BLE5101 User Manual

1、 Quick Start

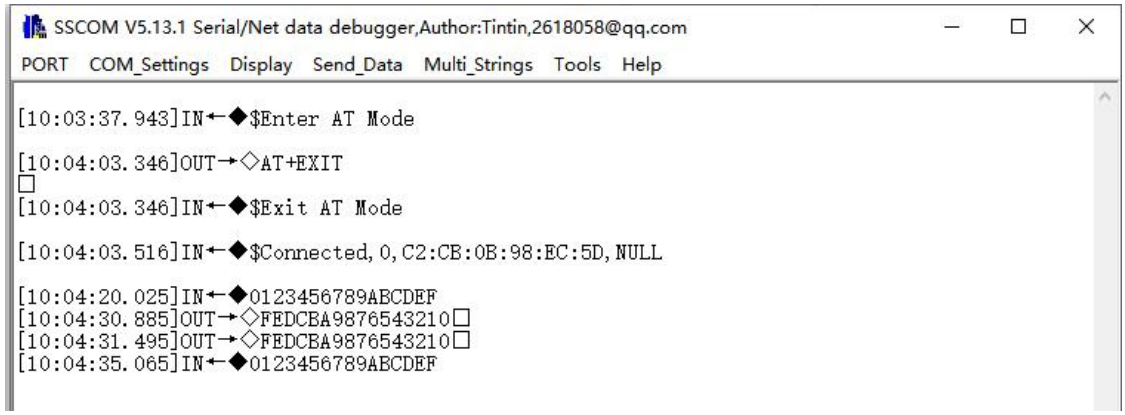
If you have purchased two BLE5101 modules that only need a simple out-of-the-box setup, follow these steps to configure transparent transmission:

1. Send the command "AT+CONS=0,1\r\n" to one module to set it as the central role.
2. Send the command "AT+RESET\r\n" to the module again to restart it and apply the changes.
3. After setup is complete, send the command "AT+EXIT\r\n" to both modules to exit configuration mode.

At this point, both modules will automatically establish a Bluetooth connection, indicated by the blue indicator light turning on. The serial port will also display messages such as $Connected and $Discovered. Users can then transmit data directly.

The steps are shown below:





To learn about the module's detailed features and other uses, and after reviewing its AT instruction set, please continue reading below.

2、 BLE Event Responses

When the module handles specific events—such as successfully establishing a connection with a Bluetooth device or disconnecting—the corresponding message is generated. The message format is fixed: it begins with the English symbol "$" followed by the event name and ends with the carriage return and line feed (CRLF) sequence "\r\n". Multiple items within the message are separated by the English comma ",". For example, a message for a successful Bluetooth connection would have the following format:

$Connected,0,11:22:33:44:55:66,BLE5101\r\n

The following list shows common message types and their contents when using the BLE5101 module:

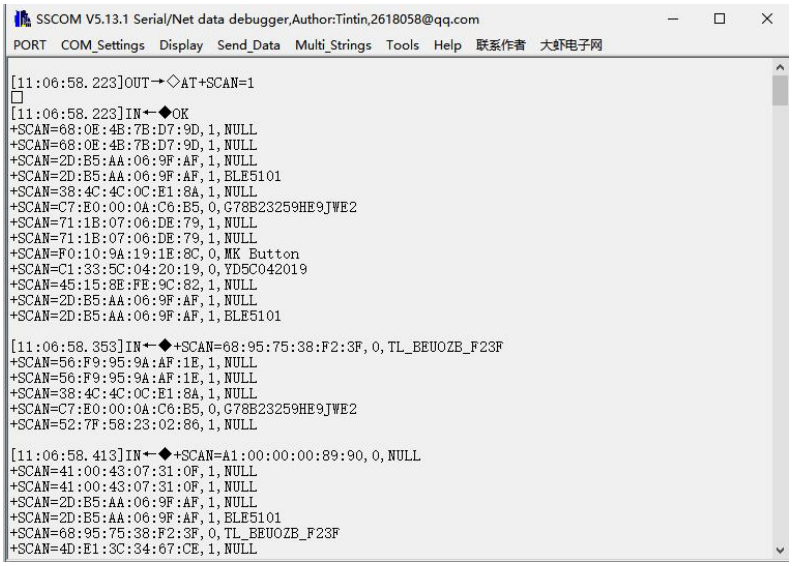
Event	Message Header	Content
Connecting to a Bluetooth device	**$StartConnecting**	None
Connection successful	**$Connected**	Link ID, MAC Address, Device Name
Peer service discovery completed	**$Discovered**	Link ID, MAC Address, Device Name
Re-discovering peer service	**$Rediscovering**	Link ID, MAC Address, Device Name
Disconnect	**$Disconnected**	Link ID, MAC address, device name, Hex error code
Received data sent by the peer device	**$Received**	Link ID, Characteristic UUID, Data Content
Read data from the peer device	**$Read**	Link ID, Characteristic UUID, Data Content
Connection timeout	**$ConnectionTimeout**	None
Connection request canceled	**$ConnectionCancel**	None
Scan stopped	**$ScanEnd**	Hex Error Code
Advertising stopped	**$AdvEnd**	Hex Error Code
Enter configuration mode	**$Enter AT Mode**	None
Exit configuration mode	**$Exit AT Mode**	None
Enter low-power mode	**$Enter Sleep**	None
Exit low-power mode	**$Exit Sleep**	None

3、 Manual Connection

If the module needs to connect to a specific device as a central, or if the Bluetooth device to be connected does not meet the module's automatic connection filtering rules, you can perform manual connection by following these steps:

1. Ensure the module is in configuration mode. Send the command "AT+SCAN=1\r\n" to activate the scanning function.

The module receives advertising packets from the air and parses their contents (e.g., MAC address, advertising address type, device name, etc.).



Please note that the information displayed for the same Bluetooth device during module scanning may sometimes include the device name and sometimes not—it is normal. This occurs because Bluetooth devices transmit two types of advertising packets: Advertising Data and Scan Response Data; they do not send both simultaneously, and typically only one packet contains the device name.

2. After obtaining the information of the device to connect, send the command "AT+SCAN=0\r\n" to stop scanning, then send the command "AT+CONA" to initiate the connection:



If you know the MAC address of the target Bluetooth device and confirm that it has started advertising, you can skip the scanning step and directly send the command "AT+CONA" to establish a Bluetooth connection.

To connect multiple peripherals, repeat the above steps. Ensure a successful connection and that the "$Discovered" event is triggered or the "$ConnectionTimeout" connection timeout event occurs before connecting to the next peripheral.

4、 Format Transmission

Unlike transparent transmission, format transmission requires users to input data in a specified format for the module to process; otherwise, the data will be discarded. The BLE5101's format transmission feature has the following characteristics:

- Supports reading data from the peer's UUID channel with the Read attribute.
- Supports sending data to any UUID channel on the opposite end with either the Write or Write no response attribute.
- Supports receiving data from any UUID channel with the Notify or Indicate attribute;
- In a multi-peripheral connection, it supports reading from or sending data to any peripheral node.

The module automatically enables format transmission during configuration mode. Users can also mod ify the settings (by sending the command "AT+TRANSMODE=0\r\n") to enable format transmission even in automatic connection mode.

For example, connect a peripheral device with multiple transmit/receive channels using Link ID 0. Its Profile structure is shown below:



When using transparent transmission, the BLE5101 module defaults to binding FFF1 as the receive channel and FFF2 as the transmit channel. In automatic connection mode, it cannot send data to the alternative transmit channel 8902 or receive data from the alternative receive channel 8901. However, with format transmission, both channels 8901 and 8902 can be operated.

1. Sending Data

Users can send commands in the following format to transmit data to a specific transmit channel on a connected device:

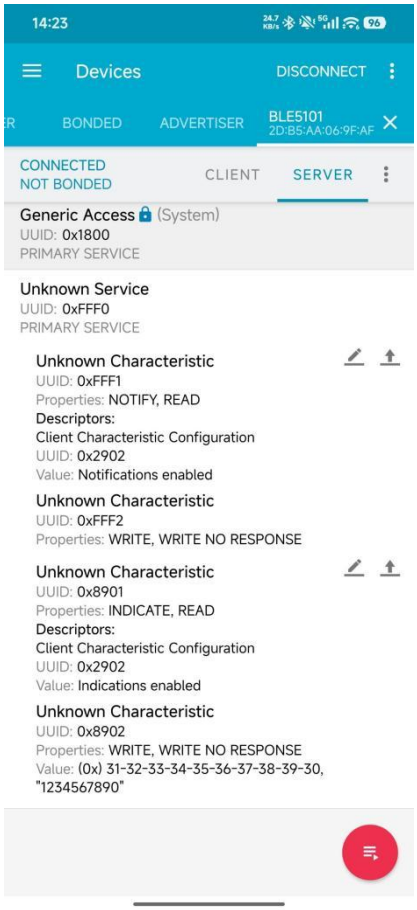
"Link ID", "Transmit Channel UUID", "Data Content"

For example, send the data "1234567890" to the alternative transmit channel of Link ID 0:

0,8902,1234567890



Operations performed by the BLE5101 central



(The peripheral device's 0x8902 shows received 1234567890)

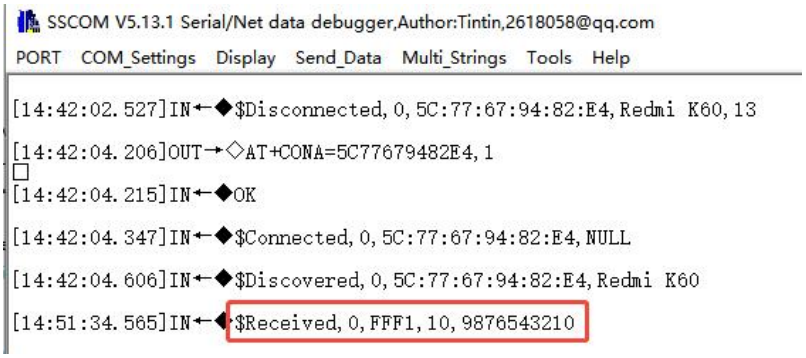
2. Receiving Data

When the BLE5101 receives data from any receive channel of a link, it encapsulates the data into a fixed format for output.

$Received,"Link ID", "Receive Channel UUID", "Data Length", "Data Content"\r\n

For example, receiving data "1234567890" from the alternative receive channel 8901:

$Received,0,8901,10,1234567890\r\n



3. Reading Data

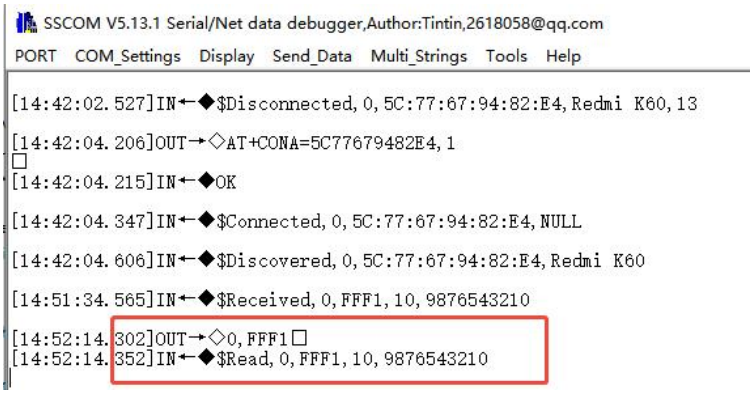
Reading data requires the specified channel to have the Read attribute. Users can send requests to read data from a channel using the following format:

"Link ID", "Channel UUID"

When the BLE5101 successfully reads the data from this channel, it encapsulates the data into a fixed format for output:

$Read, "Link ID", "Channel UUID", "Data Length", "Data Content"\r\n

For example, send a data read request to channel FFF1 with the Read attribute and output the read content:



4. Data Transmission and Reception in Peripheral Mode

When the BLE5101 operates as a peripheral device, the channel with the Notify property (default FFF1) is designated as the transmit channel, while the channel with Write/Write no response properties (default FFF2) serves as the receive channel.

When using the BLE5101 as a peripheral device for format transmission, users must send commands in the

following format to transmit data to the designated central:

"Link ID", "Data Content"

For example, send the data "1234567890" to a central with Link ID 0:

0,1234567890

When receiving data from any central, the output format matches that used when the module operates as a central; this detail will not be repeated here.

5、 Custom iBeacon Advertising

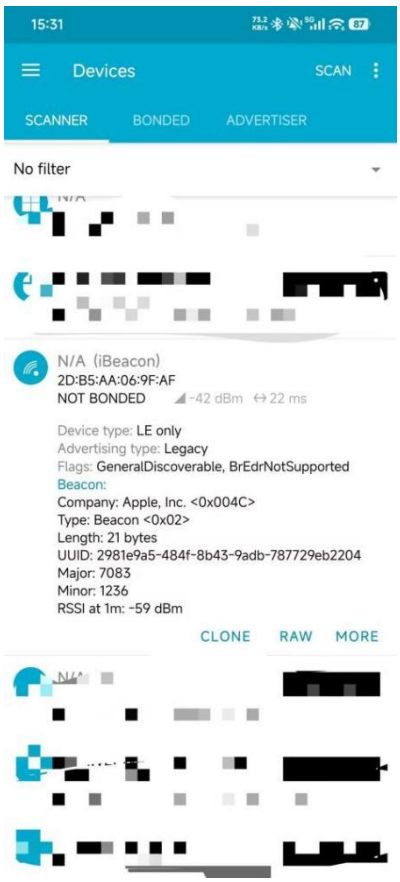
When the BLE5101 operates as a peripheral device, it supports iBeacon advertising by customizing the content of the advertising data packets.

Without enabling custom advertising, the module advertises the following content:

- UUID (Complete list of 16-bit/128-bit UUIDs): Automatically adjusted based on the Service UUID in the local GATT Profile;
- Device Name (Complete Local Name): Automatically adjusted based on the device name parameter in configuration, displaying up to 15 bytes;
- Transmission Power Level: Automatically adjusted based on the transmission power parameters in the configuration;
- **Manufacturer ID.**

When users need to control the BLE5101 device's iBeacon advertising settings, they can send the command "AT+ADVPARAM". As shown in the figure:





6、 BLE Whitelist

The BLE5101 module supports a whitelist feature, which works by adding the MAC address of a specific Bluetooth device to a list; only devices on this list can establish a Bluetooth connection with the module.

When the module operates as a central, with the whitelist enabled and in automatic connection mode, advertising packets scanned by the module must not only meet filtering criteria but also have their MAC addresses listed in the whitelist before the module establishes a Bluetooth connection. **Devices connected via the manual command "AT+CONA" are exempt from this whitelist requirement.**

When the module operates as a peripheral device with the whitelist enabled, subsequent advertising packets can only be scanned by devices on the whitelist, and only these devices can establish a Bluetooth connection with the module.

The module can add up to 22 different MAC addresses to the whitelist.

7、 Low-Power Applications

1. Maintaining the Bluetooth Connection in Low-Power Mode

The BLE5101 module enables connected Bluetooth devices to remain connected during low-power sleep mode (excluding cases where the device disconnects voluntarily, or automatically due to timeout without response caused by exceeding the communication range or co-channel interference).

When connected, the module enters low-power mode with increased current consumption compared to when unconnected; the exact consumption depends on connection parameters. Below are some reference values:

Connection Interval	Low-power mode current
7.5ms	4.09mA
10ms	3.10mA
30ms	1.07mA
50ms	0.64mA
100ms	0.34mA

Users can modify connection parameters by sending the command "AT+CONNPARAM" before entering low-power mode as the central, based on their specific application requirements.

Additionally, when receiving data from the peer in low-power mode, the module temporarily wakes up, outputs the data via the serial port, and then reverts to low-power mode. **The module cannot actively transmit data in this mode.**

2. Low-Power Advertising

The BLE5101 module supports sending BLE advertises in low-power mode. The steps are as follows:

- If necessary, send the command "AT+ADVINTV" to change the advertising interval.
- If necessary, send the command "AT+ADVPARAM" to modify custom advertising parameters.
- Send the command "AT+ADV=1\r\n" to initiate BLE advertising;
- Set the CS pin to a high level to enter low-power mode.

In low-power mode, BLE advertising consumes current determined by the advertising interval parameter. The larger the interval, the lower the power consumption and the fewer advertising packets are transmitted.

When the advertising policy is set to allow connection, the module can still be connected by the central in low-power mode and transmit packets normally.

8、 Other Functions

1. Communicating with Peripheral Devices Using Different Service UUIDs

As the central, upon successful connection to a peripheral device, it automatically searches for the peripheral's Service UUID (FFF0) and identifies all channels (Characteristic UUIDs) associated with that Service UUID. When connecting to peripheral devices with different Service UUIDs, using the default approach may prevent communication between some peripherals.

There are two ways to solve this:

- **Send the AT command "AT+DSCVSVCUUID" to change FFF0 to a different service UUID.** Subsequent connected peripherals will then perform service discovery using the configured service UUID. **Devices already connected before modification remain unaffected.**

- **Send the AT command "AT+DISCOVERYSVC" to re-discover services on the specified connected peripheral device.** For example, send "AT+DISCOVERYSVC=1,8900\r\n" to have the module re-discover the peripheral device with Link ID 1 and search for service UUIDs corresponding to all channels under UUID 8900.

2. Modifying the Transmit/Receive Channel UUID for a Specific Connection

As the central, when using the transparent transmission feature, the UUID with the default value FFF1 serves as the receive channel, while FFF2 serves as the transmit channel. To configure different receive/transmit channels for individual connections during data transmission, users can send the AT command "AT+TRXUUID".

For example, to configure the transmit/receive channels of the connected peripheral device with link ID 1: Send "AT+TRXUUID=1,8902,8901\r\n". After receiving "OK\r\n", the transmit channel will change to 8902 and the receive channel to 8901. This configuration remains effective until the connection is terminated.

Here's a tip: When you temporarily do not wish to exchange data with a connection (e.g., a peripheral device with link ID 1), send the AT command "AT+TRXUUID=1,0,0\r\n". Subsequent data will no longer be sent to this connection, and the module will not output any data received from it.

3. Modifying the MTU

The MTU (Maximum Transmission Unit) in BLE specifies the maximum packet size that the ATT (Attribute Protocol) layer can transmit or receive at once. The default MTU for the BLE5101 is 247 bytes, meaning the maximum payload size for data packets sent to the BLE5101 is 247−3 = 244 bytes.

The BLE5101 supports a maximum MTU of 512 bytes, meaning the single-packet payload is 512−3 = 509 bytes. This setting can be adjusted by sending the AT command "AT+MTU".

Note that in actual Bluetooth connections, the actual MTU size is determined by the smaller value declared by both parties. For example, if a BLE5101 device uses its default 247-byte MTU to connect with a peripheral device having a 23-byte MTU, the negotiated MTU size will be 23 bytes, allowing each party to transmit up to 23−3=20 bytes of valid data per packet.