# E01-2G4M20S1B User Manual

## 2.4GHz 100mW SPI SMD Wireless Module

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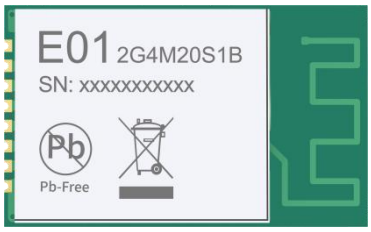
# 1. Overview

## 1.1 Introduction




E01-2G4M20S1B is a 2.4GHz SMD small-sized wireless module with PCB antenna developed by Ebyte.

Built-in power amplifier (PA) and low-noise amplifier (LNA) on the original basis, so that the maximum transmit power reaches 100mW while receiving sensitivity is further improved, Compared with products without power amplifier and low noise amplifier, the overall communication stability is greatly improved.

This product uses industrial grade high precision 16MHz crystal.

Because E01-2G4M20S1B is a pure RF transceiver module, it needs to use MCU driver or use a dedicated SPI debugging tool.

## 1.2 Features

- The maximum transmit power is 20dBm, which meets the battery power supply and greatly expands the communication distance;
- Communication distance can reach 1000m under ideal conditions;
- Global license-free ISM 2.4GHz band;
- Air data rate : 2Mbps, 1Mbps and 250kbps;
- 125 communication channels to meet the needs of multi-point communication, packet, frequency hopping and other applications;
- Connect to MCU through SPI interface, the speed is 0 ～ 10Mbps;
- Professional RF shielding cover, anti-interference, anti-static;
- Industrial grade standard design for long-term use from -40 ～ + 85 ℃;
- Built-in PCB antenna, no need for external antenna.

## 1.3 Application

- Wearable devices;
- Smart home and industrial sensors;
- Security system, positioning system;
- Wireless remote control, drone;
- Wireless game remote control;
- Health care products;
- Wireless voice, wireless headphones;
- Automotive industry applications.

# 2. Technical Parameters

## 2.1 Limit Parameter

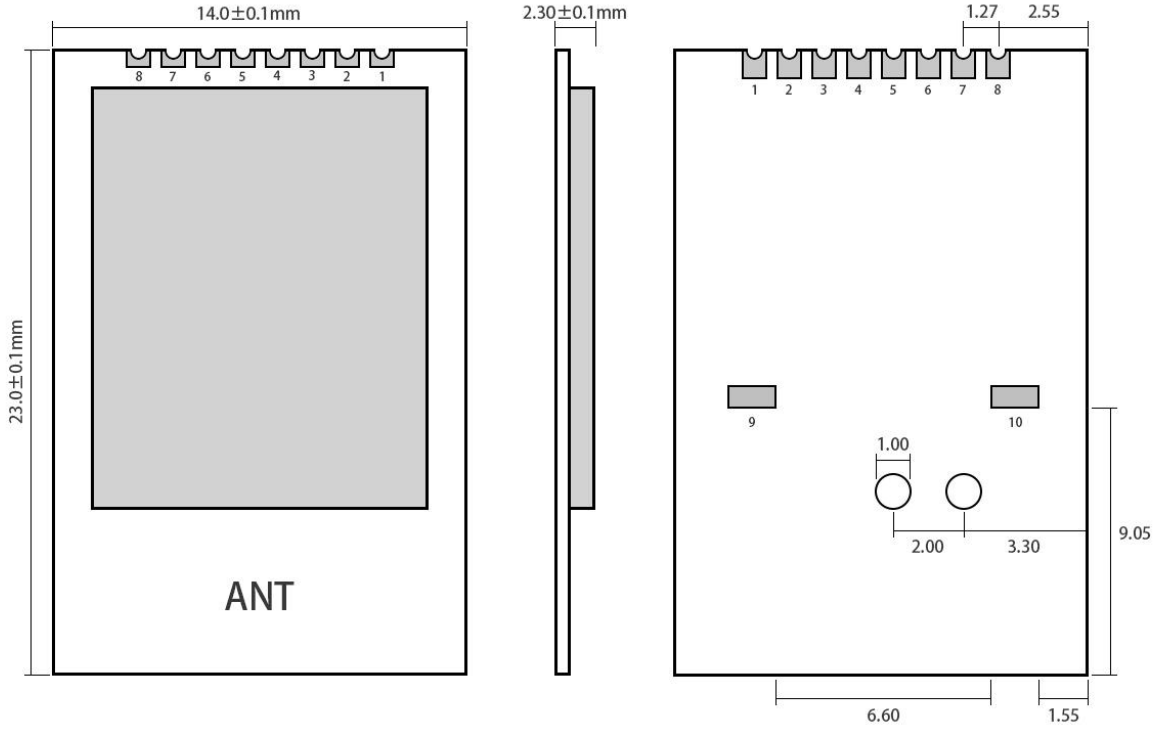
| Main parameter | Performance | | Remarks |
|---|---|---|---|
| | Min | Min | |
| Voltage supply（V） | 0 | 3.6 | Voltage over 3.6V will cause permanent damage to module |
| Blocking power（dBm） | - | -10 | Chances of burn is slim when modules are used in short distance |
| Working temperature（℃） | -40 | 85 | |

## 2.2 Working parameters

| Main parameter | | Performance | | | **Remarks** |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Operating voltage（V） | | 2.0 | 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 |
| Working temperature（℃） | | -40 | 25 | 85 | Industrial design |
| Operating frequency（GHz） | | 2.4 | - | 2.525 | Support ISM band |
| Power consumption | TX current（mA） | - | 135 | - | Instant power consumption |
| | RX current（mA） | - | 20 | - | |
| | Sleep current（μA） | 19 | 19.5 | 20 | Software is set 0dBm, built-in pa |
| Max Tx power（dBm） | | -97 | -98 | -99 | Air data rate is 250kbps |
| Receiving sensitivity（dBm） | | 250k | 250k | 2M | controlled by user's programming |

| Main parameter | Value | Remarks |
|---|---|---|
| Distance | 1000m | in open and clear air, at height of 2.5m，air data rate:250kbps |
| FIFO | 32Byte | Max packet length per time |
| Crystal Frequency | 16MHz | |
| Modulation | GFSK | |
| Package | SMD | |
| Connector | Half hole 1.27mm | |
| Communication interface | SPI | 0-10Mbps |
| Size | 23 * 14mm | with PCB antenna |
| Antenna | PCB antenna | 50 ohm impedance match |

# 3. Size and pin definition




| Pin No. | Pin item | Pin direction | Application |
|---|---|---|---|
| 1 | VCC | Power supply | Power supply must be between 2.0 and 3.6V |
| 2 | CE | Input | Module control pin |
| 3 | CSN | Input | Chip select pin for starting new SPI communication |
| 4 | SCK | Input | SPI clock pin |
| 5 | MOSI | Input | SPI data input pin |
| 6 | MISO | Output | SPI data output pin |
| 7 | IRQ | Output | Interrupt request，valid in low level |
| 8 | GND | Power supply | Ground, connected to power reference ground (Module fixed) |
| 9 | GND | Power supply | Ground, connected to power reference ground (Module fixed) |
| 10 | GND | Power supply | Ground, connected to power reference ground |

# 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 cannot 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;
- The antenna installation structure has a great impact on the performance of the module. Be sure to ensure that the antenna is exposed, preferably vertically.When the module is installed inside the case, a high-quality antenna extension cable can be used to extend the antenna to the outside of the case;
- Do not install the antenna inside the metal case,it will greatly reduce the transmission distance;
- The on-board PCB antenna should avoid conductors or other sources of interference.

## 4.2 Software programming

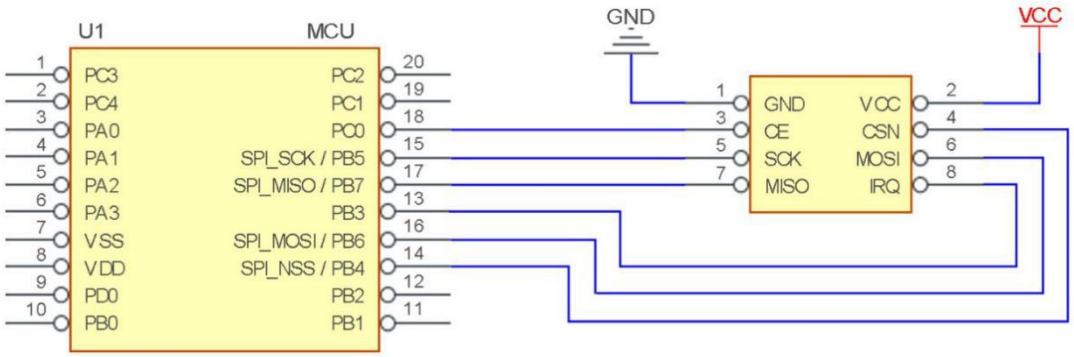
- Insert the module on the user's circuit board, use the microcontroller to communicate with it through SPI or serial port, and operate its control register and transmit / receive buffer through the SPI instruction. Please refer to the

latest nRF24L01P datasheet for the register read and write operations.

- IRQ is an interrupt pin. It is used to wake up the microcontroller and achieve fast response; users can leave it unconnected and use SPI to query the interrupt status (not recommended, not conducive to overall power consumption, low efficiency);
- CE can be connected to high level for a long time, but the module must be set to POWER DOWN power-down mode when writing to the register. It is recommended that CE be controlled by MCU pin.

# 5. Basic application

## 5.1 Basic circuit diagram




# 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 to ensure that it is between the recommended power supply voltage. If the maximum value is exceeded, the module will be permanently damaged.
- Please check the stability of power source, the voltage cannot fluctuate too much.
- Please make sure anti-static 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

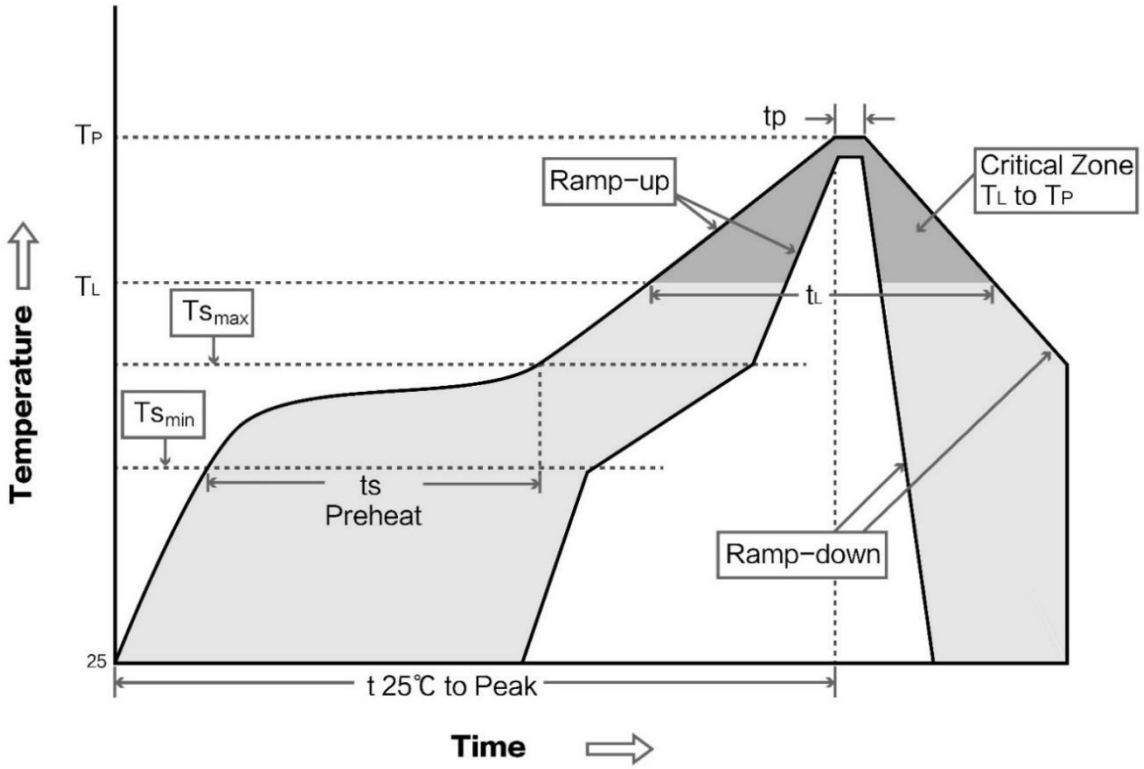
- There are co-channel signal interference nearby, please be away from interference sources or modify frequency and channel to avoid interference;
- The clock waveform on the SPI is not standard. Check whether there is interference on the SPI line. The SPI bus line should not be too long.
- Poor power 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;

# 7. Welding guidance

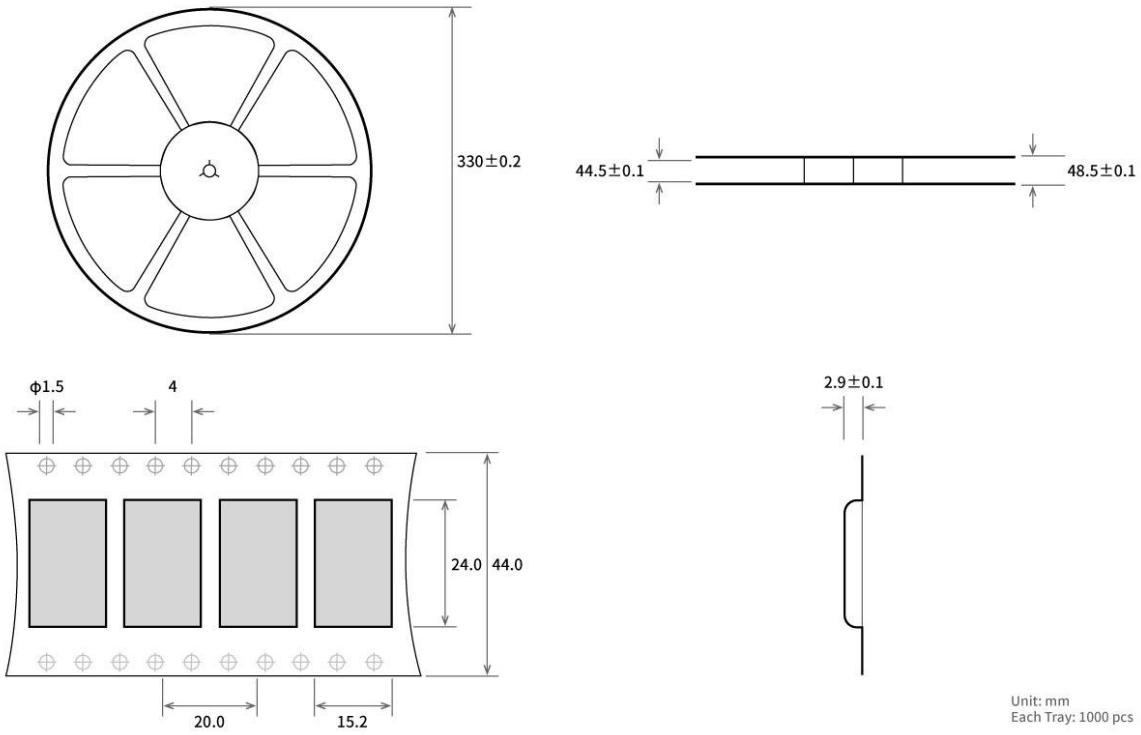
## 7. 1 Reflow Soldering Temperature

| Profile Feature | Curve feature | 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) | Preheating time | 60-120 sec | 60-120 sec |
| Average ramp-up rate(Tsmax to Tp) | Average rising rate | 3℃/second max | 3℃/second max |
| Liquidous Temperature (TL) | Liquid phase temperature | 183℃ | 217℃ |
| Time（tL）Maintained Above（TL） | Time above liquidus | 60-90 sec | 30-90 sec |
| Peak temperature（Tp） | Peak temperature | 220-235℃ | 230-250℃ |
| Aveage ramp-down rate（Tp to Tsmax） | Average descent rate | 6℃/second max | 6℃/second max |
| Time 25℃ to peak temperature | Time of 25 ° C to peak temperature | 6 minutes max | 8 minutes max |

## 7.2 Reflow Soldering Curve



# 8. Batch packaging




# Revision history

| Version | Date | Description | Issued by |
|---|---|---|---|
| 1.0 | 2019-11-19 | Initial version | Ren |
| 1.1 | 2020-04-07 | | Ren |

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