E83-2G4M03S User Manual

nRF5340 2.4GHz BLE 5.4 Module



Chengdu Ebyte Electronic Technology Co.,Ltd.

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Contents

Disclaimer and Copyright Notice 2
1 Overview 3
1.1 Product introduction 3
1.2 Features 3
1.3 Application scenarios 3
2 Parameters 4
2.1 Limit parameters 4
2.2 Working Parameters 4
3 Size and Pin Definition 6
4 Firmware flashing 9
4.1 Installation and development environment 9
4.2 Program burning 9
5 Developer Notes 11
5.1 Hardware design and circuit schematic 11
6 FAQ 12
6.1 The transmission distance is not ideal 12
6.2 Module is easily damaged 12
6.3 Bit error rate is too high 13
7 Soldering 14
7.1 Reflow temperature 14
7.2 Reflow Soldering Curve 15
8 Similar Models 15
9 Standard Packing info 16
Revision History 16
About 16

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1 Overview

1.1 Product introduction



E83-2G4M03S is a small and low-power Bluetooth module developed by EBT. It uses the nRF5340 RF chip imported from Nordic Company and supports Bluetooth BLE5.4; The chip has a dual core high-performance ARM CORTEX-M33 core, uses 32M industrial crystal oscillator, and has rich peripheral resources such as UART, I2C, I2S, high-speed SPI, QSPI, USB, ADC, DMA, PWM, PDM, etc; It also supports ZIGBEE, Thread, NFC, ANT, 802.15.4 and 2.4 GHz proprietary protocols. Please refer to the pin definitions for details; NRF5340 introduces most of the I/O ports to facilitate users' all-round development.

E83-2G4M03S is a hardware platform, the module has no program by default, and users need to develop firmware; please refer to the official Datasheet for nRF5340 chip information, and the module has maximized the RF characteristics of the chip.

1.2 Features

- Ultra-small size, only 16x16mm;
- Support BLE5.4;
- The maximum transmission power is 3dBm, and the software is adjustable at multiple levels;
- Support global license-free ISM 2.4GHz frequency band;
- Built-in 32MHz clock crystal oscillator;
- Built in dual core high-performance low-power 128/64 MHz ARM ® Cortex ® - M33 processor;
- Rich resources, application core: 1MB FLASH, 512KB RAM; Network core: 256KB FLASH, 64KB RAM;
- Support 1.7 ~ 5.5V power supply, more than 3.3V power supply can ensure the best performance;
- Industrial-grade standard design, support long-term use at -40 ~ +105 ℃;
- Generation 1 IPX interface, external antenna.
- Under ideal conditions, the communication distance can reach 170m(Transmission power 0dBm);
- Supported protocols: BLE5.4,ZIGBEE, Thread, NFC, ANT, 802.15.4 and 2.4 GHz proprietary protocols.
- The pure hardware platform requires secondary development by the customer.

1.3 Application scenarios

- Smart home and industrial sensors, etc.;
- Security system, positioning system;
- Wireless remote control, drone;
- wireless game remote control;
- healthcare products;
- Wireless voice, wireless headset;
- Automotive industry applications.

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- Wearable device.
- Asset tracking and RTLS.

2 Parameters

2.1 Limit parameters

RF parameters	Model		Remark
	Min	Max	
Supply voltage (V)	1.7	5.5	More than 5.5V will permanently burn the module
Blocking power (dBm)	-	10	The probability of burning at close distance is small
Working temperature (℃)	-40	+85	Industrial grade

2.2 Working Parameters

The main parameters		performance			Remark
		minimum	Typical value	maximum value	
Voltage mode	normal voltage mode	1.7	3.3	3.6	≥3.3V can ensure max TX power
	high voltage mode	2.5	5	5.5	
Communication level (V)		-	3.3	-	Risk of burnout with 5V TTL
Working temperature (℃)		-40	-	+ 85	Industrial grade design
Working frequency band (MHz)		2360	-	2500	Support ISM band
Emission current	TX only run current (DC/DC, 3 V) PRF = + 3 dBm	-	5.1	-	mA
	TX only run current PRF = +3 dBm	-	12.44	-	mA
	TX only run current (DC/DC, 3 V) PRF = 0 dBm	-	3.7	-	mA
	TX only run current PRF = 0 dBm	-	9.1	-	mA
receive current	RX only run current (DC/DC, 3 V) 1 Mbps / 1 Mbps BLE	-	2.7	-	mA
	RX only run current LDO,3V, 1 Mbps / 1 Mbps BLE	-	6.7	-	mA
	RX only run current (DC/DC, 3 V) 2 Mbps / 2 Mbps BLE	-	3.1	-	mA
	RX only run current LDO,3V, 2 Mbps / 2 Mbps BLE	-	7.9	-	mA
Low power consumption current		-	0.7	-	uA
Transmit power (dBm)		-	0	3	dBm

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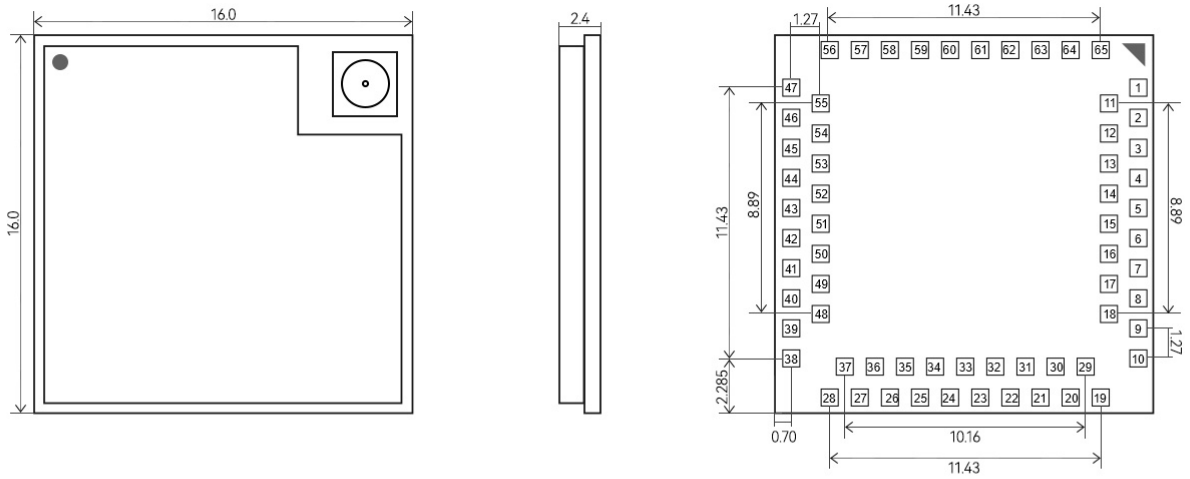
Receive Sensitivity (dBm)	-104dBm @ BLE 125kbps	long distance mode
	-98dBm @ BLE 1Mbps	

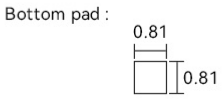
The main parameters	describe	Remark
reference distance	170m	Transmission power 0dBm,Clear and open environment, antenna gain 5dBi, height 2.5 meters, air rate 1Mbps
Crystal frequency	32MHz/32.768KHz	**32.768KHz crystal oscillator needs external connection**
supporting agreement	BLE 5.4	-
Communication interface	IO	-
Packaging method	SMD	-
IC full name	nRF5340-QKAA	-
FLASH	1M	-
RAM	512KB	-
kernel	Dual core 128/64 MHz ARM ® Cortex ® - M33	-
Dimensions	16.0 * 16.0mm	±0.1mm
Antenna interface	Generation 1 IPEX	Equivalent impedance is about 50Ω
product weight	1.2g	±0.1 g

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3 Size and Pin Definition





Unit : mm
pad quantity : 65
Tolerance value : X.X±0.1mm
X.XX±0.05mm
X.XXX±0.005mm

pin number	pin name	Pin Orientation	Pin function
1	RESET	enter	Dedicated pin for external reset (see nRF5340 manual for details)
2	SWDIO	input Output	Serial debug interface , serial data input and output (see nRF5340 manual for details)
3	SWDCLK	input Output	Serial debug interface , serial wire clock (see nRF5340 manual for details)
4	P1.10	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
5	P0.31	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
6	P1.12	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
7	P1.14	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
8	P0.04/AIN0	input Output	Configurable general-purpose IO port ; analog input (see nRF5340 manual for details)
9	D+	input Output	USB D+; D+ data line directly connected to the UBS bus (see nRF5340 manual for details)
10	VBUS	enter	USB power supply, range 4.35V-5.5V (see nRF5340 manual for details)

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11	P0.28/AIN7	input Output	Configurable general-purpose IO port ; analog input (see nRF5340 manual for details)
12	GND	-	Ground wire, connected to the power reference ground
13	P0.29	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
14	P0.30	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
15	P1.11	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
16	P1.13	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
17	P1.15	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
18	D-	input Output	USB D-; D- data line directly connected to the UBS bus (see nRF5340 manual for details)
19	GND	-	Ground wire, connected to the power reference ground
20	GND	-	Ground wire, connected to the power reference ground
21	VDD_HV	enter	Power supply, range 2.5V-5.5V (see nRF5340 manual for details)
22	GND	-	Ground wire, connected to the power reference ground
23	VDD_nRF	enter	Power supply, range 1.7V-3.6V (see nRF5340 manual for details)
24	GND	-	Ground wire, connected to the power reference ground
25	P0.00/XL1	input Output	Configurable general IO port ; can be connected to 32KHz crystal oscillator (see nRF5340 manual for details)
26	P0.01/XL2	input Output	Configurable general IO port ; can be connected to 32KHz crystal oscillator (see nRF5340 manual for details)
27	P0.02/NFC1	input Output	Configurable general IO port ; NFC antenna interface (see nRF5340 manual for details)
28	P0.03/NFC2	input Output	Configurable general IO port ; NFC antenna interface (see nRF5340 manual for details)
29	P1.01	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
30	P1.00	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
31	P0.05/AIN1	input Output	Configurable general-purpose IO port ; analog input (see nRF5340 manual for details)
32	P0.06/AIN2	input Output	Configurable general-purpose IO port ; analog input (see nRF5340 manual for details)
33	P0.07/AIN3	input Output	Configurable general-purpose IO port ; analog input (see nRF5340 manual for details)
34	P1.03/I²C	input Output	Configurable general-purpose IO port ; I²C bus interface (see nRF5340 manual for details)
35	P1.02/I²C	input Output	Configurable general-purpose IO port ; I²C bus interface (see nRF5340 manual for details)
36	P0.08/TRACEDATA3/SCK	input Output	Configurable general-purpose IO port ; trace buffer TRACEDATA[3]; SPIM4 (see nRF5340 manual for details)

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37	P0.09/TRACEDATA2/MOSI	input Output	Configurable general-purpose IO port ; trace buffer TRACEDATA[2]; SPIM4 (see nRF5340 manual for details)
38	P0.10/TRACEDATA1/MISO	input Output	Configurable general-purpose IO port ; trace buffer TRACEDATA[1]; SPIM4 (see nRF5340 manual for details)
39	P0.11/TRACEDATA0/CSN	input Output	Configurable general-purpose IO port ; trace buffer TRACEDATA[0]; SPIM4 (see nRF5340 manual for details)
40	P0.13/QSPI0	input Output	Configurable general-purpose IO port ; queue serial peripheral interface QSPI; (see nRF5340 manual for details)
41	P0.19	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
42	P1.04	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
43	P1.08	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
44	P0.20	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
45	P0.26/AIN5	input Output	Configurable general-purpose IO port ; analog input (see nRF5340 manual for details)
46	GND	-	Ground wire, connected to the power reference ground
47	GND	-	Ground wire, connected to the power reference ground
48	P0.12/TRACECLK/DCX	input Output	Configurable general-purpose IO port ; tracking buffer clock; SPIM4 (see nRF5340 manual for details)
49	P0.16/QSPI3	input Output	Configurable general-purpose IO port ; queue serial peripheral interface QSPI; (see nRF5340 manual for details)
50	P0.21	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
51	P1.06	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
52	P0.14/QSPI1	input Output	Configurable general-purpose IO port ; queue serial peripheral interface QSPI; (see nRF5340 manual for details)
53	P0.24	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
54	P0.22	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
55	GND	-	Ground wire, connected to the power reference ground
56	GND	-	Ground wire, connected to the power reference ground
57	P0.23	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
58	P1.05	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
59	P0.25/AIN4	input Output	Configurable general-purpose IO port ; analog input (see nRF5340 manual for details)
60	P0.27/AIN6	input Output	Configurable general-purpose IO port ; analog input (see nRF5340 manual for details)
61	P0.17/QSPI_CLK	input Output	Configurable general-purpose IO port ; queue serial peripheral

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			interface QSPI; (see nRF5340 manual for details)
62	P0.15/QSPI2	input Output	Configurable general-purpose IO port ; queue serial peripheral interface QSPI; (see nRF5340 manual for details)
63	P0.18/QSPI_CS	input Output	Configurable general-purpose IO port ; queue serial peripheral interface QSPI; (see nRF5340 manual for details)
64	P1.09	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)
65	P1.07	input Output	Configurable general-purpose IO port (see nRF5340 manual for details)

4 Firmware flashing

4.1 Installation and development environment

1. Download SDK

The nFR5340 only supports nrfconnect sdk

Official download link: https://academy.nordicsemi.com/lessons/lesson-1-nrf-connect-sdk-introduction/

For detailed environment installation tutorial, please refer to Nordic official:

https://academy.nordicsemi.com/topic/exercise-1-1/

2. Chip manual

Official download link: https://infocenter.nordicsemi.com/index.jsp?topic=%2Fstruct_nrf53%2Fstruct%2Fnrf5340.html

4.2 Program burning

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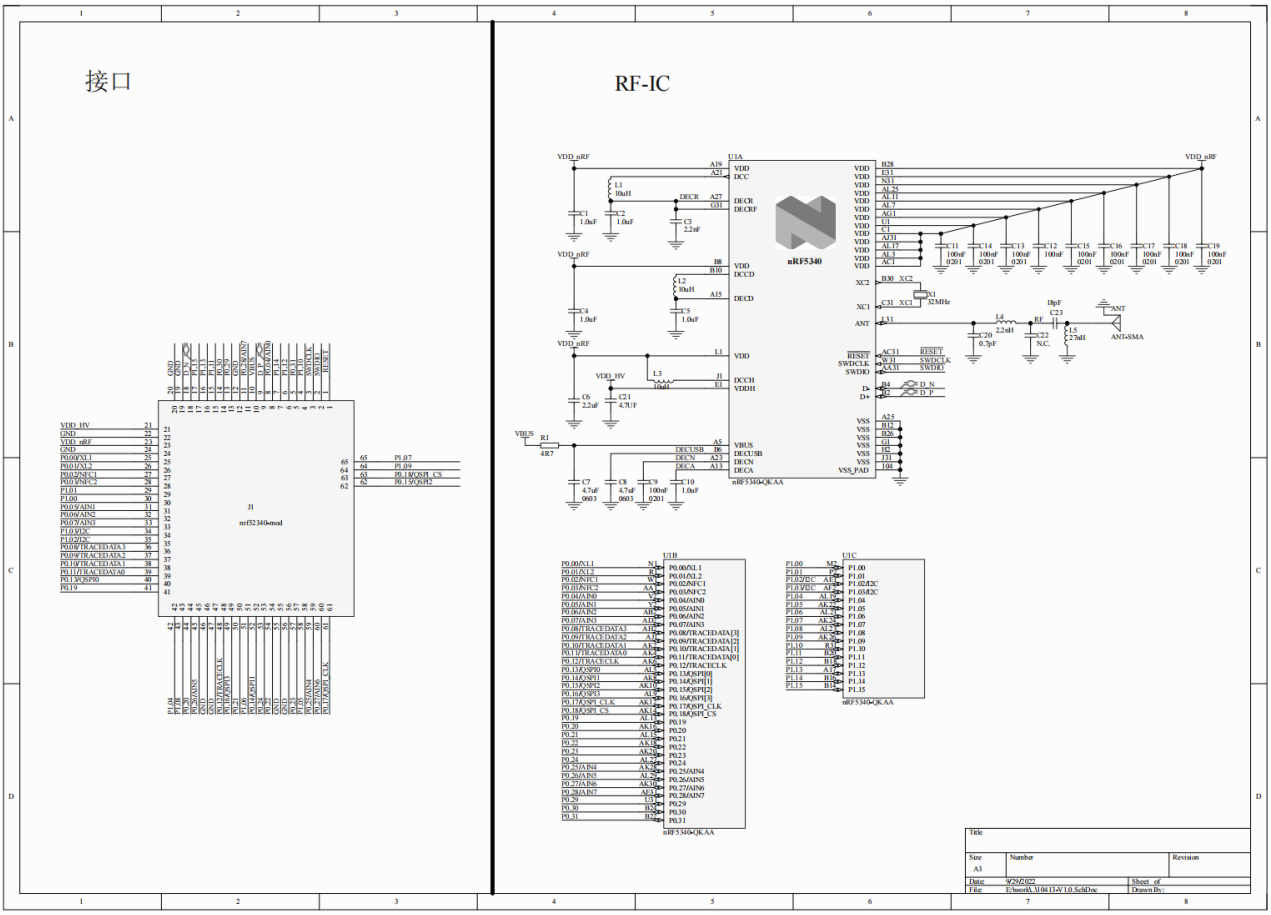
No.	keywords	Precautions
1	Flashing program	1. The module is built with ARM microcontroller, and the J-LINK downloader is used for program downloading. Serial port or any other JTAG, ISP or ICP tools cannot be used. 2. Use the Programmer tool in the official burning tool nRF Connect Desktop to burn the program, or use the VSCODE tool to burn the program. The official website tool can be downloaded at: https://www.nordicsemi.com/Products/Development-tools/nrf-connect-for-desktop 
2	Ebyte EVB	Not available for the moment.

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5 Developer Notes

5.1 Hardware design and circuit schematic



- It is recommended to use a DC regulated power supply to supply power to the module, the power supply ripple coefficient 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 poles of the power supply, such as reverse connection may cause permanent damage to the module;
- Please check the power supply to ensure that it is between the recommended supply voltages, if exceeding the maximum value will cause permanent damage to the module;
- Please check the stability of the power supply, the voltage should not fluctuate greatly and frequently;
- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the margin, so that the whole machine can work stably for a long time;
- The module should be kept away from parts with large electromagnetic interference such as power supply, transformer, and high-frequency wiring as far as possible;
- High-frequency digital traces, high-frequency analog traces, and power traces must be avoided under the module. If it is absolutely necessary to pass under the module, assuming that the module is soldered on the Top Layer, the top layer of the contact part of the module should be

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covered with ground copper (all copper). And well grounded), it must be close to the digital part of the module and routed on the Bottom Layer;

- Assuming that the module is soldered or placed on the Top Layer, it is also wrong to arbitrarily route wires on the Bottom Layer or other layers, which will affect the stray and receiving sensitivity of the module to varying degrees;
- Assuming that there are devices with large electromagnetic interference around the module, it will also greatly affect the performance of the module. It is recommended to stay away from the module according to the intensity of the interference. If the situation allows, appropriate isolation and shielding can be done;
- Assuming that there are traces with large electromagnetic interference around the module (high-frequency digital, high-frequency analog, power traces), it will also greatly affect the performance of the module. It is recommended to stay away from the module according to the intensity of the interference. isolation and shielding;
- If the communication line uses 5V level, a 1k-5.1k resistor must be connected in series (not recommended, there is still a risk of damage);
- Try to stay away from some TTL protocols whose physical layer is also 2.4GHz, for example: USB3.0;
- The antenna installation structure has a great influence on the performance of the module. Make sure that the antenna is exposed, preferably vertically upward. When the module is installed inside the casing, a high-quality antenna extension cable can be used to extend the antenna to the outside of the casing;
- The antenna must not be installed inside the metal shell, which will greatly reduce the transmission distance.

6 FAQ

6.1 The transmission distance is not ideal

- When there is a straight-line communication obstacle, the communication distance will be correspondingly attenuated;
- Temperature, humidity, and co-channel interference will increase the communication packet loss rate;
- The ground absorbs and reflects radio waves, and the test effect close to the ground is poor;
- Seawater has a strong ability to absorb radio waves, so the seaside test effect is poor;
- If there is a metal object near the antenna, or placed in a metal shell, the signal attenuation will be very serious;
- The power register is set incorrectly, and the air rate is set 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, and the lower the voltage, the lower the output power;
- The antenna and the module are poorly matched or the quality of the antenna itself is a problem.

6.2 Module is easily damaged

- Please check the power supply to ensure that it is between the recommended supply voltages, if exceeding the maximum value will cause permanent damage to the module;

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- Please check the stability of the power supply, the voltage should not fluctuate greatly and frequently;
- Please ensure anti-static operation during installation and use, and high-frequency components are electrostatically sensitive;
- Please ensure that the humidity during installation and use should not be too high, and some components are humidity-sensitive devices;
- If there is no special requirement, it is not recommended to use it at too high or too low temperature.

6.3 Bit error rate is too high

- There is co-frequency signal interference nearby, stay away from the interference source or modify the frequency and channel to avoid interference;
- If the power supply is not ideal, it may also cause garbled characters. Be sure to ensure the reliability of the power supply;
- Poor quality or too long extension cables and feeders can also cause high bit error rates.

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7 Soldering

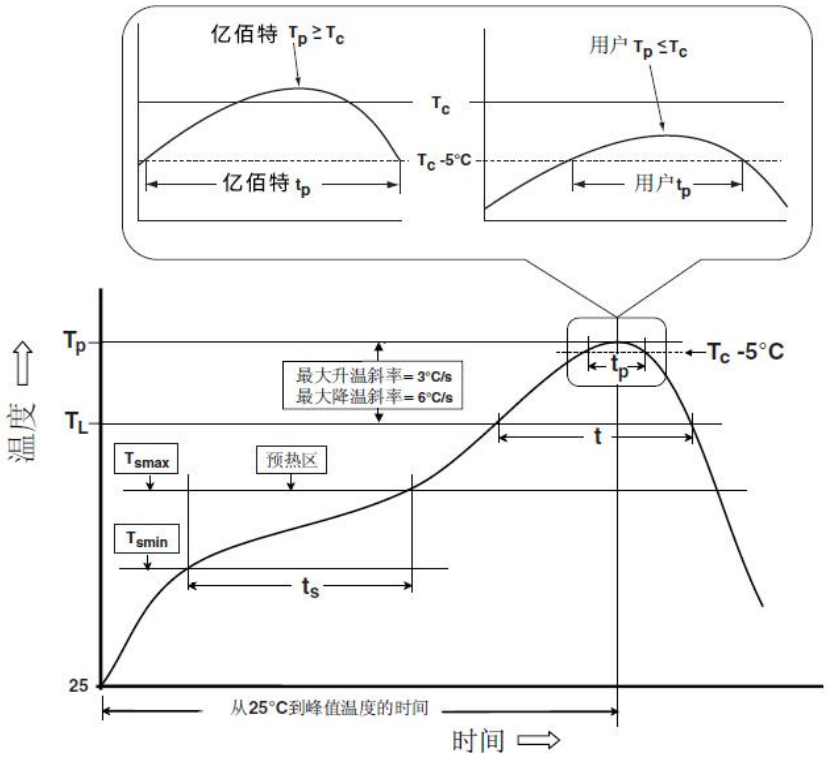
7.1 Reflow temperature

Reflow Profile Characteristics		Leaded process assembly	Lead-free process assembly
Preheat/Keep Warm	lowest temperature (Tsmin)	100℃	150℃
	maximum temperature (TSMDx)	150℃	200℃
	time (Tsmin~Tsmin)	60-120 seconds	60-120 seconds
Heating slope (TL~Tp)		3° C/sec, max	3° C/sec, max
liquidus temperature (TL)		183℃	217℃
Hold time above TL		60~90 seconds	60~90 seconds
Package body peak temperature Tp		The user cannot exceed the temperature indicated on the product's "Moisture Sensitivity" label	The user cannot exceed the temperature indicated on the product's "Moisture Sensitivity" label
Time (Tp) within 5° C of the specified grading temperature (Tc), see the figure below		20 seconds	30 seconds
cooling slope (Tp~TL)		6° C/sec, max	6° C/sec, max
Time from room temperature to peak temperature		6 minutes, maximum	8 minutes, maximum
※The peak temperature (Tp) tolerance definition of the temperature profile is the upper limit of the user			

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7.2 Reflow Soldering Curve



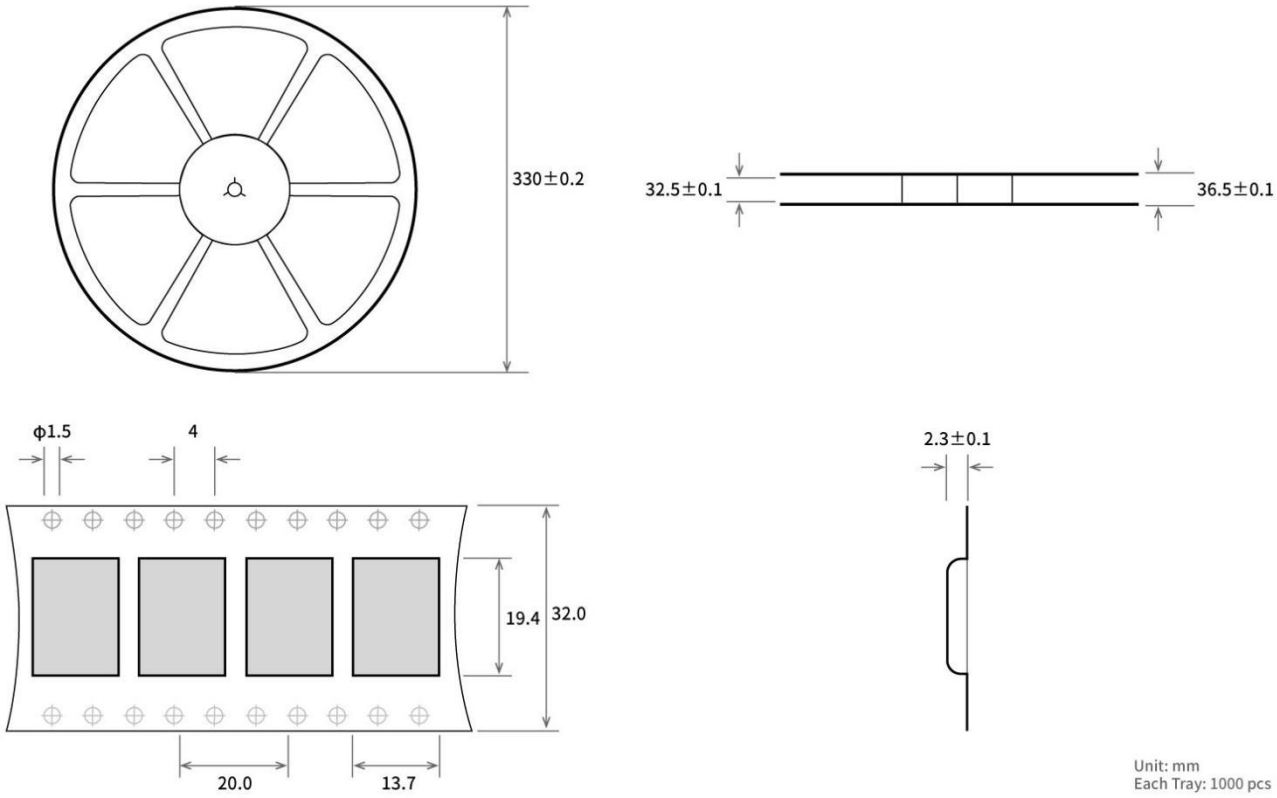
8 Similar Models

Product number	Chip solution	carrier frequency Hz	transmit power dBm	Bluetooth protocol BLE	Product Size mm	Package form	Antenna form
E73-2G4M04S1A	nRF52810	2.4G	4	4.2/5.0	17.5*28.7	patch	PCB/IPX
E73-2G4M04S1B	nRF52832	2.4G	4	4.2/5.0	17.5*28.7	patch	PCB/IPX
E83-2G4M03S	nRF5340	2.4G	3	4.2/5.0	16 * 16	patch	Ceramic Antenna
E73-2G4M04S1D	nRF51822	2.4G	4	4.2	17.5*28.7	patch	PCB/IPX

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9 Standard Packing info



Revision History

Version	revision date	Revision Notes	Maintenance man
1.0	2022-09-29	initial version	Bin
1.1	2023-02-23	Error correction	Bin
1.2	2023-07-19	Error correction	Bin
1.3	2023-10-12	Error correction	Bin
1.4	2024-04-01	Error correction	Bin
1.5	2024-07-02	Error correction	Bin
1.6	2024-6-25	Add certification mark	LAU

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