E104-BT11 User Manual

Ble mesh

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CONTENTS

1. Overview

1.1 Introduction

The E104-BT11 Bluetooth mesh ad hoc network module supports the sig mesh V1.0 standard, and the single network theory can accommodate up to 10,922 node devices. The device automatically memorizes the network information after connecting to the network. The mobile APP can proxy any node to access the network to realize the remote control of the mesh network. It can facilitate the realization of network broadcast or arbitrary fixed-point data transparent transmission. It is very suitable for the application of Internet of Things information collection, large-scale networking communication scenarios, smart home and other applications.

This manual applies to E104-BT11G-PC, E104-BT11N_PCB, E104-BT11N-IPX. The firmware functions are the same.

1.2 Feature

- Maximum transmitting power is +20dbm;
- Serial baud rate is dynamically configurable;
- Wireless channel 37、38、39;
- No network core center（gateway）;
- Memory networking information, automatically connected to the network after power on;
- Enter internet in 1 second once powered on;
- Access to internet via cellphone APP;
- Maximum node devices for networking are up to 10922;
- Custom serial data transparent transmission model available;
- Self-defined low power consumption（Not standard low power consumption）;
- Serial wake up;
- Configuration over air;
- Not compatible with BT10.

1.3 Application

- Smart home;
- Building automation;
- Light control;
- Wireless sensor network;

- Internet of Things

2 Specification and Parameter

2.1 Limit parameter

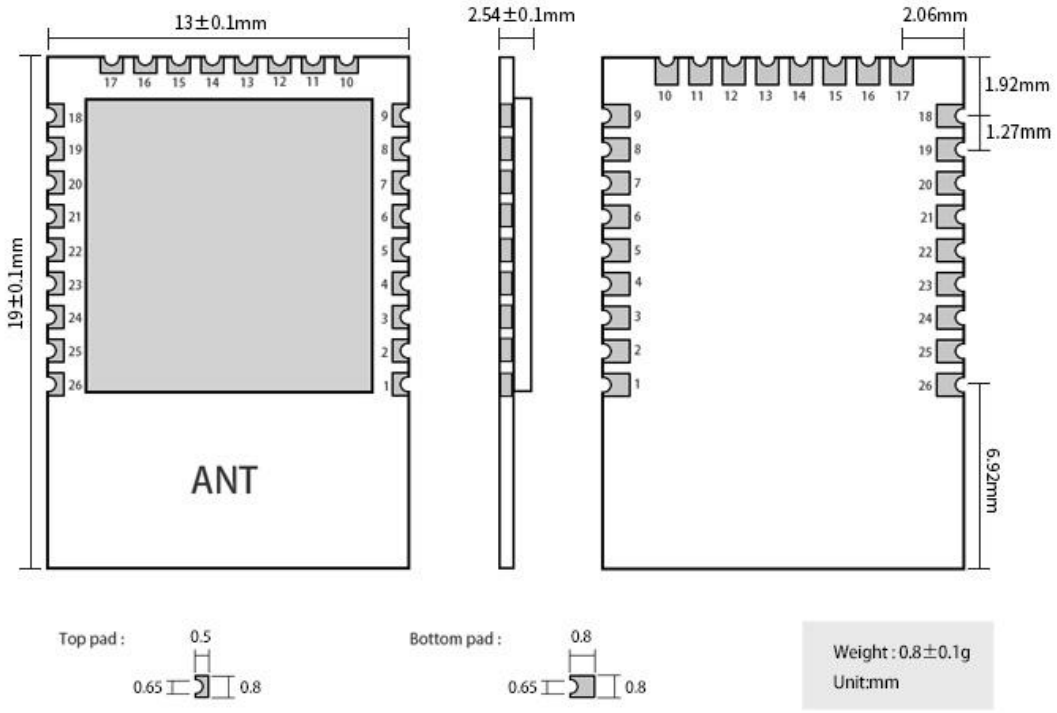
Main parameter	Performance		Remark
	Min	Max	
Power supply（V）	0	3.8	-
Blocking power（dBm）	-	10	Chance of is slim when modules are used in short distance
Operating temperature（℃）	-40	+85	Industrial grade

2.2 Operating parameter

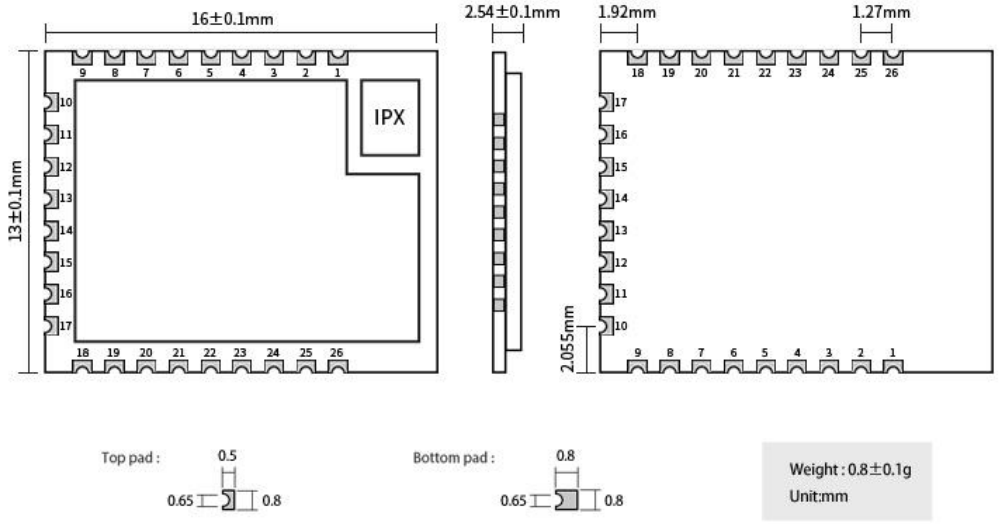
Main parameter		Performance			Remark
		Min	Typ	Max	
Operating voltage（V）		1.8	3.3	3.8	
Communication level （V）		-	3.3	-	5V TTL might burn module
Operating temperature （℃）		-40	-	+80	-
Operating frequency（MHz）		2400		2483.5	ISM band
Power consumption	Tx current（mA）	-	178mA	-	20dBm
	Rx current（mA）	-	10.8mA	-	-
	Sleep current（uA）	-	1uA	-	-
Max Tx power（dBm）		-	20	-	-
Rx sensitivity（dBm）		-88	-92	-97	Air data rate 1Mbps
Communication speed	GFSK（bps）	--	1M	--	-

Main parameter	Description	Remark
Reference distance	200m（PCB） 300m（IPX）	In open and clear air, test height 2.5m，air data rate 1Mbps
Modulation	GFSK	GFSK Mode
Package	SMD	-
Connector	1.27mm	-
Communication interface	UART	4800～230400bps
Size	19*13mm（PCB） 16*13mm（IPX）	-
RF connector	PCB/IPX	50Ω
Weight	0.8±0.1g（PCB） 0.8±0.1g（IPX）	-

3 Size and pin definition



E104-BT11G-PCB、E104-BT11N-PCB



E104-BT11G-IPX、E104-BT11N-IPX

Pin definition

No.	Function	Description
1	GND	Ground，connect to power reference ground
2	PWN	N/A
3	PWN	N/A
4	PA00	N/A
5	PA03	N/A
6	N.C	
7	N.C	
8	PA04	N/A
9	PA05	N/A
10	SWD	
11	SWC	
12	N.C	
13	NetLink	Network indicator, pin outputs high level after successfully networking
14	PD04	N/A
15	PWM	N/A
16	PD03	N/A
17	TXD	TX pin of UART，for UART receiving
18	RXD	RX pin of UART，for UART transmitting
19	VCC	Power supply 1.9～3.6V（It is recommended to add a ceramic filter capacitor externally）
20	GND	Ground，connect to power reference ground
21	PC02	N/A
22	PC03	Low-power role selection pin (internal pull-up): Low power consumption role: pull up or float; Other roles: Go directly to the ground.
23	PC04	Reset. Except for hardware information (UART configuration), all factory settings are restored.
24	Wakeup	The wake-up pin is valid in low level under low power mode.
25	RST	Chip reset trigger input pin, valid in low level
26	GND	Ground，connect to power reference ground

4 Basic operation

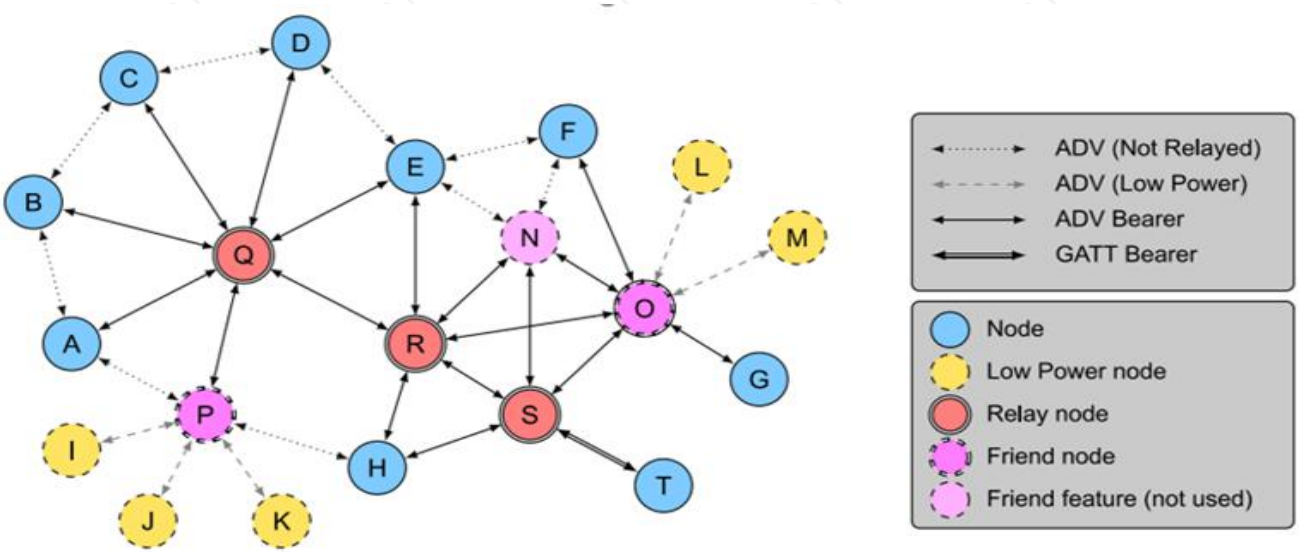
4.1 Hardware design

- It is recommended to use a DC stabilized power supply to supply power to the module. The power supply ripple coefficient 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, such as reverse connection may cause permanent damage to the module;
- Please check the power supply to ensure that it is between the recommended power supply voltage, if exceeding the maximum value will cause permanent damage to the module;
- Please check the power supply stability, the voltage cannot fluctuate significantly and frequently;
- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the margin, so that the whole machine is conducive to long-term stable work;
- The module should be as far away as possible from the parts with large electromagnetic interference such as power supplies, transformers, and high-frequency wiring;
- High-frequency digital traces, high-frequency analog traces, and power traces must be avoided under the module. If it is absolutely necessary to pass under the module, it is assumed that the module is soldered to the top layer, and copper is laid on the top layer of the module contact part (all copper And well grounded), must be close to the digital part of the module and the wiring is on the Bottom Layer;
- Assuming that the module is soldered or placed on the Top Layer, it is also wrong to randomly route on 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 of the module. It is recommended to stay away from the module according to the intensity of the interference. If the situation permits, proper isolation and shielding can be done;
- It is assumed that there are traces with high electromagnetic interference around the module (high-frequency digital, high-frequency analog, and power traces) that will greatly affect the performance of the module. It is recommended to stay away from the module according to the intensity of the interference. Isolation and shielding;
- As far as possible away from some physical layer is also 2.4GHz TTL protocol, for example: USB3.0;
- The module must not be installed inside the metal shell, which will greatly reduce the transmission distance.

5 Function introductions

5.1 Ble mesh

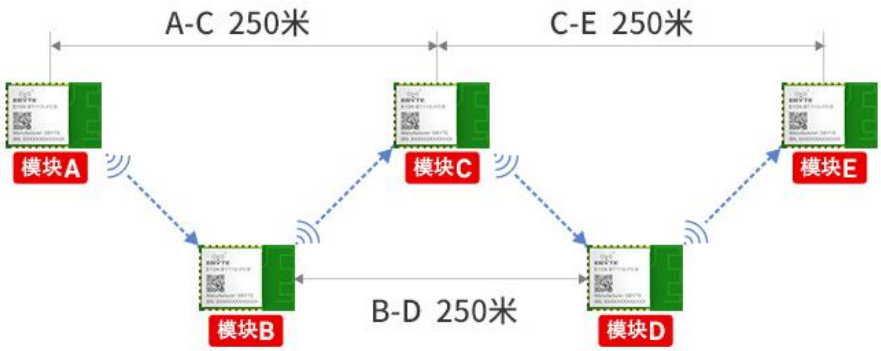
MESH network is as below：



The figure shows:

1. In addition to receiving its own data, the relay can also transfer data from other nodes. This feature can make the signal coverage of the network;

2. The operation of the low-power node must require the cooperation of the Fiend role.



Interpret the simulation application scenario above:

The distance from module A to module C is 250 meters, which exceeds the 200-meter transmission distance of our module, so module A cannot directly send data to module C. If a module B is placed between module A and module C, the data It will be relayed by B and then received by C.

Module A needs to send data to the entire network, and modules B, C, D, and E need to receive data from A. Then module A can send data at the broadcast address (0XFFFF).

If the A module needs to specify the data to be sent to the E module, you only need to fill in the address of the E module at the

address in the data format (see the instruction format for details), but the E module is 500 meters away from the A module, and the data cannot be directly communicated, but As long as these modules belong to the same network, the data will be transmitted to module E through the following link, A sends data to B, B then to C, C to D, D to E.

5.1.1 Basic knowledge

There are some items/noums in SIG mesh. This chapter introduces related items.

5.1.2 Network Keys（NetKey）

The key is used to protect network layer communication. It is a key generated using a random number generator that meets the core specifications（See more from Mesh Profile3.86）

5.1.3 Application Keys（AppKey）

The key is used to protect the upper transport layer. It is generated using a compatible random number generator, and the application key identifier (AID) is used to identify the application key（See more from Mesh Profile3.86）

5.1.4 Device roles

In SIG MESH protocol, there are node, low power node, relay node, friend node and proxy node.

Node：The edge nodes in the entire mesh network have the ability to receive and send data, but do not have the relay function

Low power node（LPN）： Due to the existence of the friend node, the low-power node does not need to send or monitor data packets on the broadcast channel all the time. It only needs to query whether the data on the friend node reaches.

Relay node： It is the core node of the network layer to extend the network coverage. After receiving the data packets sent by other nodes, it judges whether it needs to be forwarded according to the judgment conditions of the network protocol.

Friend node： low power node can connect to friend node. As proxy node of low power node， when lowpowernode data reached ， it can be buffered in Friendnode，to wait for low power node to check and obtain.

Proxy node： The proxy node can receive information through the bearer layer (broadcast bearer layer or GATT bearer layer), and resend the message through another broadcast bearer layer or GATT bearer layer. The non-mesh low-power Bluetooth device plays a key role in the process of becoming a member of the Bluetooth mesh network. The basic purpose of the proxy node is to perform bearer layer conversion. It enables the conversion from the broadcast bearer layer to the GATT bearer layer and vice versa. Therefore, devices that do not support the broadcast bearer layer can send and receive various Bluetooth mesh messages through the GATT connection.

Provision node： It is a special node and the initiator of the entire network. Also called gateway. It will join the non-networked devices to the mesh network. The Provision node provides provision data to unconfigured devices, including netkey, appkey, and the unicast address corresponding to each element of the device. After the network formation is completed, the provision node is removed without affecting the functions of other nodes.

5.1.5 Address（unicast）,element

One address corresponds to one element, as can be seen from the model introduction above, we have three elements, we can call it element address, it is the unique address assigned by the provision device to the node during the provision (networking) process In the same mesh network, each node device may have multiple addresses. However, a model in each device can only have one address, but different models can be bound to an address, in the subsequent mesh network communication process. The medium device is relying on this address to find other devices.

5.2 BT11 function

There are E104-BT11-G and E104-BT11-N.

E104-BT11-G(short as BT11-G), it is provisioner，BT11-G is the initiator of the entire network. It is unique in one network with features as follows：

- cannot communicate with nodes；
- Max configurable nodes is thirteen;
- The node role can be configured as normal, relay, proxy, low power consumption, friend role；

White list configuration is available；

Only for setting one NETKEY and one APPKEY;

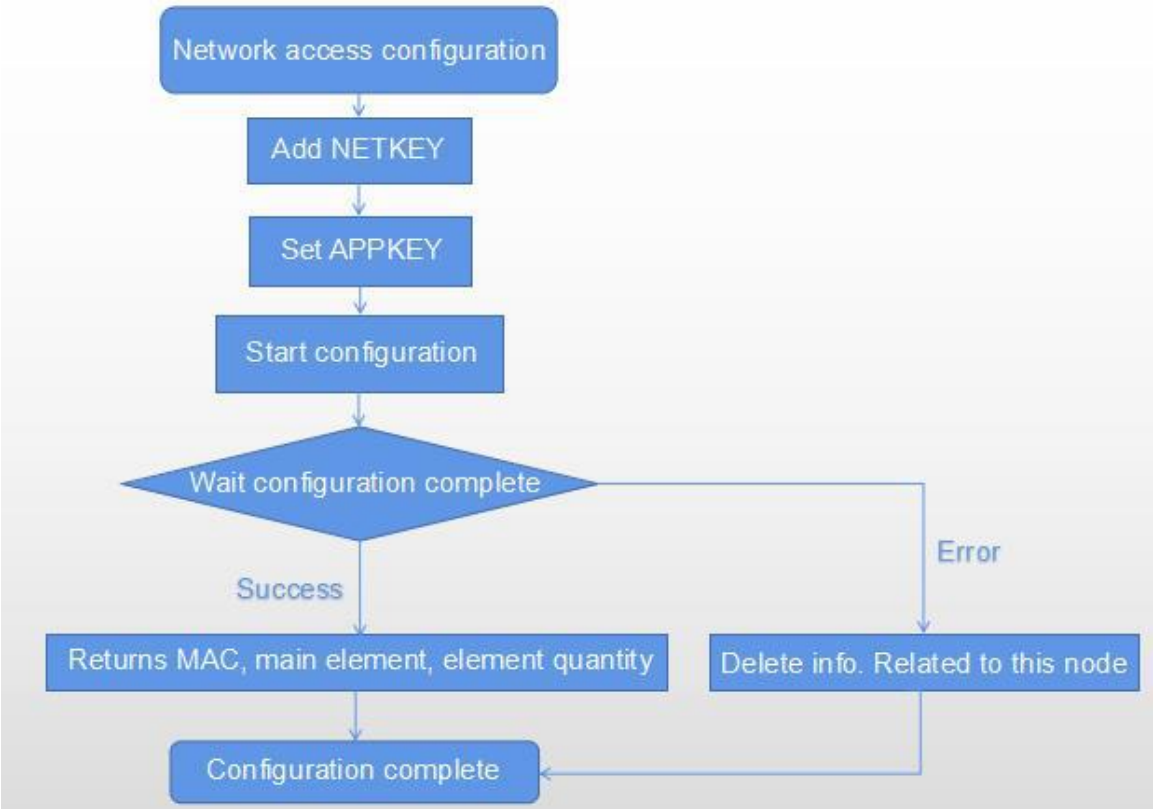
E104-BT11-N(short as BT11) it is node module，good for normal, relay, proxy, low power consumption, friend role with features as follows：

- Support all role configuration of ble mesh；
- Support format transmission, transparent transmission；
- Support air configuration；

5.2.1 Networking

Networking is to use BT11-G to add BT11-N to the BT11-G network. Therefore, at least two modules are required to implement mesh networking, one BT11-G and one BT11-N.

5.2.1.1 Networking process



Note：1. When setting NETKEY and APPKEY, you must first set NETKEY and then APPKEY;

2. If the node's MAC already exists, BT11 deletes the existing node first and then adds the current node.

5.2.1.2 Networking whitelist

Only BT11-G supports networking whitelist configuration.

If the whitelist has never been configured, BT11-G allows any ble mesh settings to be configured by default. Once the whitelist is configured, BT11-G allows only the nodes in the whitelist to be configured to the network.

5.2.1.3 Remove nodes

The command to delete a node can only be made by the BT11-G of the current network. The delete node instruction only deletes the local node information of BT11-G, and does not affect the corresponding node.

5.2.2 Over the air configuration

The so-called over-the-air configuration means that one node can configure related parameters of another node. BT11 can configure UART through the air, transparent transmission, and restart three functions. The UART hardware configuration needs to be restarted to take effect; transparent transmission takes effect immediately and is saved after power-off.

5.2.3 Data transmission

BT11 supports format transmission and transparent transmission. Transparent transmission needs to be configured using over-the-air configuration.

5.2.4 Sleep

Both BT11-G and BT11 support hibernation. Sleep here means that the module is not working anymore, and the working current is about 0.4uA. Users can wake up the module through the serial port RX pin, WakeUP pin, RST.

The module does not perform any operation during sleep.

5.2.5 Low power node

BT11 supports the low power consumption function of ble mesh standard. If users want to use low-power nodes, they need to

proceed as follows:

- There must be nodes in the role of Friend near the same network;
- The PC03 pin of BT11 is pulled up to VCC;
- When configuring the node to connect to the network (BT11-G or APP), enable LPN and prohibit relay and friend. The proxy function can be disabled according to user needs;

After completing the above three steps, you can use low-power nodes. Of course, users can also change LPN parameters according to their actual needs.

5.3 Agent access and APP configuration network access

BT11 supports the agent role. Users can connect to the agent node through the APP and communicate within the network. Regarding APP development, Ebyte provides Android and IOS platform SDKs, examples and Demo. The directory structure is as follows.

Due to the fact that the BT11-G module configuration node has a maximum of 13 network access data. It is strongly recommended that users can configure the network through the development of APP.

Ebyte's BT11 uses the manufacturer's custom model.

Element index		0
Manufacturer ID		0x0221
Module ID		0xC000
Operation code	Data channel	0xC5
	Air configuration channel	0xC6

Note:

- The operations that must be performed when developing APP configuration to access the network: binding APPKEY, publishing and subscribing to our company's modules. Otherwise, communication cannot be achieved.
- The data format of the data packet when publishing data through the proxy node is as follows, where if the target address is 0xffff, it is broadcast within the group:

Target address	Data
0x0001	……

5.4 Data format

All data exchanged by the serial port of the module, including parameter configuration, network control, and data transparent transmission, comply with the following format requirements. Any remaining data will be considered invalid and the module will not respond. The parameter configuration is used for the parameter configuration of the current module. The SIG message is a standard mesh control message defined by sig, and the transparent transmission message is a customized data transparent transmission message

of Ebyte.

Length （1 byte HEX）	Payload (N byte HEX)
N	Parameter configuration
	Transparent transmission

5.4.1 Parameter configuration

The configuration data is used to read and write various parameter information of the module and the network access operation of the device. The format is as follows

	Instruction（1 byte）	Operation code（1 byte）	Data（N byte）
TX	0xC0	0~255	request data
RX	0x40	0~255	response data

Note: The correct configuration operation will get the corresponding response data. If the configuration is incorrect, the error code will be returned as follows

Error code	Description
0xFF	Invalid parameter
0xFE	Operation busy
0xFD	Invalid command
0xFC	No network equipment
0xFB	Failed to get parameters
0xFA	Failed to assign netkey
0xF9	Binding Appkey timeout
0xF8	Failed to bind Appkey
0XF7	The last networking is not over
0x01	No network created (no NETKEY)
0x02	No group created (no APPKEY)
0x03	This operation cannot be performed in the current state
0x04	PB-ADV configuration error
0x05	PB-GATT configuration error
0x06	Startup configuration error
0x07	
0x08	
0x09	
0x0a	
0x0b	
0x0c	

5.4.1.1 NetKey configuration

Network key for the network ID assigned by the provisioner in the process, in the following format.

	Operation code	Parameter
Request	0x00	Configure 16 byte of NetKey data
Response	0x00	Return 16 byte of configured NetKey data
For example,	Request	12 C0 00 11223344556677889900112233445566
	Response	12 40 00 11223344556677889900112233445566
Remark	1. This directive only applies to BT11-G; 2. The instruction does not support repeated settings; 3. Effective immediately, save after power off.	

5.4.1.2 Read NetKey

	Operation code	Parameter
Request	0x01	N/A
Response	0x01	Return 16 byte of configured NetKey data
For example,	Request	02 C0 01
	Response	12 40 01 11223344556677889900112233445566
Remark	1. This command reads the NetKey that has been set; 2. This instruction is only for BT11-G.	

5.4.1.3 AppKey configuration

	Operation code	Parameter
Request	0x02	Configure 16 byte of AppKey data
Response	0x02	Return 16 byte of configured AppKey data
For example,	Request	12 C0 02 11223344556677889900112233445566
	Response	12 40 02 11223344556677889900112233445566
Remark	1. This directive only applies to BT11-G; 2. This command can only be used after adding Netkey, and only supports configuring one APPkey.	

5.4.1.4 AppKey read

	Operation code	Parameter
Request	0x03	Configure 16 byte of AppKey data
Response	0x03	Return 16 byte of configured AppKey data
For example,	Request	02 C0 03
	Response	12 40 03 11223344556677889900112233445566
Remark	1. This directive is only applicable to BT11-G; 2. This command reads the AppKey that has been set.	

5.4.1.5 Network whitelist configuration

	Operation code	Parameter
Request	0x06	MAC address
Response	0x06	<quantity><MAC1><…>
For example,	Request	08 C0 06 112233445566
	Response	0F 40 06 02 112233445566 aabbccddeeff
Remark	1. This directive only applies to BT11-G; 2. The same MAC is added repeatedly, no error will be returned, and no new entries will be added. 3. Return to the opened serial number and added MAC. 4. Effective immediately, save after power off.	

5.4.1.6 Network whitelist deletion

	Operation code	Parameter
Request	0x07	Mac address
Response	0x07	<quantity><MAC1><…>
For example,	Request	08 C0 07 112233445566
	Response	09 40 07 01 aabbccddeeff
Remark	1. This directive only applies to BT11-G; 2. Deleting a non-existent MAC address will not cause an error; 3. Return all remaining MAC addresses; 4. Effective immediately, save after power off.	

5.4.1.7 Network whitelist read

	Operation code	Parameter
Request	0x08	N/A
Response	0x08	<quantity><MAC1><…>
For example,	Request	02 C0 08
	Response	0F 40 08 02 112233445566 aabbccddeeff
Remark	1. This directive only applies to BT11-G; 2. Return to the opened serial number and MAC.	

5.4.1.8 Device network access

There are two ways to use the device network access instruction. The method with parameters is used to specify the enabling of the node function, and the method with N/A parameters is disabled by default.

	Operation code	Parameter (1 Byte)						
Request	0x09	With parameter	bit	7 ～ 4	3	2	1	0
			0：disable;1：enable	reserved	LPN（low power）	Relay	Proxy	Friend
		No parameter						
Response	0x09	MAC address		Network address		Element quantity		
		11 22 33 44 55		00 04		03		
For example,	With parameter request（enable friend, proxy, relay）	03 C0 09 03						
	No parameter requests（all disable）	02 c0 09						
	response	0B 40 09 11 22 33 44 55 66 00 04 03						
Remark	1. This directive only applies to BT11-G; 2. LPN roles cannot be relayed and Friend coexists. Once set to LPN, the relay and Friend roles are automatically disabled.							

5.4.1.9 Delete node

	Operation code	Parameter (2 Byte)
Request	0x0A	The address of the node to be deleted
Response	0x0A	The address of the node to be deleted
For example,	Request	04 C0 0A 00 01
	Response	04 40 0A 00 01
Remark	1. This instruction is only applicable to BT11-G; 2. This instruction only deletes the local data of BT11-G, it will not affect the node at this address;	

5.4.1.10 Get node network address

	Operation code	Parameter	
Request	0x0B	N/A	
Response	0x0B	Prov	addr
		0, no network configuration; 1 has configured	the main element address
For example,	Request	02 C0 0B	
	Response	05 40 0B 00 00 04	
Remark	1. This instruction is only applicable to E104-BT11 configuration operation; 2. The unicast address of the main element of the E104-BT11 device in the current network is returned;		

5.4.1.11 Baud rate configuration

	Operation code	Parameter (1 Byte)	
Request	0x0E	Baud rate number description	Baud rate
		0	300
		1	600
		2	1200
		3	2400
		4	4800
		5	9600
		6	14400
		7	19200
		8	38400
		9	43000
		A	57600
		B	76800
		C	115200
Response	0x0E	Returns the current baud rate serial number	
For example,	Request	03 C0 0E 0C	
	Response	03 40 0E 0C	
Remark	1. Restart takes effect, save after power off 2. The baud rate configuration parameters in the air configuration are consistent with the command parameters;		

5.4.1.12 Baud rate read

	Operation code	Parameter
Request	0x0F	N/A
Response	0x0F	Returns the serial number of the set baud rate (see definition in baud rate setting)
For example,	Request	02 C0 0F
	Response	03 40 0F 0C
Remark		

5.4.1.13 MAC read

	Operation code	Parameter
Request	0x11	N/A
Response	0x11	Returns current MAC address
For example,	Request	02 C0 11
	Response	08 40 11 11 22 33 44 55 66
Remark		

5.4.1.14 Power configuration

	Operation code	Parameter (1 byte)
Request	0x12	Power parameter
Response	0x12	Power parameter
For example,	Request	04 C0 12 00 11
	Response	04 40 12 00 10
Remark	1. The step value of the power parameter is 0.2. For example, 10 is 1.0dbm, 55 is 5.5dbm; 2. The module response is different from the request parameter, and the actual return shall prevail. 3. During power setting, ble may be disconnected, which is normal. 4. Effective immediately, save after power off.	

5.4.1.15 Power read

	Operation code	Parameter
Request	0x13	N/A
Response	0x13	Returns current power
For example,	Request	02 C0 13
	Response	03 40 13 10
Remark	The step value of the power parameter is 0.2. For example, 10 is 1.0dbm, 55 is 5.5dbm;	

5.4.1.16 Restart the device

	Operation code	Parameter
Request	0x14	N/A
Response	0x14	Returns the operating state value
For example,	Request	02 C0 14
	Response	03 43 14 00
Remark	Restarting the device requires at least 1S to complete.	

5.4.1.17 Restore Factory

	Operation code	Parameter
Request	0x15	N/A
Response	0x15	N/A
For example,	Request	02 C0 15
	Response	03 43 15 00
Remark	1. Restore factory to clear all parameters; 2. Restore the factory module and restart after 1S.	

5.4.1.18 Get the software version number

	Operation code	Parameter	
Request	0x16	N/A	
Response	0x16	High version（1byte）	Low version（1byte）
		01	00
For example,	Request	02 C0 16	
	Response	04 40 16 01 00	
Remark			

5.4.1.19 Sleep configuration

This function is used to set how many seconds the UART does not receive and then enters sleep mode.

	Operation code	Parameter (1 byte)
Request	0x17	time（s）
Response	0x17	time（s）
For example,	Request	03 C0 17 05
	Response	03 40 17 05
Remark	1. Parameter unit S, range 0X01-0XFF, parameter 00 means do not enter sleep;	

	2. Effective immediately, save after power off.

5.4.1.20 Sleep Inquiry

	Operation code	Parameter
Request	0x18	N/A
Response	0x18	E104-BT10-N whether to enter sleep and to enter sleep overtime
For example,	Request	02 C0 18
	Response	03 40 18 05
Remark		

5.4.1.21 UART data bit configuration

	Operation code	Parameter (1 byte)	
Request	0x19	0	Unavailable
		1	Unavailable
		2	Unavailable
		3	Unavailable
		4	8 data bits
		5	9 data bits
Response	0x19	Same as request	
For example,	Request	03 C0 19 04	
	Response	03 40 19 04	
Remark	1. Set unsupported data, the module responds to an error message 2. Restart takes effect, save after power off		

5.4.1.22 UART data bit acquisition

	Operation code	Parameter (1 byte)
Request	0x1A	N/A
Response	0x1A	Same as request
For example,	Request	02 C0 1A
	Response	03 40 1A 04
Remark		

5.4.1.23 UART stop bit configuration

	Operation	Parameter (1 byte)

	code		
Request	0x1B	0	0.5 stop bit
		1	1 stop bit
		2	1.5 stop bit
		3	2 stop bit
Response	0x1B	Same as request	
For example,	Request	03 C0 1B 01	
	Response	03 40 1B 01	
Remark	Restart takes effect, save after power off		

5.4.1.24 UART stop bit acquisition

	Operation code	Parameter (1 byte)
Request	0x1C	N/A
Response	0x1C	Same as request
For example,	Request	02 C0 1C
	Response	03 40 1C 01
Remark		

5.4.1.25 Parity digit configuration

	Operation code	Parameter (1 byte)	
Request	0x1D	0	None parity
		1	Even
		2	Odd
Response	0x1D	Same as request	
For example,	Request	03 C0 1D 00	
	Response	03 40 1D 00	
Remark	Restart takes effect, save after power off		

5.4.1.26 Parity digit acquisition

	Operation code	Parameter
Request	0x1E	N/A
Response	0x1E	Same as parity digit setting parameter
For example,	Request	02 C0 1E
	Response	03 40 1E 00
Remark		

5.4.1.27 Low-power node configuration

	Operation code	Parameter		
Request	0x0C	enable（1bytes）	Queue length in Friend role (1bytes)	Time gap for pooling Frendi node (4 bytes)
		01	4	32
Response	0x0C	Same as request		
For example,	Request	08 C0 0C 01 05 00 00 0F A0		
	Response	08 40 0C 01 05 00 00 0F A0		
Remark	1. This directive only applies to BT11 2. Queue length support range: 2~128, and the number of queues is even; the default is 2 queues 3. The unit of time gap is ms, and the supported range is: 1s ~ 95h59min900ms; default 4000ms 4. Take effect next time, save after power off			

5.4.1.28 Low-power node acquisition

	Operation code	Parameter
Request	0x20	N/A
Response	0x20	See low-power node setting parameters
For example,	Request	02 C0 20
	Response	08 40 20 01 05 00 00 0F A0
Remark	This directive only applies to BT11	

5.4.2 Format transmission

- BT11 supports user data format transmission,
- The maximum length of serial port sub-packet is 241 bytes.
- Ble mesh does not support continuous data transmission, and a certain gap time is required between each two data. The data format is as follows:
- BT11 supports fixed-point transmission and broadcast transmission. The broadcast transmission address within the group is 0xFFFF.
- BT11-G does not support data transmission function.

TX			
Operation code（1 byte）	Target address（2 byte）	Data	
0xC2	00 01	Valid data	
RX			
command（1 byte）	My address（2 byte）	Original address（2 byte）	Data
0x42	00 01	00 04	Valid data

5.4.2.1 Fixed-point transmission example

Module 0x0003 sends "30313233343536373839" hex data to module 0x0001

Tx end	**0D C2 00 03 30 31 32 33 34 35 36 37 38 39**
Rx end	0F 42 00 01 00 03 30 31 32 33 34 35 36 37 38 39

5.4.2.2 Broadcast example

The device 0x0003 broadcasts the data "30313233343536373839". Other modules in the network receive broadcasts. Take module 0x0001 and module 0x0005 as examples.

Tx end	**0D C2 ff ff 30 31 32 33 34 35 36 37 38 39**
0x0001 Rx end	0F 42 00 03 FF FF 30 31 32 33 34 35 36 37 38 39
0x0005 Rx end	0F 42 00 03 FF FF 30 31 32 33 34 35 36 37 38 39

5.4.3 Configuration over air

Command（1 byte）	**Target address (2 byte)**	**Configure parameter**												
		Transparent transmission target address（2 byte）	Baud rate（1 byte）	1 byte							1 byte			
				Reserved	parity bit		Data bit			Stop bit	Reserved	Restart	Transparent transmission enables	
				7	6	5	4	3	2	1	0	7~2	1	0
0xC3	00 01	00 02	0C	0	0		4			1		0	1	1
For example,	Request	07 C3 00 01 00 03 0C 11 03												
	Response	0A 42 00 01 00 03 13 00 0C 11 01												
Remark	1. Check digit parameters are consistent with 3.1.25 check digit setting configuration parameters; 2. The data bit parameters are consistent with the 3.1.21 setting uart data bit configuration parameters; 3. The stop bit parameters are consistent with 3.1.23 setting uart stop bit configuration parameters; 4. The baud rate parameter is consistent with the 3.1.11 baud rate setting configuration parameter 5. The restart function is to restart after configuration. 1 means restart, 0 means no restart. 6. Transparent transmission enable indicates that transparent transmission is enabled and prohibited. 1 is enabled, 0 is disabled. 7. Any node can initiate air configuration. 8. Among them, the UART configuration restart takes effect and is saved after power-off; 9. Restart and transparent transmission enable will take effect immediately, save after power off.													

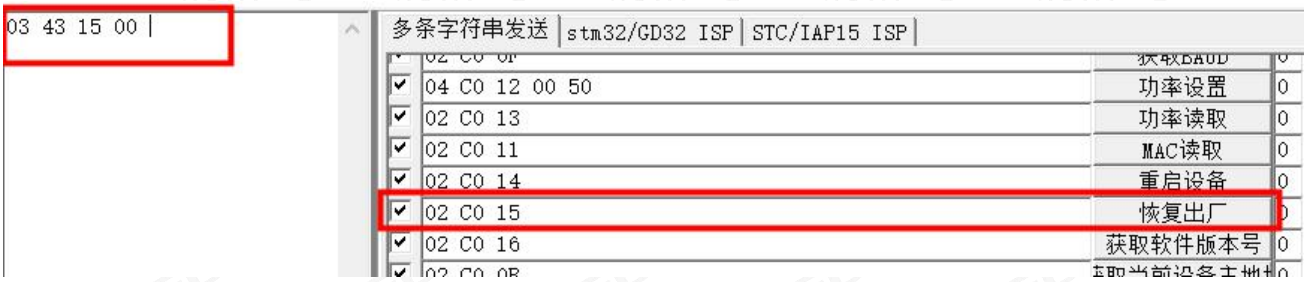
Note:

After configured for transparent transmission, uart will no longer receive configuration parameters. If you need to set the module through uart, you need to cancel the transparent transmission enable through the air configuration, or use the restart pin to restart the parameters.

6 Quick Start

6.1 Factory reset

Send the following command 02 C0 15 (restore the factory) and then you will receive a return, 03 43 15 00 00, E104-BT11-G and E104-BT11-N command format is consistent.

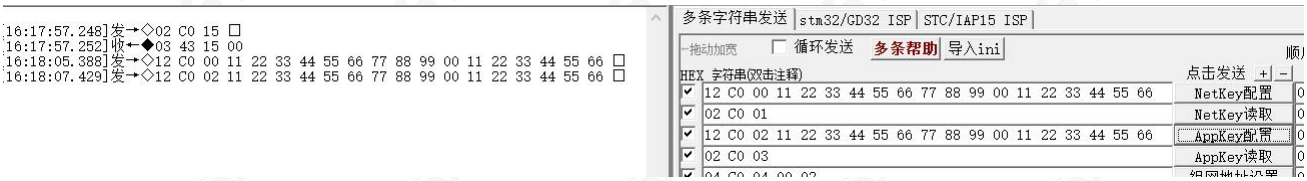


6.2 Access to network

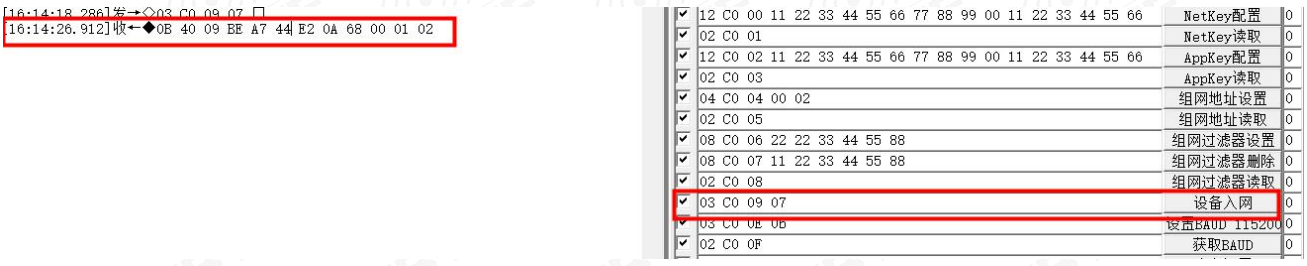
E104-BT11-G test board and E104-BT11-N are plugged into the computer USB interface respectively (PC needs to install USB to serial drive, see the data compression package for details), open the serial debugging assistant and select the baud rate 115200bps, 8 data bits, no school Check, 1 stop bit.

STEP 1. Set NETKEY first, then

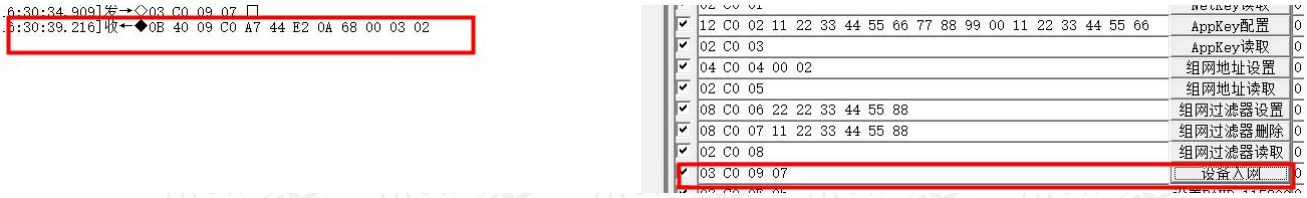
APPKEY;



STEP 1. Send the device network connection instruction to configure the node network connection. After the configuration is successful, the following data is returned, which indicates that the MAC address is: 09 BE A7 44 E2 0A 68, the network address is: 0x0001, the number of elements is: 2



STEP 2. Repeat STEP2, continue to configure module



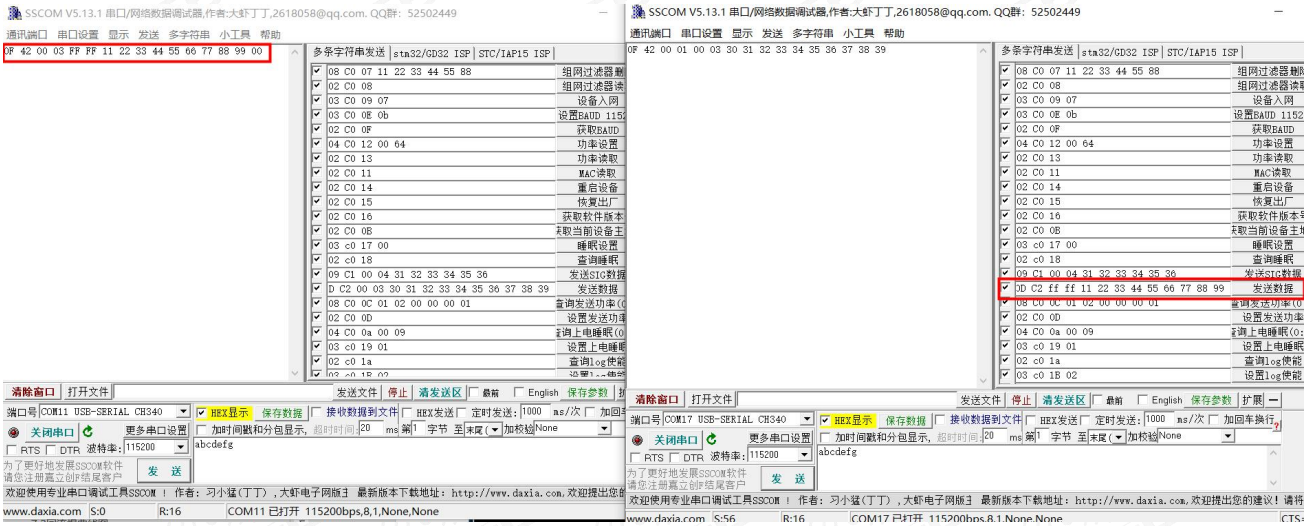
STEP 3. Enter network configuration

6.3 Transparent transmission

6.3.1 Broadcast data transmission

Device 0003 broadcasts hexadecimal data of "11 22 33 44 55 66 77 88 99

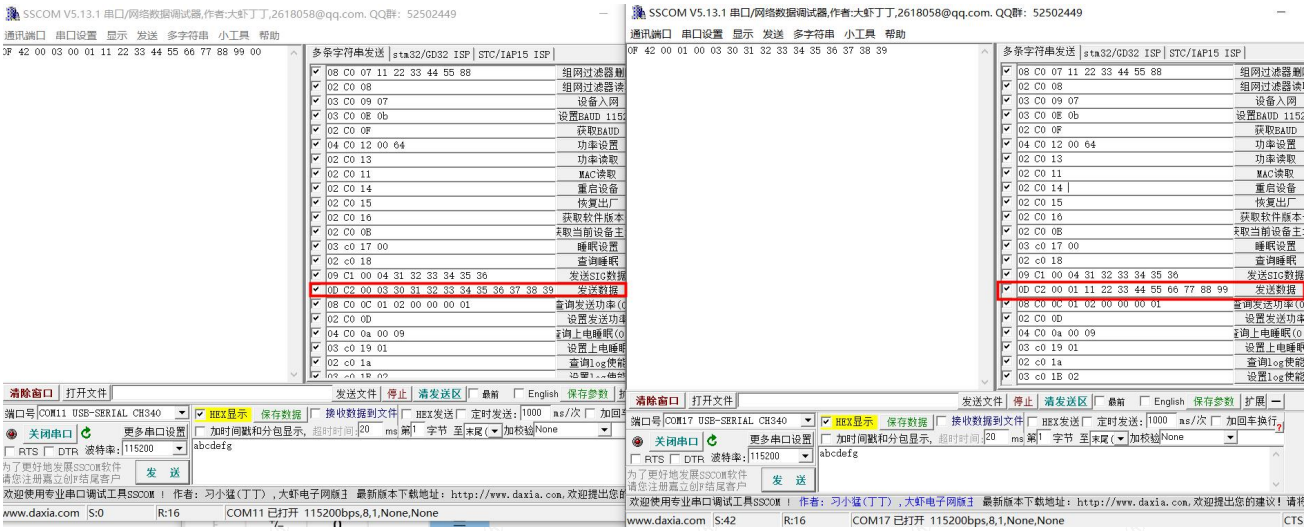
00"



6.3.2 Fixed-point data transmission

Example: Device 0001 sends "30 31 32 33 34 35 36 37 38 39" hexadecimal data to device 0003;

Device 0003 sends "11 22 33 44 55 66 77 88 99 00" hexadecimal data to device 0001;



7 FAQ

7.1 Communication distance 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 higher the air data rate, the shorter the distance);
- 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.

7.2 Module is easy to damage

- Please check the power supply source, ensure it is between the recommended supply voltage, voltage higher than the maximum will damage the module.
- Please check the stability of power source, the voltage cannot fluctuate too much;
- Please make sure antistatic measure are taken when installing and using, high frequency devices have electrostatic susceptibility;
- Please ensure the humidity is within limited range, some parts are sensitive to humidity;
- Please avoid using modules under too high or too low temperature.

7.3 BER(Bit Error Rate) is high

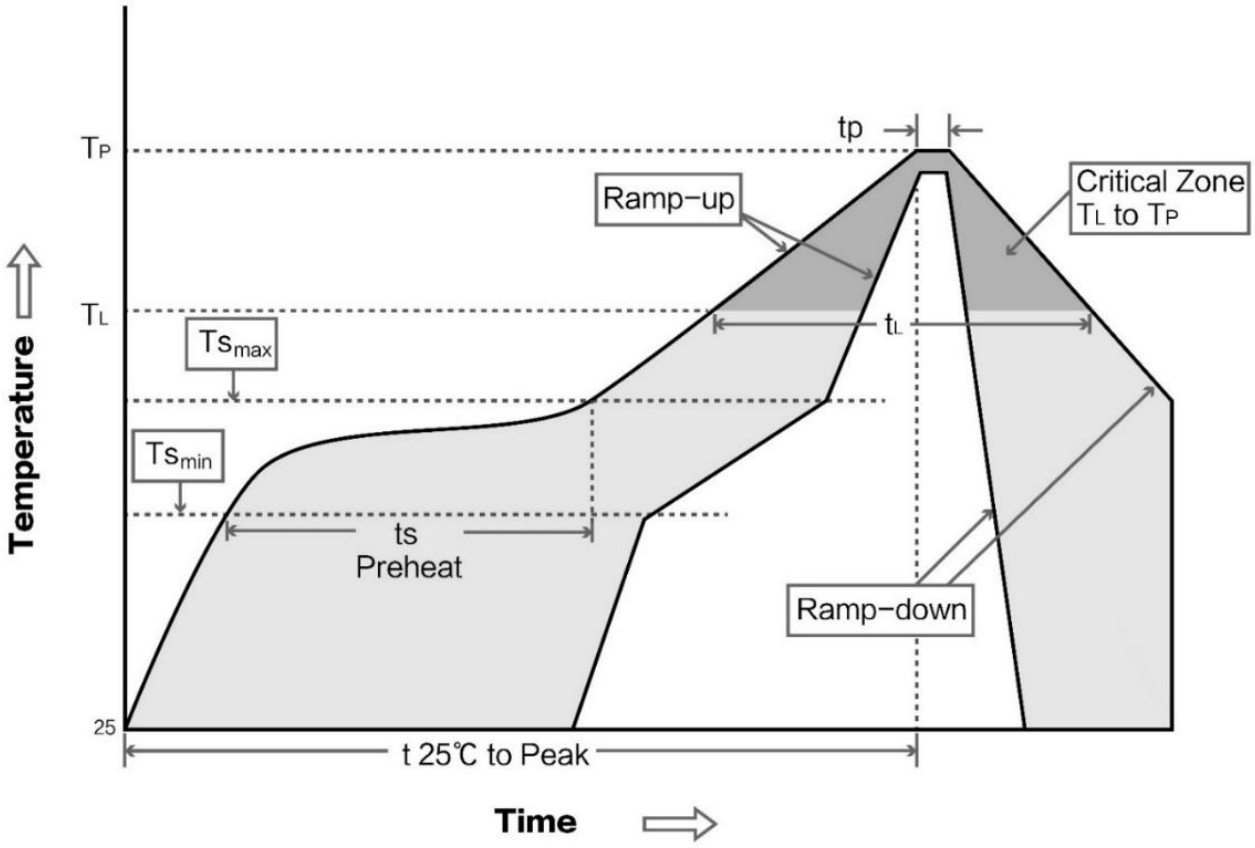
- There are co-channel signal interference nearby, please be away from interference sources or modify frequency and channel to avoid interference;
- Poor power supply may cause messy code. Make sure that the power supply is reliable;
- The extension line and feeder quality are poor or too long, so the bit error rate is high.

8 Welding instruction

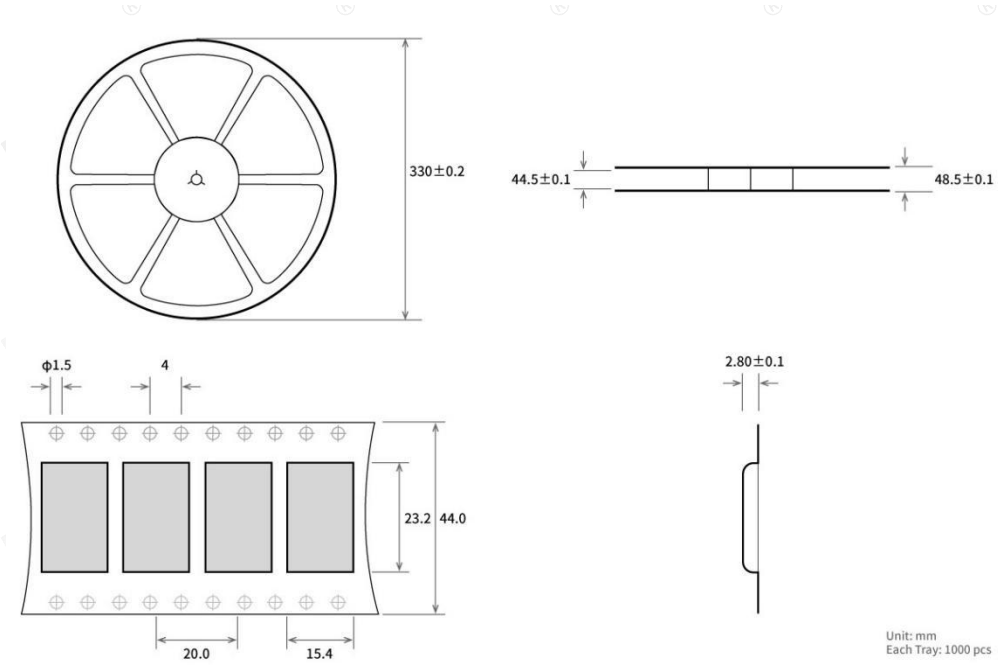
8.1 Reflow soldering temperature

Profile Feature	Curve characteristics	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℃
Aveage 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

8.2 Reflow soldering curve



9 Package



Revision history

Version	Date	Description	Issued by
1.0	2020-06-02	Initial version	Xxx
1.1	2020-10-21		REN

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