

Bluetooth LE Module

MS88SF3



Datasheet

V 1.0.0



Version Note

Version	Details	Contributor(s)	Date	Notes
1.0.0	First edit	Michelle	2024.05.06	

Part Number

Model	Hardware Code
MS88SF31	1Y40AI



*Due to the limited module size, regulatory marks and certification IDs are provided in this datasheet and/or on the packaging. The final product incorporating this module shall include a label indicating that it contains a certified module.

Click the icon to view and download the latest product documents electronically.
https://en.minewsemi.com/file/MS88SF3-nRF52840_Datasheet_K_EN.pdf



MS88SF3-nRF52840

High-performance, Full I/O port, multi-protocol Bluetooth 5.4 module

The MS88SF3 is a low-power, cost-effective wireless BLE 5.4 module based on the nRF52840 SoC. Its powerful 32-bit ARM Cortex™ M4F CPU, 1M FLASH program space, 256kB RAM, integrated 2.4 G transceiver, and other powerful supporting resources provide the perfect solution for Bluetooth connectivity. nRF52840 can support protocols such as ANT, BLE, BLE MESH, ZIGBEE, and THREAD. It has an estimated range of up to 250 meters in open space at a data rate of 125kbps.

FEATURES



Bluetooth 5.4



High-performance



Leads 48 I/O ports



Support ANT, BLE, BLE MESH, ZIGBEE and THREAD protocols, etc

KEY PARAMETER

MS88SF3-nRF52840			
Chip Model	nRF52840	Antenna	PCB
Module Size	18.5×12.5×2mm	GPIO	48
Flash	1M	RAM	256KB
Receiving Sensitivity	-95dBm(1Mbps) -103dBm(125kbps)	Transmission Power	-40 ~ +8dBm
Current(TX)	0dBm-4.8mA	Current(RX)	4.6mA

APPLICATION



Smart Buildings



Consumer Electronics



Intelligent Medical care



Smart Agriculture



Security Equipment



Automotive Equipment

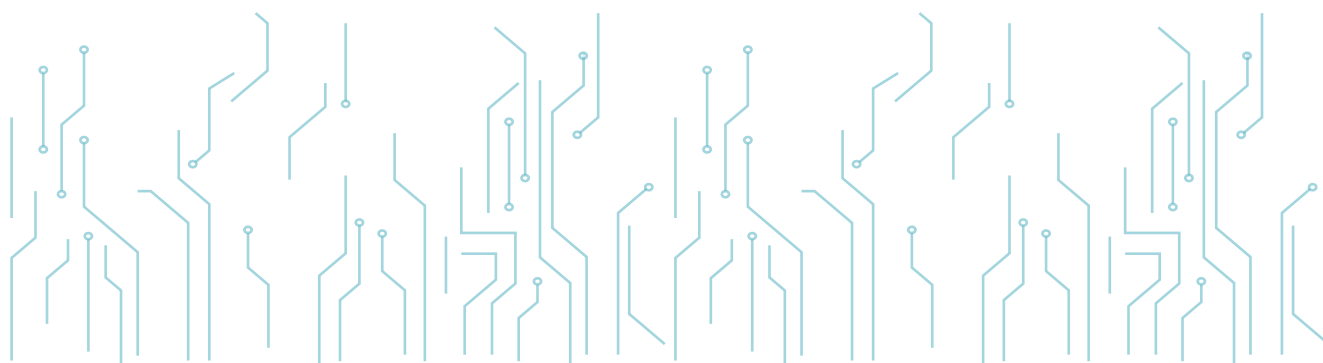
CERTIFICATION



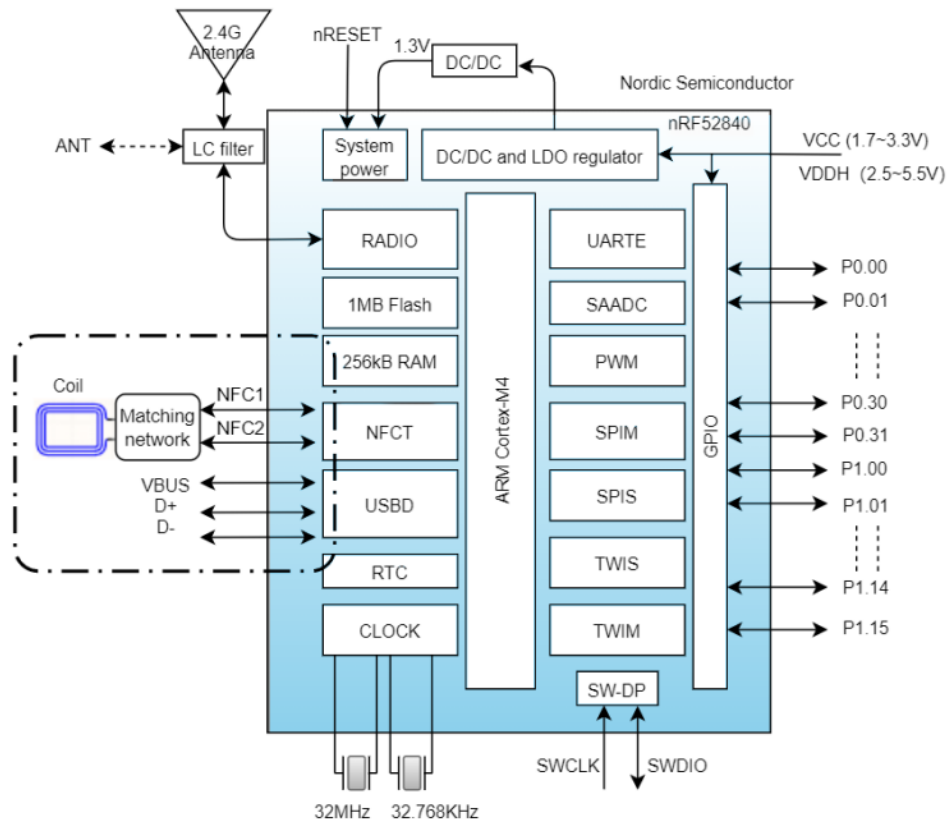


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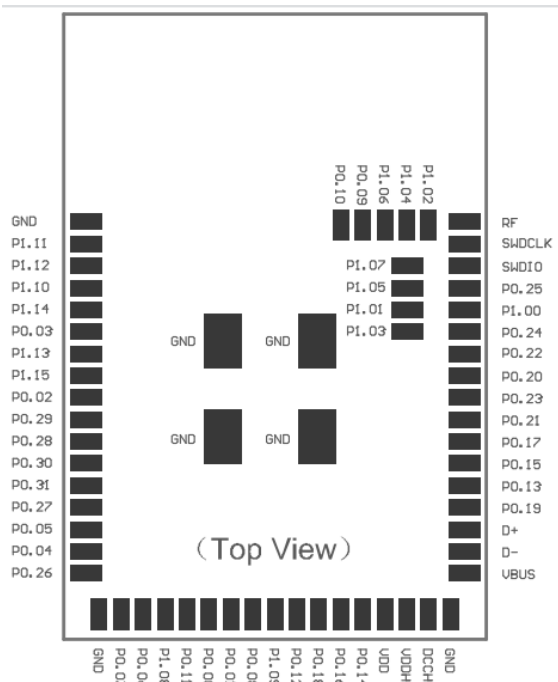
1 BLOCK DIAGRAM



2 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 receiving current under 1Mbps pattern
Current(TX)	4.8mA	RF transmission current under 0dBm pattern
Module Dimension	18.5*12.5*2mm	
Quantity of IO Port	48	

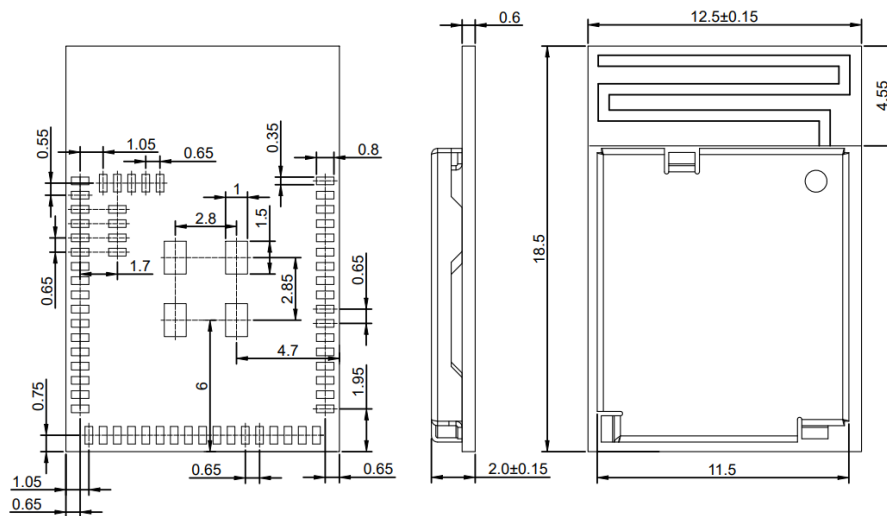
3 PIN DESCRIPTION



4 PIN DEFINITION

Symbol	Type	Definition
GND	ground	ground
SWCLK / SWDIO	Burn Pins	Burn pins, burn only need to connect the power supply pin, ground, and these two pins
P0.02-P0.31 P1.00-P1.09	I/O	General Purpose I/O Port
VDD	power	Power supply, 1.7V-3.6V, use this pin for power supply, need to short VDD and VDDH
VDDH	power	Power supply, 2.5V-5.5V, use this pin for power supply, not connected to VDD pin
DCCH	power	DC/DC converter output
VBUS	power	USB Power Supply, 4.35V-5.5V
D+	Digital interfaces	USB D+
D-	Digital interfaces	USB D-
RF	External Antenna Pin	By default, the module comes with an antenna, this pin is directly suspended. If you don't use the module antenna, you can connect an external antenna through this pin, when connecting an external antenna, the module needs to connect the resistor with the antenna to this pin..

5 MECHANICAL DRAWING

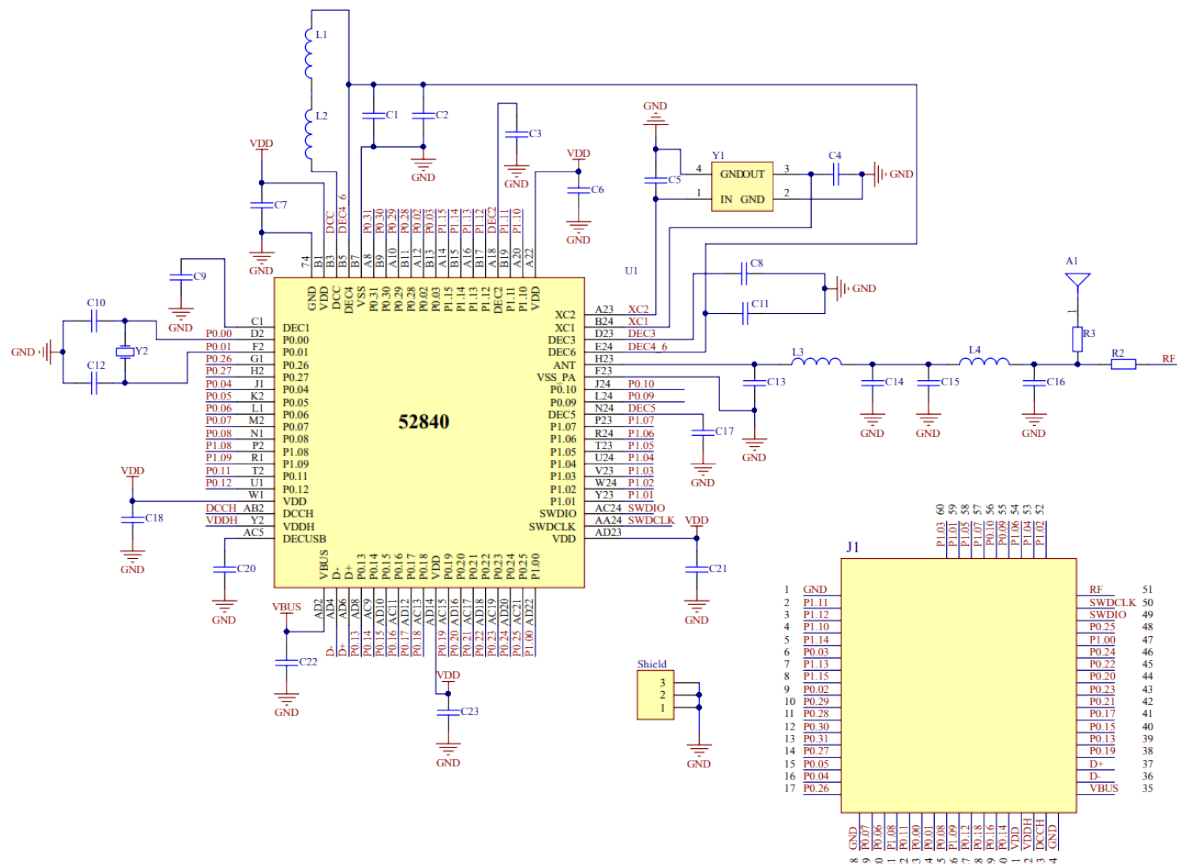


Default unit: mm Default tolerance: ± 0.15



Important: Unit: mm Tolerance: +/- 0.1, default
Recommend solder pad size: 1.1*0.35mm, Center GND pad: 1.8*1.3mm.

6 ELECTRICAL SCHEMATIC



Notice: Before placing an order, please confirm the specific configuration required with the salesperson.

7

PCB DESIGN

7.1 Disclaimer

This document is provided as a recommended design reference for wireless modules and does not constitute any explicit or implied guarantee of performance or compliance. Due to differences in PCB layout, enclosure structure, antenna selection, and application environments of the end product, this document cannot guarantee RF performance in all scenarios. Users must conduct sufficient RF performance and compliance verification after completing the final product design and shall bear full responsibility for design and application outcomes. Our company reserves the right to modify the contents of this document without prior notice.

7.2 Core Rules for Module Placement

Board Edge Priority Rule

The RF output/antenna side of the module must face the edge of the main PCB to ensure that antenna radiation is directed outward from the board without obstruction. Placing the module in a closed central area of the PCB is strictly prohibited.

Keep-Out Area Rule

A 0.5 mm area around the module body must be kept clear. Non-ground components and non-ground signal traces are prohibited within this area. Within 4 mm around the RF side of the module, copper pours, unrelated components, and non-RF signal traces are strictly prohibited.

Interference Isolation Rule

The module must maintain a minimum safe distance from strong interference sources. Adjacent placement on the same layer is prohibited. Isolation using different PCB layers and shielding covers is recommended. General isolation requirements are as follows:

Interference Source Type	Minimum Recommended Isolation Distance
DC-DC switching power supplies, power inductors, power transformers	20mm
USB 3.0 / HDMI 2.0 / DDR / High-speed SDIO interfaces	20mm
MCU high-frequency clock circuits, Ethernet PHY chips	15mm
Displays, cameras, FPC cables with wiring	25mm

Structural Clearance Rule

The minimum distance between the module and metal screws, clips, standoffs, and other structural parts must be ≥ 5 mm. At least 4 mm of SMT soldering and rework clearance must be reserved around the module. The RF side of the module must not be enclosed inside a fully metal cavity.

Multiple Modules on the Same PCB

When placing multiple wireless modules of the same or different types on the same PCB, the minimum spacing between modules must be ≥ 50 mm to avoid mutual interference.

7.3 GENERAL PCB DESIGN REQUIREMENTS

Grounding Design

The main PCB must maintain a complete and continuous ground plane. Splitting the ground plane within the module projection area or RF surrounding area is strictly prohibited. All module ground pins must be soldered. At least one grounding via should be placed near each ground pad and connected to the main ground plane. A complete ground plane with dense grounding vias may be placed under the non-RF area of the module to improve shielding performance.

Power Supply Design

Decoupling capacitor combinations must be placed close to the module power input pins. The trace length between capacitor pads and power pins should be ≤ 0.5 mm, and at least two grounding vias should be placed near the ground terminal. For switching power supply applications, a π -type filter circuit footprint must be reserved near the module power input pins.

RF Trace Design

The entire RF path must maintain a strict 50 Ω characteristic impedance (tolerance $\pm 10\%$). RF traces should be as short as possible and routed preferably in straight lines. Sharp or right-angle corners are prohibited; curved routing with a radius ≥ 3 times the trace width is recommended. Branch traces and stub traces are prohibited. A continuous reference ground plane must exist beneath the RF traces, and no other signal traces should be routed within 3 times the trace width on either side. Ground shielding should be applied throughout the RF routing.

Control Interface Design

Control signal traces such as UART, SPI, and I2C should be routed away from RF areas with short and simple routing paths and continuous ground shielding. Parallel routing adjacent to RF traces is prohibited. ESD protection devices must be placed close to external PCB connectors and must not be placed near module pins.

Footprint Design

Strictly use the standard PCB footprint provided by our company. Unauthorized modification of pad size or spacing is prohibited to ensure soldering reliability.

7.4 DESIGN RESTRICTIONS

Do not place the RF side of the module facing the inside of the PCB or away from the board edge.

Do not place copper pours, components, or fully enclosed metal housings without openings over the antenna area.

Do not route RF traces across split ground planes, without a complete reference ground, or with right-angle corners.

Do not place modules adjacent to strong interference sources or split the ground plane in the module area.

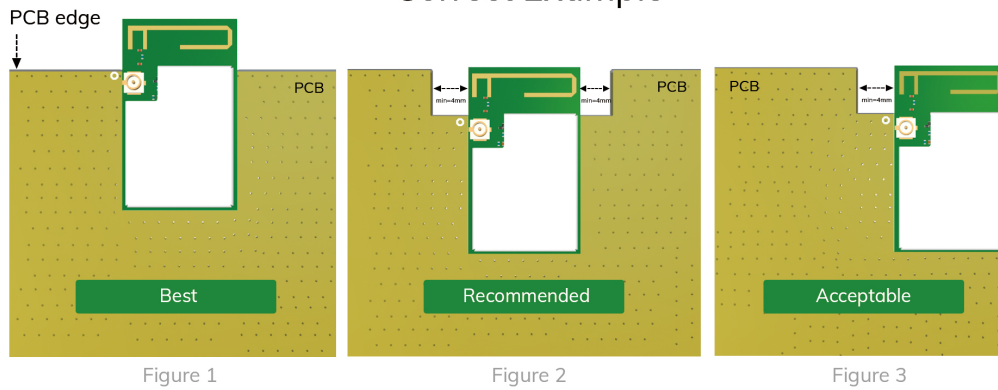
Do not leave module ground pins unconnected or inadequately grounded.

7.5 MODULE PLACEMENT EXAMPLE

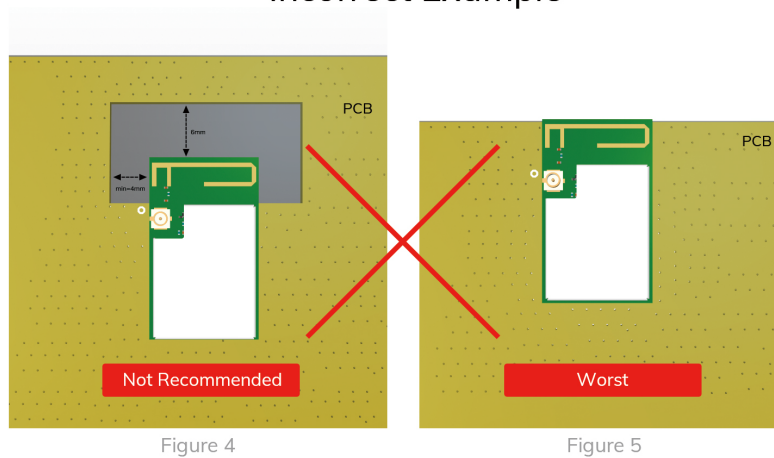
For end products, antenna position significantly affects overall system performance. The module should preferably be placed at the edge or corner of the PCB to maximize the clearance area and reduce interference from surrounding components. The PCB area directly beneath the module antenna should be hollowed out to keep the antenna region suspended, while no signal traces, metal objects, or other interference sources should exist within 3–5 mm around the antenna area. The figure below demonstrates an example of proper module placement on the main PCB for optimal RF performance. The first recommended layout method should be used whenever possible, as the module antenna design has been tuned and optimized based on this configuration.



Correct Example



Incorrect Example



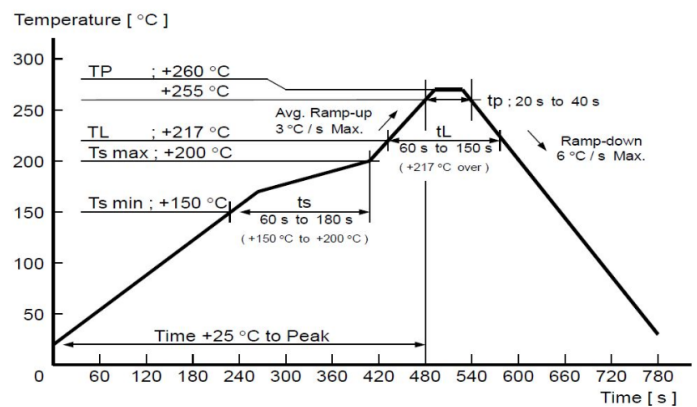
8 REFLOW AND SOLDERING

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.

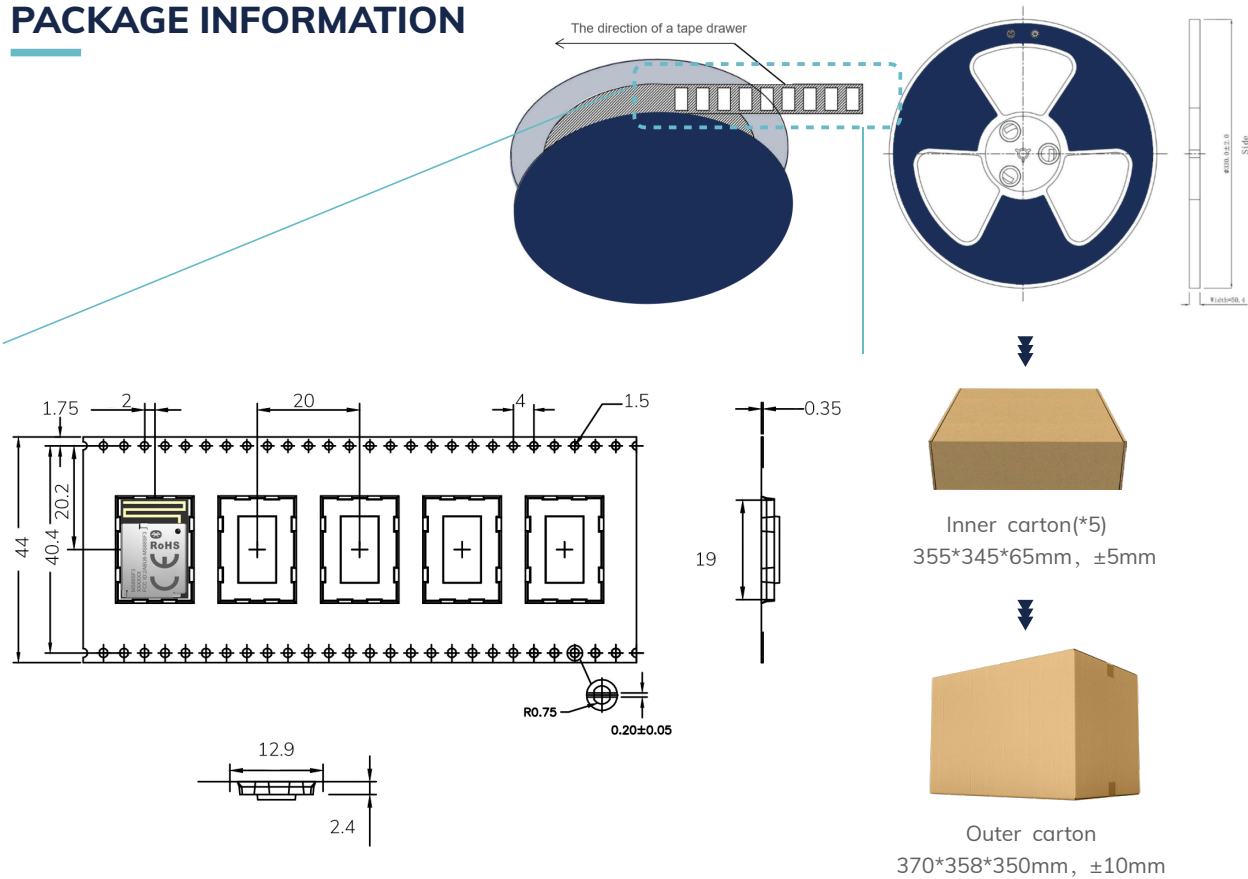
3) Module SMT recommends a steel mesh thickness of 0.1~0.12mm, and the steel mesh openings should be reduced relative to the solder pads (ratio 1:0.9).

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.

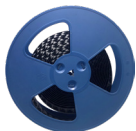
5) ESD protection measures should be implemented before using SMT.



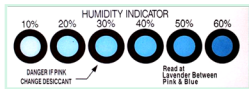
9 PACKAGE INFORMATION



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
MS88SF3	850PCS	680g	1537g	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.

The device has been evaluated to meet general RF exposure requirement. It can be used in portable exposure condition without restriction.

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: 2ABU6-MS88SF3

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: 2ABU6-MS88SF3"

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
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