E76-2G4M10S1A Product Manual

EFR32BG24 BLE6.0 SOC Surface mount wireless module



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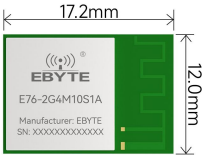
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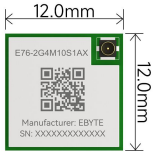
Chapter 1 Overview

1.1 Introduction

The E76-2G4M10S1A series modules are multi-protocol wireless communication modules based on the Silicon Labs EFR32BG24A010F1024IM40-B SoC. They feature long communication distance, low power consumption, strong anti-interference capabilities, abundant interface resources, powerful processing capabilities, and small size. The E76-2G4M10S1A series wireless communication modules require secondary development by the user and can be widely used in the Internet of Things (IoT) industry.



E76-2G4M10S1A



E76-2G4M10S1AX

1.2 Features and Functions

- Unlicensed ISM 2.4GHz band worldwide;
- Supported protocols: BLE 6.0, Bluetooth Mesh , proprietary 2.4 GHz protocol ;
- Built-in high-performance Arm Cortex-M33 processor;
- Maximum transmit power of 10 dBm;
- The quiescent current is as low as 1.3 uA ;
- The external crystal oscillator uses a 40 MHz high-precision industrial-grade crystal oscillator to ensure stable operation of the module;
- Industrial-grade standard design, supporting long-term use at temperatures ranging from -40 to 85 ℃;
- Small size , easy to integrate ;
- For users to use in secondary development .

1.3 Application scenarios

- Access control system;
- Automotive electronics applications;
- Smart remote control;
- Location services;
- Healthcare;
- Wireless alarm security system;
- Smart home and industrial sensors, etc.

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Chapter Two Specifications

2.1 Product Selection Comparison

Product Model	Chip solutions	Carrier frequency ① GHz	Transmit power ② dBm	Communication distance ③ m	Product size ④ mm	Antenna type ⑤
E76-2G4M10S1A	EFR32BG24A010F1024IM40-B	2.4	10	110	12.0*17.2	PCB
E76-2G4M10S1A X	EFR32BG24A010F1024IM40-B	2.4	10	160	12.0*12.0	IPEX 3rd Generation

Note:

① Communication channel: User programming settings are supported within the channel range;

② Transmit power: 10 dBm, power adjustable in multiple levels , see EFR32BG24A010F1024IM40 -B chip datasheet for details ;

③ Communication distance: Clear and open terrain, antenna height 2 meters, BLE, airspeed 1Mbps (for reference only, actual measurement recommended);

④ Product dimensions: tolerance ±0.2mm;

⑤ Antenna type: equivalent impedance approximately 50Ω .

2.2 Basic Parameters

Conditions: Tc = 25℃, VDD = 3.3V

parameter	describe
Chip Model	EFR32BG24A010F1024IM40 -B
RAM	128 KB
FLASH	1024 KB
Crystal oscillator frequency	40 MHz, built-in passive crystal oscillator
Packaging	LGA
Communication interface	UART, SPI, I²C, GPIO, ADC, and PWM require user-defined configuration.
E76-2G4M10S1A weight	0.8g ± 0.1g
E76-2G4M10S1A X weight	0.6g ± 0.1g
Work environment	
Operating temperature	-40℃~+85℃, industrial grade standard
Operating humidity	10~95%RH, no condensation
Storage temperature	-40℃～+125℃
RF parameters	
Transmit power	10 dBm power adjustable in multiple levels
Operating frequency band	2.4GHz
Receiver sensitivity	-105.7 dBm @ Long Range 125K bps
	-97.6 dBm @Bluetooth LE 1Mbps

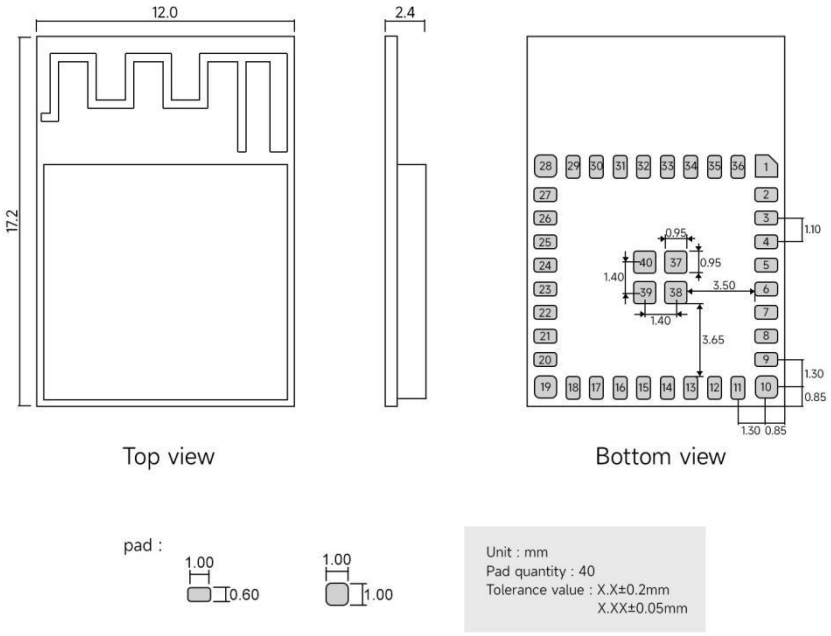
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parameter	describe
	-94.8 dBm @Bluetooth LE 2 Mbps
Electrical parameters	
Power supply voltage	2.2V to 3.8V , with 3.3V being recommended. Voltages exceeding 3.8V may burn out the module.
Communication level	3.3V (See EFR32BG24A010F1024IM40 chip datasheet for details)
Emission current	≈ 24.5 mA, instantaneous power consumption
Received current	≈ 4.4 mA
Dormant current	≈ 1.3 uA, deep sleep mode

Chapter 3 Mechanical Dimensions and Pin Definitions

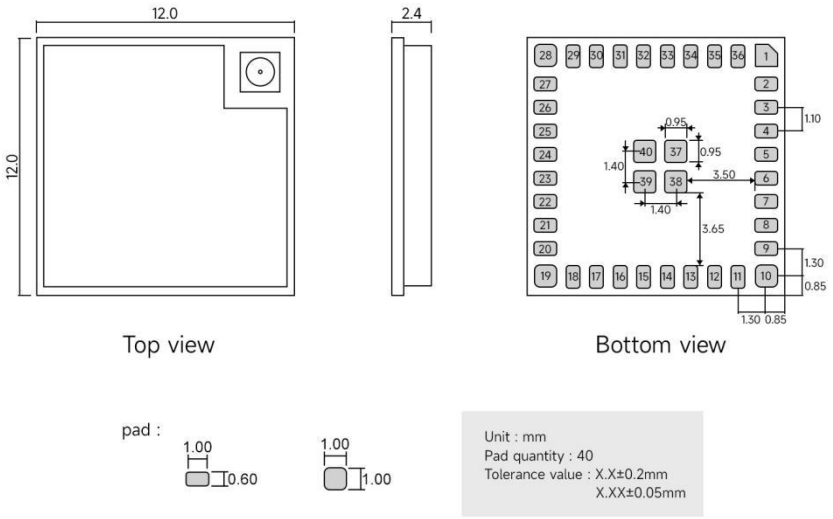
3.1 Mechanical Dimensions and Pin Definitions



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E76-2G4M10S1AX

Pin number	Pin Name	Pin direction	Pin Applications
1	PA00	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
2	PA01	Input/Output	Program debugging/download port SWCLK
3	PA02	Input/Output	SWDIO (Program Debug/Download Port)
4	PA03	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
5	PA04	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
6	PA05	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
7	PA06	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
8	PA07	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
9	VDD	Input	Power supply interface: DC 2.2 ~ 3.8 V
10	GND	-	Ground wire, connected to power reference ground
11	PA08	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
12	PD03	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details) .
13	PD02	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
14	PD01	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details) .
15	PD00	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
16	PC00	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for

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Pin number	Pin Name	Pin direction	Pin Applications
			details) .
17	PC01	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
18	PC03	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
19	nRESET	Input	Reset pin, low level reset
20	PC04	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
twenty one	PC02	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
twenty two	PC05	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
twenty three	PC06	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
twenty four	PC07	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
25	NC	-	With feet off the ground, it is recommended to keep them suspended in the air.
26	NC	-	With feet off the ground, it is recommended to keep them suspended in the air.
27	NC	-	With feet off the ground, it is recommended to keep them suspended in the air.
28	NC	-	With feet off the ground, it is recommended to keep them suspended in the air.
29	NC	-	With feet off the ground, it is recommended to keep them suspended in the air.
30, 31	GND	-	Ground wire, connected to power reference ground
32	PB04	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
33	PB03	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
34	PB02	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
35	PB01	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
36	PB00	Input/Output	Configurable general-purpose I/O ports (see EFR32BG24A010F1024IM40 manual for details)
37~40	GND	-	Ground wire, connected to power reference ground

Chapter 4 Basic Operations

4.1 Hardware Design

- It is recommended to use a DC regulated power supply to power this module, with the power supply ripple coefficient as small as possible, and the module must be reliably grounded;

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- Please ensure the correct connection of the positive and negative power terminals. Reversing the connection may cause permanent damage to the module.
- Please check the power supply and ensure it is within the recommended voltage range. Exceeding the maximum value will cause permanent damage to the module.
- Please check the power supply stability; the voltage should not fluctuate significantly or frequently.
- When designing power supply circuits for modules, it is often recommended to retain a margin of more than 30% to ensure long-term stable operation of the entire unit.
- The module should be kept as far away as possible from power supplies, transformers, high-frequency traces, and other parts with high electromagnetic interference.
- High-frequency digital traces, high-frequency analog traces, and power traces must avoid the area under the module. If it is absolutely necessary to run under the module, assuming the module is soldered on the Top Layer, lay ground copper on the Top Layer of the module contact area (all copper and well grounded), and run the traces close to the digital part of the module on the Bottom Layer.
- Assuming the module is soldered or placed in the Top Layer, it is also wrong to arbitrarily route traces in the Bottom Layer or other layers, as this will affect the module's stray emissions and receiver sensitivity to varying degrees.
- If there are devices around the module that cause significant electromagnetic interference, it will greatly affect the module's performance. Depending on the intensity of the interference, it is recommended to keep them away from the module. If possible, appropriate isolation and shielding can be implemented.
- If there are traces around the module that cause significant electromagnetic interference (high-frequency digital, high-frequency analog, power supply traces), it will greatly affect the module's performance. Depending on the intensity of the interference, it is recommended to keep them away from the module. If possible, appropriate isolation and shielding can be implemented.
- Antennas should never be installed inside a metal casing, as this will greatly reduce the transmission distance.
- It is recommended to add a 200Ω protection resistor to the RXD/TXD of the external MCU.

4.2 Software Development

4.2.1 Environment Setup

The module's built-in RF chip is the EFR32BG24A010F1024IM40 , and users can follow the datasheet for this RF chip. Setting up the compilation environment requires using Silicon Labs' IDE . Simplicity Studio 5, download link: https://www.silabs.com/software-and-tools/simplicity-studio/simplicity-studio-version-5 .

After downloading Simplicity Studio 5, open the .iso file and double-click setup.exe. Follow the default download steps. After the download is complete, you will need to download the software package and install it according to the steps shown in the image below .

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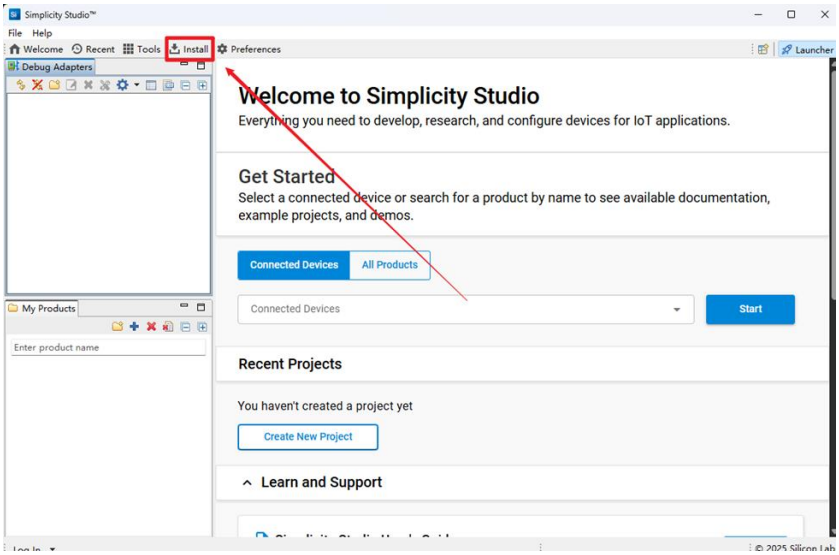


Figure 4.1

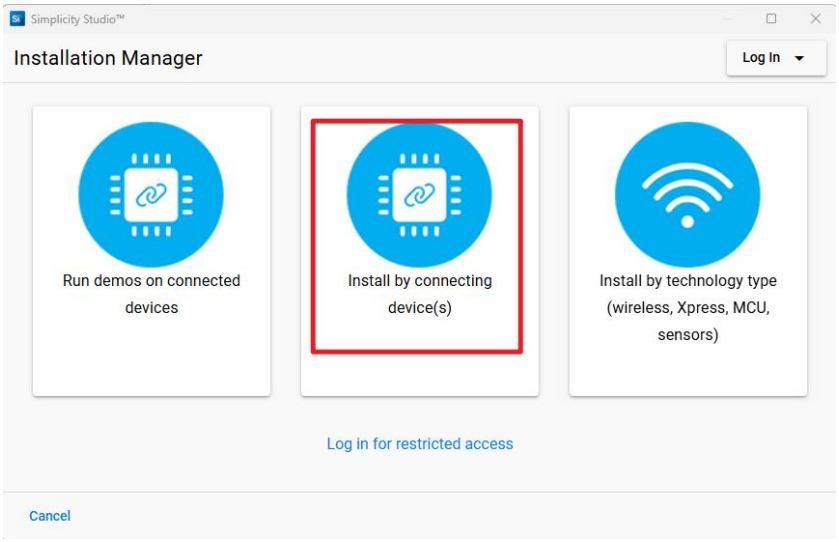


Figure 4.2

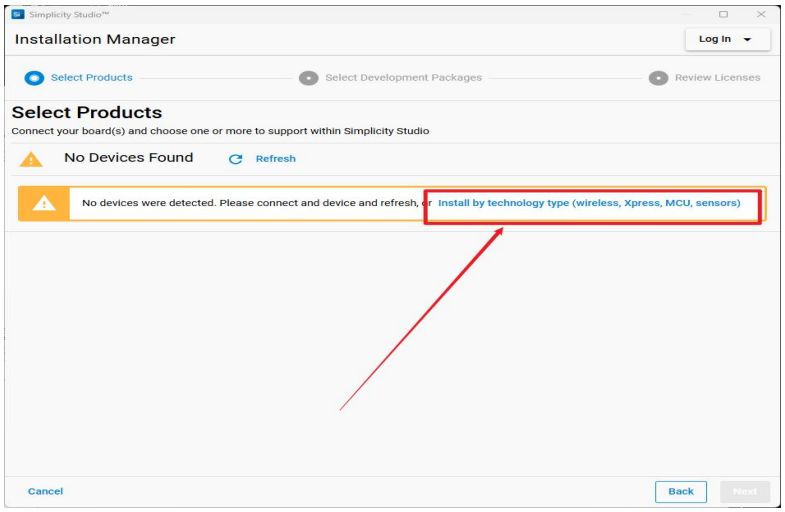


Figure 4.3

As shown in Figure 4.4, when installing Simplicity Studio 5, you can choose to install according to your

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needs;

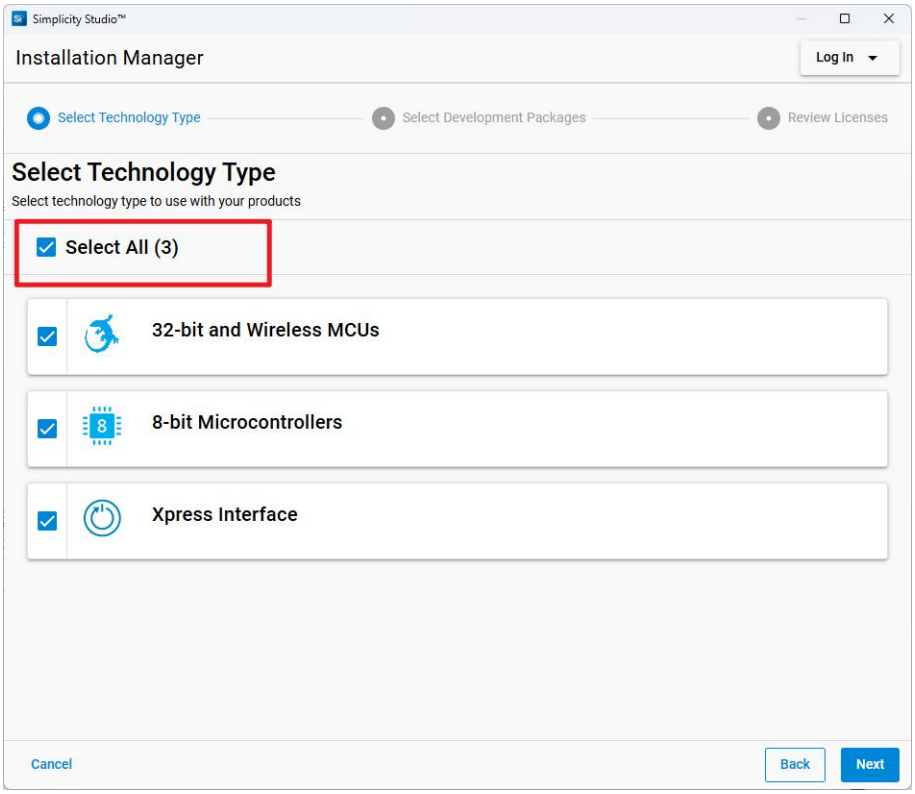


Figure 4.4

Select automatic installation according to Figure 4.5, and then follow the steps to install.

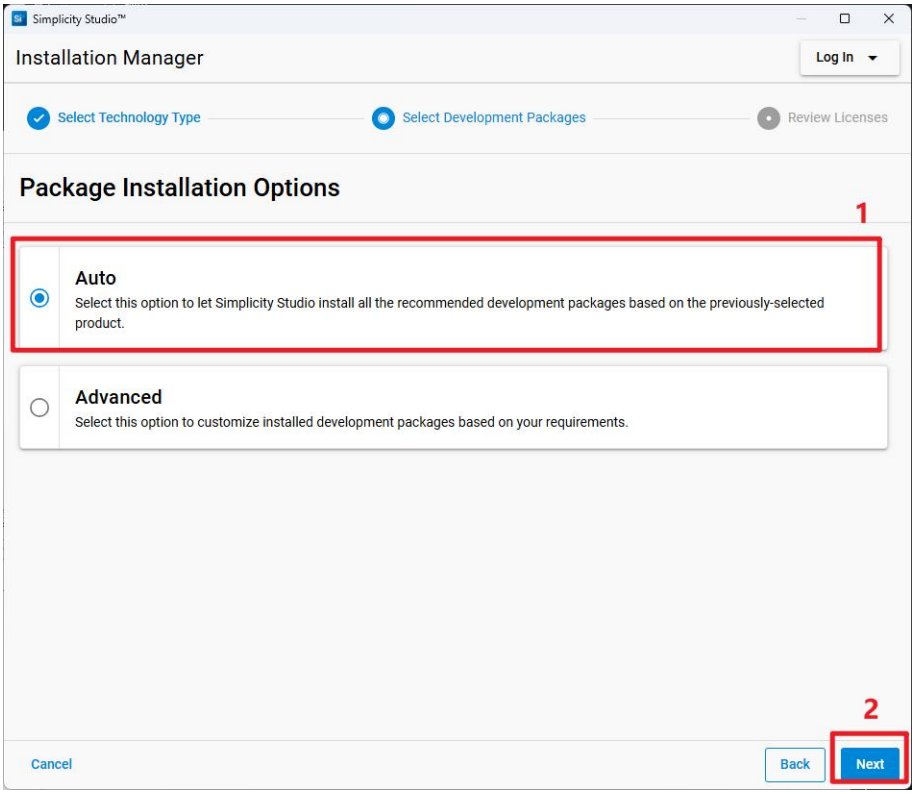


Figure 4.5

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4.2.2 Create the first project

A complete project requires two programs: a bootloader and a main program.

- Create a Bootloader project:

Create a Bootloader project as shown in Figure 4.6 ;

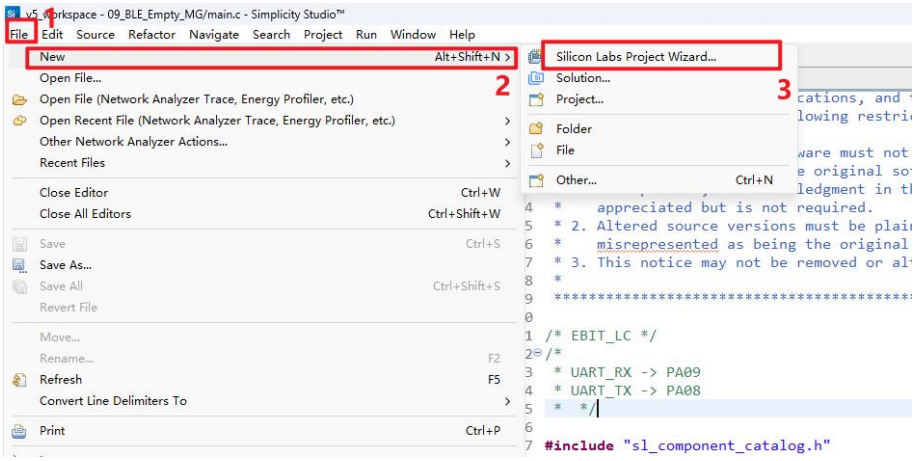


Figure 4.6

Then, as shown in the image below , select the corresponding empty template and the corresponding chip model, and select the latest SDK and Tool chain.

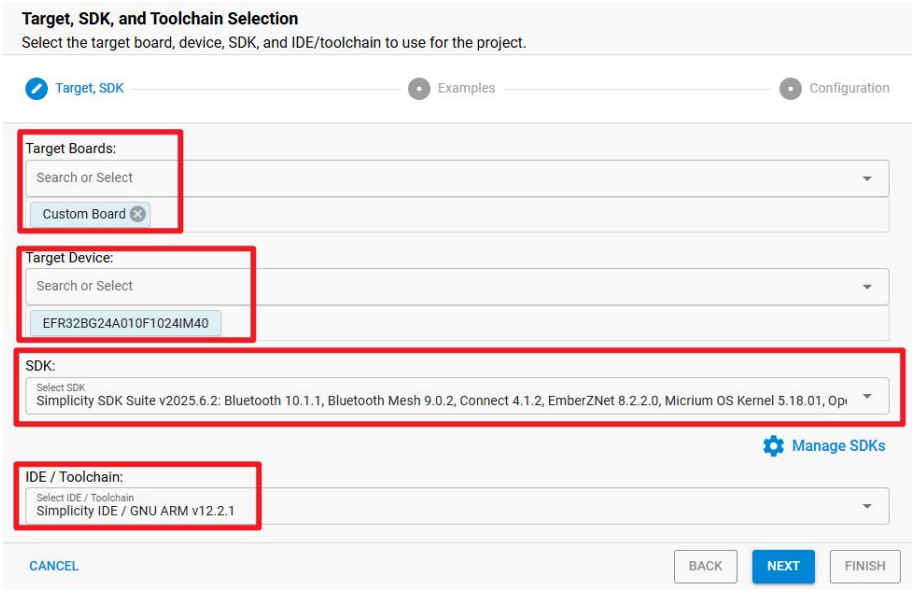


Figure 4.7

Select the project sample program as shown in the image below ;

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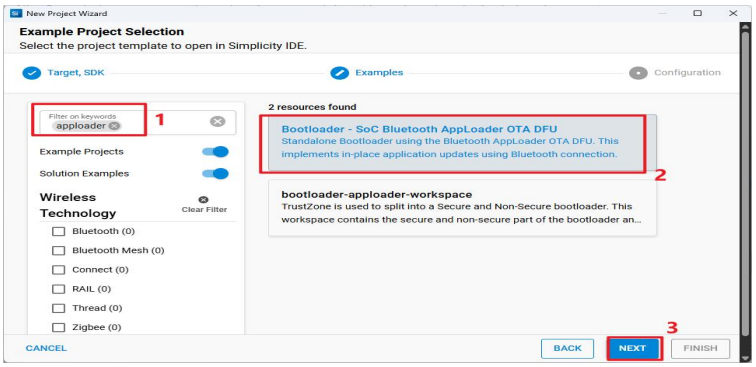


Figure 4.8

Finally, follow the steps shown in the image below to complete the bootloader project creation ;

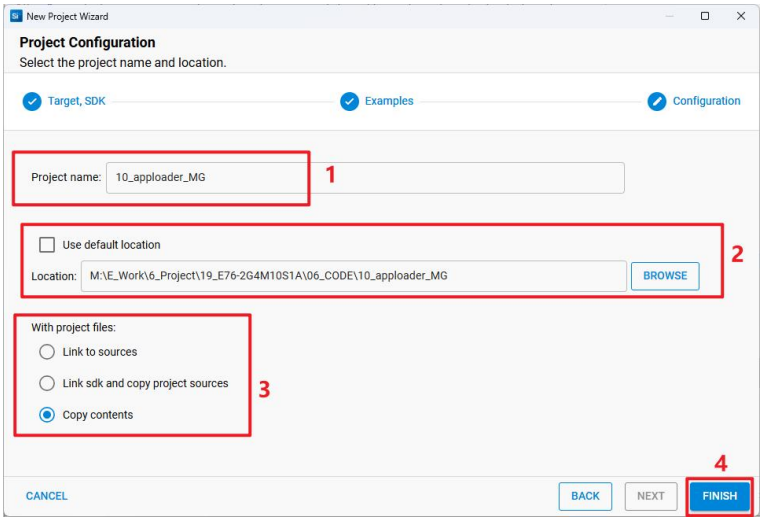


Figure 4.9

as shown in the diagram below .

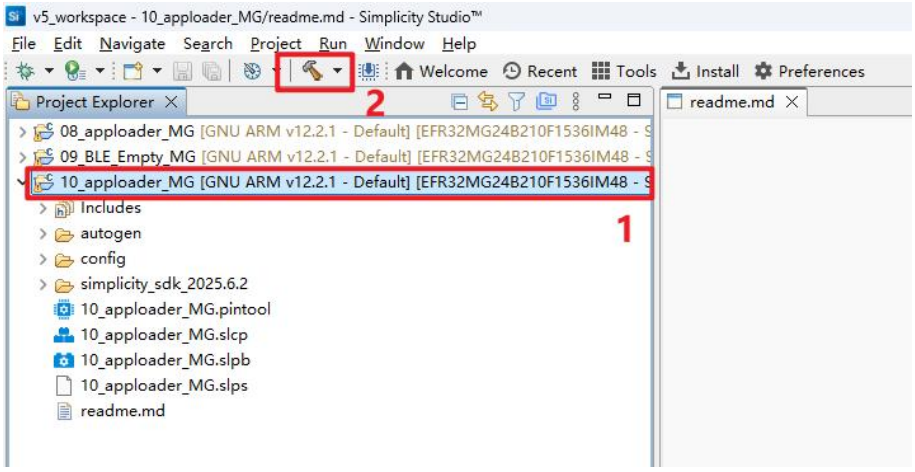


Figure 4.10

- Create the main program project

Creating the main program project is similar to creating the bootloader project, except for the part shown in Figure 4.11 . Select the Bluetooth empty project according to the image prompts, and then create and compile it.

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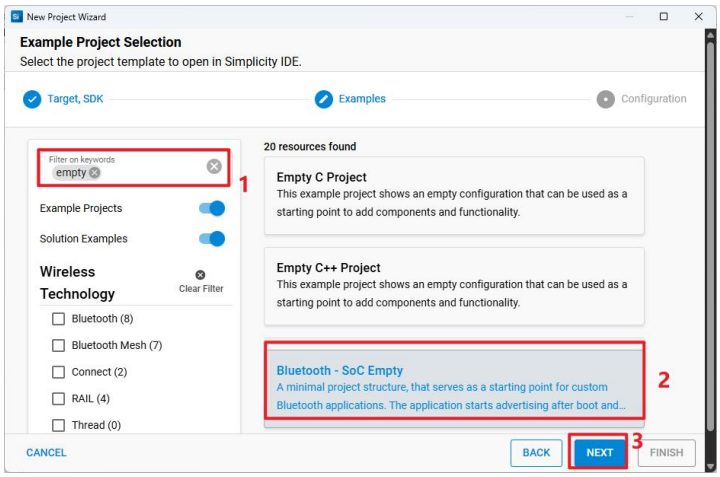


Figure 4.11

4.2.3 Program Burning

A complete project requires burning two programs: a bootloader program and a main program. Taking the bootloader program burning as an example, connect the module to the J-Link, wire according to the manual, and then open the burning interface as shown in Figure 4.12 .

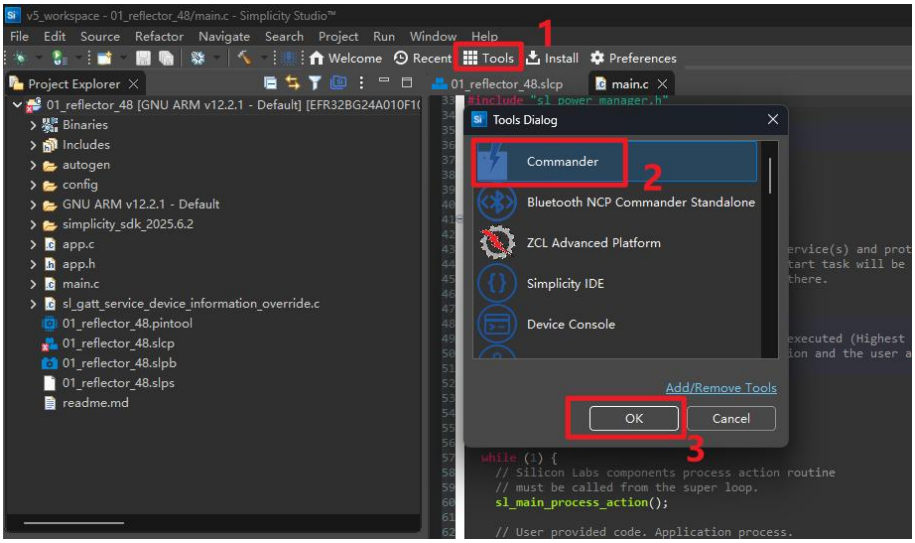


Figure 4.12

Identify J-link based on the prompts in the image below .

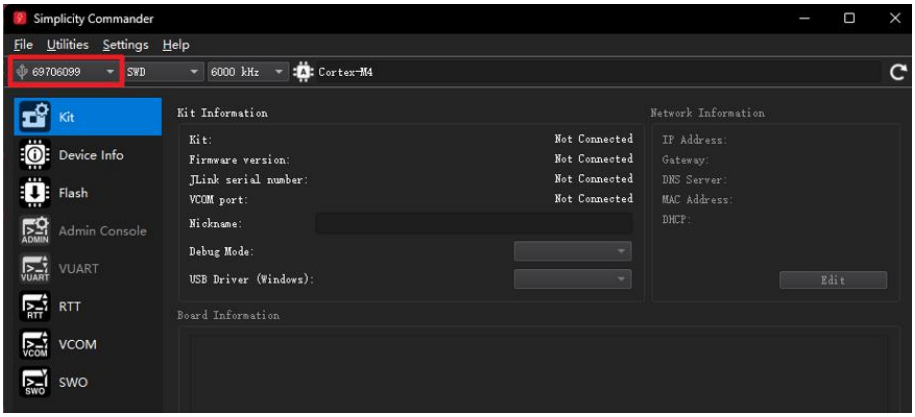


Figure 4.13

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As shown in the diagram below , the Bootloader program is burned , and the main program is burned in the same way as the Bootloader program.

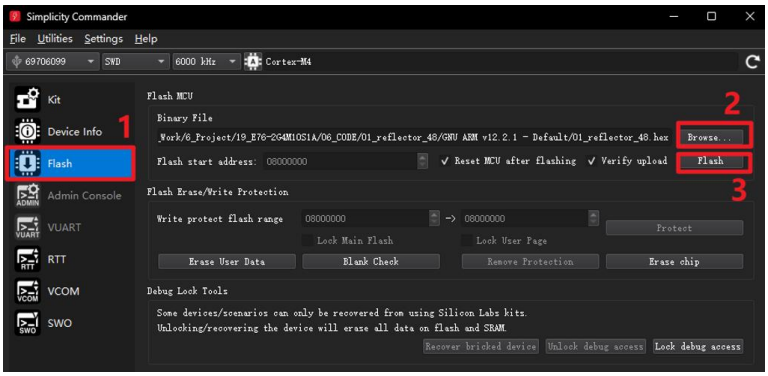
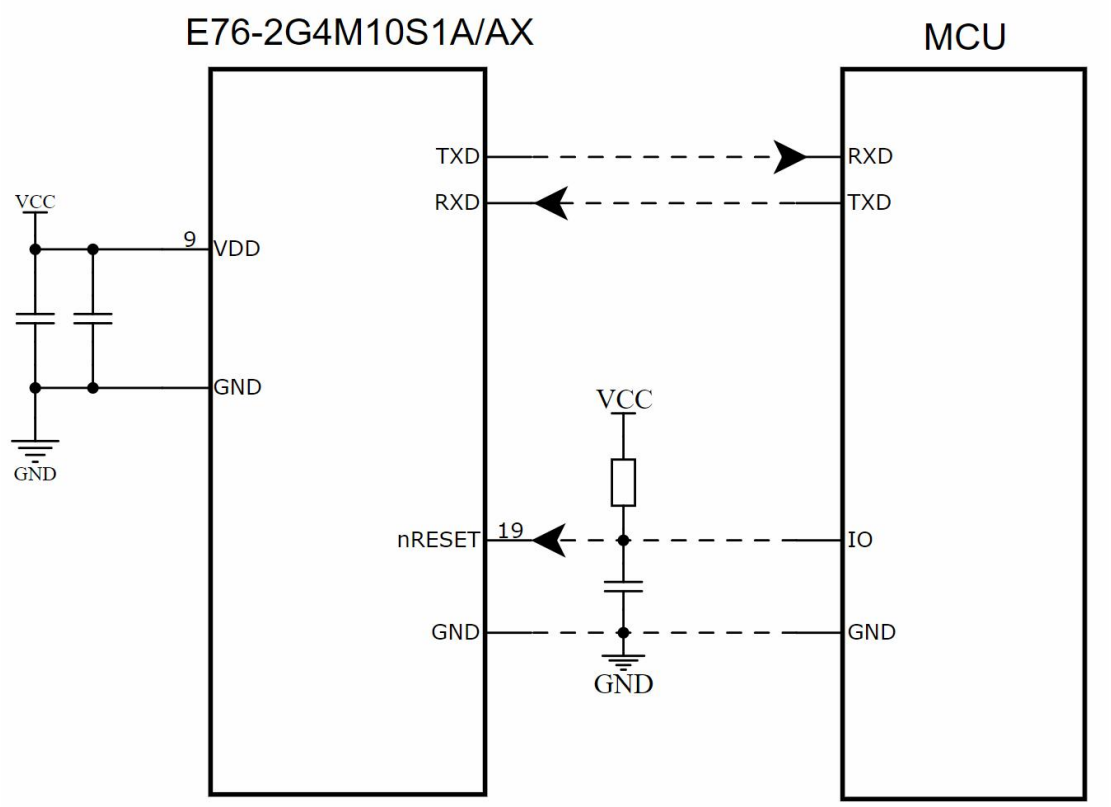


Figure 4.14

Chapter 5 Recommended Circuits

5.1 Recommended Circuit Diagram



Note: The TXD and RXD pins of this module are customized by the customer according to the chip manual.

Chapter Six Frequently Asked Questions

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6.1 Transmission distance is not ideal

- When there are obstacles in line-of-sight communication, the communication distance will be reduced accordingly;
- Temperature, humidity, and co-channel interference can all lead to increased packet loss rates in communications.
- The ground absorbs and reflects radio waves, and the test results are poor when the ground is close to the ground.
- Seawater has a strong ability to absorb radio waves, so tests conducted at the seaside are ineffective.
- If there are metal objects near the antenna, or if it is placed inside a metal casing, the signal attenuation will be very severe.
- Power register settings are incorrect; air speed is set too high (the higher the air speed, the shorter the distance).
- At room temperature, the power supply voltage is lower than the recommended value; the lower the voltage, the lower the power output.
- The antenna may be poorly matched with the module or have quality issues.

6.2 The module is easily damaged.

- Please check the power supply and ensure it is within the recommended voltage range. Exceeding the maximum value will cause permanent damage to the module.
- Please check the power supply stability; the voltage should not fluctuate significantly or frequently.
- Please ensure anti-static operation during installation and use, as high-frequency devices are sensitive to electrostatic discharge.
- Please ensure that the humidity is not too high during installation and use, as some components are humidity-sensitive.
- Unless there are special requirements, it is not recommended to use it at excessively high or low temperatures.

6.3 The error rate is too high.

- If there is interference from a co-channel signal nearby, move away from the source of interference or change the frequency or channel to avoid the interference.
- Check for interference on the UART line; the UART cable should not be too long.
- An inadequate power supply can also cause garbled characters, so it is essential to ensure the reliability of the power supply.
- Poor quality or excessive length of extension lines or feeders can also lead to a high bit error rate .

Chapter 7 Welding Operation Instructions

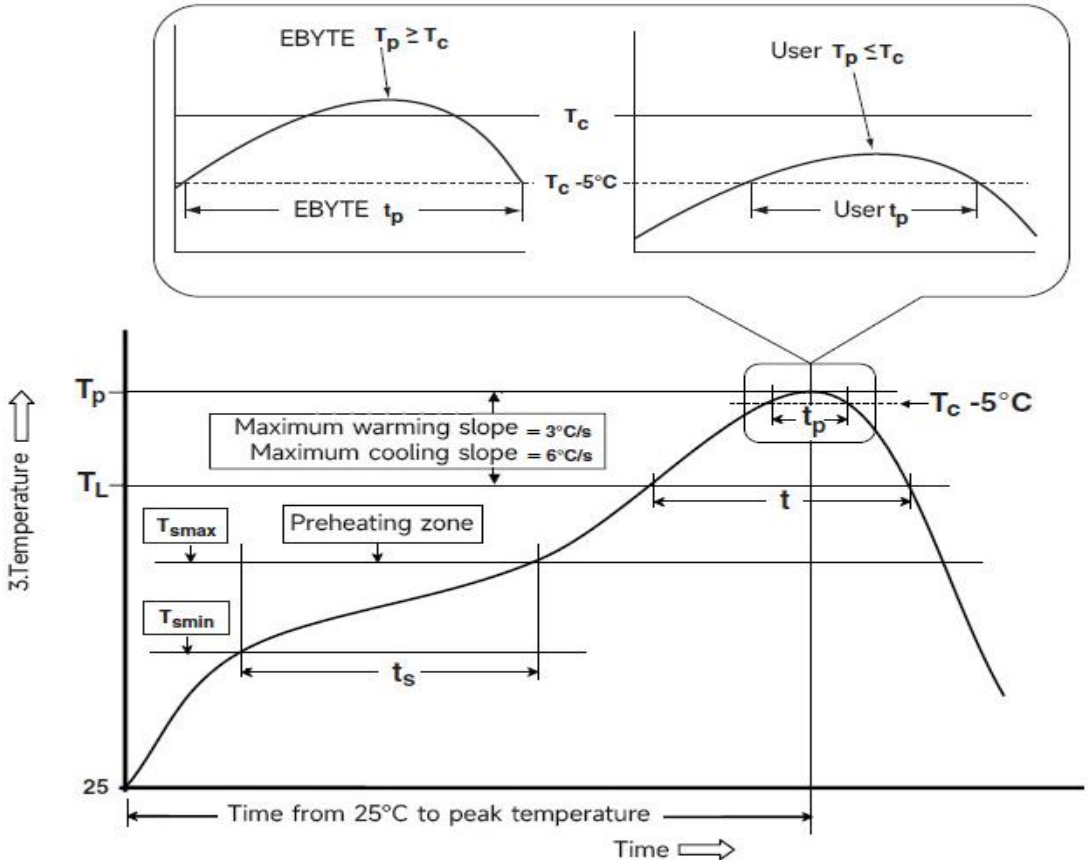
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7.1 Reflow soldering temperature

Reflow soldering profile characteristics		Lead-based assembly	Lead-free assembly
Preheating/Insulation	Minimum temperature (Tsmin)	100℃	150℃
	Maximum temperature (Tsmax)	150℃	200℃
	Time (Tsmin~Tsmin)	60-120 seconds	60-120 seconds
Temperature rise slope (TL~Tp)		3℃/second, maximum value	3℃/second, maximum value
Liquid phase temperature (TL)		183℃	217℃
Duration above TL		60~90 seconds	60~90 seconds
Package peak temperature Tp		Users must not exceed the temperature specified on the product's "humidity sensitivity" label.	Users must not exceed the temperature specified on the product's "humidity sensitivity" label.
The time (Tp) within 5°C of the specified grading temperature (Tc) is shown in the figure below.		20 seconds	30 seconds
Cooling slope (Tp~TL)		6℃/second, maximum value	6℃/second, maximum value
Time from room temperature to peak temperature		6 minutes, the longest	8 minutes, the longest
* The peak temperature (Tp) tolerance of the temperature profile is defined as the user's upper limit.			

7.2 Reflow Soldering Profile



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Revision history

Version	Date	Description	Issued by
1.0	2026-01-09	Initial version	Bin

About us

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