MBL Series Testing Kit User Manual

New Generation Package Compatible

Sub-1G Wireless Module

E07-400MBL-01



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Chengdu Ebyte Electronic Technology Co.,Ltd.

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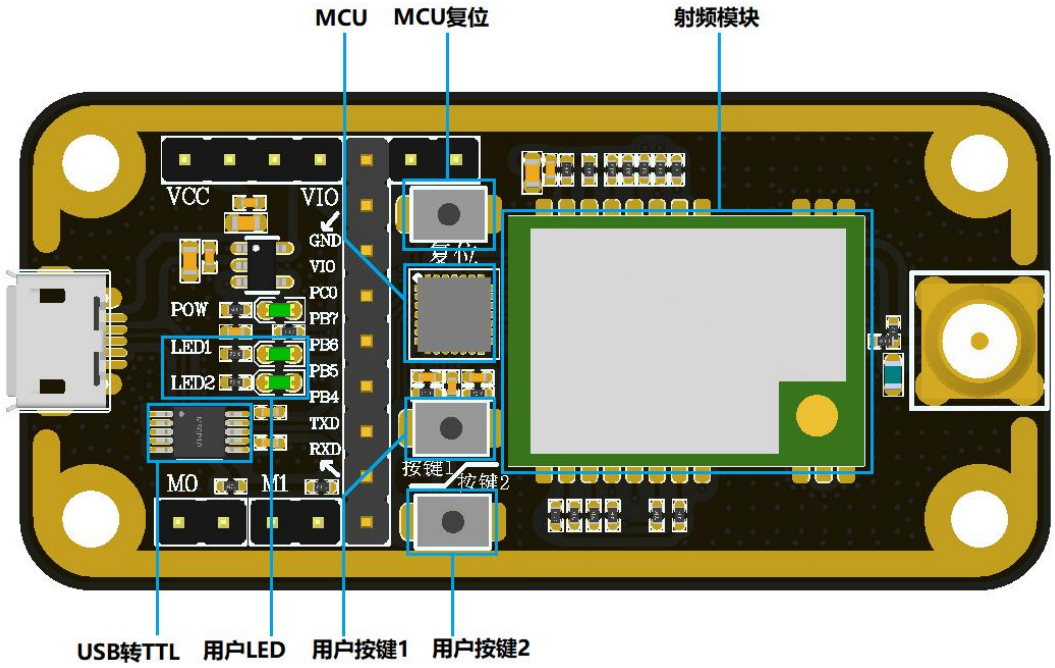
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I. Product Overview



1.1 Product Introduction

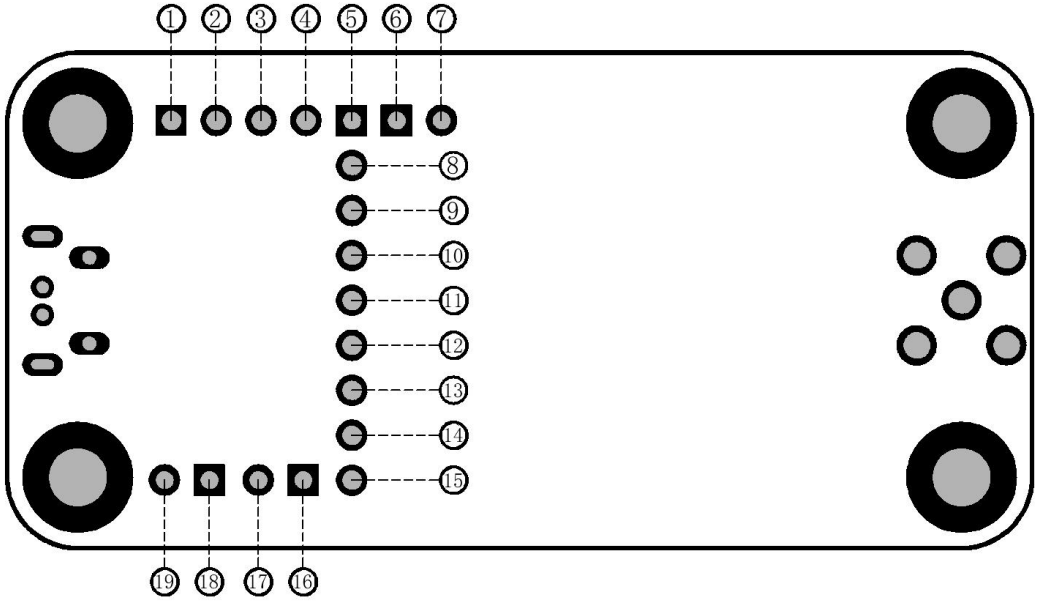
MBL series testing kits are designed to help users quickly evaluate Ebyte's new generation of package-compatible wireless modules. Most of the pins on the board have been led out to pin headers on both sides, and developers can easily connect various peripheral devices through jumpers according to actual needs.

The kit provides complete software application examples to help customers quickly get started with wireless data communication development. According to customer needs, different types of Sub-1G wireless modules can be mounted on board. Supported modules are available in pin-compatible packages for quick replacement.

1.2 Dimensions, interface description

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Pin	Definition	Function Description
1	VCC	Module power supply pin. It needs to be shorted with pin 2 to supply power to the module.
2	3.3V	3.3V power pin
3	3.3V	3.3V power pin
4	VIO	MCU power supply pin. It needs to be shorted with pin 3 to power the MCU.
5	GND	Backplane reference ground
6	REST	MCU external reset pin
7	SWIM	MCU's SWIM pin
8	VIO	MCU power supply pin
9	PC0	Module reset pin
10	PB7	Module MISO pin
11	PB6	Module MOSI pin
12	PB5	Module SCLK pin
13	PB4	Module NSS pin
14	TXD	MCU serial port TXD
15	RXD	MCU serial port RXD
16	M1	Module mode switching pin (see module product manual for details)
17	GND	Backplane reference ground
18	M0	Module mode switching pin (see module product manual for details)
19	GND	Backplane reference ground

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1.3 Support List

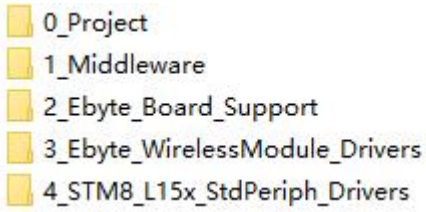
	Chip solution	Manufacturer	Module model
1	CC1101	Texas Instruments	E07-400M10S
2	CC1101	Texas Instruments	E07-900M10S
3	SI4438	Silicon Labs	E30-400M20S
4	SI4463	Silicon Labs	E30-900M20S
5	LLCC68	Semtech	E220-400M22S
6	LLCC68	Semtech	E220-900M22S
7	SX1278	Semtech	E32-400M20S
8	SX1276	Semtech	E32-900M20S
9	SX1268	Semtech	E22-400M22S
10	SX1262	Semtech	E22-900M22S
11	AX5243	ON Semiconductor	E31-400M17S
12	LLCC68	Semtech	E220-400MM22S
13	LLCC68	Semtech	E220-900MM22S

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II. Software Introduction

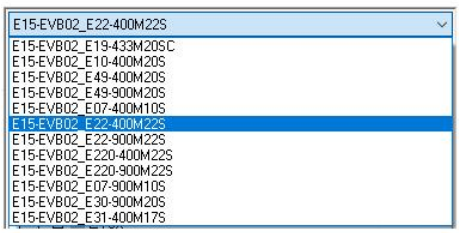
2.1 Directory structure

	Item	Description
1	File Directory	You can download the sample file from the official website, and open the directory as shown in the figure below. 
2	Catalog description	You can use the IAR For STM8 development environment to find the entry file and open the project. 

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2.2 IAR Engineering

	Item	Description
	Engineering structure	Use the IAR For STM8 development environment to open the project, and you can see the basic structure. 
	Switch workspace	The global macro definition and file path are defined in the C/C++ Compiler option, which are used to distinguish the driver files of different modules. When switching the workspace, different macro definitions will be used to switch the driver files of different modules.  When the "Exclude from build" attribute of "Drivers/Ebyte/RF" is changed, the target module driver folder is selected to participate in the compilation process. When the "Additional include" in the project "C/C++ Compiler" is changed, the module driver file path is specified. When the "Defined symbols" in the project "C/C++ Compiler" is changed, the global macro definition is defined to help configure the module driver properties. 

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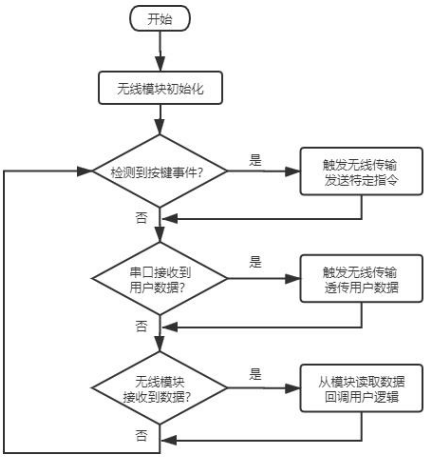
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2.3 Main function

main.c is the main function entry. The demo function process is simplified as follows:

	Item	Description
1	Key Function	When a button is pressed, the command data is sent wirelessly. Essentially sending a specific string "ping" and expecting a "pong" in response.
2	Serial data to wireless transmission	After the serial port receives the data, it automatically starts wireless transparent transmission of data. Of course, it contains some special command responses, which are mainly used for special tests and can be ignored by users. After the sending is completed, the user function will be automatically called back to process the sending logic by itself.
3	Receive data wirelessly	Generally, the internal status flag of the module is read to determine whether there is data, and the underlying driver will copy the data and pass it to the user callback function, so as to process the receiving logic by itself.

The software process is simplified as shown in the figure below:



2.4 Transceiver timing

There are multiple operating states of the wireless module, and specific functions can only be completed in the corresponding states. From the simplest sending and receiving data, only the sending mode and receiving mode are considered.

	Item	Description
1	Receiving mode	After the default initialization is completed, it automatically enters the receiving mode. In essence, the receiving function is called in the initialization to enter the receiving mode. If you need to consider entering other modes after initialization, such as sleep, you can directly

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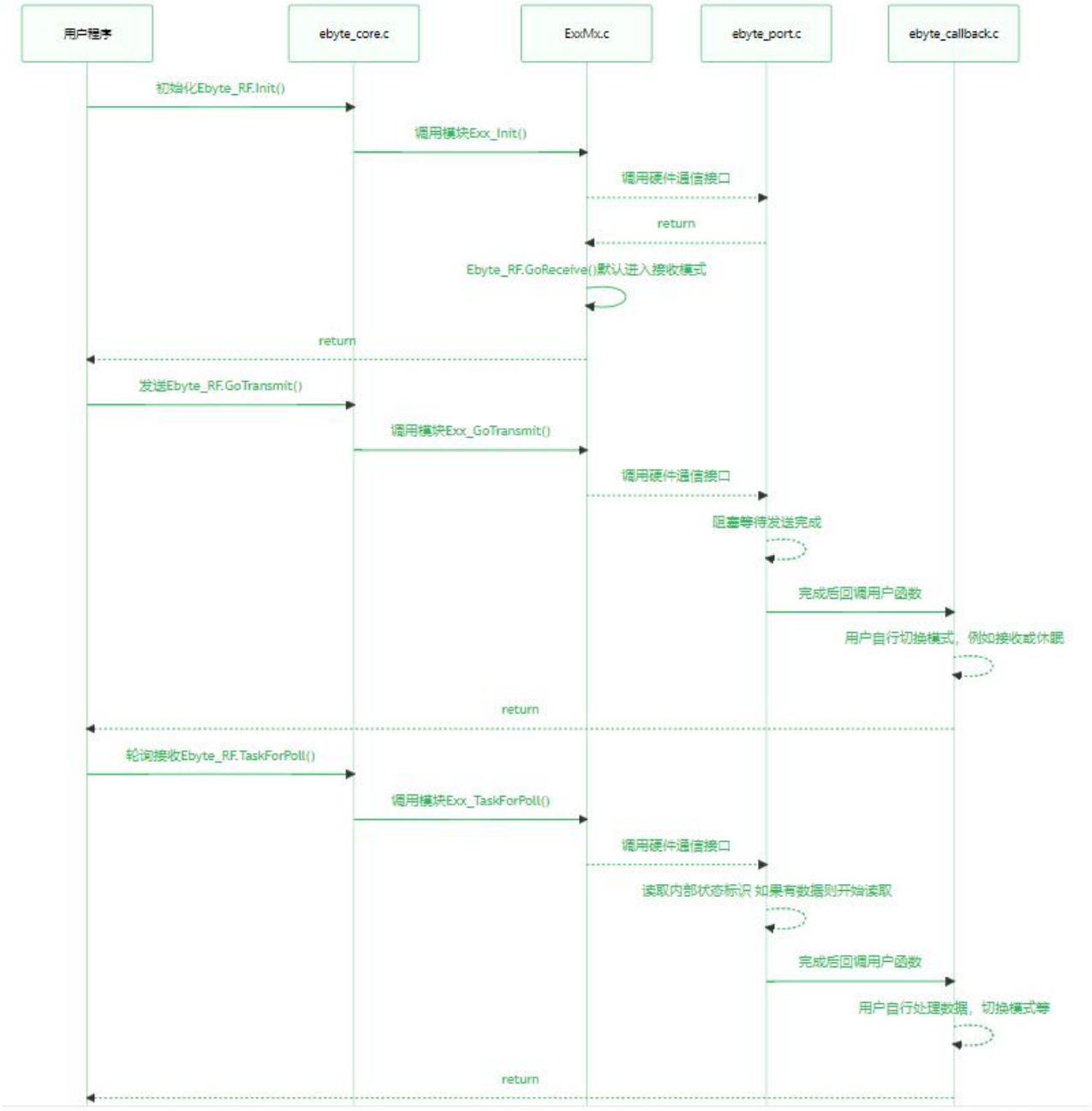
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		replace it with the same type of function Go_xxxxx().
2	Sending mode	When calling the sending function, the underlying driver actually switches the module into standby mode first, and usually completes the modulation parameter configuration in this mode, such as frequency, power, frequency offset, etc. After the parameters are configured correctly, gradually enter some intermediate modes, open the internal FIFO, PA, external XTAL, etc., and the current consumption will gradually increase. Eventually switch into send mode, triggering wireless data transmission. After completion, the module enters the standby mode. In this state, sending and receiving cannot continue, and the user needs to handle the next step in the callback function. When the function is complex, if continuous reception or continuous transmission is required, please further switch to other modes according to the characteristics of the chip.

The timing diagram is as follows:

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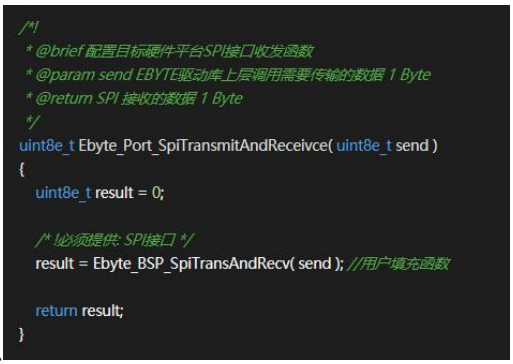


2.5 Programming

	Document	Key Description
1	ebyte_core.h	A module structure is defined, the basic functions are abstracted, and the functions of the underlying module will be bound to the structure. When used in simple sending and receiving applications, there is no need to understand the underlying working details of each module, and the data can be sent and received by directly calling the abstracted function. If you need to customize some functions, you can also consider integrating them into the structure. If you know enough about the functions of the

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		underlying modules, you can also directly remove the ebyte_core.c/h file, and there is no strong coupling between the layers.
2	ebyte_exx.c	It is a specific module driver file, which is generally packaged and does not need to be modified by the user. It only needs to consider how to input and output data from this "box".
3	ebyte_port.c	It is specially used to bind SPI and GPIO under different hardware platforms, abstracted as the input of "box". Users need to fill the communication interface in their own hardware platform to a fixed position according to the comments. Generally speaking, it is to provide the SPI transceiver function and the level control of the pin. Some modules are slightly special. For example, E49 uses half-duplex SPI. If you don't want to write a communication driver, you can directly bind the IO to a fixed position, and leave the rest to the module driver to simulate IO to realize communication. As shown in the figure below, in the comments, it is required to provide the SPI interface position to fill in the specific sending and receiving functions, send the data into the SPI to send data, and return the SPI to receive data from the result.
	ebyte_callback.c	It is specially used to bind the user's own sending and receiving logic, abstracted as the output of the "box". Essentially, the module driver is to directly call the user's callback function after confirming that the sending or receiving is completed. As shown in the figure below, just fill in the user's logic function in the To-do prompt position. The state is transmitted by the module driver, and is actually processed by the Exx_GoTransmit() function. When the function is complex, it can be considered to be modified to support more

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		situations.
		``
		/*!
		 * @brief 发送完成回调接口 由客户实现自己的发送完成逻辑
		 * @param state 上层回调提供的状态码 客户请根据示例注释找到对应区域
		 */
		void Ebyte_Port_TransmitCallback(uint16e_t state)
		{
		  /* 发送: 正常完成 */
		  if(state &= 0x0001)
		  {
		  //To-do 实现自己的逻辑
		  UserTransmitDoneCallback();
		  }
		  /* 发送: 其他情况 */
		  else
		  {
		  //To-do 实现自己的逻辑
		  }
		}
		``

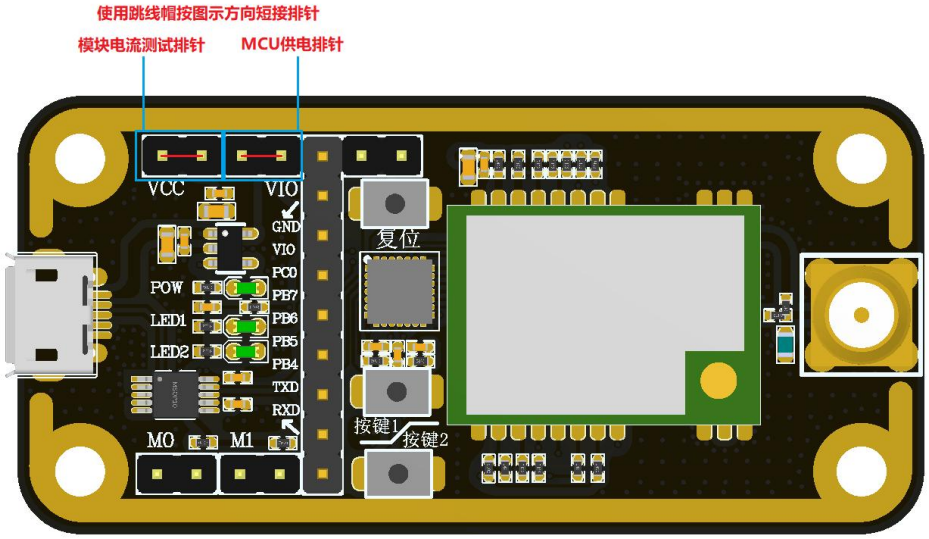
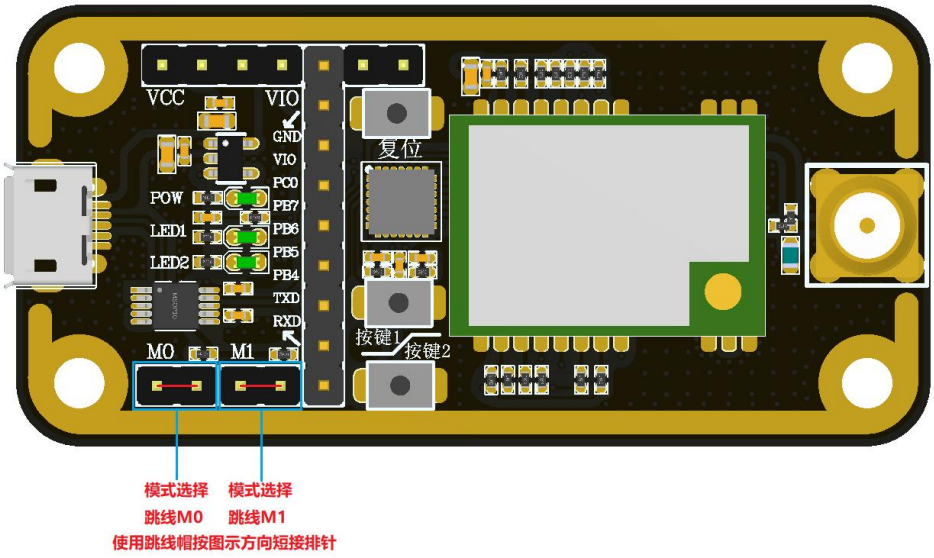
	ebyte_exx.h	Some conventional modulation parameters are defined, generally do not need to be modified, you can adjust them by yourself. Note, please understand the instructions in the comments when modifying. There is a range check for parameters in the module driver, and wrong modulation parameters will cause initialization failure. The following figure shows an example of FSK modulation parameters: ``` #define E07_DATA_RATE 1200 //空速 1.2 KBps #define E07_FREQUENCY_DEVIATION 14300 //频偏 14.3 K #define E07_BANDWIDTH 58000 //接收频宽 58 K #define E07_OUTPUT_POWER 10 //功率 [10 7 5 0 -10 -15 -20 -30] #define E07_PREAMBLE_SIZE 4 //前导码长度 [0:2 1:3 2:4 3:6 4:8 5:12 6:16 7:24] #define E07_SYNC_WORD 0x2DD4 //同步字 #define E07_IS_CRC 1 //CRC开关 [0:关闭 1:开启] ```
	board.c	STM8 peripheral initialization, involving SPI, TIMER, GPIO, etc., is strongly coupled with the hardware used.
	board_button.c	The key event queue is a FIFO in terms of data structure. After the timer detects the button, it will store the corresponding event in the queue and wait for the main loop to respond.
	board_mini_printf.c	Simplified printf, although the function has shrunk, it occupies a small volume. The DEBUG macro in the project mainly depends on the mprintf provided by this file.
	ebyte_kfifo.c	Used for serial port data reception, optimized general-purpose FIFO queue, suitable for cache.
	ebyte_debug.c	It is used to connect to a PC for some tests, and generally does not need to be used.
	stm8l15x_it.c	All interrupt function entries are concentrated here for interrupt service functions such as serial ports, timers, key IO, etc.

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III. Quick Demo

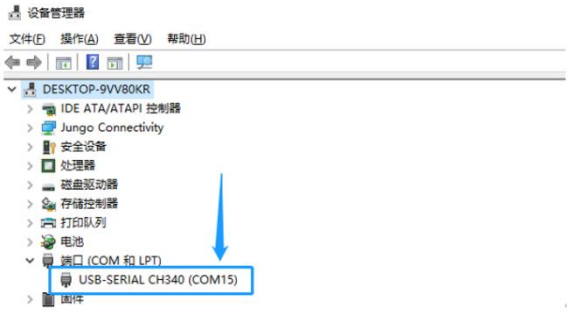
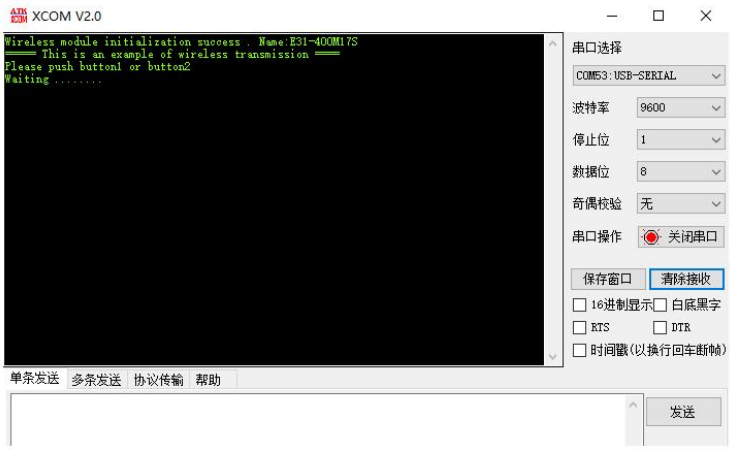
3.1 Signal line connection

	Item	Description
1	Power jumper cap	
2	Mode selection jumper cap	
3	Auxiliary	USB cable, antenna, PC, etc.

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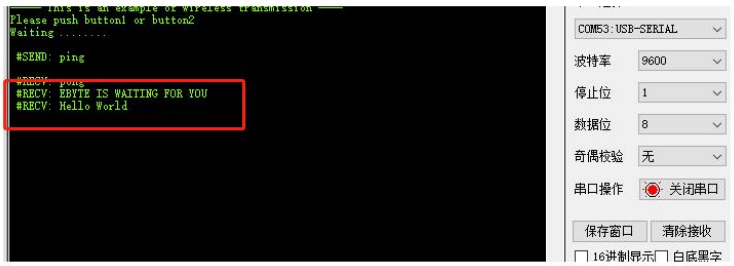
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3.2 Serial Assistant

	Item	Description
1	Device manager View the serial port number	
2	Serial software	
3	Example of push button communication	#RECV Identifier, used only for prompting, indicates the data received by the wireless module. #SEND identifier, only used for prompting, indicating the data sent by the wireless module. 
4	Serial data transparent transmission	Serial data transparent transmission Directly transmit the required content through XCOM

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IV. FAQ

4.1 The transmission distance is not ideal.

- When there is a straight-line communication obstacle, the communication distance will be attenuated accordingly;
- Temperature, humidity, and co-channel interference will increase the communication packet loss rate;
- The ground absorbs and reflects radio waves, and the test effect is poor when it is close to the ground;
- Sea water has a strong ability to absorb radio waves, so the seaside test effect is poor;
- There are metal objects near the antenna, or placed in a metal case, the signal attenuation will be very serious;
- The power register is set incorrectly, and the air speed is set too high (the higher the air speed, the closer the distance);
- The low voltage of the power supply at room temperature is lower than the recommended value, and the lower the voltage, the lower the power output;
- The matching degree between the antenna and the module is poor or the quality of the antenna itself is problematic.

4.2 The module is fragile

- Please check the power supply to ensure that it is within the recommended power supply voltage. If it exceeds the maximum value, the module will be permanently damaged;
- Please check the stability of the power supply, the voltage cannot fluctuate greatly and frequently;
- Please ensure anti-static operation during installation and use, and high-frequency devices are electrostatically sensitive;
- Please ensure that the humidity during installation and use should not be too high, some components are humidity sensitive devices;
- If there is no special requirement, it is not recommended to use it at too high or too low temperature.

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4.3 BER is too high

- There is co-channel signal interference nearby, stay away from the source of interference or modify the frequency and channel to avoid interference;
- Unsatisfactory power supply may also cause garbled characters, so ensure the reliability of the power supply;
- Poor quality or too long extension cables and feeders will also cause high bit error rates.

Revise history

Version	Revision date	Revision Notes	Maintenance man
1.0	2021-09-22	Initial version	JH
1.1	2022-12-29	Modify the schematic diagram of the module and how to use it	HWJ

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