E04-400/900M20S Product Specification

STM32WL33 400/900MHz SoC SMD Wireless Module



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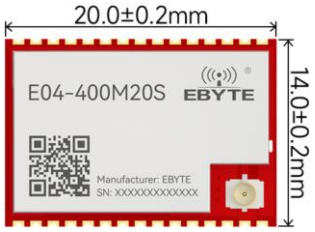
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1 Overview

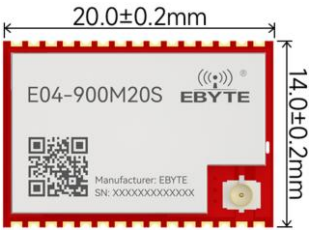
1.1 Introduction

E04-400/900M20S is a wireless communication module designed based on STMicroelectronics' newly launched STM32WL33KCV6 (ARM Cortex-M0+) SoC, which is characterised by far-reaching communication, low standby power consumption, strong anti-jamming capability, rich interface resources, strong processing capability and small form factor. It is also suitable for 433/470/868/915MHz band chip wireless module, using industrial-grade high-precision 32.768KHz and 48MHz crystals to ensure the stable operation of the module.

E04-400/900M20S wireless communication module needs user's secondary development, which can be widely used in IOT industry.



E04-400M20S



E04-900M20S

1.2 Features

- Ideal conditions for communication distances up to 3.5km;
- Maximum transmit power 20dBm;
- Air Rate: 0.1 ~ 600kbps;
- Supports global licence-free ISM 433/470/868/915MHz bands;
- Modulation: 2(G)FSK, 4(G)FSK, OOK, ASK, D-BPSK, DSSS, I/Q channel data access;
- Supports protocols: W-MBUS, Sigfox, Mioty, KNX-RF, IEEE 802.15.4g, etc;
- Supports 2.8~3.6V power supply, any power supply greater than 3.3V can ensure the best performance;
- The external crystal uses 32.768KHz high-precision industrial-grade crystal and 48MHz active temperature-compensated crystal to ensure the stable operation of the module;
- 14.0*20.0*2.7mm small-size SMD package, facilitating system integration and development;
- Industrial-grade standard design, supporting long time use at -40～+85℃;
- Dual antennas are optional (IPEX/stamp hole), which is convenient for users' secondary development and facilitates system integration development;

1.3 Application

- Smart Cities/Municipal Infrastructure;
- Industrial applications/building automation/power distribution automation;
- Building security systems;

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- Smart lighting/street lighting;
- Asset tracking;
- Home energy management systems;
- Smart home and alarm systems;

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2 Specification parameters

2.1 RF parameters

RF parameters	Parameters	Remark
E04-400M20S Working Frequency	413~478 MHz	Supports ISM bands
E04-900M20S Working Frequency	850~930 MHz	Supports ISM bands
Transmitting power	0~20 dBm	The software is adjustable and requires user-developed settings.
Receiver sensitivity	-132 dBm	@1%BER
Communication distance	3500 meters	Clear and open environment, maximum power, antenna gain 3.5dBi, height 2m, airspeed 1.2kbps.

2.2 Hardware parameters

Hardware parameters	Parameters	Remark
IC full name	STM32WL33KCV6	-
Core	ARM Cortex-M0+	-
FLASH	256 KB	-
RAM	32 KB	-
Crystal Oscillation frequency	48MHz/32.768KHz	External crystal; The 48MHz is an active crystal oscillator, and the crystal oscillator power supply control pin is PB1
Size	14 * 20 mm	-
Antenna	IPEX/Stamp Hole	The equivalent impedance is about 50Ω.
Communications interface	UART、SPI、I²C、GPIO、ADC	User-developed settings are required.
Package	SMD Stamp Hole	-
Weights	1.2g	±0.1g

2.3 Electrical parameters

Electrical parameters	Minimum Value	Typical Value	Maximum	Unit	Remark

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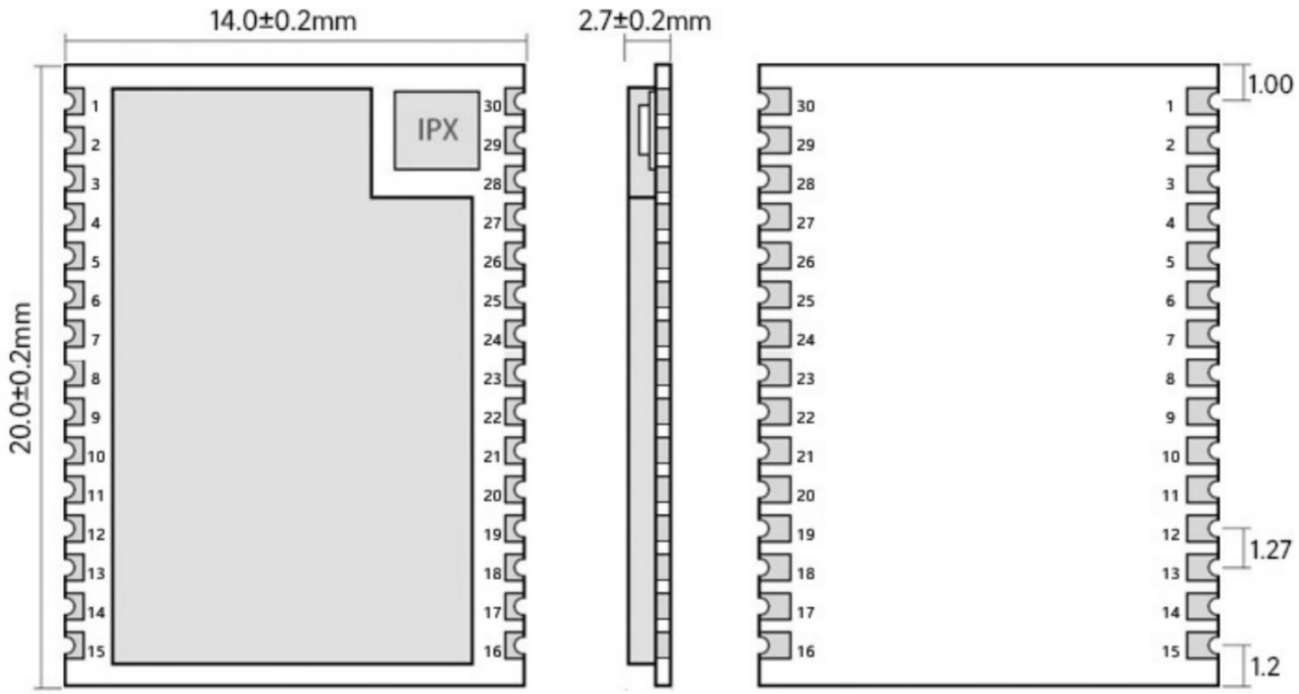
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			Values		
Supply Voltage	2.8	3.3	3.6	V	≥3.3V guarantees output power, exceeding 3.6V may damage module
Communications Level	-	3.3	-	V	Use of 5.0V TTL recommended plus level shifting
Transmitting Current	-	150	-	mA	Instantaneous power consumption
Receiving Current	-	18	-	mA	-
Sleeping Current	-	2.5	-	μA	-
Operating Temperature	-40	20	85	℃	-
Operating Humidity	10	60	90	%	-
Storage Temperature	-40	20	125	℃	-

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3 Mechanical Dimensions and Pin Definitions



Pin Number	Pin Name	Pin Direction	Pin Usage
1	NC	-	-
2	NRST	Input	Chip reset trigger input pin, active low
3	NC	-	-
4	NC	-	-
5	NC	-	-
6	NC	-	-
7	NC	-	-
8	PA1	Input/Output	Configurable general-purpose IO ports (see STM32WL33KCV6 manual for details)
9	PB2	Input/Output	Configurable general-purpose IO ports (see STM32WL33KCV6 manual for details)
10	NC	-	-
11	PB0	Input/Output	Configurable general-purpose IO ports (see STM32WL33KCV6 manual for details)
12	GND	Output	Ground, connected to power reference ground

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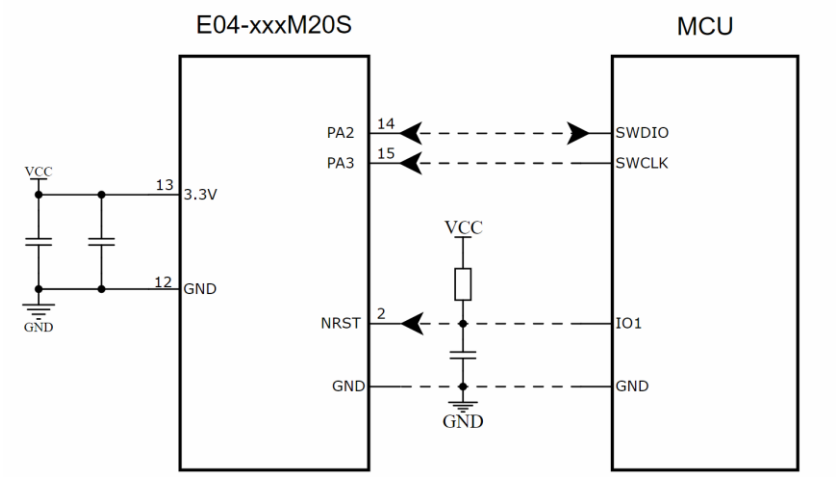
13	3.3V	Input	Power input, support 2.8~3.6V power supply
14	PA2	Input/Output	Program debugging/download port SWDIO
15	PA3	Input/Output	Program debugging/download port SWCLK
16	PAO	Input/Output	Configurable general-purpose IO ports (see STM32WL33KCV6 manual for details)
17	PA11	Input/Output	Configurable general-purpose IO ports (see STM32WL33KCV6 manual for details)
18	PA10	Input/Output	Configurable general-purpose IO ports (see STM32WL33KCV6 manual for details)
19	PA9	Input/Output	Configurable general-purpose IO ports (see STM32WL33KCV6 manual for details)
20	PA8	Input/Output	Configurable general-purpose IO ports (see STM32WL33KCV6 manual for details)
21	PB15	Input/Output	Configurable general-purpose IO ports (see STM32WL33KCV6 manual for details)
22	PB14	Input/Output	Configurable general-purpose IO ports (see STM32WL33KCV6 manual for details)
23	NC	-	-
24	PB6	Input/Output	Configurable general-purpose IO ports (see STM32WL33KCV6 manual for details)
25	PB7	Input/Output	Configurable general-purpose IO ports (see STM32WL33KCV6 manual for details)
26	NC	-	-
27	NC	-	-
28	GND	Output	Ground, connect to power reference ground.
29	ANT	Output	Antenna connector, stamp hole (50Ω characteristic impedance), to IPEX-1 connector.
30	GND	Output	Ground, connected to power reference ground
Note: The 48MHz module is an active crystal oscillator, and the crystal oscillator power supply control pin is PB1			

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4 Basic Applications

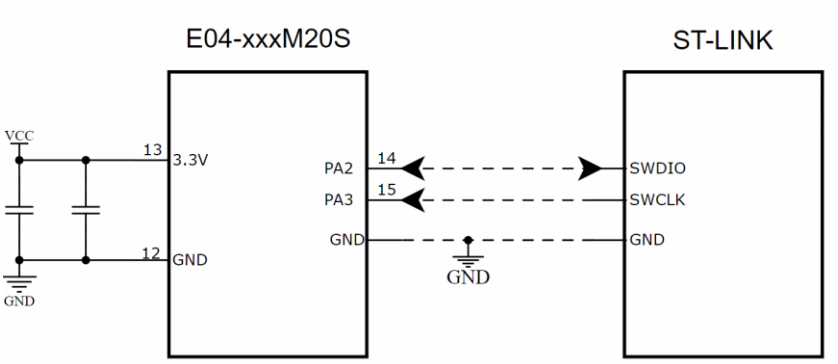
4.1 Basic Circuit Wiring Diagram



Note: Users can develop the general-purpose GPIO ports into relevant function pins according to the requirements.

4.2 ST-LINK programme download/debugging wiring diagram

To download the programme, connect VCC, GND, SWCLK and SWDIO pins.



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5 Basic operations

5.1 Hardware Designs

- It is recommended to use a DC regulated power supply to power this module, the power supply ripple factor should be as small as possible, and the module should be reliably grounded;
- Please pay attention to the correct connection of the positive and negative terminals of the power supply, if reversed it may cause permanent damage to the module;
- Please check the power supply to ensure that it is between the recommended supply voltages, if it exceeds the maximum value it may cause permanent damage to the module;
- Check the stability of the power supply to ensure that the voltage does not fluctuate significantly and frequently;
- When designing the power supply circuit for the module, it is often recommended to keep more than 30% of the residual capacity, and the whole machine is conducive to long-term stable operation;
- Modules should be kept as far as possible from power supplies, transformers, high-frequency alignments and other parts with high electromagnetic interference;
- High-frequency digital alignment, high-frequency analogue alignment, power supply alignment must be avoided below the module, if it is really necessary to go through the module below, assuming that the module is welded in the Top Layer, the Top Layer in the contact part of the module to lay the ground copper (all paved with copper and a good ground), it must be close to the digital part of the module and alignment in the Bottom Layer;
- Assuming that the module is soldered or placed in the Top Layer, it is also a mistake to route the wires randomly in the Bottom Layer or any other layer, which will affect the spuriousness of the module as well as the reception sensitivity to varying degrees;
- It is assumed that the module is surrounded by large electromagnetic interference devices will also greatly affect the performance of the module, according to the intensity of the interference is recommended to stay away from the module, if the situation permits you can do appropriate isolation and shielding;
- Assuming that there is a large electromagnetic interference around the module alignment (high-frequency digital, high-frequency analogue, power supply alignment) will also greatly affect the performance of the module, according to the intensity of the interference is recommended to stay away from the module, if the situation permits you can do appropriate isolation and shielding;
- If 5V level is used for the communication line, 1k-5.1k resistors must be connected in series (not recommended, there is still a risk of damage);
- Try to stay away from TTL protocols where part of the physical layer is also 2.4GHz, e.g. USB3.0;
- The antenna mounting structure has a large impact on the module performance, make sure the antenna is exposed, preferably vertically upwards. When the module is installed inside the chassis, a good quality antenna extension cable can be used to extend the antenna to the outside of the chassis;
- The antenna must not be installed inside the metal casing, which will result in a great weakening of the transmission distance.
- If the module is externally connected to an MCU, it is recommended to add a 200R protection resistor to the RXD/TXD of the external MCU.

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5.2 Software development

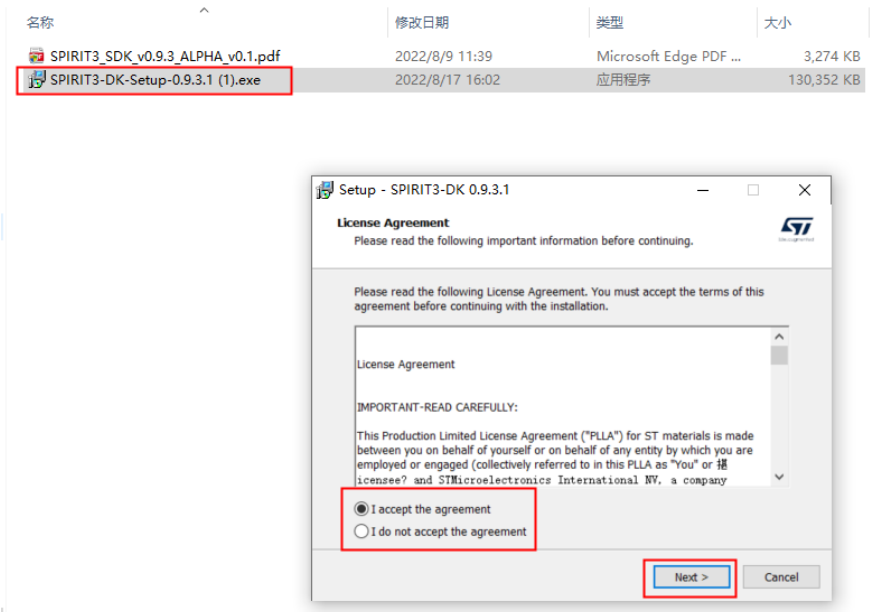
- Software related demo, please download and use it from the official website according to the description of software related guide.
- This document is based on the production of demo synchronous production, used to assist the development of E04-400/900M20S, if the subsequent official SDK has a new use, please follow the official documents.

5.2.1 Preparation of tools

- E04-400/900M20S Module
- ST-LINK V2
- IAR EW for ARM version 8.40.1

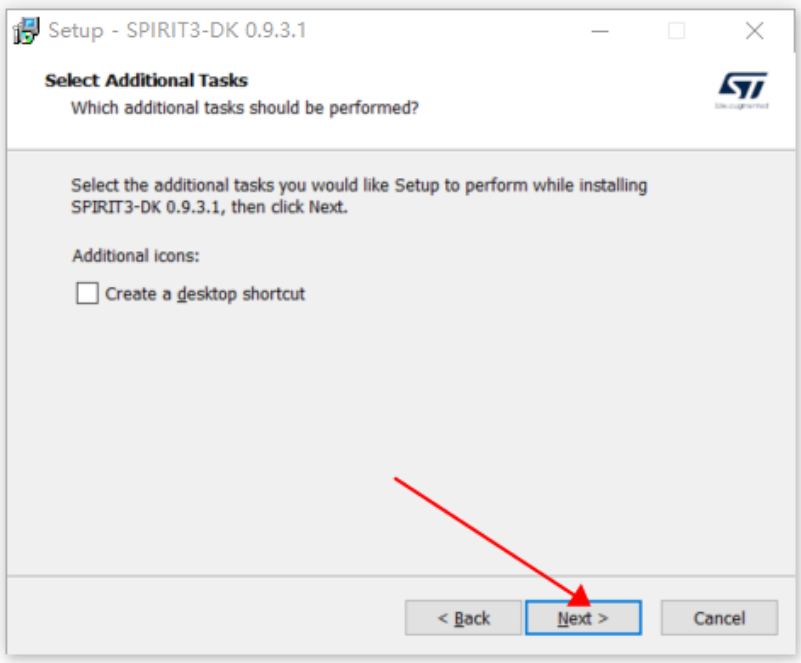
5.2.2 SDK package installation

1.Download the SDK package SPIRIT3-DK-Setup-0.9.3.1 and install SPIRIT3-DK-Setup-0.9.3.1.exe.

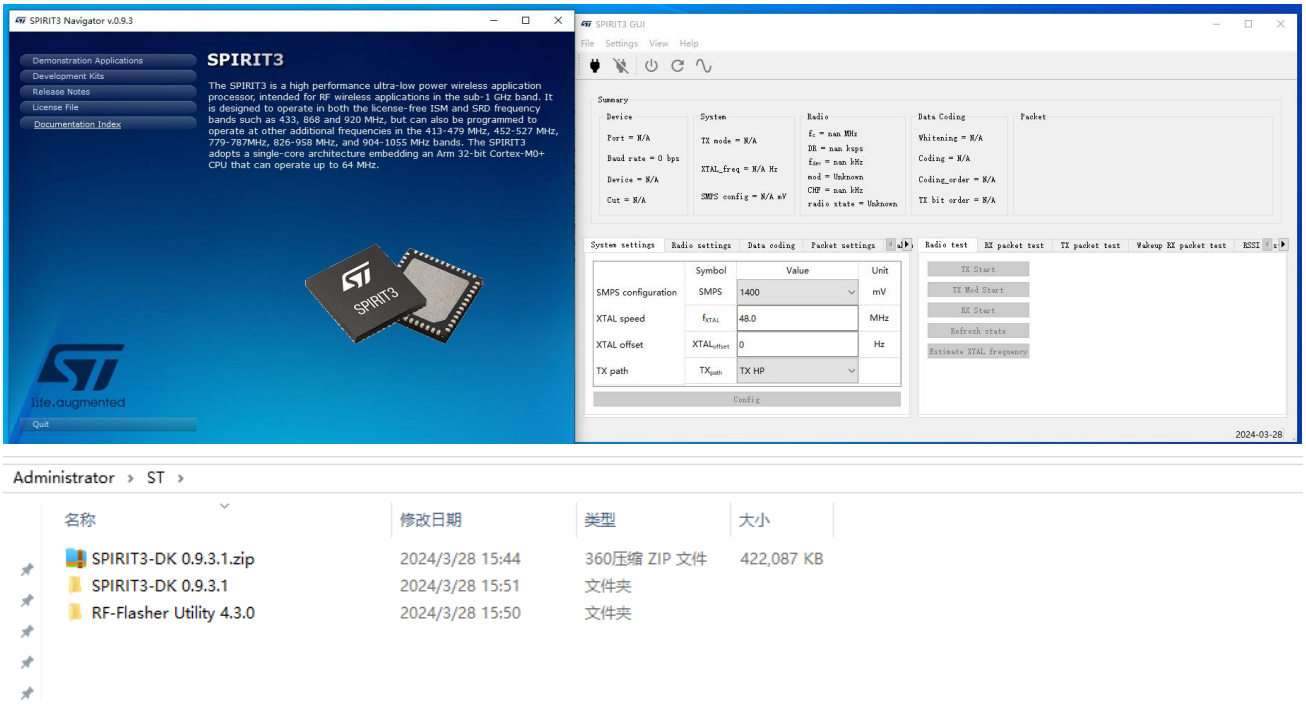


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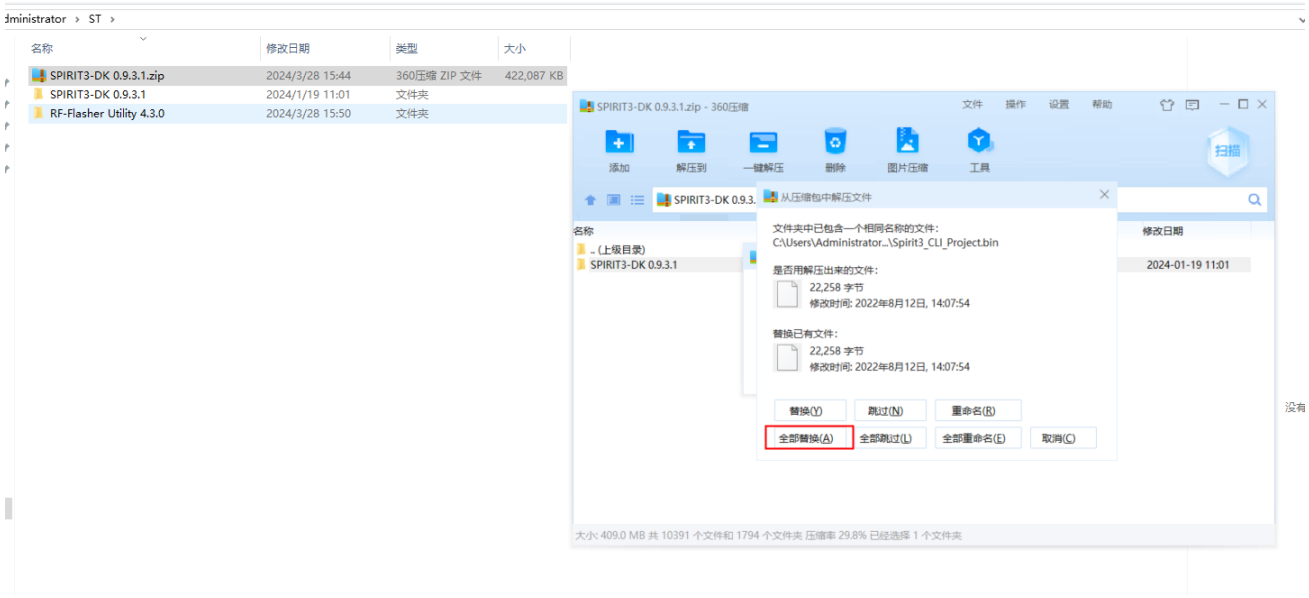
2.After the installation is completed, the SDK is installed in C:\Users\Administrator\ST (default installation path), after the installation of Navigator and GUI software, which Navigator can be used to describe the SDK, the GUI can be used with the CLI firmware in the SDK for the debugging of RF parameters.



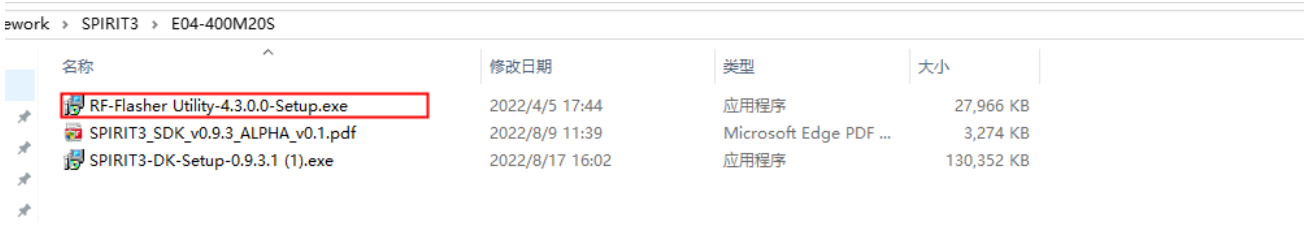
3.Go to the installation path, delete the initial SDK package installed (customers can skip this step if they need to develop from scratch), and replace it with the SDK demo version provided by EVERBUILT official website.

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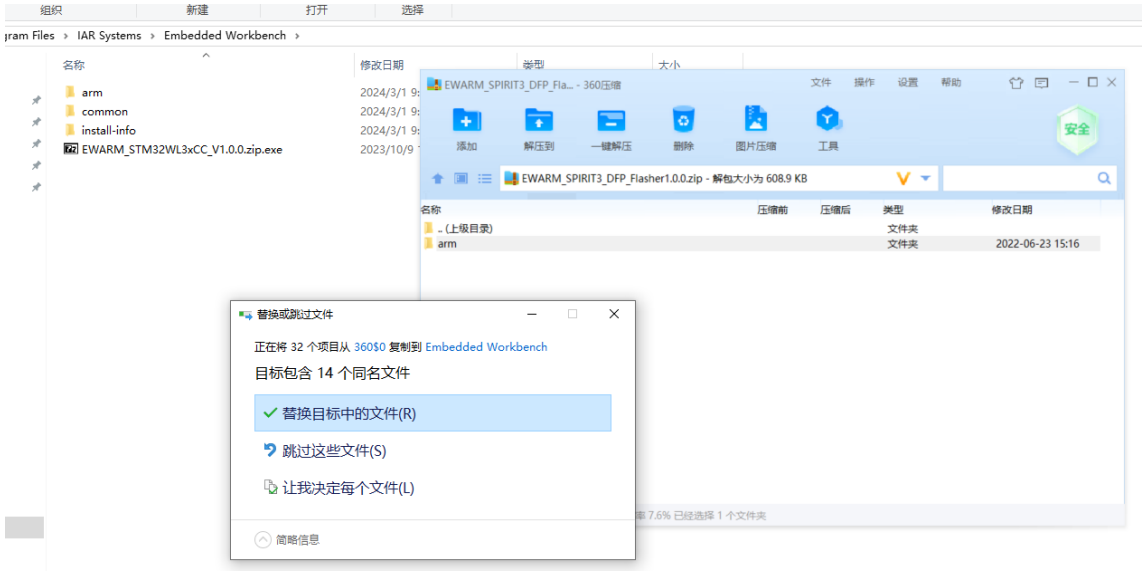
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4.Install the RF-Flasher Utility-4.3.0.0-Setup.exe downloaded from EVERBUILT official website for burning firmware, the installation path is still C:\Users\Administrator\ST (default installation path).



5.Merge EWARM_SPIRIT3_DFP_Flasher1.0.0.zip under the path C:\Users\Administrator\ST\Flashloaders to the path of IAR.

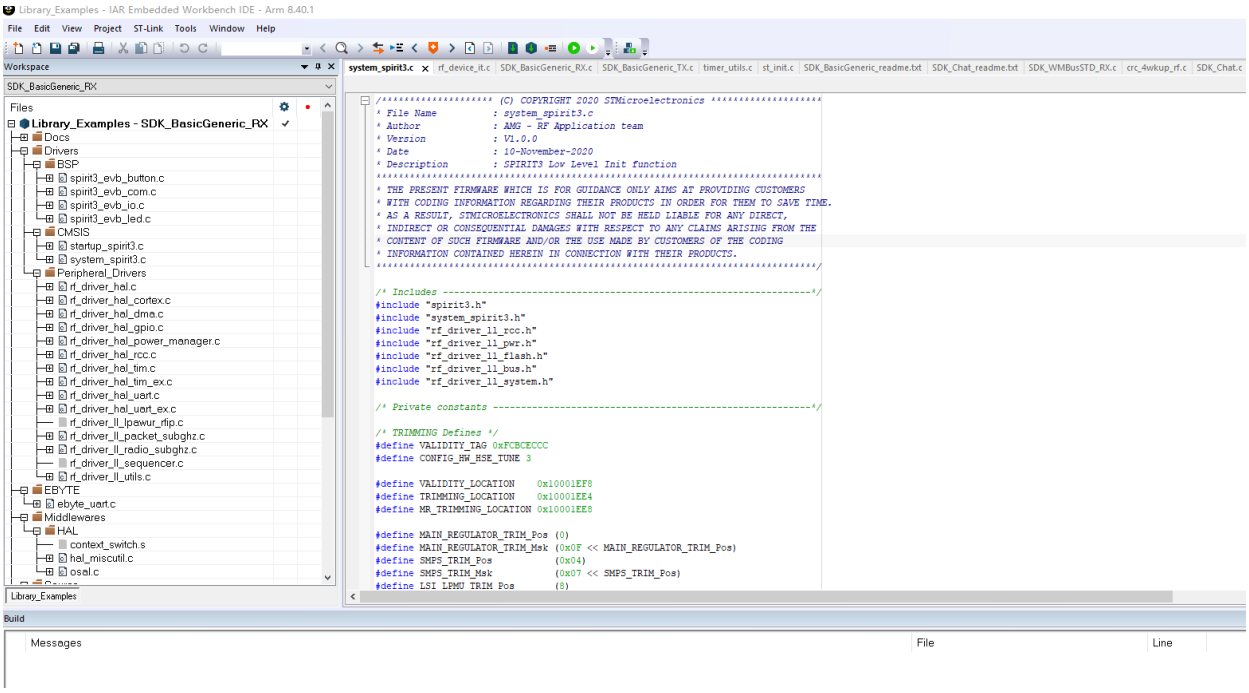


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5.2.3 Engineering Options

1.Go to the SDK installation path, under \Projects\SDK\Library_Examples\EWARM\STEVAL-S38681V1 path, use IAR to open the Library_Examples.eww file.



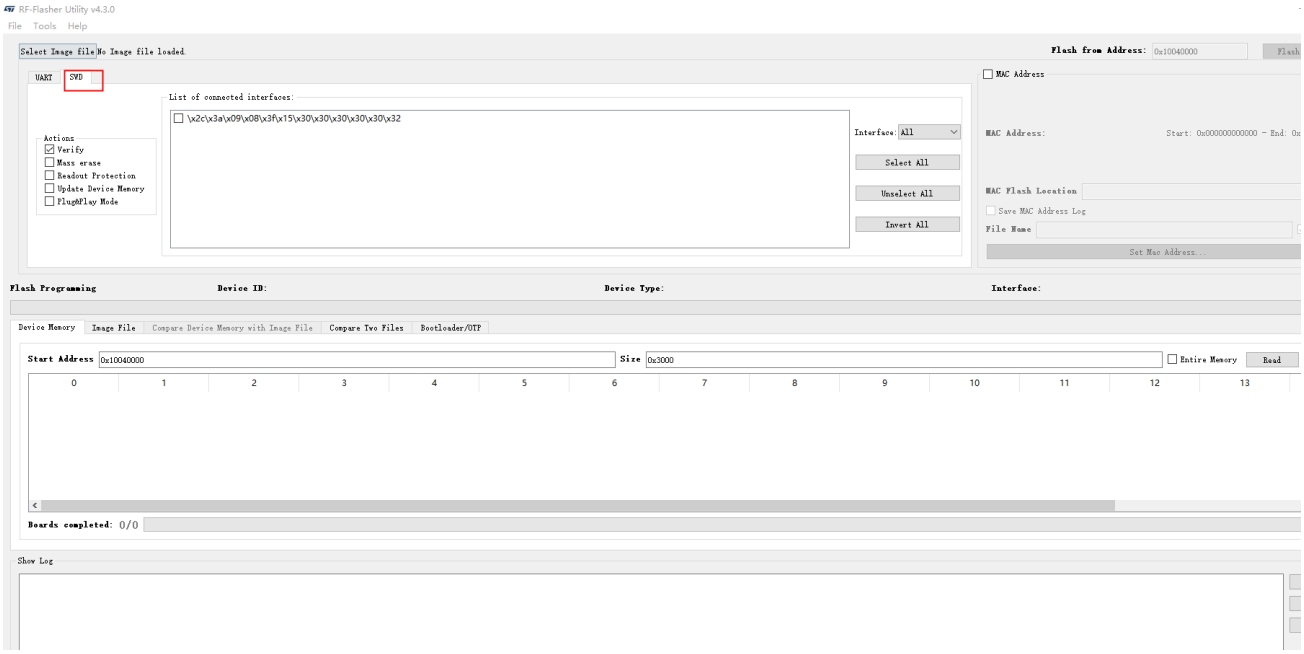
Note: Only demo routines modified at SDK_BasicGeneric_RX are provided.

5.2.4 Compiling and Burning

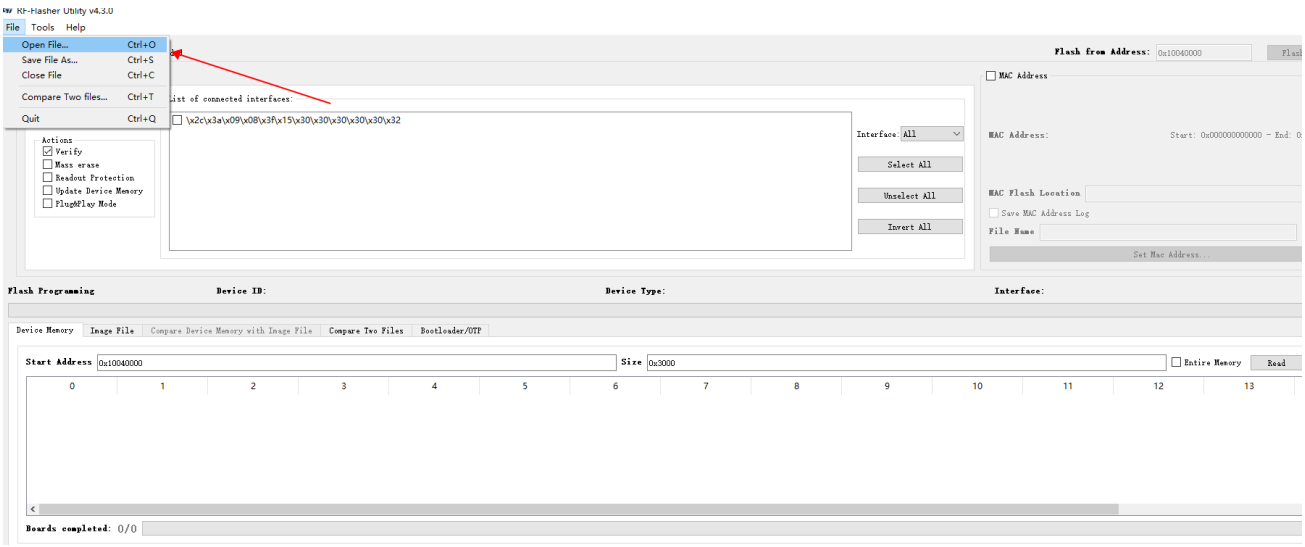
1.The compilation is consistent with the normal compilation of IAR, and there are two ways to burn, one is to directly use IAR to select ST-LINK to burn, and the other is to use the previously installed burning software to burn. Under the path of \Projects\SDK\Library_Examples\EWARM\STEVAL-S38681V1\SDK_BasicGeneric_RX\Exe, find SDK_BasicGeneric_RX.bin, this is the firmware we generated and need to burn, open the \RF-\Flasher Utility 4.3.3.0. Flasher Utility 4.3.0\Application path under the RF-Flasher_GUI.exe, into the burning tool interface, the burning mode selected for the SWD mode.

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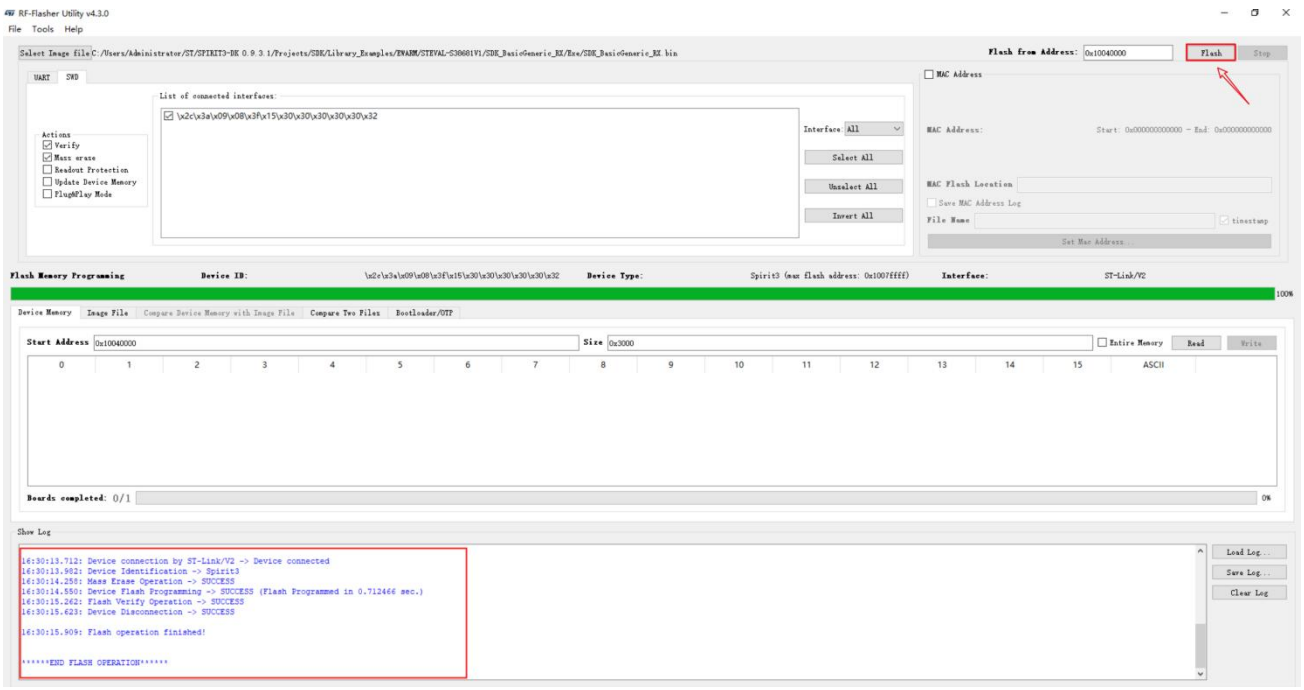
2.Select the file to be burned.



3.Click on Flash Burning

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At this point, the burn is complete.

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6 FAQ

6.1 Unsatisfactory transmission distance

- When there are linear communication barriers, the communication distance will decay accordingly;
- Temperature, humidity, and co-channel interference, which can lead to higher communication packet loss;
- The ground absorbs and reflects radio waves, and the test effect is poorer near the ground;
- Seawater has a strong ability to absorb radio waves, so the effect of the seaside test is poor;
- Metal objects near the antenna, or placed in a metal casing, the signal attenuation will be very serious;
- Wrong power register setting, air rate setting is too high (the higher the air rate, the closer the distance);
- The low voltage of the power supply at room temperature is lower than the recommended value, the lower the voltage, the lower the power generation;
- The antenna used is poorly matched to the module or the antenna itself is of poor quality.

6.2 Modules are vulnerable

- Please check the power supply to ensure that it is between the recommended supply voltages, exceeding the maximum value can cause permanent damage to the module;
- Please check the stability of the power supply, the voltage should not fluctuate significantly and frequently;
- Please ensure that the installation and use of the process of anti-static operation, high-frequency devices electrostatic sensitivity;
- Please ensure that the installation and use of the process of humidity should not be too high, part of the components for humidity-sensitive devices;
- If there is no special demand, it is not recommended to use it under too high or too low temperature.

6.3 BER is too high

- There is interference from the same frequency signal nearby, stay away from the interference source or modify the frequency and channel to avoid interference;
- SPI clock waveform is not standard, check whether there is interference on the SPI line, and the SPI bus line should not be too long;
- The unsatisfactory power supply may also cause garbled code, make sure the reliability of the power supply;
- Poor quality or too long extension cable or feeder cable may also cause high BER.

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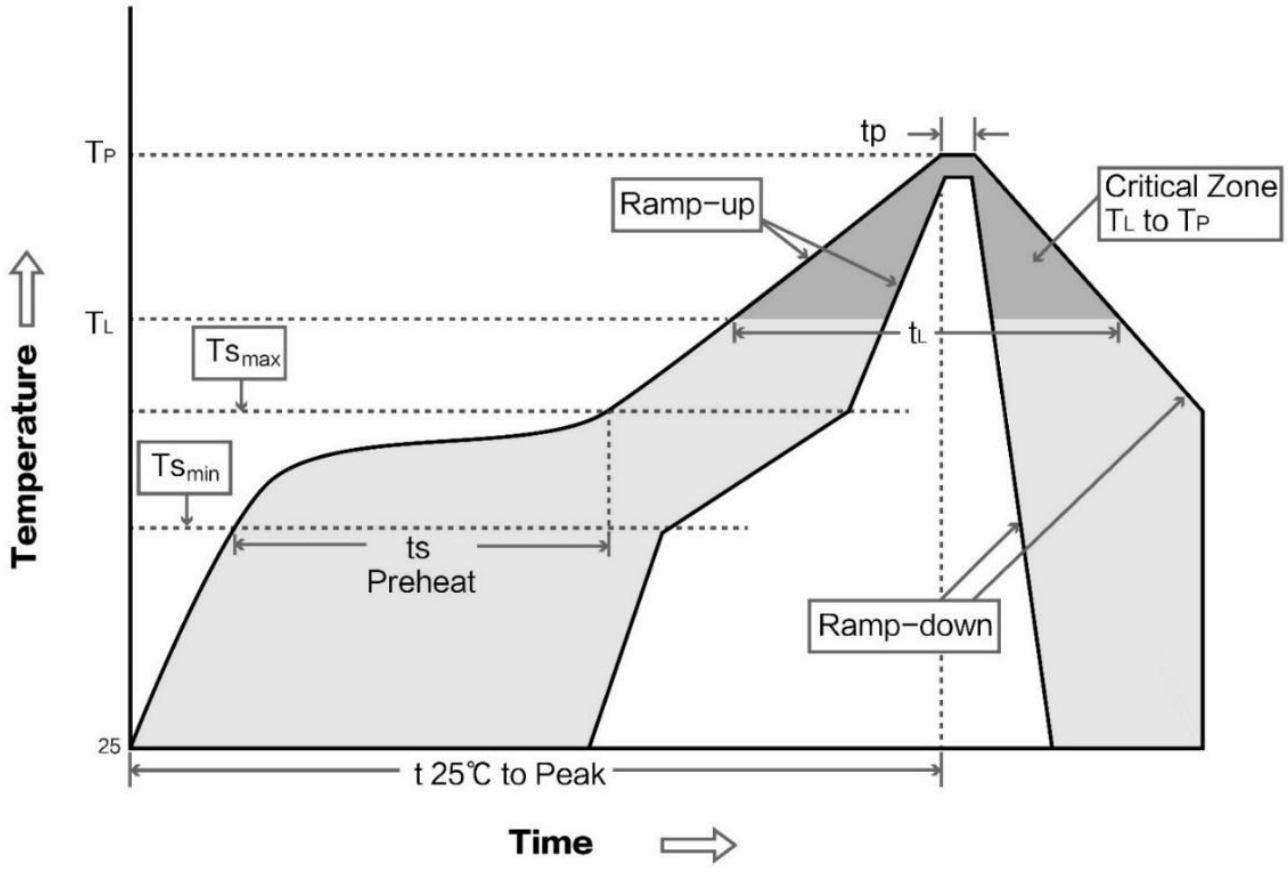
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7 Welding instructions

7.1 Reflow temperature

Profile Feature	Curve characteristic	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Solder paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min （Tsmin）	Minimum preheating temperature	100℃	150℃
Preheat temperature max (Tsmax)	Maximum preheating temperature	150℃	200℃
Preheat Time (Tsmin to Tsmax)(ts)	Preheating time	60-120 sec	60-120 sec
Average ramp-up rate(Tsmax to Tp)	Average rate of increase	3℃/second max	3℃/second max
Liquidous Temperature (TL)	Liquid phase temperature	183℃	217℃
Time（tL）Maintained Above（TL）	Time above the liquid phase line	60-90 sec	30-90 sec
Peak temperature（Tp）	Peak temperature	220-235℃	230-250℃
Aveage ramp-down rate（Tp to Tsmax）	Average rate of decline	6℃/second max	6℃/second max
Time 25℃ to peak temperature	Time from 25°C to peak temperature	6 minutes max	8 minutes max

7.2 Reflow Profile



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8 Related Models

Model	Chip	Carrier frequencies Hz	Transmitting power dBm	Testing Distance km	Package form	Product Size mm	Communications interface
E77-400M22S	STM32WLE5CCU6	433/470M	22	5.6	SMD	14*20	UART、SPI、I²C、GPIO、ADC
E77-900M22S	STM32WLE5CCU6	868/915M	22	5.6	SMD	14*20	UART、SPI、I²C、GPIO、ADC

9 Antenna Guide

9.1 Antenna Recommendations

Antenna is an important role in the communication process, often poor-quality antenna will have a great impact on the communication system, so we recommend some of the antenna as a supporting our wireless module and the performance is more excellent and reasonably priced antenna.

Model	**Type**	**Frequency Hz**	**Interface**	**Gain dBi**	**Heights mm**	**Feeders cm**	**Functional features**
TX433-NP-4310	Flexible Antenna	433M	Soldered	2.0	43.8*9.5	-	Built-in flexible, FPC soft antenna
TX433-JZ-5	Glue Stick Antenna	433M	SMA-J	2.0	52	-	Ultra Short Straight, Omni-Directional Antenna
TX433-JZG-6	Glue Stick Antenna	433M	SMA-J	2.5	62	-	Ultra Short Straight, Omni-Directional Antenna
TX433-JW-5	Glue Stick Antenna	433M	SMA-J	2.0	50	-	Bending Rubber Stick, Omni-Directional Antenna
TX433-JWG-7	Glue Stick Antenna	433M	SMA-J	2.5	75	-	Bending Rubber Stick, Omni-Directional Antenna
TX433-JK-11	Glue Stick Antenna	433M	SMA-J	2.5	110	-	Bendable Rubber Stick, Omnidirectional Antenna
TX433-JK-20	Glue Stick Antenna	433M	SMA-J	3.0	210	-	Bendable Rubber Stick, Omnidirectional Antenna
TX433-XPL-100	Suction Cup Antenna	433M	SMA-J	3.5	185	100	Small Suction Cup Antenna, Cost Effective

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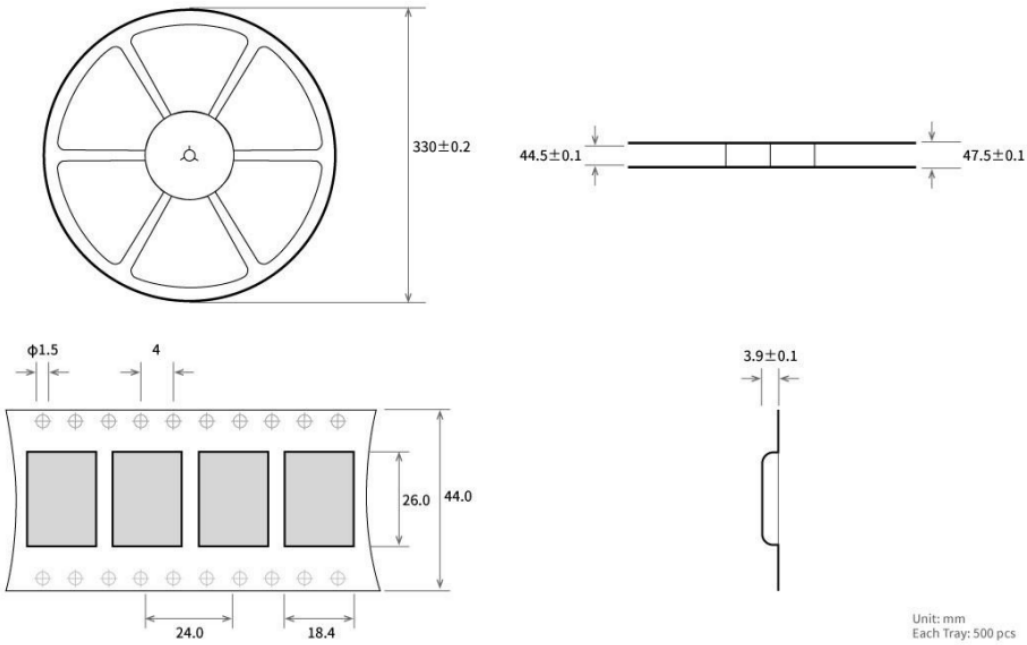
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TX433-XP-200	Suction Cup Antenna	433M	SMA-J	4.0	190	200	Neutral suction cup antenna, low loss
TX433-XPH-300	Suction Cup Antenna	433M	SMA-J	6.0	965	300	Large suction cup antenna, high gain
TX900-FPC-4420	Flexible Antenna	868/915M	IPEX-1	3.0	20*44	15	Built-in flexible, FPC soft antenna
TX915-FPC-4510	Flexible Antenna	915M	IPEX-1	2.0	10*45	8.5	Built-in flexible, FPC soft antenna
TX915-FPC-8521	Flexible Antenna	915M	IPEX-1	4.0	21*85	14	Built-in flexible, FPC soft antenna
TX868-JZ-5	Glue Stick Antenna	868M	SMA-J	2.0	52	-	Ultra Short Straight, Omni-Directional Antenna
TX915-JZ-5	Glue Stick Antenna	868M	SMA-J	2.0	52	-	Ultra Short Straight, Omni-Directional Antenna
TX868-JKD-20	Glue Stick Antenna	868M	SMA-J	3.0	200	-	Bending Rubber Stick, Omni-Directional Antenna
TX915-JKD-20	Glue Stick Antenna	915M	SMA-J	3.5	200	-	Bending Rubber Stick, Omni-Directional Antenna
TX915-JKS-20	Glue Stick Antenna	915M	SMA-J	3.0	200	-	Bending Rubber Stick, Omni-Directional Antenna
TX868-XPL-100	Suction Cup Antenna	868M	SMA-J	3.5	290	100	Small Suction Cup Antenna, Cost Effective
TX915-XPL-100	Suction Cup Antenna	868M	SMA-J	3.5	260	100	Small Suction Cup Antenna, Cost Effective

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10 Batch packing method



Revision history

Version	Date	Description	Issued by
1.0	2024-5-15	Initial version	Bin
1.1	2025-3-21	Modify the crystal related description	Bin

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