MKL62ST-DT User Manual

Version V1.1

CONTENTS

1 About This Manual

This manual is used to introduce the hardware interface of development board to help users get familiar with AT commands of MKL62BA and quickly start with DEMO application firmware.

2 Packing List

Items	Description
Development Board	The development board has been welded with the required MKL62BA module, and has all available hardware interfaces.
Type-C USB cable	Used for USB power supply and data communication
2pin jumpers x 4	The jumpers are for 2.54 mm pitch headers used on JP1,JP2,JP3,JP4
External LoRa dipole antenna	External multiband LoRa dipole antenna, 1.6dBi, 860-930MHz
IPEX to IPEX cable	By connecting two IPEX sockets,enable LoRa SMA connector
7pin header	Used to connect SMT32 peripheral P1
2.54mm pitch 2*3 pin header	Used for peripheral power supply J1
2.54mm pitch 1*15 female header	Used for connecting Arduino board P2
2.54mm pitch 1*4 female header	Used for connecting Arduino board P3
2.54mm pitch 1*2 female header x 2	Used for connecting Arduino board P6,P7
2.0mm pitch PH-2AWD 2pin connector	Used for connecting battery

3 Overview and Specification

3.1 Brief Introduction

MKL62ST-DT is a small, open-source IoT development board specially designed for MOKO LORAWAN®-Based module MKL62BA.

The low-power SMT32 chip is used as the external MCU, and it is integrated with the Sensirion SHT30 temperature and humidity sensor. By running the demo application firmware provided by MOKO, users can quickly familiar with the LORA®-Based network and see the temperature and humidity sensor data on the LORAWAN®-Based network server.

Users also can connect different external sensors through a rich peripheral interface to quickly design and validate a LORA®-Based node device. Moreover, since the Arduino NANO connection is compatible, it will be easy to begin the LORA®-Based application design process.

3.2 Key Features

- Support standard LoRaWAN protocol
- Power supply interface with a complete anti - surge, ESD, anti - reverse connection and other protective design
- Provide Li-battery connection interface, integrated lithium battery charge and discharge management circuit
- CP2102 USB-UART chip provides serial port function to facilitate program download and debugging information printing
- Provide SMT32 and LoRaWAN module serial port program interface
- Compatible with Arduino NANO interface
- Offers a variety of on-board peripheral SHT30 sensor, button, and LED

3.3 Specification

Items	Parameters
MCU	STM32L151C8T6A
Flash	64KB
RAM	32KB
Power Supply	3.7V rechargeable Li-battery or Type-C USB
Output Voltage	5V or 3.3V
Output Current	Max. 500mA
LORAWAN Module	MKL62BA
Protocol	LORAWAN V1.0.2 and BLE V4.2
LORA Frequency Band	868MHZ/915MHZ(configurable by AT Command)
LORA TX Power	Max.22dB
LORA Antenna	IPEX or SMA interface antenna
On-board Peripheral	SHT30 Sensor,2xLED,2xswitch
Dimension	80x36X12mm

4 Development Environment

To use the on-board MCU SMT32 to develop different application firmware, it is recommended to use the following tools, and only supports Windows system computers.

- Development software: Keil MDK5(http://www2.keil.com/mdk5)
- Debugger and programmer tool: SEGGER J-LINK

To quickly get started with the MKL62BA LoRaWAN module AT commands, it only needs a SerialNet data debugger software, such as SSCOM.

5 System Block and Interface Instruction

5.1 Function Block Diagram

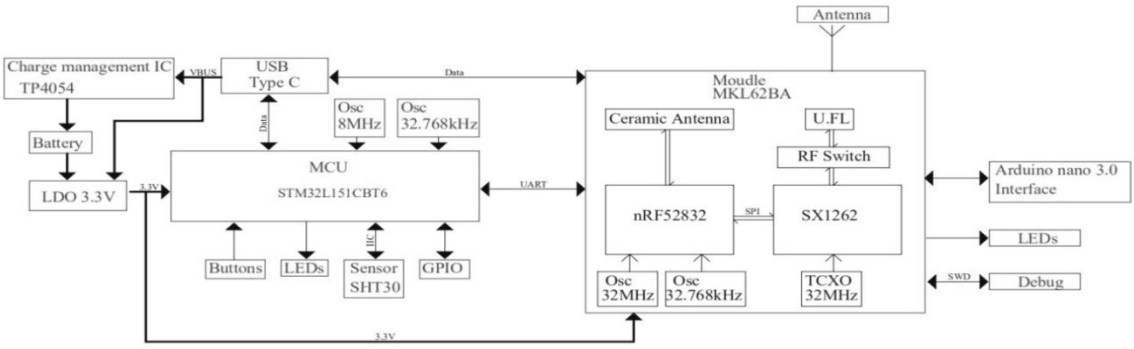


Figure 1: MKL62ST-DT block diagram

5.2 Development Board Overview

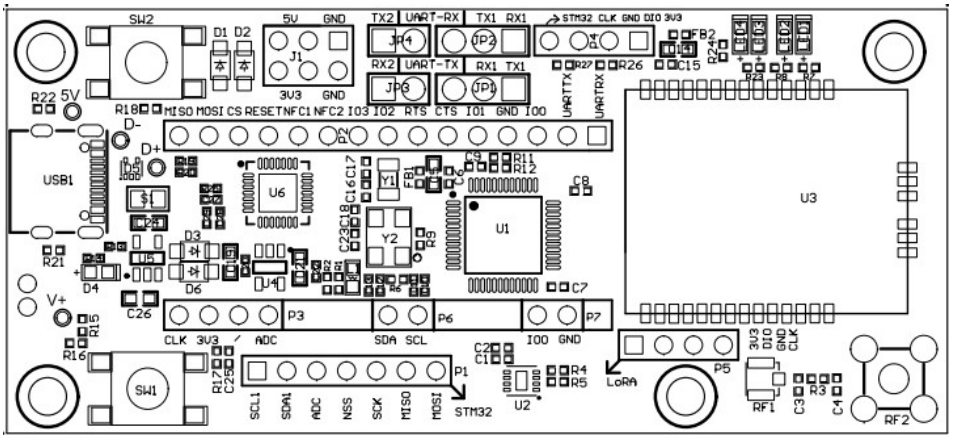


Figure 2: MKL62ST-DT top view

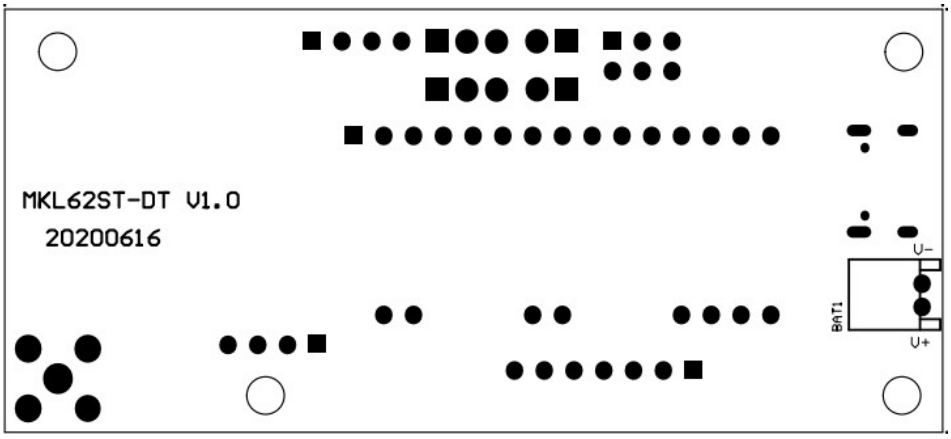


Figure 3: MKL62ST-DT bottom view

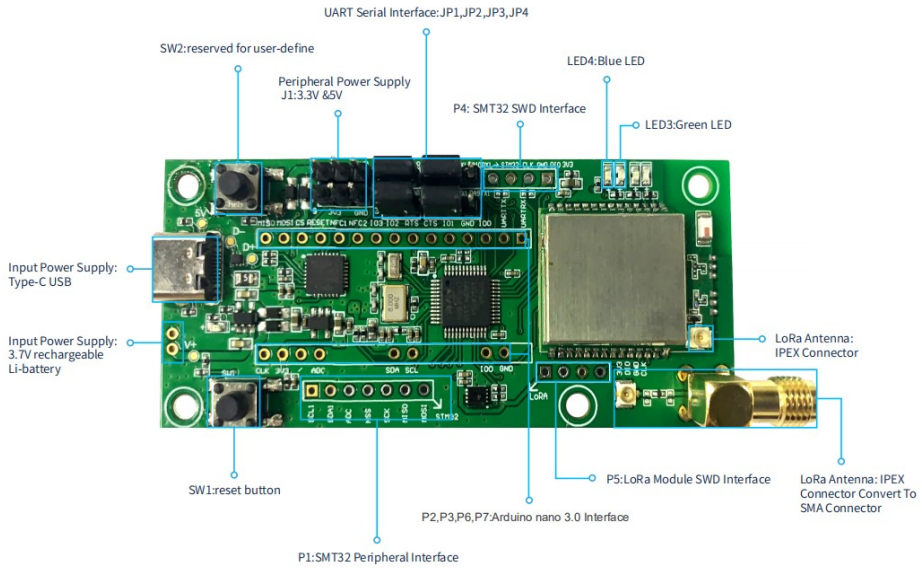


Figure 4: MKL62ST-DT interface overview

5.3 Interface Instruction

5.3.1 Power Supply

There are three different parts for the power supply:

- Input power supply: optional 5V type-C USB power supply or 3.7V rechargeable Li-battery
- Power supply VCC 3.3V for on-board MCU SMT32, MKL62BA module and Arduino
- Power supply 3.3V or 5V for peripheral

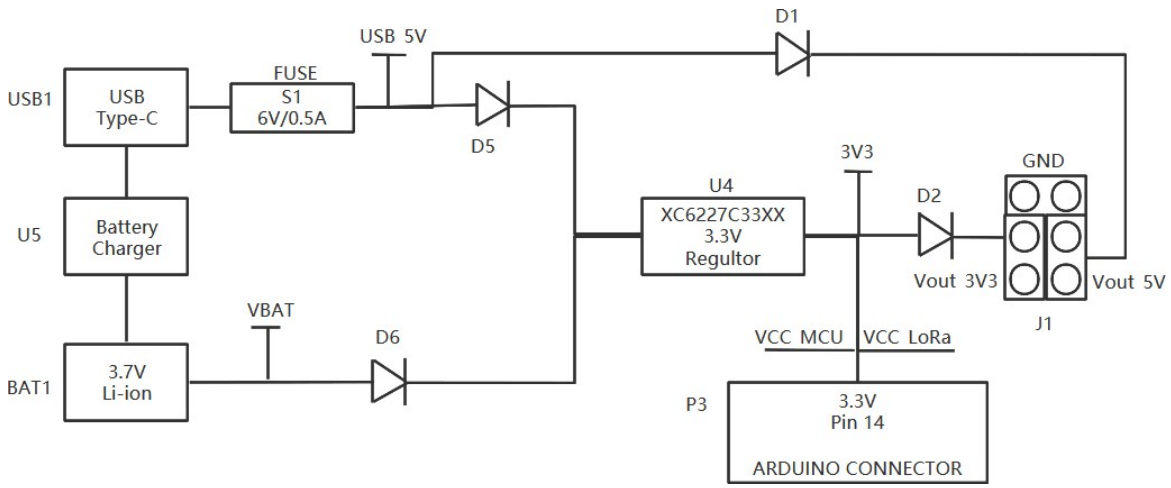


Figure 5: MKL62ST-DT power supply block

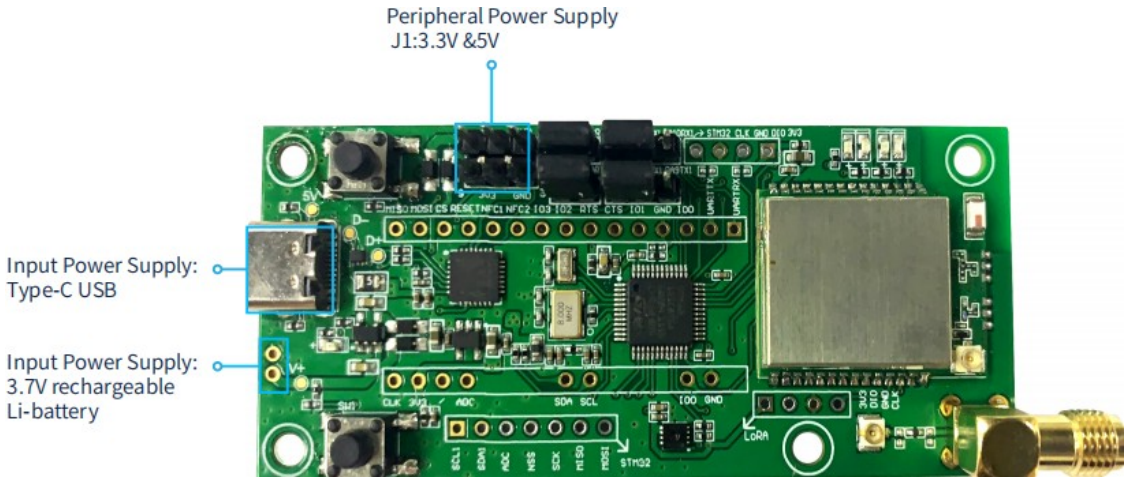


Figure 6: Power supply on board interface

5.3.2 UART Serial Interface

Through the different connections of jumper caps to JP1, JP2, JP3 and JP4, different serial communication between USB, STM32 and MKL62BA can be realized.

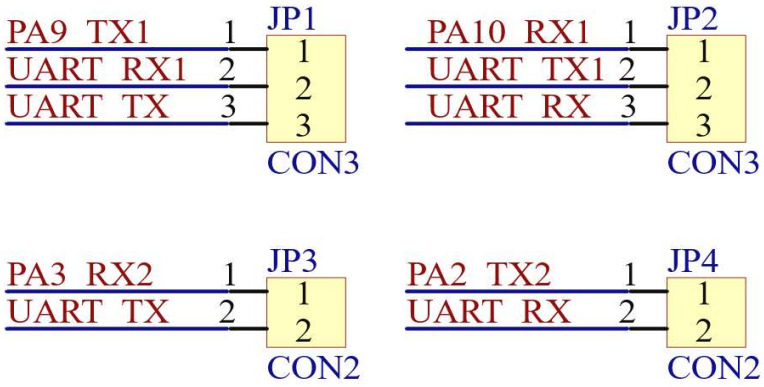


Figure 7: UART serial interface pinouts diagram

UART mapping for MKL62ST-DT USB connect to MKL62BA module directly

USB	MKL62BA	Remark
UART_RX1	UART_TX	Use a jumper connect JP1 PIN 2 and PIN 3
UART_TX1	UART_RX	Use a jumper connect JP1 PIN 2 and PIN 3

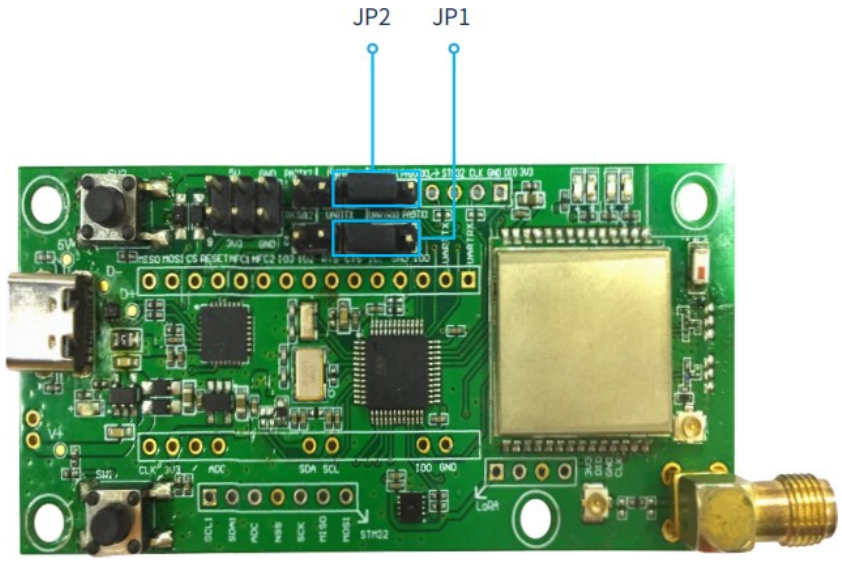


Figure 8: Connecting USB UART to ML62BA modul

UART mapping from MKL62ST-DT USB connect to SMT32 then MKL62BA module

USB	SMT32	Remark
UART_RX1	PA9_TX1	Use a jumper connect JP1 PIN 1 and PIN 2
UART_TX1	PA10_RX1	Use a jumper connect JP2 PIN 1 and PIN 2

SMT32	MKL62BA	Remark
PA3_RX2	UART_TX	Use a jumper connect JP3 PIN 1 and PIN 2
PA2_TX2	UART_RX	Use a jumper connect JP4 PIN 1 and PIN 2

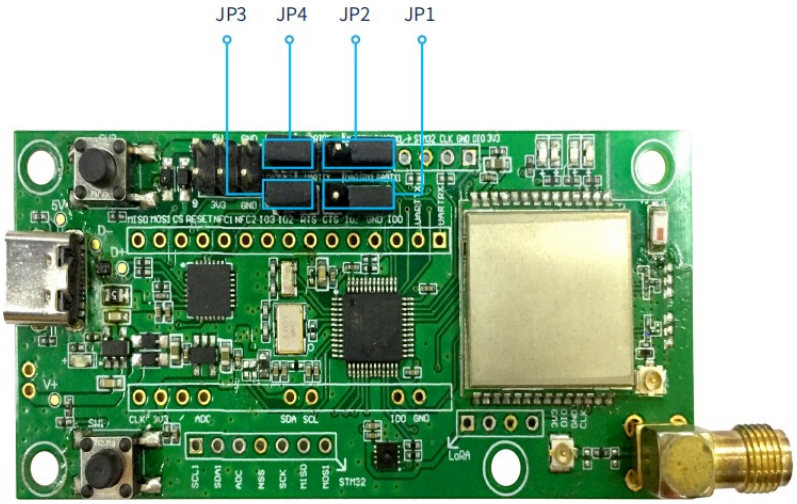


Figure 9: Connecting USB UART to SMT32

5.3.3 Arduino nano 3.0 Interface

Through the Arduino nano 3.0 interface, user can drive the module by an external MCU board compatible with Arduino nano 3.0.

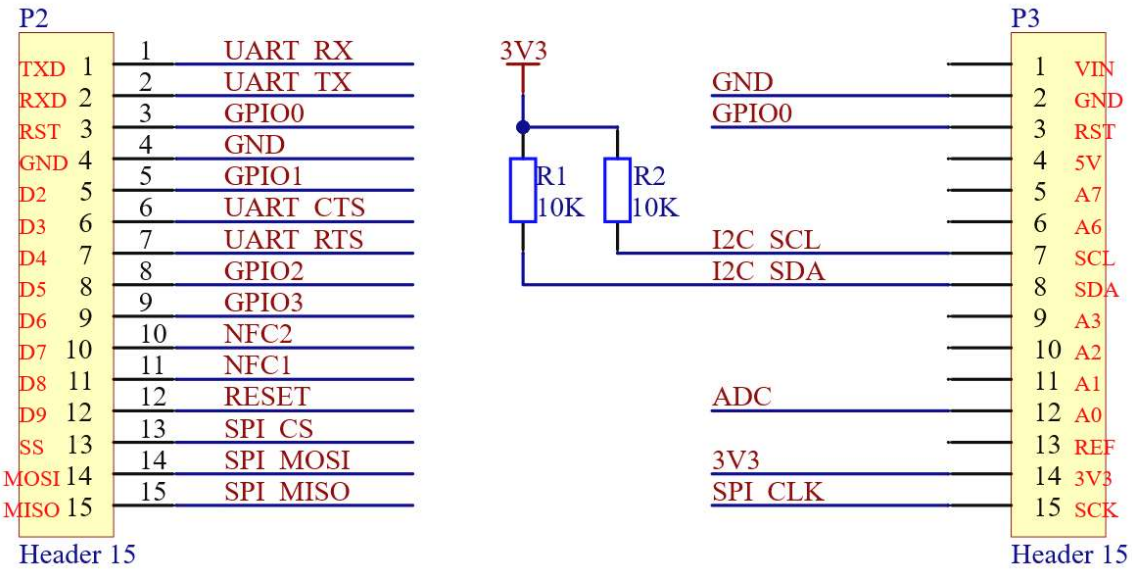


Figure 10: Arduino nano 3.0 pinout diagram

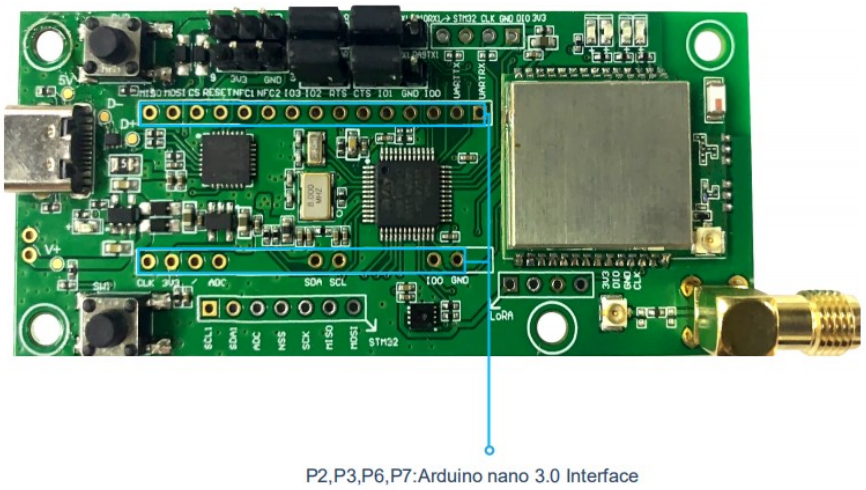


Figure 11: Arduino nano 3.0 interface on board

Notes: When use an external MCU to driven the module, all jumper caps should be removed from JP1,JP2,JP3,JP4 .

5.3.4 STM32 Peripheral Interface

The on-board MCU STM32L151CBT6A reserves the STM32 peripheral interfaces SPI, ADC, I2C, and its pinout corresponds to the following:

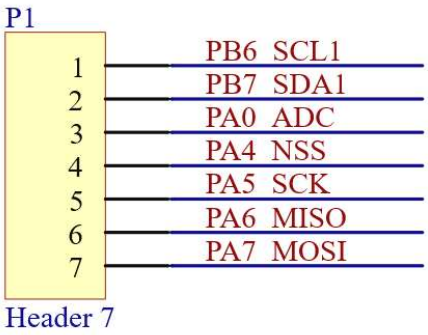


Figure 12: STM32 peripheral interface pinouts

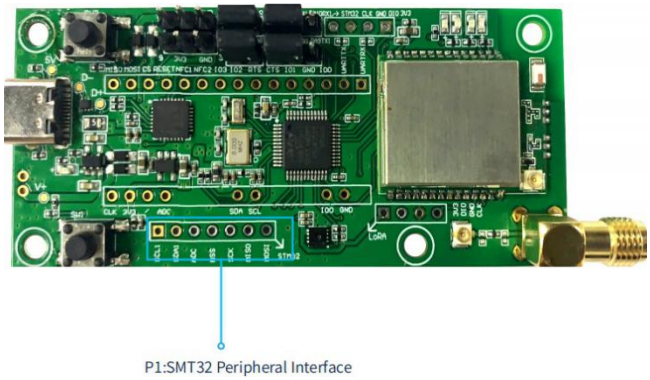


Figure 13: STM32 peripheral interface on board

5.3.5 STM32 Firmware Download Debugging Interface

Through the SMT32 SWD interface, user can download firmware. The SWD pinout corresponds to the following:

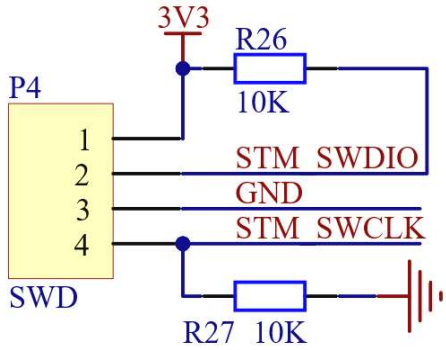


Figure 14: STM32 SWD pinouts

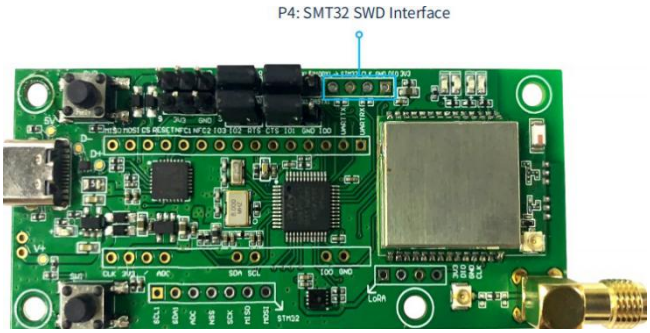
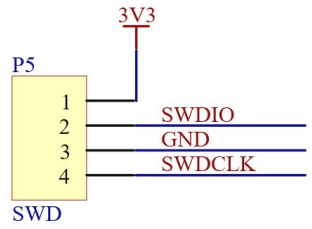


Figure 15: STM32 SWD interface on board

5.3.6 MKL62BA LoRaWAN Module Firmware Download Debugging Interface

This interface is reserved for updating the firmware of MKL62BA LoRaWAN Module, and its pinout corresponds to the following:



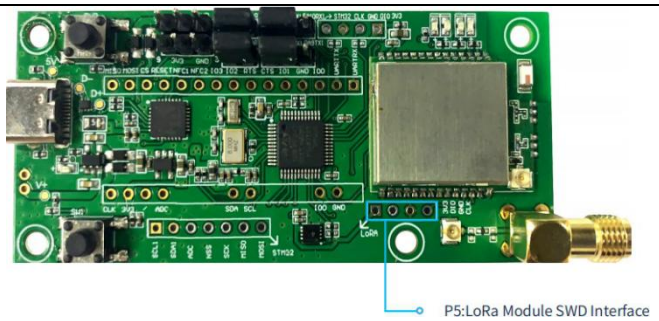


Figure 16: MKL62BA SWD pinouts *Figure 17: MKL62BA SWD interface on board*

5.3.7 External LoRa Antenna Interface

There are two different external antenna interface: IPEX(U.FL) connector on MKL62BA module and SMA connector on development board. Our standard package will provide a LoRa antenna which requires use a IPEX to IPEX cable to connecting two IPEX sockets, and then enable SMA antenna.

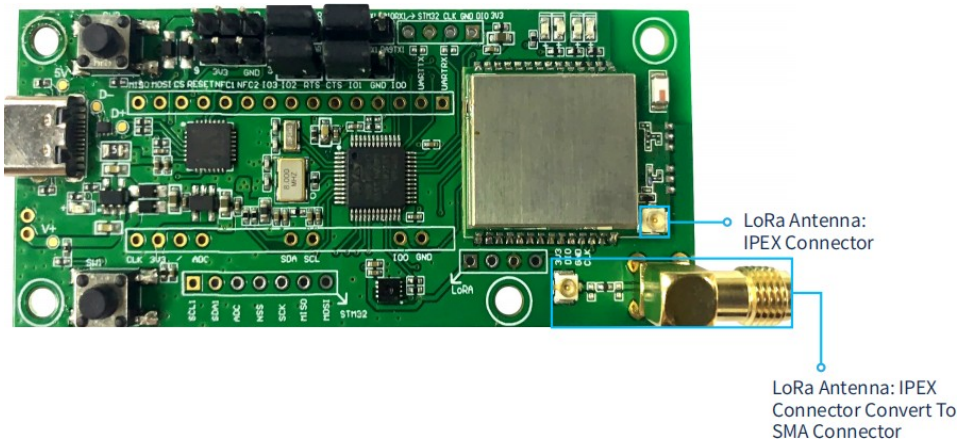
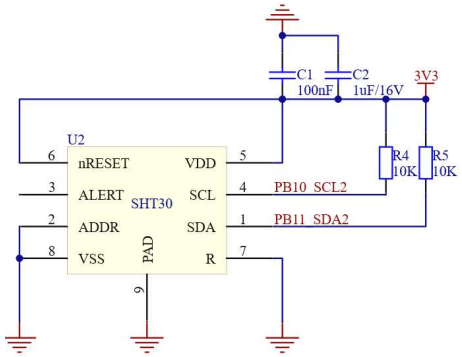


Figure 18: External LoRa antenna interface on board

5.3.8 On Board Temperature and Humidity Sensor

The on-board temperature sensor (Sensirion SHT30 https://www.sensirion.com/en/environment al-sensors/humidity-sensors/digital-humidity-sensors-for-various-applications/) has an I2C interface and can be connected to the PB10 and PB11 interfaces of MCU SMT32.



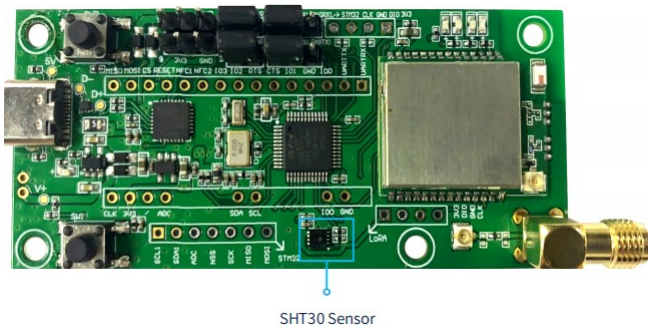
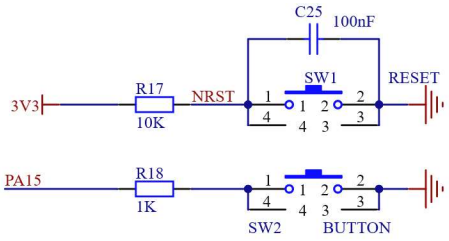


Figure 19: SHT30 sensor interface schematic *Figure 20: SHT30 sensor on board*

5.3.9 Button

The development board has two buttons, one button SW1 is the reset button. And the other button is connected to the PA15 of SMT32,which can be reserved for subsequent development of other functions.



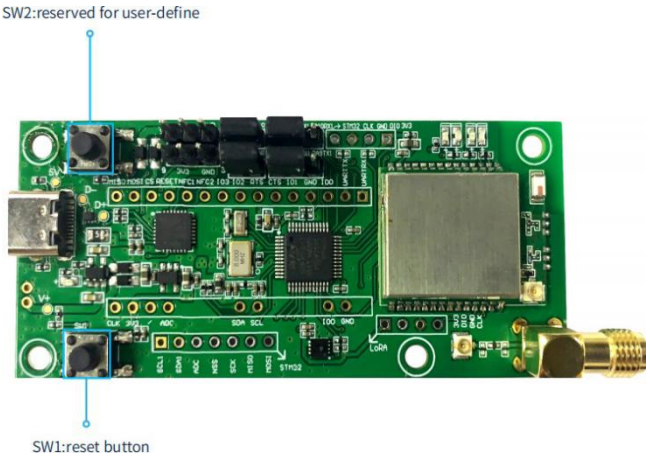
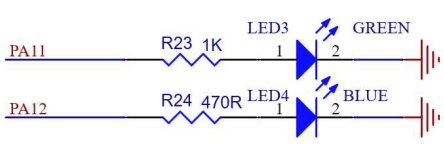


Figure 21: Button schematic *Figure 22: Button on board*

5.3.10 LED

There are 2 LEDs on the development board for users to use, and users can control them through the PA11 and PA12 interfaces of STM32.



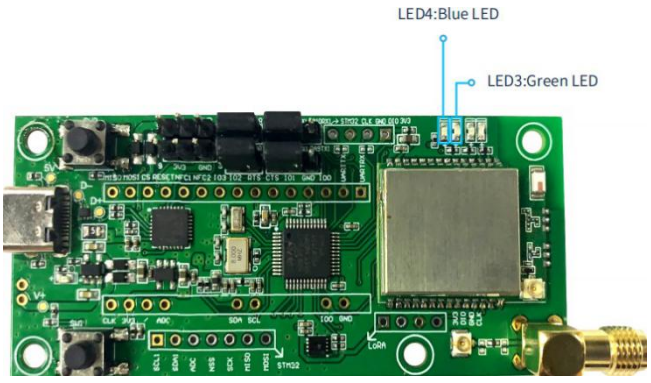


Figure 23: LED schematic *Figure 24: LED on board*

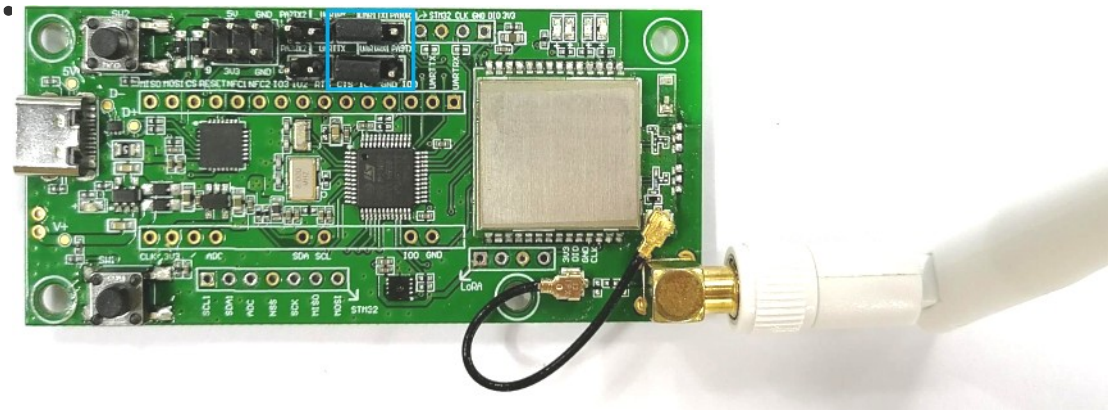
6 Quick Start

MKL62ST_DT supports two different working modes: AT command mode and host mode. The two working modes will be introduced separately below.

6.1 AT Command Mode

The purpose of AT Command mode is to help user get familiar with AT commands of MKL62BA module.

6.1.1 Quick Start AT Command Debugging

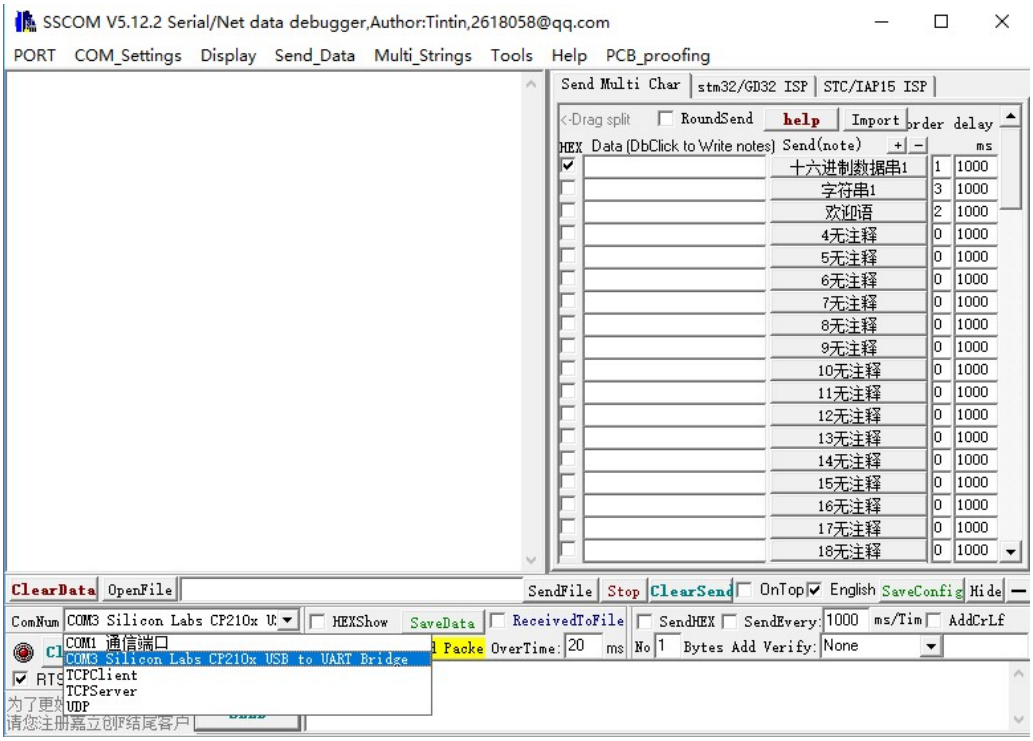
- 

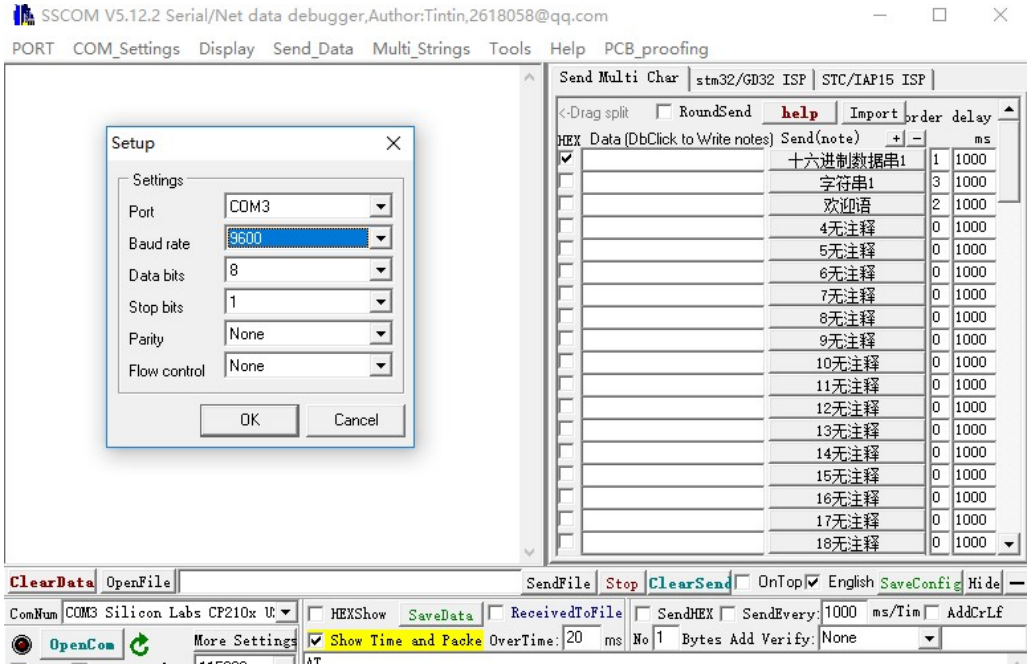
  Check the UART interface and make sure that the USB UART is directly connected to the MKL62BA module UART. Install the LoRa antenna in the following way. You also can use your own antenna with the IPEX connector to install it directly on the MKL62BA IPEX connector.

- Connect the USB cable to the computer, LED4 will be solid blue to indicate a successful power connection.

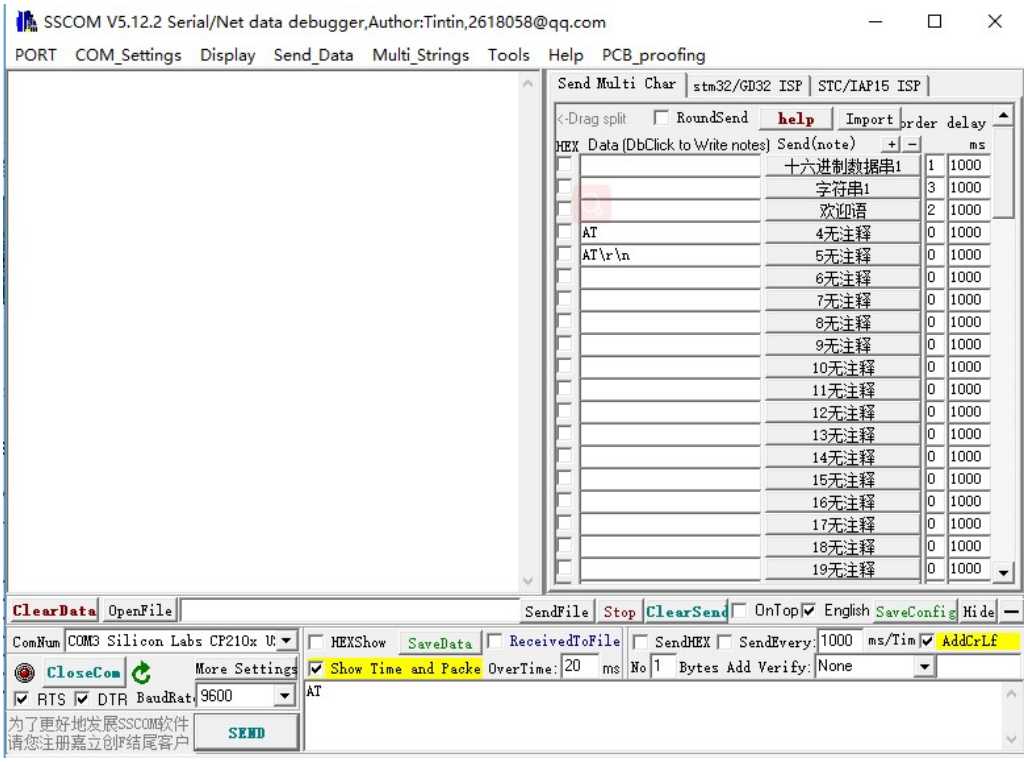
- Open the SerialNet data debugger software and set the COM, the following takes SSCOM as an example:

  1. Set ComNum: select COM with silicon Labs CP210x USB to UART Bridge.
  2. Set COM parameters: set according tp the default values in the MKL62BA module.
     Baud rate: 9600
     Data bits: 8
     Stop bits: 1
     Parity: None
     Flow control: None



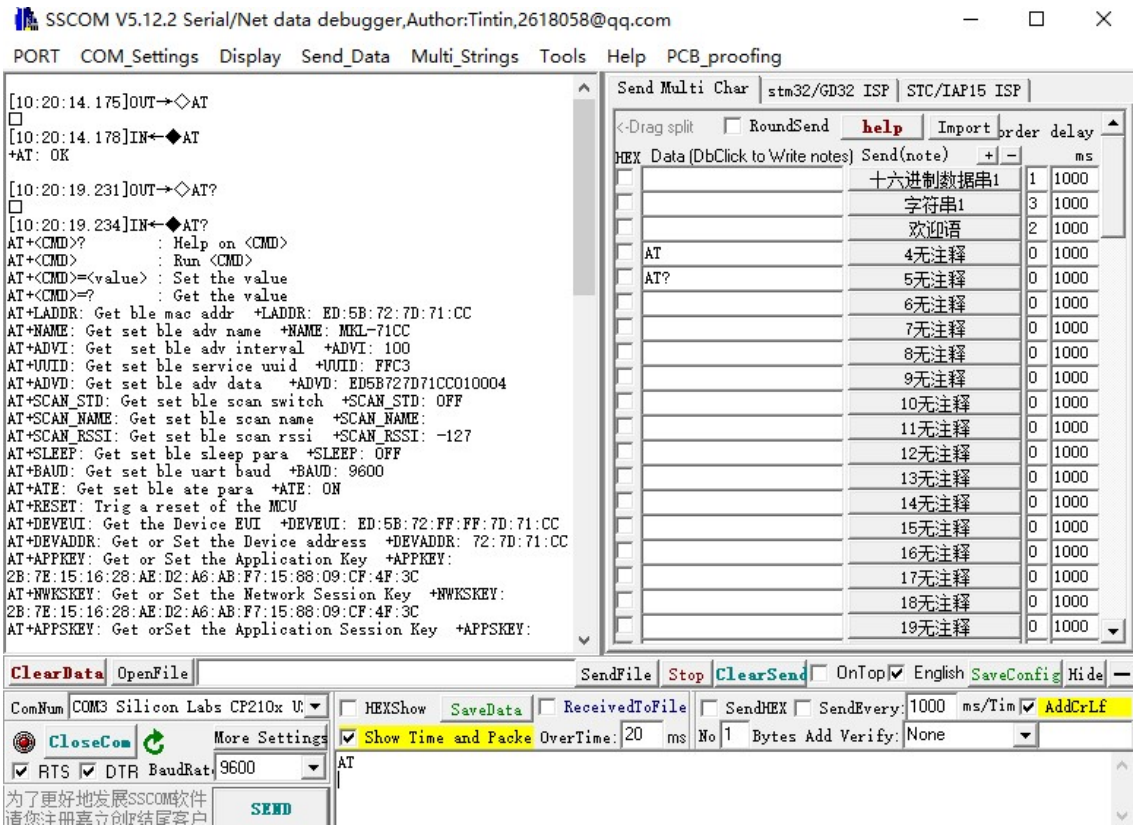


3. Other SSCOM settings: select AddCRLF(CRLF will be added to each command in default. Otherwise the \r\n is required type in at the end of each command.)



- Start communication with MKL62BA module

1. Use AT commands to check communication status



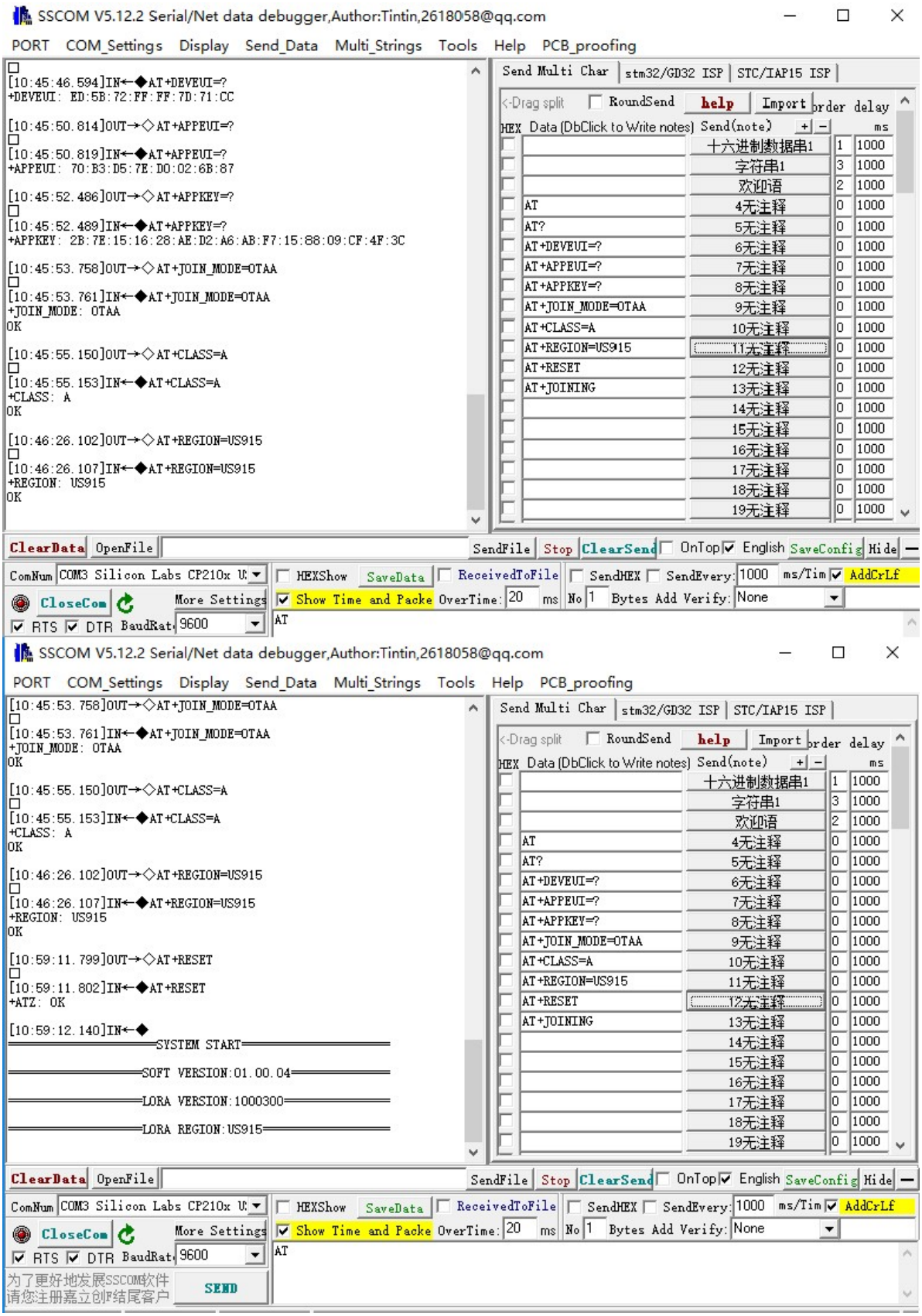
2. The screenshot of the SSCOM will show the following settings:

A. Query and Get the device ID and KEY of the MKL62BA module through AT commands.

B. Configure the network type as ABP or OTAA

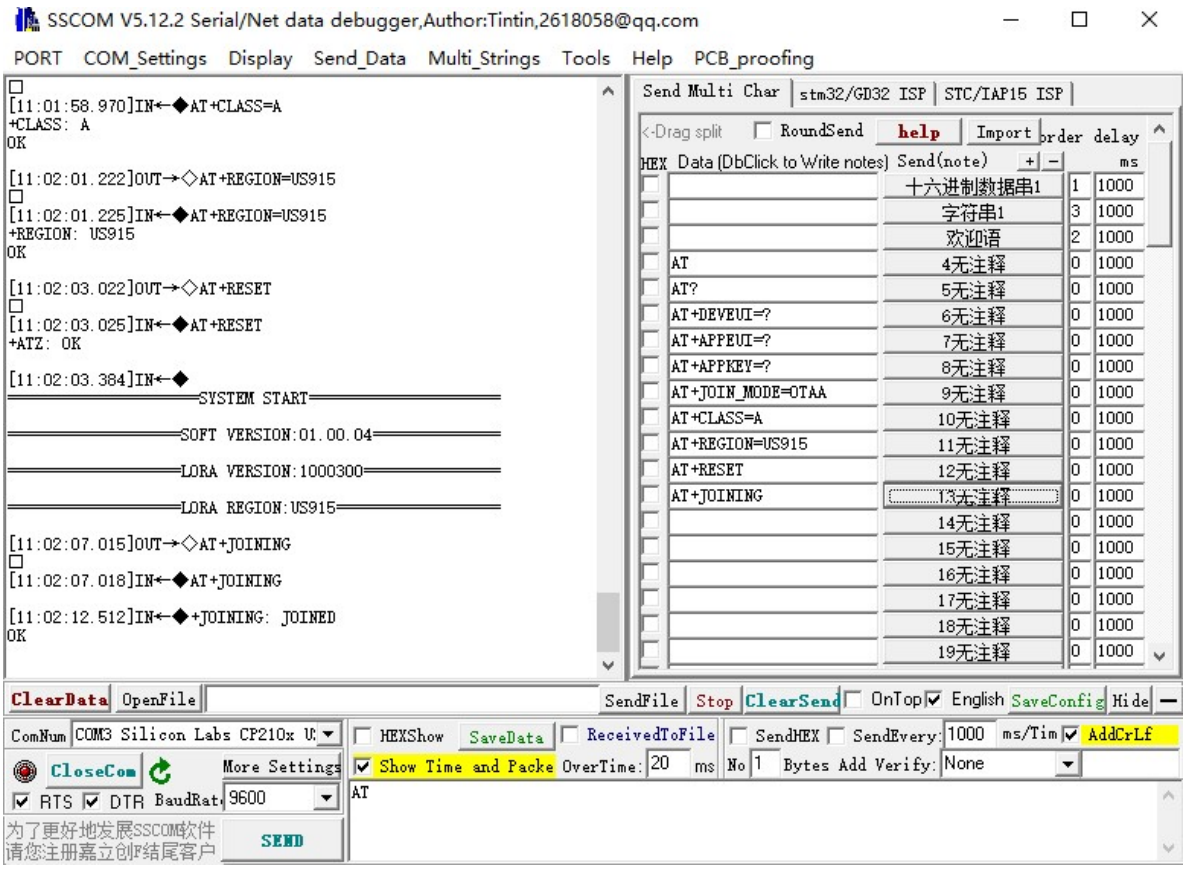
C. Set Region Frequency

D. Set CLASS type



Notes: After configuring the network join parameter, the user must reset the MKL62BA, otherwise MKL62BA will not be able to join the network. If the user reads the default parameters of the module and uses the default parameters to join the network, there is no need to reset MKL62BA.

3. Register the module as an end device in the LoRa server and ensure that all the parameters are correct. Send a network join request and get JOINED response. You can see from the screenshot below that the module has established a connection with the LoRa server.



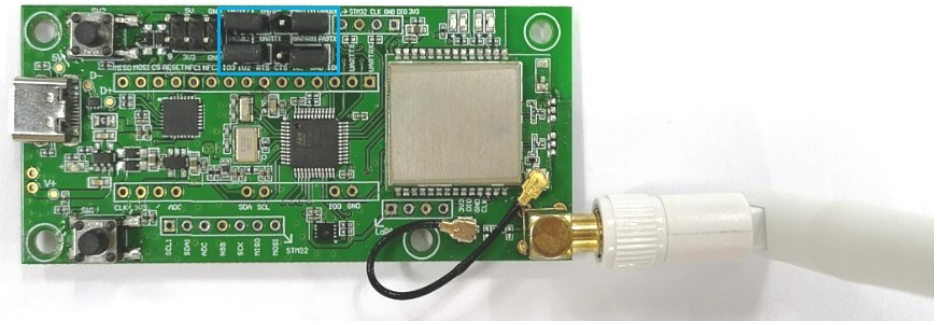
For more AT Command applications, please refer to AT Command Specifications: **<MKL62BA AT Command>**

6.2 Host Mode

In the host mode, users can download their own firmware to the SMT32 on the development board or use an external MCU through Arduino interface to achieve communication with the MKL62BA LoRaWAN module. The standard MKL62ST-DT has built-in MOKO DEMO application. Let's take MOKO's DEMO application firmware as an example to demonstrate the uplink data of temperature and humidity transmitted through the LoRa network. The following are the specific steps.

6.2.1 Operation Instruction

- Check and install the jumper caps according to the following figure. You can directly install your own IPEX external antenna to the IPEX connector, or you can connect the IPEX socket according to the following figure and install the SMA antenna provided by MOKO. And plug in the USB to power on the development board and the blue LED will light on.



- Get the join network parameters of MKL62BA.The default parameters are as follows. You can also use AT command to get and set the parameters. Please refer to the operation in chapter 6.1.1.

NO.	Type	Default value
1	Join Mode	OTAA
2	DevEUI	BLE MAC+ FFFF,
3	AppEUI	70B3D57ED0026B87
4	AppKey	2b7e151628aed2a6abf7158809cf4f3c
5	DevAddr	The last four bytes of MAC address
6	AppSKey	2b7e151628aed2a6abf7158809cf4f3c
7	NwkSkey	2b7e151628aed2a6abf7158809cf4f3c
8	Region	US915
9	Device Type	ClassA

- Register the module as an OTAA end device in the LoRa server and ensure that all the parameters are correct.

- After registering the device in the LoRa sever, a join network request from MKL62ST-DT will be send automatically.

- After successfully joining the network, the user can see on the server that the temperature and humidity sensor data are reported every 10 seconds.

6.2.2 LED Indicator

Items	Indicator
Power on	Solid blue
Communication light	Solid green
Transmitter data	Green LED blink
Receive data	Blue LED blink

6.2.3 Uplink packet format

Bytes	Type	Data Type	Description
1-2	Temperature	Int	The data format is Little-endian, and data type is signed int. After the data is converted, the actual value needs to be divided by 100.
3-4	Humidity	Uint	The data format is Little-endian, and data type is unsigned int. After the data is converted, the actual value needs to be divided by 100.
5-7	Battery Level	Uint	Reserved for battery information

Examples:C2 0B 14 1A 00 00 00
C2 0B: The converted integer is 3010, and the actual temperature is 30.1 degree
14 1A: The converted integer is 6676, and the actual humidity is 66.76%RH

7 Reference Document

7.1 Demo Firmware

GitHub link: https://github.com/Moko-MKL62ST-DT

7.2 AT Command Specification

MKL62BA LoRaWAN Module AT Command Specification: **<MKL62BA AT Command>**

8 Ordering Information

Part Number	Description	Remark
MKL62ST-DT-EU868	Development kit for EU868 LoRaWAN module MKL62BA with SMT32 MCU and SHT30 sensor	IN865 is compatible
MKL62ST-DT-US915	Development kit for US915 LoRaWAN module MKL62BA with SMT32 MCU and SHT30 sensor	AU915, AS923 are compatible

9 Revision

Version	Description	Editor	Date
V1.0	Initial version	Iris	2020/7/4
V1.1	Update development board interface figure and document structure	Iris	2020/8/10