MINEWSEMI

Bluetooth Low Energy Module

MS52SF2

Specification V1.0

MinewSemi

- Subsidiary of Minew Technologies
- Nordicsemi Strategy Partner
- Bluetooth SIG Associated Member
- Fira Alliance Adopter Member

Telink TLSR8208 BLE Module MS52SF2 Specification

PCB Antenna

MS52SF2 is a cost-effective, low-power Bluetooth 5.0 slave UART module based on Telink TLSR8208 SoC, supports transparent UART data service of BLE with master devices such as mobile phones/tablets，skips the firmware development, and reduces your time to market.

MS52SF2 Specification			
Model Series.	MS52SF2	Antenna	PCB
SoC	Telink TLSR8208	Size	20×12×2mm
Flash	128kB	RAM	16kB
RX Sensitivity	-97dBm	TX Power	-45~+10dBm
TX Current Consumption	0dBm-9.5mA	RX Current Consumption	9.1mA
GPIO	15	Firmware	Slave Uart
Application	Smart Home、Advanced Wearables、Consumer Electronics Medical、Security Device、Automotive Equipment、Industrial		

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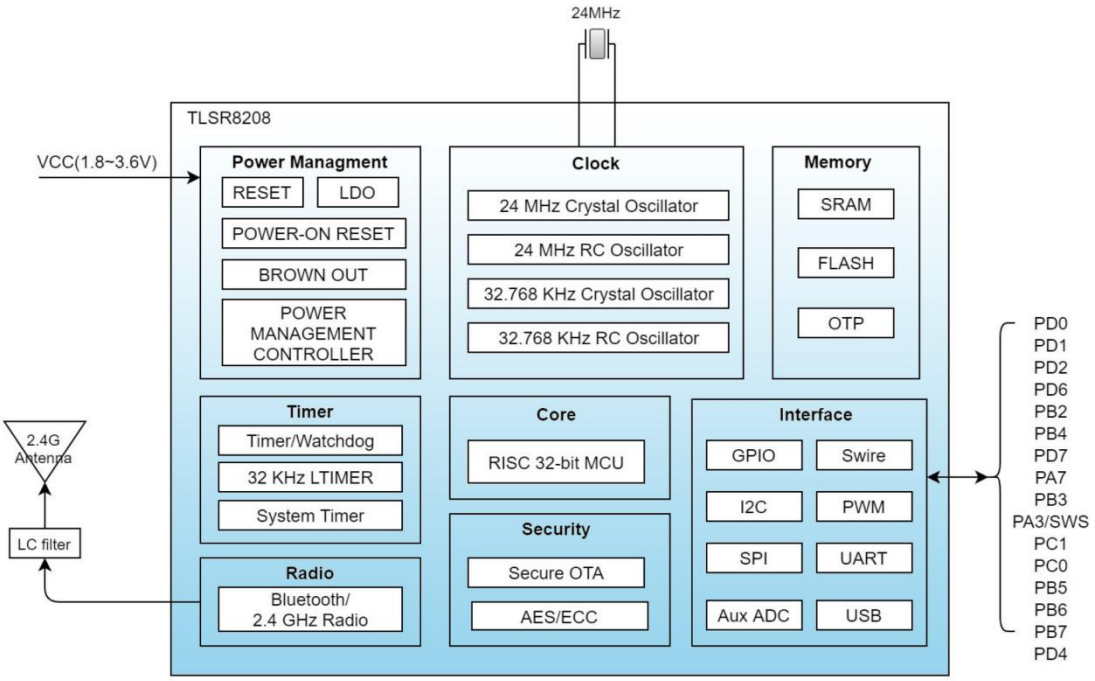
1 Product Information

This module is a slave module with broadcast and connection mode. It communicates with MCU through the UART interface. When in broadcast mode, the MCU can set and view the broadcast name of the module by sending command through the UART interface, set custom data, and modify parameters such as broadcast interval and connection interval. When a host connects to the device over Bluetooth, the device will act as a bridge between the host and the MCU for transparent data transmission.

Features:

- Max data transfer rate 5kB/s
- Support UART command configuration
- Support iBeacon broadcast mode
- Max TX power up to +10dBm

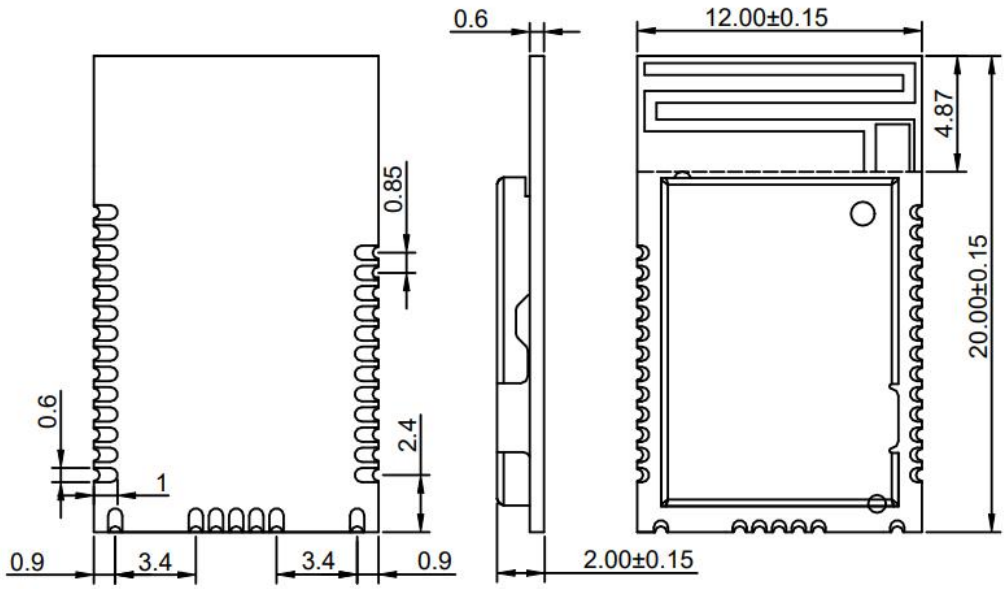
2 Block Diagram



3 Electrical Specification

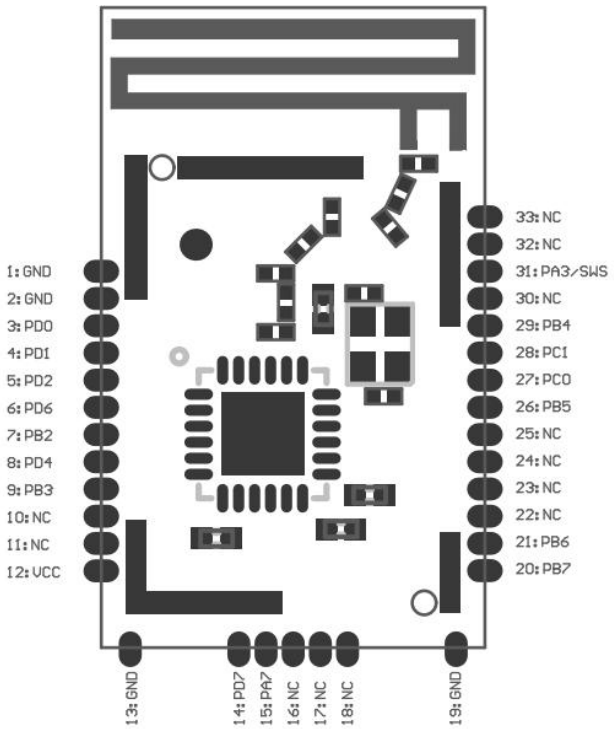
Parameter	Value	Note
Supply Voltage	1.8V-3.6V	Voltage should be at least 2.5V
Working Temperature	-40℃~+85℃	Storage temperature -60℃~+150℃
TX Power	-45 ~ +10dBm	Configurable
RX Current Consumption	9.1mA	@1Mbps
TX Current Consumption	9.5mA	@0dB
Size	20*12*2mm	
GPIO	15	

3.1 Mechanical drawing



Important: Unit: mm Tolerance: +/- 0.1, default
Recommend solder pad size: 1.7*0.8mm.
Recommend the pad extends out:0.5mm

4 Pin Description



5 Pin Assignment

Item	Symbol	Definition	Description	Note
1~2	GND	GND	Ground	
3~9	PD0~PB3		GPIO	Not used in UART, floating
10-11	NC		Not Connected	
12	VCC	VCC	Power Supply	
13	GND	GND	Ground	
14	PD7	BTX	UART TX	TX of Bluetooth Module
15	PA7	BRX	UART RX	RX of Bluetooth Module
16~18	NC		Ground	
19	GND	GND	GND	
20	PB7	CON_IND	Connection indication	Sleep mode：low level Broadcast mode：low level Connect mode：high level
21	PB6		GPIO	
22-25	NC		Not Connected	
26	PB5	SLP	Sleep/Awake	Low level to wake-up,high level to sleep, no floating
27	PC0	BTDATA	Active/Close UART	Serial port on / off to control pin, no floating 0: serial port open, can send and receive serial port data 1: Serial port off
28-29	PC1-PB4		GPIO	Not used in UART, floating
30	NC		Not Connected	
31	PA3/SWS		Serial Wire Debug I/O	Program and debug
32~33	NC		Not Connected	

6 Module Operation Instruction

6.1 Tool

Smartphone APP：Minew UART or nRF connect(General APP, also named: nRF Master Control Panel)，

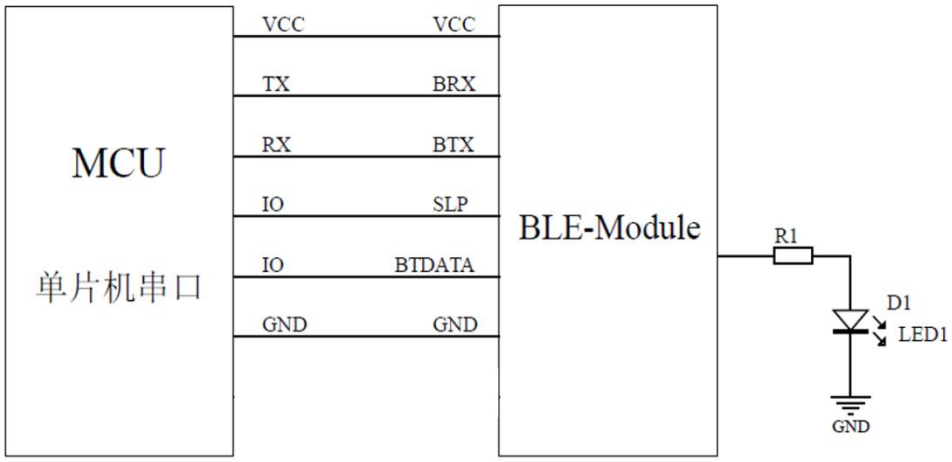
When testing BLE module, system built-in Bluetooth is not available, especially for IOS system, it will not find any BLE devices.An BLE app is a must for testing.

IOS system can download it from APP store.

Android system can download it from Google play store.

Windows system can download and install the Serial Port Utility.

6.2 Demonstration of module application



6.2.1 Power supply

The SoC working voltage is 1.8V-3.6V, to ensure a stablefunction, supply voltage should be 3.0V-3.6V.

6.2.2 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.

6.2.3 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 transfered.

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

6.2.4 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 date over BLE between each smart phone.

6.2.5 PB7(CON_IND)

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

6.3 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\n\0) is returned after command sent successfully

54544D3A4552500D0A00 (TTM:ERP\r\n\0) 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.

Function	Command（hex/ASCII）	Description
Set broadcast name	54544D3A52454E2Dxxx TTM:REN-xxx	Length：1-16 Byte, Value：ASCII
Set broadcast interval	54544D3A4144502Dxxx TTM:ADP-xxx	Length：1 Byte, Value： 1-20，broadcast interval Para*100ms
Set connection interval	54544D3A4349542Dxxx TTM:CIT-xxx	Length：1 Byte, Value：1-100，min connection interval Para*10ms，max connection interval=min connection+20ms
Set baud rate	54544D3A4250532Dxxx TTM:BPS-xxx	Length：1 Byte, Value：0-4 corresponding to 9600/19200 /38400/57600/115200 (unit：bps)
Set transmit power	54544D3A54504C2Dxxx TTM:TPL-xxx	Length：1 Byte, Value：0-9，corresponding to -40、-20、-16、-12、-8、-4、0、+4、+8、+10（unit：dBm）
Set broadcast data	54544D3A4144442Dxxx TTM:ADD-xxx	Length：1-16 Byte, Value：any hexadecimal number
Set factory ID	54544D3A5049442Dxxx TTM:PID-xxx	Length：2 Byte, Value：any hexadecimal number
Set service UUID	54544D3A5549442Dxxx TTM:UID-xxx	Length：6 Byte, (2 Byte service uuid+ 2 Byte tx UUID+ 2 Byte rx UUID) Value：any hexadecimal number，service 、tx、rx UUID should not be the same，should not be 0
Set broadcast mode	54544D3A4D4F442Dxxx TTM:MOD-xxx	Set broadcast packet format：0：transparent transmission broadcast packet 1：iBeacon broadcast packet，for details, please refer to the description of the broadcast packet format.
Set iBeacon UUID	54544D3A4149442Dxxx TTM:AID-xxx	Length：16 Byte，Value：any hexadecimal number
Set iBeacon Major	54544D3A4D414A2Dxxx TTM:MAJ-xxx	Length：2 Byte，Value：any hexadecimal number
Set iBeacon Minor	54544D3A4D494E2Dxxx TTM:MIN-xxx	Length：2 Byte，Value：any hexadecimal number
Set connection mode	54544D3A5057452Dxxx TTM:PWE-xxx	0：can connect without pass word 1：connect with pass word
Set connection pass word	54544D3A5057442Dxxx TTM:PWD-xxx	Length：1-8 Byte，Value：ASCII， correct password must be entered within 5s of the connection, otherwise it will be disconnected
Factory reset	54544D3A5253542D464143 TTM:RST-FAC	Consistent with the setting instruction
Reset	54544D3A5253542D535953	Return TTM:OK\r\n\0 after succeed

In order to ensure that the parameter setting is successful, a parameter reading command is added to read out the current valid parameters of the device. When the command is wrong, it will return 54544D3A4552500D0A00 (TTM:ERP\r\n\0).

Function	Command（hex/ASCII）	Description
Read broadcast name	54544D3A52454E3F TTM:REN?	Return TTM:REN-xxx\r\n\0，return parameter is by ASCII format
Read broadcast interval	54544D3A4144503F TTM:ADP?	Return TTM:ADP-xxx\r\n\0，return parameter is by ASCII format
Read Connection interval	54544D3A4349543F TTM:CIT?	Return TTM:CIT-xxx\r\n\0，return parameter is by ASCII format
Read baud rate	54544D3A4250533F TTM:BPS?	Return TTM:BPS-xxx\r\n\0，return parameter is by ASCII format
Read transmit power	54544D3A54504C3F TTM:TPL?	Return TTM:TPL-xxx\r\n\0，return parameter is by ASCII format
Read broadcast data	54544D3A4144443F TTM:ADD?	Return TTM:ADD-xxx\r\n\0，return parameter is by ASCII format
Read factory ID	54544D3A5049443F TTM:PID?	Return TTM:PID-xxx\r\n\0，return parameter is by ASCII format
Read service UUID	54544D3A5549443F TTM:UID?	Return TTM:UID-xxx\r\n\0，return parameter is by ASCII format
Read broadcast mode	54544D3A4D4F443F TTM:MOD?	Return TTM:MOD-xxx\r\n\0，return parameter is by ASCII format
Read iBeacon UUID	54544D3A4149443F TTM:AID?	Return TTM:AID-xxx\r\n\0，return parameter is by ASCII format
Read iBeacon Major	54544D3A4D414A3F TTM:MAJ?	Return TTM:MAJ-xxx\r\n\0，return parameter is by ASCII format
Read iBeacon Minor	54544D3A4D494E3F TTM:MIN?	Return TTM:MIN-xxx\r\n\0，return parameter is by ASCII format
Read connection mode	54544D3A5057453F TTM:PWE?	Return TTM:PWE-xxx\r\n\0，return parameter is by ASCII format
Read connection pass word	54544D3A5057443F TTM:PWD?	Return TTM:PWD-xxx\r\n\0，return parameter is by ASCII format
Read MAC address	54544D3A4D4143(2D)3F TTM:MAC-? OR TTM:MAC?	Return TTM:MAC-xxx\r\n\0，return parameter is by ASCII format
Read firmware version	54544D3A564552(2D)3F TTM:VER-?OR TTM:VER?	Return TTM:VER-xxx\r\n\0，return parameter is by ASCII format

6.4 Operation examples

6.4.1 Factory default parameters

Broadcast Name：Minew_Vxxxxx

Baud Rate：9600bps,8N1

Transmission Power：0dBm

Broadcast Interval：1s

Broadcast Mode：Transparent transmission broadcast packet

Custom Data:Minew Tech

Min and Max Connection Interval：20ms - 40ms

Connection Password Enable：Closed

Connection Password：minew123

Major：0x1234

Minor：0x1235

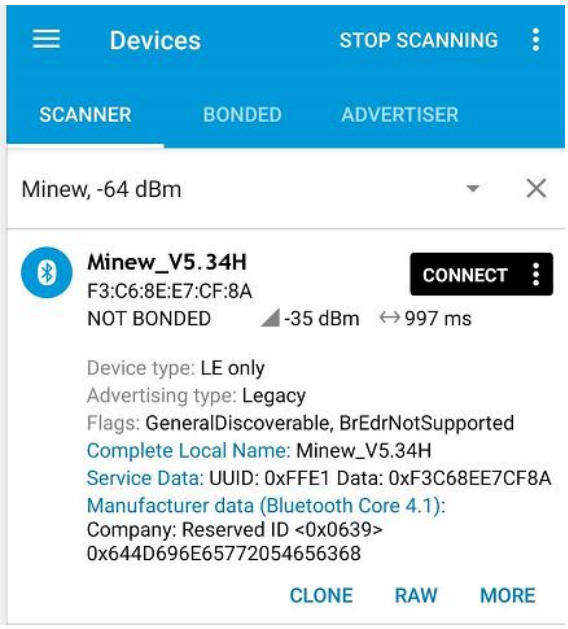
UUID：74278BDA-B644-4520-8F0C-720EAF059935

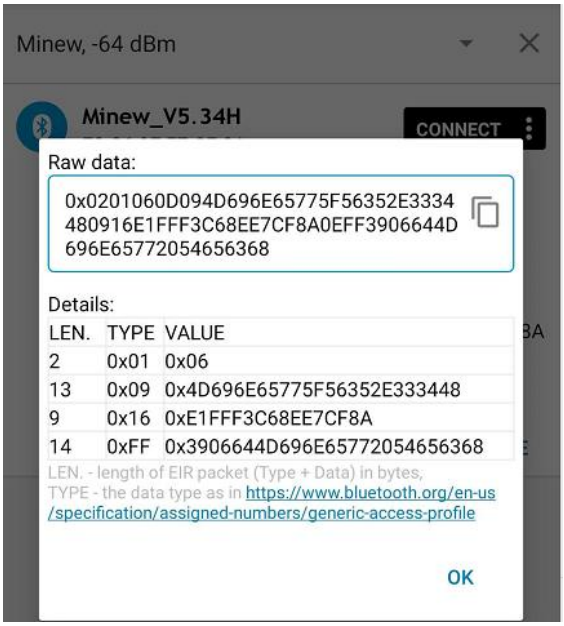
6.4.2 Broadcast packet(Broadcast packet + Reply packet)

Use nRF Connect App to scan the device, click Raw after found to the device, Raw data is the unparsed data from the device. Parsing data according to the BLE data type, see the detail section. BLE broadcast data has a certain format: length + type + content。

The broadcast content can be changed, while data type is fixed, and the length is determined by the content. The device has two broadcast formats, transparent broadcast packets and iBeacon broadcast packets. Both formats contain four types: flag (0x01), broadcast name (0x09), service data (0x16), manufacturer data (0xFF).。

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

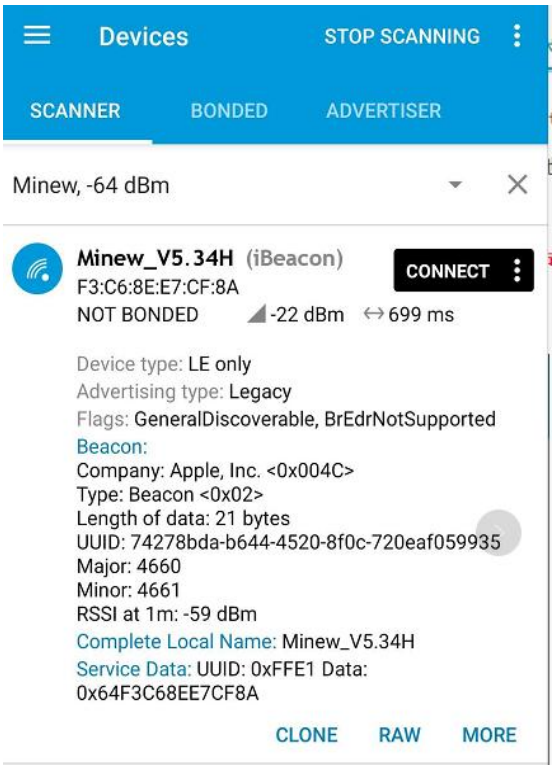


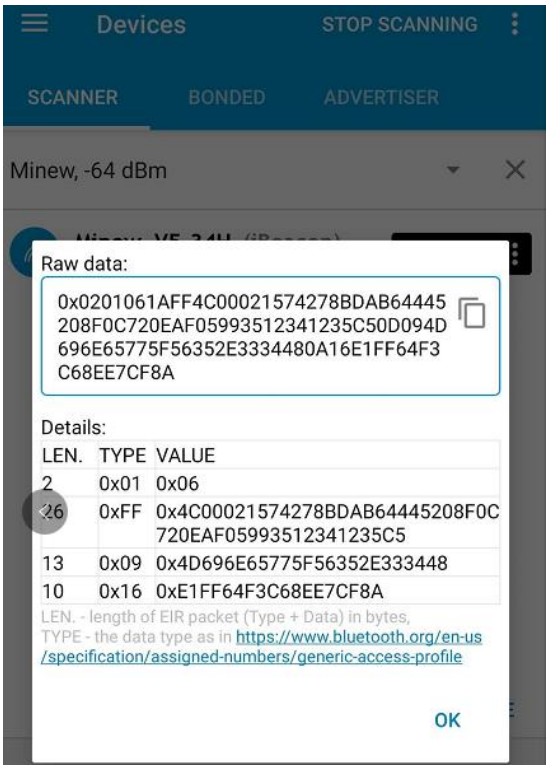


Note：The IOS system cannot obtain the contents of the MAC address field, so the MAC address is put into the broadcast packet again to ensure that the IOS system can obtain the MAC address of the device.

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

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

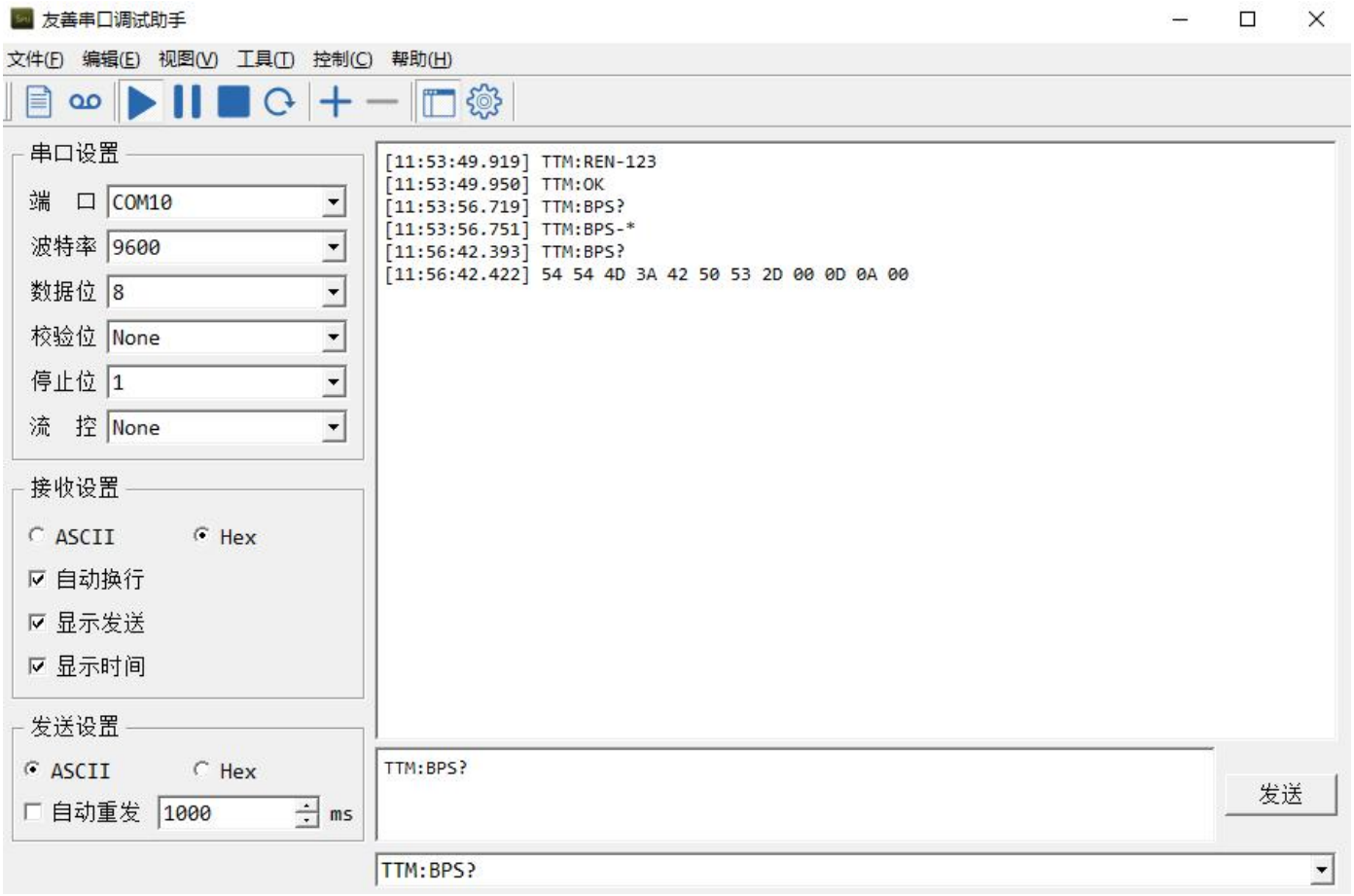




6.4.3 Operation examples

Connect all necessary pins according to the wiring mode, connect SLP and BTDATA to ground, and check device with the broadcast name " Minew_Vxxxxx " by phone App（Minew UART or nRF Connect）. In this state, send TTM:REN-XXXXXX by serial port, it will return TTM:OK\r\n\0. Then you can see that the broadcast name has been modified on the mobile phone. If you need to save the modified content after power-off, you need to send a reset command to take it into effect.

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



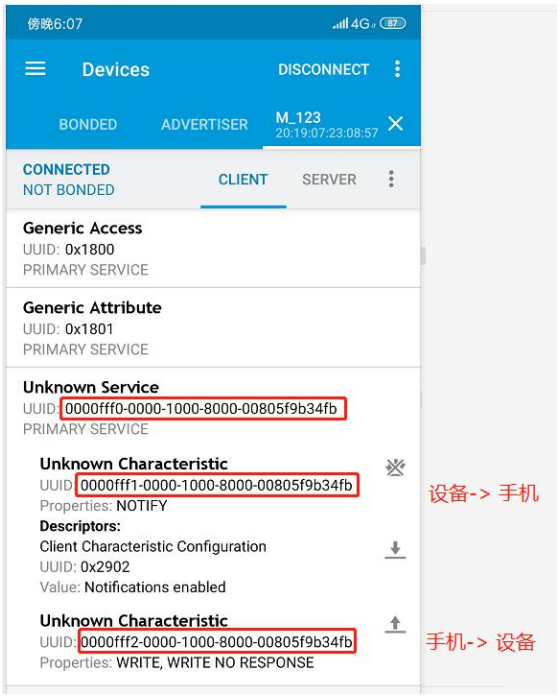
When querying the device parameters, it is shown with hexadecimal numbers. When choose to display by ASCII format, the parameter position may be garbled. At this time, it needs to be set to display by HEX format , and parameters correspond to the position after " 2D " . In above picture,to check the baud rate, you need to select the HEX display to view the specific parameters.

6.4.4 Transparent transmission

On the basis of above step, use the mobile phone APP to connect with module, keep the BTDATA pin low, then the data can be transparently transmitted. When BTDATA is in high level, it does not affect the module to broadcast and connection with phone, but transparent transmission is not available. Use nRF connect to read specific services, characteristics and their corresponding properties.

UUID consists of alias UUID (2 bytes, " fff0 " ,the third line in below picture) + base UUID (the remaining 14 bytes).

In the service in the transparent transmission , the base UUID used by the feature is standard, and the alias UUID is indicated in below:



FFF0 is service UUID，FFF1 is data received by phone which sent by module；FFF2 is data sent by phone and received by module.

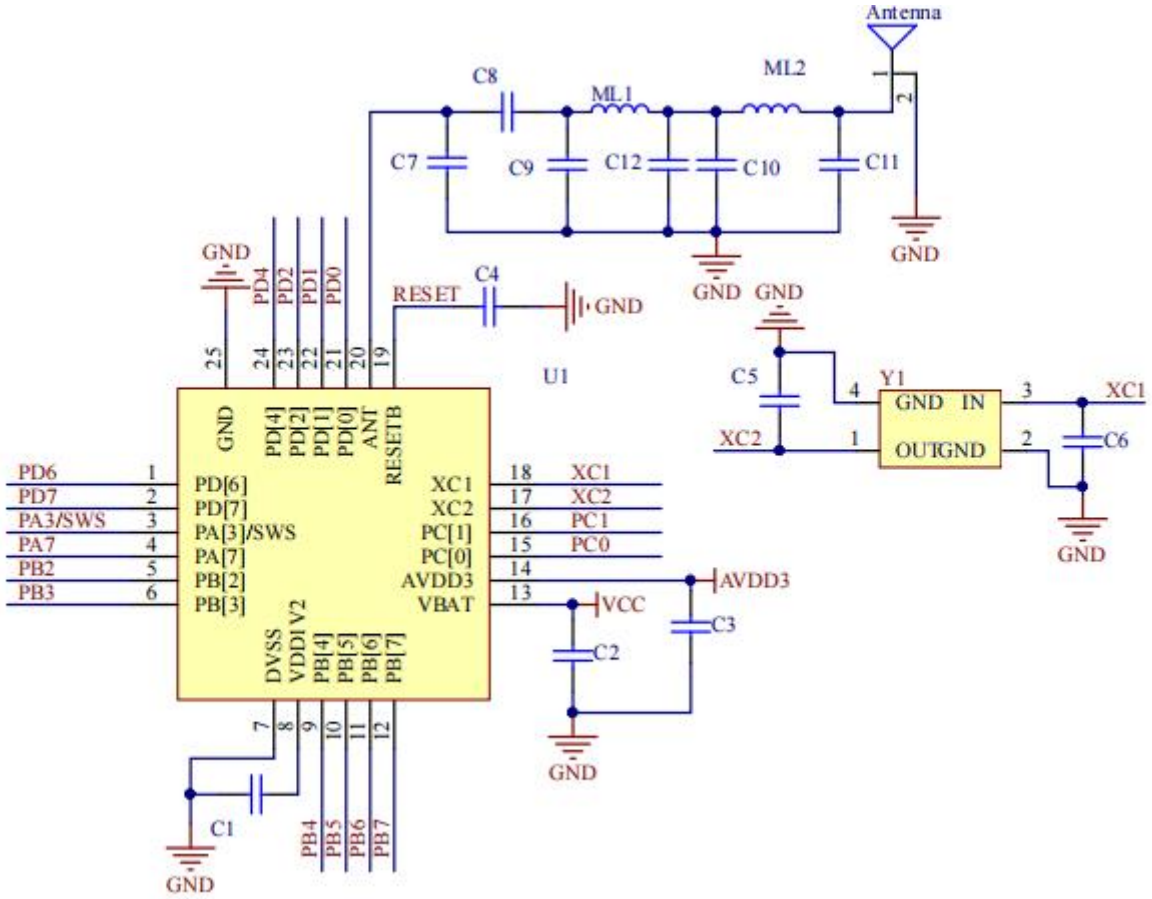
Eigenvalue UUID	Executable Action	Max Packet Length	Description
FFF1	notify	244	MCU send date to module through UART，then send to mobile phone over BLE. The data can only be obtained after the mobile phone enable notify. The max data length in each packet is 244 byte
FFF2	write	244	Mobile phone send data to module，then transfer to MCU through UART.When write data with API interface, the maximum data length of one packet is 244 bytes

7 Current Consumption Characteristics

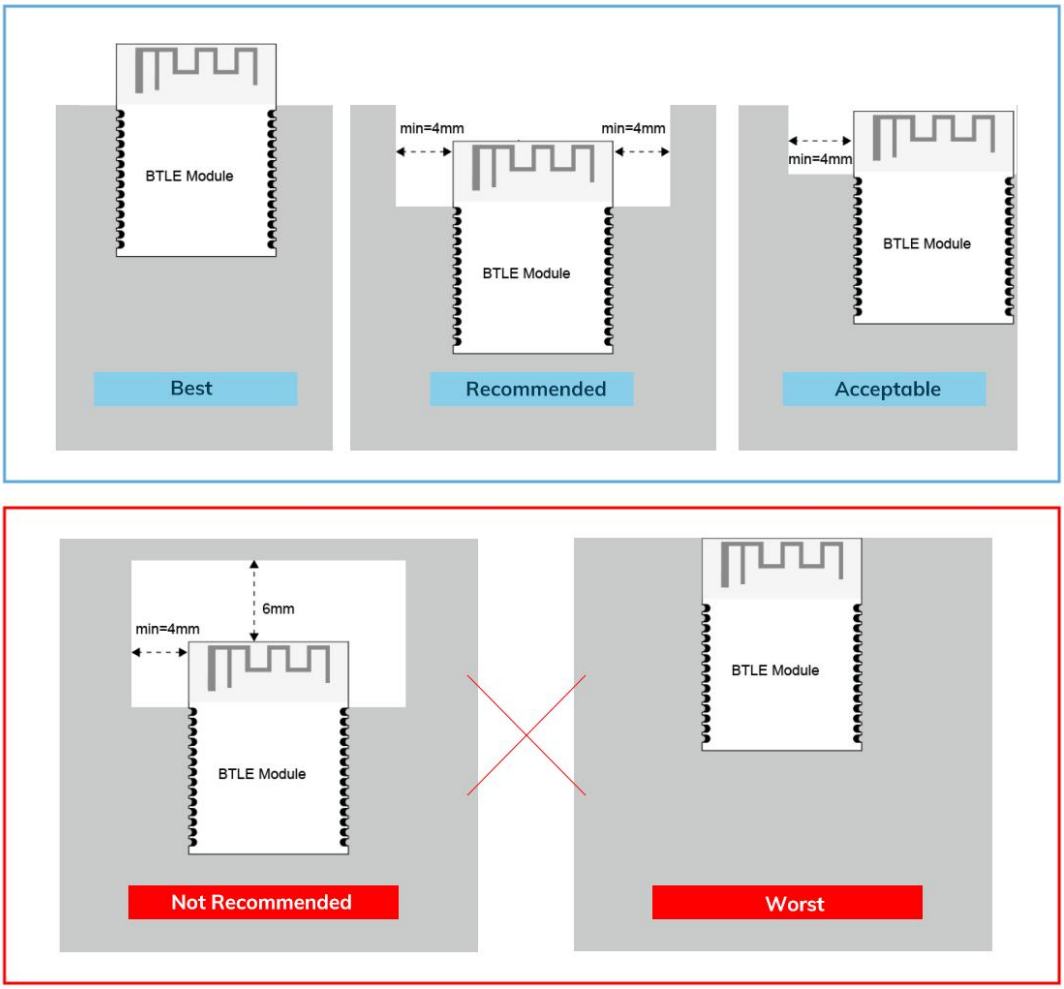
The current consumption measurements are taken with a 3.3 V supply at 25 °C of ambient Temperature.The broadcast interval is 1s, and the maximum and minimum connection interval is 20-40ms. The calculation of the service life is generally based on the average power consumption (Avg).

Status / Consumption	Peak(mA)	Avg(mA)
Average current in sleep state (SLP and BTDATA pulled high)	0.0018	0.00067
Average current in broadcast state (SLP pin is connected to GND, BTDATA is pulled high)	12.29	0.0435
Average current in connection state (SLP pin is connected to GND, BTDATA is pulled high)	13.14	0.295
Transparent transmission average current (SLP, BTDATA pins are connected to GND, connected to mobile phones)	13.22	3.59

8 Electrical Schematic



9 Layout Pattern



* Notes & Cautions

We cannot assure that the specification has no errors and omission even though this specification is under collate and check strictly.

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9.1 Design notes

- It is critical to following the recommendations of this document to ensure the module meets the specifications.
- The module should be placed at the edge of the circuit board as far as possible to keep away from other circuits.
- Antenna should be kept away from other circuits. It can prevent low radiation efficiency and the normal use of other circuits from being affected.
- The landing of components should be appropriate and that is better for reducing the parasitic inductance.
- Please refuse to supply voltage that is not within the range of specification.
- Please make sure the module or its surface may not suffer from the physical shock or extreme stress.

9.2 Layout Note：

To make sure wireless performance is at its best condition, please layout the MS45SF1 module
on the carrier board as below instructions and picture.

a) Placement of the antenna

The antenna area of module shall lay clearance completely and should not be blocked by the metal. Otherwise it will have effect on antenna performance (As the picture indicated below).

b) Placement of top-layer

The placement of top-layer in carrier board shall be lay copper completely to reduce the signal line in carrier board or other interference.

c) Clearance

The upper and below area of antenna (including the case) shall have 4mm or more than 4mm clearance to reduce the influences for antenna

9.3 Installation and soldering

Please do not lay copper under the module antenna. It can prevent the influence of signal radiation and the transmission distance from being affected.

9.4 Handling and storage

a) Due to the fact that CMOS components are included in the module, it is better to eliminate static electricity at any methods when transporting or working with the module. Moreover, it is strongly recommended adding anti-ESD components to circuit design to hinder damage from real-life ESD events. Anti-ESD methods can be also used in mechanical design.

b) Please store the modules within -40℃ to +125℃ before and after installation and make sure the modules is away from the direct sunlight exposure for a long duration. Modules should be far away from humid and salty air conditions, and any corrosive gasses or substances.

c) Please not to wash the module. No-Clean Paste is used in production. The metal shield may be oxidized by the washing process and may lead to chemistry reaction with No-Clean Paste. If modules goes through the washing process, functions of the module may not guaranteed.

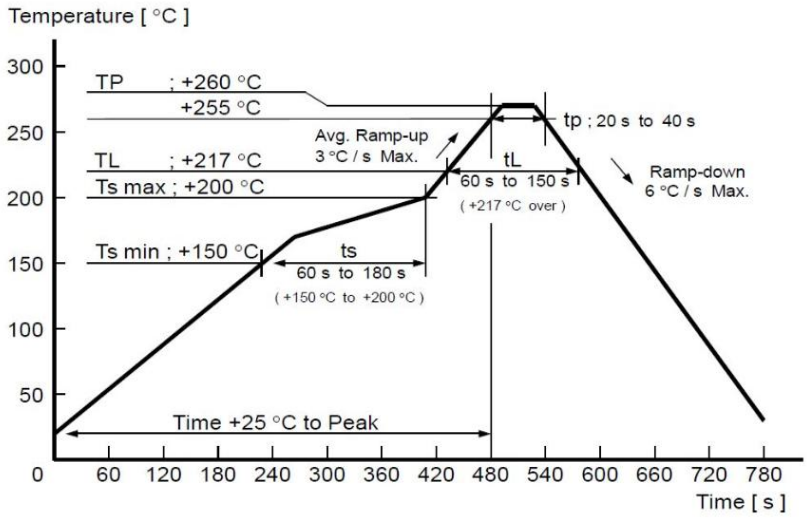
d) After opening the package, it should be stored in vacuum environment. Module should no t be exposed to the air for a long time to prevent moisture and pad oxidation. If there is a n interval of 7 to 30 days during SMT process.

9.5 Life support applications

a) The module is not design for life support device or system and not allowed to be used in destructive devices or system in any direct, or indirect ways. Minewsemi is not responsible for compensation of any losses when applying modules under such application as described above.

b) Minewsemi shall not responsible for the customer's products or application.

10 Reflow and Soldering



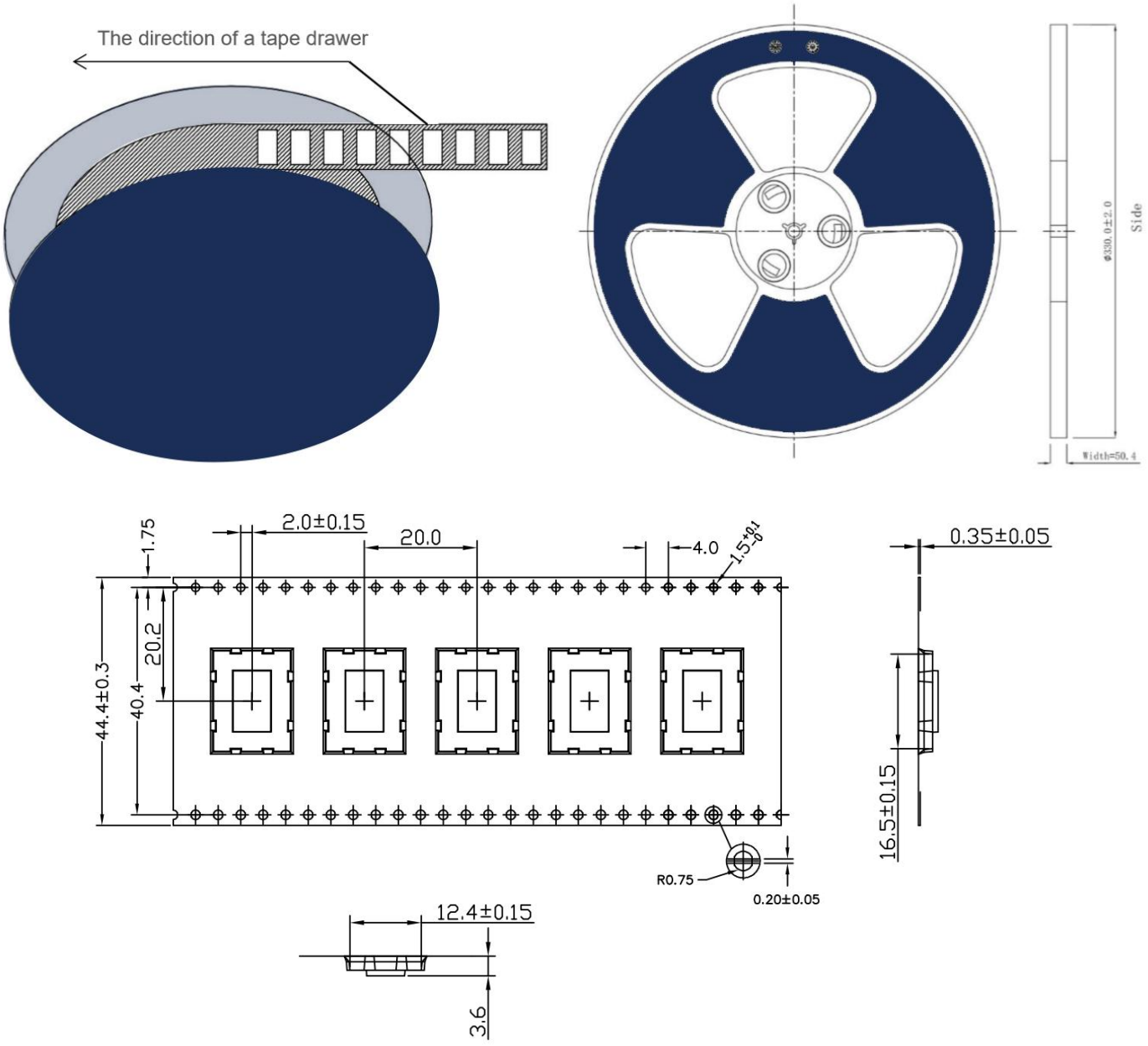
Profile Feature	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min (Tsmin)	100°C	150°C
Preheat Temperature max (Tsmax)	150°C	200°C
Preheat Time (Tsmin to Tsmax)(ts)	60-120 sec	60-120 sec
Average ramp-up rate (Tsmax to Tp)	3°C/second max	3°C/second max
Liquidous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

Important:

- When SMT involves double-sided patch, it is recommended that the module surface be reflowed only once.
- For module SMT, it is recommended to make a partial stepped stencil with a thickness of 0.2mm, and the stencil hole should be extended by 0.8mm size.
- After opening the package, it should be stored in vacuum environment. Module should not be exposed to the air for a long time to prevent moisture and pad oxidation. If there is an interval of 7 to 30 days during SMT process, it is recommended to bake it with reel at 65-70 degrees for 24 hours before using for SMT again.

11 Package Information

11.1 Package dimension



*（Unit：mm　　Tolerance：±0.1）

Item	QTY	Net Weight	Gross Weight	Size
MS52SF2	850PCS	515g	1150g	W=44mm，T=0.35mm

Note：The weight tolerance is within 10g（unless any special note).

11.2 Part number description

Each module is with different code no. To devine whether with 32.768k or not，with on-board antenna or external antenna，the code no. will be marked on the metal shield，description as below：

Part No. in the first line		MS52SF2	Part No. in the second line	1Y08AI
MS52SF2	Model No.			
1	Antenna Type		1	PCB Antenna
			2	Ceramic Antenna（Chip）
			3	IPEX Connector（1st Generation）
Y	32.768KHz		Y	With 32.768K Crystal Oscillaor
			N	Without 32.768K Crystal Oscilltaor
10	SoC		05	m1805，nRF52805
			08	TLSR8208
			10	nRF52810
			20	nRF52820
			32	nRF52832
			33	nRF52833
			40	nRF52840，nRF5340
			C3	ESP32-C3FH4
A	SoC Package		A	=AA
			B	=AB
			C	=AC
I	RF Signal Output		I	internal
			E	external

12 Quality Disclaimer

The factory has passed the ISO9001 quality management system, ISO14001 environmental management system and OAHS18001 occupational health and safety assessment . Each product has been rigorously tested (transmission power test, sensitivity test, power consumption test, stability test, aging test, etc.).

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13 Revision History

Version	Content	Contributor	Date	Note
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