E04-2G4M10S1AX Product Specifications

STM32WBA54 2.4GHz SoC SMD wireless module



Chengdu Ebyte Electronic Technology Co.,Ltd.

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1 Overview

1.1 Introduction

E04-2G4M10S1AX is based on the STM32WBA54KGU6TR launched by STMicroelectronics This SoC-designed wireless communication module features long communication distance , low power consumption , strong anti-interference capabilities , rich interface resources , high processing power , and a compact size. The E04-2G4M10S1AX wireless communication module requires no user development and is widely applicable in the Internet of Things (IoT) industry.



1.2 Module Features

- Maximum transmit power 10dBm;
- Supports the global license-free ISM 2.4 GHz frequency band;
- Supported protocols: BLE5.4 , IEEE 802.15.4 , ZigBee, Matter, Thread , etc.
- Support 1.8 ~ 3.6V power supply;
- The external crystal oscillator uses 32.768KHz and 32MHz high-precision industrial-grade crystal oscillators to ensure stable operation of the module;
- 16*16 mm small size SMD package ;
- IPEX 1st generation antenna interface facilitates system integration and development .

1.3 Application Scenarios

- Smart city/municipal infrastructure;
- Industrial applications/building automation/distribution automation;
- Building security systems;
- Smart lighting/street lighting;
- Home energy management systems;
- Smart home and alarm system .

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2 Specifications

2.1 RF Parameters

RF parameters	Parameter value	Remark
Operating frequency band	2.4GHz	-
Transmit power	10dBm	Software adjustable, users need to develop and set it up by themselves
Receive sensitivity	-96dBm	@ Bluetooth® Low Energy at 1Mbps
Communication distance	210m	Clear and open environment, antenna gain 5dBi, height 2m, BLE , airspeed 1M bps

2.2 Hardware Parameters

Hardware Parameters	Parameter value	Remark
IC full name	STM32WBA54KGU6TR	-
kernel	ARM Cortex-M 33	-
FLASH	1024 KB	-
RAM	128 KB	-
High-speed crystal oscillator frequency	32MHz	Built-in passive crystal oscillator
Low-speed crystal oscillator frequency	32.768KHz	
Size	16.0 * 16.0 mm	±0.2mm
Antenna type	IPEX 1st Generation	Equivalent impedance is about 50Ω
interface	UART, SPI, I²C, GPIO, ADC	Users need to develop and set up their own
Packaging	LGA package	-
weight	1.1 g	±0.1g

2.3 Electrical parameters

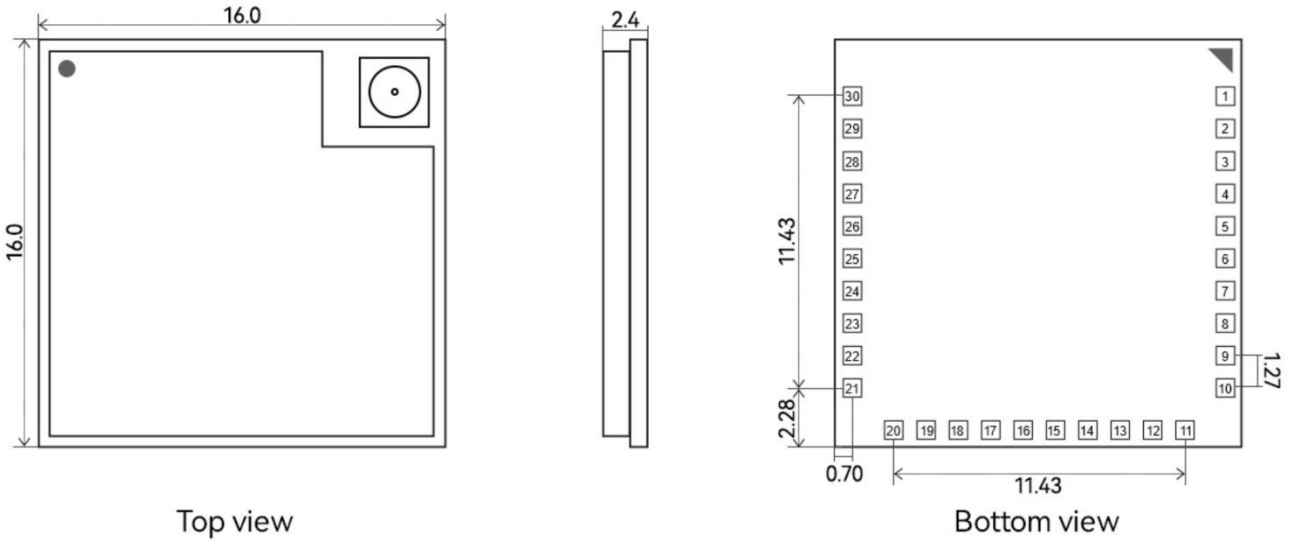
Electrical parameters	Minimum	Typical values	Maximum	unit	Remark
Power supply voltage	1.8	3.3	3.6	V	Exceeding 3.6V may damage the module
Communication level	-	3.3	-	V	-
Emission current	-	21.5	-	mA	VCC=3.3V,TX 10dBm , instantaneous power consumption
Working current	-	3.1	-	mA	-

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Sleep current	-	2	-	μA	Standby mode
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 Purpose
1	PB12	Input/Output	Configurable general-purpose IO port (see STM32WBA54KGU6TR manual for details)
2	PA8	Input/Output	Configurable general-purpose IO port (see STM32WBA54KGU6TR manual for details)
3	PA7	Input/Output	Configurable general-purpose IO port (see STM32WBA54KGU6TR manual for details)
4	PA6	Input/Output	Configurable general-purpose IO port (see STM32WBA54KGU6TR manual for details)
5	PA5	Input/Output	Configurable general-purpose IO port (see STM32WBA54KGU6TR manual for details)
6	PA2	Input/Output	Configurable general-purpose IO port (see STM32WBA54KGU6TR manual for details)
7	PA1	Input/Output	Configurable general-purpose IO port (see STM32WBA54KGU6TR manual for details)
8	PA0	Input/Output	Configurable general-purpose IO port (see STM32WBA54KGU6TR manual for details)
9	GND	-	Power ground
10	GND	-	Power ground
11	GND	-	Power ground
12	GND	-	Power ground

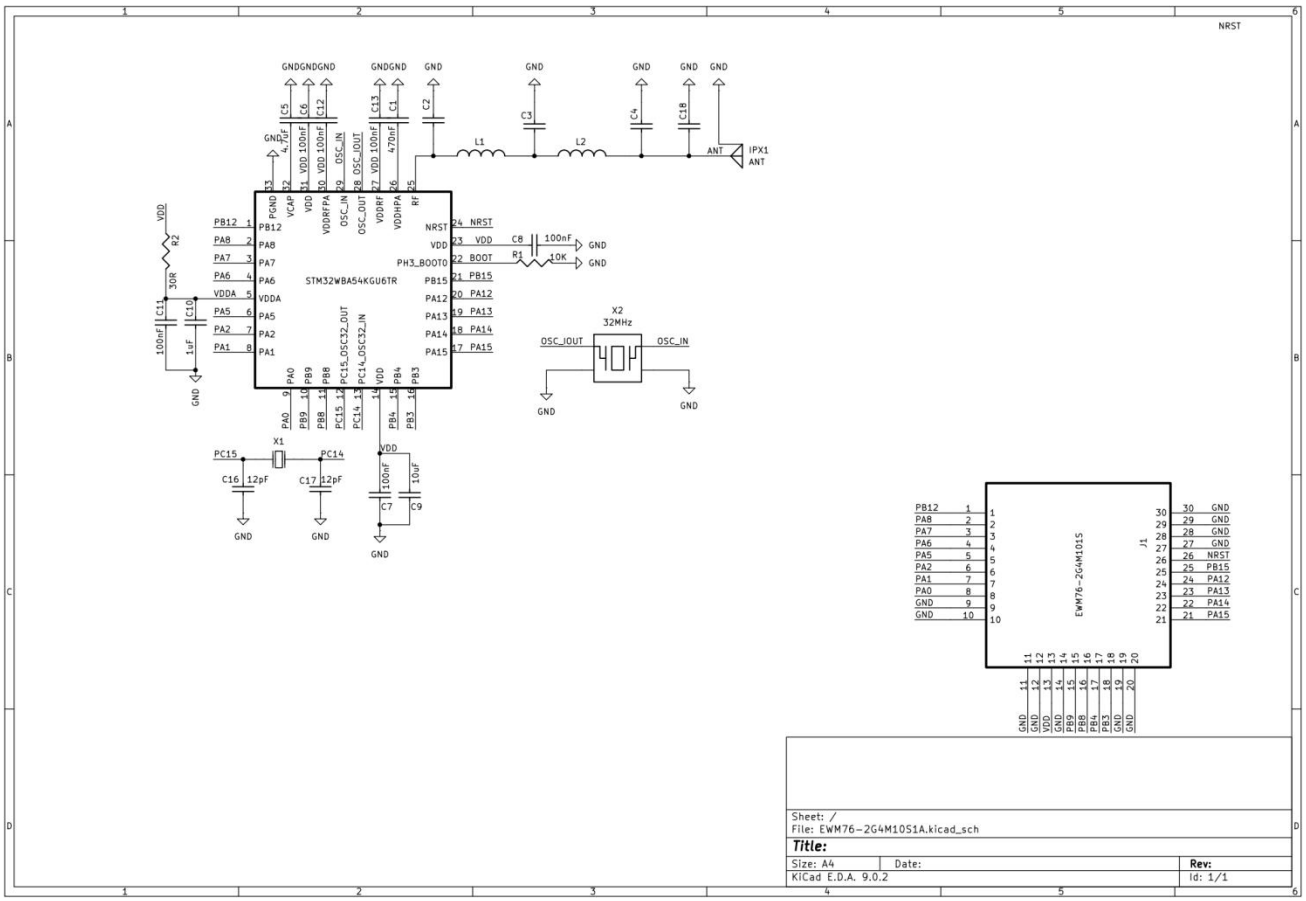
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13	VDD	enter	Power supply, DC 1.8V-3.6V
14	GND	-	Power ground
15	PB9	Input/Output	Configurable general-purpose IO port (see STM32WBA54KGU6TR manual for details)
16	PB8	Input/Output	Configurable general-purpose IO port (see STM32WBA54KGU6TR manual for details)
17	PB4	Input/Output	Configurable general-purpose IO port (see STM32WBA54KGU6TR manual for details)
18	PB3	Input/Output	Configurable general-purpose IO port (see STM32WBA54KGU6TR manual for details)
19	GND	-	Power ground
20	GND	-	Power ground
21	PA15	Input/Output	Configurable general-purpose IO port (see STM32WBA54KGU6TR manual for details)
22	PA14	Input/Output	Program debugging/downloading port SWCLK
23	PA13	Input/Output	Program debugging/downloading port SWDIO
24	PA12	Input/Output	Configurable general-purpose IO port (see STM32WBA54KGU6TR manual for details)
25	PB15	Input/Output	Configurable general-purpose IO port (see STM32WBA54KGU6TR manual for details)
26	NRST	enter	Reset pin, low level reset
27	GND	-	Power ground
28	GND	-	Power ground
29	GND	-	Power ground
30	GND	-	Power ground

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4 Basic Applications

4.1 Reference Schematic



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5 Basic Operations

5.1 Hardware Design

- It is recommended to use a DC regulated power supply to power the module. The power ripple coefficient should be as small as possible and the module must be reliably grounded.
- Please pay attention to the correct connection of the positive and negative poles of the power supply. Reverse connection may cause permanent damage to the module.
- Please check the power supply to ensure that it is within the recommended power supply voltage. Exceeding the maximum value may cause permanent damage to the module.
- Please check the power supply stability, the voltage should not fluctuate greatly or frequently;
- When designing the power supply circuit for the module, it is often recommended to retain more than 30% margin, which is conducive to long-term stable operation of the entire machine;
- The module should be kept as far away as possible from power supplies, transformers, high-frequency wiring and other parts with large electromagnetic interference;
- High-frequency digital traces, high-frequency analog traces, and power traces must avoid the bottom of the module. If they must pass under the module, assuming the module is soldered to the top layer, lay ground copper on the top layer of the module contact part (all copper is laid and well grounded). They must be close to the digital part of the module and routed on the bottom layer.
- If the module is soldered or placed on the top layer, it is also wrong to randomly route the wires on the bottom layer or other layers, which will affect the module's spurious emission and receiving sensitivity to varying degrees.
- If there are devices with large electromagnetic interference around the module, it will greatly affect the performance of the module. It is recommended to keep them away from the module according to the intensity of the interference. If possible, appropriate isolation and shielding can be performed.
- If there are traces with strong electromagnetic interference around the module (high-frequency digital, high-frequency analog, power supply traces), it will greatly affect the module's performance. It is recommended to keep them away from the module according to the intensity of the interference. If possible, appropriate isolation and shielding can be performed.
- The antenna installation structure has a significant impact on the module's performance. Make sure the antenna is exposed, preferably pointing vertically upward. When the module is installed inside the housing, use a high-quality antenna extension cable to extend the antenna to the outside of the housing.
- The antenna must not be installed inside a metal shell, as this will significantly reduce the transmission distance.
- If the module is connected to an external MCU, it is recommended to add a 200R protection resistor to the RXD/TXD of the external MCU.

5.2 Software Writing

- The following is a tutorial on setting up and configuring the software environment, for reference only.
- Please download the software demo from the official website. If you download the official demo, you only need to refer to 5.2.1 to set up the environment.

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- This document was created during the demo production period to assist in the development of E04-2G4M10S1AX . If there are new uses for the official SDK in the future, please follow the official documentation.

5.2.1 Keil and STM32CubeMX Environment Description

- The main control chip of the E04-2G4M10S1AX module used this time is STM32WBA54KGU6. It is recommended to download and install Keil version 5.27 or above. The download address of the STM32WBA54KGU6 chip firmware package is: https://www.keil.arm.com/packs/stm32wbaxx_dfp-keil/.
- After downloading the STM32WBA chip firmware package, double-click to install. Note that if the installation fails midway, just close it directly without affecting the subsequent environment setup..
- Please download the latest version 6.15.0 of STM32CubeMX from the download address:: https://www.st.com.cn/zh/development-tools/stm32cubemx.html#st-get-software.

5.2.2 Create a new STM32CubeMX project

1. First open STM32CubeMX, as shown in Figure 5.1, and click "No. 1" to create a project.

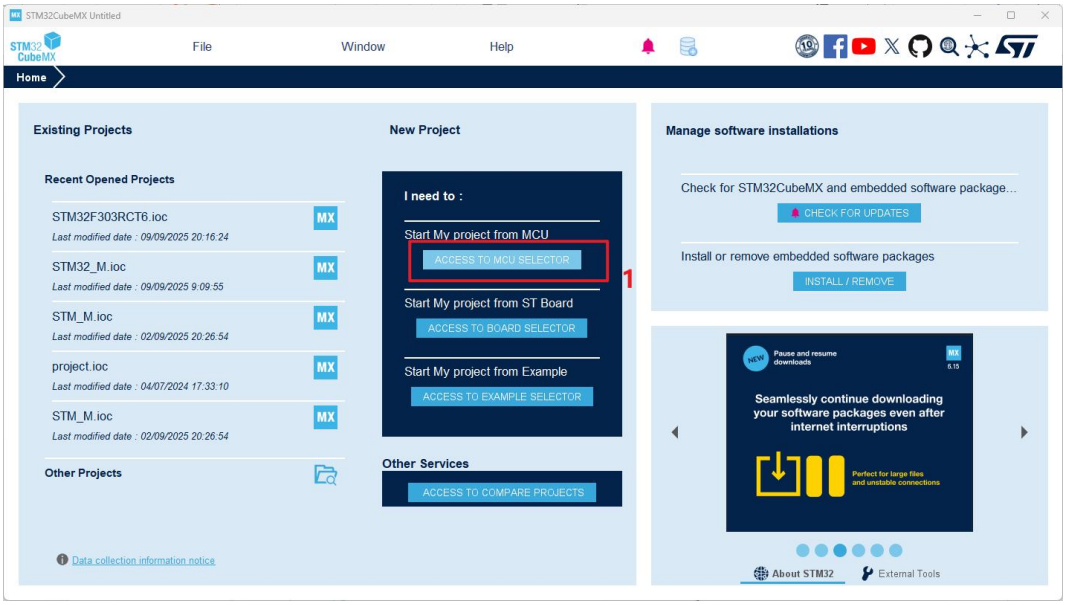


Figure 5.1

2. Then, as shown in Figure 5.2, open STM32CubeMX, select STM32WBA54KGU6TR in the option box of "Serial No. 1", then click "Serial No.2", and finally click "Serial No. 3" to complete the project creation.

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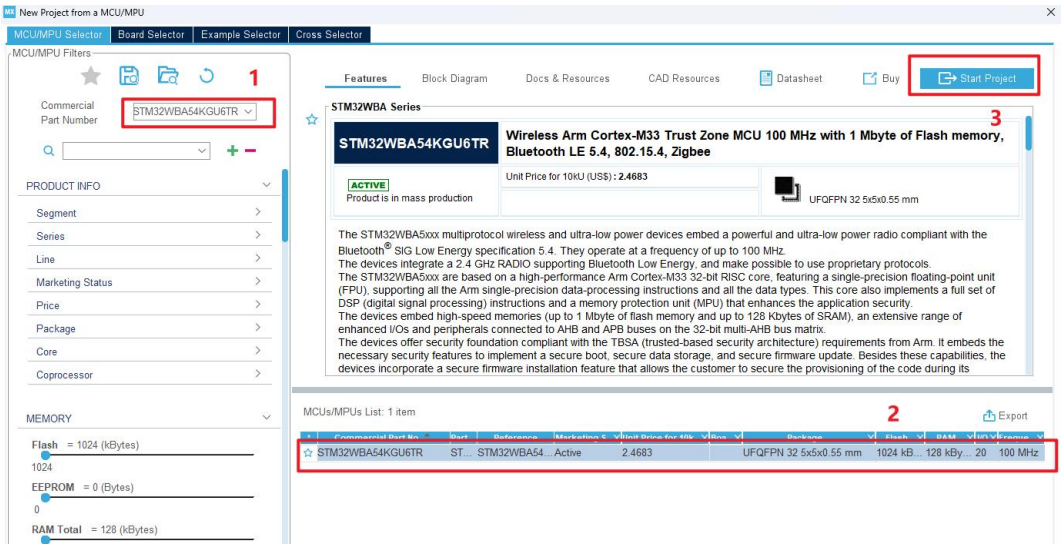


Figure 5.2

3. After creation, an option box will pop up. Generally, select the first one, as shown in Figure 5.3.

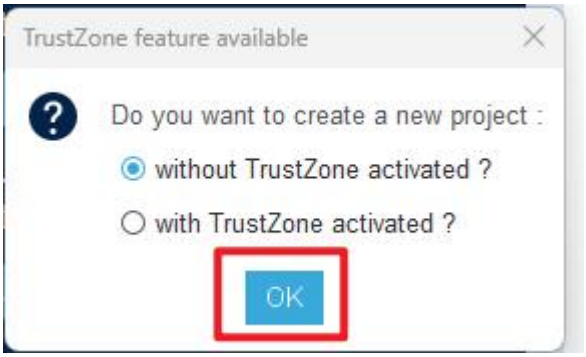


Figure 5.3

4. Configure the clock system. After entering the STM32CubeMX configuration interface, as shown in Figure 5.4, use the shortcut key (Alt+X) to expand all options, then click "No.1", and then select Crystal/Ceramic Resonator in the "No. 2" selection box.

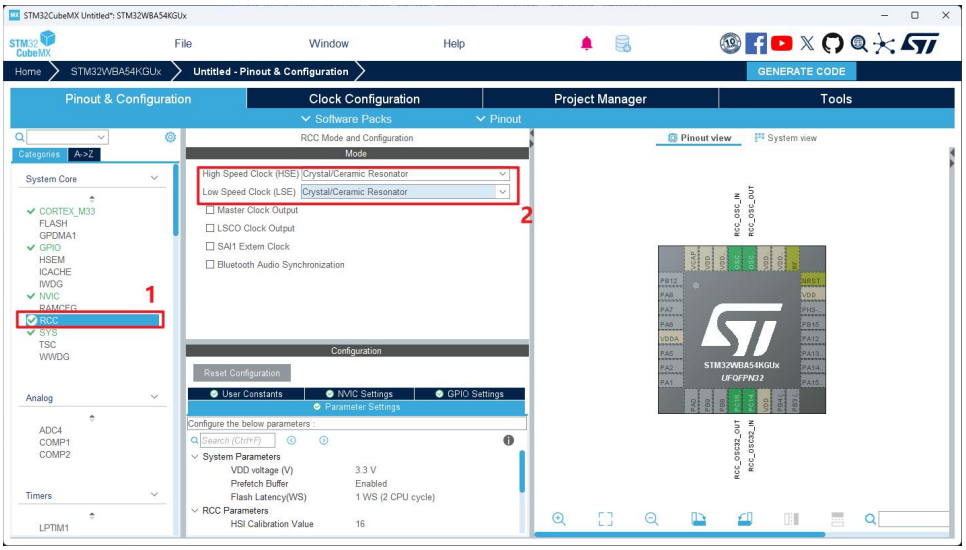


Figure 5.4

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5. Configure the serial port. Configure serial port 1 as shown in Figure 5.5.

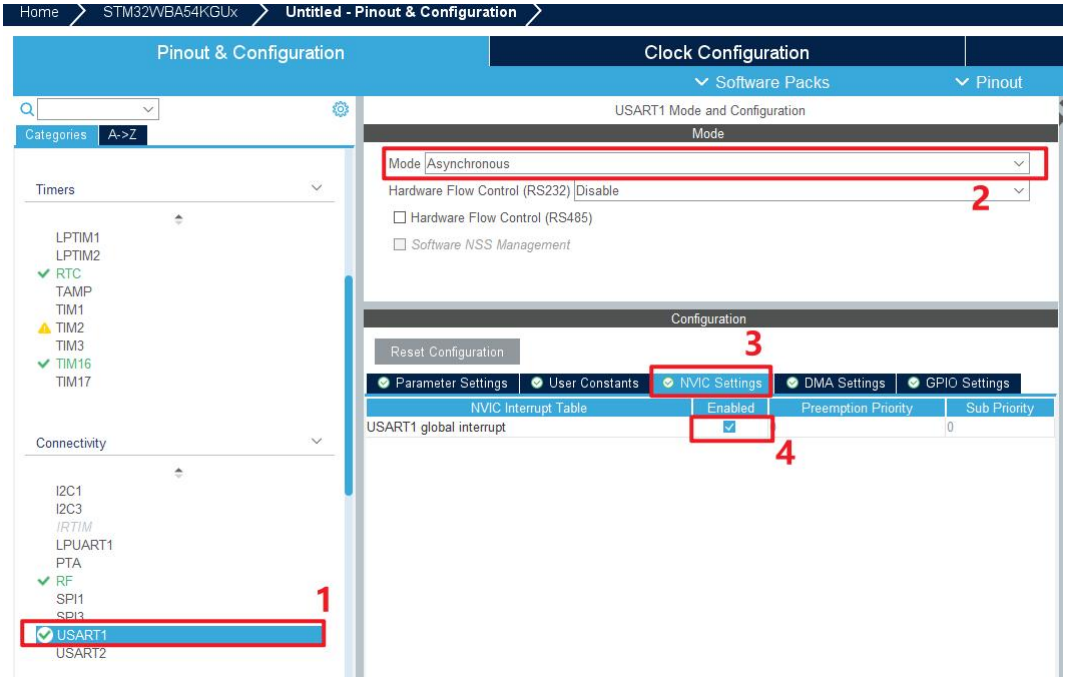
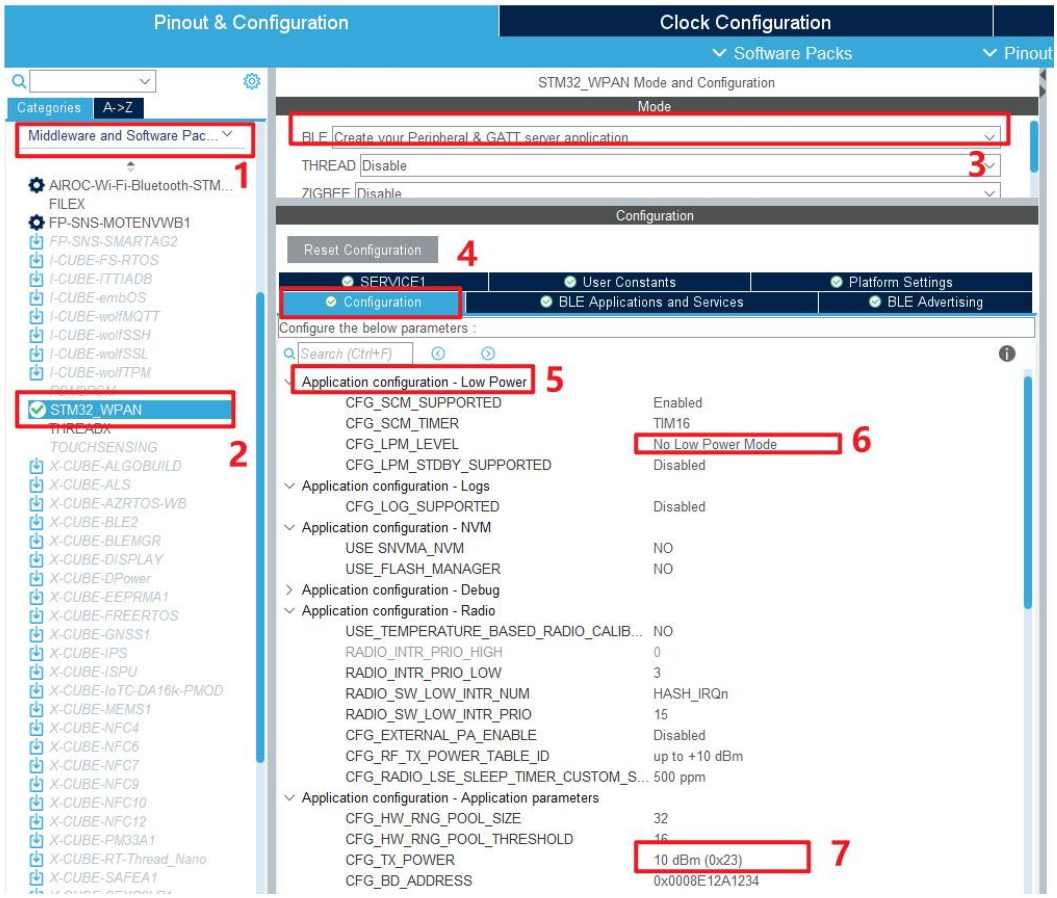


Figure 5.5

6. Configure the module's wireless radio. As shown in Figure 5.6, in the "No. 1" directory, click "No. 2." In the "No. 3" selection box, select as shown. Then, follow "No. 4-6" to configure CFG_LPM_LEVEL to No Low Power Mode. "No. 7" is used to modify the RF transmit power; here, it is set to a maximum of 10dBm.



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Figure 5.6

7. Then configure a Bluetooth service as shown in Figure 5.7.

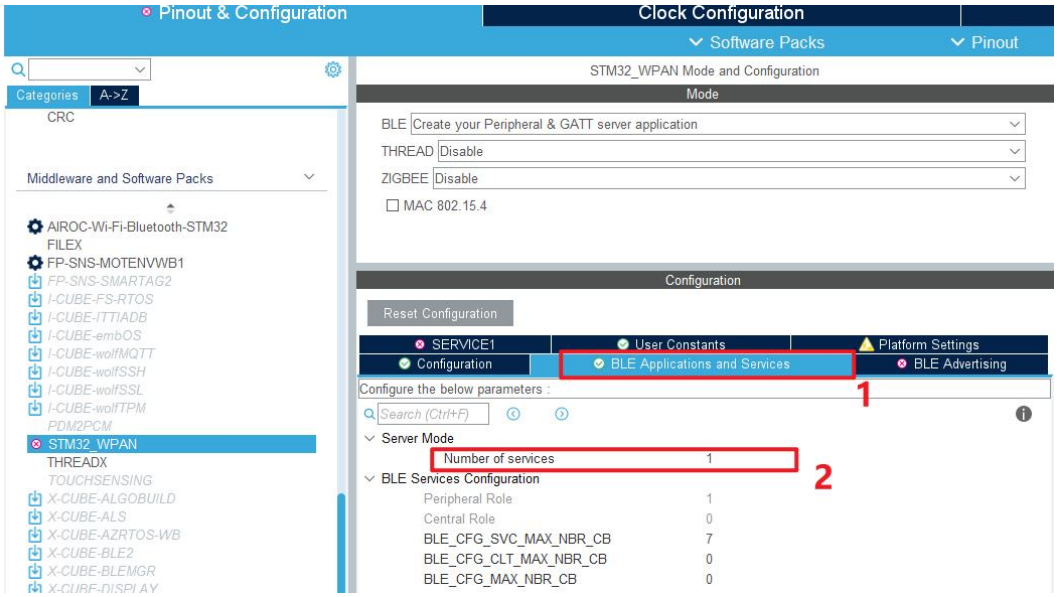


Figure 5.7

8. Follow the steps shown in Figure 5.8 . "Serial No. 3" is the name of the Bluetooth reset and can be changed.

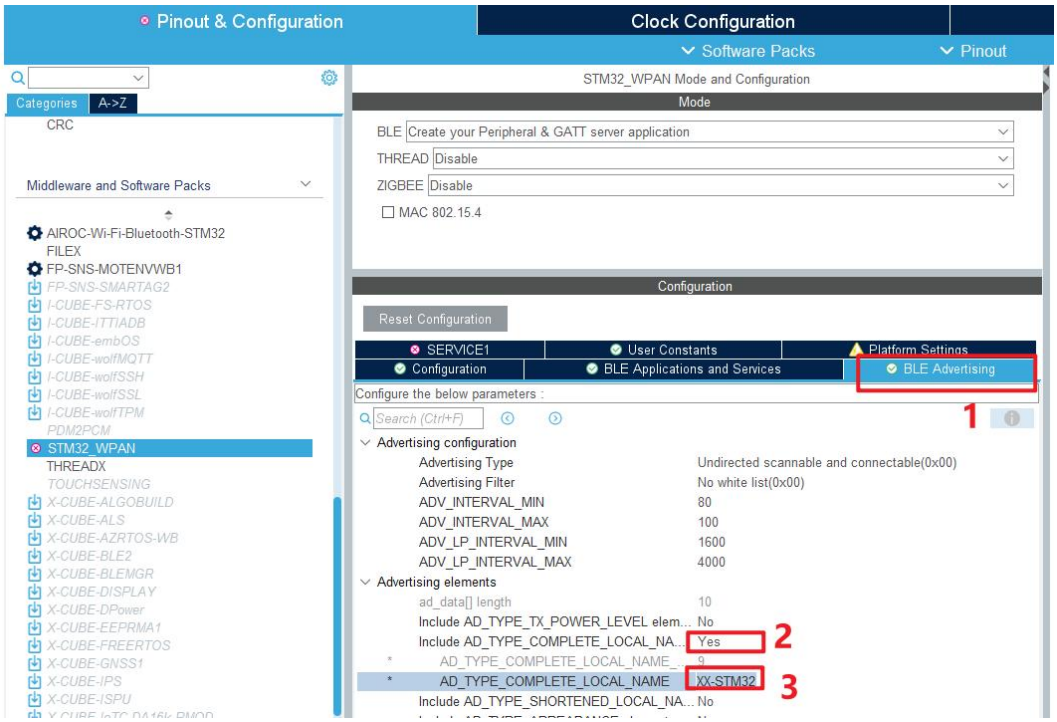


Figure 5.8

9. Enable two services.

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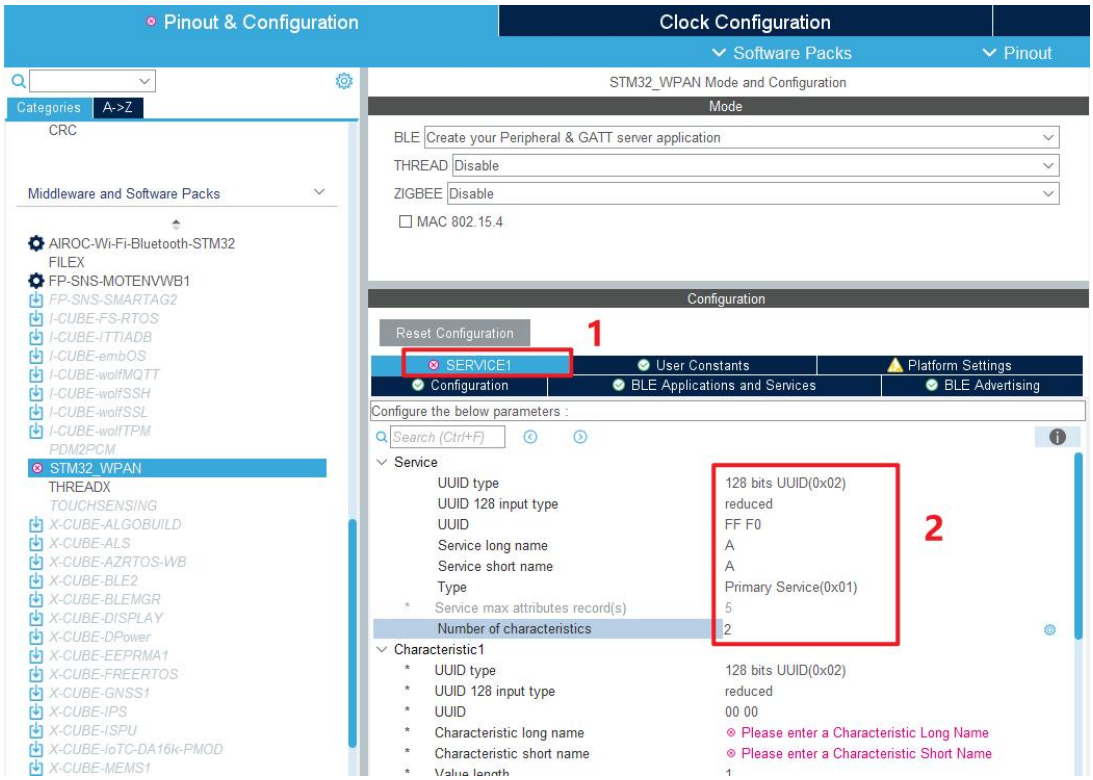


Figure 5.9

10. As shown in Figure 5.10, configure the parameters of Characteristic1 as shown.

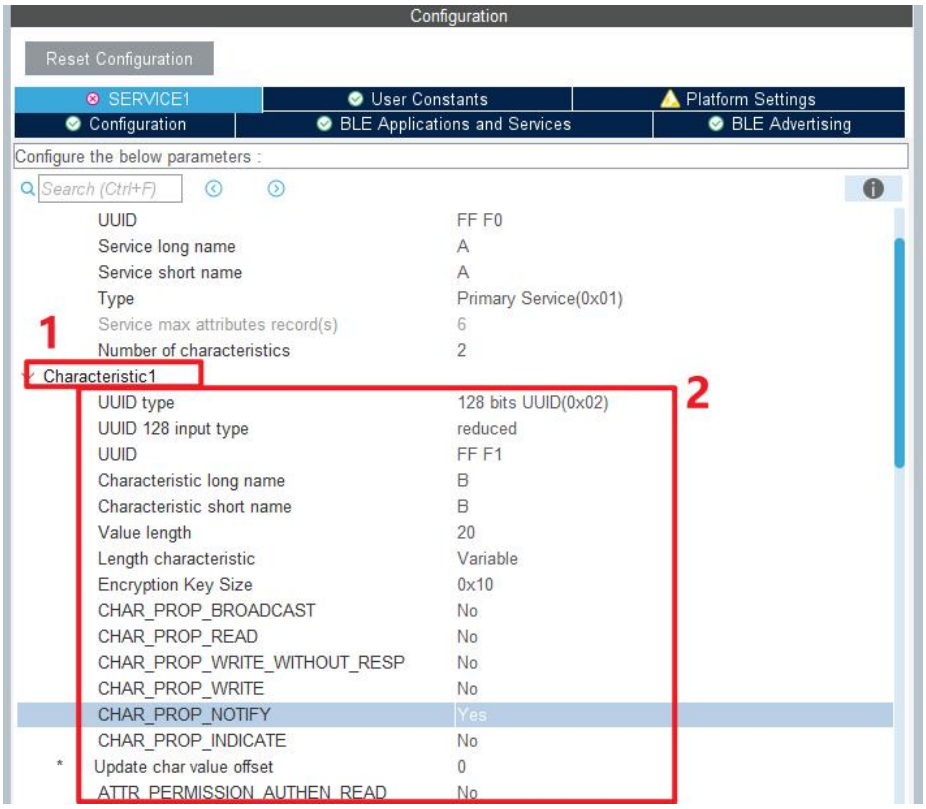


Figure 5.10

11. As shown in Figure 5.11, configure the parameters of Characteristic2 as shown.

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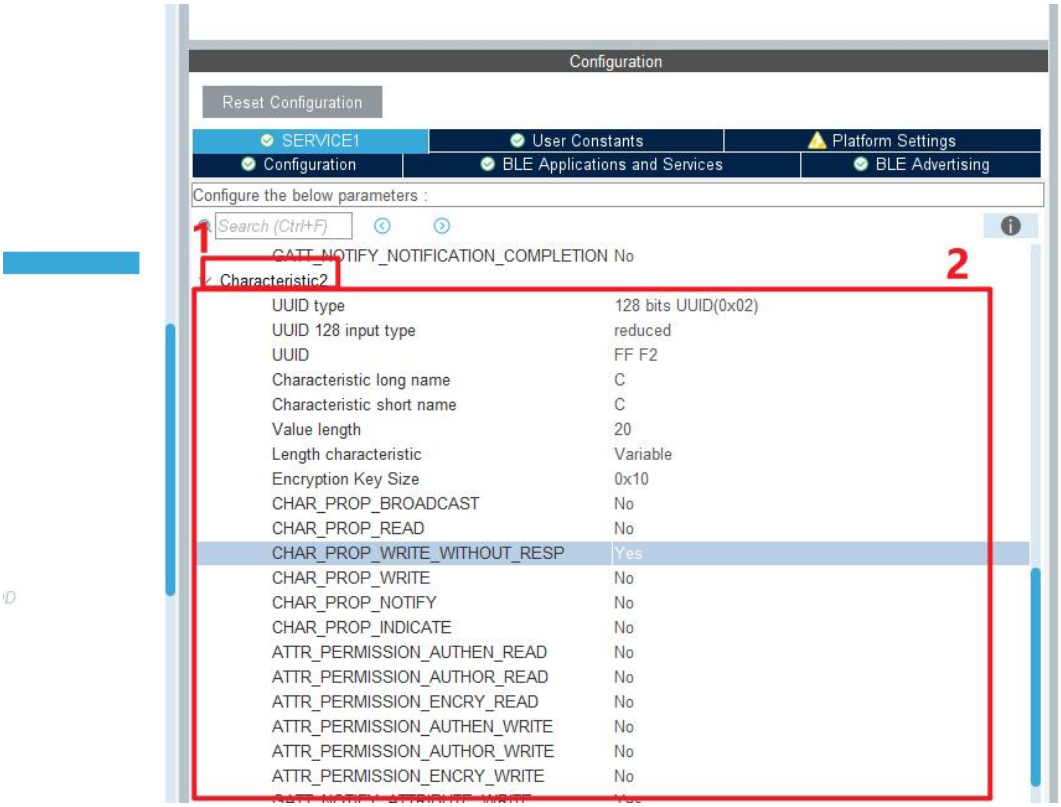


Figure 5.11

12. As shown in Figure 5.12, configure the following parameters as shown.

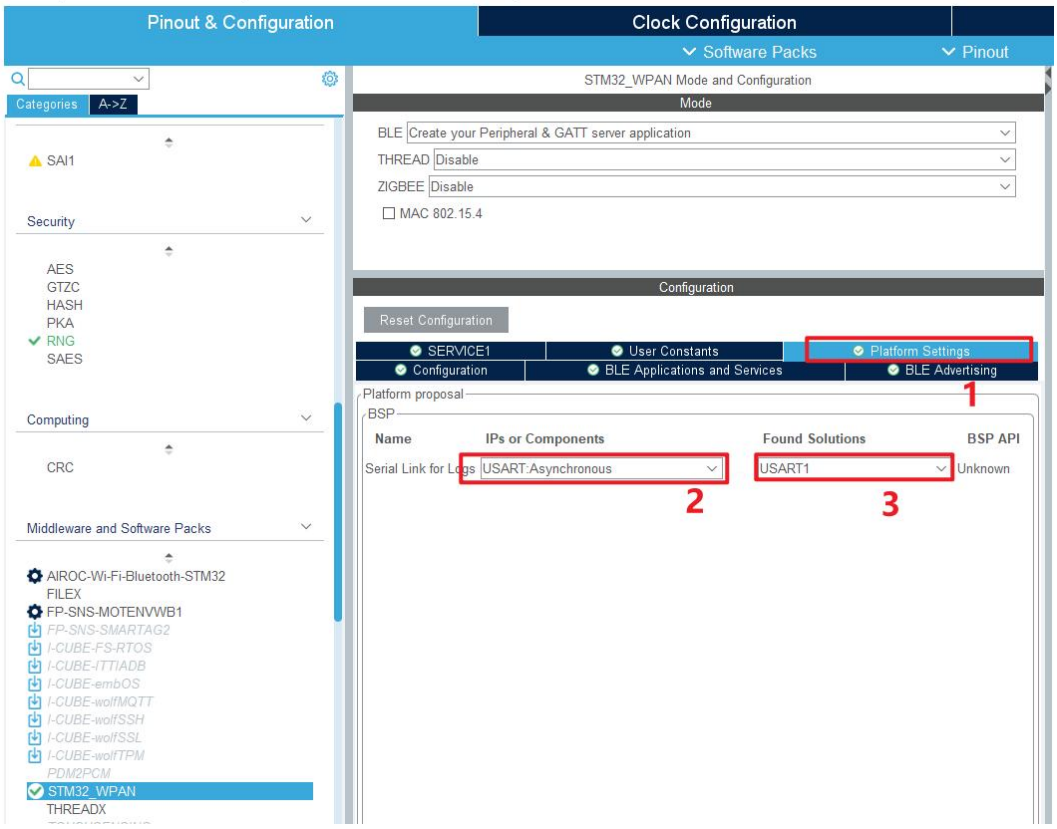


Figure 5.12

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13. Configure the program download and debug interface. As shown in Figure 5.13, select Serial Wire.

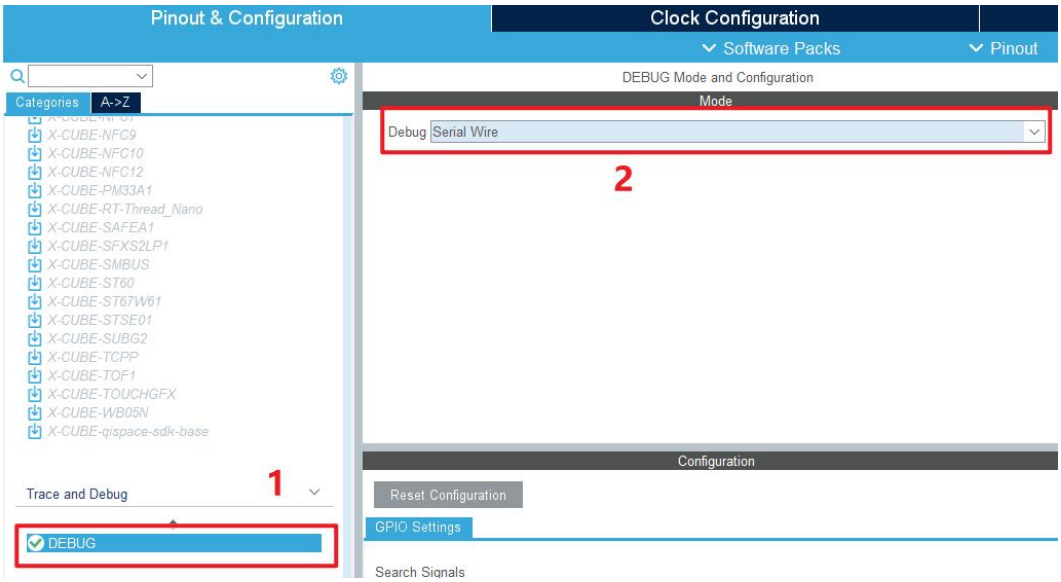


Figure 5.13

14. Configure DMA. Configure DMA as shown in Figures 5.14, 5.15, and 5.16. Note "Sequence number 3". After entering the parameters, press Enter to save.

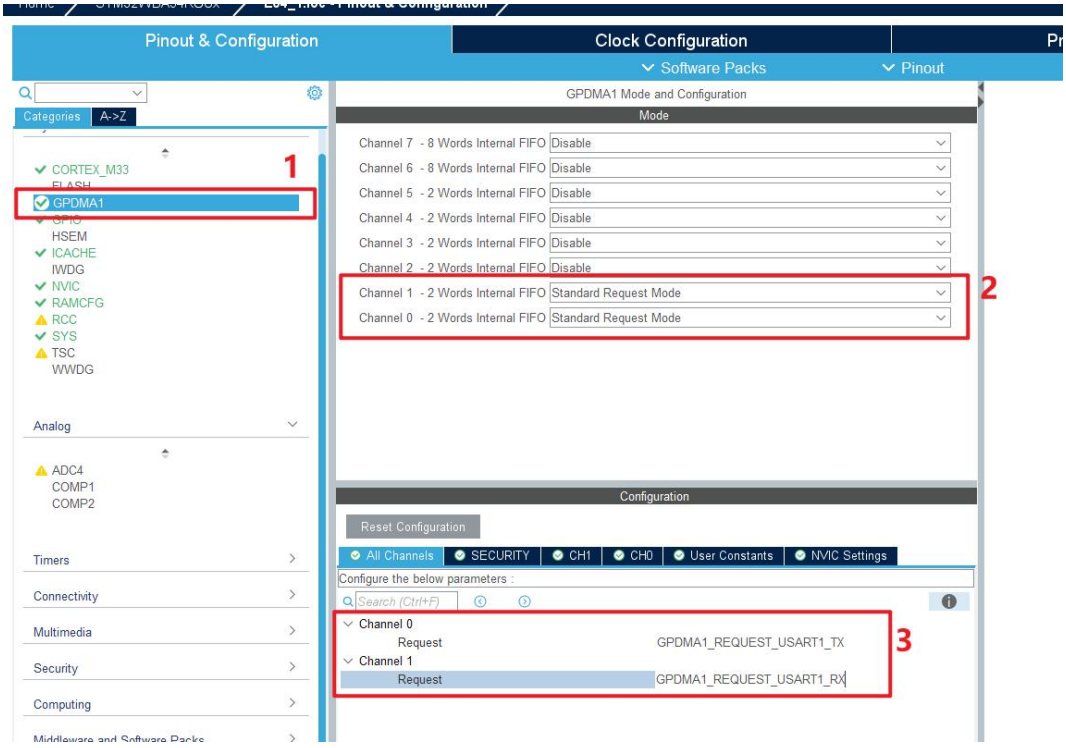


Figure 5.14

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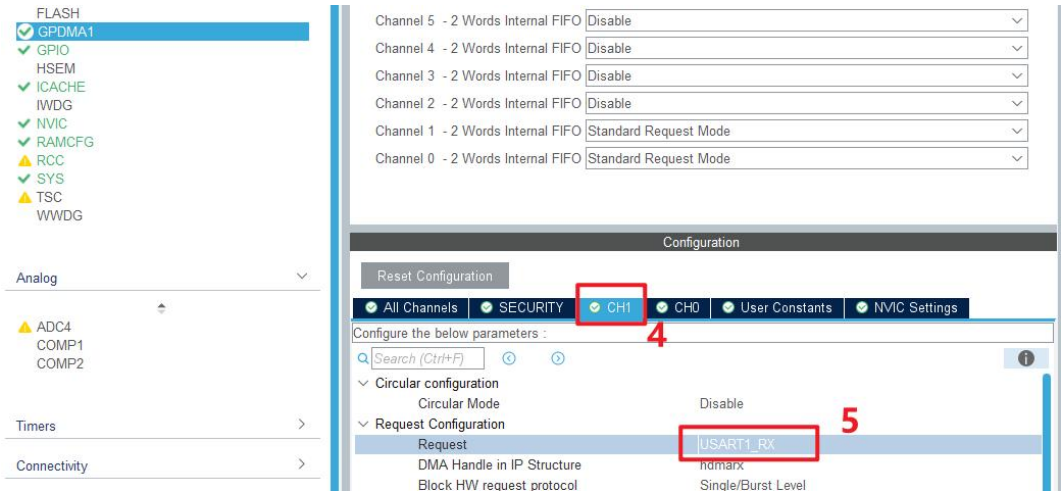


Figure 5.15

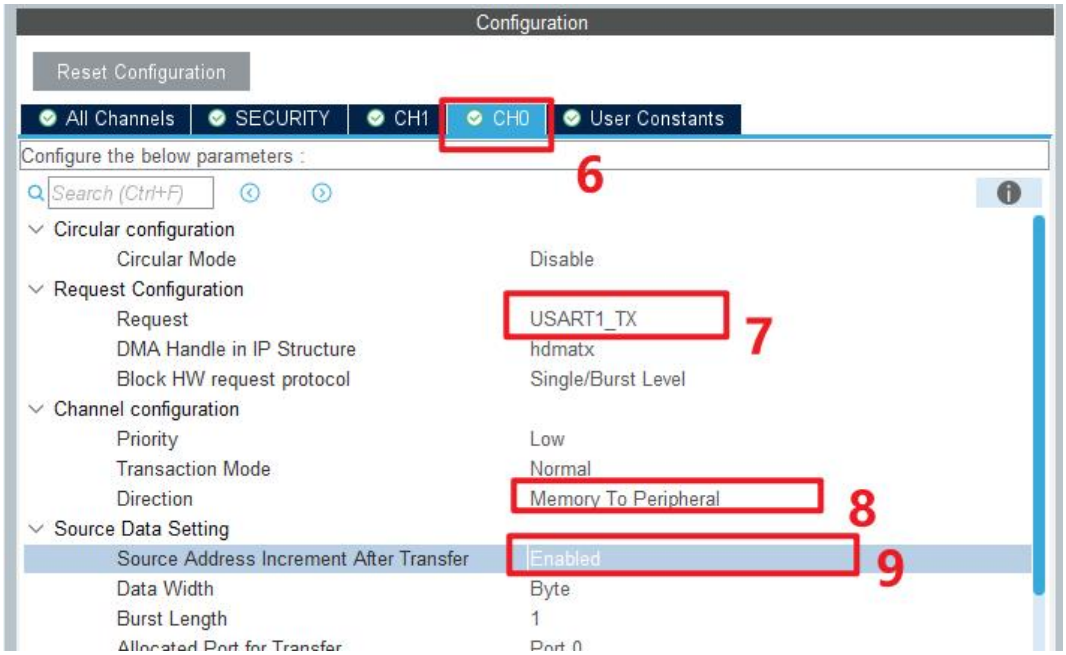


Figure 5.16

15. Configure the system clock as shown in Figure 5.17.

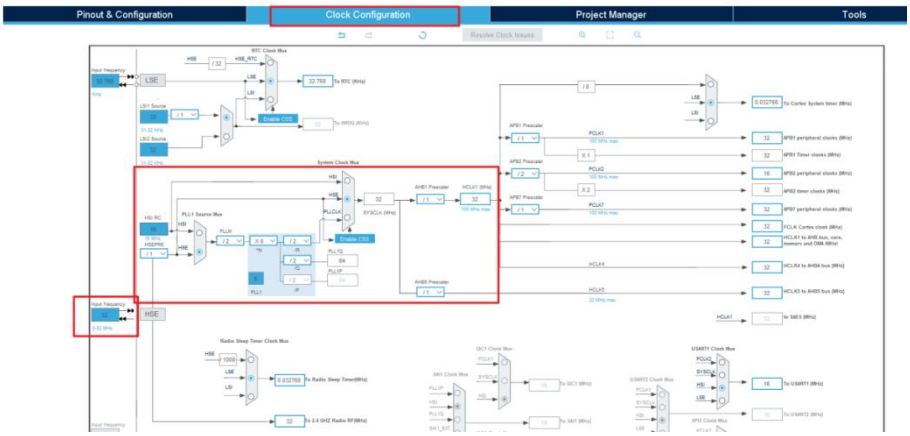


Figure 5.17

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16. Configure project management. Perform the configuration as shown in Figures 5.18 and 5.19. Note that the path for "Sequence No. 4" should not contain any Chinese characters.

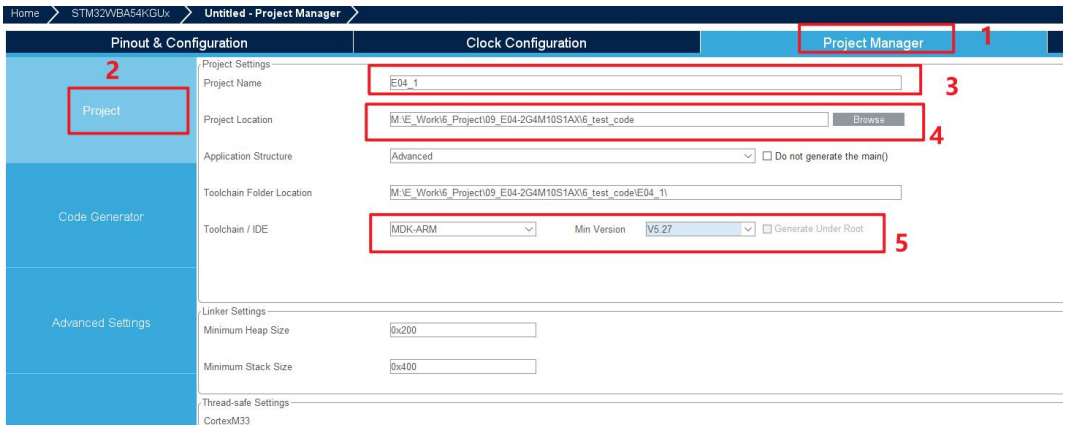


Figure 5.18

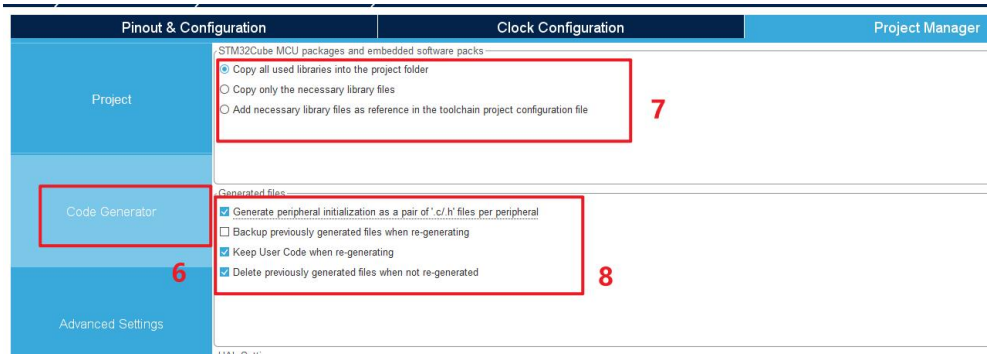


Figure 5.19

5.2.3 Keil environment configuration

After opening the Keil project, first follow the steps shown in Figure 5.20. Note that the content added in "Sequence No. 4" is "-fshort-enums".

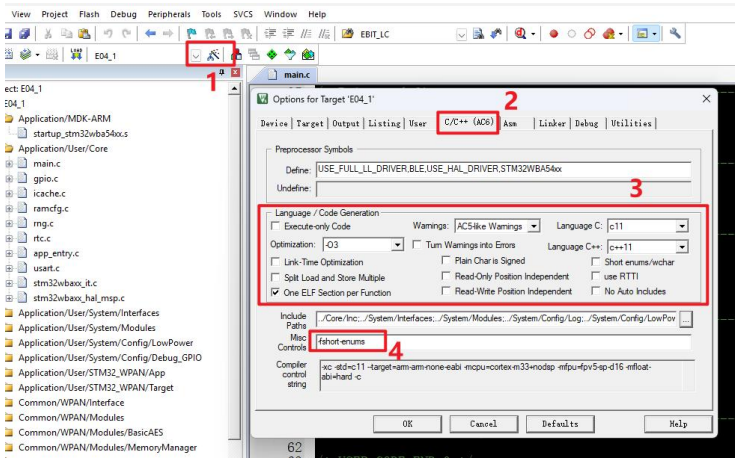


Figure 5.20

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6 Frequently Asked Questions

6.1 Transmission distance is not ideal

- When there is a straight-line communication obstacle, the communication distance will be reduced accordingly;
- Temperature, humidity, and co-channel interference can increase the communication packet loss rate;
- The ground absorbs and reflects radio waves, so the test results are poor when close to the ground;
- Seawater has a strong ability to absorb radio waves, so the test results at the seaside are poor;
- If there are metal objects near the antenna, or if it is placed in a metal shell, the signal attenuation will be very serious;
- The power register is set incorrectly or the air rate is set too high (the higher the air rate, the closer the distance);
- The power supply voltage is lower than the recommended value at room temperature. The lower the voltage, the lower the power output.
- The antenna used does not match the module well or the antenna itself may have quality issues.

6.2 Modules are easily damaged

- Please check the power supply to ensure that it is within the recommended power supply voltage. Exceeding the maximum value may cause permanent damage to the module.
- Please check the power supply stability, the voltage should not fluctuate greatly or frequently;
- Please ensure anti-static operation during installation and use, as high-frequency components are sensitive to static electricity;
- Please ensure that the humidity is not too high during installation and use, as some components are humidity sensitive.
- If there is no special requirement, it is not recommended to use it at too high or too low temperatures.

6.3 Bit Error Rate Too High

- There is interference from the same frequency signal nearby. Move away from the interference source or change the frequency or channel to avoid interference.
- The SPI clock waveform is not standard. Check whether there is interference on the SPI line. The SPI bus line should not be too long.
- An unsatisfactory power supply may also cause garbled characters, so the reliability of the power supply must be ensured;
- Poor quality or excessive length of extension cables or feeders can also cause high bit error rates.

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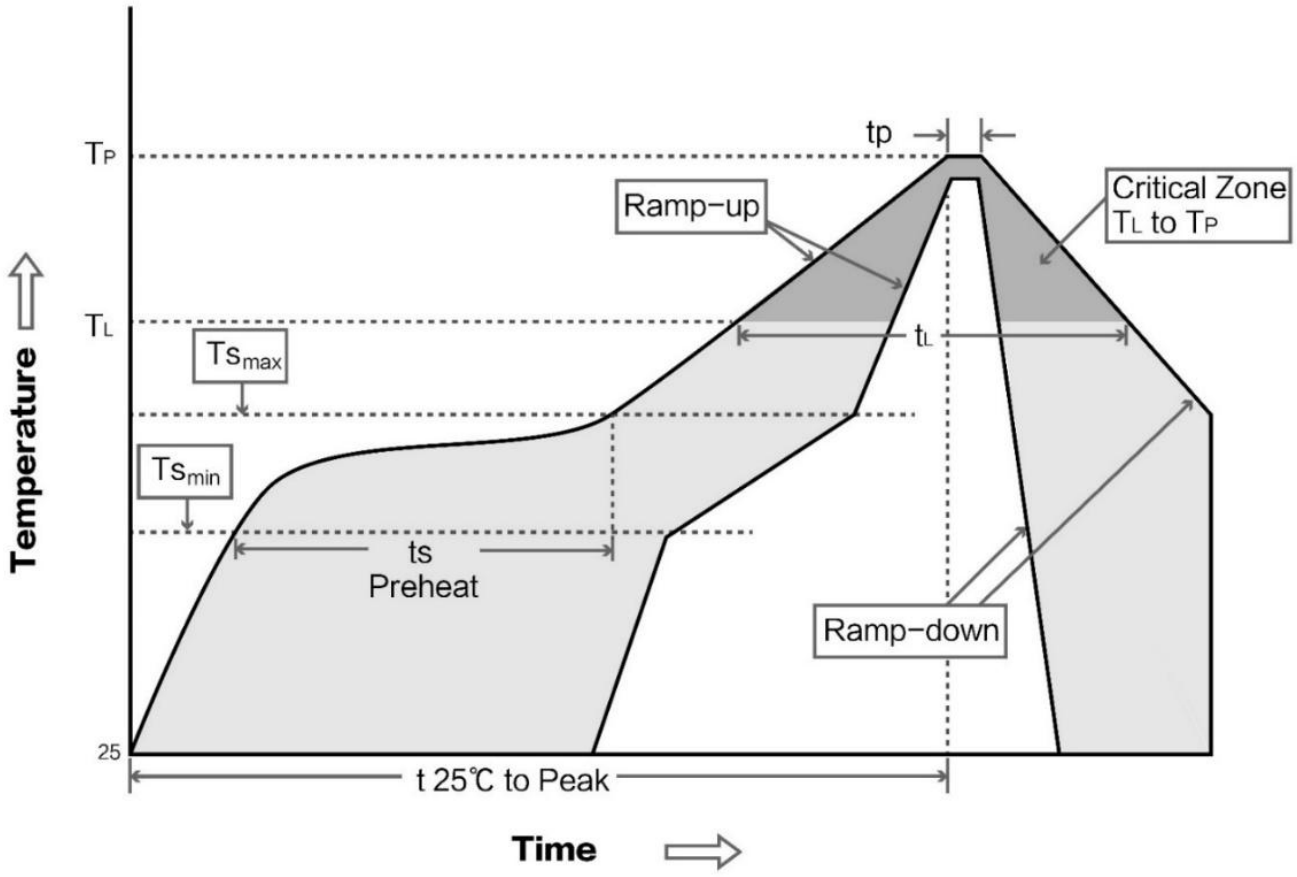
7 Welding Operation Instructions

7.1 Reflow Temperature

Profile Feature	Curve characteristics	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)	Warm-up time	60-120 seconds	60-120 seconds
Average ramp-up rate(Tsmax to Tp)	Average ascent rate	3℃/second max	3℃/second max
Liquidous Temperature (TL)	Liquidus temperature	183℃	217℃
Time(tL)Maintained Above(TL)	Time above liquidus	60-90 seconds	30-90 seconds
Peak temperature (Tp)	Peak temperature	220-235℃	230-250℃
Aveage ramp-down rate（Tp to Tsmax）	Average descent rate	6℃/second max	6℃/second max
Time 25℃ to peak temperature	Time from 25℃ to peak temperature	6 minutes max	8 minutes max

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7.2 Reflow Oven Curve



8 Related Models

Product Model	Chip Solutions	Carrier frequency Hz	Transmit power dBm	Test distance km	Package	Product size mm	interface
E77-400M22S	STM32WLE5CCU6	433/470M	twenty two	5.6	patch	14*20	UART, SPI, I²C, GPIO, ADC
E77-900M22S	STM32WLE5CCU6	868/915M	twenty two	5.6	patch	14*20	UART, SPI, I²C, GPIO, ADC

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Revision History

Version	Revision Date	Revision Notes	Maintainer
1.0	2025-09-29	first edition	Bin

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