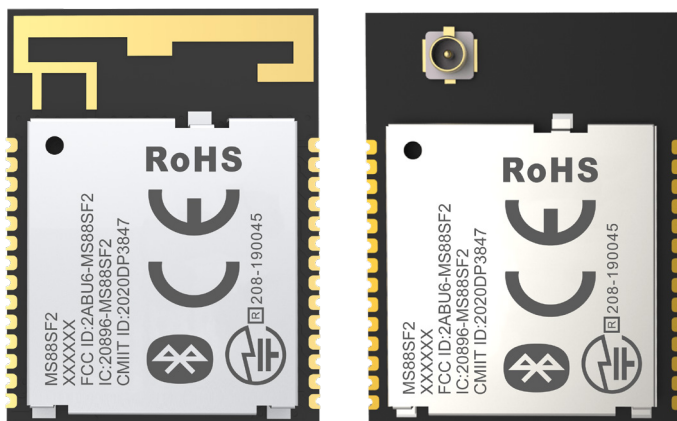


Bluetooth LE Module

MS88SF2



Datasheet
V 1.0.0



Version Note

Version	Details	Contributor(s)	Date	Notes
1.0.0	First edit	Michelle	2024.05.09	

Part Numbers

Model	Hardware Code
MS88SF21	1Y40AI
MS88SF23	3Y40AI

Click the icon to view and download the latest product documents electronically.
https://en.minewsemi.com/file/MS88SF2-nRF52840_Datasheet_M_EN.pdf



MS88SF2-nRF52840

Support BLE master-slave mode switching, serial port command configuration, Bluetooth transmitting master-slave module

The MS88SF2 is a master-slave module that can be switched into master/slave mode by command, master and slave cannot work at the same time and only one-to-one connection is possible. The device defaults to master mode. In master mode, the device can be scanned and connected through commands. The device communicates with the MCU through the UART interface. In command mode, commands can be sent through the UART to modify the scanning interval, scanning timeout, connection interval, broadcasting interval, broadcasting customized data, and baud rate.

FEATURES



Supports master-slave switching



One-to-one connection



Transmission rates as fast as 11kB/S



Support serial command configuration



Transmission distance up to 600 meters in open space



Support iBeacon broadcast mode

KEY PARAMETER

MS88SF2-nRF52840			
Chip Model	Nordic nRF52840	Antenna	PCB/IPEX
Module Size	23.2×17.4×2mm	GPIO	20
Flash	1M	RAM	256KB
Receiving Sensitivity	-95dBm(1Mbps)	Transmission Power	-40~ +8dBm
Current(TX)	0dBm-4.8mA	Current(RX)	4.6mA
Firmware	Master-Slave UART firmware		

APPLICATION



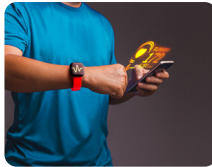
Smart Home



Consumer Electronics



Intelligent Medical care



Smart Wearable Devices



Security Equipment



Automotive Equipment

CERTIFICATION

 Bluetooth®





REACH

RoHS

IC

SRRC

TELEC

WPC

RCM

EN50498



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1 ELECTRICAL SPECIFICATION

Parameters	Value	Notes
Working Voltage	1.7V-5.5V	To ensure RF work, supply voltage suggest not lower than 2.3V
Working Temperature	-40℃~+85℃	Storage temperature is -40℃~+125℃
Transmission Power	-40 ~ +8dBm	Configurable
Current(RX)	4.6mA	RF reception current in 1Mbps mode
Current(TX)	4.8mA	RF emission current in 0dBm mode
Module Dimension	23.2*17.4*2mm	
Quantity of IO Port	20	

2 CURRENT CONSUMPTION CHARACTERISTICS

The following power consumption tests were conducted with a supply voltage of 3.3V and at room temperature. The power consumption is not the same in master mode and slave mode.

In slave mode, the power consumption is as follows: (broadcast interval is 1s, maximum and minimum connection interval is 20-40ms, and transmit power is 0dBm).

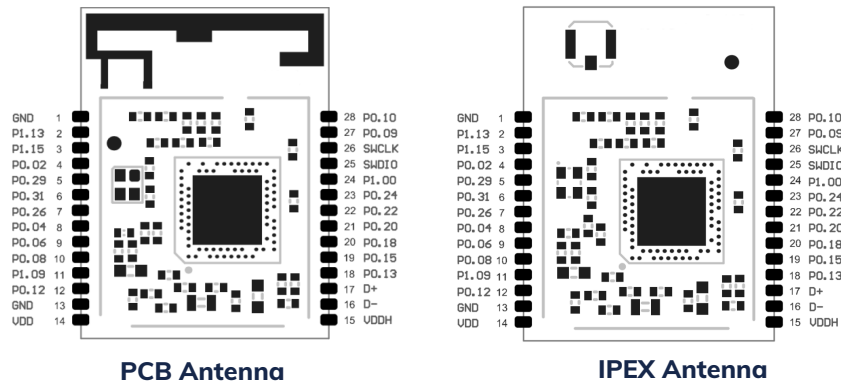
Status	Consumption	Airspeed _(bps)	Peak(mA)	Avg(mA)
Average current in sleep state (SLP pulled high, BTDATA pulled low)		/	2.11	0.00027
		1M	6.69	0.0148
		125k	6.64	0.0561
Average current in broadcast state (SLP pin is connected to GND, BTDATA is pulled high)		1M and 125k switching	6.31	0.0587
Transparent transmission average current (SLP, BTDATA pins are connected to GND, connected to mobile phones)		1M	6.82	0.738
		125k	7.18	1.08

In host mode, the power consumption is as follows: (Maximum minimum connection interval of 20-40ms, transmit power 0dBm)

Status	Consumption	Airspeed _(bps)	Peak(mA)	Avg(mA)
Average current in sleep state (SLP pulled high, BTDATA pulled low)		/	0.6085	0.0013
Transparent transmission average current (SLP, BTDATA pins are connected to GND, connected to mobile phones)		1M	7.18	1.18
		125k	7.16	1.06



3 PIN DESCRIPTION



4 PIN DEFINITION

Pin Number	Symbol	Type	Definition	Note
1	GND	GND	Ground	
2~7	P1.13 to P0.26		GPIO	Not used in UART, floating
8	P0.04	BTX	UART TX	TX of Bluetooth Module
9	P0.06	BRX	UART RX	RX of Bluetooth Module
10-12	P0.08 to P0.12		GPIO	Not used in UART, floating
13	GND	GND	Ground	
14	VDD	Power	Power Supply	3.3V power supply interface, need to be connected with VDDH
15	VDDH	Power	Voltage Positive	For 5V power supply, connect this pin only. For 3.3V supply, connect with VDD.
16	D-		USB interface	The firmware does not enable USB function
17	D+		USB interface	The firmware does not enable USB function
18	P0.13	SLP	Sleep/Awake	Low level to wake-up, high level to sleep, no floating
19	P0.15	BTDATA	Serial port control	Serial port on / off to control pin, no floating 0: serial port open, can send and receive serial port data 1: Serial port off
20	P0.18	CON_IND	Connection indication	Sleep state: low level Broadcast status: Low level Connection status: High level
21	P0.20	FIFO_FULL	Transmission space full	Determine if the transmission space is available when it is full 0: Bluetooth module has available space for transmission 1: Host stops transmitting and waits for free space to be released



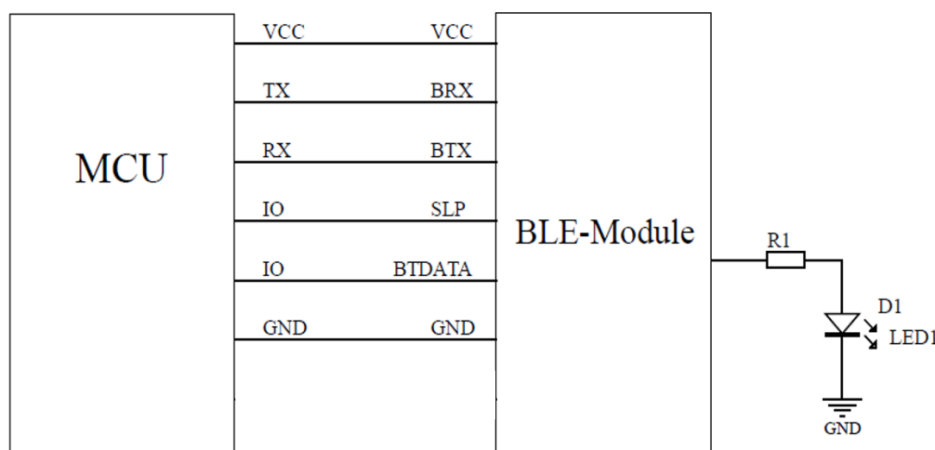
Pin Number	Symbol	Type	Definition	Note
22-24	P0.22 to p1.00		GPIO	Not used in UART, floating
25	SWDIO		Burn data pins	For burning firmware
26	SWCLK		Burn-in Clock Pins	For burning firmware
27-28	P0.09 to P0.10		GPIO	Not used in UART, floating

5 MODULE OPERATION INSTRUCTION

5.1 Tool

PC serial port assistant: Baidu "Friendly Serial Port Assistant" can be downloaded. The PC serial port assistant is used to debug the UART interface of the module. Demonstration of module application

5.2 Demonstration of module application



5.2.1 Power supply

The SoC working voltage is 1.7V-3.6V, to ensure a stable function, supply voltage should be 3.0V-3.6V.

5.2.2 SLP(Sleep/Awake)

When pull SLP low, the module in broadcast mode. BLE device can be found by smartphone APP, Device name: Minew_Vxxxxx(default) name, module can be connected with smartphone and enters connection mode. When pull SLP high, device will enter sleep mode.



Note: This pin cannot be left floating to avoid unpredictable errors.



5.2.3 BTDATA(UART control)

Only when BTDATA in low level,UART will be available. Both SLP and BTDATA in low level,when module in broadcast mode,all UART commands will be effective.When module in connection mode,all command or data will be transparently transferred.



Note: This pin cannot be left floating to avoid unpredictable errors.

5.2.4 UART interface:TX and RX

When both SLP and BTDATA in low level,UART port will be activated,the module TX and RX should be connected to MCU RX and TX,then start to communicate through UART.

In the test,module TX and RX can be connected with an UART to USB module's RX and TX pin, then send command through Serial Port Utility App from PC.



Note: The TX and RX of 2 modules can be connected reversed, each module connect with a smart phone, then transfer data over BLE between each smart phone.

5.2.5 CON_IND

CON_IND is used to indicate module status,high level in connection mode, low level in sleep or broadcast mode to wake up MCU and save power.

5.2.6 FIFO_FULL

FIFO_FULL is used to indicate whether the cache is full or not. When sending large amount of data from MCU to module, this pin can be added to judge. If it is high, then the FIFO is full, and you can not continue to send UART data at this time to avoid packet loss.

5.2.7 Command instruction

Connect VCC、GND to power and GND,SLP、BTDATA to GND,module in broadcast mode(not connect with other device),UART interface activated,send command to configure or check parameter.

For all device instructions, the returning result is the same:

54544D3A4F4B0D0A00(TTM:OK\r\n0) is returned after command sent successfully

54544D3A4552500D0A00 (TTM:ERP\r\n0) is returned after command failed

After sending the correct setting command, the new parameters will take effect immediately(Expect that baud rate change command will only be effective after reset command sent successfully). While only after sending reset command then the command will be kept in flash and automatically effective after power off.

Below is the list of setup instructions:



Note: The first line in the command list should be sent by Hex format, the second line should be sent by ASCII format. When checking the parameter, the returned result are all hexadecimal numbers, so you need to use hexadecimal numbers to parse the command.phone.

The BLE device has scanning and connected states in master mode and broadcast and connected states in slave mode. This module has normal transmission mode as well as long distance transmission mode, for long distance transmission, the air rate is 125kbps, i.e. PHY selection is coded, and the distance is up to 600 meters. In normal transmission mode, the air rate is 125kbps, i.e. PHY is coded, and the distance is up to 600 meters. PHY selection is available in all three states: Broadcast, Scan, and Connected. After SLP and BTDATA are grounded, the PHY can be selected by the following command.



Function	Command (hex/ASCII)	Description
Set Broadcast PHY	54544D3A4144542D <Para> TTM:ADT-<Para>	Length: 1 Byte, Values: 1-3, 1: 1M phy broadcast 2: coded phy broadcast 3: 1M+coded phy toggle broadcast
Read Broadcast PHY	54544D3A4144543F TTM:ADT?	Return TTM:ADT-<Para>\r\n\0, Para: Hexadecimal
Set Scanning PHY	54544D3A5343562D <Para> TTM:SCV-<Para>	Length: 1 Byte, Values: 1-2, 1: only scanning 1M phy broadcasts 2: only scanning coded phy broadcasts
Read Scanning PHY	54544D3A5343563F TTM:SCV?	Return TTM:SCV-<Para>\r\n\0, Para: Hexadecimal
Set Transport PHY	54544D3A434E502D <Para> TTM:CNP-<Para>	Length: 1 Byte, values: 1-2, 1: in 1M phy 2: in coded phy
Read Transport PHY	54544D3A434E503F TTM:CNP?	Length: 1 Byte, values: 1-2, 1: in 1M phy 2: in coded phy

The host-related parameters are scan timeout, scan interval, and connection interval. The Set Connection Interval command is effective for both master and slave modes. Scan Timeout and Scan Interval are valid only under the host module:

Function	Command (hex/ASCII)	Description
Setting the scan timeout	54544D3A5343542D<Para> TTM:SCT-<Para>	Length: 1 Byte, Values: 0-29, Para*5S, 0 means scanning all the time and output scanning result in real time.
Query Scan Timeout	54544D3A5349572D<Para> TTM:SIW-<Para>	Return TTM:SCT-<Para>\r\n\0, Para: Hexadecimal
Setting the scanning interval	54544D3A5349572D<Para> TTM:SIW-<Para>	Length: 1 Byte, Value: 0-100, Para*10S
Query Scan Interval	54544D3A5349573F TTM:SIW?	Return TTM:SIW-<Para>\r\n\0, Para: Hexadecimal
Setting up RSSI filtering	54544D3A5253492D<Para> TTM:RSI-<Para>	Value: -120 ~ -30dBm, if less than -100dbm, then disable RSSI filtering.
Query RSSI Filtering	54544D3A5253493F TTM:RSI?	Return TTM:RSI-<Para>\r\n\0, Para: Hexadecimal



Function	Command (hex/ASCII)	Description
Setting up broadcast name filtering	54544D3A404E462D<Para> TTM:AVF-<Para>	Length: 16 Byte, Value: ASCII code
Query Broadcast Name Filtering	54544D3A404E463F TTM:ANF?	Return TTM:ANF-<Para>\r\n\0, Para: Hexadecimal
Cancel broadcast name filtering	54544D3A404E462D TTM:ANF-	Cancel broadcast name filtering
Setting up MAC address filtering	54544D3A4D41462D<Para> TTM:MAF-<Para>	Length: 6 Byte, value: hexadecimal number
Query MAC Address Filtering	54544D3A4D41463F TTM:MAF?	Return TTM:MAF-<Para>\r\n\0, Para: Hexadecimal
Cancel MAC address filtering	54544D3A4D41462D	Cancel MAC address filtering



Note: RSSI, broadcast name and MAC address filtering are added to make it easier to locate the device; only one of MAC address filtering and broadcast name filtering can be effective at the same time; when MAC address filtering is turned on, broadcast name filtering will be turned off automatically; when broadcast name filtering is turned on, MAC address filtering will be turned off automatically.

As a host, you need to send relevant commands to let the device enter the Bluetooth state, such as scanning and initiating a connection to a certain device, and after connecting, when transmitting data, you will judge all the data whether it is a disconnect command.

Function	Command (hex/ASCII)	Description
Turn on scanning	54544d3a5343414e TTM:SCAN	Command correctly return: TTM:SCANNING\r\n\0, error return TTM:ERP\r\n\0, after scanning to the device serial port output 10 RSSI value of the strongest device, scanning timeout is 0 or MAC address filtering scanning output results format 0xAA + MAC + RSSI + adv_data + 0x0D0A, the rest of the output for MAC + broadcast name
stop scanning (computing)	54544d3a5343414e2d53544f50 TTM:SCAN-STOP	The instruction returns correctly: TTM:S-CAN-STOP\r\n\0, incorrectly returns TTM:ERP\r\n\0
Connect to the specified MAC	54544D3A434F4E4E2D <MAC> TTM:CONN-<MAC>	Command return: TTM:CONNING\r\n\0, indicating connection in progress TTM:CONN-TOUT\r\n\0, connection timeout TTM:NO-DEVICE\r\n\0, device not found TTM:CONN-MAC-XXXXXXXXXXXX\r\n\0, connected TTM:MAC-DCON-XXXXXXXXXXXX\r\n\0, Disconnect TTM:ERP\r\n\0, Command Error
Disconnect all connections	54544D3A444953432D414C4C TTM:DISC-ALL	Correctly return TTM:DISC-XXXXXXXXXXXX\r\n\0, incorrectly return TTM:ERP\r\n\0



Note: The above commands are only valid in host mode, sending these commands when the device role is not host will return TTM:ERP\r\n0.
Except for the above four commands, all other device commands, whether in master or slave mode, will return TTM:OK\r\n0 as long as they fulfill their parameter range requirements, and the parameters will take effect when the corresponding roles are in effect.

A master device can initiate a connection to a slave device with a specified MAC and enter connection mode. When the MAC address of the desired connected device is known, the connection command can be sent directly without scanning.

When the device is switched from master mode to slave mode, it is necessary to first ensure that the device is in the unconnected state, call the set role command, and then call the reset command, which can successfully switch to the slave role, and vice versa.

Function	Command (hex/ASCII)	Description
Setting up the rol	54544D3A524F4C2D <Para> TTM:ROL-<Para>	Length: 1 Byte, Values: 0-1, 0 for slave mode, 1 for master mode
Query Role	54544d3a524f4c3f TTM:ROL?	Return to TTM:ROL-<Para>\r\n0, Para: Hexadecimal

When in slave mode, you can set and query many parameters of the broadcast process and connection process as follows:

Function	Command (hex/ASCII)	Description
Setting the broadcast name	54544D3A52454E2D <Para> TTM:REN-<Para>	Length: 1-16 Byte, Value: ASCII
Query broadcast name	54544d3a52454e3f TTM:REN?	Return TTM:REN-<Para>\r\n0, Para is ASCII
Setting the broadcast interval	54544D3A4144502D <Para> TTM:ADP-<Para>	Length: 1 Byte, value: 1-20, corresponding to broadcast interval 1*100ms.
Query broadcast interval	54544D3A4144503F TTM:ADP?	Return TTM:ADP-<Para>\r\n0, Para: Hexadecimal
Setting the transmit power	54544D3A54504C2D <Para> TTM:TPL-<Para>	Length: 1 Byte, Values: 0-8, corresponding to -40, -20, -16, -12, -8, -4, 0, +4, +8 (unit: dB)
Query Transmit Power	54544D3A54504C3F TTM:TPL?	Return TTM:TPL-<Para>\r\n0, Para: Hexadecimal



Function	Command (hex/ASCII)	Description
Setting the broadcast data	54544D3A4144442D <Para> TTM:ADD-<Para>	Length: 1-16 Byte, value: any hexadecimal number
Query Broadcast Data	54544D3A4144443F TTM:ADD?	Return TTM:ADD-<Para>\r\n\0, Para: Hexadecimal
Setting the factory ID	54544D3A5049442D <Para> TTM:PID-<Para>	Length: 2 Byte, value: any hexadecimal number
Query Factory ID	54544D3A5049443F TTM:PID?	Return TTM:PID-<Para>\r\n\0, Para: Hexadecimal
Setting the Service UUID	54544D3A5549442D <Para> TTM:UID-<Para>	Length: 6Byte, (2 Byte service uuid+2 Byte rx UUID+2 Byte tx UUID) Values: Any hexadecimal number, service, rx, tx UUID can't be the same.
Query Service UUID	54544D3A5549443F TTM:UID?	Return TTM:UID-<Para>\r\n\0, Para: Hexadecimal
Setting the broadcast mode	54544D3A4D4F442D <Para> TTM:MOD-<Para>	Set device broadcast packet format: 0: pass-through broadcast packet 1: iBeacon broadcast packet, you can see the specific broadcast packet format instructions
Query broadcast mode	54544d3a4d4f443f TTM:MOD?	Return TTM:MOD-<Para>\r\n\0, Para: Hexadecimal
Setting the UUID	54544D3A4149442D <Para> TTM:AID-<Para>	Length: 16 bytes, value: any hexadecimal number
Query UUID	54544D3A4149443F TTM:AID?	Return TTM:AID-<Para>\r\n\0, Para: Hexadecimal
Set Major	54544D3A4D414A2D<Para> TTM:MAJ-<Para>	Length: 2 bytes, value: any hexadecimal number
Query Major	54544D3A4D414A3F TTM:MAJ?	Return to TTM:MAJ-<Para>\r\n\0, Para: Hexadecimal
Set Minor	54544D3A4D494E2D <Para> TTM:MIN-<Para>	Length: 2 bytes, value: any hexadecimal number
Query Minor	54544d3a4d494e3f TTM:MIN?	Return TTM:MIN-<Para>\r\n\0, Para: Hexadecimal



Function	Command (hex/ASCII)	Description
Setting the connection mode	54544D3A5057452D <Para> TTM:PWE-<Para>	Whether the device requires a password to connect, 0: no password required to connect 1: Connection password required
Query Connection Mode	54544D3A5057453F TTM:PWE?	Return TTM:PWE-<Para>\r\n0, Para: Hexadecimal
Setting the connection password	54544D3A5057442D <Para> TTM:PWD-<Para>	Length: 1-8 bytes, value: ASCII, the correct password must be entered within 5s on the connection, otherwise the connection will be disconnected
Query connection password	54544D3A5057443F TTM:PWD?	Return to TTM:PWD-<Para>\r\n0, Para:ASCII

Whether it is the host mode or the slave mode, all the setting commands need the reset command to take effect. while the query command will return the relevant parameters, and the command error will return TTM:ERP\r\n0. For the whole device, the baud rate, the connection interval commands take effect regardless of whether it is the host mode or the slave mode.

Function	Command (hex/ASCII)	Description
Setting the baud rate	54544D3A4250532D <Para> TTM:BPS-<Para>	Length: 1 Byte, Values: 0-4, corresponding to 9600/ 19200/38400/57600/115200 (unit: bps) respectively.
Query Baud Rate	54544D3A4250533F TTM:BPS?	Return TTM:BPS-<Para>\r\n0, Para: Hexadecimal
Setting the connection interval	54544D3A4349542D <Para> TTM:CIT-<Para>	Length: 1 Byte, <Para> can only be represented in hexadecimal as 0x01~0x64; The actual connection interval is (<Para>*10~<Para>*10+20)ms
Query Connection Interval	54544D3A4349543F TTM:CIT?	Return to TTM:CIT-<Para>\r\n0, Para: Hexadecimal
Retrieve MAC address	54544d3a4d4143(2d)3f TTM:MAC-? or TTM:MAC?	Return TTM:MAC-<Para>\r\n0, Para: Hexadecimal
Read version information	54544d3a564552(2d)3f TTM:VER-? or TTM:VER?	Return to TTM:VER-<Para>\r\n0, Para:ASCII



Function	Command (hex/ASCII)	Description
Restore factory equipment	54544d3a5253542d464143 TTM:RST-FAC	Consistent with the return of the setup command
reset (a dislocated joint, an electronic device etc)	54544d3a5253542d535953 TTM:RST-SYS	Success will return TTM:OK\r\n\0

5.3 Example of operation

5.3.1 Factory Default Parameters

Factory Default Parameters:

Serial port baud rate: 9600bps,8N1

Transmit power: 0dBm

Minimum and maximum connection interval: 20ms - 40ms

Device Role: Host

Broadcast, Scan, Connect PHY: 1M

DC_RC: DCDC on, external 32K

Default parameters related to host mode:

Scanning timeout: 10s

Scanning interval: 100ms

Default parameters related to slave mode:

Broadcast Name: Minew_Vxxxxx

Broadcast interval: 1s

Broadcast mode: pass-through broadcast package

Customized data: MinewTech

Connection password enable: not enabled

Connection password: minew123

Major: 0x1234

minor: 0x1235

UUID:

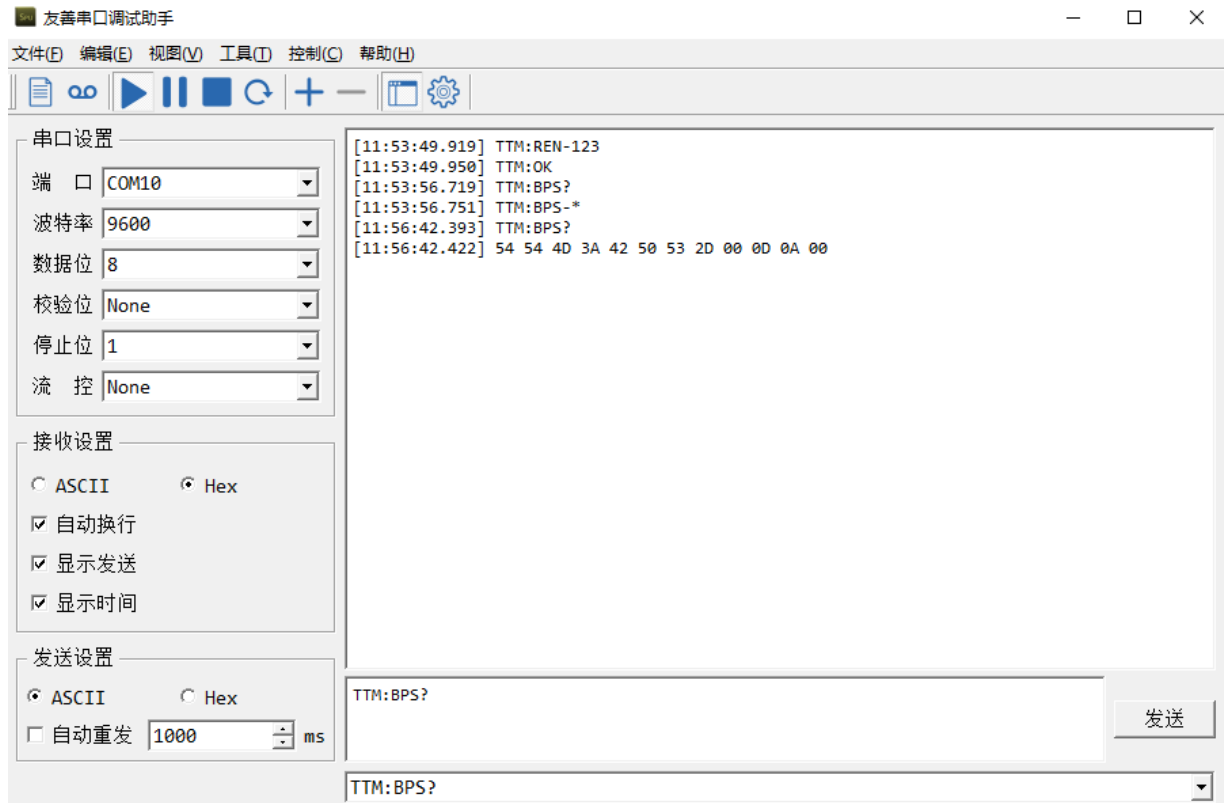
74278BDA-B644-4520-8F0C-720EAF059935

5.3.2 Example of Modifying Parameters

Connect all the pins according to the wiring, ground SLP and BTDATA, the device enters the unconnected state, at this time you can set the parameters, whether it is the host mode or the slave mode, all the parameters can be set, the parameters take effect immediately. Parameters after taking effect can only be reflected under the corresponding role. For example, if the broadcast name of the device is changed in the host mode, the parameters will take effect, but only when the device is switched to the slave mode will you see that the broadcast name has been changed. After sending the reset command, all the parameters are powered down and saved.



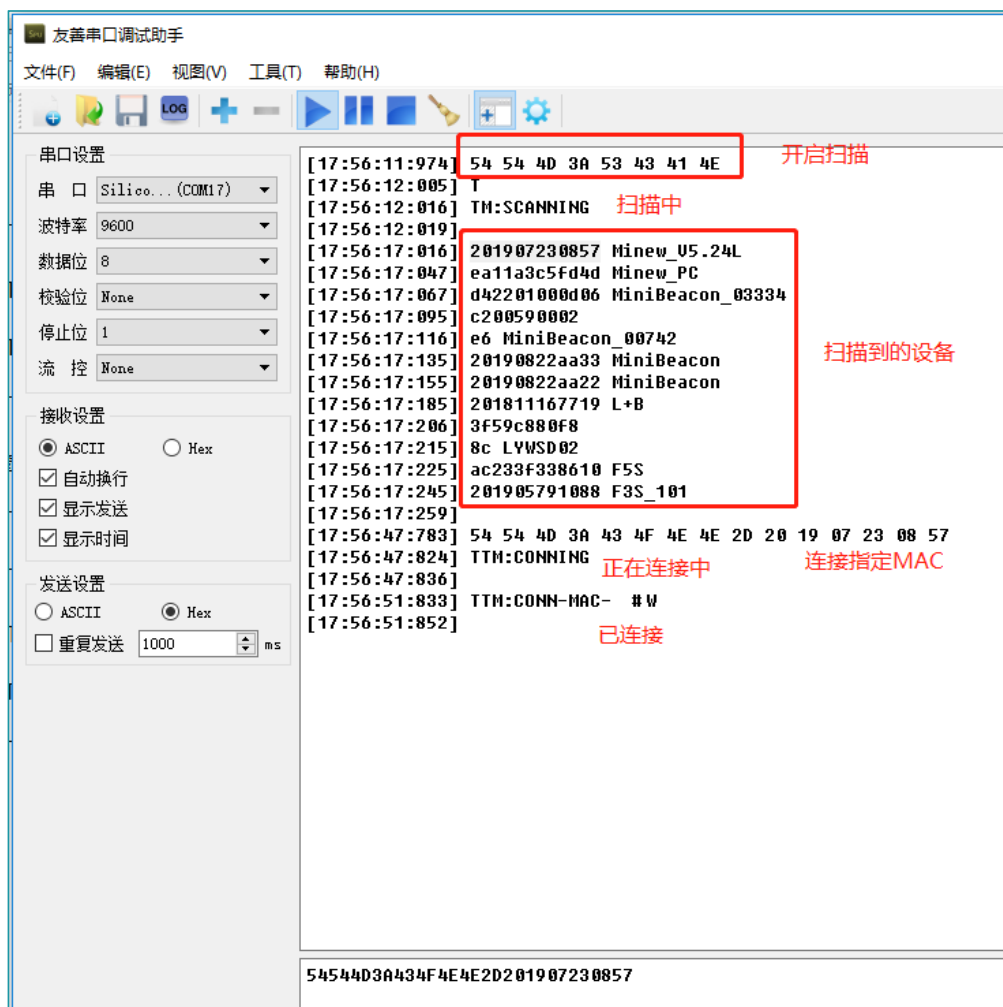
Note: When you need to modify multiple parameters, you can send all the setting commands first and then send the reset command.



When querying the device parameters, because the parameters are hexadecimal numbers, when selecting the ASCII display, the parameter position may be garbled, at this time, you need to set to HEX display, the parameters correspond to the position after 2D, see the above figure, query the baud rate, you need to use the HEX display to view the specific parameters.

5.3.3 Scanning devices and connections

Send the 54544D3A5343414E (TTM:SCAN) command to scan for a device and obtain its MAC address. The scanned device returns MAC + broadcast name information. Send the 54544D3A434F4E4E2D201907230857 command and the module will connect the device with MAC address 20:19:07:23:08:57. The device connected will return TTM:CONN-MAC-XXXXXXXXXXXX\r\n0. Since MAC is a hexadecimal number, the entire command is sent as a hexadecimal number. Once connected you can perform data passthrough.



5.3.4 mainframe transmission

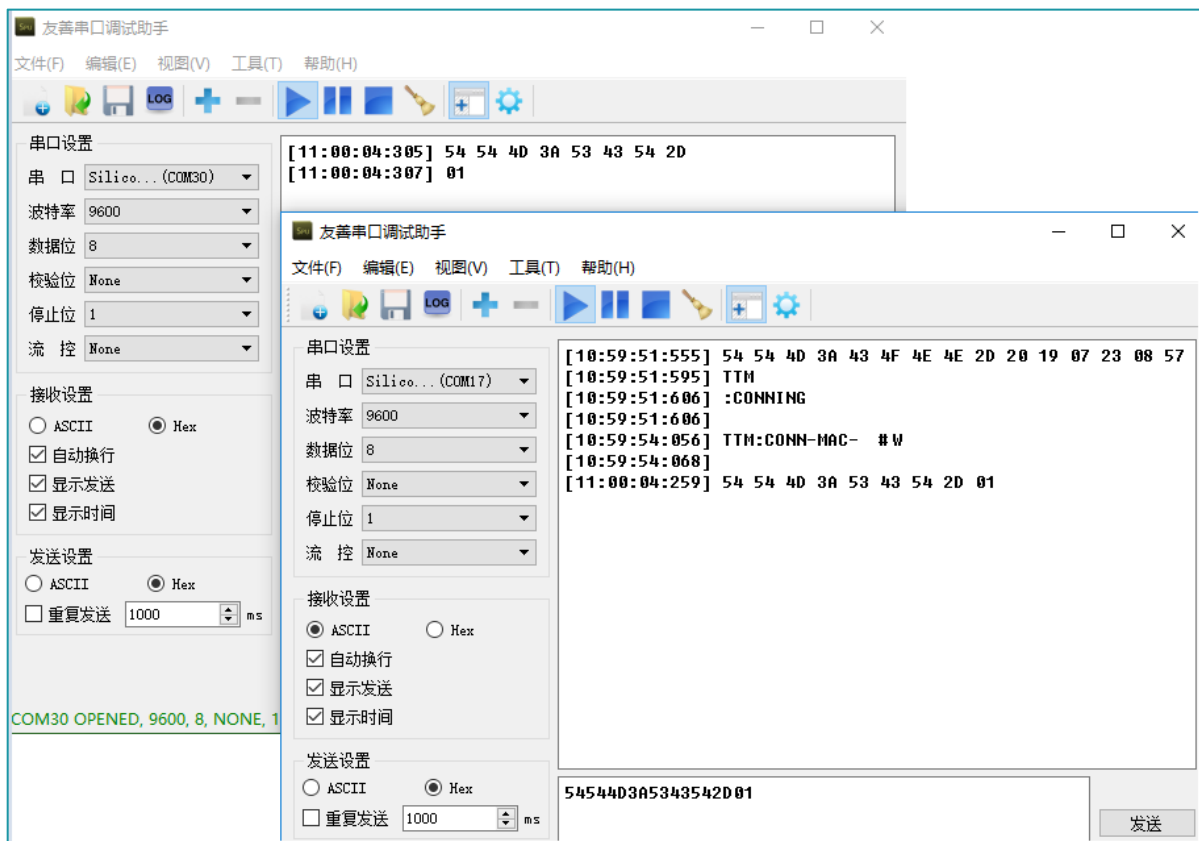
Data passthrough is possible after the connected command is returned in step 7.3. The prerequisite for correct communication between the module and the slave device is that the slave device must have the same services, features, and their UUIDs and attributes as the module.

Relevant information is provided below:

Eigenvalue UUID	Executable operation	Packet length	Note
FFF1	notify	244	Module data reception, the data sent from the device to the module shall not exceed 244 Byte per packet.
FFF2	write	244	Module data sending, the module has to do automatic packetization, data more than 244 Byte will be automatically divided into 244 packets sent to the slave device.



As an example, the master module connects to the passthrough slave module, and then sends the data after connecting.

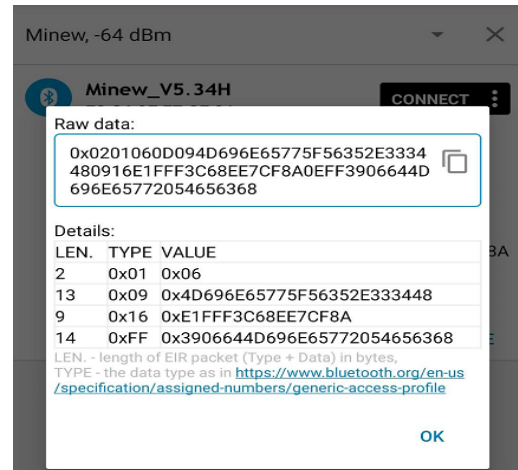
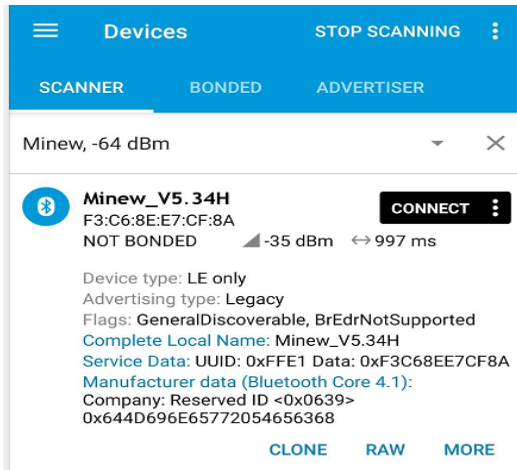


5.3.5 slave radio

After setting the device role to slave mode with the command TTM:ROL-0, data can be transmitted to and from the cell phone. With the SLP pin low, the device is in broadcast state. Use nrf connect to scan the device, click Raw after scanning to the device, Raw data is the unparsed data of the scanned device. After parsing the data according to BLE data type, see Detail section, BLE broadcast data has a certain format: length + type + content.

The content is changeable, the type is fixed and the length is determined by the content. There are two broadcast formats for the device, the pass-through broadcast packet and the iBeacon broadcast packet. Both formats contain four types: flag(0x01), broadcast name(0x09), service data(0x16), and manufacturer data(0xFF).

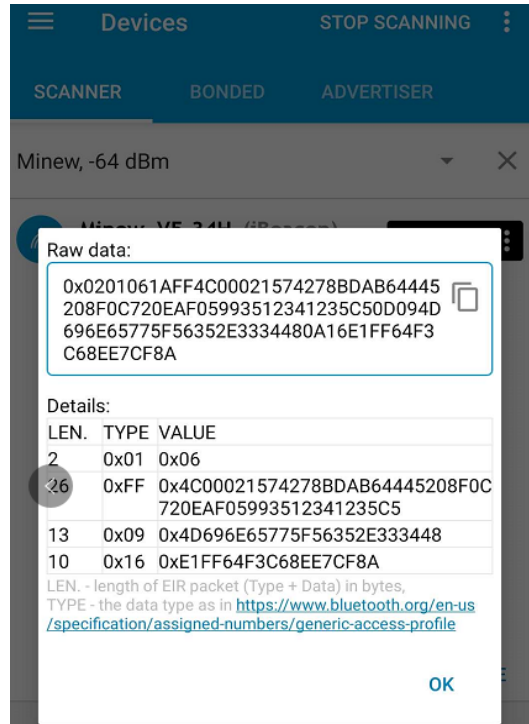
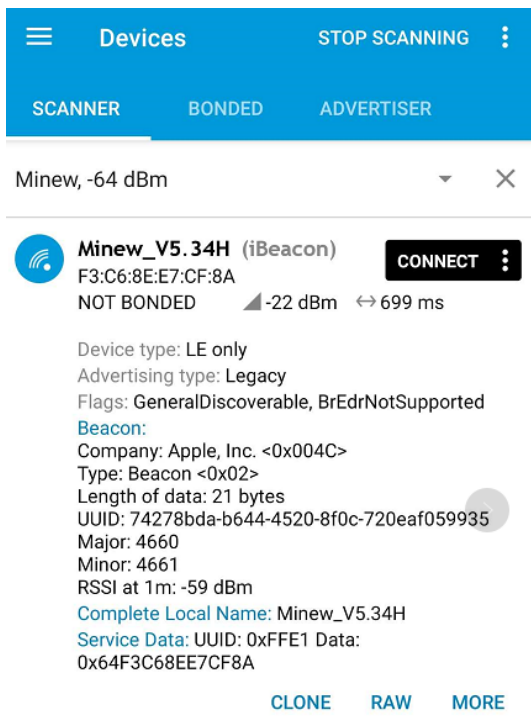
The following figure shows the transmitting broadcast packet: flag, broadcast name, service data is put in the broadcast packet, manufacturer data is put in the reply packet. The service data content is: service data UUID(E1FF) + MAC address. manufacturer data content consists of company id(3906) + battery level information(1 byte) + custom data.



Note: The IOS side can not get the content of the MAC address field, so the MAC address is put back into the broadcast packet to ensure that the IOS side can get the device MAC address. In addition, the WeChat applet can't get the reply packet, so the MAC is put into the service data of the broadcast packet to ensure that the IOS side can also get the device MAC address using the WeChat applet connection.

The following figure shows the iBeacon broadcast packet: flag, manufacturer data is put in the broadcast packet, service data and broadcast name are put in the reply packet. The broadcast packet must follow this fixed format to fulfill the iBeacon protocol definition. In manufacturer data data, 4C 00 is Apple's company id, 02 15 is iBeacon's fixed format, Proximity uuid(16 bytes)+Major(2 bytes)+Minor(2 bytes)+Measured power(1 byte). In iBeacon broadcast mode, manufacturer data can only change the value of Proximity uuid, Major, Minor.

service data= service data UUID(FFE1) + battery level information + MAC address.

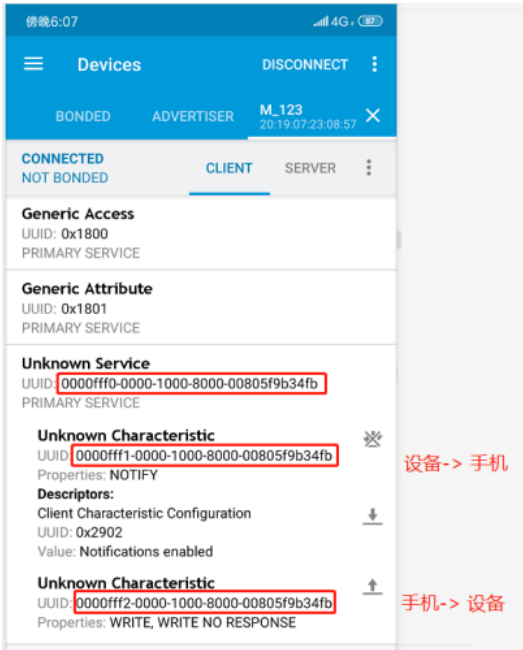


5.3.6 Slave transponder

Based on 7.2, connect to the device using the mobile app and keep the BTDATA pin low to perform data passthrough. when BTDATA is not low, it does not affect the broadcasting and connecting of the device, just that passthrough is not possible. Using nRF connect, you can see the specific service, characteristic and corresponding properties.

The UUID consists of the alias UUID (2 byte, 3.4 byte on the left in the figure) + the base UUID (the remaining 14 byte).

The base UUID used for services, features in the passthrough program is standard and is illustrated below with the alias UUID.

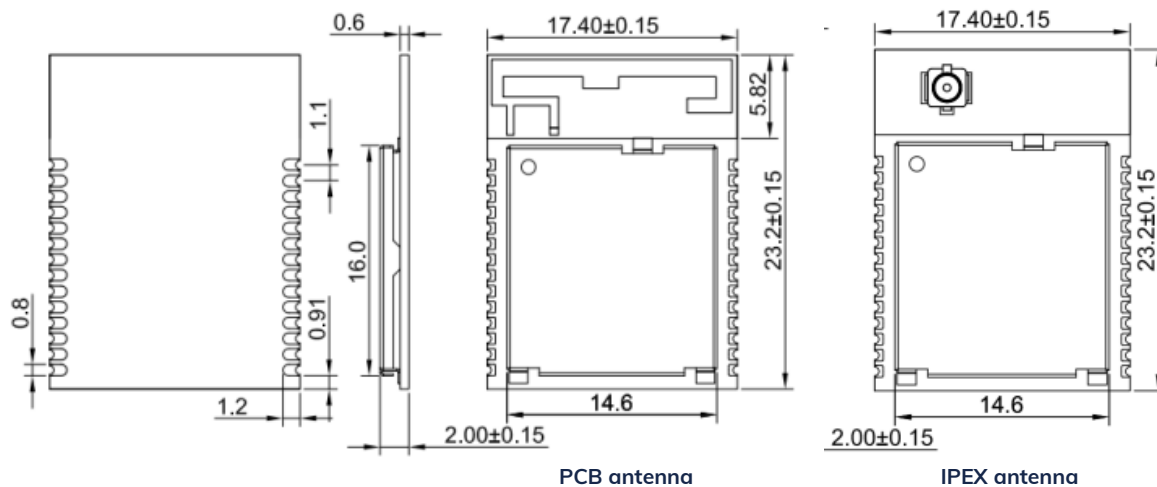


FFF0 is the service UUID, FFF1 is the cell phone receives data and the module sends data; FFF2 is the cell phone sends data and the module receives data.

Eigenvalue UUID	Executable operation	Maximum Packet Length	Note
FFF1	notify	244	The serial port sends data to the module, which is forwarded to the phone. The cell phone enables notify before it can get the data. The maximum number of bytes the module can send in a packet is 244 byte. Note: This process firmware does automatic sub-package processing, you can do not have to follow the length of a package for sub-pack- age.
FFF2	write	244	The phone sends data to the module and forwards it to the serial port. When using the API interface function to write data, the maximum length of data written at one time is 244 bytes



6 MECHANICAL DRAWING



Default unit: mm Default tolerance: ±0.15



Note: Recommended pad size 1.8*0.8mm, pad extends outward 0.5mm

7 PCB LAYOUT

There should be no GND plane or metal cross wiring in the module antenna area, and no components should be placed nearby. It is best to make a hollow or clear area, or place it on the edge of the PCB board. The reference example is as follows:



Notice: It is strongly recommended to use the first design method. The module antenna design is debugged according to the first wiring.

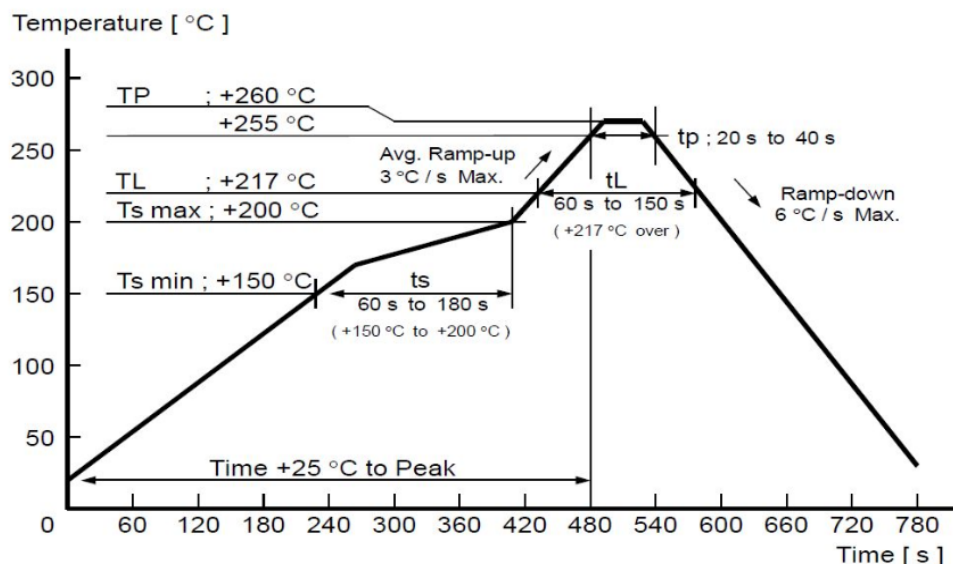
Layout Notes:

- 1)The module's antenna area should be completely clear of any metal obstructions to avoid affecting antenna performance (as shown in the diagram).
- 2)Outside the module's antenna area, try to maintain a solid copper pour to minimize interference from the mainboard signal lines or other sources.
- 3)A clear area of at least 4mm should surround the module's antenna (including its casing) to reduce interference with the antenna.
- 4)Ensure good grounding for components to minimize parasitic inductance.
- 5)Do not place copper under the module's antenna to prevent interference with signal radiation, which could affect transmission distance.
- 6)The antenna should be kept away from other circuits to maintain radiation efficiency and avoid impacting the normal operation of other circuits.
- 7)Position the module as close to the edge of the circuit board as possible, away from other circuitry.
- 8) It is recommended to use a ferrite bead for isolation when connecting the module to the power supply.



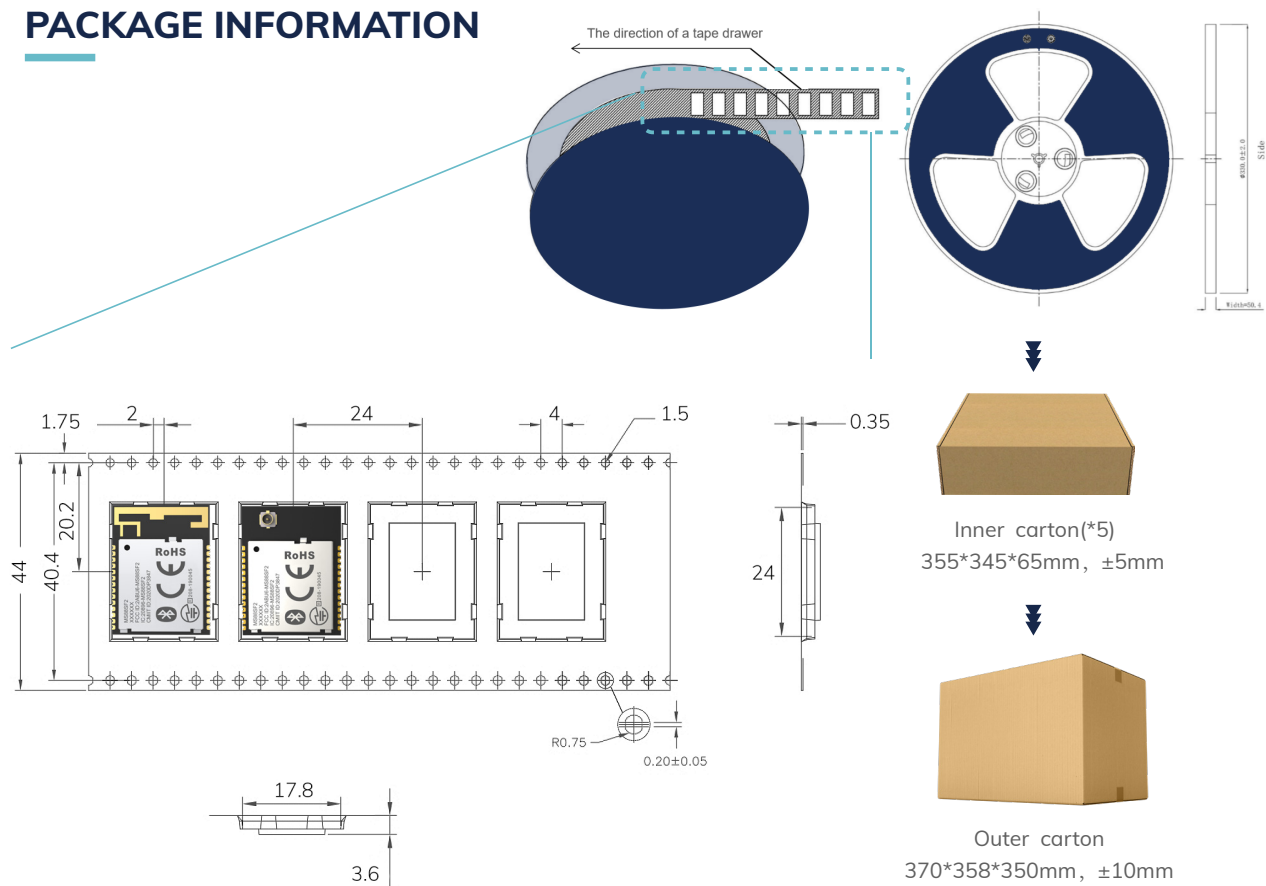
8 REFLOW AND SOLDERING

- 1) Perform SMT according to the reflow oven temperature profile provided below, with a maximum temperature of 260°C;
- 2) Follow IPC/JEDEC standards; Peak temperature: < 260°C; Number of reflows: ≤2 times; For SMT involving double-sided placement, it is recommended that the module side undergoes reflow soldering only once. For any special processes, please contact our company.
- 3) For module SMT, it is recommended to make the steel mesh thicker by 0.13-0.15mm, and then expand the pin length by 1-1.3mm;
- 4) After opening, if the entire package is not used at once, it should be stored in a vacuum to prevent long-term exposure to air, which can cause moisture absorption and pad oxidation. If there is a gap of 7 to 30 days before reuse, it is recommended to bake the tape at 65-70°C for 24 hours without unrolling it before returning to SMT.
- 5) ESD protection measures should be implemented before using SMT.

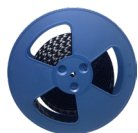


9

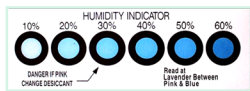
PACKAGE INFORMATION



Remarks
General material list for FCL packaging:



Carrier tape packaging tray



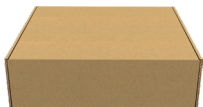
Humidity Indicator
(1 pcs/bag)



Desiccant
(placed in a vacuum bag)



Vacuum bag



Inner carton(*5)
355*345*65mm, ±5mm



Outer carton
370*358*350mm, ±10mm

Other:

- Moisture-proof label (attached to the vacuum bag)
- Certification label (attached to the vacuum bag)
- Outer box label

Default unit: mm Default tolerance: ±0.1

Packing detail	Specification	Net weight	Gross weight	Dimension
MS88SF2	650PCS	460g	1200g	W=44mm, T=0.35mm

Note: Default weight tolerance all are within 10g (except the special notes)

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference
- (2) This device must accept any interference received, including interference that may cause undesired operation.

10 FCC WARNING

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the device.

Note: This device has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This device generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this device does cause harmful interference to radio or television reception, which can be determined by turning the device off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the device and receiver.
- Connect the device into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body." This module is designed to comply with the FCC statement, FCC ID is:2BDJ6-MS88SF2

Requirement per KDB996369 D03

2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.3Explanation: This module meets the requirements of FCC part 15C(15.247).

2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

Explanation: The EUT has a PCB Antenna, , and the antenna use a permanently attached Antenna which is not replaceable.

2.4 Limited module procedures

If a modular transmitter is approved as a "limited module", then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

Explanation: The module is not a limited module.

2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects: layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

- a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);
- b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
- c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;
- d) Appropriate parts by manufacturer and specifications;
- e) Test procedures for design verification;
- f) Production test procedures for ensuring compliance.

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

Explanation: Yes, The module with trace antenna designs, and This manual has been shown the layout of trace design,, antenna, connectors, and isolation requirements.

2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information:

- (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and
- (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility for the module through a change in FCC ID (new application).

Explanation: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This device should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body." This module is designed to comply with the FCC statement, FCC ID is: 2BDJ6-MS88SF2

2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions.

For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that, for example, an “omnidirectional antenna” is not considered to be a specific “antenna type”).

For situations where the host product manufacturer is responsible for an external connector, for example, with an RF pin and antenna trace design, the integration instructions shall inform the installer that a unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: The EUT has a PCB Antenna, and the antenna uses a permanently attached antenna, which is unique.

2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating “Contains FCC ID” with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation: The host system using this module, should have label in a visible area indicated the following texts:
"Contains FCC ID: 2BDJ6-MS88SF2

2.9 Information on test modes and additional testing requirements

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer's determination that a module as installed in a host complies with FCC requirements.

Explanation: Topband can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

11 STORAGE CONDITIONS

- Please use this product within 6 months after signing the receipt.
 - This product should be stored without opening the package at an ambient temperature of 5~35°C and a humidity of 20~70%RH.
 - This product should be left for more than 6 months after receipt and should be confirmed before use.
 - The product must be stored in a non-corrosive gas (Cl₂, NH₃, SO₂, NO_x, etc.).
 - To avoid damaging the packaging material, do not apply any excessive mechanical shocks, including but not limited to sharp objects adhering to the packaging material and product dropping.
- This product is suitable for MSL2 (based on JEDEC standard J-STD-020).
 - After opening the package, the product must be stored at ≤30°C/≤60%RH. It is recommended to use the product within 3-6 months after opening the package.
 - When the color of the indicator in the package changes, the product should be baked before welding.
- Baking is not required for one year if exposure is limited to <30°C and 60%RH. Refer to MSL2 for exposure criteria for moisture sensitivity level. If exposed to (≥168h@85°C/60%RH) conditions or stored for more than one year, recommended baking conditions.
 1. 120 ±5/-5°C, 8 hours, 1 timeProducts must be baked individually on heat-resistant trays because the materials (base tape, reel tape, and cover tape) are not heat-resistant, and the packaging material may be deformed at temperatures of 120 °C;
 2. 90 °C ±8/-0 °C, 24hours, 1timesThe base tape can be baked together with the product at this temperature. Please pay attention to the uniformity of heat.

12 HANDLING CONDITIONS

- Be careful in handling or transporting products because excessive stress or mechanical shock may break products.
- Handle with care if products may have cracks or damages on their terminals. If there is any such damage, the characteristics of products may change. Do not touch products with bare hands that may result in poor solder ability and destroy by static electrical charge.

13 QUALITY

Cognizant of our commitment to quality, we operate our own factory equipped with state-of-the-art production facilities and a meticulous quality management system. We hold certifications for ISO9001, ISO14001, ISO27001, OHSAS18001, BSCI.

Every product undergoes stringent testing, including transmit power, sensitivity, power consumption, stability, and aging tests. Our fully automated module production line is now in full operation, boasting a production capacity in the millions, capable of meeting high-volume production demands.

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15 RELATED DOCUMENTS

- nRF52840_Chip_Datasheet
https://en.minewsemi.com/file/nRF52840_Chip_Datasheet_EN.pdf
- MinewSemi_Product_Naming_Reference_Manual
https://en.minewsemi.com/file/MinewSemi_Product_Naming_Reference_Manual_EN.pdf
- MinewSemi_Connectivity_Module_Catalogue
https://en.minewsemi.com/file/MinewSemi_Connectivity_Module_Catalogue_EN.pdf



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