E104-BT02 User Manual

DA14580 BLE5.1 Low Power Bluetooth to Serial Module



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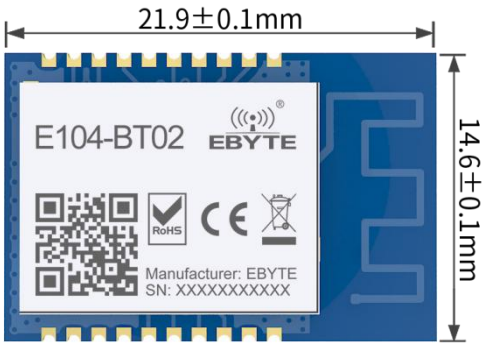
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1 Product Overview

1.1 Brief Introduction



E104-BT02 is a SMD 1mW (0dBm) wireless UART to BLE module with high cost performance, small size and embedded PCB antenna and operates at 2.4 GHz frequency band. Serial port (UART) can be used to receive and transmit Bluetooth data, which lowers the threshold to apply Bluetooth.

Based on IC DA14580 imported from Dialog, E104-BT02 is researched and developed by Chengdu Ebyte Electronic Technology Co., Ltd., integrated with transparent transmission, master and slave integration and ready-to-use function. Parameters and functions are configurable according to instructions of serial port. The module is widely applied in wearable devices, home automation, family security and protection, individual healthcare, smart household appliances, accessory and remote control, automobile, illumination and Industrial Internet. The module has a stable sleep function with ultra-low power consumption and a minimum operating current below 2uA in slave mode (with broadcasting function on). Power supply with button monocell is available. Data transmission is stable and highly efficient. In slave mode, it supports the data transmission with the baud rate of 19200bps in maximum as the veritable module for transparent data transmission.

E104-BT02 is compliant with Bluetooth V5.1 protocol. It can connect with any masters that are compliant with Bluetooth V5.1 protocol after a simple configuration to achieve transparent data transmission of serial port. The module supports configuration of master and slave to achieve quick transparent data transmission and point-to-point connection between the master and the slave, and to reduce user's time for operation and project development to a maximum limit.

1.2 Features

- Support BLE Bluetooth V5.1 protocol
- Maximum transmission power of 1mW，software multi-level adjustable;
- Support the global license-free ISM 2.4GHz band;
- Support 250k~2Mbps air data rate；
- Support BLE sniffing, ibeacon and beacon synchronized broadcast
- Enable serial port wake-up
- Industrial grade standard design, support -40 ~ 85 °C for working over a long time;
- Support 2.5V~3.6VVpower supply, power supply over 3.3Vcan guarantee the best performance;
- Support 250k~2Mbps air data rate
- Support 16-bit UUID and 128-bit UUID customization;
- Onboard PCB antenna，no antenna is required for the built-in antenna.
- supports the master/slave system. A host can connect to a maximum of two slave modules.

1.3 Application

- Wireless meter reading; wireless sensing;
- Smart home;
- Industrial tele-control and tele-metering

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- Intelligent building
- Automatic data collection
- Health sensor
- Smart wearable device
- Intelligent robot

2 Specification and parameter

2.1 Limit parameter

Main parameter	Performance		Remark
	Min	Max	
Power supply (V)	0	3.6	Voltage over 3.6V will cause permanent damage to module
Blocking power (dBm)	-	10	Chances of burn is slim when modules are used in short distance
Operating temperature (℃)	-40	+85	Industrial grade

2.2 Operating parameter

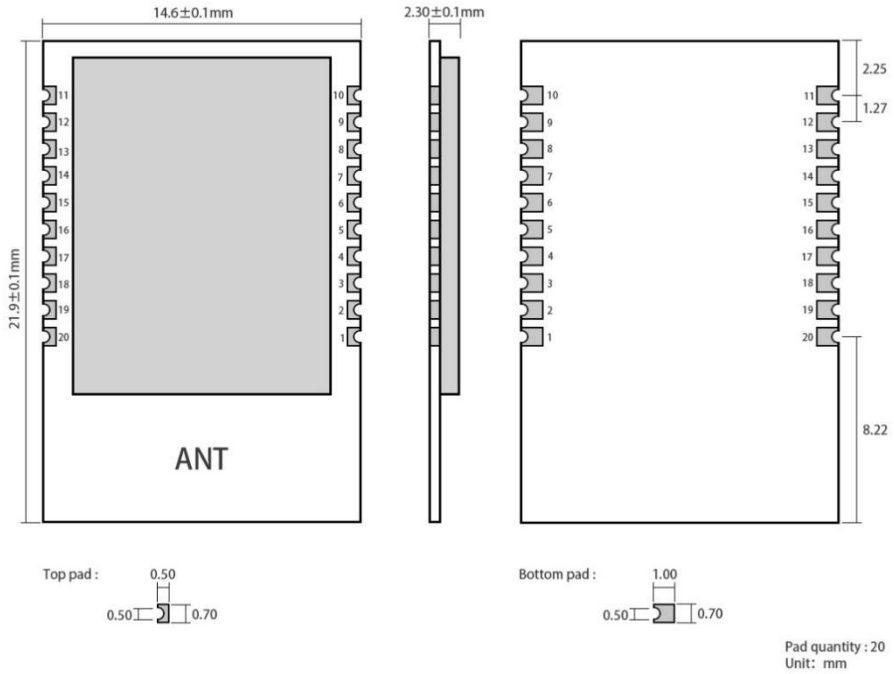
Main parameter		Performance			Remark
		Min	Type	Max	
Operating voltage (V)		2.5	3.3	3.6	≥3.3V ensures output power
Communication level (V)			3.3		For 5V TTL, it may be at risk of burning down
Operating temperature (℃)		-40	-	+85	Industrial grade
Operating frequency (MHz)		2379	-	2496	Support ISM band
Power Consumption	TX current (mA)		3.4		
	RX current (mA)		3.7		Shout-down by software
	Sleep current (μA)		3		
Max TX power (dBm)		-	0	-	
Receiving sensitivity (dBm)		-93.5	-94	-94.5	
Arbitrary I/O		VIL/VIH	GND/0.84	GND/VCC	0.36/VCC
		VOL/VOH	GND/1.88	GND/VCC	0.47/VCC
Sleep disconnect current (default)		1.7	13	614	uA
Sleep connection current (default)		365	418	511	uA
Wake-up connection current (default)		763	804	821	uA
Wake-up disconnect current (default)		739	746	1143	uA
No broadcasting		1.4	2.8	155	Sleep(default)
		738	738	738	Wake-up(default)

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Main parameter	Description	Remark
Reference range	70m	clear and open area, antenna gain: 5dBi, antenna height: 2.5m
Launch length	128Byte	
BLE protocol	BLE5.1	
Communication interface	UART	Leads out MCU IO，See details in data sheet
Package	SMD	
Interface	1.27 mm	
Size	14.6*21.9 mm	
Antenna	PCB onboard antenna	50 ohm impedance

3 Size and pin definition



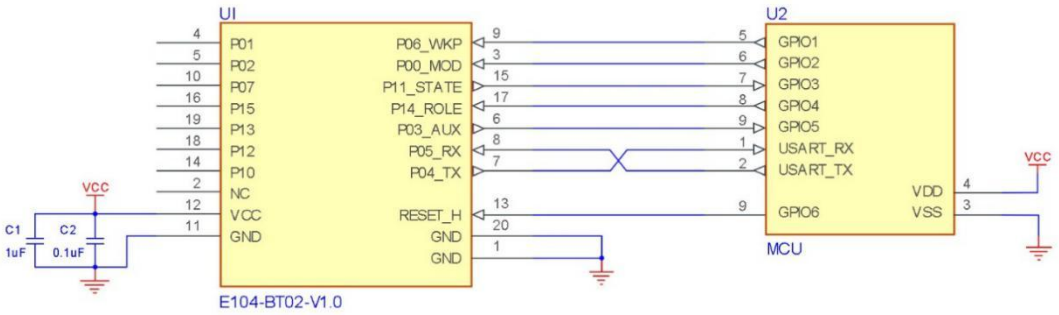
Pin	Name	Direction	I/O	说明
1	GND	-	Ground 地	Referenced ground
2	NC	-	Reserved	-
3	P00	Input	Mode configuration (MOD)	When low level is inputted, module enters configuration mode; when high level is inputted, module enters transparent transmission mode (it contains internal pull-up resistance and operates in transparent transmission mode by default)
4	P01	-	Reserved	-
5	P02	-	Reserved	-
6	P03	Output	Valid data output (APP)	To indicate data outputted via serial port is valid, and the low level indicates that data is in transmission and the high level indicates that data transmission has completed (see more details on <See 5.4 Data Validity Instructions for details >)

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7	P04	Output	UART transmit data	Module outputs serial port data
8	P05	Input	UART receive data	Module receives external serial port data
9	P06	Output	Wake-up (WKP)	In any case, module enters wake-up mode when a low level is inputted and module enters sleep mode when a high level is inputted(it contains internal pull-up resistance and operates in sleep mode by default)
10	P07	-	Reserved	-
11	GND	-	Ground	Referenced ground
12	VCC	-	3.3V	Input power
13	RESET_H	Input	Reset (RST)	Module inputted a high level enters hardware reset state and module inputted a low level come back to normal operating state, which is used for restoration in emergency
14	P10	-	Reserved	-
15	P11	Output	Connection state (STA)	To indicate connection state of Bluetooth, when connected the pin output a low level; when interrupted the pin output a high level.
16	P15	-	Reserved	-
17	P14	Input	Role selection	To configure the role of the module and it is a slave when a high level is inputted and it is a master when a low level is inputted. (It contains internal pull-up resistance and operates as a slave by default. See more on 5.5 Role selection)
18	P12	-	Reserved	-
19	P13	-	Reserved	-
20	GND	-	Ground	Referenced ground

4 Circuit diagram



5 Operating mode

5.1 Low power mode

In any case, Pin P06 input high enters sleep mode and reduces the whole power consumption. Now the serial port stops receiving any data while the transparent transmission of the Bluetooth remains unaffected. In this mode the output function of the serial port is still valid and data received in Bluetooth port can output via serial port.

Description:

1) If Bluetooth is connected, after entering the low power mode, you can command <BKTOSLPON>/<BKTOSLPOFF > to select whether to disconnect the current connection. This function can be used to quickly disconnect the Bluetooth connection and enter the

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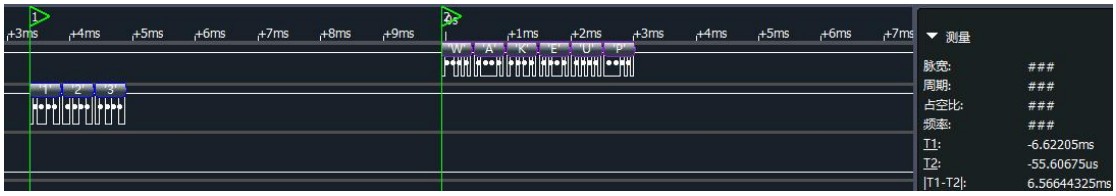
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low power mode after the external MCU is sent and received.

2) When masters and slaves enter this mode, its scanning and broadcasting function remain unaffected.

5.2 Wake-up mode

In any case, WKP (P06) or serial RX pin (selectable command <COMWKPON> configuration to enable serial port wake-up) input falling edge, the module wakes up from low power mode, if the command <WSMON> turns on mode feedback, wake up The serial port will automatically output WAKEUP to notify the user that the wake-up operation is successful. From the detection of the falling edge to the completion of the module wake-up for about 7 ms, the transparent transmission function is temporarily disabled until the system wakes up successfully and the system returns to normal.



5.3 Configuration mode

In wake-up mode, the module enters configuration mode via pulling down Pin P00 and now any data received by the module is regarded as configuration instructions rather than for transparent data transmission, that is, the transparent transmission function is invalid.

Description:

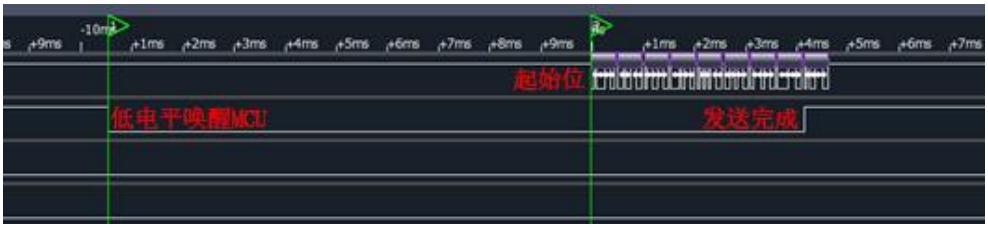
1) Any data transmitted by the master via Bluetooth channel “CENTER DATA BUFF” is not for transparent transmission if Bluetooth is connected now, and channel “BLE DATA BUFF” will receive feedback information “<CONFIG MODE BUSY>”to indicate that the slave is in configuration mode and doesn’t receive data via transparent transmission.

2) In configuration mode, all configured information for the module will be saved after powering down and it will operate according to the new configuration when powering up next time.

5.4 Data validity

Bluetooth outputs transparent transmission via serial port when receiving data. To ensure correct receiving of external MCU, at 10 ms before UART outputs the first start bit, P03 (APP) pulls down and wakes up external MCU till data transmission is completed and P03 recovers a high level.. As shown in the figure:

Description: 1) The data output valid function can be commanded to turn on or off with <APPON>/<APPOFF>.



5.5 Role selection

The module can be configured as a master or a slave. In 160ms after powering up it starts to read the level signal of Pin P14. If a low level signal is detected the module will be configured as the master; if a high level signal is detected it will be the slave; if the pin

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floats, module with internal pull-up resistance will act as a slave. Role configuration is only valid when the module is powered up and initialized and the role is fixed after powering up is completed till next restart to redetect role configuration.

Description:

1) When operating as a master and with scanning started, the module will automatically scan surrounding slaves until valid slaves are detected (If MAC address bonding is set, it is likely to connect to slaves with assigned MAC address) and the Bluetooth connection is completed automatically.

2) When operating as a slave and with broadcasting started, the module will transmit broadcasting data packet to surrounding areas via configured broadcasting gap and wait the Bluetooth master to initialize connection.

5.6 MAC address bonding

The module supports bonding of MAC address connected via Bluetooth, which bond connected MAC address via instruction " <BONDMAC> " . When master sets bonded address, before a connection is completed, the master will firstly search that if address of devices is compliant with bonded address, and only bonded devices can complete connection. Likewise, when slave sets bonded address, before receiving request for connection from master it will search if MAC address of the master is the bonded address, and when address is successfully matched the connection can be enabled or the salve will continue to broadcast. Carrying out instruction "<DISBOND>" will stop MAC bonding. The slave can receive any request for connection from master when being stopped and the master will connect to any slave devices in a valid area.

Description:

MAC address bonding can help to realize directional connection in complex conditions. For example, there are several slaves in a valid scanning area for a master device. The master can filter requests for connection from salve devices to realize directional connection.

5.7 Transparent continuous transmission

Slave supports transparent continuous transmission in which mode configured UART baud rate can be as high as 19200bps, i.e., no matter how large the data packet UART received is, or it is continuous data flow, transparent transmission remains unaffected. Abnormal packet loss will not happen. This function realizes transparent transmission in a real sense.

Description:

After receiving the Bluetooth data, the slave module transmits the serial port transparently. Due to the "data valid indication" function, the serial port delays the data output. Turning off the "data valid indication" can improve the data throughput speed.

5.8 Bluetooth packet length configuration

The module supports the long-packet standard of Bluetooth 5.1, and can command <MTU> to configure the length of the Bluetooth single-packet packet. The default is 20 bytes, and the optional 20~128 bytes. The packet length can be increased to realize the big-band data transmission of Bluetooth.

Description:

After the packet length is configured, it takes effect on the next Bluetooth connection.

5.9 UUID configuration

The module supports UUID flexible configuration, and can command <UUID128EN> to enable the 128-bit UUID function. The command <SVRUUID>, <RXUUID>, <TXUUID> can be used to customize the transparent transmission service UUID, the reception

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feature field UUID, and the transmission feature field UUID. This function can solve the problem that the UUID does not match the APP communication, meet more customization requirements, and is more practical.

5.10 Bluetooth sniffing

The module supports the Bluetooth sniffing function in the host state. In the host configuration mode, the command <STARTSNIF> turns on the Bluetooth sniffing. The module automatically sniffs the surrounding Bluetooth broadcast data packet and outputs the acquired Bluetooth information through the serial port. The output format is MAC (6 bytes) +RSSI (1 byte) a total of 7 bytes of hexadecimal data. (Special note: This function is valid in both master and slave modes, and it has nothing to do with whether Bluetooth is connected or not. That is to say, the sniffing function is enabled in the Bluetooth connection state.)

Description:

1) The sniffing function is valid only in the Bluetooth host role and the configuration mode.

2) The broadcast packet sniffing speed can be configured by the command <SCANGAP>/<SCANWN>. The shorter the gap, the larger the window and the faster the sniffing response.

5.11 Beacon data switchable

The slave module can be configured with "<ADVDATA>" and "<IBACON>" respectively, and the normal broadcast data and Ibeacon broadcast data. After the broadcast is enabled, the module uses the configured broadcast gap as a fixed interval and broadcasts 3 ordinary broadcast data packets each time, switch broadcast 3 Ibeacon broadcast packets, and loop. This function realizes synchronous transmission of ordinary broadcast and Ibeacon broadcast, which can achieve seamless connection effect.

In addition, the command <ADVSUST> can be configured as a broadcast non-switching function, that is, the ibeacon and the normal beacon switch broadcast mechanism are turned off, and the broadcast mode is set to a fixed broadcast mode.

The default factory configuration enables Beacon data switching mode.

Description：

1）、Ibeacon data format is as follows：

Ibeacon Data				
0-8	9-24	25、26	27、28	29
Ibeacon Prefix 9bytes	UUID 16bytes	Major Number 2bytes	Minor Number 2bytes	Tx Power 1bytes

Ibeacon Prefix:Specific byte

UUID：Used to distinguish the ID numbers of the same Beacon device. The same group device uses the same ID number.

Major：Used to mark related Beacons as a group

Minor：ID number of each device

Tx Power：The measured signal strength value of 1 meter can be used for ranging.

2）、Normal broadcast packet format：

0-3	4-N
03 03 FFF0	Manufacture DATA

3）、Fixed broadcast packet format：

N
Manufacture DATA

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5.12 Air configuration

The module supports the air configuration function. After the Bluetooth connection is established in the slave state, the host can access the "BLE DATA CONFIG" feature value under the transparent transmission service (FFF0). The configuration steps are as follows:

1）、In the air configuration login authentication, send the command <PWDXXXXXX>, where XXXXXX is the login password, the default is 123456, and return <OK> after success.

2）、The parameter configuration is executed, and the command is consistent with the serial port configuration command.

3）、Disconnect the Bluetooth connection.

Description：

1）、After the <PWDXXXXXX> command fails, the current login status will be exited immediately. That is, the configuration operation needs to be resumed after the login is successful.。

2）、After the <RESTORE> command is executed, the login password is restored to the default settings.

6 Operating Instruction

Warning: Make sure the module is in wake-up mode and enters configuration mode before sending operating instruction or it is unable to receive any configuration instruction.

Description：

1、Instruction format: the format for all operation instruction uses prefix sign ‘<’and suffix sign ‘>’, instruction format is <instruction>

For example, for transmitting and receiving baud rate of serial port the format is <COMBAUD>

2、Instruction returning

Returning value	Description
INVALID_ERR	Unrecognized instruction
HT_ERR	Unrecognized instruction or lack of prefix/suffix sign of instruction
LEN_ERR	Parameter length out of range
OK	Correct execution

3、Factory parameter setting

Others	Baud rate	19200bps
	Calibration	NONE
	Stop bit	1
	Air configuration password	123456
	Serial wakeup	Shut Down
	Data output indication	Open
	Bluetooth packet length	20
	Bluetooth binding	Shut Down
Transparent Transmission service	UUID	16 bits
	Transparent Transmission UUID	0xFFF0
	BLE DATA BUFF UUID	0xFFF1
	CENTER UUID BUFF	0xFFF2

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	BLE DATA CONFIG	0xFFF3
Slave	Broadcast function	Open
	Module name	E104-BT02
	Broadcasting gap	1s
	Min connecting gap	10ms
	Max connecting gap	10ms
	Connecting timeout	5s
	General broadcasting data	02 01 06 03 03 58 69 05 FF 01 02 03 05
	Ibeacon broadcasting data	02 01 06 1A FF 4C 00 02 15 52 41 44 49 55 00 4E 45 54 57 4F 52 4B 53 43 4F 00 01 00 02 D2
	Eddystone broadcasting data	02 01 06 03 03 AA FE 0C 16 AA FE 00 63 64 65 62 79 74 65 07
	Manufacturer name	CDEBYTE
	Serial number (SN)	160705000004
	SYSTEM ID	Same as MAC address
Master	Scanning gap	12.5ms
	Scanning time	10ms
	Min connecting gap	10ms

6.1 Module reset instruction

Instruction	Description
<RESET>	Restart BLE protocol stack (different from pin reset, it only resets protocol stack and buffered data will be remained)
No returning	

6.2 Restore factory mode

Instruction	Description
<RESTORE>	All parameters are restored to factory settings.
When succeed return to<OK>	

6.3 Configuration instruction for baud rate of serial port

Instruction	Description
<BAUDxxx>	To configure baud rate assigned by xxx (ASCII code) and optional baud rate includes 4800, 9600, 19200, 38400, 57600, 115200, 230400

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When parameter is out of range return to<RANGE_ERR>; when succeed return to<OK> Special note: The configuration is stored at once but it only takes effect after exiting configuration mode. Uninterrupted continuous transmission below 19200bps from the slave to the master is available.

6.4 Read instruction for baud rate of serial port

Instruction	Description
<COMBAUD>	Read the current baud rate configuration.
For example, the baud rate is 19200bps, return <19200>	

6.5 Serial port stop bit configuration

Instruction	Description
<xSB>	Configure the number of serial port stop bits specified by x (ASCII code), optional 1 and 2 stop bits.
When succeed return to<OK> Special note: This configuration is saved immediately, but only takes effect after exiting configuration mode.	

6.6 Read instruction for stop bit of serial port

Instruction	Description
<STOPBIT>	Read present stop bit configuration
For example, for one stop bit return to <STOPBIT1>	

6.7 Configuration instruction for parity bit of serial port

Instruction	Description
<PEVEN>	Even parity check of serial port
<PODD>	Odd parity check of serial port
<PNO>	No parity
When succeed, return to<OK> Special note: The configuration is stored at once but it only takes effect after exiting configuration mode.	

6.8 Read instruction for parity bit of serial port

Instruction	Description
<PARITY>	Read parity bit configuration
For example， for no parity return to<NOP>, for even parity check return to <EVENP>, for odd parity check return to <ODDP>	

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6.9 Instruction for starting broadcast

Instruction	Description
<STARTADV>	Start broadcasting
When succeed return to <OK>	

6.10 Instruction for stopping broadcast

Instruction	Description
<STOPADV>	Stop broadcasting
When succeed return to <OK>	

6.11 Broadcast state inquiry

Instruction	Description
<ADVSTATE>	Read present broadcast state
For example, when broadcast is started, return to <ADVON>, when closed, return to <ADVOFF> Special note: When broadcast is started in any case (including sleep mode), module will carry out periodic broadcasting according to configured gap. This instruction only supports master. Slave sends instruction and returns to <INVALID_ERR>.	

6.12 Set general broadcasting data

Instruction	Description
<ADVDATAxxx>	Set broadcasting data of max 22 bytes (hex) assigned by xxx, update data in the next broadcasting period, and clear data if it is not assigned by xxx.
Length of broadcasting data is out of range, return to<RANGE_ERR>, when succeed, return to<OK>. Special note: General broadcasting and IBeacon broadcasting can be started at the same time, i.e., every two general broadcasting data is broadcasted, two IBeacon broadcasting data is switched. Special note: General broadcasting and IBeacon broadcasting can be started at the same time, i.e., every two general broadcasting data is broadcasted, two IBeacon broadcasting data is switched.	

6.13 Set IBeacon broadcasting data

Instruction	Description
<IBACONxxx>	Set broadcasting data of max 25 bytes (hex) assigned by xxx, update data in the next broadcasting period, and clear data if it is not assigned by xxx.
Length of broadcasting data is out of range, return to<RANGE_ERR>, when succeed, return to<OK>. Special note: General broadcasting and IBeacon broadcasting can be started at the same time, i.e., when every two general broadcasting data is broadcasted, two IBeacon broadcasting data is switched.	

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6.14 Set fixed broadcast data

Instruction	Description
<ADVCUSTxxx>	Configure up to 26 bytes (hexadecimal) of broadcast data specified by xxx (ASCII code) and update the data in the next broadcast cycle. If xxx is not specified, the broadcast data will be cleared.
When succeed return to <OK>	

6.15 Set device name

Instruction	Description
<NAMExxx>	Set device name of max 18 bytes (ASCII code) assigned by xxx, update broadcasting data in the next broadcasting period when disconnected, and update after interruption when connected.
Length of device name is out of range, return to<RANGE_ERR>, when succeed, return to<OK>.	

6.16 Read device name

Instruction	Description
<MNAME>	Read device name
For example, device name is E104-BT02, return to <E104-BT02>	

6.17 Set manufacturer name

Instruction	Description
<FACxxx>	Set manufacturer name of max 18 bytes (ASCII code) assigned by xxx, and update at once.
Length of manufacturer name is out of range, return to<RANGE_ERR>, when succeed, return to<OK>	

6.18 Read manufacturer name

Instruction	Description
<FNAME>	Read manufacturer name
For example, manufacturer name is CDEBYTE, return to <CDEBYTE>	

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6.19 Set software version number

Instruction	Description
<SOFTxxx>	Set software version number of max 18 bytes (ASCII code) assigned by xxx, and update at once
Length of software version number is out of range, return to<RANGE_ERR>, when succeed, return to<OK>.	

6.20 Read software version number

Instruction	Description
<SVER>	Read software version number
For example, if software version number is VER1.0, return to<SVER1.0>	

6.21 Set hardware version number

Instruction	Description
<HARDxxx>	Set hardware version number of max 18 bytes (ASCII code) assigned by xxx, and update at once.
Length of hardware version number is out of range, return to<RANGE_ERR>, when succeed, return to<OK>.	

6.22 Read hardware version number

Instruction	Description
<HVER>	Read hardware version number
For example, if the hardware version number is VER1.0 return to <HVER1.0>.	

6.23 Set module SN

Instruction	Description
<SNxxx>	Set module SN of max 18 bytes (ASCII code) assigned by xxx, and update at once.
SN length is out of range, return to<RANGE_ERR>, when succeed, return to<OK>.	

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6.24 Read module SN

Instruction	Description
<MSN>	Read module SN
For example, if SN is 160705000004, return to<N160705000004>	

6.25 Set System ID

Instruction	Description
< SYSIDx>	Configure 8-byte (hexadecimal) data specified by x (ASCII code), which is the same as the MAC address by default.
When the data length is out of range, it returns <RANGE_ERR>.,when succeed, return to<OK>. For example,<SYSID0102030405060708> <OK>	

6.26 Inquire System ID

Instruction	Description
< MSYSID>	Inquire System ID
When the data length is out of range, it returns <RANGE_ERR>,when succeed, return to<OK> For example, <SYSID0102030405060708> <OK>	

6.27 Set module SN

Instruction	Description
< MODNB>	Set module SN
when succeed, return to<OK>	

6.28 Inquire module number

Instruction	Description
< MMODNB>	Inquire module number
when succeed, return to<OK>	

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6.29 Set broadcasting gap

Instruction	Description
<ADVGAPxxx>	Set broadcasting gap assigned by xxx (ASCII code) ranging from 32 to 16000, i.e., from 20ms to 10s correspondingly.
If parameter is out of range return to <RANGE_ERR>, when succeed return to <OK>.	

6.30 Read broadcasting gap

Instruction	Description
<AGAP>	Read broadcasting gap configuration，ranging from 6 to 3200, i.e., from 7ms to 4s correspondingly.
For example, if the gap is 1s, return to<A1600>.	

6.31 Set max connecting gap

Instruction	Description
<CONMAXxxx>	Set max connecting gap assigned by xxx (ASCII code) ranging from 6 to 3200, i.e., from 7.5ms to 4s correspondingly.
If parameter is out of range return to <RANGE_ERR>, when succeed return to <OK>. Special note: The max connecting gap must be larger than or equal to the min connecting gap.	

6.32 Read max connecting gap

Instruction	Description
<MAXCGAP>	Read max connecting gap
For example, if the gap is 10ms return to <CX8>.	

6.33 Set min connecting gap

Instruction	Description
<CONMINxxx>	Set min connecting gap assigned by xxx (ASCII code) ranging from 6 to 3200, i.e., from 7.5ms to 4s correspondingly.
If parameter is out of range return to <RANGE_ERR>, when succeed return to <OK>. Special note: The min connecting gap must be less than or equal to the max connecting gap.	

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6.34 Read min connecting gap

Instruction	Description
<MINCGAP>	Read min connecting gap
For example if connecting gap is 10ms return to <CN8>.	

6.35 Set connecting timeout

Instruction	Description
<TIMEOUTxxx>	Set connecting timeout assigned by xxx (ASCII code) ranging from 10 to 3200, i.e., from 100ms to 32s correspondingly.
If parameter is out of range return to <RANGE_ERR>, when succeed return to <OK>.	

6.36 Read connecting timeout

Instruction	Description
<CTIMEOUT>	Set connecting timeout configuration
For example, if the connecting timeout is 5s return to < T500 >	

6.37 Disconnect present connection

Instruction	Description
<DISCONNECT>	Disconnect presently connected devices
If it is connected return to <OK>, if not return to <DISCONNECTED>	

6.38 Inquire Bluetooth connecting state

Instruction	Description
<STATE>	Inquire Bluetooth connecting state
In connected state return to<CONNECTED>, in disconnected state return to<DISCONNECTED>.	

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6.39 Inquire local MAC address

Instruction	Description
<MAC>	Read local MAC address (6 s in total with hex system).
For example, MAC address of module is 010203040506 return to 0x3C 0x01 0x02 0x03 0x04 0x05 0x06 0x3E. (in which 0x3C corresponds to'<', 0x3E corresponds to '>', 0x01 0x02 0x03 0x04 0x05 0x06 corresponds to MAC address).	

6.40 Inquire MAC address of connected devices

Instruction	Description
<PEERMAC>	Read the MAC address (hex) of devices connected to the locality
In connected state return to <xxx>, xxx (hex) is the MAC address of connected devices; in disconnected state return to < DISCONNECTED >.	

6.41 Set bonded MAC address

Instruction	Description
<BONDMACxxx>	Set MAC filtered address with 6 bytes assigned by xxx (hex), i.e., only receive requests for connection from devices with MAC address.
If parameter is out of range return to <RANGE_ERR>, when succeed return to <OK>. Special note: This function can be applied in conditions where several requests for connection happen and to choose MAC-matching connection.	

6.42 Read set bonded MAC address

Instruction	Description
<RBMAC>	Read set MAC filtered address (hex).
For example, the filtered address is 010203040506 return to < B010203040506 > (hex).	

6.43 Turn off MAC address filtering

Instruction	Description
<DISBOND>	Stop Turn off MAC address filtering，i.e., receive random connecting request from MAC master.

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When succeed return to <OK>.

6.44 Start mode feedback

Instruction	Description
<WSMON>	Start mode feedback. To switch to ports in sleep mode, output “SLEEP”; to switch to wake-up mode, output “WAKEUP”
When succeed return to <OK>.	

6.45 Turn off mode feedback

Instruction	Description
<WSMOFF>	Turn off mode feedback.
When succeed return to <OK>.	

6.46 Start scanning

Instruction	Description
<STARTSCAN>	Start master’s scanning
When succeed return to<OK>. NOTE: 1. This instruction is only valid for master. It is not available for slave and return to <INVALID_ERR>. 2. If the master is connected return to <CONNECTED>, which means scanning is stoppedwhen connected and one can carry out scanning after disconnected. 3. Power consumption of master will rise when scanning is on.	

6.47 Stop scanning

Instruction	Description
<STOPSCAN>	Stop master’s scanning
When succeed return to<OK>. NOTE: 1. This instruction is only valid for master. It is not available for slave and return to<INVALID_ERR>. 2. If the master is connected return to <CONNECTED>, which means scanning is stopped when connected and one can carry out scanning after disconnected. 3. Power consumption of master will rise when scanning is on.	

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6.48 Read scanning state

Instruction	Description
<SCANSTATE>	The master returns to present scanning enabled state.
For example, when scanning is on, return to <SCANON>, when it is off return to <SCANOFF>	

6.49 Set scan gap time

Instruction	Description
<SCANGAPxxx>	The configuration is specified by xxx (ASCII code), x ranges from 10 to 10000 to set the scanning gap, and the range is 10ms-10s.
If parameter is out of range return to <RANGE_ERR>,When succeed return to <OK>.	

6.50 Inquiry scan gap

Instruction	Description
<SGAP>	Inquiry scan gap
For example, if the scan gap is 20 milliseconds, return <SGAP 20>.	

6.51 Set scan gap time

Instruction	Description
<SCANWND>	The configuration is specified by xxx (ASCII code), x ranges from 20 to 10000 to set the scanning gap, and the range is 20ms-10s.
When succeed return to <OK>.	

6.52 Inquiry scan gap time

Instruction	Description
<SWND>	Inquiry scan gap time
For example, the scan gap is 20 milliseconds and return < SWND20>.	

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6.53 Turn on sniffing

Instruction	Description
<STARTSNIF>	Turn on sniffing
When succeed return to <OK>.	

6.54 Turn off sniffing

Instruction	Description
<STOPSNIF>	Turn off sniffing
When succeed return to <OK>.	

6.55 Read current RSSI value

Instruction	Description
<RSSI>	Read the RSSI value (1 byte hex) in the connected state.
return<Rx>，x represent the RSSI value. Note：1、The RSSI is valid only when the connection is established, and the connection is not established to return <DISCONNECTED>. 2、The signal strength is not in dBm units and the conversion formula is: RSSI * 0.474 – 112dBm.	

6.56 Turn on 128bit UUID display

Instruction	Description
<UUID128ON>	Turn on128bit UUID display
When succeed return to <OK>.	

6.57 Turn off 128bit UUID display

Instruction	Description
<UUID128OFF>	Turn off 128bit UUID display
When succeed return to <OK>.	

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6.58 Set service name UUID

Instruction	Description
<SVRUUIDxxx>	The length of the configuration xxx (HEX format) is mainly specified by "<SVRUUIDxxx >", and the UUID parameter is 2 bytes (or 16 bytes). This command mainly configures the service name UUID and is updated on the next connection.
After the data length is out of range, return <RANGE_ERR>,When succeed return to <OK>.	

6.59 Set RXUUID

Instruction	Description
<RXUUIDxxx>	The length of configuration xxx (HEX format) is mainly specified by "<RXUUIDx>", and the UUID parameter is 2 bytes (or 16 bytes). This command mainly configures the UUID of BLE DATA BUFF and is updated on the next connection.
After the data length is out of range, return<RANGE_ERR>,When succeed return to <OK>.	

6.60 Set TXUUID

Instruction	Description
<TXUUIDxxx>	The length of configuration xxx (HEX format) is mainly specified by "<TXUUIDxxx>", and the UUID parameter is 2 bytes (or 16 bytes). This command mainly configures the UUID of CENTER DATA BUFF and is updated on the next connection.
After the data length is out of range, return<RANGE_ERR>, When succeed return to <OK>.	

6.61 Set MTU length

Instruction	Description
<MTUx>	Configure 1-byte (hex) data specified by x. The value of x ranges from 20 to 128. The default is 20 bytes.
After the data length is out of range, return <RANGE_ERR>， When succeed return to <OK>. If set to 20 bytes, <MTULEN14> <OK>.	

6.62 Inquiry MTU length

Instruction	Description

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<MMTU>	Inquiry MTU length
After the data length is out of range, return <RANGE_ERR>, When succeed return to <OK>. For example, <20>	

6.63 Inquiry device roles

Instruction	Description
<ROLETYPE>	Inquiry device roles
master， return to <CENTER>, slave, return to <SLAVER>	

6.64 Serial Wake-up open

Instruction	Description
<COMWKPON>	Open the serial port software wake-up switch.
When succeed return to <OK>.	

6.65 Serial Wake-up off

Instruction	Description
<COMWKPOFF>	Turn off the serial port software wake-up switch.
When succeed return to <OK>.	

6.66 Indication for turning on data output

Instruction	Description
<APPON>	Delay of opening serial port 10ms.
When succeed return to <OK>.	

6.67 Indication for turning off data output

Instruction	Description

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<APPOFF>	Turn off the serial port delay.
When succeed return to <OK>.	

6.68 Turn off Bluetooth connection after entering hibernation

Instruction	Description
<DISBEFSLPON>	Turn off the Bluetooth connection after the device goes to sleep.
When succeed return to <OK>.	

6.69 Keep Bluetooth connection after entering hibernation

Instruction	Description
<DISBEFSLPOFF>	Keep the Bluetooth connection after the device goes to sleep.
When succeed return to <OK>.	

6.70 Air configuration password authentication

Instruction	Description
<PWDxxx>	The parameter consists of xxx (ASCII code) and the initial password is 123456. This command is used to enter the wireless upgrade password matching. After the password pairing is successful, the wireless configuration can be entered.
When succeed return to <OK>.	

6.71 Air configuration password update

Instruction	Description
<UPDPWDxxx>	Configure the data specified by xxx (ASCII code), the value range is 6 characters. This command is used to modify the identification password.
When succeed return to <OK>.	

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7 UUID description

Channel Name	UUID	Property	Description
BLE DATA BUFF	0xFFF1 (default)	Read only, inform	This channel is for receiving UART data and it returns to Bluetooth master by informing. The biggest data length for a single packet is 20 bytes and data more than 20 bytes are to be sent separately. NOTE: If IPHONE or Android mobile phone is set as the master, the Notification function should be activated for receiving module data .
CENTER DATA BUFF	0xFFF2 (default)	Read, write	This channel is for master to transmit data. The biggest data length for a single packet is 20 bytes and data more than 20 bytes are to be sent separately. The transmitted data will be outputted via serial port.
BLE DATA CONFIG	0xFFF3 (default)	Read, write	Air configuration channel

8 Quick usage

Use Android mobile phone (version 4.3 and above), IPHONE 4s and above version or Ipad with BLE function to achieve connection and communication with the module.

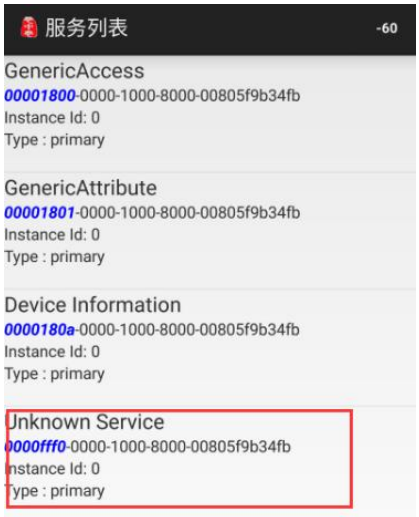
Take android mobile phone as an example:

1.Download and install “BLE Test Tool”.

2.Open “BLE Test Tool”, scan surrounding broadcasting packages and list all surrounding broadcasting devices.

3.Click and enter this service. UUID: FFF0 is transparent data transmission service. Click and enter this service.

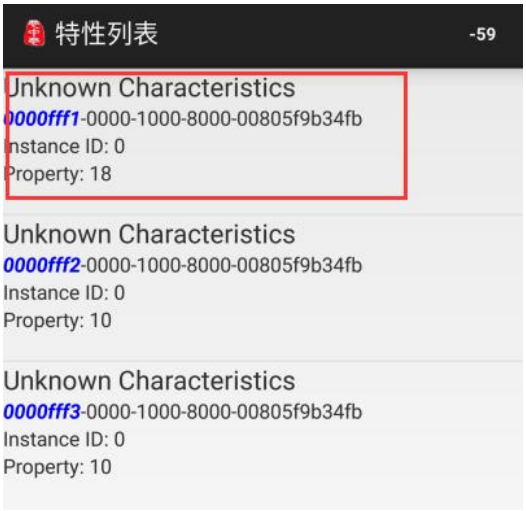




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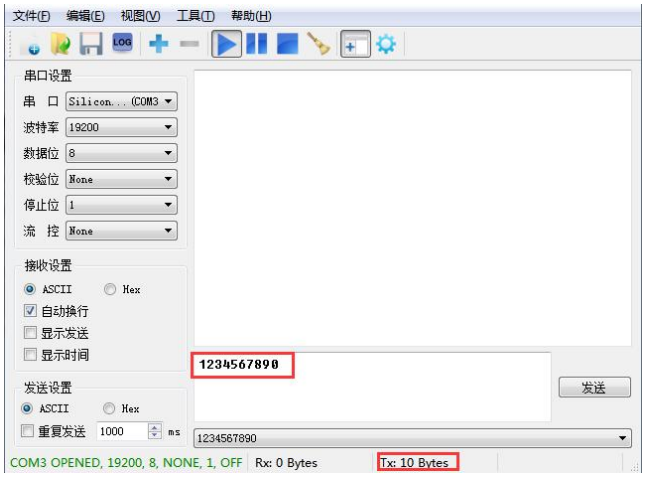
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4.Display 3 channels and FFF1 is channel for data transmission from module to master. Enter this channel and click “Start notification”.





5.Use COM debugging assistant and transmit character string “1234567890” via module E104-BT02 (operating in wake-up transparent transmission mode). APP says character string is received.

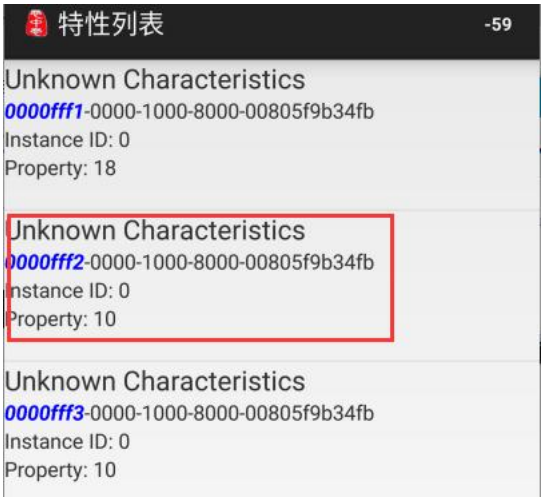




6. Return to the previous level, enter the FFF2 channel, the channel is the host data transmission channel, click "write".

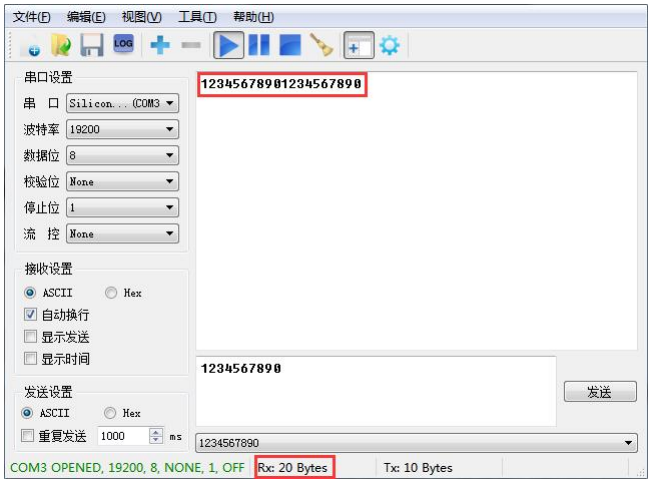
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7.Fill in and send the data "12345678901234567890", the module E104-BT02 will transmit the received data through the serial port.





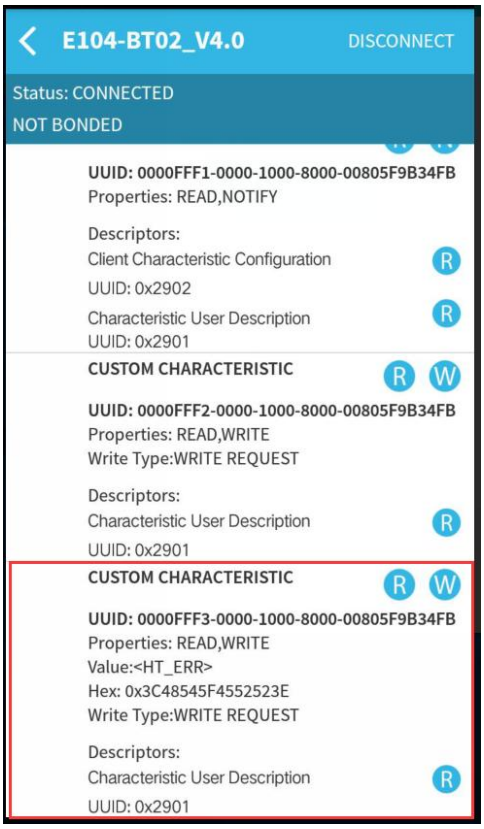
Wireless configuration operation

Android operating system, host computer software BLE_Scanner.

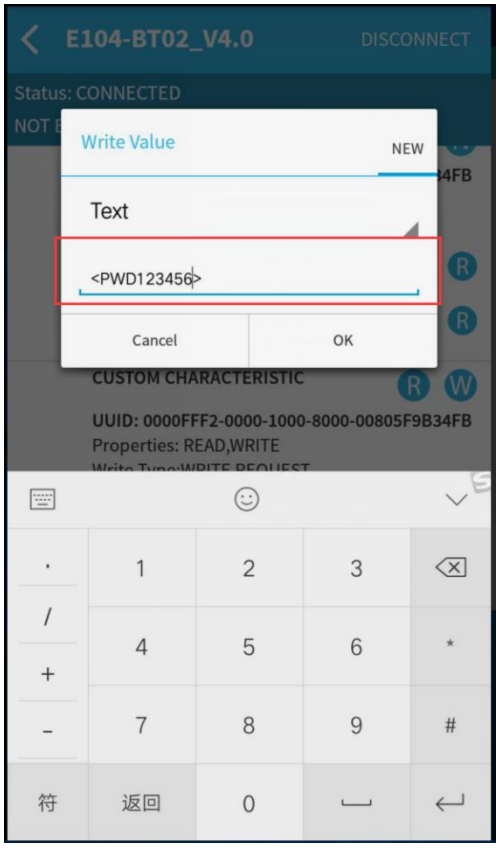
1.After connecting to Bluetooth, open the wireless configuration function as shown below.

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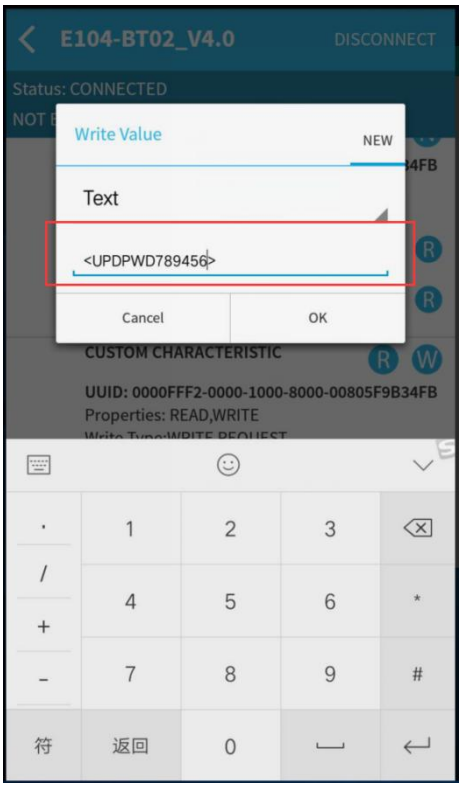
2.Click “W” to pop up the identification interface. After entering the correct ID, it will enter the wireless configuration interface.



3.The ID password can be configured by the <UPDPWDxxx> command, and the configuration can be taken out after the change.

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9 Hardware design

- It is recommended to use a DC stabilized power supply. The power supply ripple factor is as small as possible and the module needs to be reliably grounded;
- Please pay attention to the correct connection of the positive and negative poles of the power supply, reverse connection may cause permanent damage to the module;
- Please check the power supply to ensure that between the recommended supply voltage, if exceeding the maximum, the module will be permanently damaged;
- Please check the stability of the power supply. Voltage can not fluctuate greatly and frequently;
- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the margin, so the whole machine is beneficial for long-term stable operation;
- The module should be as far away as possible from the power supply, transformers, high-frequency wiring and other parts with large electromagnetic interference;
- Bottom Layer High-frequency digital routing, high-frequency analog routing, and power routing must be avoided under the module. If it is necessary to pass through the module, assume that the module is soldered to the Top Layer, and the copper is spread on the Top Layer of the module contact part(well grounded), it must be close to the digital part of the module and routed in the Bottom Layer;
- Assuming the module is soldered or placed over the Top Layer, it is wrong to randomly route over the Bottom Layer or other layers, which will affect the module's spurs and receiving sensitivity to varying degrees;
- It is assumed that there are devices with large electromagnetic interference around the module that will greatly affect the performance. It is recommended to keep them away from the module according to the strength of the interference. If necessary, appropriate isolation and shielding can be done;
- Assume that there are traces with large electromagnetic interference (high-frequency digital, high-frequency analog, power traces)

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around the module that will greatly affect the performance of the module. It is recommended to stay away from the module according to the strength of the interference. If necessary, appropriate isolation and shielding can be done;

- If the communication line uses a 5V level, a 1k-5.1k resistor must be connected in series (not recommended, there is still a risk of damage);
- Try to stay away from some physical layers such as TTL protocol at 2.4GHz , for example: USB3.0;
- The mounting structure of antenna has a great influence on the performance of the module. It is necessary to ensure that the antenna is exposed, preferably vertically upward. When the module is mounted inside the case, use a good antenna extension cable to extend the antenna to the outside.
- The antenna must not be installed inside the metal shell, which will greatly reduce the transmission distance.

10 FAQ

10.1 Communication range is too short

- The communication distance will be affected when obstacle exists;
- Data lose rate will be affected by temperature, humidity and co-channel interference;
- The ground will absorb and reflect wireless radio wave, so the performance will be poor when testing near ground;
- Sea water has great ability in absorbing wireless radio wave, so performance will be poor when testing near the sea;
- The signal will be affected when the antenna is near metal object or put in a metal case;
- Power register was set incorrectly, air data rate is set as too high;
- The power supply low voltage under room temperature is lower than recommended value, the lower the voltage, the lower the transmitting power;
- Due to antenna quality or poor matching between antenna and module.

10.2 Module is easy to damage

- Please check the power supply and ensure it is within the recommended range. Voltage higher than the peak will lead to a permanent damage to the module;
- Please check the stability of power supply and ensure the voltage not to fluctuate too much;
- Please make sure anti-static measures are taken when installing and using, high frequency devices have electrostatic susceptibility;
- Please ensure the humidity is within limited range for some parts are sensitive to humidity;
- Please avoid using modules under too high or too low temperature.

10.3 BER(Bit Error Rate) is high

- Here are co-channel signal interference nearby, please be away from interference sources or modify frequency and channel to avoid interference;;

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- Poor power supply may cause messy code. Make sure that the power supply is reliable;
- The extension line and feeder quality are poor or too long, so the bit error rate is high.

11 Production guidance

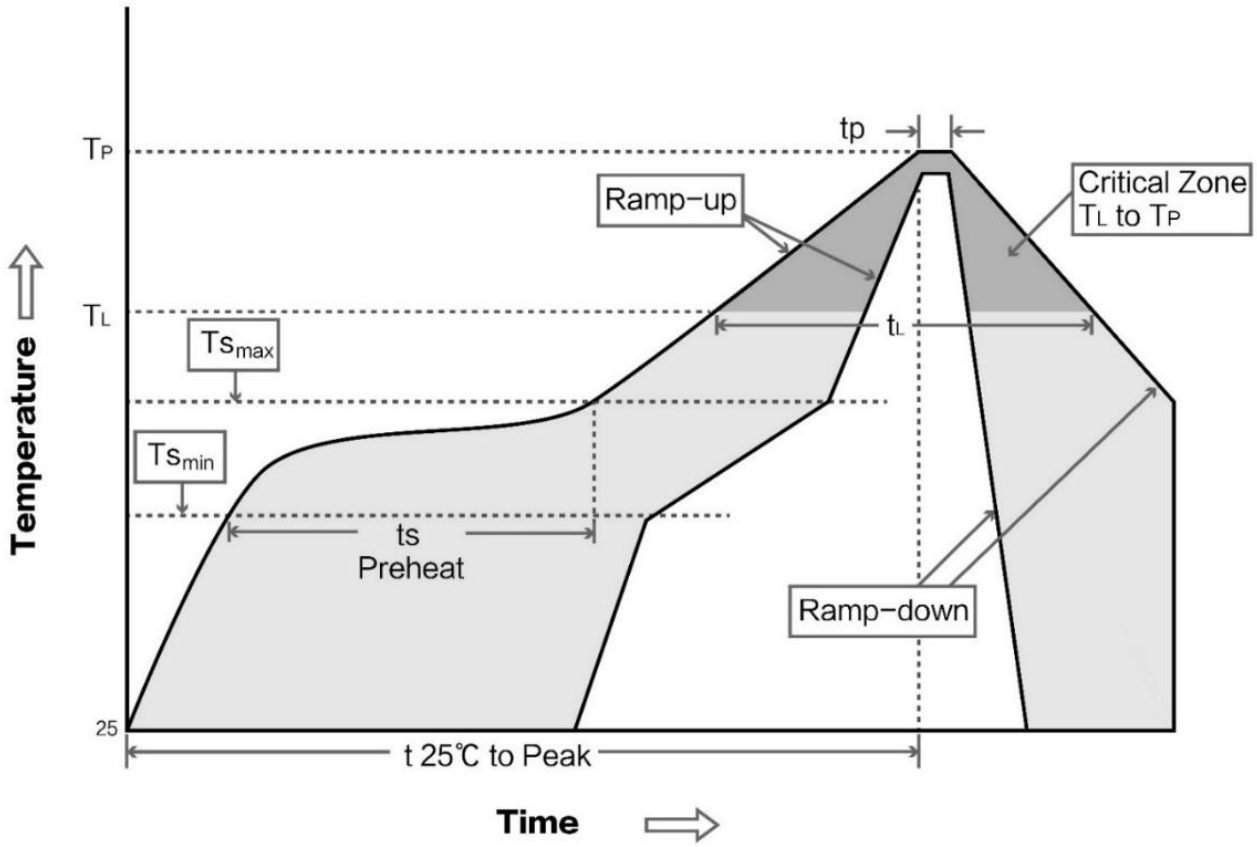
11.1 Reflow soldering temperature

Profile Feature	Profile Feature	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Solder Paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min (Tsmin)	Min preheating temp	100℃	150℃
Preheat temperature max (Tsmax)	Max preheating temp	150℃	200℃
Preheat Time (Tsmin to Tsmax)(ts)	Preheating time	60-120 sec	60-120 sec
Average ramp-up rate(Tsmax to Tp)	Average ramp-up rate	3℃/second max	3℃/second max
Liquidous Temperature (TL)	Liquid phase temp	183℃	217℃
Time(tL)Maintained Above(TL)	Time below liquid phase line	60-90 sec	30-90 sec
Peak temperature(Tp)	Peak temp	220-235℃	230-250℃
Average ramp-down rate(Tp to Tsmax)	Average ramp-down rate	6℃/second max	6℃/second max
Time 25℃ to peak temperature	Time to peak temperature for 25℃	6 minutes max	8 minutes max

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11.2 Reflow soldering curve



12 E104 series

Model	IC	Frequency Hz	Tx power dBm	Communication Interface	Bluetooth Version	Size mm	Antenna	Feature
E72-2G4M05S1B	CC2640	2.4G	5	I/O	4.2	17.5*28.7	PCB/IPX	Hardware resource Secondary development
E73-2G4M04S1A	nRF52810	2.4G	4	I/O	4.2/5.0	17.5*28.7	PCB/IPX	Hardware resource Secondary development
E73-2G4M04S1B	nRF52832	2.4G	4	I/O	4.2/5.0	17.5*28.7	PCB/IPX	Hardware resource Secondary development
E73-2G4M08S1C	nRF52840	2.4G	8	I/O	4.2/5.0	13*18	PCB/IPX	Hardware

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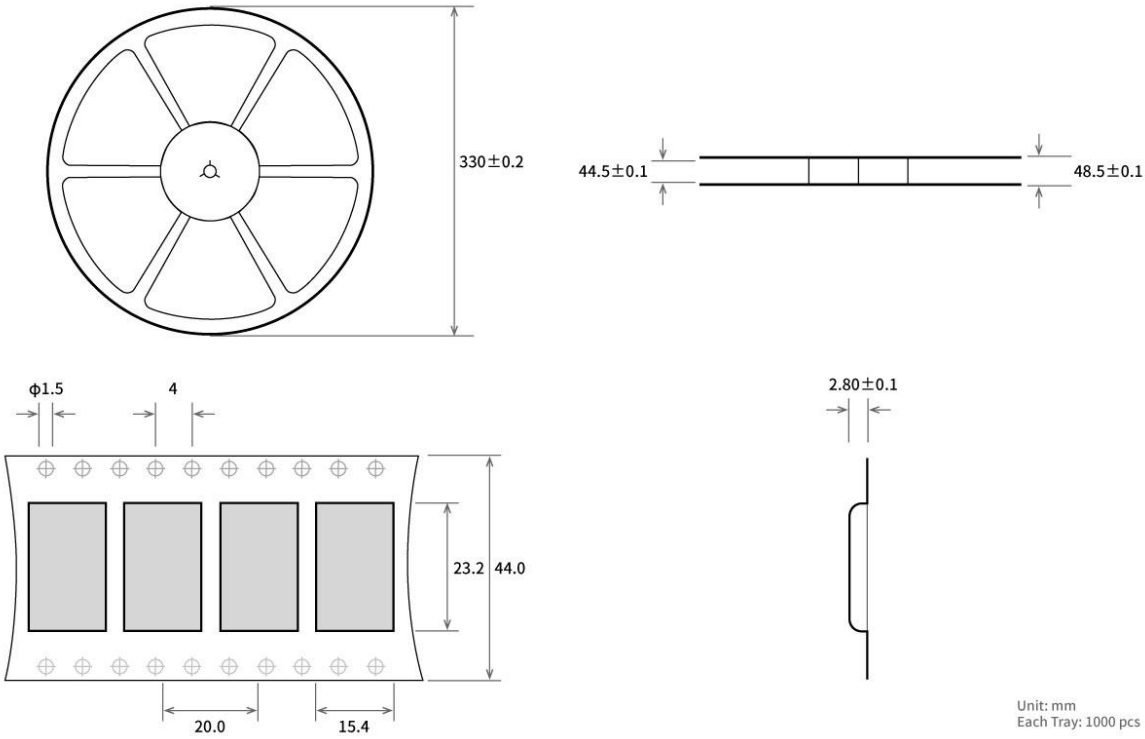
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								resource Secondary development
E73-2G4M04S1D	nRF51822	2.4G	4	I/O	4.2	17.5*28.7	PCB/IPX	Hardware resource Secondary development
E104-BT01	CC2541	2.4G	0	I/O	4.0	14*22	PCB	Hardware resource Secondary development
E104-BT02	DA14580	2.4G	0	TTL	4.2	14*22	PCB	Industry's lowest power consumption; High-speed continuous transmission; Sniffing
E72-2G4M04S2B	CC2640	2.4G	2	TTL	4.2	14*23	PCB/IPX	Built-in ARM dual core; multi-role mode
E104-2G4U04A	CC2540	2.4G	0	USB	4.0	18*59	PCB	Dongle protocol analyzer

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Revision history

Version	Date	Description	Issued by
1.0	2016-12-1	Initial version	huaa
1.1	2017-6-12	Content update	huaa
1.2	2018-8-4	Content update	Huaa
1.3	2019-1-26	Bug fixes	Ray
1.4	2019-7-5	Bug fixes	Blue
1.5	2022-5-30	Bug fixes	Yan
1.6	2022-09-07	Bug fixes	Bin
1.7	2023-02-09	Bug fixes	Bin
1.8	2023-08-08	Bug fixes	Bin
1.9	2023-09-14	Bug fixes	Bin
2.0	2024-12-23	Bug fixes	Bin

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