E01-2G4M27SX User Manual

nRF24L01+ 2.4GHz 500mW SPI SMD wireless module



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1. Overview

1.1 Brief Introduction

E01-2G4M27SX is a 2.4GHz SMD wireless module with ultra-small size and maximum transmit power of 500mW independently developed based on nRF24L01P produced by Nordic in Norway.



The original imported nRF24L01P is used to ensure its compatibility. On the original basis, a power amplifier (PA) and a low noise amplifier (LNA) are built in, so that the maximum transmit power reaches 500mW and the receiving sensitivity is further improved. The overall communication stability is greatly improved compared to products without power amplifiers and low noise amplifiers.

This product uses industrial grade high precision 16MHz crystal.

Because E01-2G4M27SX is a pure RF transceiver module, users need to use the MCU driver or use a dedicated SPI debugging tool.

1.2 Features

- Ultra-small volume, only 18 * 14.5mm;
- Maximum transmission power of 500mW, software multi-level adjustable;
- Under ideal conditions, the communication distance can reach 4 km;
- Support global license-free ISM 2.4GHz band;
- Support air date rate of 2Mbps, 1Mbps, 250kbps;
- 125 communication channels to meet the needs of multi-point communication, grouping, frequency hopping, etc.
- Connect with MCU through SPI interface, the rate is 0～10 Mbps;
- Support2.3～3.6V power supply, power supply over 3.3V can guarantee the best performance；
- Professional RF shield, anti-interference, anti-static;
- IPEX interface, can be easily connected to coaxial cable or external antenna (shared by IPEX interface);
- Enhanced ShockBurst is fully compatible with all nord24n series, nRF24E series, nRF24U series of NORDIC.

1.3 Application

- Smart home and industrial sensors;
- 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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2. Specification and parameter

2.1 Limit parameter

Main parameter	Performance		Remark
	Min.	Max.	
Power supply（V）	2.3	3.6	Voltage over 3.6 V will cause permanent damage to module
Operating temperature（℃）	-40	+85	Industrial grade

2.2 Operating Parameter

Main parameter		Performance			Remark
		Min.	Typ.	Max.	
Operating voltage（V）		2.3	3.3	3.6	≥3.3 V ensures output power
Communication level（V）		-	3.3	-	For 5V TTL, it may be at risk of burning down
Operating temperature（℃）		-40	-	+85	Industrial design
Operating frequency（GHz）		2400	-	2525	Support ISM band
Power consumption	TX current（mA）	-	720	-	Instant power consumption
	RX current（mA）	-	23	-	-
	Sleep current （μA）	-	-	-	Does not support low power mode
Max Tx power（dBm）		26	27	27	-
Receiving sensitivity（dBm）		-113	-114	-115	Air data rate is 250 kbps
Air data rate（bps）		250 k	-	2 M	Controlled via user’s programming

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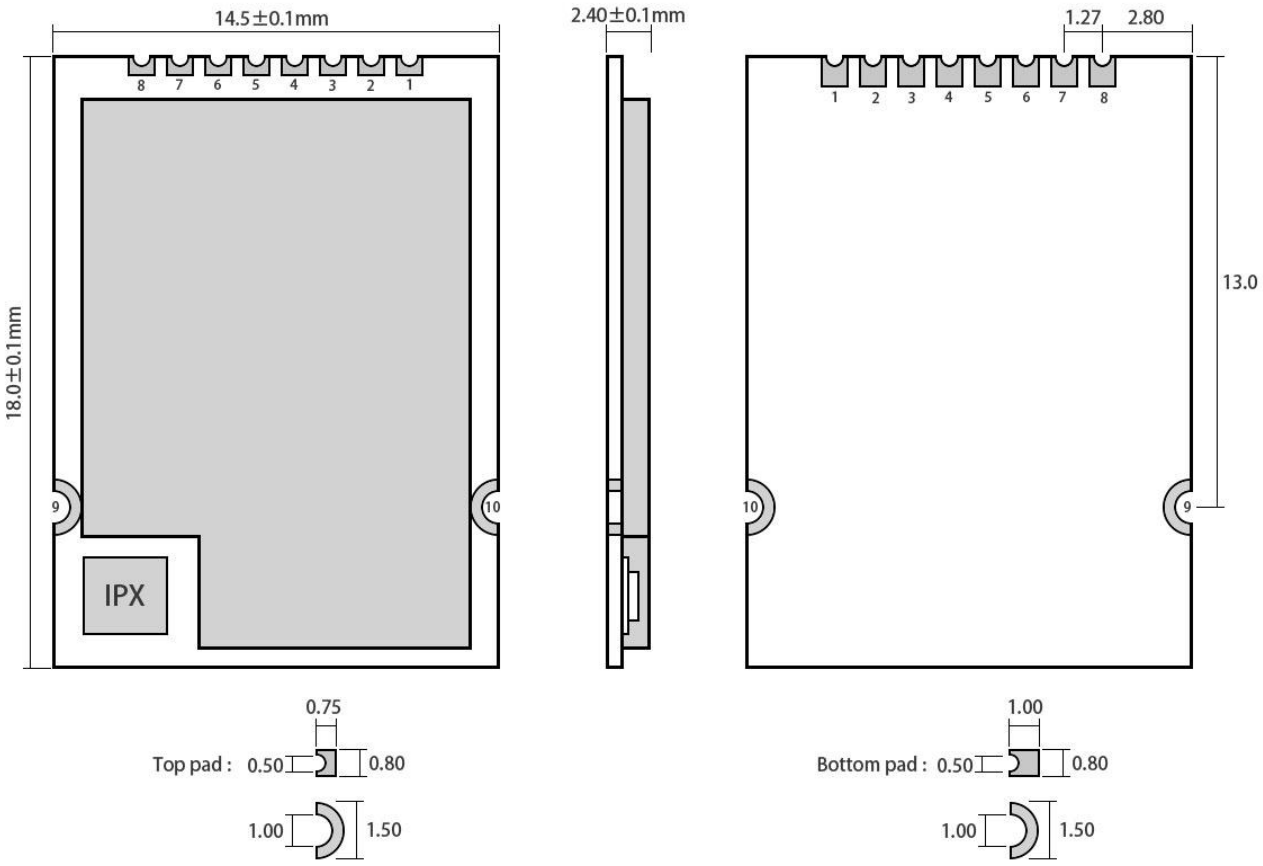
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Main parameter	Description	Remark
Distance for reference	4 km	Test condition：clear and open area, antenna gain: 5dBi，antenna height: 2.5m，air data rate: 250kbps
FIFO	32 Byte	Max length transmitted each time
Crystal frequency	16 MHz	-
Modulation	GFSK	-
Package	SMD	-
Connector	1.27 mm pin	-
Communication interface	SPI	0～10 Mbps
Size	18*14.5 mm	-
RF interface	IPEX	50ohm impedance
Weight	1.0±0.1g	-

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3. Size and pin definition



Pin No.	Pin item	Pin direction	Pin application
1	VCC	-	Power supply must be 2.3 ~ 3.6V
2	CE	Input	Module control pin
3	CSN	Input	The chip select pin of the module is used to start an SPI communication.
4	SCK	Input	Module SPI bus clock
5	MOSI	Input	Module SPI data input pin
6	MISO	Output	Module SPI data output pin
7	IRQ	Output	Module interrupt signal output, low level is effective.
8	GND	-	Ground wire, connect to power reference ground.
9	GND	-	Ground wire, connect to power reference ground.
10	GND	-	Ground wire, connect to power reference ground.

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4. Basic operation

4.1 Hardware design

- It is recommended to use a DC stabilized power supply. The power supply ripple factor is as small as possible, and the module needs to 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 it is within the recommended voltage otherwise when it exceeds the maximum value the module will be permanently damaged;
- Please check the stability of the power supply, the voltage can not be fluctuated frequently;
- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the margin, so the whole machine is beneficial for long-term stable operation.;
- The module should be as far away as possible from the power supply, transformers, high-frequency wiring and other parts with large electromagnetic interference.;
- High-frequency digital routing, high-frequency analog routing, and power routing must be avoided under the module. If it is necessary to pass through the module, assume that the module is soldered to the Top Layer, and the copper is spread on the Top Layer of the module contact part(well grounded), it must be close to the digital part of the module and routed in the Bottom Layer;
- Assuming the module is soldered or placed over the Top Layer, it is wrong to randomly route over the Bottom Layer or other layers, which will affect the module's spurs and receiving sensitivity to varying degrees;
- It is assumed that there are devices with large electromagnetic interference around the module that will greatly affect the performance. It is recommended to keep them away from the module according to the strength of the interference. If necessary, appropriate isolation and shielding can be done;
- Assume that there are traces with large electromagnetic interference (high-frequency digital, high-frequency analog, power traces) around the module that will greatly affect the performance of the module. It is recommended to stay away from the module according to the strength of the interference.If necessary, appropriate isolation and shielding can be done.
- Try to stay away from some physical layers such as TTL protocol at 2.4GHz , for example: USB3.0;
- The antenna installation structure has a great impact on the performance of the module. Make sure that the antenna is exposed, preferably vertically. When the module is installed inside the chassis, you can use high-quality antenna extension cords to extend the antenna to the outside of the chassis;
- The antenna must not be installed inside the metal shell, which will greatly weaken the transmission distance.

4.2 Software writing

- This module is nRF24L01+PA+LNA, and its driving method is completely equivalent to nRF24L01+, users can operate in accordance with nRF24L01+ chip manual (see nRF24L01P manual for details);
- IRQ is an interrupt pin, which can be used to wake up the microcontroller and achieve fast response, etc.; it can be disconnected, and the interrupt status can be obtained by SPI query (not recommended, which is not conducive to the overall power consumption and the efficiency is low);

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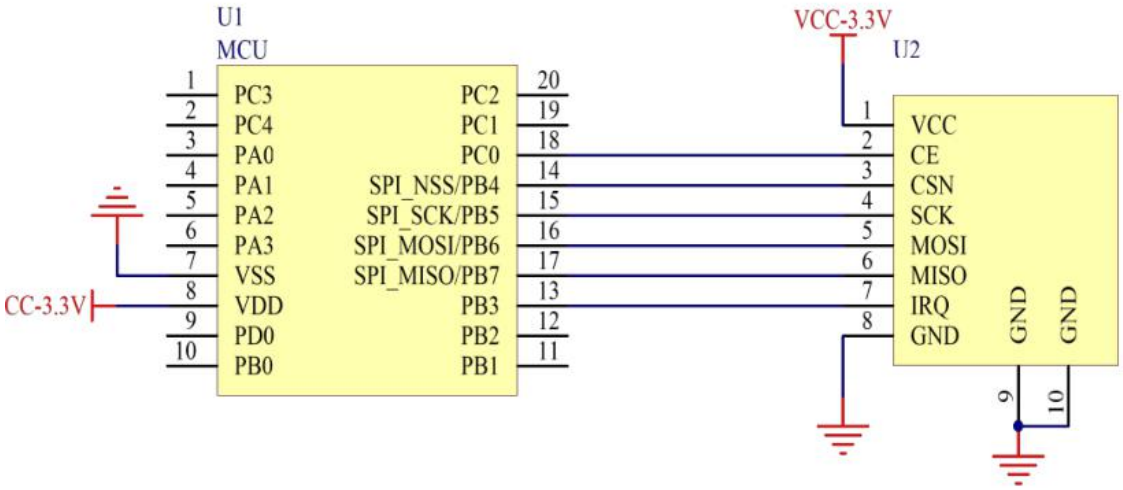
- CE can be connected to high level for a long time, but the module must first be set to POWER DOWN power-down mode when writing the register. It is recommended that CE be controlled by the single-chip pin;
- The CE pin is connected to the LNA enable pin. When CE=1, the LNA is turned on, and when CE=0, the LNA is turned off. This operation is a transceiver mode of nRF24L01;
- If the user needs to answer automatically, the CE pin must maintain a high level during the transmission process, instead of the high-level time mentioned in the nRF24L01+ manual greater than 10us. The correct operation is: CE=1 triggers the transmission. After knowing that the transmission is completed, it will set CE=0, instead of CE=0 after 10us. The reason is: after L01+ transmission, it will immediately switch to the receiving mode. If CE= 0, the LNA has been turned off, which is not conducive to receiving sensitivity.

4.3 Power binning

No.	nRF24L01P setting power (dBm)	Module output power (dBm)
1	0dBm	27dBm
2	-6dBm	25dBm
3	-12dBm	22dBm
4	-18dBm	14dBm

5. Basic application

5.1 Basic circuit



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6. FAQ

6.1 Communication range is too short

- The communication distance will be affected when obstacle exists.
- Data lose rate will be affected by temperature, humidity and co-channel interference.
- The ground will absorb and reflect wireless radio wave, so the performance will be poor when testing near ground.
- Sea water has great ability in absorbing wireless radio wave, so performance will be poor when testing near the sea.
- The signal will be affected when the antenna is near metal object or put in a metal case.
- Power register was set incorrectly, air data rate is set as too high (the higher the air data rate, the shorter the distance).
- The low voltage of the power supply is lower than the recommended value at room temperature, the lower the voltage, the lower the power;
- Due to antenna quality or poor matching between antenna and module.

6.2 Module is easy to damage

- Please check the power supply to ensure that it is between the recommended power supply voltage, if exceeding the maximum value will cause permanent damage to the module;
- Please check the stability of power source, the voltage cannot fluctuate too much.
- Please make sure antistatic measure are taken when installing and using, high frequency devices have electrostatic susceptibility.
- Please ensure the humidity is within limited range, some parts are sensitive to humidity.
- Please avoid using modules under too high or too low temperature.

6.3 BER(Bit Error Rate) is high

- There are co-channel signal interference nearby, please be away from interference sources or modify frequency and channel to avoid interference;
- The clock waveform on the SPI is not standard. Check whether there is interference on the SPI line. The SPI bus trace should not be too long;
- Poor power supply may cause messy code. Make sure that the power supply is reliable.
- The extension line and feeder quality are poor or too long, so the bit error rate is high;

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7. Welding operation guidance

7.1 Reflow soldering 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）	Min preheating temp.	100℃	150℃
Preheat temperature max (Tsmax)	Mx preheating temp.	150℃	200℃
Preheat Time (Tsmin to Tsmax)(ts)	Preheating time	60-120 sec	60-120 sec
Average ramp-up rate(Tsmax to Tp)	Average ramp-up rate	3℃/second max	3℃/second max
Liquidous Temperature (TL)	Liquid phase temp.	183℃	217℃
Time（tL）Maintained Above（TL）	Time below liquid phase line	60-90 sec	30-90 sec
Peak temperature（Tp）	Peak temp.	220-235℃	230-250℃
Aveage ramp-down rate（Tp to Tsmax）	Aveage ramp-down rate	6℃/second max	6℃/second max
Time 25℃ to peak temperature	Time to peak temperature for 25℃	6 minutes max	8 minutes max

7.2 Reflow soldering curve

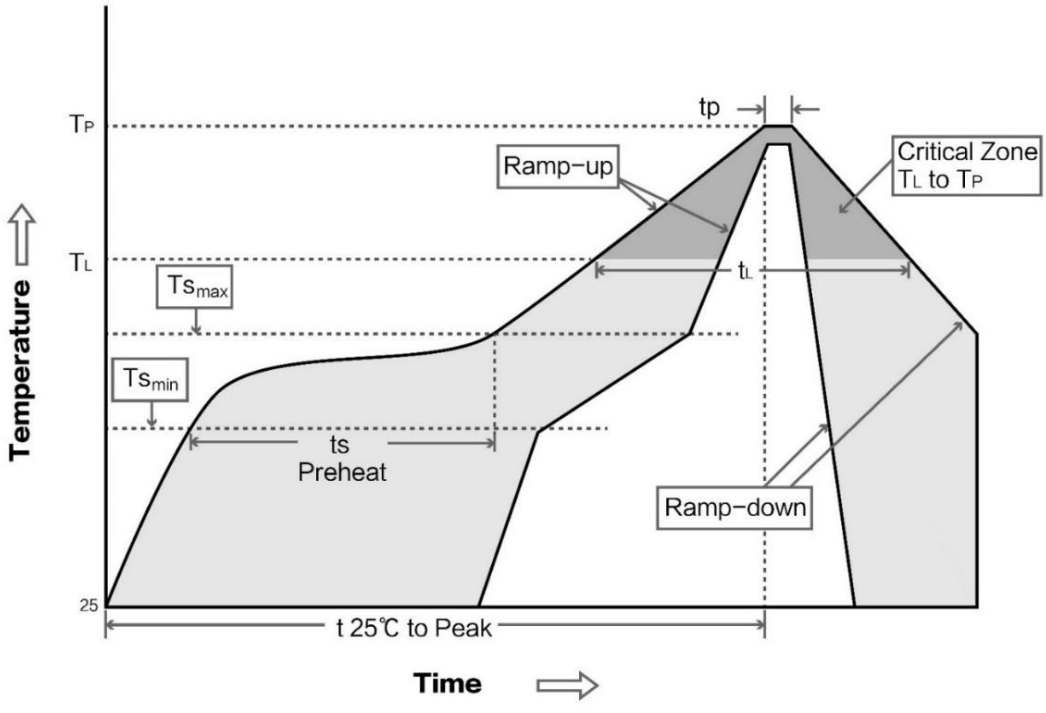


图 7-1 回流焊曲线图

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8. Related models

Model NO.	IC	Frequency	Transmit power	Communication distance	Package form	Antenna form
		Hz	dBm	m		
E01-ML01S	nRF24L01+	2.4G	0	100	SMD	PCB
E01-ML01D	nRF24L01+	2.4G	0	100	DIP	PCB
E01-ML01IPX	nRF24L01+	2.4G	0	200	SMD	IPEX
E01-2G4M13S	nRF24L01+	2.4G	13	1200	SMD	PCB
E01-ML01SP2	nRF24L01+	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
All models of E01 series wireless modules can communicate						

9. Antenna guidance

9.1 Antenna recommendation

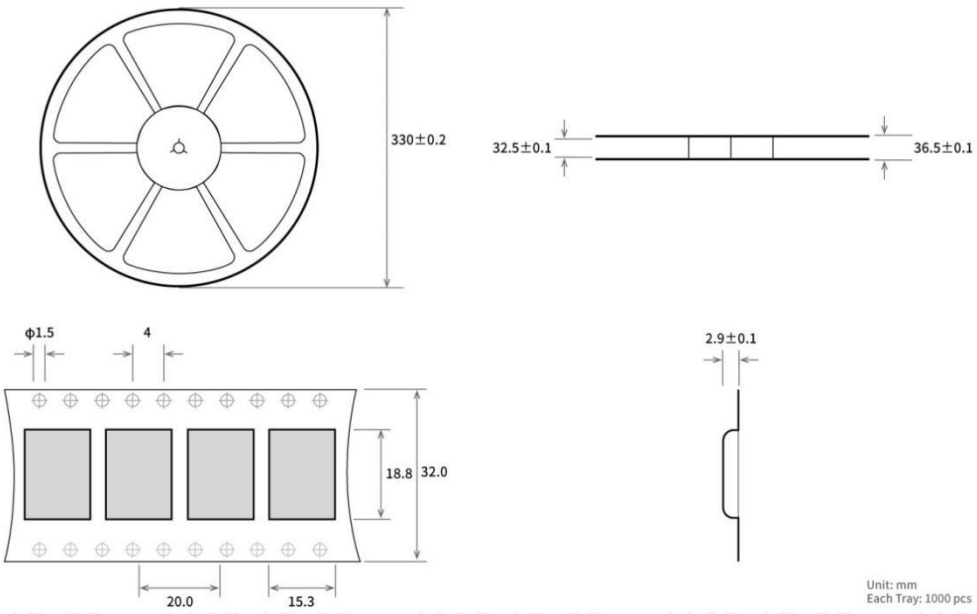
Antennas are an important role in the communication process. Often inferior antennas will have a great impact on the communication system. Therefore, our company recommends some antennas as matching antennas with excellent performance and reasonable price.

Model NO.	Type	Frequency	Gain	Size	Feeder	Connector	Feature
		Hz	dBi	mm	cm		
TX2400-NP-5010	Flexible	2.4G	2.0	10x50	-	IPEX	Flexible FPC soft antenna
TX2400-JZ-3	Rubber	2.4G	2.0	30	-	SMA-J	Ultra-short straight, omnidirectional antenna
TX2400-JZ-5	Rubber	2.4G	2.0	50	-	SMA-J	Ultra-short straight, omnidirectional antenna
TX2400-JW-5	Rubber	2.4G	2.0	50	-	SMA-J	Fixed bending, omnidirectional antenna
TX2400-JK-11	Rubber	2.4G	2.5	110	-	SMA-J	Bendable glue stick, omnidirectional antenna
TX2400-JK-20	Rubber	2.4G	3.0	200	-	SMA-J	Bendable glue stick, omnidirectional antenna
TX2400-XPL-150	Sucker	2.4G	3.5	150	150	SMA-J	Small suction cup antenna, high cost performance

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10. Packing method for batch order



Revision history

Version	Date	Remark	By
1.0	2020-05-19	First version	

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