MINEWSEMI

LoRaWAN Module
MS23SF1

Datasheet
V 1.0.0

Version Note

Version	Details	Contributor(s)	Date	Notes
1.0.0	First edit	Vincle, Leo	2024.06.06	

Part Number

Model	Hardware Code
MS23SF1-STM32WLE5CC	4YE5AI

MS23SF1-STM32WLE5CC

Low-power,ultra-long-range,small and easy to operate, high-sensitivity,support LoRaWAN

MS23SF1 Module is selected from ST LoRaWAN STM32WLE5CC, Wireless Half duplex transceiver chips, which supports global frequency ISM. It is a typical LoRa®WAN transceiver module, that supports multiple interfaces. The current in receive mode is only 4.2mA. It can achieve transmission power up to +20.5dBm with higher reception sensitivity, and 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

Small dimension, built-in 48MHz Arm Cortex-M4

Programmable bit rate, 64KB internal RAM, 256KB Flash

Transmission Range up to 5KM

Multi-IO port support GPIO24

Tx Power maximum up to +20.5dBm, RSSI -146dBm

KEY PARAMETER

MS23SF1			
Chip Model	STM32WLE5CC	Antenna	None
Module size	20.72x19.13x3mm	GPIO	24
Flash	256KB	RAM	64KB
Receiving Sensitivity	-146dBm	Transmission Power	+20.5dBm
Current(TX)	120mA	Current(RX)	4.2mA

APPLICATION
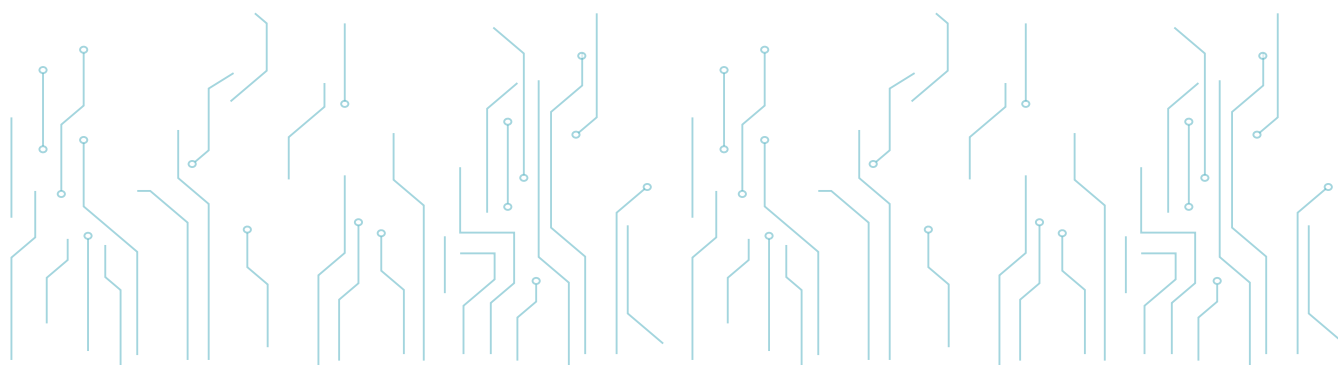
Smart
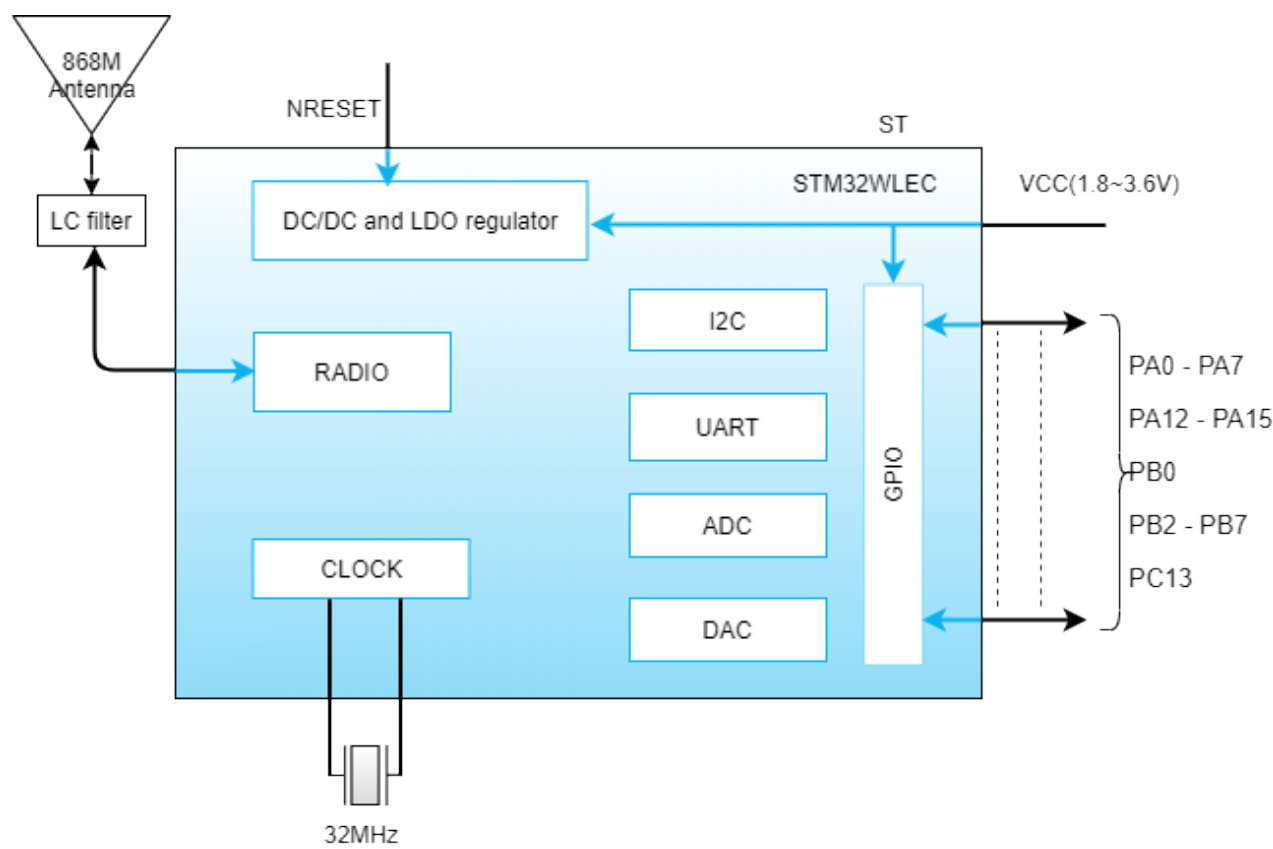Metering

Building
Automation

Agriculture
Sensor

Retail
Sensor

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1 BLOCK DIAGRAM

2 ELECTRICAL SPECIFICATION

Parameter	Values	Notes
Operation Voltage	1.8V-3.6V	To ensure RF work, supply voltage suggest not lower than 3.3V
Operation Temperature	-40℃~+85℃	
Transmission Power	+20.5dBm	Optional 14dBM
ISM Frequency	150~960MHz	Optional，Default 868MHz
Current(RX)	4.2mA	Rx mode
Current(TX)	120mA	Max. in Tx mode
Module Dimension	20.72x19.13x3mm	
Quantity of IO Port	24	

3 PIN DESCRIPTION
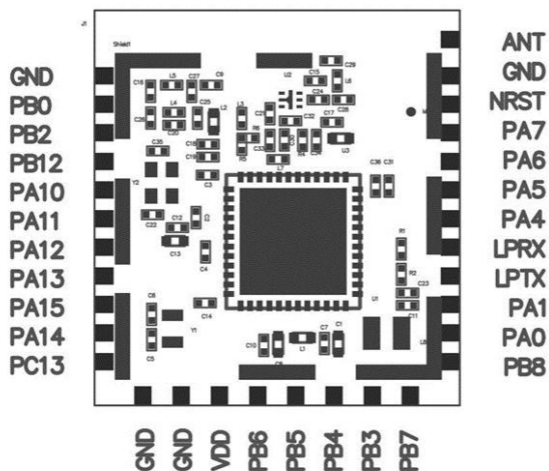
4 PIN DEFINITION

Number	Symbol	Definition	Description	Notes
1	GND	-	Ground	
2	PB0	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
3	PB2	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
4	PB12	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
5	PA10	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
6	PA11	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
7	PA12	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
8	PA13	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)SWDIO
9	PA15	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
10	PA14	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)SWCLK
11	PC13	I	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
12	GND	-	Grounded	
13	GND	-	Grounded	
14	VDD	I	Power supply	
15	PB6	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
16	PB5	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
17	PB4	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
18	PB3	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)

| Number	Symbol	Definition	Description	Notes
19	PB7	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
20	PB8	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
21	PA0	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
22	PA1	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
23	LPTX	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
24	LPRX	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
25	PA4	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
26	PA5	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
27	PA6	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
28	PA7	I/O	Multi-functional digital I/O interface	Configurable general purpose IO interface (Check STM32WLE5CCU6 manual for details)
29	NRST	I/O	Reset	Module reset
30	GND	-	Grounded	
31	ANT	I/O	Antenna Connection	RF Antennas Access

5 MECHANICAL DRAWING
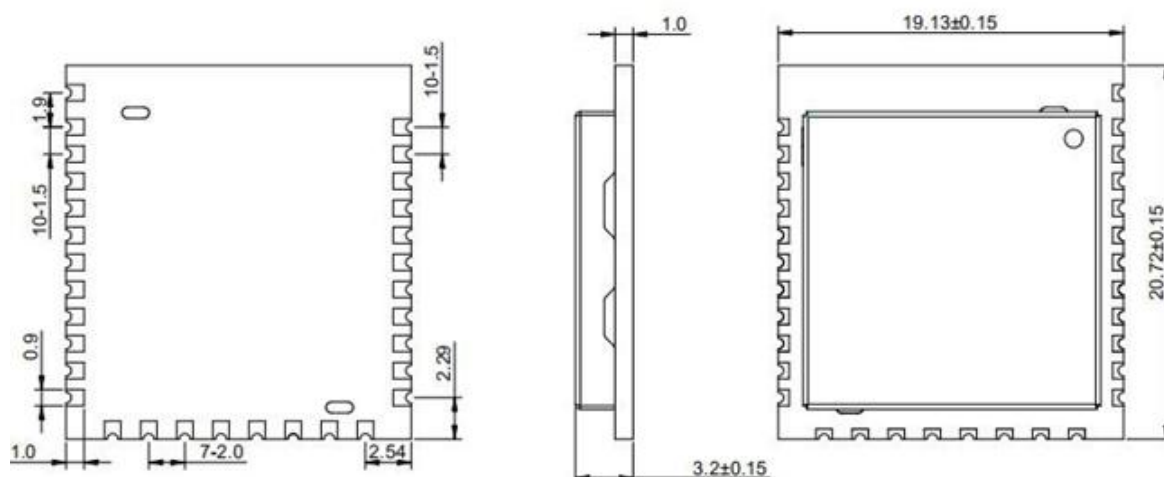
⚠ Default unit：mm Default tolerance：±0.15

6 MODULE OPERATION INSTRUCTION

6.1 Demonstration of module application
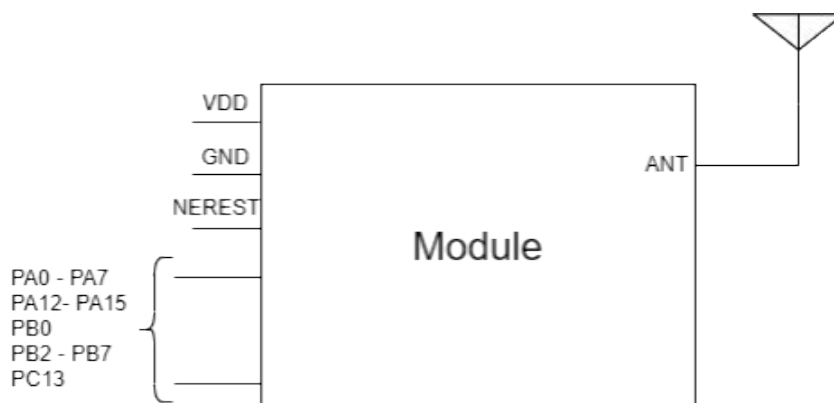
6.1.1 Power supply

The operation voltage is 1.8V-3.6V, to ensure a stable function, supply voltage should be 3.3V as far as possible.

6.1.2 Module consumption description

The power consumption test below is tested at a power supply voltage of 3.3V and normal temperature. 868MHz transmit BW is 125kHz, transmit power is +20.5dBm, Tx mode SF12 frequency band power consumption.

Status Power	SF Mode	Peak	Avg
TX	SF12	86.41mA	77.19mA

6.1.3 Software development

For LoRaWANTM development, please download and refer to the instructions in ST's STM32CubeWL library file, and use stm32cubemx software to generate the protocol stack project of the relevant development platform;

The PA8 and PA9 pins are used as the internal control RF switch of the module, which are RF_TXEN and RF_RXEN respectively, and the modes are shown in the figure below.

Generally, it is not recommended to enable RX and TX at the same time. When transmitting, TX is enable and RX is disable ; When receiving, RX is enable and TX is disable.
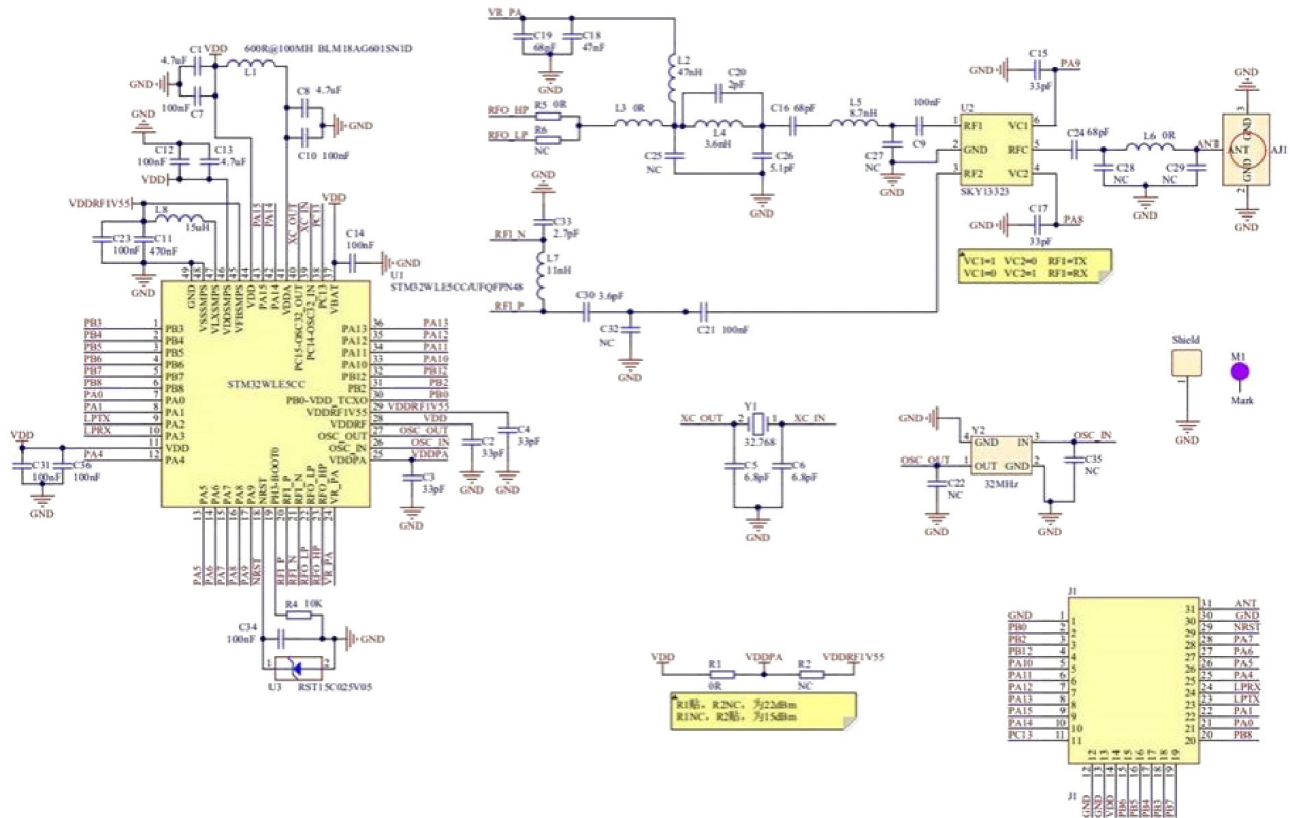
Mode	PA9	PA8
RF_TXEN	1	0
RF_RXEN	0	1

⚠️ Notice: At present, the supported firmware is "LoRaWAN Transparent Firmware" and "AT Firmware (for demo use)".

7 ELECTRICAL SCHEMATIC

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

8 PCB LAYOUT

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

> ⚠ **Notice**: Refer to examples as below, and highly suggest to use the first design and the adjustment of modules antenna design according to the first wiring.

Layout Notes：

1) Preferred Module antenna area completely clearance and not be prevented by metals, otherwise it will influence antenna's effect (as above DWG. indication).

2) Cover the external part of module antenna area with copper as far as possible to reduce the main board's signal cable and other disturbing.

3) It is preferred to have a clearance area of 4 square meter or more area around the module antenna (including the shell) to reduce the influence to antenna.

4) Device should be grounded well to reduce the parasitic inductance.

5) Do not cover copper under module's antenna in order to avoid affect signal radiation or lead to transmission distance affected.

6) Antenna should keep far from other circuits to prevent radiation efficiency reduction or affects the normal operation of other lines.

7) Module should be placed on edge of circuit board and keep a distance away from other circuits.

8) Suggesting to use magnetic beads to insulate module's access power supply.

9 REFLOW AND SOLDERING

1) Do SMT according to above reflow oven temperature deal curve. Max. Temperature is 260℃;
Refer to IPC/JEDEC standard; Peak TEMP<260℃; Times：≤2 times, suggest only do once reflow soldering on module surface in case of SMT double pad involved. Contact us if special crafts involved.
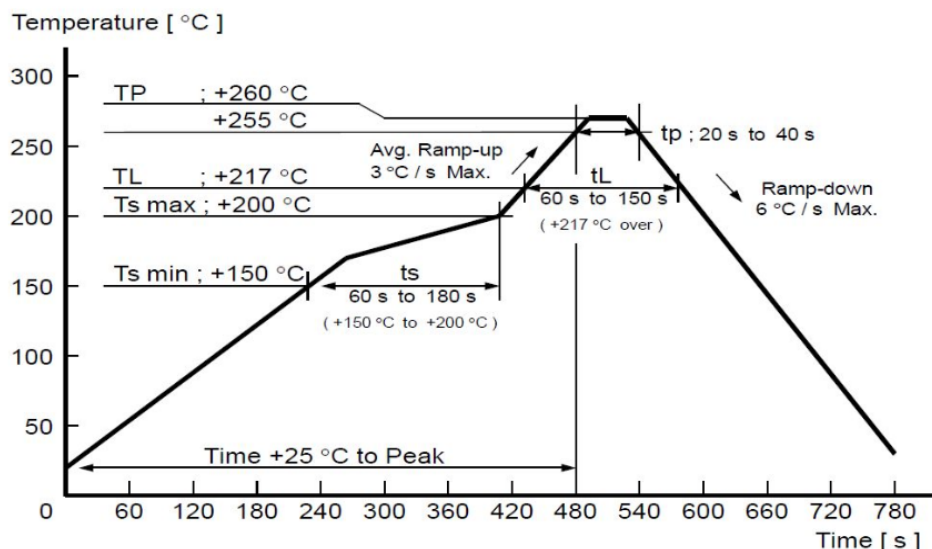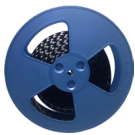

2) Suggesting to make 0.2mm thickness of module SMT for partial ladder steel mesh, then make the opening extend 0.8mm
3) After unsealing, it cannot be used up at one time, should be vacuumed for storage, couldn't be exposed in the air for long time. Please avoid getting damp and soldering-pan oxidizing.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

10 PACKAGE INFORMATION

Inner carton(*5)
355*345*65mm，±5mm

Outer carton
370*358*350mm，±10mm
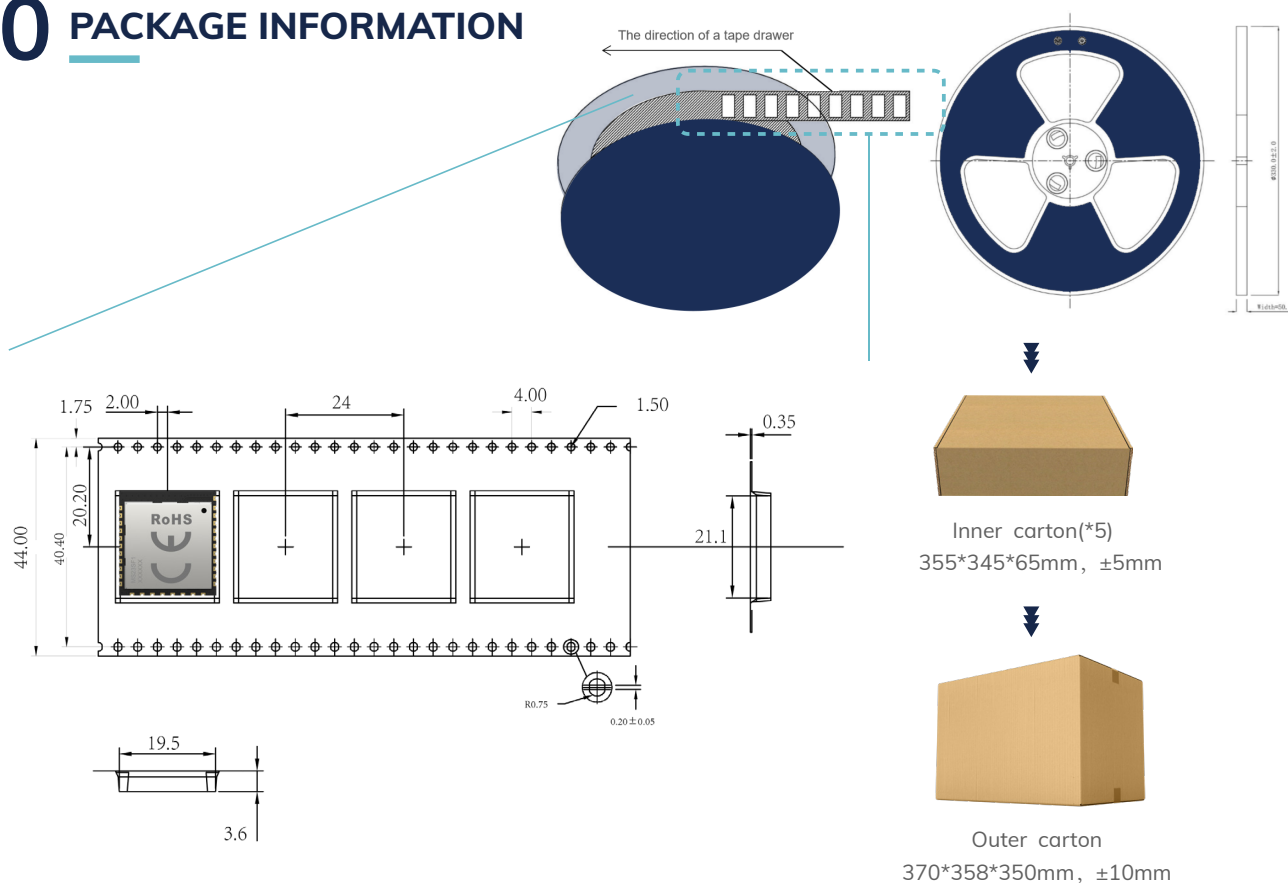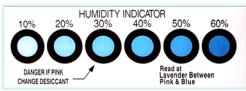
Remarks
General material list for FCL packaging:

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
MS23SF1	750PCS	1395g	1935g	W=44mm，T=0.35mm

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

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 (CI2, NH3, SO2, NOx, 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 time

  Products 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℃;

  2、90℃ +8/-0℃，24hours，1times

  The 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, OHSA18001, 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.

14 COPYRIGHT STATEMENT

15 RELATED DOCUMENTS

- stm32WLE5c8_Chip_Datasheet
  https://en.minewsemi.com/file/stm32WLE5c8_Chip_Datasheet_EN.pdf

- MinewSemi_Product_Naming_Reference_Manual_V1.0
  https://en.minewsemi.com/file/MinewSemi_Product_Naming_Reference_Manual_EN.pdf

- MinewSemi_Connectivity_Module_Catalogue_V2.0
  https://en.minewsemi.com/file/MinewSemi_Connectivity_Module_Catalogue_EN.pdf

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