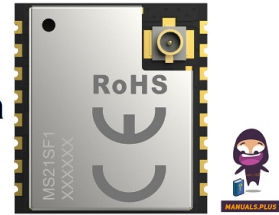


MINEWSEMI MS21SF1 LoRa Module



MINEWSEMI MS21SF1 LoRa Module Owner's Manual

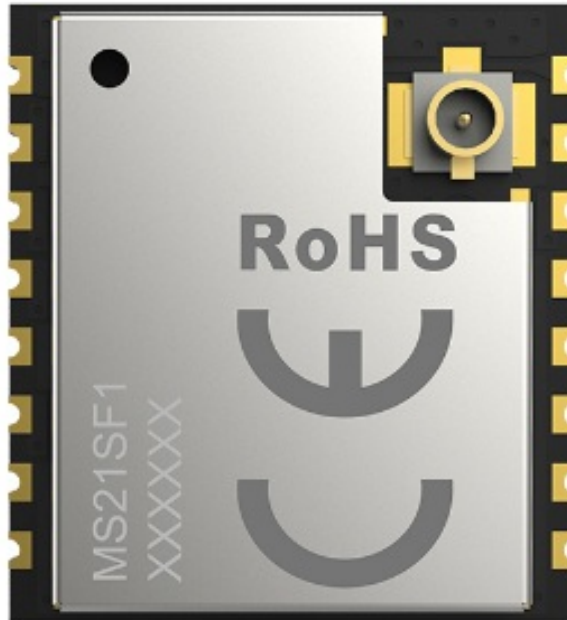
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MINEWSEMI MS21SF1 LoRa Module



Version Note

MS21SF1-LLCC68/SX1262 Low-power, ultra-long-range, Small and easy to operate, high-sensitivity

Version	Details	Contributor(s)	Date	Notes
1.0.0	First edit	Vincle	2023.08.29	
1.1.0	Addition of modules TX, RX mode control	Vincle	2023.09.29	

MS21SF1 module is based on Semtech's LoRa wireless half-duplex transceiver chip, LLCC68/SX1262, and supports global ISM frequencies. It is a low-power, ultra-long-range, small, and easy-to-use SPI-interfaced LoRa® transceiver module, with a current of only 4.7mA in receive mode, and achieves a high transmission power through the internal integrated high-efficiency power amplifier. Higher reception sensitivity down to -146dBm, compliance with the physical layer requirements of the LoRaWAN® standard specification, and support for LoRa® P2P(points-to-point). Supporting customers in the rapid set-up of their private, long-range LoRa® networks.



Features

- Non-MCU Control, An external MCU is required to connect and control through the SPI interface
- Programmable bit rates, with bit rates reaching up to 62.5 kbps for both LoRa and FSK modulation
- Transmission Range up to 5KM
- Support SPI interface, which can be connected directly to a variety of MCUs Application

Application

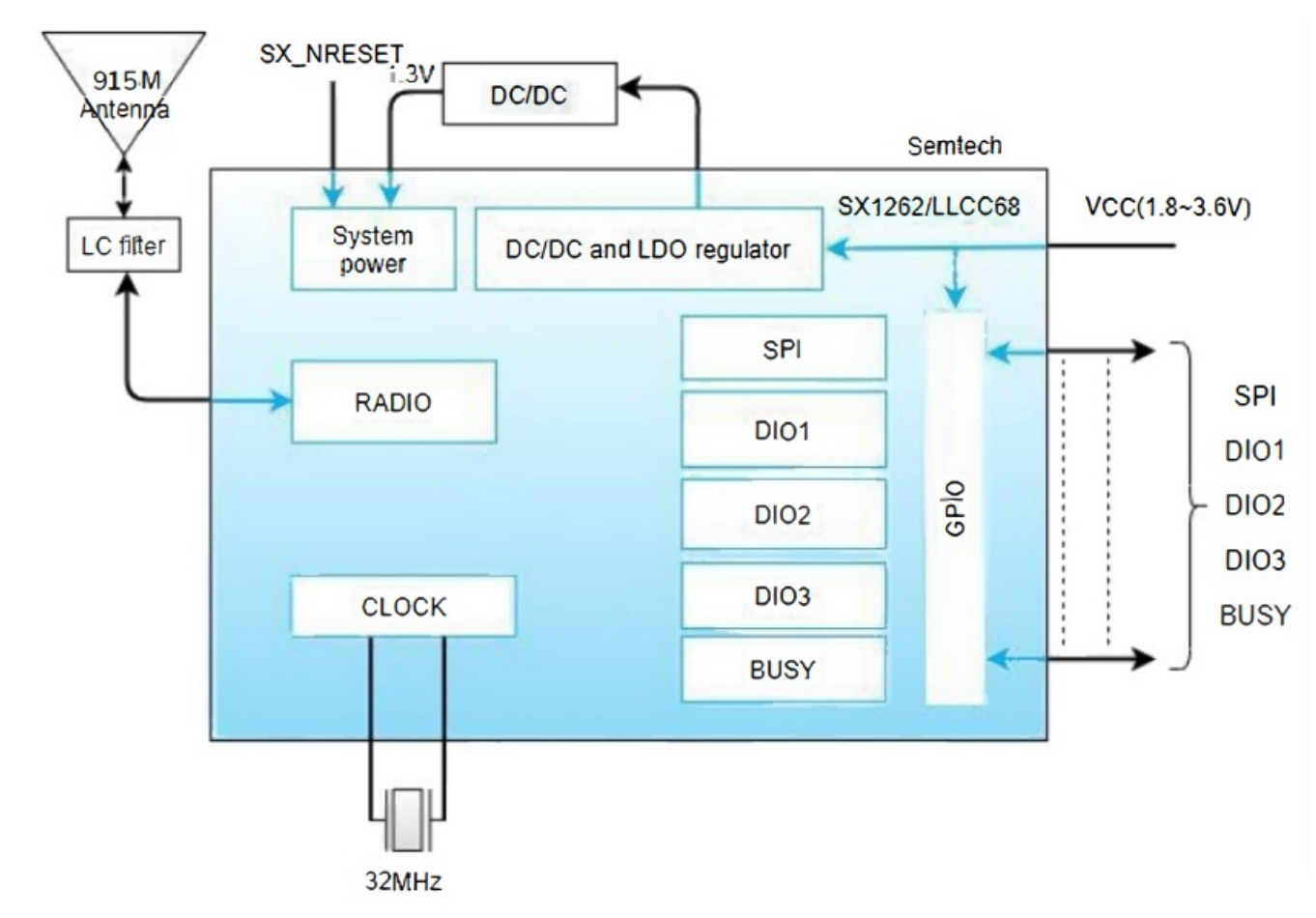
Security and early warning equipment

Instrumentation smart metering Agricultural sensors Retail Store Sensors street

Key parameter

Chip Model	LLCC68/SX1262	Antenna	IPEX
Module size	16.4x15x3mm	GPIO	5
Receiving Sensitivity	-146dBm		
Current(TX)	118mA	Current(RX)	4.7mA

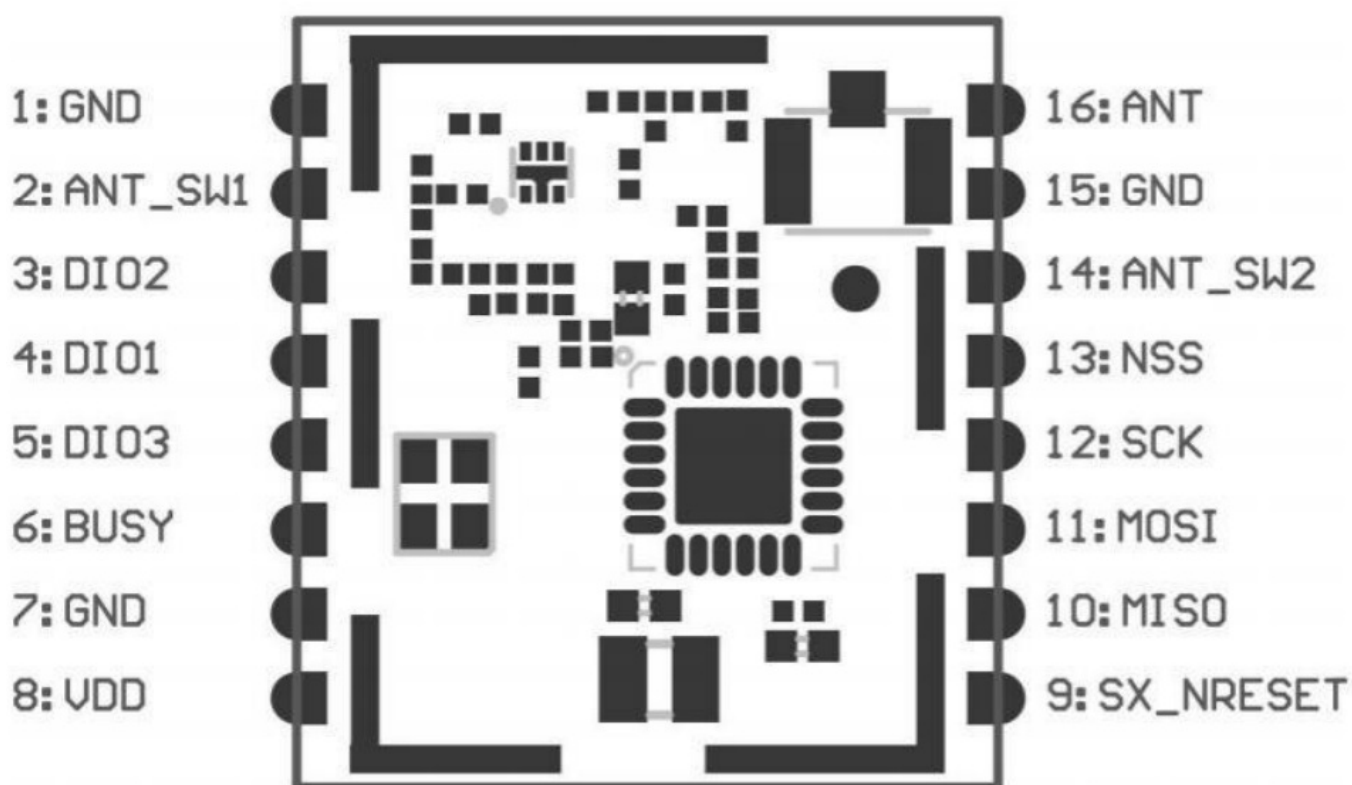
BlockDiagram



ElectricalSpecification

Parameter	Values	Notes
Operation Voltage	1.7V-3.7V	To ensure RF work, supply voltage suggest not lower than 3.3V
Operation Temperature	-40℃~+85℃	
		Configurable
ISM Frequency	903.2~927.5MHZ	Optional, default 915MHZ
Current(RX)	4.7mA	RX mode
Current(TX)	118mA	TX mode
Module Dimension	16.4x15x3mm	
Quantity of IO Port	5	

Pin Description

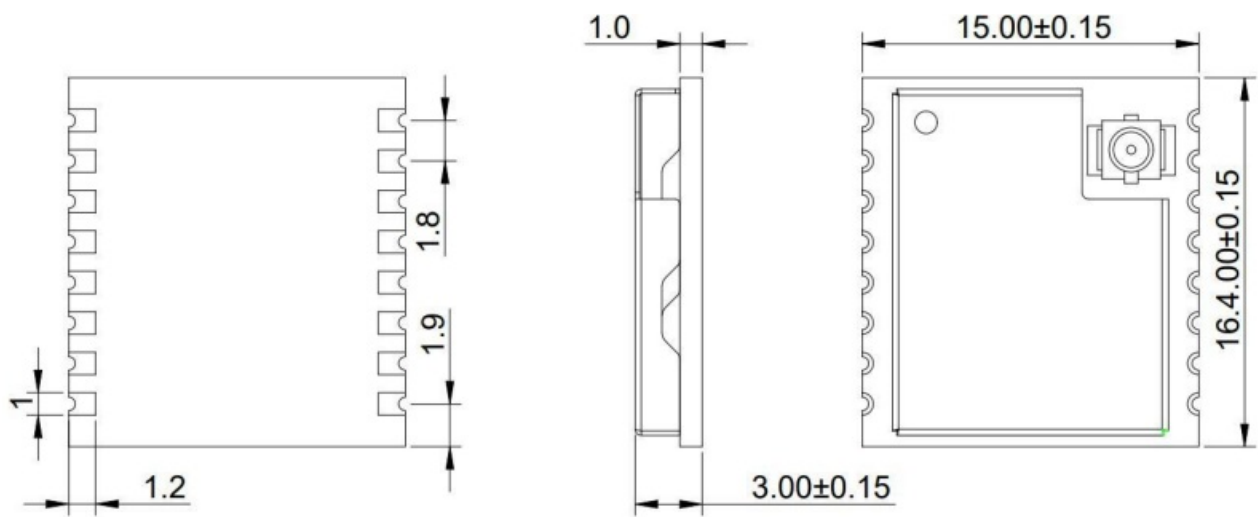


Pin Definition

Number	Symbol	Type	Function description	Notes
1	GND	—	Grounded	

2	ANT_SW1	SWITCH	Antenna switch control	RF TX signal Control Switch connect the external MCU IO or DIO2, and the high level is valid
3	DIO2	I/O	Multi-purpose digital I/O / RF Switch control	
4	DIO1	I/O	Multi-purpose digital I/O	
5	DIO3	I/O	Multi-purpose digital I/O – external TCXO supply voltage	
6	BUSY	O	Busy instruct	
7	GND	–	Ground	
8	VDD	I	Input voltage for power amplifier regulator	Power supply to voltage 3.3V
9	SX_NRESET	I/O	Reset signal	Active low
10	MISO	O	SPI Slave output	
11	MOSI	I	SPI Slave input	
12	SCK	I	SPI clock	
13	NSS	I	SPI chip select (CS)	
14	ANT_SW2	SWITCH	Antenna switch control	
15	GND	–	Grounded	RF switch receiving control pin, connected to external MCU IO, active at high level
16	ANT	–	Antenna connect pin	

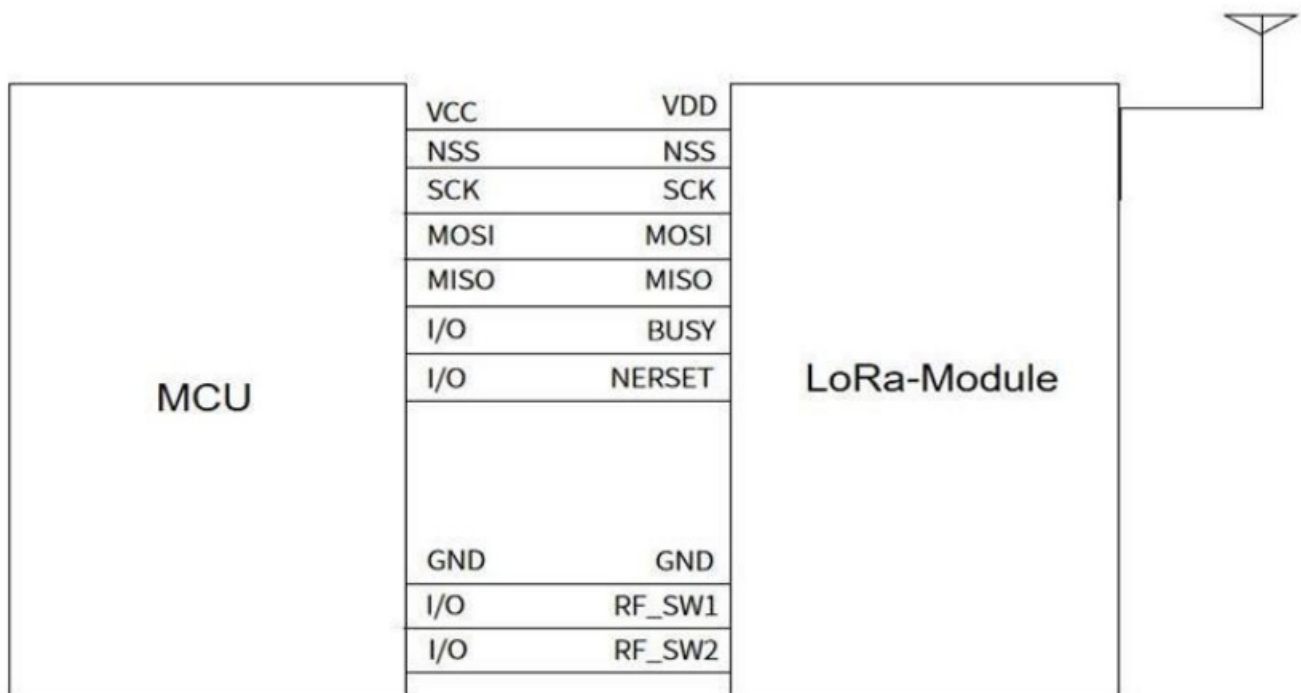
Mechanical Drawing



* (Default unit: mm Default tolerance: ±0.1)

Module Connection Description

Connection diagram



Power supply

The chip-sets operating voltage range is 1.8V-3.6V, to ensure normal use, the power supply voltage shall be 3.3V as far as possible.

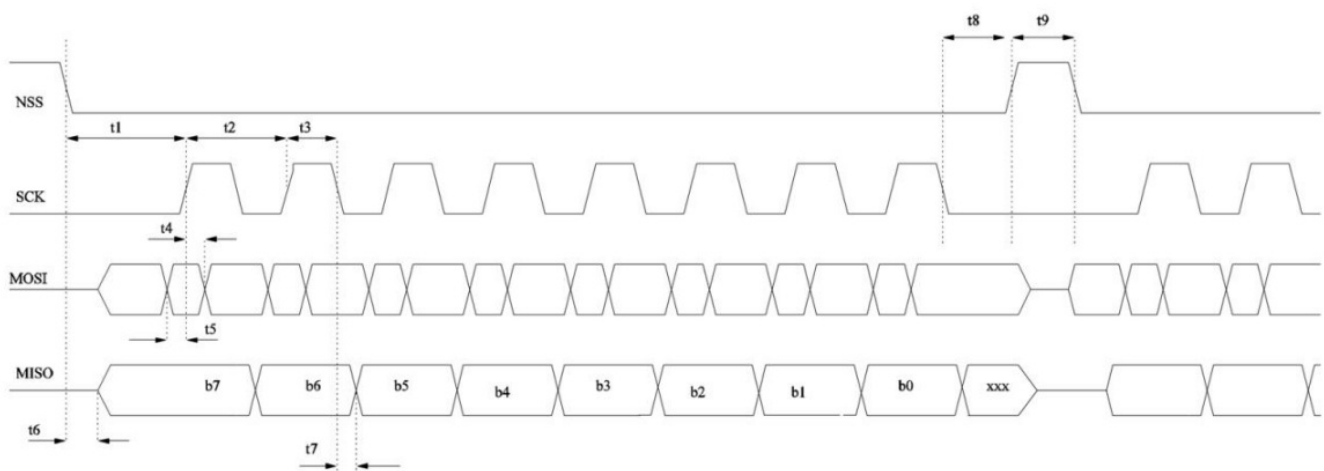
SPI Interface character

The SPI runs on an external SCK clock, allowing it to reach 16MHz. Transmission is initiated when the NSS pin level goes low. When NSS is high, MISO is in a high impedance state.

SPI Timing Requirements (The chip implements only the Slave side function.)

Symbol	Description	Minimum	Typical	Maximum	unit
t1	NSS falling edge to SCK setup time	32	—	—	ns
t2	SCK period	62.5	—	—	ns
t3	SCK high time	31.25	—	—	ns
t4	MOSI to SCK hold time	5	—	—	ns
t5	MOSI to SCK setup time	5	—	—	ns
t6	MOSI to SCK setup time	0	—	15	ns
t7	SCK falling to MISO delay	0	—	15	ns
t8	SCK to NSS rising edge hold time	31.25	—	—	ns
t9	NSS high time	125	—	—	ns
t10	NSS falling edge to SCK setup time when switching from SLEEP to STDBY_RC mode	100	—	—	s
t11	NSS falling to MISO delay when switching from SLEEP to STDBY_RC mode	0	—	150	s

Active Timing



DIO with IRQ control

Commands Controlling the Radio IRQs and DIOs (At least one DIO is required for IRQ, and BUSY cable is also required to be used compulsorily).

Command	Operate code	Parameters	Description
SetDioIrqParams	0x08	IrqMask[15:0], Dio1Mask[15:0], Dio2Mask[15:0], Dio3Mask[15:0],	Configure the IRQ and the DIOs attached to each IRQ
GetIrqStatus	0x12	—	Get the values of the triggered IRQs
ClearIrqStatus	0x02	—	Clear one or several of the IRQs
SetDIO2AsRfSwitchCtrl	0x9D	Enable	Configure radio to control an RF switch from DIO2
SetDIO3AsTcxoCtrl	0x97	tcxoVoltage, timeout[23:0]	Configure the radio to use a TCXO controlled by DIO3

Module TX, RX Mode controls

In ANT_SW1 and DIO connection Points, the two connection points are 10 pins and external MCU GPIO for detecting TX and RX level pins, ANT_SW2 is the synchronization control pin:

1. When 10 pin detects a high level, pin ANT_SW2 sets the level to low, and the mode is TX mode.
2. When 10 pin detects a low level, pin ANT_SW2 sets the level too high, and the mode is RX mode

Mode	IO	ANT_SW2
TX	1	0
RX	0	1

Module power consumption description

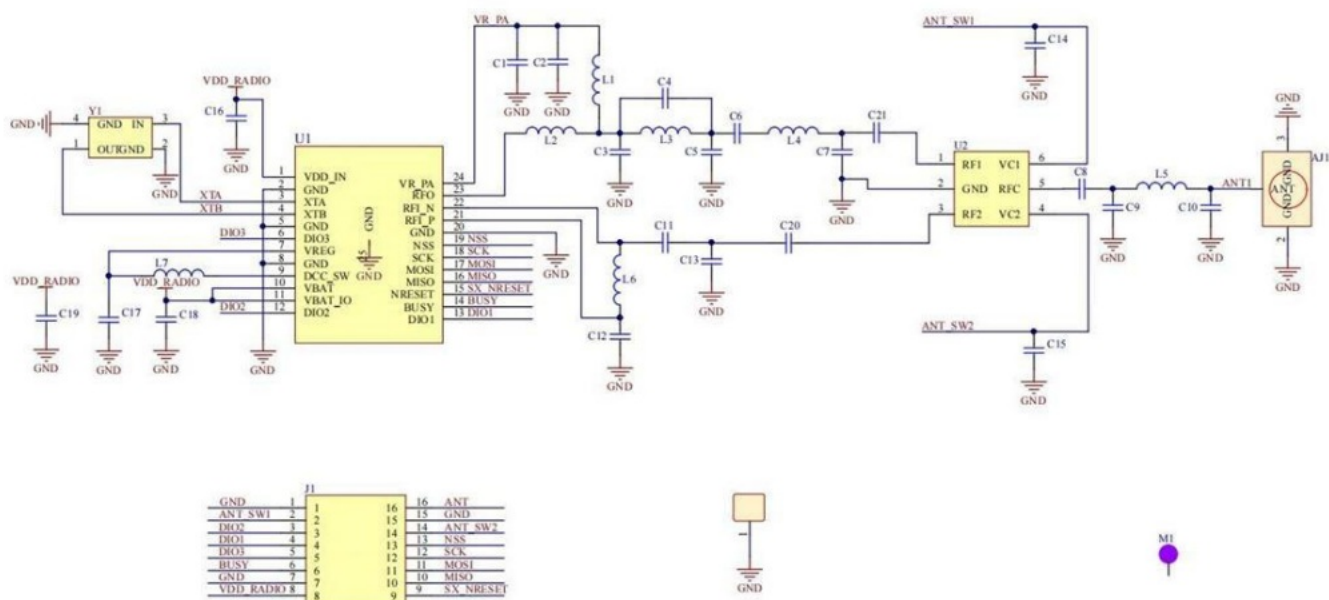
The following power consumption test is conducted under the normal temperature condition when the power supply voltage is 3.3V. The power consumption in the 915MHz frequency band is measured.

Mode	Power	SF Mode	Peak	Avg
TX		SF7	112.01mA	98.60mA
		SF12	123.32mA	115.62mA

Mode	Power	Peak	Avg
Sleep		538.41uA	0.85uA
RX		4.76mA	4.22mA

Electrical Schematic

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



PCB Layout

Module antenna area couldn't have a GND plane or metal cross line, and couldn't place components nearby. It is better to make a hollow out or clearance treatment or place it on the edge of the PCB board.

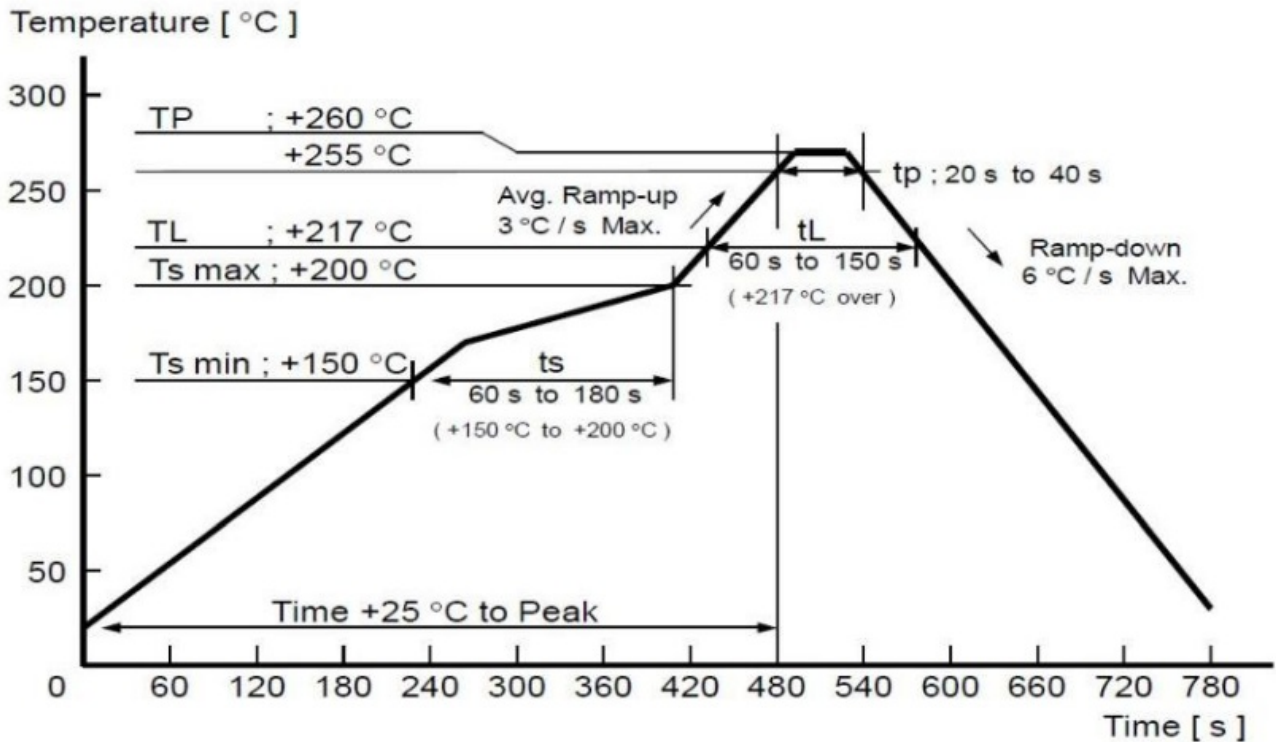
Layout notes

1. Preferred Module antenna area completely clearance and not be prevented by metals, otherwise, it will influence the antenna's effect (as above DWG. indication).
2. Cover the external part of the module antenna area with copper as far as possible to reduce the main board's signal cable and other disturbances.
3. It is preferred to have a clearance area of 4 square meters or more area around the module antenna (including the shell) to reduce the influence on the antenna.
4. The device should be grounded well to reduce the parasitic inductance.
5. Do not cover copper under the module's antenna to avoid affecting signal radiation or leading to transmission distance.
6. The antenna should be kept far from other circuits to prevent radiation efficiency reduction or affect the normal operation of other lines.
7. The module should be placed on the edge of the circuit board and keep a distance away from other circuits.
8. Suggesting to use of magnetic beads to insulate the module's access power supply.

Reflow and Soldering

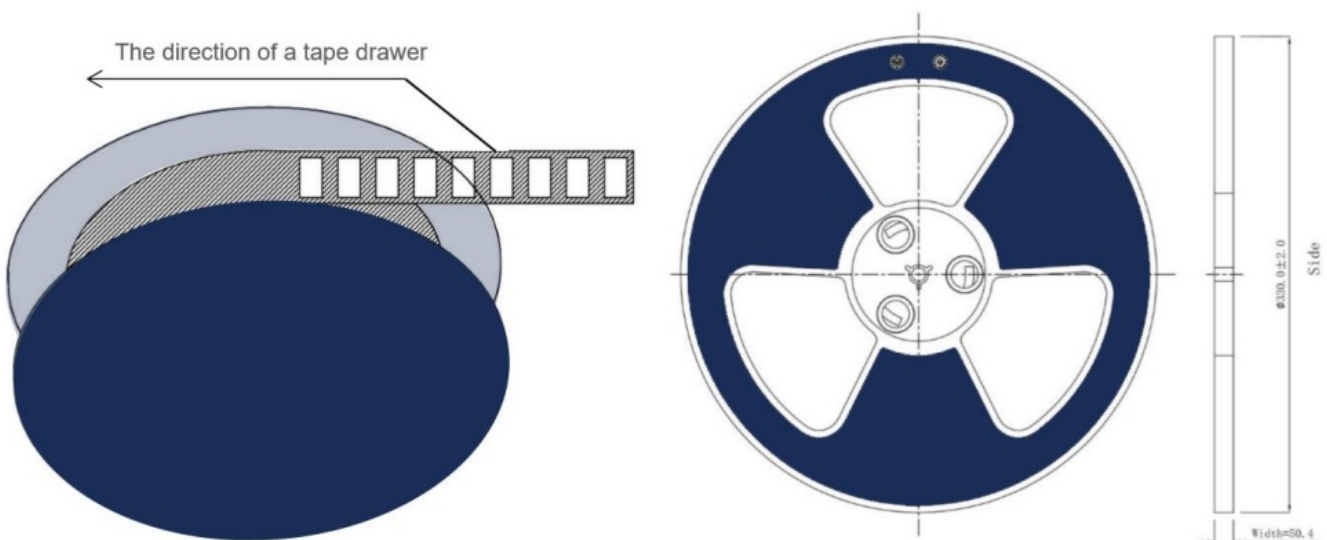
1. Do SMT according to the above reflow oven temperature deal curve. Max. Temperature is 260°C;

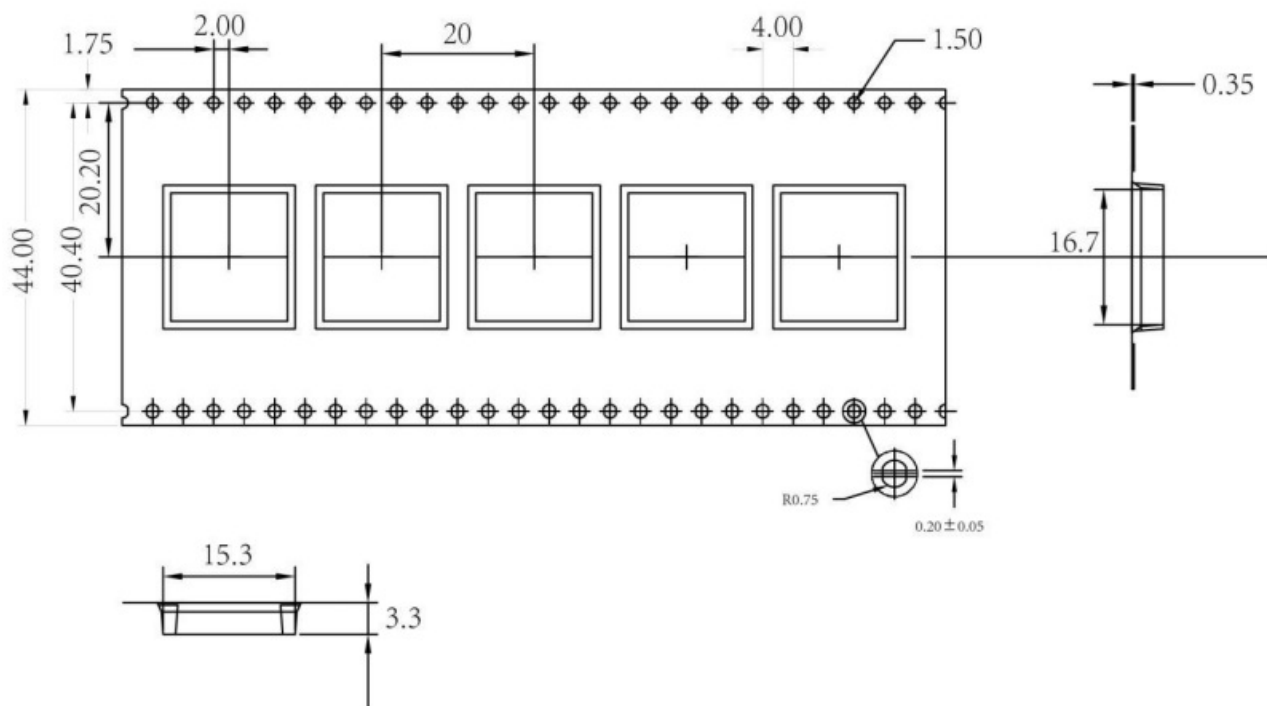
- Refer to IPC/JEDEC standard; Peak TEMP<260°C; Times: ≤2 times, suggest only do once reflow soldering on module surface in case of SMT double pad involved. Contact us if special crafts are involved.



- Suggesting to make 0.2mm thickness of module SMT for partial ladder steel mesh, then make the opening extend 0.8mm
- After unsealing, it cannot be used up at one time, should be vacuumed for storage, and shouldn't be exposed to the air for a long time.
- Please avoid getting damp and soldering-pan oxidizing. If there are 7 to 30 days intervals before using online SMT, suggest bake at 65-70 C for 24 hours without disassembling the tape.
- Before using SMT, please adopt ESD protection measures.

Package Information





* (Default unit: mm Default tolerance: ±0.1)

Packing detail	Specification	Net weight	Gross weight	Dimension
Quantity	850PCS	935g	1475g	W=44mm T=0.35mm

Quality

Cognizant of our commitment to quality, we operate our 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.

Contact Us

Shenzhen Minewsemi Co., Ltd. is committed to swiftly delivering top-quality connectivity modules to our customers. For assistance and support, please feel free to contact our relevant personnel, or contact us as follows:

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Email: minewsemi@minew.com

Linkedin: www.linkedin.com/company/minewsemi

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Click the icon to view and download the latest product documents electronically

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The respective textual trademarks and logos belong to their respective owners. For example, the Bluetooth® textual trademark and logo are owned by Bluetooth SIG, Inc. Other trademarks and trade names are those of their respective owners. Due to the small size of the module product, the “®” symbol is omitted from the Bluetooth Primary.

Trademarks information in compliance with regulations.

The company has the right to change the content of this manual according to technological development, and the revised version will not be notified otherwise. Without the written permission and authorization of the company, any individual, company, or organization shall not modify the contents of this manual or use part or all of the contents of this manual in other ways. Violators will be held accountable by the law.

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, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC Warning

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

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, under part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used by 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 equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment 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 equipment and the receiver.
- Connect the equipment to 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 complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator & your body.

Requirement per KDB996369 D03

22 List of applicable FOC rules

List the FCC rules that apply 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.3

Explanation: This module meets the requirements of FCC part 15C(15.249).

Summarize the specific operational use conditions

Describe use conditions that apply to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require a 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: This module is stand-alone modular. If the end product will involve Multiple simultaneous transmitting conditions or different operational conditions for a stand-alone modular transmitter in a host, the host manufacturer has to consult with the module manufacturer for the installation method in the end system.

Limited module procedures

If a modular transmitter is approved as a limited modulation 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 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 the limited module manufacturer reviewing detailed test data or host designs before 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 with 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.

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.

- 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):
- 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):
- The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout:
- Appropriate parts by manufacturer and specifications:
- Test procedures for design verification; and
- 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, requires that the host product manufacturer 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 I permissive change application.

Explanation: The antenna is not a trace antenna.

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 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-MS21SF1.

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). example with a KR pin and antenna trace design, the ancoraton astrostons shan mico one Installer that 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 an External Antenna, If you desire to increase antenna gain and either change the antenna type or use the same antenna type certified, a Class II permissive change application is required to be filed by us, or you (the host manufacturer) can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application

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 a label in a visible area indicating the following texts: “Contains FCC ID: 2BDJ6-MS215F1.


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 simulate or characterize a connection by enabling a transmitter. This can greatly simplify a host manufacturer's determination that a module as installed has host comments with FeCI requirements.

Explanation: MS21SF1 can increase the utility of our modular transmitters by providing instructions that simulate or characterize a connection by enabling a transmitter.

Documents / Resources

	MINEWSEMI MS21SF1 LoRa Module [pdf] Owner's Manual MS21SF1-LLCC68, MS21SF1-SX1262, MS21SF1 LoRa Module, MS21SF1, LoRa Module, Module
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References

- [MS IoT Wireless Modules | Connectivity Modules](#)
- [Company Overview - Shenzhen Minewsemi Co.,Ltd.](#)
- [User Manual](#)