E01-2G4M27S User Manual

nRF24L01P 2.4GHz 27dBm SPI Wireless Module



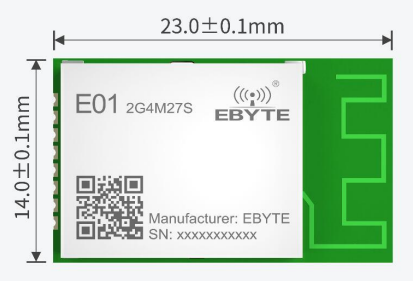
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1 Overview

1.1 Introduction

E01-2G4M27S is a 2.4GHz SMD wireless module on Nordic's NRF24L01P RF chip, which is small in size and has the maximum transmission power of 27dBm.



The module uses imported nrf24l01p chip, built-in power amplifier (PA) and low-noise amplifier (LNA), with PCB antenna, and the maximum transmission power is 27dBm. At the same time, the communication stability has been greatly improved by using industrial high-precision 16 MHz crystal oscillator.

Since the E01-2G4M27S is a SPI RF transceiver module, you need to use the MCU driver or a dedicated SPI debugging tool.

1.2 Features

- Small size,only 14*23mm;
- Maximum transmission power of 27dBm, software multi-level adjustable;
- Communication distance tested is up to 2.2km;
- Support the global license-free ISM 2.4GHz;
- Support air date rate of 2Mbps,1Mbps and 250kbps;
- 125 communication channels to meet the needs of multi-point communication, grouping, frequency hopping, etc.;
- Connect to the MCU through the SPI interface at a rate of 0 ~ 10Mbps;
- Support 2.3V~3.6V power supply, power supply over 3.3V can guarantee the best performance;
- Professional RF shield design, anti-interference, anti-static;
- Onboard PCB antenna, no need to connect external antenna;
- Enhanced ShockBurst, fully compatible with nRF24L, nRF24E, nRF24U series of NORDIC.

1.3 Application

- Smart home and industrial sensors;
- Security system and positioning system;
- Wireless remote control, UAV;
- Wireless game remote control;
- Health care 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 3.6V will cause permanent damage to module
Blocking power（dBm）	-	10	Chances of burn is slim when modules are used in short distance
Operating temperature（℃）	-40	85	/

2.2 Operating parameter

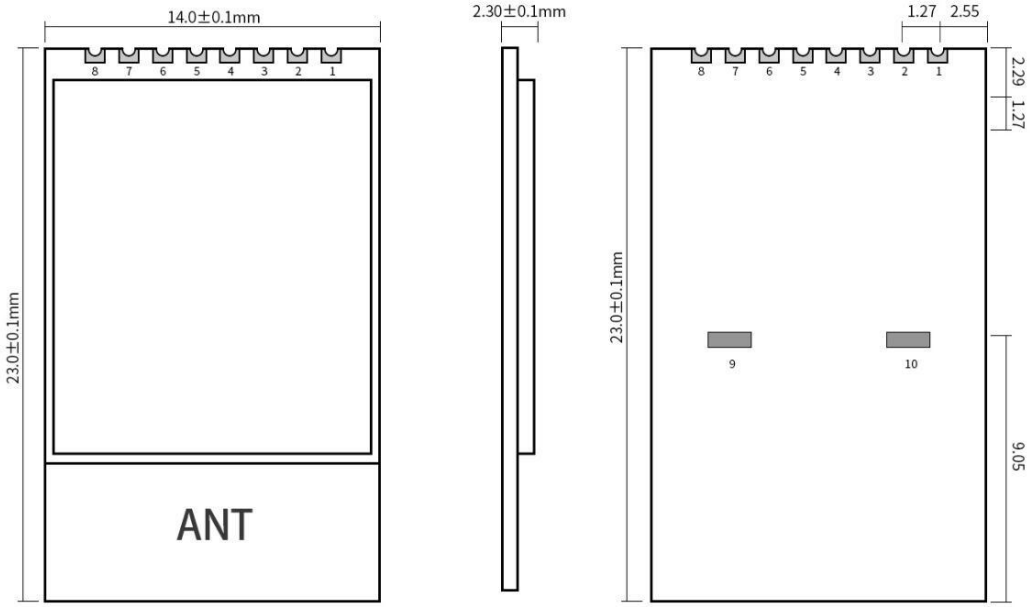
Main parameter		Performance			Remark
		Min.	Typ.	Max.	
Operating voltage（V）		2.3	3.3	3.6	Voltage over 3.6V will cause permanent damage to module
Communication level（V）		-	3.3	-	For 5V TTL, it may be at risk of burning down
Operating temperature（℃）		-40	-	85	Industrial design
Operating frequency（MHz）		2.4	-	2.525	Support ISM band
Power consumption	TX current（mA）	-	700	-	Instant power consumption
	RX current（mA）	-	23	-	
	Sleep current （μA）	-	-	-	Software is shut down
Max Tx power（dBm）		14	-	27	
Receiving sensitivity（dBm）		-	-99	-	Air data rate is 250 kbps
Air data rate（bps）		250k	-	2M	Controlled via user's programming

Main parameter	Description	Remark
Distance for reference	2km	Test condition：clear and open area, antenna gain: 5dBi, antenna height: 2.5m， air data rate: 250kbps
FIFO	32 Byte	Max. Transmitting length per packet
Crystal frequency	16	
Modulation	GFSK	
Package	SMD	
Communication interface	SPI	0-10Mbps
Size	14 * 23mm	
Antenna	PCB antenna	50 ohm impedance
Weight(g)	1.2±0.1	

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3 Size and pin definition





No.	Name	Direction	Function
1	VCC	-	Power supply ： 2.3~ 3.6V DC
2	CE	Input	Chip enable
3	CSN	Input	SPI Chip select
4	SCK	Input	SPI Clock
5	MOSI	Input	SPI master output slave input
6	MISO	Output	SPI master input slave output
7	IRQ	Output	Interrupt request, valid in low communication level
8	GND		Ground
9	GND		Ground
10	GND		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.
- If the communication line uses a 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 physical layers such as TTL protocol at 2.4GHz , for example: USB3.0;
- Onboard PCB antennas should avoid conductors or other sources of interference.

4.2 Software editing

- The module is nRF24L01P+PA+LNA. Its driving mode is exactly the same as nRF24L01P. Users can operate according to nRF24L01P manual (please refer to the latest nRF24L01P data sheet.)
- IRQ is an interrupt pin, which can be used to wake up the microcontroller and achieve fast response. If it is not connected, the SPI query mode can be used to obtain the interrupt status (not recommended, which is not conducive to the overall power consumption, and the efficiency is not enough);

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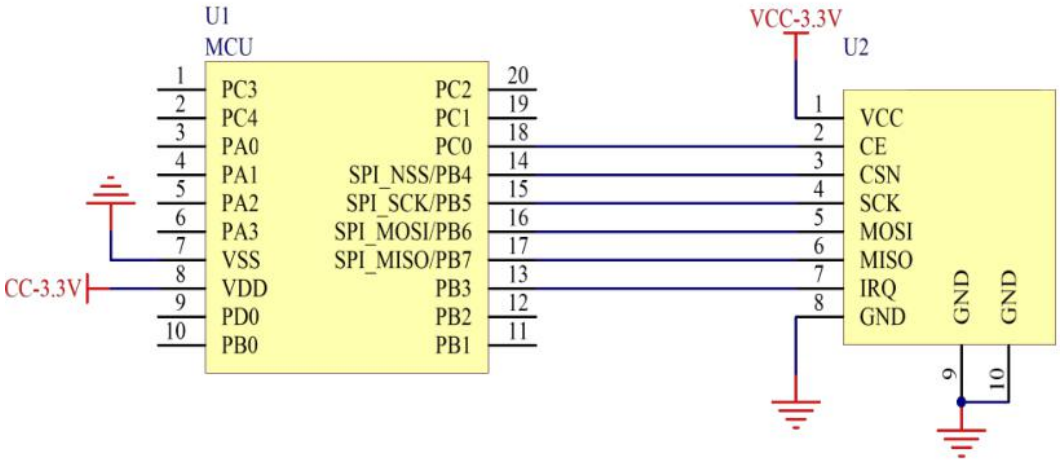
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- CE can be connected to a high level for a long time, but the module must first be set to the POWER DOWN mode when writing the register. It is recommended that the CE be controlled by a MCU pin.
- Make sure the CE pin connects to LNA enable pin ,when CE equal to 1,LNA is turned on,when CE to O,LNA is turned off .This operation is perfectly matched with the transceiver mode of NRF24L01;that is to say,users do not have to care about the LNA operation.
- If the automatic response is needed, the CE pin must keep high level when transmitting, instead of keeping high level time just more than 10us like the datasheet mentioned. The operation we recommended is: when CE equal to 1,the module begin sending, after sending all, then make the CE equal to 0, instead of making the CE equal to 0 after 10us. The reason is: the module turns into receiving mode immediately after sending LOIP f CE equal to 0,it means LNA closed, will not be beneficial to the receiving senility.
- Transmitting power settings

No	nRF24L01P Setting Power（dBm）	Transmitting power（dBm）
1	0	27
2	-6	25
3	-12	22
4	-18	14
Note: The above transmit power leveling needs to be achieved through software settings		

5 Basic application

5.1 Basic circuit diagram



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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 power supply low voltage under room temperature is lower than 2.5V, the lower the voltage, the lower the transmitting power.
- Due to antenna quality or poor matching between antenna and module.

6.2 Module is easy to damage

- Please check the power supply source, ensure it is 2.0V~3.6V, voltage higher than 3.6V will damage 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;
- 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;

7 Production guidance

7.1 Reflow soldering temperature

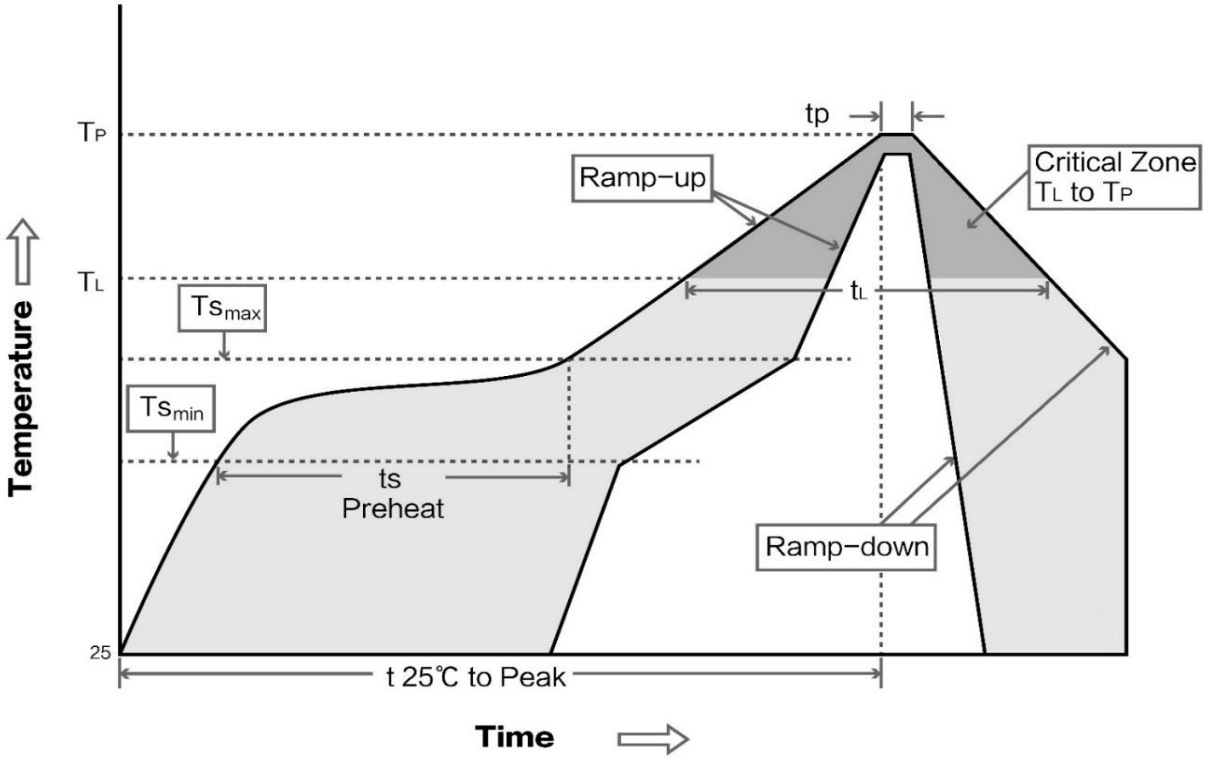
Profile Feature	Curve characteristics	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Solder paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min (Tsmin)	Min preheating temp.	100℃	150℃
Preheat temperature max (Tsmax)	Mx preheating temp.	150℃	200℃
Preheat Time (Tsmin to Tsmax)(ts)	Preheating time	60-120 sec	60-120 sec
Average ramp-up rate(Tsmax to Tp)	Average ramp-up rate	3℃/second max	3℃/second max

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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℃	max 6 minutes	max 8 minutes

7.2 Reflow soldering curve



8 E01 Series

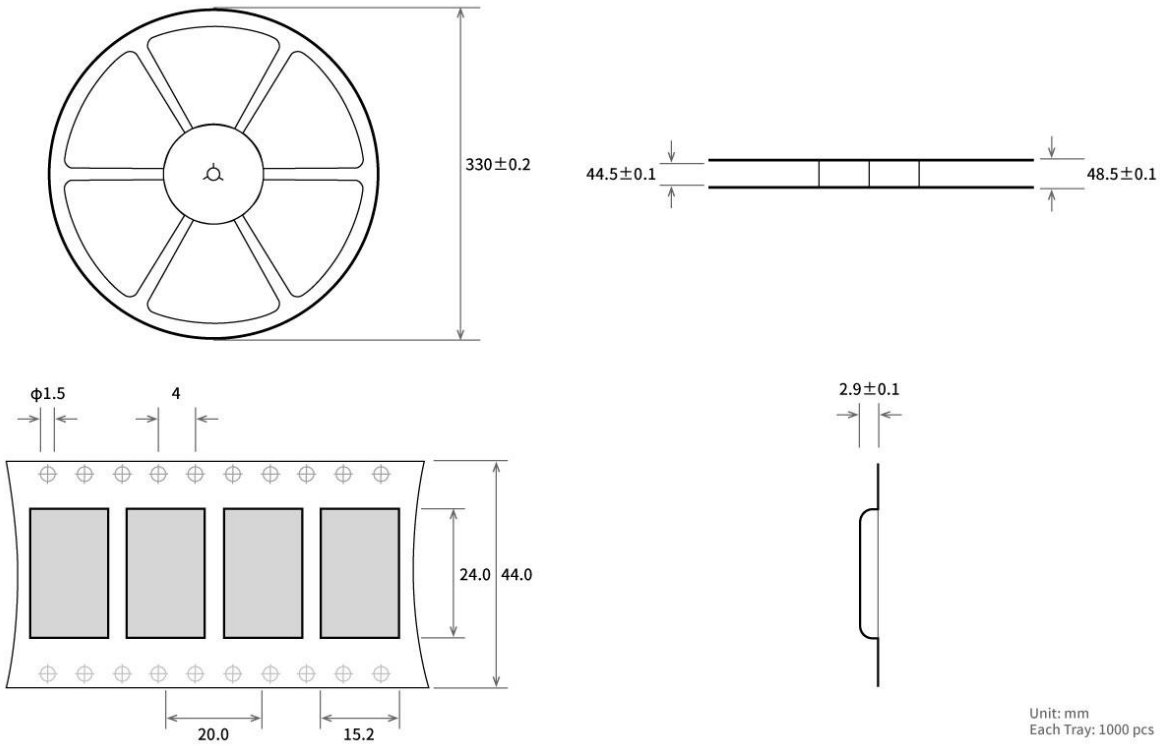
Model No.	RFIC	Frequency	TX power	Distance	Package	Antenna
		Hz	dBm	km		
E01-ML01S	nRF24L01P	2.4G	0	0.1	SMD	PCB
E01-ML01D	nRF24L01P	2.4G	0	0.1	DIP	PCB
E01-ML01IPX	nRF24L01P	2.4G	0	0.2	SMD	IPEX
E01-2G4M13S	nRF24L01P	2.4G	13	0.8	SMD	PCB
E01-ML01DP4	nRF24L01P	2.4G	20	1.8	DIP	PCB

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E01-ML01DP5	nRF24L01P	2.4G	20	2.5	DIP	SMA-K
E01-ML01SP2	nRF24L01P	2.4G	20	1.8	SMD	PCB/IPEX
E01-ML01SP4	nRF24L01P	2.4G	20	2	SMD	IPEX
E01-2G4M27D	nRF24L01P	2.4G	27	5	DIP	SMA-K
E01-2G4M27S	nRF24L01P	2.4G	27	2.2	SMD	PCB
E01-2G4M27SX	nRF24L01P	2.4G	27	4	SMD	IPEX
All E01 series module are compatible with each other.						

9 Packing method for batch order



Revision history

Version	Date	Description	Issued by
1.0	2020.06.05	Initial version	Ken

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