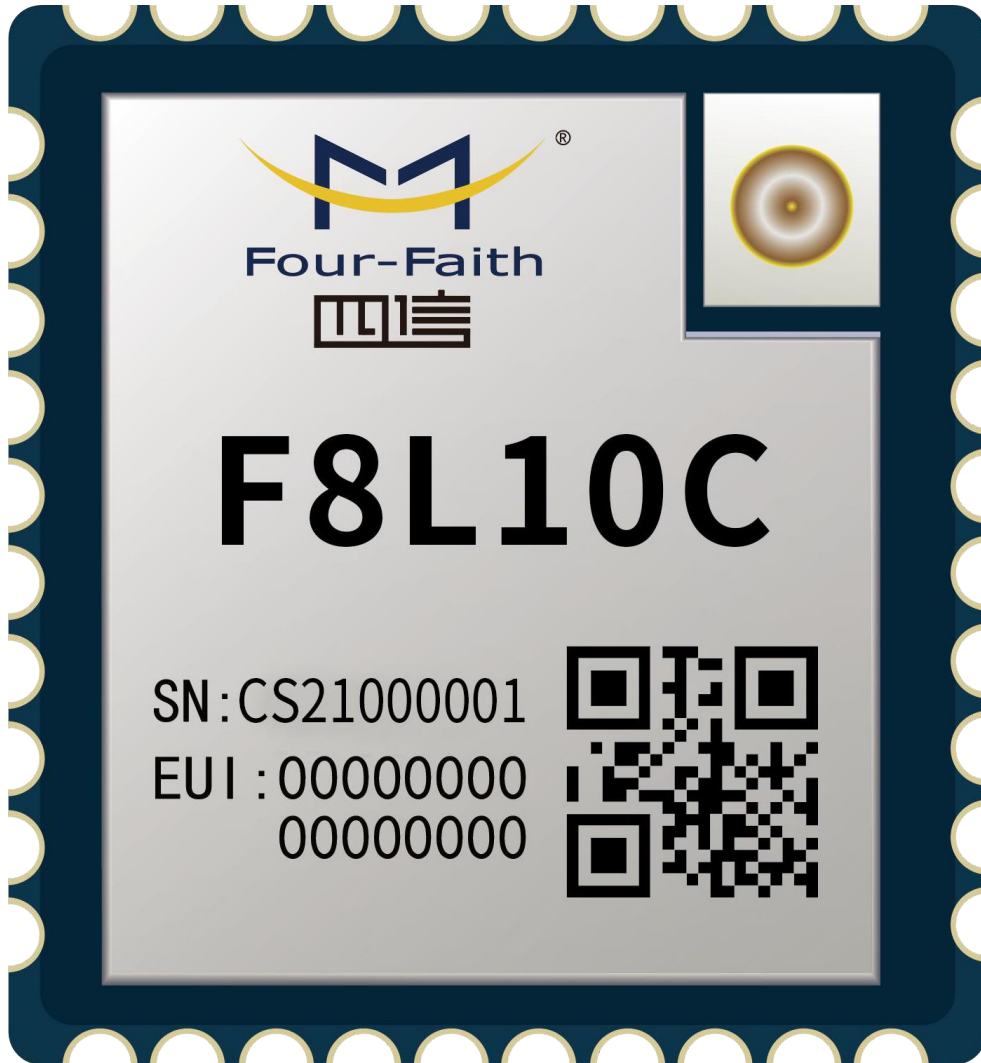
Industrial grade application design

- ◆ The use of high-performance domestic industrial-grade chips, to meet the four-trust private agreement, LoRaWAN 1.0.2, LinkWAN, CLAA.

Agreement

- ◆ Series products support all ISM bands from 150MHz to 960 MHz
- ◆ Multiple baud rates, multiple RF rates
- ◆ Low power design with sleep and wake mode support, less than 2 μ A minimum
- ◆ Maximum transmit power 22dBm, multi-level power adjustable
- ◆ Theoretical maximum receive sensitivity up to -139dBm @ 125KHz, SF12, CR1
- ◆ Power input: DC 1.7-3.7V
- ◆ Module built-in power-on reset function
- ◆ Support serial port software upgrade
- ◆ Using miniature four-sided 1.27mm * 10 stamp hole packaging method
- ◆ IPEX connector and pin two RF signal output mode supported

1.3 Product Picture



1.4 Production considerations

1.4.1 Humidity sensitivity level and protection requirements

The four-letter LoRa module is a humidity-sensitive product, which is easy to cause the module to be damp in humid environment, resulting in the module not being able to be used normally. Therefore, the Lora module is shipped in a vacuum bag, and a humidity-sensitive card and desiccant are additionally placed in the bag to prevent the module from being damp.



1-1 Vacuum Package Display

Before using the module, it is necessary to confirm whether the packaging is in good condition; after opening the packaging bag, it is necessary to confirm the status of the humidity indicator card in the vacuum packaging bag. If the following conditions occur, the module needs to be baked before use.

- Humidity indicator card: The 10% indicator circle is pink and the 10% indicator circle is no longer blue, as shown in the figure below.

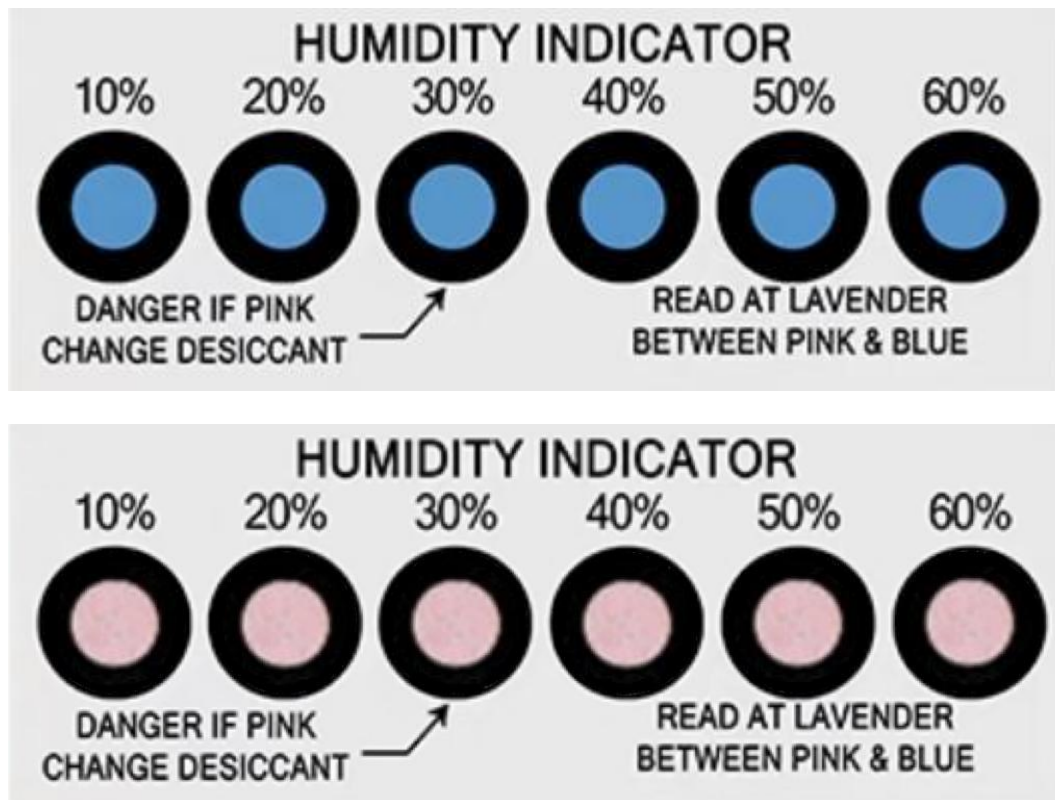


Figure 1-2 Humidity Indicator Card

1.4.2 Workshop life and temperature and humidity control

LoRa module humidity sensitivity level is 3, workshop life is 168 hours

1) In the environment where the workshop temperature is $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ and the relative humidity is lower than 60%, the module needs to be reflow or other high-temperature operations within 168 hours after unpacking. Otherwise, the module needs to be stored in an environment where the relative humidity is lower than 10% (for example, moisture-proof cabinet) to maintain the dryness of the product.

2) Not sure whether the workshop temperature environment meets the conditions, or the relative ambient humidity is greater than 60%, please in the unpacking after 24 hours to complete the patch return, do not advance a large number of unpacking.

3) In order to prevent and reduce the occurrence of poor welding such as blistering and delamination caused by moisture, strict control should be carried out. It is not recommended to unpack the vacuum package and expose it to the air for a long time.

4) In case of air leakage of sealed vacuum packaging, failure to comply with humidity sensitive control requirements after disassembly, bulk materials or more than 1-year validity period, pre-baking treatment shall be carried out before the module is put on-line or repaired, and high-temperature baking shall be carried out at $120^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for 24 hours to prevent blistering, cracks and delamination after high-temperature welding caused by moisture absorption and moisture.

5) Before baking, the module shall be taken out of the package, and the bare module shall be placed on the high-temperature-resistant appliance (it is forbidden to directly bake the plastic tray or packaging reel); the module for secondary baking shall be welded within 24 hours after baking, otherwise it shall be stored in the drying oven. Pay attention to ESD protection and wear anti-static gloves when removing the module.

6) After the baking is completed, when the bare module is put on the patch, the placement machine needs to bring a tray, and the method is as follows: **Method 1:** Only after the module is placed, can the patch be put on the line;

Method 2: When there is no special tray, the black electrostatic carrier tape of the packaging module can be used to cut out a plurality of carrier tapes with the same length and tiled neatly on the tray of the mounter as a simple tray.

1.4.3 Storage

recommend storage conditions: $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ with 35% ~ 60% relative humidity.

Storage period (under sealed vacuum packaging conditions): Under recommend storage conditions, the storage period is 12 months.

Chapter 2 Module Interface

2.1 Module Pin Definition

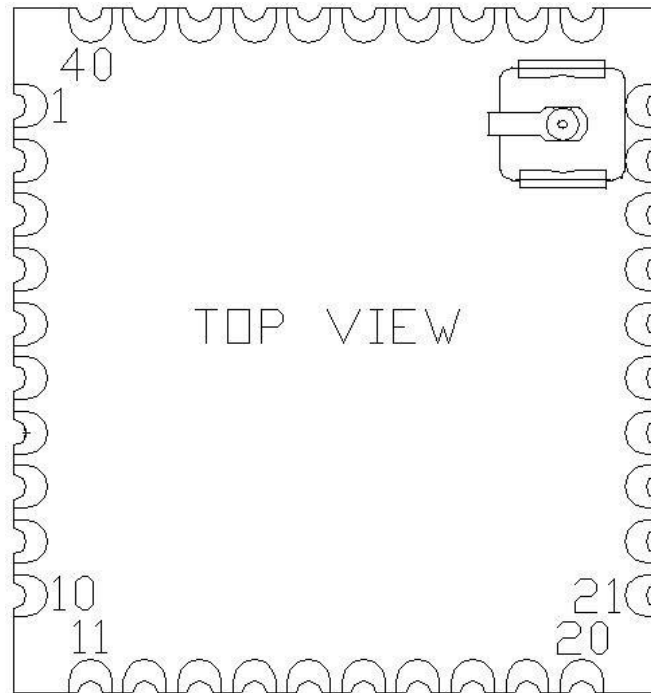


Figure 2-1 Pin diagram of module F8L10C-00

Table 2-1-1 Module Interface Definition

Serial Number	Definition	Input/Output	Description
1	GND	N/A	Ground
2	VCC	Input	Power Supply
3	D5	I/O	GPIO05/ADC_IN7
4	GND	N/A	Ground
5	D2	I/O	GPIO02/ADC_IN0
6	D10/TXDone	I/O	GPIO10 (send completion notification)
7	RX	Input	UART Data In
8	TX	Output	UART Data Out
9	JIMS_SWDIO	Input	Debug Data
10	JTCK_SWCLK	Input	Debug Clock
11	GND	N/A	Ground
12	D6	Either	NC, Hanging, Customizable
13	D7	Either	NC, Hanging, Customizable
14	D8	Either	NC, Hanging, Customizable
15	D9	Either	NC, Hanging, Customizable
16	GND	N/A	Ground
17	D12	Either	NC, Hanging, Customizable
18	D13	Either	NC, Hanging, Customizable
19	D14	Either	NC, Hanging, Customizable
20	GND	N/A	Ground
21	GND	N/A	Ground
22	D11/RXDone	Either	GPIO11 (receive completion notification)
23	STATUS	Either	Sleep status indication
24	D1/SLEEP_RQ	Either	GPIO01 (sleep control)
25	D3	Either	GPIO03/UART1_TXD (reserved)/ADC_IN2
26	D4	Either	GPIO04/UART1_RXD (reserved)/ADC_IN3
27	GND	N/A	Ground
28	NC	NC	NC, suspended
29	GND	N/A	Ground
30	RF_OUT	N/A	F8L10C-00-00XN version for RF input and output
31	GND	N/A	Ground
32	NC	NC	NC, suspended
33	D15	Either	NC, Hanging, Customizable

34	GND	N/A	Ground
35	D16	Either	NC, Hanging, Customizable
36	D17	Either	NC, Hanging, Customizable
37	GND	N/A	Ground
38	D18	Either	NC, Hanging, Customizable

39	D19	Either	NC, Hanging, Customizable
40	GND	N/A	Ground

The signal input/ output is relative to the module. D1 - D5 in the table description column is IO1 - IO5 in the IO application of the configuration tool, where the reference voltage of ADC is 1.2V, the acquisition range is 0.1-1.1V, and the accuracy is 0.01V.

Note: Signal input/output is relative to the module

Note: sleep control pin high level wake-up, low level sleep;

The high level of the Sleep state indicator pin indicates that the module is in the wake-up state, and the low level indicates that the module is in the sleep state; the sending completion notification pin is normally low, and the sending completion is pulled high for 10ms;

The receive completion notification pin is normally low, and the receive completion is pulled high for 10ms (default, AT command can be configured).

2.2 UART Interface

The serial communication port 1 of the module is a UART interface, and the pin definition is shown in Table 2-2.

Table 2-2 UART Pin Definition

UART Signal Name	Module Pin Number
TX0	8
RX0	7

2.3 GPIO Specifications

F8L10C-00 module has 26 GPIO ports. The DC characteristics are shown in Table 2-3. **Table 2-3 GPIO**

DC characteristics

Parameters	Minimum	Typical	Max.
0 input voltage (V)	0		<0.3 VBAT
Input voltage (V) for logic 1	> 0.7VBAT		VBAT
Input pull-up and pull-down resistors (k Ω ;))		30K	
GPIO Pin Capacitance (pF)		3pF	

2.4 Limit parameter

Table 2-5 Limit Parameters

Parameters	Minimum	Maximum	Unit
Input power	-0.3	3.9	V
Pin input voltage	-0.3	3.9	V
RF level input		+10	dBm
Storage temperature range	-55	125	° C

Note: If the limit parameters are exceeded, it may cause permanent damage to the module.

2.5 Antenna Interface

The antenna interface used in the default version is the 1 generation Ipex connector, and the F8L10C-00LN and F8L10C-00HN versions use 30 pins as RF input and output pins.

The RF interface of the module is Ipex 1 generation interface and 30-pin output.

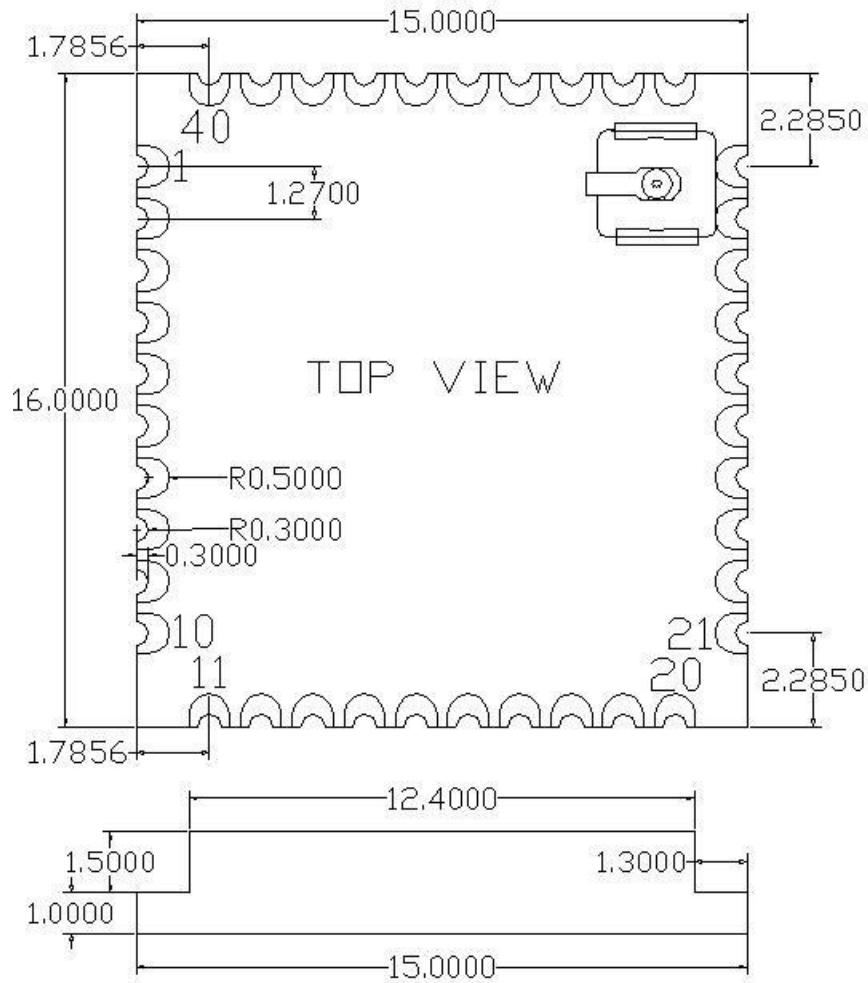
The voltage standing wave ratio of the external antenna should not be greater than 2, and the radio frequency coaxial line should be used as short as possible to reduce the insertion loss. The placement of the antenna should avoid large-area metal as much as possible to avoid affecting the radiation performance of the antenna

Need to use the built-in antenna, PCB should be designed to reserve enough headroom, antenna design should be completed by a professional antenna engineer, in order to achieve optimal radiation performance. The built-in antenna needs to be designed in combination with the terminal PCB, housing, installation environment, etc. Different terminal antennas need to be separately designed and cannot be mixed.

Peripheral RF circuit and antenna design need to follow the 50 ohm system impedance matching design specification, or with our technical support personnel.

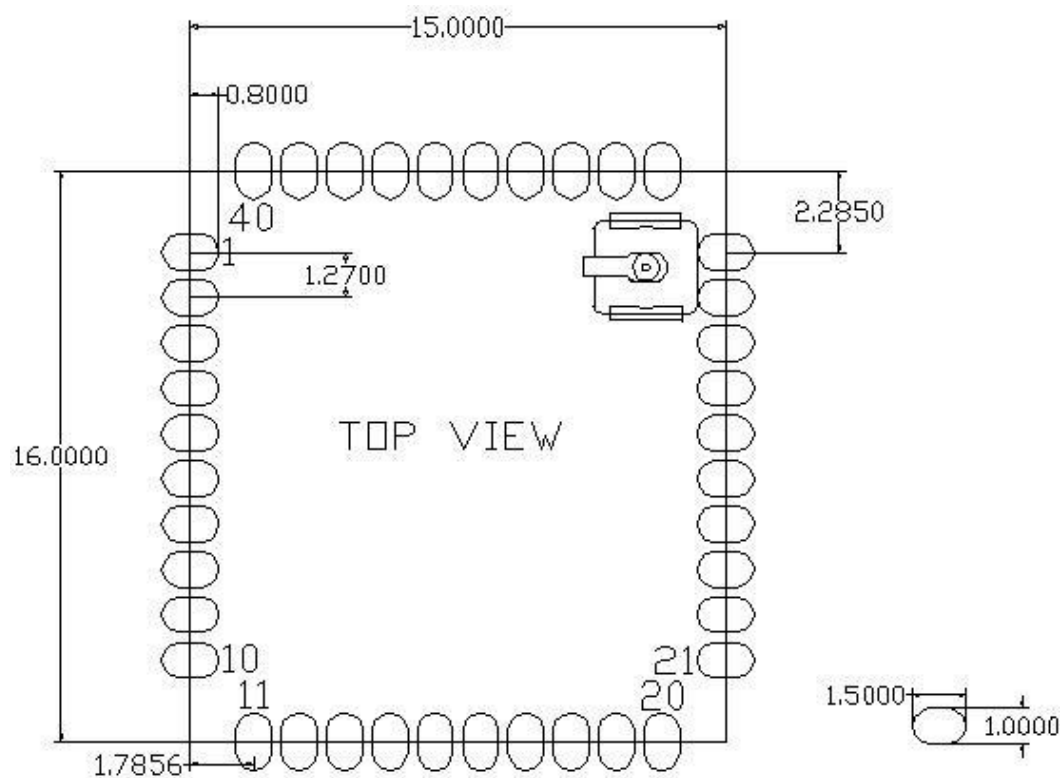
Chapter 3 Module Encapsulation

3.1 Module Package View



Note: All dimensions are in millimeters (mm)

3.2 recommend package design dimensions



Note: All dimensions are in millimeters (mm)

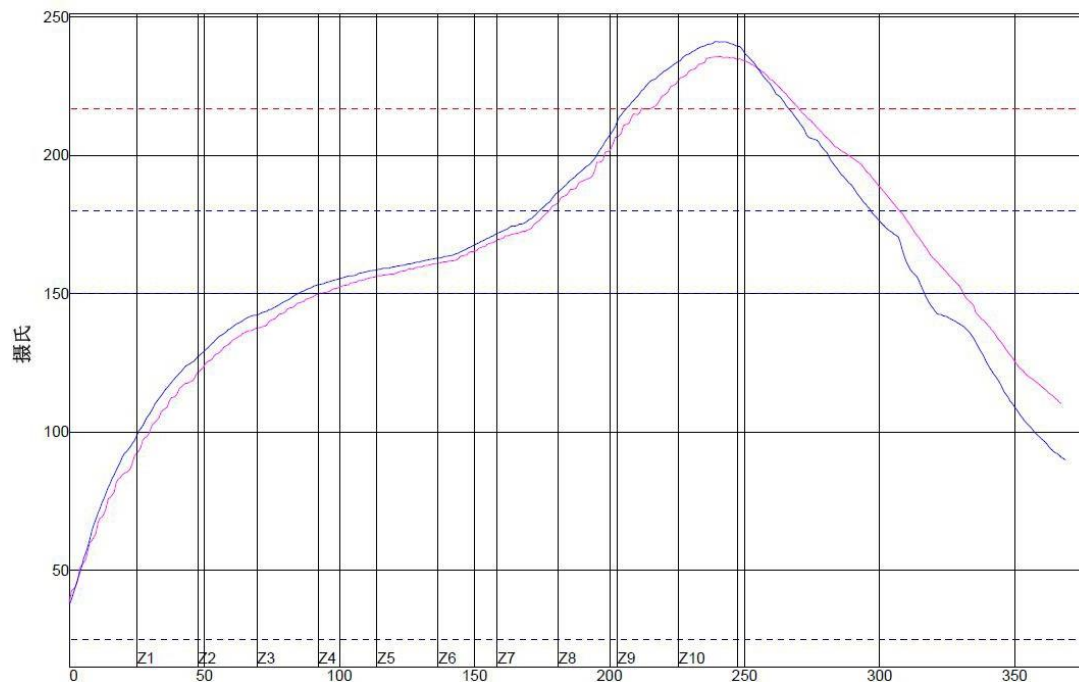
3.3 Re-flow reflow soldering temperature range

It is recommended to weld in accordance with IPC/JEDEC J-STD-020B standards. **Welding temperature**

The soldering temperature shall not exceed 340 ° C with a thermostatic electric soldering iron, and the soldering time for each pin shall not exceed 2S.

SMT temperature curve

SMT Reflow Soldering recommends the following temperature profile:



PWI=94%		Maximum rising slope		Maximum descent slope		Preheating 25~150 °C	
	2	1.96	-4%	-1.28	72%	93.1	23%
	3	2.05	5%	-1.43	57%	84.4	2%
Gap		0.09		0.15		8.70	

attached form

PWI=94%	Constant temperature time 150~180 °C	Reflux time 217 °C	Maximum temperature	3 250~200 °C slope
---------	--------------------------------------	--------------------	---------------------	--------------------

	2	85.4	-15%	55.5	-27%	235.8	-54%	-1.15	94%
	3	89.4	-2%	60.5	-14%	241.3	-10%	-1.48	81%
Gap	4			4.5		5.5		0.33	

Chapter 4 Module Interface Operation

4.1 UART communication mode

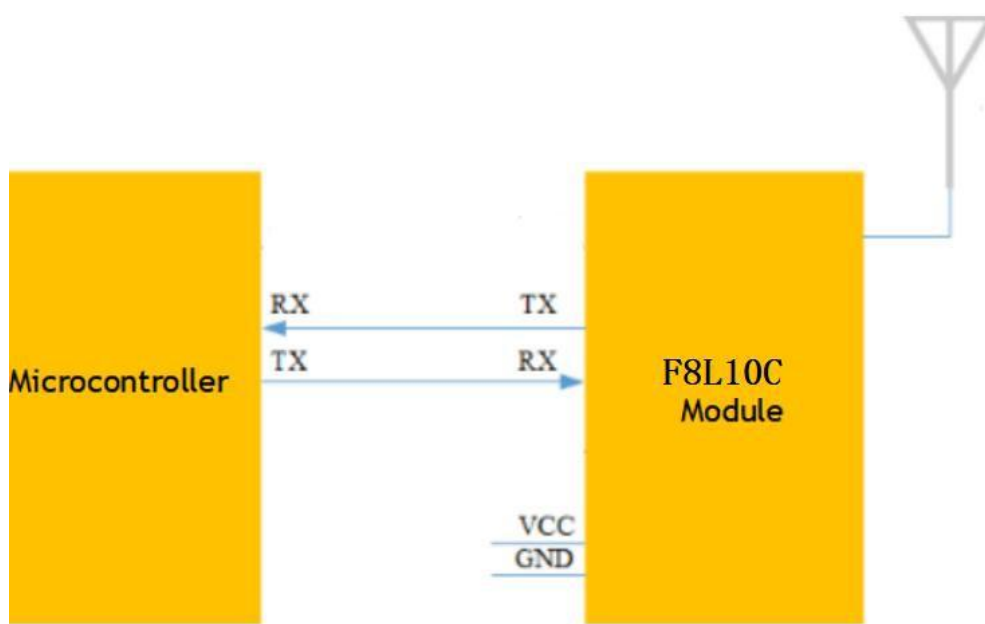
4.1.1 Signal Description

Use the following standard UART signals:

- TX: Send data
- RX: Receive Data

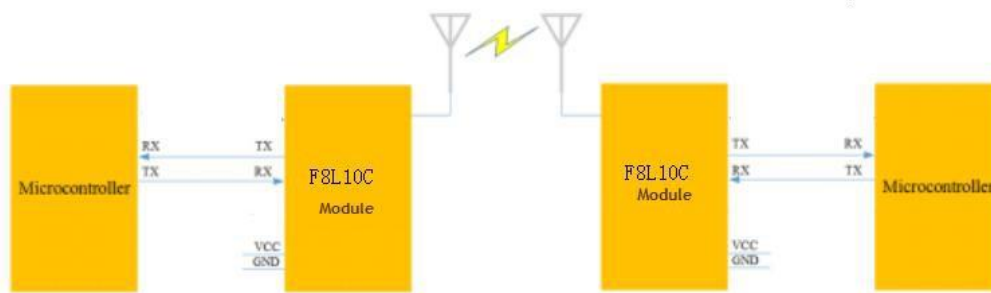
4.1.2 Hardware Connection

UART hardware connection is shown in Figure 4-1:



4-1 UART Interface Connection

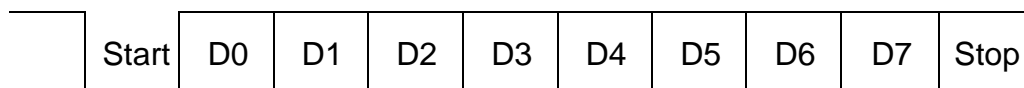
For example, as shown in fig. 4-2, if the equipment with UART interface is directly connected to the F8L10C-00 module pin, the 1 set of UART to RF communication equipment can be obtained.



4-2 Two Modules Communicate with Each Other

4.1.3 Communication transmission byte format

UART interface communication transmission byte format as shown in Figure 4-3



4-3 UART interface communication transmission byte format

- 1) Communication interface: UART
- 2) 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps
- 3) Start bit: 1 bit
- 4) Data bits: 8 bits
- 5) Stop bit: 1 bit, 2 bits
- 6) Check: no check/odd check/even check

UART sends and receives data asynchronously, sending and receiving can be carried out at the same time, realizing full duplex mode. The data transmission may be initiated by the external device or by the module itself.

4-3, each data byte contains a start bit (low), 8 bits of data and a stop bit (high).

Example: Figure 4-4 shows the UART in the data mode of 8-N-1(8 data bits, no parity bit, 1 stop bit), the transmission byte of 0x1F(number of decimal 31) data diagram.

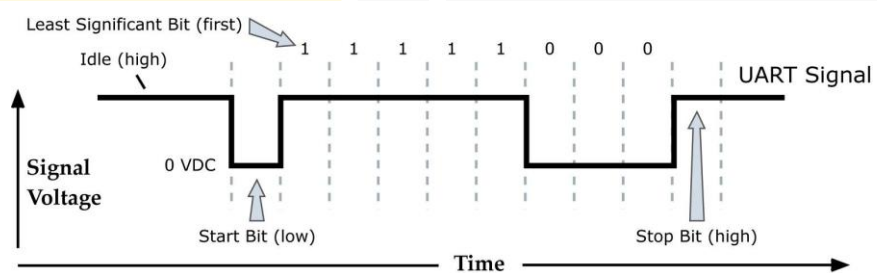


Figure 4-4 0x1F data diagram

Chapter 5 Parameter Configuration

5.1 Configure Connections

Before configuring the F8L10C -00 series module, it is necessary to connect the module with the host. The host can be a PC or other hosts with UART interface according to Figure 3-1. To connect with PC, we can use our company's LoRa module supporting development board (F8L10C-00 need to be mounted on the adapter board). the connection diagram is shown in fig. 5-1:

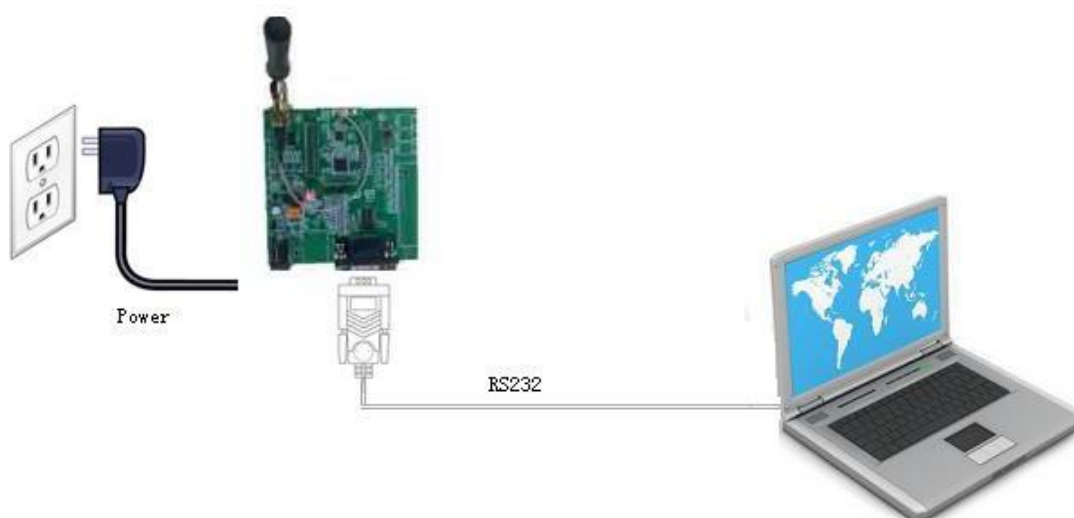


Figure 5-1 F8L10C -00 PC Configuration Connection

5.2 Parameter Configuration Mode Introduction

There are two parameter configuration methods for F8L10C-00 series modules:

Through the "latest four-letter LoRa configuration software LoRaConfig" configuration: all configuration through the software interface of the corresponding entry configuration, this configuration method is only suitable for users to facilitate the use of PC configuration.

By extending the AT command (hereinafter referred to as the AT command) to configure: in this configuration mode, the user only needs a serial communication program to configure all the parameters of the F8L10C -00 module, such as the super terminal under the WINDOWS, LINUX minicom, putty, etc., or directly by the user's microcontroller system to configure the node. In the use of extended AT commands to configure F8L10C-00 series modules need to let the module enter the configuration state.

For AT command configuration, please refer to AT Command Manual.

Configure the parameters by configuring the software, as shown in Figure 5-2.



5-2 Configuration Interface

Select the sub-window "Serial Port Settings" in the toolbar "Options" to display the serial port parameters currently opened. Please select the correct value in this configuration and open the serial port at the same time. If the right button in the serial communication setting column is displayed as "Close Serial Port", it indicates that the serial port has been opened, otherwise please open the serial port.

After the device is powered on, the configuration software will click "Load Parameters", and the module will automatically load the current configuration parameters in the device according to the current software version and display them in the parameter area. At this point, all the parameters in F8L10C -00 can be configured, as shown in Figure 5-2.

5.3 Detailed introduction of parameters

The following describes in detail the configuration items of the F8L10C-00 module based on the AT command configuration method.

5.3.1 LoRa network parameters

配置

网络参数 | 系统参数 | 串口参数 | IO端口

Network

网络号

0

(0~65527)

设备类型

终端

设备ID

13654

(0~65527)

中继地址

(0~65535)

透传地址

0

(0~65535)

(个别项在当前版本不能修改)

Radio

载波频率

433

(410~441, 470~510, 850~950) MHz

(需要相应的天线)

空中速率

3 level

发射功率

20

dBm

5.3.1.1 Network Number

The network number is used to distinguish between different LoRa networks, only in the same channel and using the same network number of devices will communicate with each other.

5.3.1.2 Device Type

The device type 1 node (repeater) has a relay function and requires long-term power supply. Device type 2 node (terminal), no relay function, can sleep.

5.3.1.3 Device ID

Set the ID of the module, which can be configured from 0 to 65527.

5.3.1.4 Relay Address (not used)

Note: The F8L10C-00 supports the MESH protocol. This parameter is not used. To use the relay function, you only need to configure the device type of the relay node as a relay.

5.3.1.5 Transparent address

In the pass-through mode, serial data can be sent directly to the device of the pass-through address. The range can be configured from 0 to 65535.

5.3.1.6 Carrier Frequency

Module data transmission operating frequency, different hardware modules can work in different frequency bands, roughly divided into low frequency band (525MHz below) and high frequency band (525MHz above). A typical working frequency band is 410M ~ 510MHz, 850~950 MHz, etc., and 1000KHz is a channel. Different application areas have different frequency band restrictions, as well as different channel interference factors, bit error rate is different, so it is necessary to adjust this value according to the actual situation.

The default value for the low-band hardware module is 433, and the default value for the high-band module is 868.

5.3.1.7 Transmit power

The maximum settable transmit power is 22dBm, and the factory default setting is 20dBm.

5.3.1.8 Air Rate

The rate selection of data in the air can be divided into 6 levels. The higher the level, the higher the rate. Under the same conditions, the higher the rate, the closer the transmission distance. Therefore, this value needs to be adjusted according to the actual application environment.

Note: Once the rate is determined, all devices must be at the same rate, otherwise they cannot communicate. default value: Level 3.

5.3.2 System parameters

配置

网络参数 系统参数 串口参数 IO端口

工作模式 透传模式

调试等级 1

信号强度展示 不显示

发送完成通知 不通知

休眠模式 不休眠

☒ 唤醒端

前导码时间 0 (0~60)sec

☐ 休眠端

休眠时间 0 (0~60)sec

唤醒时间 0 (0~65535)ms

加载参数 写参数 重启设备 恢复出厂配置 升级 导入参数 导出参数

5.3.2.1 Serial port working mode

Module serial port work mode, can be divided into "TRNS", "AT", "API", "MODBUS ". Among them:

"TRNS": data pass-through mode. In this case, you need to configure the pass-through destination address, that is, the destination address.

"AT": AT operation mode, refer to the AT command operation module in the AT Command Manual, usually used for parameter configuration and manual testing.

"API": API operation mode, refer to the API command format operation module in the API Command Manual. The API Payload

The data length is a maximum of 75 bytes.

"MODBUS": API operation mode. For more information, see the API command format operation module in the MODBUS Command Manual. Default value: TRNS

5.3.2.2 Commissioning Level

The log display of the debugging level control module can be divided into 3 debugging levels, of which:

- 0 No log information is output
- 1 Output critical log information
- 2 Output detailed log information
- Default value: 1

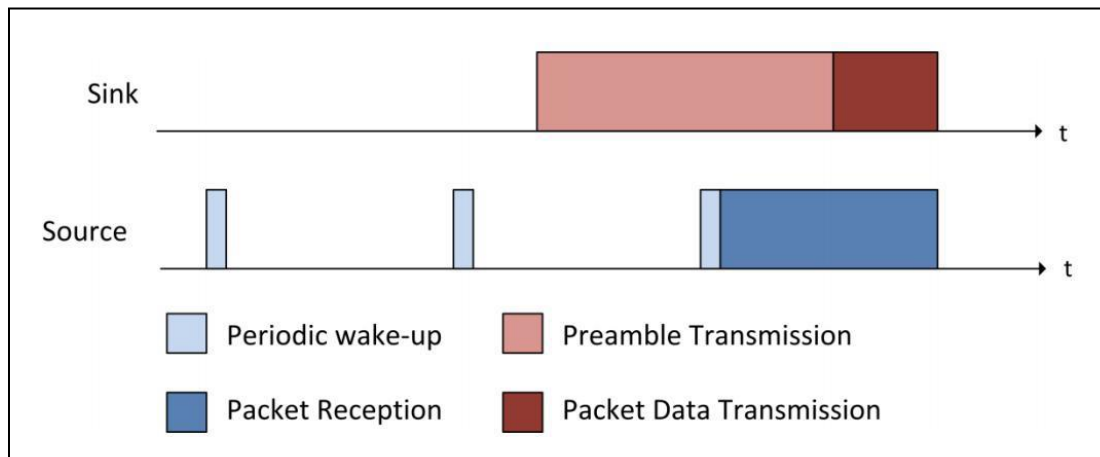
5.3.2.3 Sleep mode

When the device is in low-power mode, it can be set to NONE (no sleep), TIME (timed sleep), and DEEP (deep sleep). During deep sleep, only RST reset module or sleep control pin is set to high level to wake up.
Default value: NONE

5.3.2.4 Air Wake

In wireless network applications, there is a low-power operation mode, that is, an air wake-up mode: even if a node is in sleep, when a node is required to work, the node can be directly awakened by wireless means to receive data.

The basic principle of the wake-up in the air is that the wake-up initiator adds a long preamble before the valid data, and the wireless node at the to-be-woken end wakes up periodically to monitor the network. Once the preamble is captured, it enters a normal receiving process. If not, it immediately sleeps and waits for the next wake-up.



If you need to enable the wake-on-the-air mode, you can configure it separately according to the wake-up end and the sleep end.

配置

网络参数
系统参数
串口参数
IO端口

工作模式

Modbus

调试等级

1

信号强度展示

不显示

发送完成通知

不通知

休眠模式

空中唤醒

唤醒端

前导码时间

0

(0~60)sec

休眠端

休眠时间

0

(0~60)sec

唤醒时间

0

(0~65535)ms

加载参数

写参数

重启设备

恢复出厂配置

升级

导入参数

导出参数

The "wake-up time" and "sleep time" need to be configured for the sleep terminal of air wake-up: wake-up time, which refers to the time to keep the device awake after receiving air data, unit MS, when the device receives air data and finishes sending serial port data, it keeps this the length of the wake-up state and then enter sleep; sleep time, refers to the period of time to keep the device sleep, unit. s, when the device sleeps for more than this time, it will wake up and listen to the preamble.

The wake-up end of the air wake-up needs to configure the "preamble time", which needs to be consistent with the sleep time of the sleep end, otherwise it will cause the situation that communication cannot be done.

5.3.3 Serial port parameters

can configure the communication serial port baud rate, data bit, check bit, stop bit. Default value, baud rate

配置

网络参数
系统参数
串口参数
IO端口

波特率

115200

数据帧间隔

20

(1~65535)ms

校验位

无

停止位

1

加载参数

写参数

重启设备

恢复出厂配置

升级

导入参数

导出参数

115200, attribute 8N1.

Chapter 6 Reference Circuit

F8L10C-00 series modules are compatible with patch wireless radio frequency modules. When designing a circuit board, the module should be designed as a component unit. Therefore, the following two points should be paid attention to in PCB layout and wiring:

PCB Layout

In PCB layout, on the premise of conforming to the mold structure, the wireless module should be far away from some components that are prone to magnetic field interference or heat generation, such as horns, buzzers, switching power supplies and inductors, etc. In the area where the module is pasted, as many fast response capacitive components as possible should be placed near the power interface to avoid damage to the module by instantaneous pulses of the power supply.

PCB routing

The connection of the data lines is best parallel. On the same surface, the lines should be as long as possible. The inside of the area where the module is pasted should avoid wiring and try to maintain the integrity of the copper sheet (ground).

6.1 Supply reference circuit

The power supply design of the module is particularly important. F8L10C -00 can use LDO with low quiescent current and output current capability greater than 0.5A as power supply. During the data transmission operation of the module, it is necessary to ensure that the power supply is within the normal working range, otherwise the module will be abnormal and even cause permanent damage to the module. Note, please ensure the stability of the power supply, and the voltage cannot fluctuate significantly.

to guarantee VBAT the voltage will not drop significantly near the module. VBAT input, it is recommended to parallel a low ESR($ESR=0.7R$) of 100uF above capacitance, and 100nf, 33pf(0603 encapsulation), 10pf(0603 encapsulation) filter capacitor, VBAT the input reference circuit is shown in the figure below. In addition, it is suggested that the PCB trace of VBAT should be as short as possible and wide enough to reduce the equivalent impedance of VBAT trace and ensure that too large voltage drop will not be generated under high current at the maximum transmission power. It is recommended that the VBAT trace width should not be less than 2mm, and the longer the trace, the wider the line width.

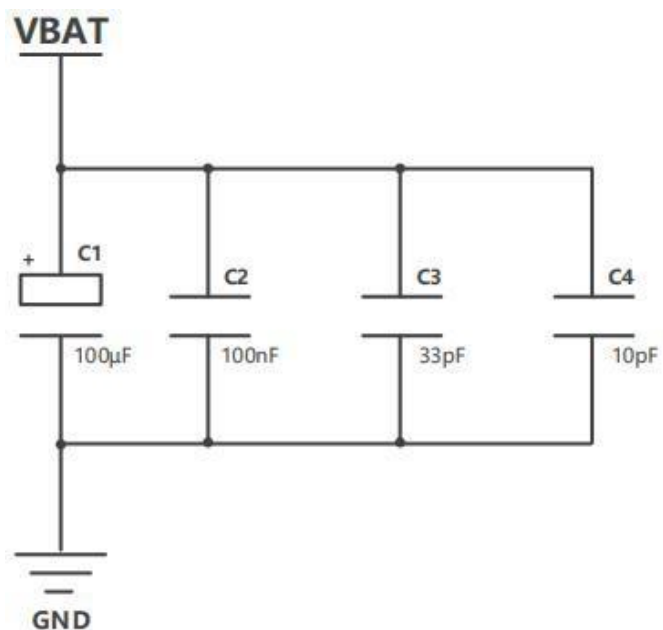


Figure 6-1 VBAT Input Reference Circuit for F8L10C -00

6.2 serial communication reference circuit

The following describes the situation of the two upper machines respectively:

1. The PC is used as the upper computer: the F8L10C-00 is connected to the PC through the RS232 serial port, which requires the use of RS232 chip conversion (e. g., SP3243), as shown in Figure 6-2.

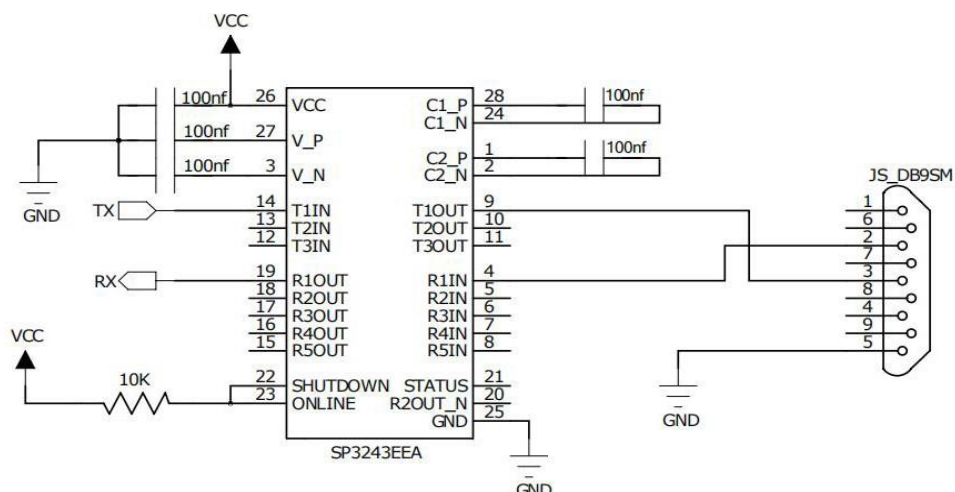


Figure 6-2 F8L10C -00 PC RS232 Connection Reference Circuit

2. The industrial control computer is used as the upper computer: F8L10C-00 is connected to the industrial control computer through RS485 bus, and RS485 chip conversion (SP3485) is required, as shown in Figure 6-3.

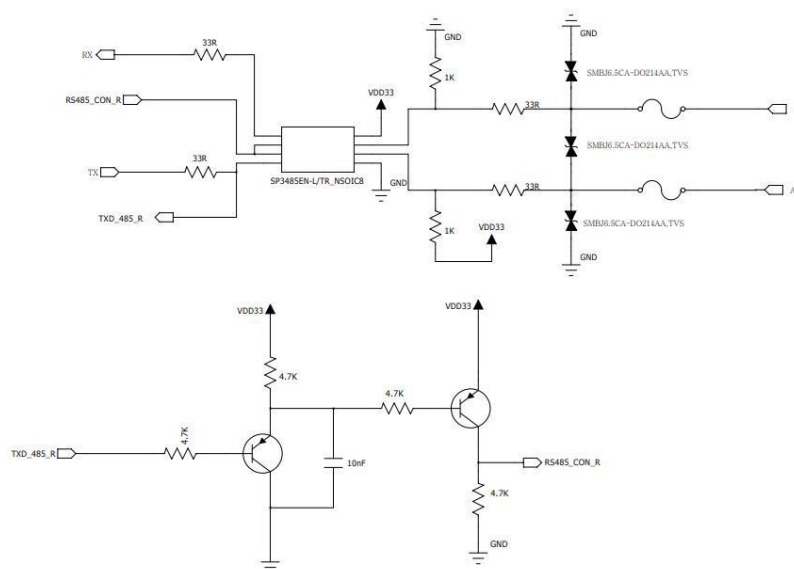


Fig. 6-3 F8L10C-00 RS485 Connection Reference Circuit

3. Single chip microcomputer is used as upper computer: if the power supply of single chip microcomputer is inconsistent with the power supply of module, level conversion chip is required. for example, as shown in fig. 6-4/6-5, triode is used to realize level conversion. The diode in the figure is a Schottky diode (the forward voltage drop is 0.3V). If you choose other diodes, please choose the forward voltage drop small to ensure that the RXD_module level is below the low level input threshold when the input is low.

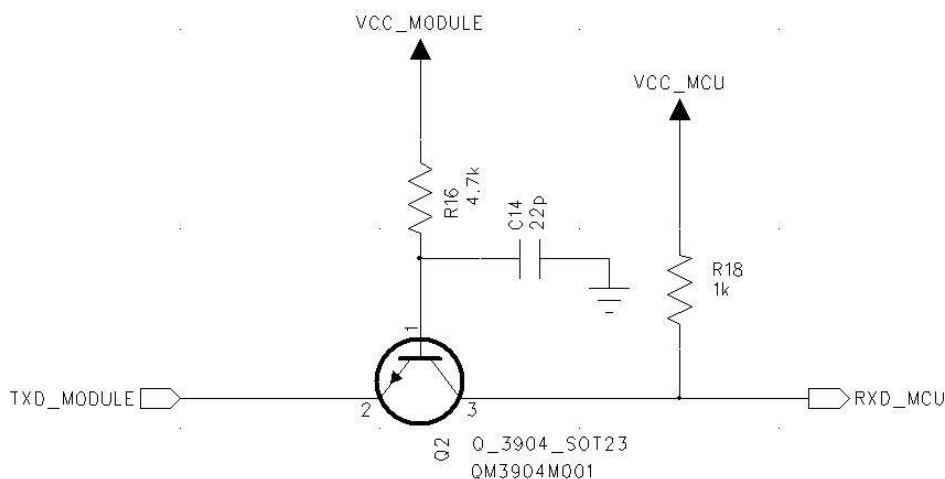


Figure 6-4 RX Level Translation Reference Design for UART Interface

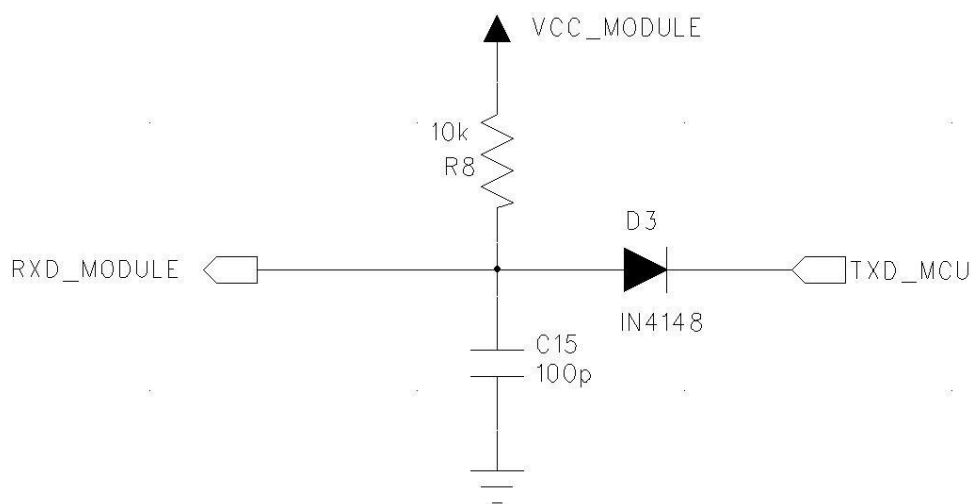
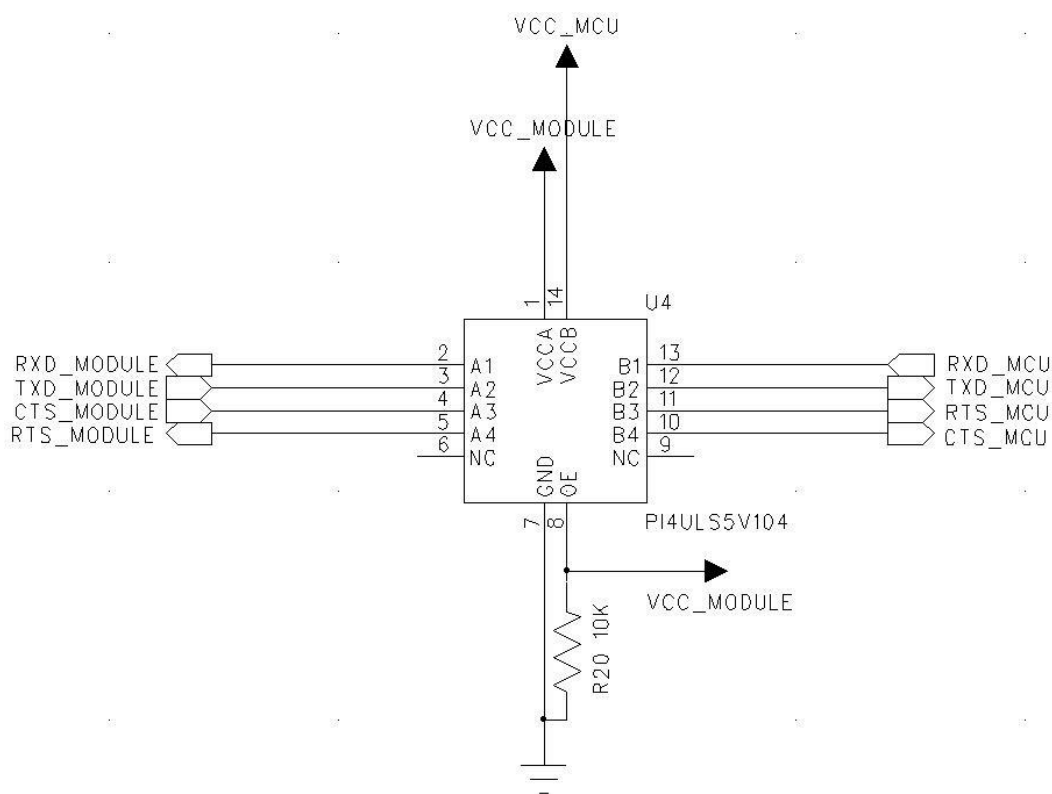


Figure 6-5 RX Level Translation Reference Design UART Interface

As shown in Figure 6-6, the use of level conversion chips for level conversion, such chips more customers can according to their own needs to choose.

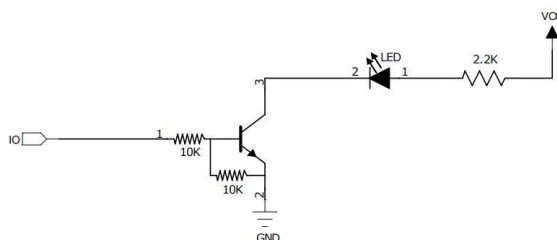


6-6 UART Interface Level Chip Translation Reference Design

6.3 IO input and output control design

6.3.1 LED light control

The IO provided by the module can be used to control the LED indicator. Since the IO output current is relatively small, it is recommended to use triode control, as shown in the following figure:



6-7 LED lamp control circuit

6.3.2 ADC Acquisition Reference Circuit

ADC acquisition function can be realized by configuring IO port as analog input. There are

two acquisition methods: voltage acquisition method

And the current acquisition method, the acquisition circuit can refer to Figure 6-8 and Figure 6-9.

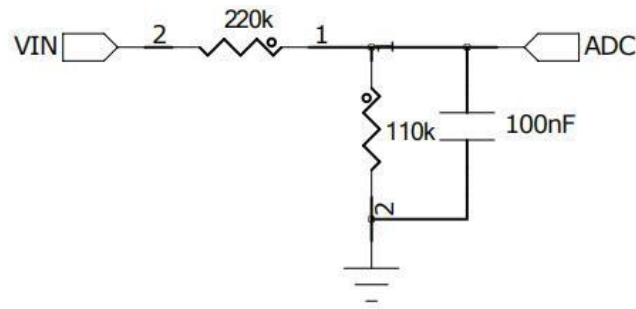


Figure 6-8 0.3V-3.3V Voltage Acquisition Mode

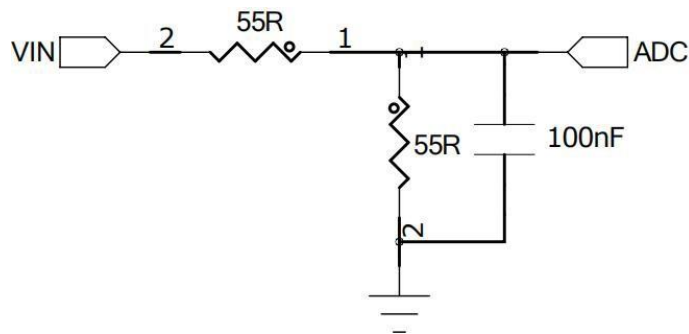


Figure 6-9 2mA-20mA current acquisition mode

6.4 IO port protection circuit

The default ESD level of module IO pin is HBM $\pm 2000V$ and CDM $\pm 800V$. When the need to enhance the module level of static electricity, the user can be in the module IO pin add electrostatic protection circuit to enhance the anti-static level, electrostatic protection circuit as shown below:

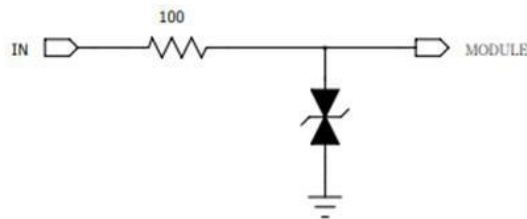


Figure 6-10 IO port protection circuit

KDB 996369 D03 statements

2.2 List of applicable FCC rules:

The module complies with FCC Part 15.247.

FCC ID: 2ALUWF8L10C on User manual and on the external of the packaging.

2.3 Summarize the specific operational use conditions

2.4 Limited module procedures

The module is not a limited module.

2.5 Trace antenna designs

Not applicable

2.6 RF exposure considerations

This equipment complies with FCC's RF radiation exposure limits set forth for an uncontrolled environment. The antenna(s) used for this transmitter must not be collocated or operating in conjunction with any other antenna or transmitter.

2.7 Antennas

The EUT use a permanently attached antenna which is unique.

2.8 Label and compliance information

The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: 2ALUWF8L10C

2.9 Information on test modes and additional testing requirements

When testing host product, the host manufacture should follow FCC KDB Publication 996369 D04

Module Integration Guide for testing the host products. The host manufacturer may operate their product during the measurements. In setting up the configurations, if the pairing and call box options for testing does not work, then the host product manufacturer should coordinate with the module manufacturer for access to test mode software.

The module has been certified for Potable applications. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter

2.10 Additional testing, Part 15 Subpart B disclaimer

The module without unintentional-radiator digital circuitry, so the module does not require an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart 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 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 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.

FCC Caution.

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.

Any 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, 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 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.

FCC 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 20 cm between the radiator & your body.