E28-2G4M27S User Manual

SX1281 2.4GHz 27dBm SPI High Speed LoRa Module



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1. Product Overview

1.1 Brief Introduction

E28-2G4M27S is a 2.4GHz small SMD module (pin spacing 1.27mm)designed by Chengdu Ebyte. With built-in PCB antenna, SPI interface, it owns TX power of 500mW with power consumption.



The IC SX1281 from Semtech features multiple physical layers and various modulating methods such as LoRa, FLRC and GFSK, the special

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modulating methods and processing ways enable longer operating range under LoRa and FLRC modulating methods, and the GFSK method covers BLE protocol. The outstanding ultra-low power consumption and the DC-DC and Time-of-Flight on chip make the chip much more capable for smart home, security system, tracking and locating, wearable electronics, smart bracelet and health management & etc.

E28-2G4M27S is a hardware platform without firmware, so users need to conduct secondary development.

1.2 Feature

- Communication distance tested is up to 8km in ideal condition;
- Maximum transmitting power of 27dBm with PA+LNA;
- Compatible with BLE;
- Support the global license-free ISM 2.4GHz;
- Support air data rate of 0.595k～2Mbps;
- Support various modulation such as GFSK Mode，FLRC Mode，LoRa Mode;
- Support 2.5V~3.6V power supply, power supply over 3.3V can guarantee the best performance;
- PCB and IPEX antenna optional, good for secondary and embedded development;
- For high speed usage, under FLRC, it is up to 1.3Mbps;
- Excellent anti-blocking ability;

1.3 Application

- Smart Home and Industrial Sensors;
- Wireless toy and remote control;
- Wireless alarm security system;
- Building automation solutions;
- Wireless industrial-grade remote control;
- Health care products;
- Advanced Meter Reading Architecture(AMI);
- Automotive industry applications.

2. Technical Parameters

2.1 Limit parameter

Main parameter	Performance		Note
	Min	Max	
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
Operating temperature [℃]	-40	+85	-

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2.2 Operating parameter

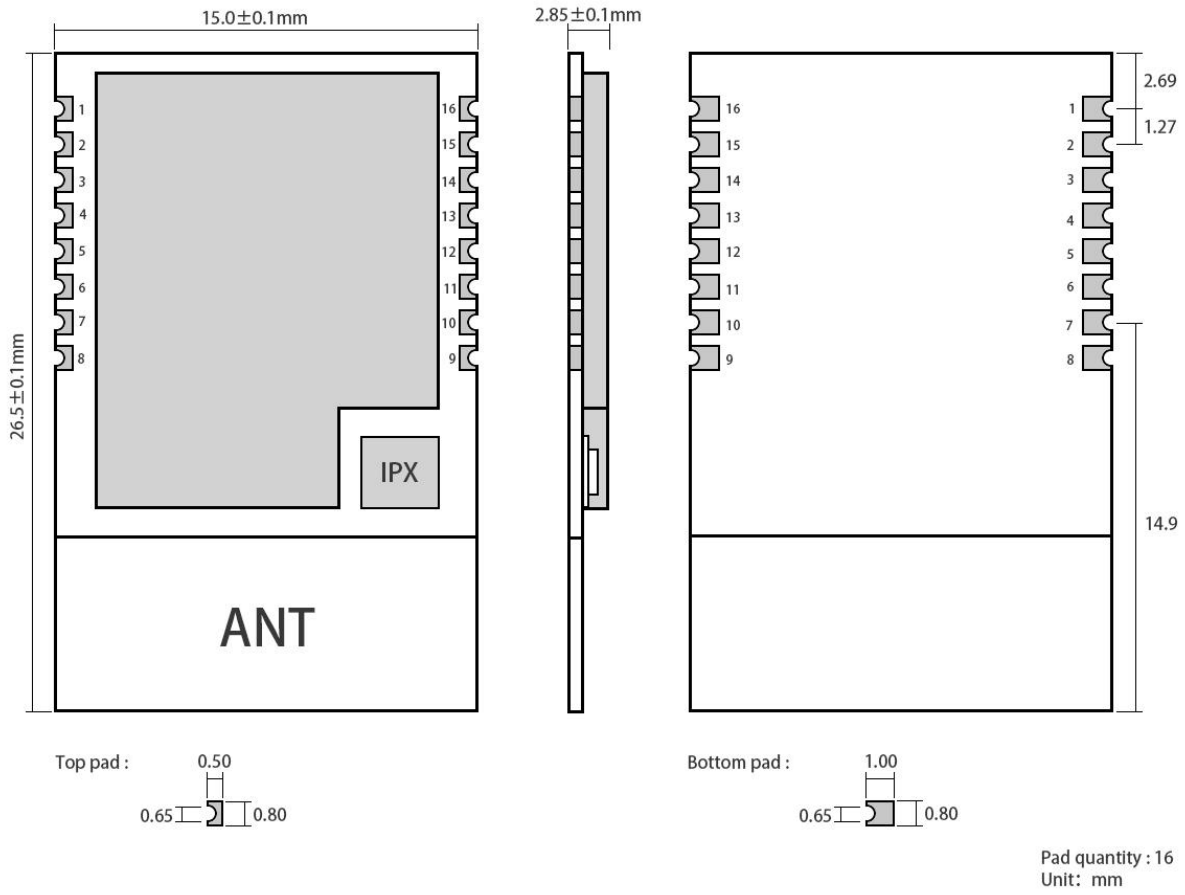
Main parameter		Performance			Note
		Min	Typ	Max	
Voltage supply [V]		2.5	3.3	3.6	≥3.3 V ensures output power
Communication level [V]			3.3		For 5V TTL, it may be at risk of burning down
Operating temperature [℃]		-40	-	+85	-
Frequency [MHz]		2400	2450	2500	ISM band
Power consumption	Transmitting current [mA]		580		Instant power consumption
	Receiving current [mA]		14.5		
	Turn-off current [μA]		2.0		Software is shut down
Transmitting power [dBm]		26	26.5	27	See more from 4.2
Receiving sensitivity [dBm]		-130	-131	-132	LoRa receiver sensitivity with CR=4/5 and high sensitivity mode enabled 1 SF12,BW=203kHz
Air data rate	LoRa（bps）	0.595k	-	253.9k	Defined by user via programming
	FLRC（bps）	260k	-	1.3M	Defined by user via programming
	GFSK（bps）	125k	-	2M	Defined by user via programming

Main parameter	Description	Note
Distance	8000m	Test condition：clear and open area, antenna gain: 5dBi，antenna height: 2.5m，air data rate: 1kbps
FIFO	256Byte	Max. Transmitting length per packet
Crystal oscillator	52MHz	±10ppm/11pF
Modulation	LoRa [Recommended]	GFSK，FLRC，LoRa
Package	SMD	
Connector	1.27mm	
Interface	SPI	0～10Mbps
Size	15*26.5mm	
Antenna	IPEX/PCB	50Ω Impedance

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3 Dimension and Pin Definition



No.	Pin item	Pin direction	Application
1	VCC		Power supply, 2.5 ~ 3.6V (recommend to add external ceramic filter capacitor)
2	GND		Ground, connecting to power source reference ground
3	MISO_TX	Output	SPI data output pin, can be used as UART transmitting pin
4	MOSI_RX	Input	SPI data input pin, can be used as UART receiving pin
5	SCK_RTSN	Input	SPI clock input pin, can be used as UART request transmitting pin
6	NSS_CTS	Input	Module chip selection pin, used to start a SPI communication; and can be used as UART clearing transmitting pin(refer to SX1281 Datasheet for details)
7	GND		Ground, connecting to power source reference ground
8	RX_EN	Input	LNA control pin，valid in high level
9	TX_EN	Input	PA control pin，valid in high level
10	GND		Ground, connecting to power source reference ground
11	NRESET	Input	Chip reset initiation input pin, valid under low level, built-in 50k pull-up resistor
12	BUSY	Output	For status indication(refer to SX1281 Datasheet for details)
13	DIO1	Input/Output	GPIO(refer to SX1281 Datasheet for details)
14	DIO2	Input/Output	GPIO(refer to SX1281 Datasheet for details)
15	DIO3	Input/Output	GPIO(refer to SX1281 Datasheet for details)
16	GND		Ground, connecting to power source 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 current supply circuit, 30% margin is recommended to be remained so as to ensure long-term stable operation of the whole module;
- 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 position has a great influence on the performance of the module. Make sure that the antenna is exposed, preferably vertically. When the module is installed inside the shield, a high-quality antenna extension cable can be used to extend the antenna outside;
- The antenna must not be installed inside the metal case, which will greatly reduce the transmission distance.

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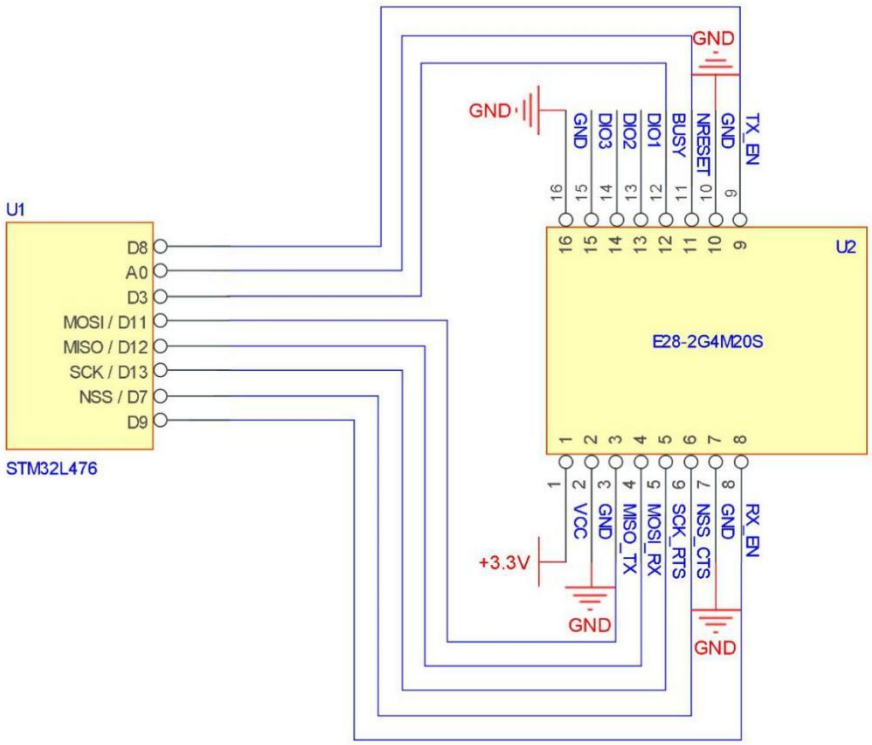
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4.2 Software editing

- With SX1281+PA+LNA，its driving method is similar to SX1281, please refer to SX1281 datasheet for operation guidance;
- GDO0 is GPIO，refer to SX1281 datasheet for details;
- GDO2 is generally configured as an IRQ-like function, or it can be disconnected. The SPI query mode can be used to obtain the interrupt status, but it is recommended to use the external interrupt via connecting MCU;
- After the SX1281 restores the IDLE mode or configured in sleep mode, it is recommended to reinitialize the power configuration table;
- It is recommended that the power output parameter of the SX1281 be set to 0dBm. At this time, the module outputs 27dBm. When the output power of the SX1281 is increased, the current will become larger and the power will not increase significantly.

5 Basic Application

5.1 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.
- Seawater 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).
- When the power supply at room temperature is lower than the recommended low voltage, the lower the voltage is, the lower the transmitting power is.
- Due to antenna quality or poor matching between antenna and module.

6.2 Module is easy to damage

- Please check the power supply and ensure it is within the recommended range. Voltage higher than the peak will lead to a permanent damage to the module.
- Please check the stability of power supply and ensure the voltage not to fluctuate too much.
- Please make sure anti-static measures are taken when installing and using, high frequency devices have electrostatic susceptibility.
- Please ensure the humidity is within limited range for some parts are sensitive to humidity.
- Please avoid using modules under too high or too low temperature.

6.3 Bit error rate is too high

- When there are co-channel signal interference nearby, 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 should not be too long.
- Unfavorable power supply may cause messy code. Make sure that the power supply is reliable.
- Extension line and feeder with poor quality or too long ones will cause high bit error rate.

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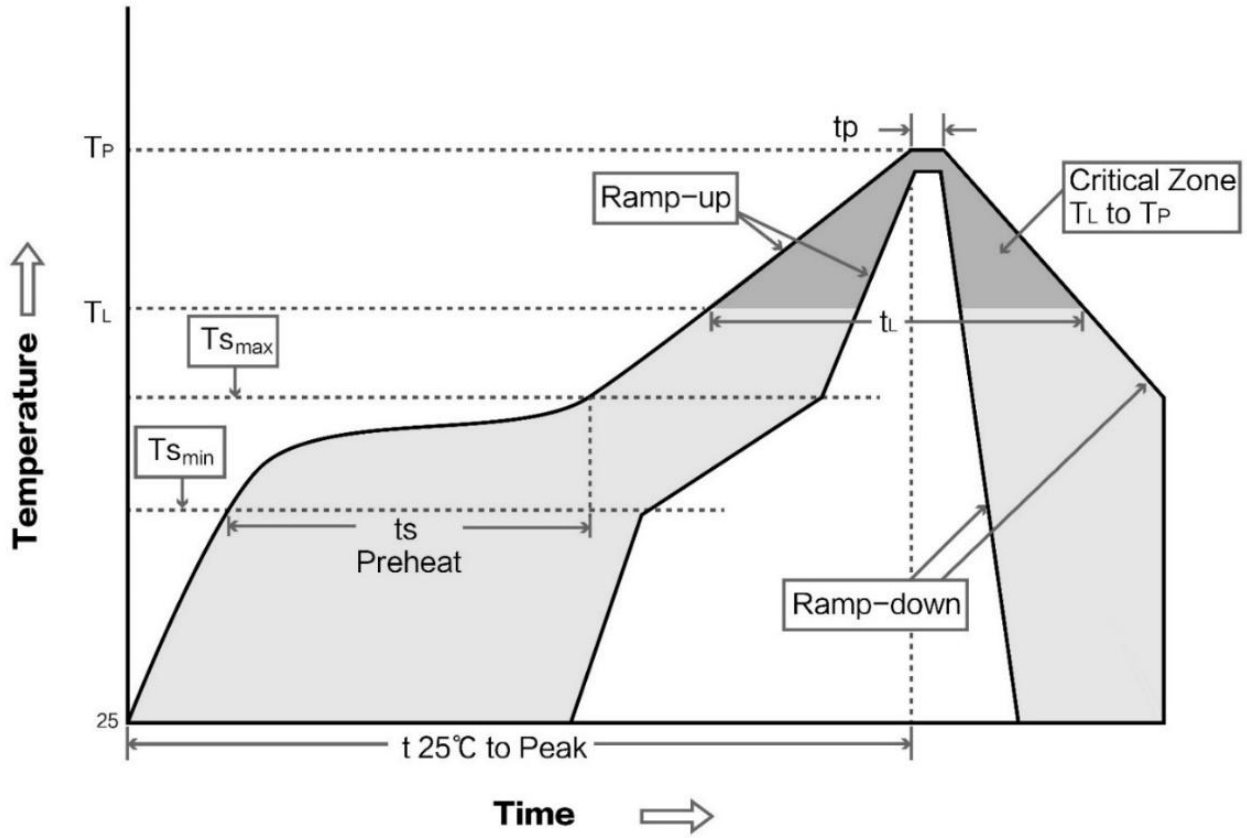
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7. Production Guidance

7.1 Reflow Soldering Temperature

Profile Feature	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min （Tsmin）	100℃	150℃
Preheat temperature max (Tsmax)	150℃	200℃
Preheat Time (Tsmin to Tsmax)(ts)	60-120 sec	60-120 sec
Average ramp-up rate(Tsmax to Tp)	3℃/second max	3℃/second max
Liquidous Temperature (TL)	183℃	217℃
Time（tL）Maintained Above（TL）	60-90 sec	30-90 sec
Peak temperature（Tp）	220-235℃	230-250℃
Aveage ramp-down rate（Tp to Tsmax）	6℃/second max	6℃/second max
Time 25℃ to peak temperature	6 minutes max	8 minutes max

7.2 Reflow Soldering Curve



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8 E28 Series

Model	IC	Frequency	TX power	Distance	Size	Package	Interface
		Hz	dBm	km	mm		
E28-2G4T12S	SX1280	2.4G	12.5	3	17.5*28.7	SMD	TTL
E28-2G4M27S	SX1281	2.4G	27	8	15*26.5	SMD	SPI
E28-2G4M20S	SX1281	2.4G	20	6	15*26.5	SMD	SPI
E28-2G4M12S	SX1281	2.4G	12.5	3	25*14	SMD	SPI

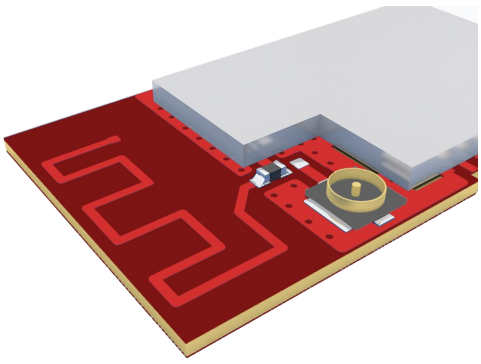
9 Antenna Guidance

9.1 Antenna recommendation

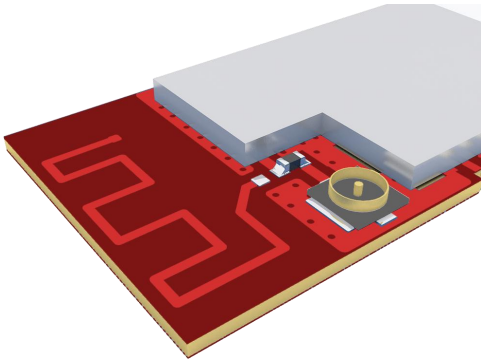
Antenna plays an important role in the communication process. Inferior antennas often have a great impact on the communication system. Therefore, we recommend some antennas that support our wireless modules and have excellent performance and reasonable price.

Model	Type	Frequency	Gain	Size	Feeder	Interface	Feature
		Hz	dBi	mm	cm		
TX2400-NP-5010	FPC	2.4G	2.0	10x50	-	IPEX	FPC antenna
TX2400-JZ-3	Rubber	2.4G	2.0	30	-	SMA-J	Straight antenna,ultra short
TX2400-JZ-5	Rubber	2.4G	2.0	50	-	SMA-J	Straight antenna,ultra short
TX2400-JW-5	Rubber	2.4G	2.0	50	-	SMA-J	Fixed bending antenna
TX2400-JK-11	Rubber	2.4G	2.5	110	-	SMA-J	Flexible antenna，omnidirectional
TX2400-JK-20	Rubber	2.4G	3.0	200	-	SMA-J	Flexible antenna，omnidirectional
TX2400-XPL-150	Sucker	2.4G	3.5	150	150	SMA-J	Small sucker antenna，high gain

9.2 Antenna selection



PCB（Default）



IPEX

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Revision history

Version	Date	Description	Operator
1.0	2019-02-28	Initial Version	Ray
1.1	2019-04-04	Content Update	Ray
1.2	2023-2-16	Bug fixes	Yan
1.3	2024-2-23	Bug fixes	Hao
1.4	2024-4-18	Modified ranging description	Hao

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