E01C-2G4M27SX Product Specification

Si24R1 2.4GHz 500mW SPI SMD Wireless Module

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Catalog

I Introduction

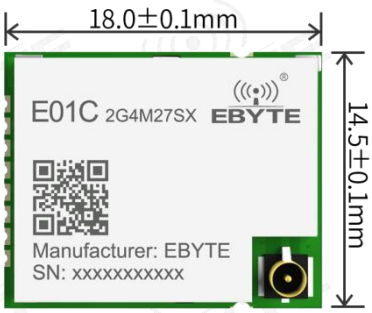
1.1 Introduction

The E01C-2G4M27SX is an ultra-small 2.4GHz SMD wireless module with a maximum transmit power of 500mW based on the domestic Si24R1 core.

The module has a built-in power amplifier (PA) and low noise amplifier (LNA), which enables the maximum transmit power of 500mW and further improves the reception sensitivity, and significantly improves the overall communication stability compared to products without power amplifier and low noise amplifier.

The product uses an industrial grade high precision 16MHz crystal.

Since the E01C-2G4M27SX is a pure RF transceiver module, it needs to be driven by MCU or use a special SPI debugging tool.



1.2 Feature

- Ultra-small size, only 18 * 14.5 mm.
- Maximum transmitting power of 500 mW, adjustable in multiple steps by software.
- Communication range of up to 4 km under ideal conditions.
- Support for the global license-free ISM 2.4 GHz band.
- Support for 2 Mbps, 1 Mbps and 250 kbps airtime rates.
- 125 communication channels for multipoint communication, packet, frequency hopping and other applications.
- Connects to MCU via SPI interface at 0 to 10 Mbps.
- Support 2.3~3.6V power supply, more than 3.3V power supply can ensure the best performance.
- Professional RF shield, anti-interference and anti-static.
- IPEX interface for easy connection to coaxial cables or external antennas (shared IPEX interface).
- Enhanced ShockBurst, interoperable with Nordic's nRF24L01+, nRF2401 and other 2.4G product families.

1.3 Application Scenarios

- Smart homes and industrial sensors, etc..
- Security systems, positioning systems.
- Wireless remote control, drones.
- Wireless game remote controls.
- Health care products.
- Wireless voice, wireless headphones.
- Automotive industry applications.

Ⅱ Specification parameters

2.1 Limit parameters

Table 2-1 Table of limit parameters

Main Parameters	Performance		Remark
	Min. value	Max. value	
Supply voltage (V)	2.3	3.6	Permanent module burnout above 3.6V
Operating temperature (℃)	-40	+85	Industrial Grade

2.2 Working parameters

Table 2-2 Table of working parameters

Main Parameters		Performance			Remark
		Min. value	Typical value	Max. value	
Operating voltage (V)		2.3	3.3	3.6	≥3.3V for guaranteed output power
Communication level (V)		-	3.3	-	Risk of burnout with 5V TTL
Operating temperature (℃)		-40	-	+85	Industrial grade design
Operating frequency band (MHz)		2400	-	2525	ISM band support
Power consumption	Emission current (mA)	-	720	-	Instantaneous power consumption
	Receiving current (mA)	-	23	-	-
	Dormant current (μA)	-	-	-	Low power mode not supported
Maximum transmit power (dBm)		26	27	27	-

Receiving Sensitivity (dBm)	-113	-114	-115	Air speed of 250 kbps
Air Rate (bps)	250 k	-	2 M	User-programmed control

Main parameters	Description	Remark
Reference Distance	4 km	Clear and open, antenna gain 5dBi, antenna height 2.5m, air rate 250kbps
FIFO	32 Byte	Maximum length of a single transmission
Crystal Frequency	16 MHz	-
Modulation method	GFSK	-
Packaging method	SMD	-
Interface method	1.27 mm pin	-
Communication Interface	SPI	0～10 Mbps
Dimension	18*14.5 mm	-
RF Interface	IPEX	Equivalent impedance approx. 50Ω
Product weight	1.1g	±0.1g

Ⅲ Mechanical dimensions and pin definition

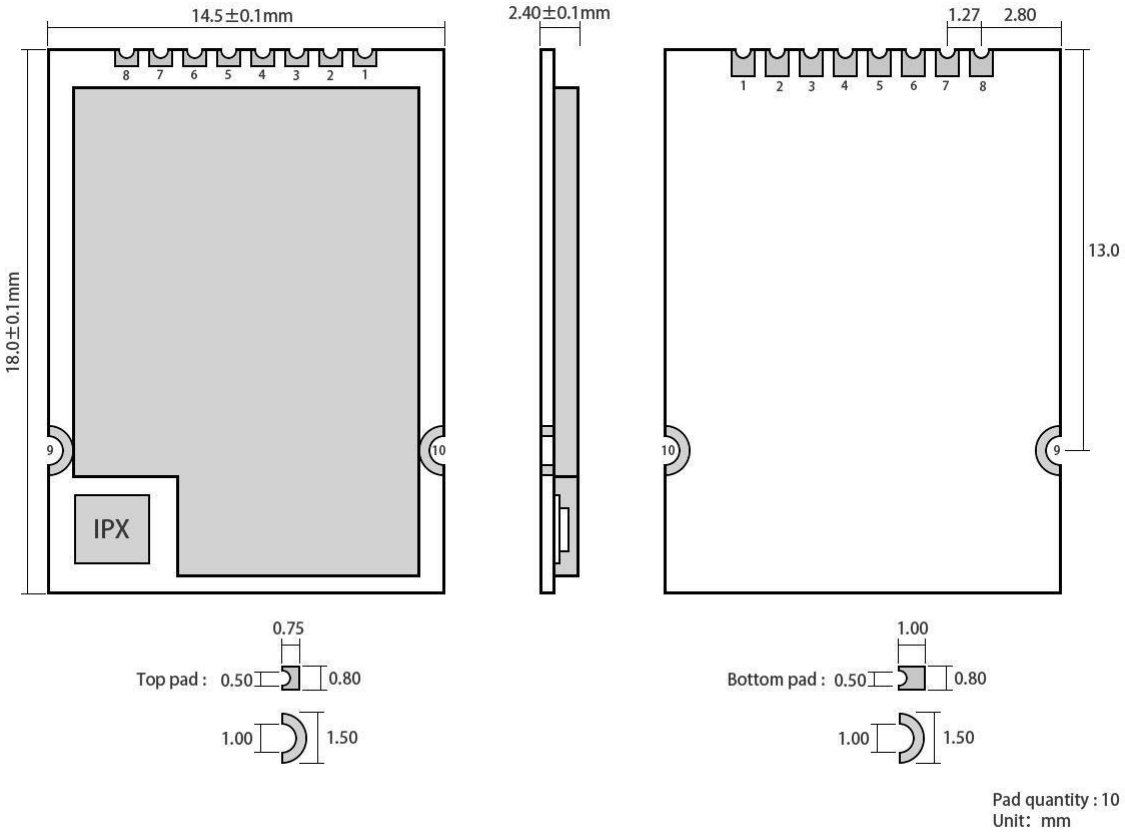


Figure 3-1 Mechanical Dimensions and Pin Definitions

Table 3 Pin Definition Table

Pin Serial Number	Pin Name	Pin Direction	Pin Usage
1	VCC	-	Power supply, must be between 2.3 ~ 3.6V
2	CE	Input	Module control pins
3	CSN	Input	Module chip select pin, used to start an SPI communication
4	SCK	Input	Module SPI Bus Clock
5	MOSI	Input	Module SPI Data Input Pins
6	MISO	Output	Module SPI Data Output Pins
7	IRQ	Output	Module interrupt signal output, active low
8	GND	-	Ground wire, connected to power reference ground
9	GND	-	Ground wire, connected to power reference ground
10	GND	-	Ground wire, connected to power reference ground

Ⅳ Basic operation

4.1 Hardware Design

- Recommend using a DC regulated power supply to power the module with as small a ripple coefficient as possible, and the module needs to be reliably grounded.
- Please pay attention to the correct connection of the positive and negative terminals of the power supply, as a reversed connection may cause permanent damage to the module.
- Please check the power supply to ensure that it is between the recommended supply voltage, if it exceeds the maximum value it may cause permanent damage to the module.
- Please check the stability of the power supply, the voltage should not fluctuate significantly and frequently.
- When designing the power supply circuit for the module, it is often recommended to retain more than 30% margin to have the whole machine facilitate long-term stable operation.
- modules should be as far as possible from the power supply, transformers, high-frequency alignments and other parts of the electromagnetic interference.
- high-frequency digital alignment, high-frequency analog alignment, power supply alignment must be avoided below the module, if it is necessary to pass below the module, assuming that the module is soldered in the Top Layer, in the module contact part of the Top Layer pavement copper (all pavement copper and good grounding), 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 wrong to run the wires randomly in the Bottom Layer or other layers, which will affect the spurious and reception sensitivity of the module to different degrees.
- Assuming that there is a large electromagnetic interference device around the module will also greatly affect the performance of the module, according to the strength of the interference recommended appropriate away from the module, if the situation allows appropriate isolation and shielding.
- Assuming that there are large electromagnetic interference alignments around the module (high-frequency digital, high-frequency analog, power supply alignments) will also greatly affect the performance of the module, according to the intensity of the interference, it is recommended to keep away from the module, if the situation allows appropriate isolation and shielding can be done.
- Try to stay away from some of the physical layer is also 2.4GHz TTL protocol, for example: USB3.0.
- Antenna installation structure has a big impact on the module performance, make sure the antenna is exposed, preferably vertically up. When the module is installed inside the case, you can use high quality antenna extension cable to extend the antenna to the outside of the case.
- The antenna must not be installed inside the metal case, it will cause the transmission distance to be greatly weakened.

4.2 Software Writing

- This module is Si24R1, its driving method is fully equivalent to nRF24L01+, users can follow the nRF24L01+ chip manual for operation (see nRF24L01P manual for details).
- RQ is an interrupt pin, you can use this pin to wake up the microcontroller, to achieve a fast response, etc.; can not be connected to the SPI query to obtain the interrupt status (not recommended, not

conducive to the overall power consumption, and inefficient).

- CE can be connected high for a long time, but the module must first be set to POWER DOWN mode when writing registers, it is recommended that CE be controlled by a microcontroller pin.
- CE pin and LNA enable pin is connected, when CE = 1, LNA is turned on, when CE = 0, LNA is turned off. This operation is fully compatible with the transceiver mode of the nRF24L01; that is, the user does not have to care about LNA operation at all.
- If the user needs to answer automatically, the CE pin must be held high during transmit, not high for more than 10us as mentioned in the nRF24L01+ manual. The correct operation is: CE = 1 to trigger the transmission, know that after the completion of the transmission, CE = 0, rather than 10us after the CE = 0, the reason is: L01 + transmission, immediately switch to receive mode, at this time, if CE = 0, then the LNA has been turned off, will not be conducive to receive sensitivity.

- Power Staging

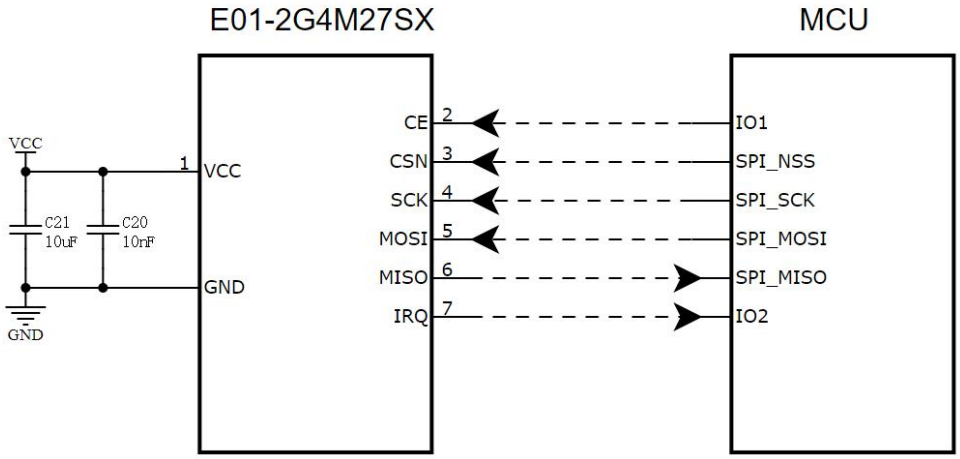
Table 4 Power Staging

Serial number	Si24R1 Setting Power (dBm)	Module Output Power (dBm)
1	0dBm	27dBm
2	-6dBm	25dBm
3	-12dBm	22dBm
4	-18dBm	14dBm

V Basic Applications

5.1 Basic Circuit

Figure 5-1 Basic Circuit



Ⅵ Frequently Asked Questions

6.1 Unsatisfactory transmission distance

- A corresponding attenuation of communication distance when linear communication barriers exist.
- Temperature, humidity, and co-channel interference, which can lead to higher communication packet loss rates.
- The ground absorbs and reflects radio waves, and the test effect is poor near the ground.
- seawater has a very strong ability to absorb radio waves, so the seaside test effect is poor.
- metal objects near the antenna, or placed in a metal shell, the signal attenuation will be very serious.
- Wrong setting of power register, too high setting of air rate (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 less power is generated
- The use of antenna and module match the degree of poor or antenna itself quality problems.

6.2 Module is vulnerable to damage

- Please check the power supply to ensure that it is between the recommended supply voltages, as exceeding the maximum will cause permanent damage to the module.
- Please check the stability of the power supply, the voltage must not fluctuate.
- Please ensure that the installation and use process anti-static operation, high-frequency devices electrostatic sensitivity.
- Please ensure that the installation and use process humidity should not be too high, some components are humidity-sensitive devices.
- If there is no special demand is not recommended to use in too high and 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.
- The clock waveform on the SPI is not standard, check whether there is interference on the SPI line, and the SPI bus alignment should not be too long.
- Unsatisfactory power supply may also cause garbled code, be sure to ensure the reliability of the power supply.
- Poor quality or too long extension lines or feeders may also cause high BER.

Ⅶ Welding work instruction

7.1 Reflow Temperature

Table 7 Reflow temperature reference table

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 sec	60-120 sec
Average ramp-up rate(Tsmax to Tp)	Average rise rate	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 drop rate	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 Profiles

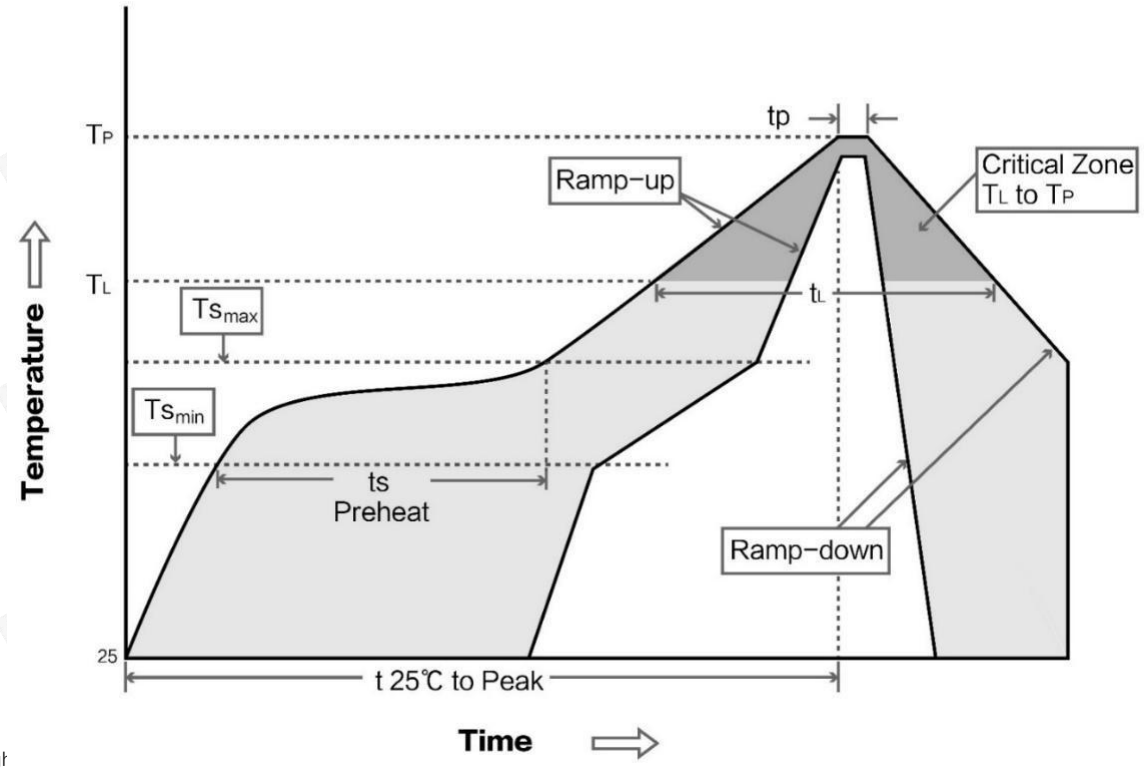


Figure 7-1 Reflow Profile

Ⅷ Related Models

Table 8 Table of related models

Module Model	Chip	Carrier frequency	Transmitting power	Communication distance	Package form	Antenna Form
		Hz	dBm	m		
E01C-ML01S	Si24R1	2.4G	0	100	SMD	PCB
E01C-ML01D	Si24R1	2.4G	0	100	DIP	PCB
E01C-ML01DP5	Si24R1	2.4G	20	2500	DIP	SMA-K
E01C-ML01DP4	Si24R1	2.4G	20	1800	DIP	PCB
E01C-ML01SP2	Si24R1	2.4G	20	1800	SMD	PCB/IPEX
E01-2G4M27SX	nRF24L01+	2.4G	20	2000	SMD	IPEX
E01-ML01DP4	nRF24L01+	2.4G	20	1800	DIP	PCB
E01-ML01DP5	nRF24L01+	2.4G	20	2500	DIP	SMA-K
E01-2G4M27D	nRF24L01+	2.4G	27	5000	DIP	SMA-K

Ⅸ 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 antennas as supporting our wireless module and more excellent performance and reasonable price.

Table 9 Antenna Recommendation Table

Product Model	Type	Frequency	Gain	Size	Feeders	Interface	Feature
		Hz	dBi	mm	cm		
TX2400-NP-5010	Flexible Antenna	2.4G	2.0	10x50	-	IPEX	Flexible FPC Soft Antenna
TX2400-JZ-3	Glue Stick Antenna	2.4G	2.0	30	-	SMA-J	Ultra Short Straight, Omni-directional Antenna
TX2400-JZ-5	Glue Stick Antenna	2.4G	2.0	50	-	SMA-J	Ultra Short Straight, Omni-directional Antenna
TX2400-JW-5	Glue Stick Antenna	2.4G	2.0	50	-	SMA-J	Fixed bend, omni-directional antenna
TX2400-JK-11	Glue Stick Antenna	2.4G	2.5	110	-	SMA-J	Bendable glue stick, omni-directional antenna
TX2400-JK-20	Glue Stick Antenna	2.4G	3.0	200	-	SMA-J	Bendable glue stick, omni-directional antenna
TX2400-XPL-150	Suction	2.4G	3.5	150	150	SMA-J	Small suction cup

	cup antenna						antenna, cost effective

X Batch packing method

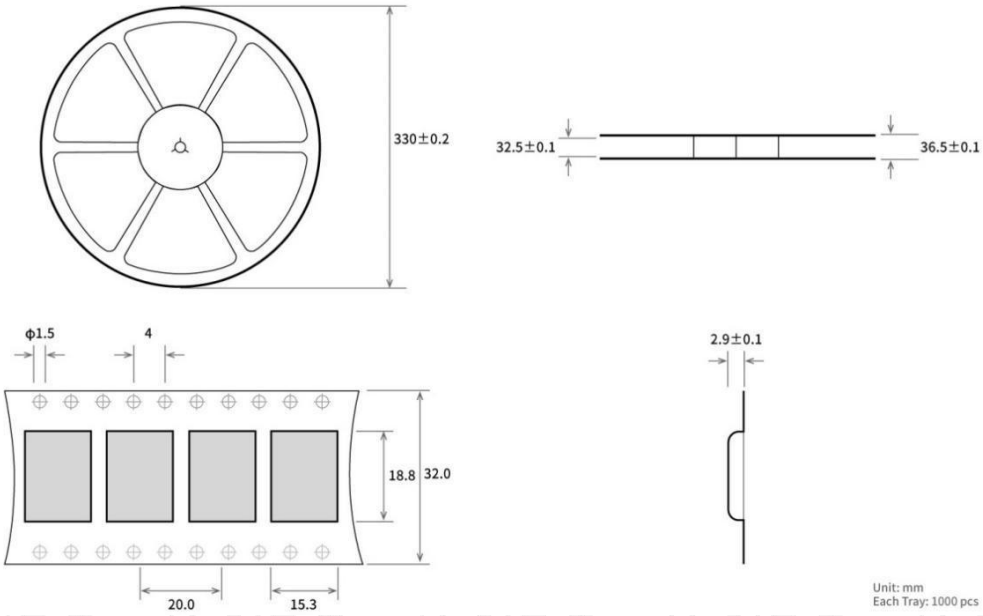


Figure 10 Batch packing method diagram

Revision History

Version	Revision Date	Revision Notes	Maintainer
1.0	2020-05-19	Initial Version	

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