



LoRa Module

F8L10C

User Manual

V1.0.0

This manual is applicable to the following products: F8L10C-00LU, F8L10C-00LN, F8L10C-00HU, F8L10C-00HN

Document Revision History

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Note: There may be differences between models of accessories and interfaces, actual products shall prevail.

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Chapter 1 Product Introduction

1.1 Overview

F8L10C series LoRa data transmission module is an embedded wireless data transmission module based on LoRa technology. It adopts LoRa network to provide users with wireless data transmission function, and is compatible with FSK* modulation method.

This product uses an ultra-low-power LoRa integrated chip. The chip uses Semtech's advanced low-power RF chip and 32-bit RISC MCU. The MCU uses ARM Cortex M4. The module supports LoRaWAN, private, CLAA*, LinkWAN * etc. Agreement.

The ultra-small size design of the product can be widely used in the M2M industry in the IoT industry chain, such as smart grid, intelligent transportation, wireless water, gas and heat meter reading, wireless automatic data collection, industrial automation, intelligent building, fire protection, public safety, environmental protection, meteorology, digital medical treatment, telemetry, military, space exploration, agriculture, forestry, water affairs, coal mining, petrochemical and other fields.

1.2 Product Features

Industrial-grade application design

- ◆ It adopts high-performance industrial-grade chips to meet the Four-Faith proprietary protocol, LoRaWAN 1.0.2, LinkWAN, claa protocol
- ◆ The series supports all ISM bands from 150MHz to 960MHz
- ◆ Multiple baud rates, multiple RF rates
- ◆ Low-power design, support sleep and wake-up modes, minimum less than 2 μ A
- ◆ The maximum transmit power is 22dBm, and the multi-stage power is adjustable
- ◆ Theoretical maximum reception 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
- ◆ It is packaged with miniature four-sided 1.27mm*10 stamp holes
- ◆ Supports ipex connector and pin two kinds of RF signal output mode

1.3 Product Images



Chapter 2 Module Interfaces

2.1 Module Pin Definitions

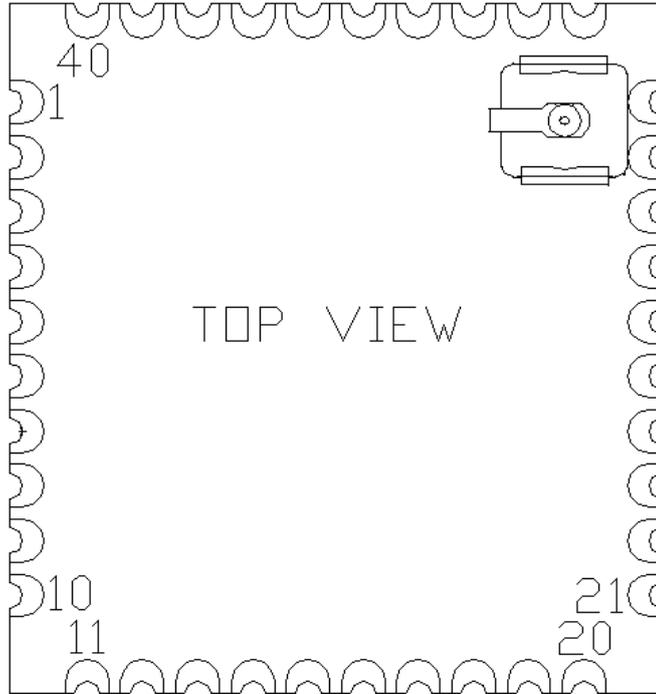


Figure 2-1 Module Pin Diagram F8L10C

Table 2-1-1 Module Interface Definitions

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	GPIO06/SSP0_NSS
13	D7	Either	GPIO07 /SSP0_CLK
14	D8	Either	GPIO08 /SSP0_RX
15	D9	Either	GPIO09/SSP0_TX
16	GND	N/A	Ground
17	D12	Either	GPIO12/WKUP
18	D13	Either	GPIO13/LPUART_RX (Reserved).
19	D14	Either	GPIO14/LP_TIMER
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
29	GND	N/A	Ground
30	RF_OUT	N/A	F8L10C-00XN version is RF input and output
31	GND	N/A	Ground
32	NC	NC	NC
33	D15	Either	GPIO15/UART2_TXD (Reserved).
34	GND	N/A	Ground
35	D16	Either	GPIO16/UART3_TX (Reserved).

36	D17	Either	GPIO17/UART3_RX (Reserved).
37	GND	N/A	Ground
38	D18	Either	GPIO18
39	D19	Either	GPIO19
40	GND	N/A	Ground

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

Note: Signal input/output is relative to the module

Note: The sleep control pin wakes up at high level and sleeps at low level.

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 always low, and the sending completion is pulled high for 10ms.

The reception completion notification pin is always low, and the reception completion is pulled high for 10ms (default value, AT command configurable).

2.2 UART Interface

The serial communication port 1 of the module is the UART interface, and the pins are defined as shown in Table 2-2:

Table 2-2 UART Pin Definitions

UART signal name	Module pin number
TX0	8
RX0	7

2.3 GPIO Specifications

The F8L10C module has 26 GPIO ports, and the DC characteristics are shown in Table 2-3:

Table 2-3 DC characteristics of GPIOs

Parameter	Least	Typical	Utmost
The input voltage (V) of logic 0	0		<0.3 VBAT
The input voltage (V) of logic 1	>0.7VBAT		VBAT
The input pull-up and pull-down resistors (kΩ).		30K	
GPIO pin capacitance (pF).		3pF	

2.4 Limit Parameters

Table 2-5 Limit parameters

Parameter	Minimum	Maximum	Unit
Input power	-0.3	3.9	V
Pin input voltage	-0.3	3.9	V
Enter the RF rating		+10	dBm
Storage temperature range	-55	125	°C

Note: Exceeding the limit parameters may cause permanent damage to the module.

2.5 Antenna Interface

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

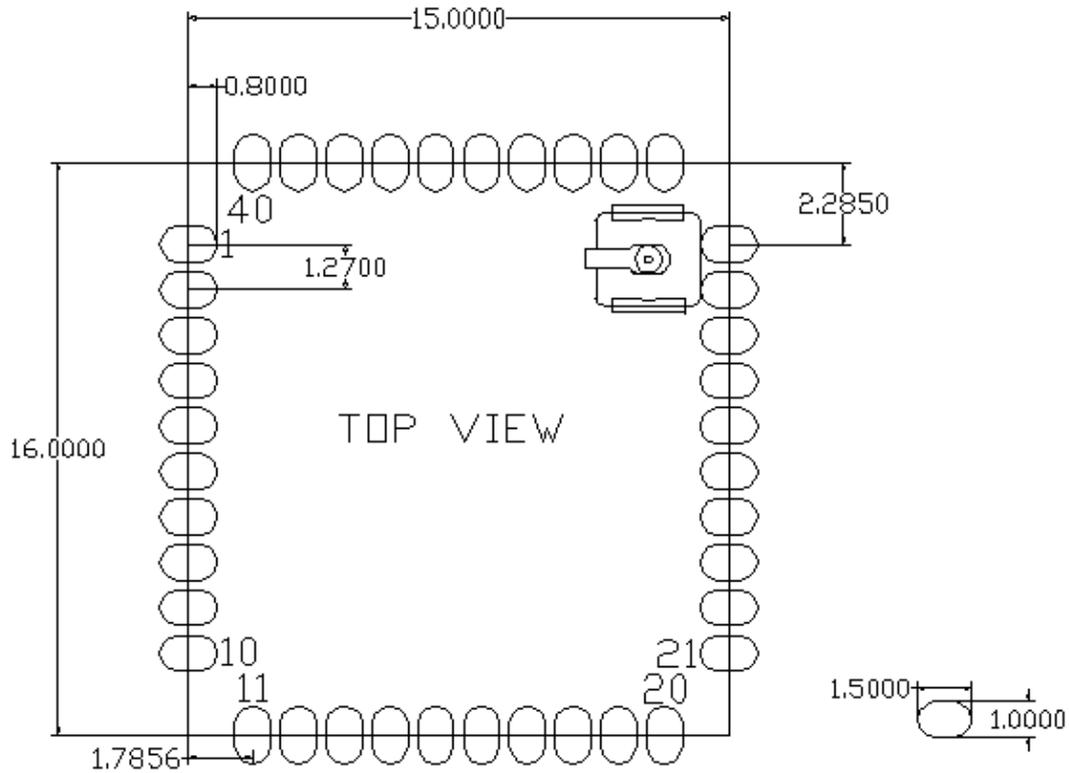
The module RF interface is IpeX Generation 1 interface and 30-pin output.

The voltage standing wave ratio of the external antenna should not be greater than 2, and the RF coaxial cable should be as short as possible to reduce the insertion loss. The placement of the antenna should avoid large areas of metal as much as possible to avoid affecting the radiation performance of the antenna.

When the built-in antenna is required, the PCB design should reserve enough clearance space, and the antenna design should be completed by a professional antenna engineer to achieve the best radiation performance. The built-in antenna needs to be designed in combination with the terminal's PCB, housing, and installation environment. Antennas for different terminals need to be designed separately and cannot be mixed.

The peripheral RF circuit and antenna design need to follow the 50 ohm system impedance matching design specification, or communicate with our technical support staff.

3.2 Recommended Package Design Dimensions



Note: All dimensions are in millimeters (mm)

3.3 Re-flow Reflow Temperature Range

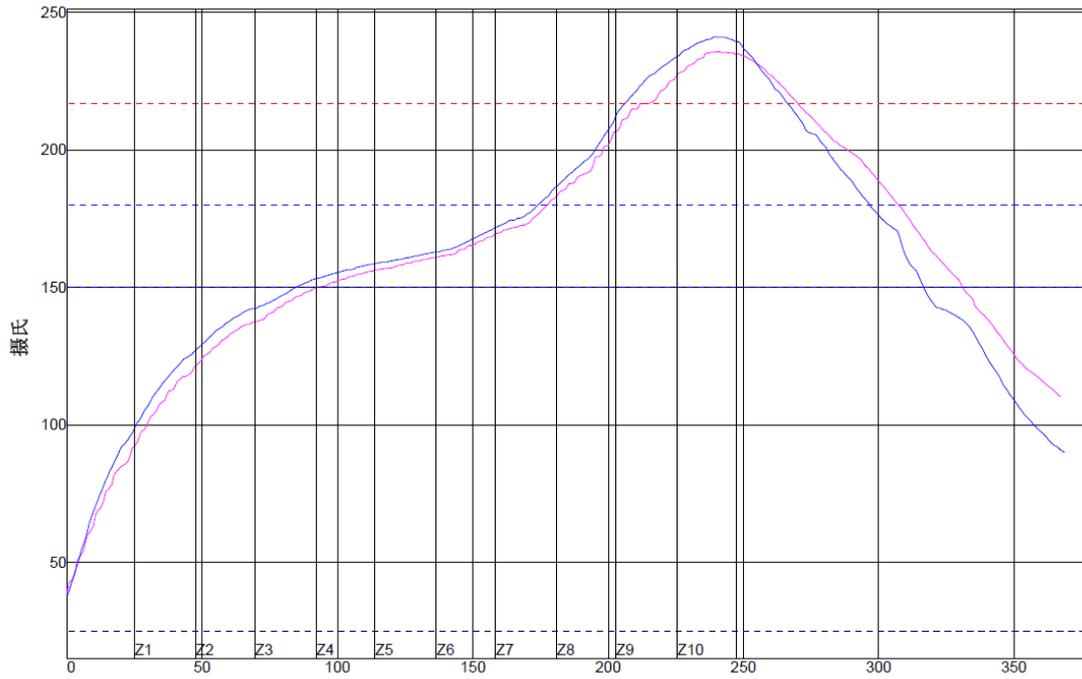
Welding according to IPC/JEDEC J-STD-020B standard is recommended.

Welding temperature

Use a constant temperature electric soldering iron to solder the temperature not to exceed 340°C, and the soldering time of each pin should not exceed 2S.

SMT temperature curve

The following temperature profiles are recommended for reflow soldering with SMT:



PWI=94%		Highest rise slope		Highest drop slope		preheat 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	

Connect to the form

PWI=94%		Constant temperature time 150 ~ 180 °C		Backflow time 217°C		Maximum temperature		Slope 3 250~200°C	
	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: Receives data

4.1.2 Hardware Connection

The UART hardware connection is shown in Figure 4-1:

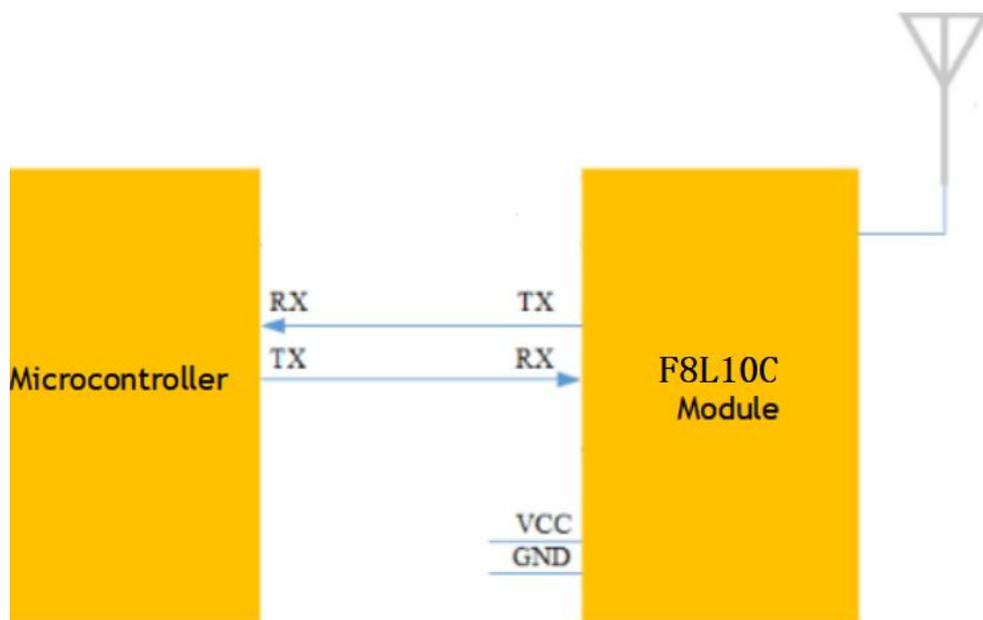


Figure 4-1 UART interface connection

For example, as shown in Figure 4-2, a device with UART interface is directly connected to the pins of the F8L10C module, and a group of UART-to-RF communication devices can be obtained

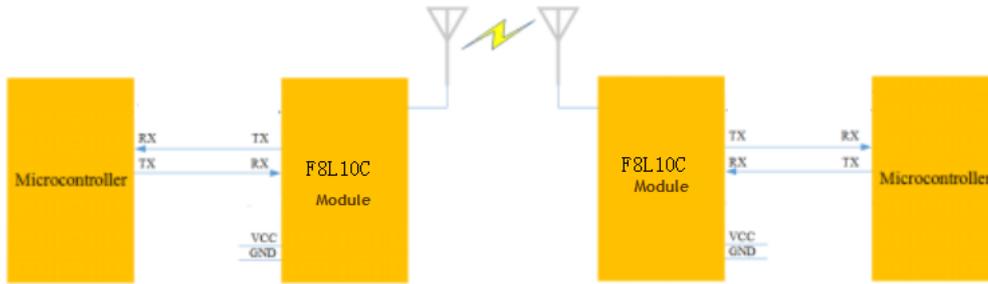


Figure 4-2 Two modules communicate with each other indicating diagram

4.1.3 Communication Transmission Byte Format

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

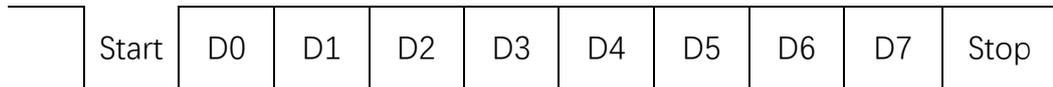


Figure 4-3 UART interface communication transmission byte format

- 1) Communication interface: UART
- 2) Baud rate: 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 bit
- 6) Check: No check/odd check/parity

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

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

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

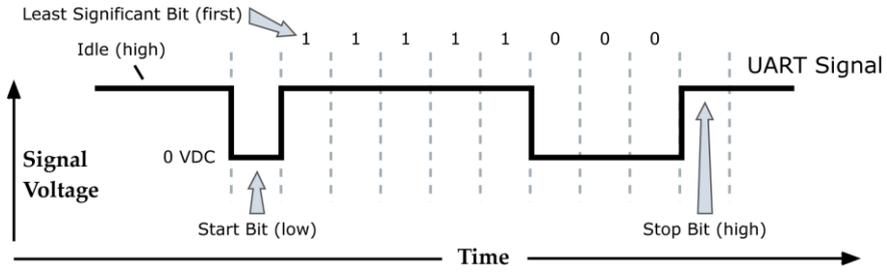


Figure 4-4 Data plot of the transmission 0x1F

Chapter 5 Parameter Configuration

5.1 Configure the Connection

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

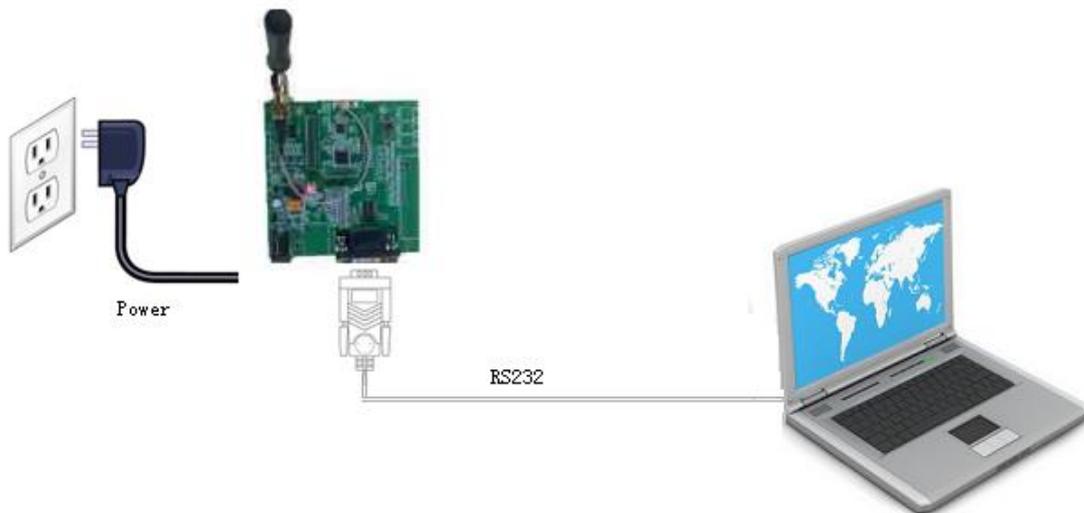


Figure 5-1 The F8L10C is connected to the PC configuration

5.2 Introduction to Parameter Configuration

There are two ways to configure parameters of F8L10C series modules:

Configuration through the "Latest Four-Faith LoRa Configuration Software LoRaConfig": All configurations are configured through the corresponding entries in the software interface. This configuration method is only suitable for users to configure with a PC.

Configure by extending the AT command (hereinafter referred to as AT command): In this configuration mode, the user only needs to have a serial communication program to configure all the parameters of the F8L10C module, such as HyperTerminal under WINDOWS, under LINUX minicom, putty, etc., or directly configure the node by the user's Single-chip microcomputer system. Before using the extended AT command to configure the F8L10C series module, the module needs to enter the configuration state.

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

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

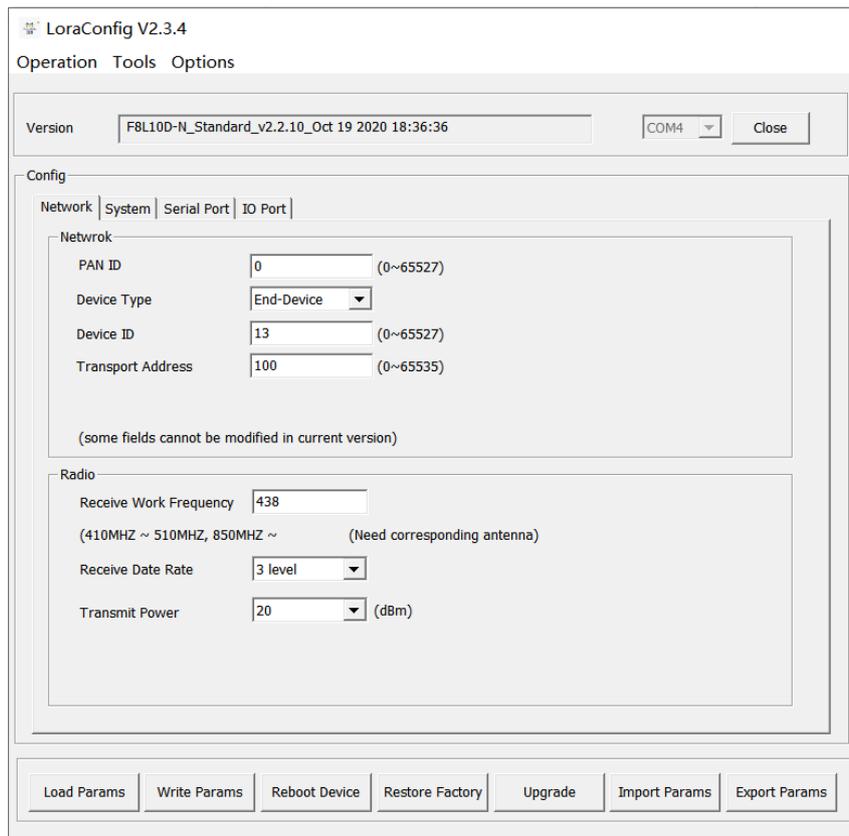


Figure 5-2 Configuration interface

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

After the device is powered on, click "Load Parameters" in the configuration software, 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, you can start to configure all parameters in the F8L10C, as shown in Figure 5-2 shown.

5.3 Parameter Details

The following is mainly based on the AT command configuration method, and introduces each configuration item of the F8L10C module in detail.

5.3.1 LoRa Network Parameters

Config

Network | System | Serial Port | IO Port

Network

PAN ID (0~65527)

Device Type

Device ID (0~65527)

Transport Address (0~65535)

(some fields cannot be modified in current version)

Radio

Receive Work Frequency
(410MHZ ~ 510MHZ, 850MHZ ~ (Need corresponding antenna)

Receive Data Rate

Transmit Power (dBm)

5.3.1.1 Network Number

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

5.3.1.2 Device Type

The node (repeater) with device type 1 has the relay function and needs long-term power supply.

A node (terminal) with device type 2 has no relay function and can sleep.

5.3.1.3 Device ID

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

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

5.3.1.4 Relay Address (not used)

Note: F8L10C supports MESH protocol, this parameter is not used; if you want to use the relay function, you only need to configure the device type of the relay node as a repeater.

5.3.1.5 Transparent Address

In the transparent transmission mode, the serial port data can be sent directly to the device with the transparent transmission address. The configurable range is 0~65535.

5.3.1.6 Carrier Frequency

The working frequency of module data transmission, different hardware modules can work in different frequency bands, roughly divided into two categories: low frequency band (below 525MHz) and high frequency band (above 525MHz). Typical working frequency bands are 410M~510MHz, 850~950MHz, etc. 1000KHz is a channel. Different application areas have different frequency band restrictions, as well as interference factors of different channels, and bit error rates are different, so this value needs to be adjusted according to the actual situation. The default value of the low-band hardware module is 433, and the default value of the high-band module is 868.

5.3.1.7 Transmit Power

The maximum transmit power that can be set is 22dBm, and the factory default setting is 20dBm.

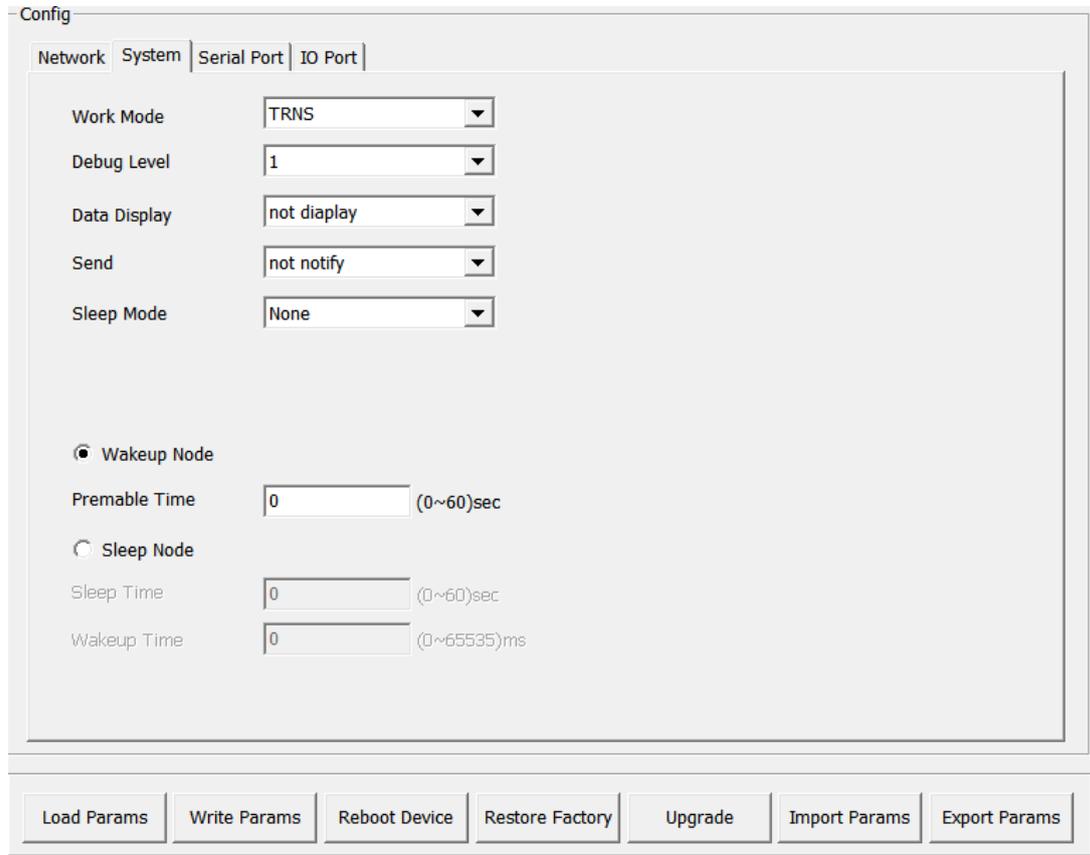
5.3.1.8 Air Rate

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, then all devices must be at the same rate, otherwise they cannot communicate.

Default value: Level 3.

5.3.2 System Parameters



Config

Network System Serial Port IO Port

Work Mode TRNS

Debug Level 1

Data Display not display

Send not notify

Sleep Mode None

Wakeup Node

Preamble Time 0 (0~60)sec

Sleep Node

Sleep Time 0 (0~60)sec

Wakeup Time 0 (0~65535)ms

Load Params Write Params Reboot Device Restore Factory Upgrade Import Params Export Params

5.3.2.1 Serial Port Working Mode

The serial port working mode of the module can be divided into "TRNS", "AT", "API", "MODBUS".

in:

"TRNS": data transparent transmission mode, you need to configure the transparent transmission destination address, that is, the destination address.

"AT": AT operation mode, refer to the AT command operation module in "AT Command Manual", which is 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 maximum length of the API Payload data is 75 bytes.

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

Default: TRNS

5.3.2.2 Debug Level

The log display of the debug level control module can be divided into three debug levels,

including:

- 0 do not output any log information
- 1 Output key log information
- 2 Output detailed log information
- Default: 1

5.3.2.3 Sleep Mode

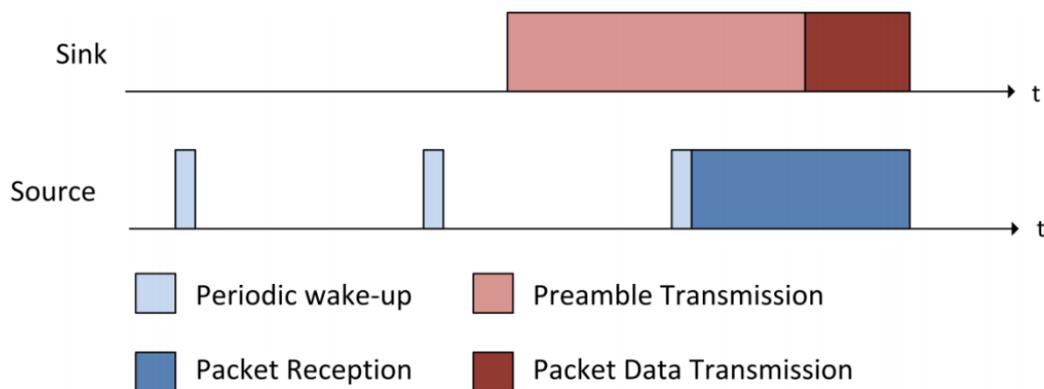
When the device is in low power mode, it can be set to NONE (no sleep), TIME (timed sleep) and DEEP (deep sleep). During deep sleep, it can only be woken up by setting the RST reset module or the sleep control pin to a high level.

Default value: NONE

5.3.2.4 Wake-up Over the Air

There is a low-power operation mode in wireless network applications, that is, the wake-up mode in the air: even if the node is sleeping, when the node needs to work, it can directly wake up the node through wireless means to allow it to receive data.

The basic principle of over-the-air wake-up is that the wake-up initiator adds a long preamble before the valid data, and the wireless node of the wake-up terminal periodically wakes up and monitors the network. Once the preamble is captured, it will enter the normal receiving process. If not, it will sleep immediately and wait for the next wake-up.



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

Config

Network System **Serial Port** IO Port

Work Mode	Modbus
Debug Level	1
Data Display	not diaplay
Send	not notify
Sleep Mode	Wakeup

Wakeup Node

Preamble Time (0~60)sec

Sleep Node

Sleep Time (0~60)sec

Wakeup Time (0~65535)ms

Load Params
Write Params
Reboot Device
Restore Factory
Upgrade
Import Params
Export Params

For the sleep side of air wake-up, you need to configure "wake-up time" and "sleep time": wake-up time, refers to the time to keep the device awake after receiving air data, in ms, when the device receives air data and sends serial port data, it keeps The wake-up state for this length of time will then go to sleep; the sleep time refers to the period of keeping the device sleeping, in s. When the device sleeps for more than this time, it will wake up and monitor the preamble.

The wake-up end of the wake-up in the air needs to configure the "preamble time". This value needs to be consistent with the sleep time of the sleep end, otherwise it will cause communication failure.

5.3.3 Serial Port Parameters

The baud rate, data bit, check bit, and stop bit of the communication serial port can be configured.

The default value, baud rate 115200, property 8N1.

Config

Network | System | Serial Port | IO Port

BaudRate

Frame Interval (1~65535)ms

Parity

StopBits

Chapter 6 Reference Circuit

F8L10C series modules are compatible with SMD wireless radio frequency modules. The module should be designed as a component unit when designing the circuit board, so the following two points should be paid attention to in PCB layout and wiring:

PCB Layout

In the PCB layout, under 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-prone components, such as: speakers, buzzers, switching power supplies and inductors, etc. Place as many fast-response capacitive elements as possible at the power interface to avoid damage to the module by the instantaneous pulse of the power supply.

PCB traces

The connection of the data lines is preferably parallel. On the same surface, the lines should be as long as possible. The wiring should be avoided in the area where the module is attached, and the integrity of the copper skin (ground) should be maintained as much as possible.

6.1 Power Supply Reference Circuit

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

In order to ensure that the VBAT voltage will not drop significantly, it is recommended to connect a capacitor with a low ESR ($ESR=0.7R$) above 100uF in parallel, and a capacitor of 100nf, 33pf (0603 package), 10pf (0603 package) near the VBAT input end of the module. Filter capacitor, VBAT input reference circuit as shown in the figure below. It is also recommended that the PCB trace of VBAT be as short and wide as possible to reduce the equivalent impedance of the VBAT trace and ensure that there will not be too much voltage drop under high current at the maximum transmit power. It is recommended that the VBAT trace width be no less than 2mm, and the longer the trace, the wider the trace width.

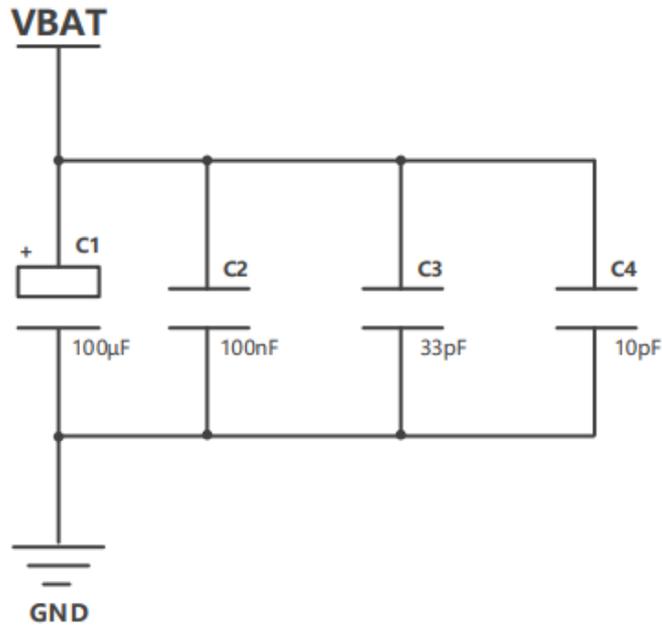


Figure 6-1 VBAT input reference circuit for the F8L10C

6.2 Serial Port Communication Reference Circuit

The following describes the two situations of the upper computer:

1. PC as host computer: F8L10C is connected with PC through RS232 serial port, and it needs to use RS232 chip conversion (such as SP3243), as shown in Figure 6-2.

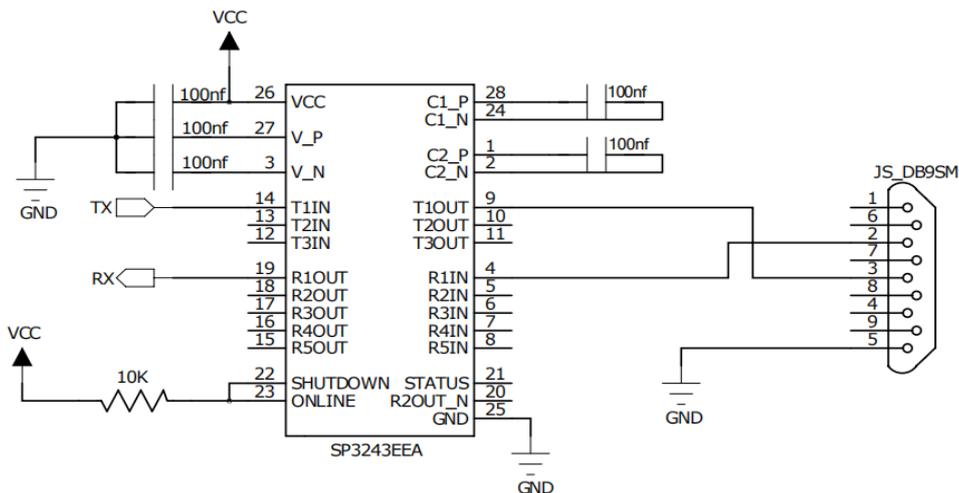


Figure 6-2 Reference circuit for connecting the F8L10C to PC RS232

2. The industrial computer is used as the host computer: F8L10C is connected with the industrial computer through the RS485 bus and needs to use the RS485 chip conversion (such as SP3485), as shown in Figure 6-3.

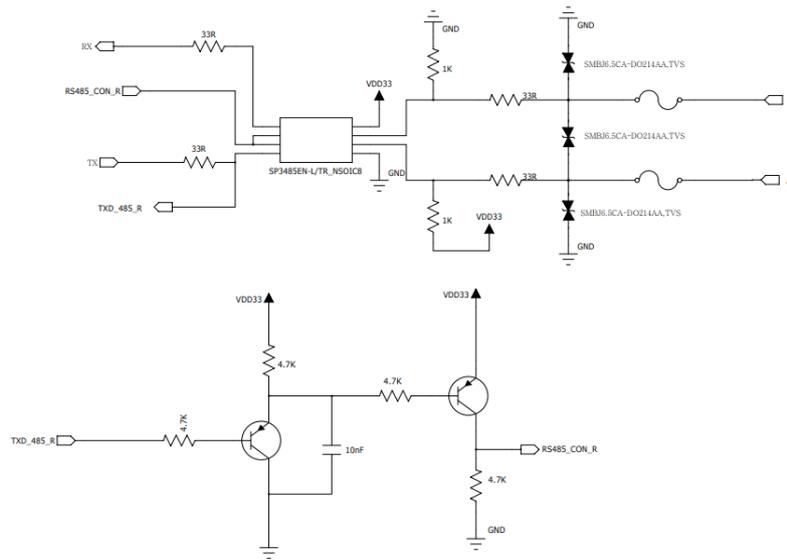


Figure 6-3 Reference circuit of F8L10C connected to industrial computer RS485

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

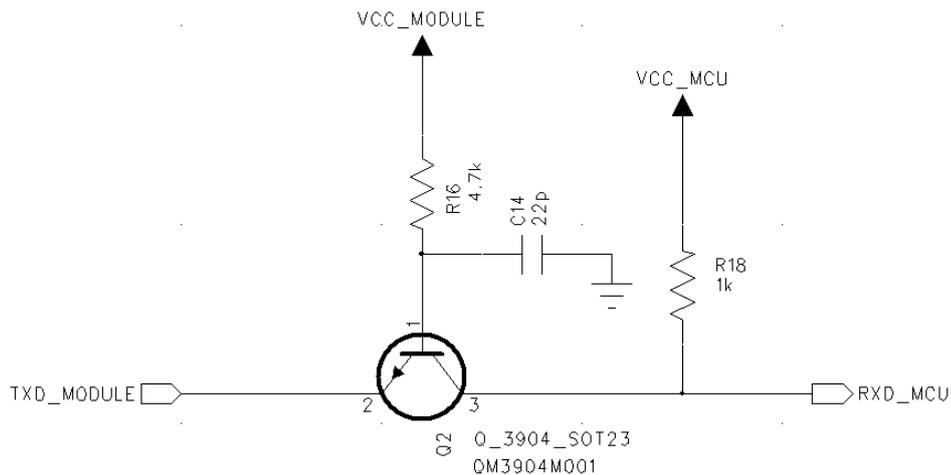


Figure 6-4 UART Interface RX Level Shift Reference Design

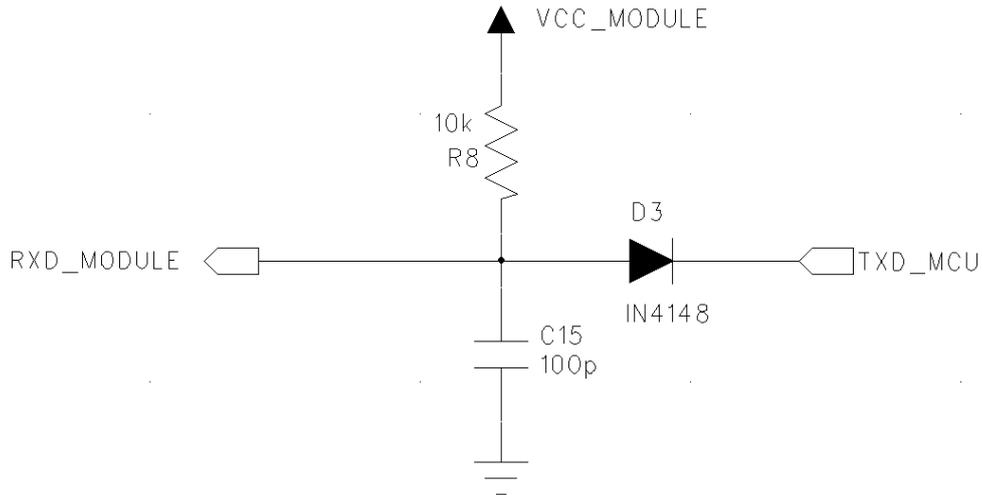


Figure 6-5 UART Interface RX Level Shift Reference Design

As shown in Figure 6-6, the level conversion chip is used for level conversion. There are many such chips that customers can choose according to their own needs.

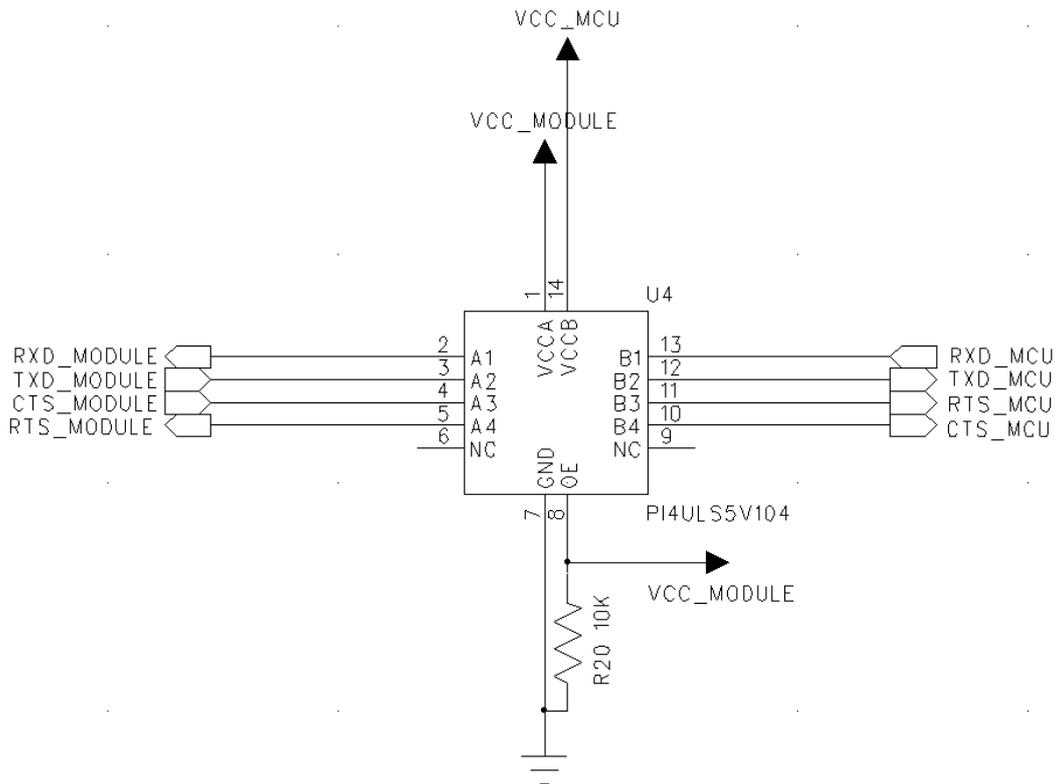


Figure 6-6 UART Interface Level Chip Shift Reference Design

6.3 IO Input and Output Control Design

6.3.1 Control LED Lights

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

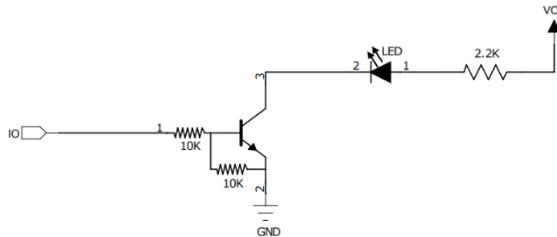


Figure 6-7 LED lamp control circuit

6.3.2 ADC Acquisition Reference Circuit

Configure the IO port as an analog input to realize the ADC acquisition function. There are two acquisition methods: voltage acquisition method and current acquisition method. Please refer to Figure 6-8 and Figure 6-9 for the acquisition circuit.

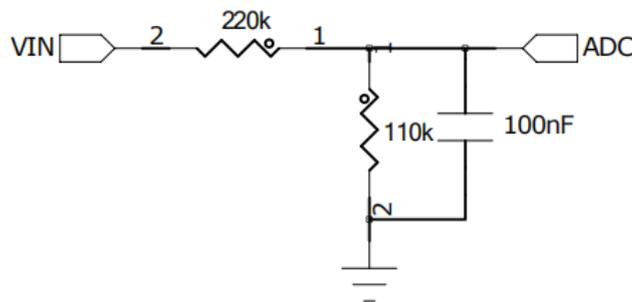


Fig. 6-8 0.3V-3.3V voltage acquisition method

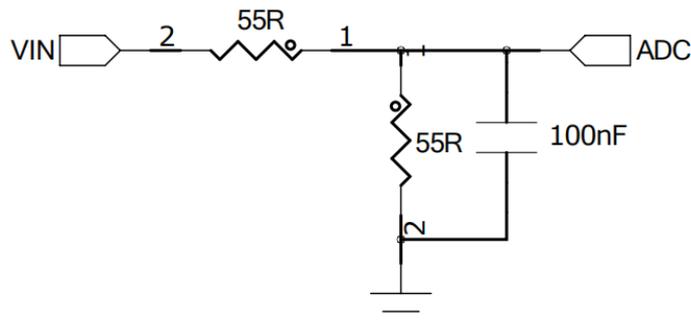


Fig. 6-9 2mA-20mA current acquisition method

6.4 IO Port Protection Circuit

The default level of ESD protection for module IO pins is HBM \pm 2000V and CDM \pm 800V. When it is necessary to improve the electrostatic level of the module, the user can add an electrostatic protection circuit to the IO pins of the module to improve the antistatic level. The electrostatic protection circuit is shown in the figure below:

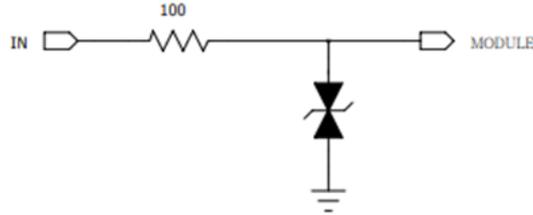


Figure 6-10 IO port protection circuit