E32-400M33S

SX1278 433/470MHz SPI SMD Wireless Module



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Features

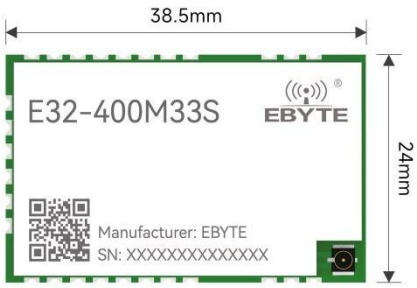
- The measured communication distance can reach 10km;
- Maximum transmission power of 1W, software multi-level adjustable;
- Support 433/470 MHz band;
- Support data transmission rate between 0.018K and 37.5Kbps in LoRaTM mode;
- Support data transmission rate of up to 300kbps in FSK mode;
- Support for multiple modulation mode, LoRa™/FSK/GFSK/MSK/GMSK/OOK;
- Large FIFO capacity, support 256Byte data cache;
- Support 3.3V~5.5V power supply, power supply over 5 V can guarantee the best performance;
- Industrial grade standard design, support -40 ~ 85 °C for working over a long time;
- IPEX and stamp hole optional, good for secondary development and integration.

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1 Introduction

1.1 Brief Introduction



E32-400M33S is a self-developed, 433/470MHz LoRa™ SMD wireless module with the maximum transmission power of 2W which is based on the SX1278 produced by Semtech in the United States.

Due to adopt the original installation import SX1278 as the core module, on the basis of the original with built-in power amplifier (PA) and low noise amplifier (LNA), for achieving maximum transmitted power of 1W at the same time receiving sensitivity for further ascension, also on the overall stability of communication is no power amplifier with low noise amplifier products significantly increase. Due to its advanced LoRa™ modulation technology, its anti-interference performance and communication distance are far superior to the current FSK and GFSK modulation products. This module is mainly aimed at intelligent home, wireless meter reading, scientific research and medical treatment, and medium and long distance wireless communication equipment. Since this module is a pure RF transceiver module, it needs to be programmed by using MCU drive or special SPI debugging tools.

1.2 Features

- Under ideal conditions, the communication distance can reach 16km;
- Maximum transmission power 2000mW, software multi-stage adjustable;
- Support global license-free ISM 410~493MHz frequency band;
- Support multiple modulation modes, LoRaTM/FSK/GFSK/MSK/GMSK/OOK;
- LoRaTM mode supports 0.018k~37.5kbps data transmission rate;
- FSK mode supports data transmission rate up to 300kbps;
- Large FIFO capacity, support 256Byte data cache;
- Support 3.3～5.5V power supply, more than 3.3V power supply can ensure the best performance;
- Industrial-grade standard design, support long-term use at -40~+85° C;
- Stamp hole, convenient for user secondary development, conducive to integration.

1.3 Application

- Home security alarm and remote keyless entry;
- Smart home and industrial sensors;
- Wireless alarm security system;
- Building automation solutions;
- Wireless industrial-grade remote control;
- Health care products;

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- Advanced Meter Reading Architecture(AMI);

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2 Specification and parameter

2.1 Limit parameter

Main parameter	Performance		Remark
	Min	Max	
Power supply（V）	0	5.5	Voltage over 5.5V 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	Industrial grade

2.2 Operating parameter

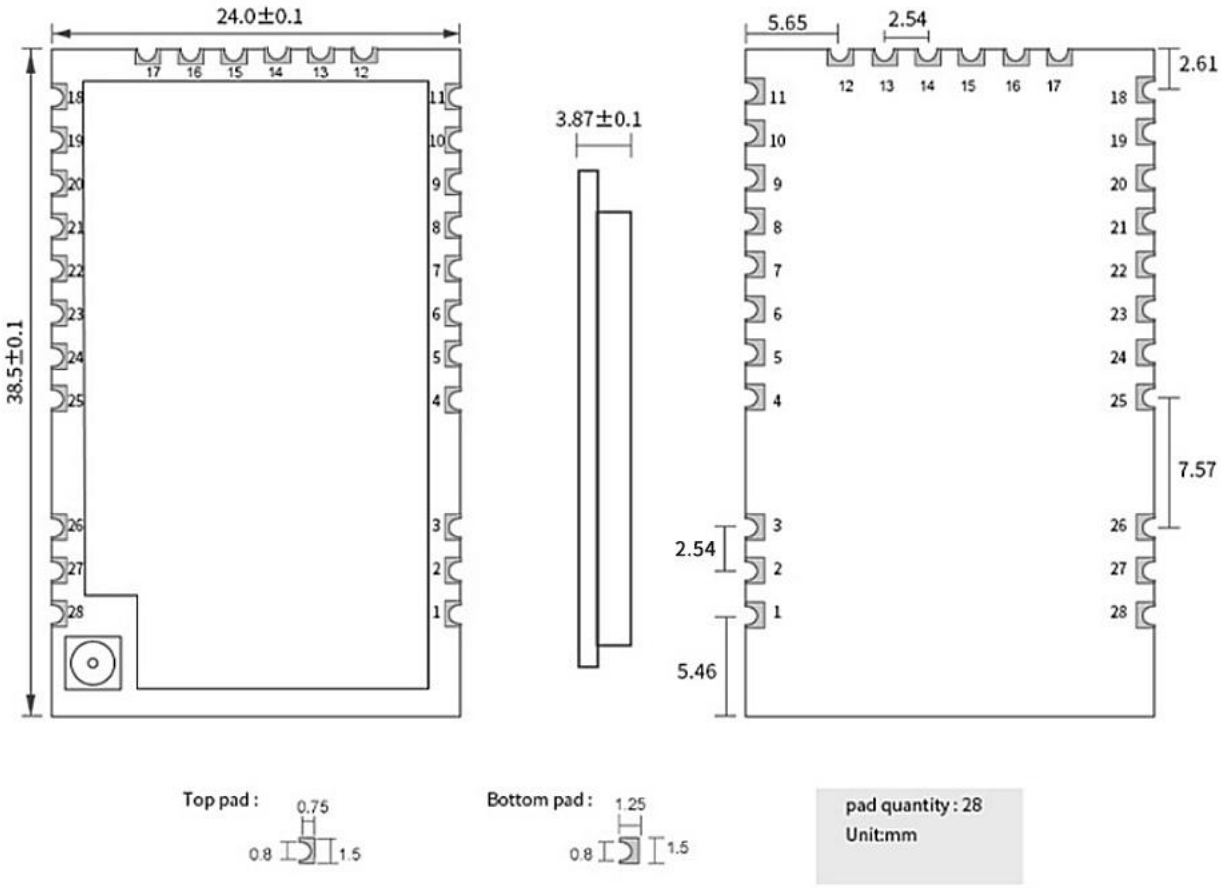
Main parameter		Performance			Remark
		Min	Type	Max	
Operating voltage（V）		3.3	5	5.5	≥5.5 V ensures output power
Communication level（V）		-	3.3	-	-
Operating temperature（℃）		-40	-	85	Industrial grade
Operating frequency（MHz）		410	-	493	-
Power Consump-tion	TX current（mA）	-	1100	-	-
	RX current（mA）	-	19	-	-
	Sleep current （μA）	-	2	-	-
Max TX power（dBm）		-	33	-	-
Receiving sensitivity（dBm）		-123	-124	-125	Air data rate is 1.2 kbps

Main parameter	Description	Remark
Reference distance	16km	Test condition：clear and open area, antenna gain: 5dBi，antenna height: 2.5m，air data rate: 250 kbps
FIFO	256Byte	Maximum length of single send
Crystal Oscillator	32MHz	Passive crystals
Protocol	LoRaTM(recommended)	FSK/GFSK/MSK/GMSK/OOK
Package	SMD	Spacing of 2.54 mm
Interface	2.54mm	Sample hole
Communication interface	SPI	0~10Mbps
Size	24 * 38.5 mm	-
Antenna	Sample hole / IPEX	50 ohm impedance

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3 Size and pin definition



Pin No.	Item	Direction	Description
1	GND	–	Ground
2	GND	–	Ground
3	GND	–	Ground
4	GND	–	Ground
5	GND	–	Ground
6	RXEN	Input	RF switch receiving control pin, connected to external MCU IO, high level effective
7	TXEN	Input	RF switch receiving control pin, connected to external MCU IO, high level effective
8	DIO2	Input/Output	General IO port (see SX1278 manual for details)
9	VCC	–	Power supply, range 3.3 ~ 5.5V (external ceramic filter capacitor is recommended)
10	VCC	–	Power supply, range 3.3 ~ 5.5V (external ceramic filter capacitor is recommended)
11	GND	–	Ground
12	GND	–	Ground

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13	NC	–	Suspend
14	DIO3	Input/Output	General IO port (see SX1278 manual for details)
15	DIO4	Input/Output	General IO port (see SX1278 manual for details)
16	DIO5	Input/Output	General IO port (see SX1278 manual for details)
17	GND	–	Ground
18	GND	–	Ground
19	DIO1	Input/Output	General IO port (see SX1278 manual for details)
20	DIO0	Input/Output	General IO port (see SX1278 manual for details)
21	NRST	Input	Chip reset trigger input pin
22	MISO	Output	SPI data output pin
23	MOSI	Input	SPI data output pin
24	SCLK	Input	SPI data output pin
25	NSS	Input	the module chip selects the pin used to start an SPI communication
26	GND	–	Ground
27	ANT	–	Antenna interface, Sample hole (50Ω characteristic impedance)
28	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 that between the recommended supply voltage, if exceeding the maximum, the module will be permanently damaged;
- Please check the stability of the power supply. Voltage can not fluctuate greatly and 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;
- Bottom Layer 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 mounting structure of antenna has a great influence on the performance of the module. It is necessary to ensure that the antenna is exposed, preferably vertically upward. When the module is mounted inside the case, use a good antenna extension cable to extend the antenna to the outside;
- The antenna must not be installed inside the metal case, which will cause the transmission distance to be greatly weakened.

4.2 Programming

- The core of this module is SX1278/SX1278+PA+LNA, its driving method is completely equivalent to SX1278/SX1276, the user can operate according to the SX1278/SX1276 chip manual
- DIO0, DIO1, DIO2, DIO3, DIO4 and DIO5 are general I/O ports, which can be configured into a variety of functions. See SX1278 manual for details. If not used can be suspended;

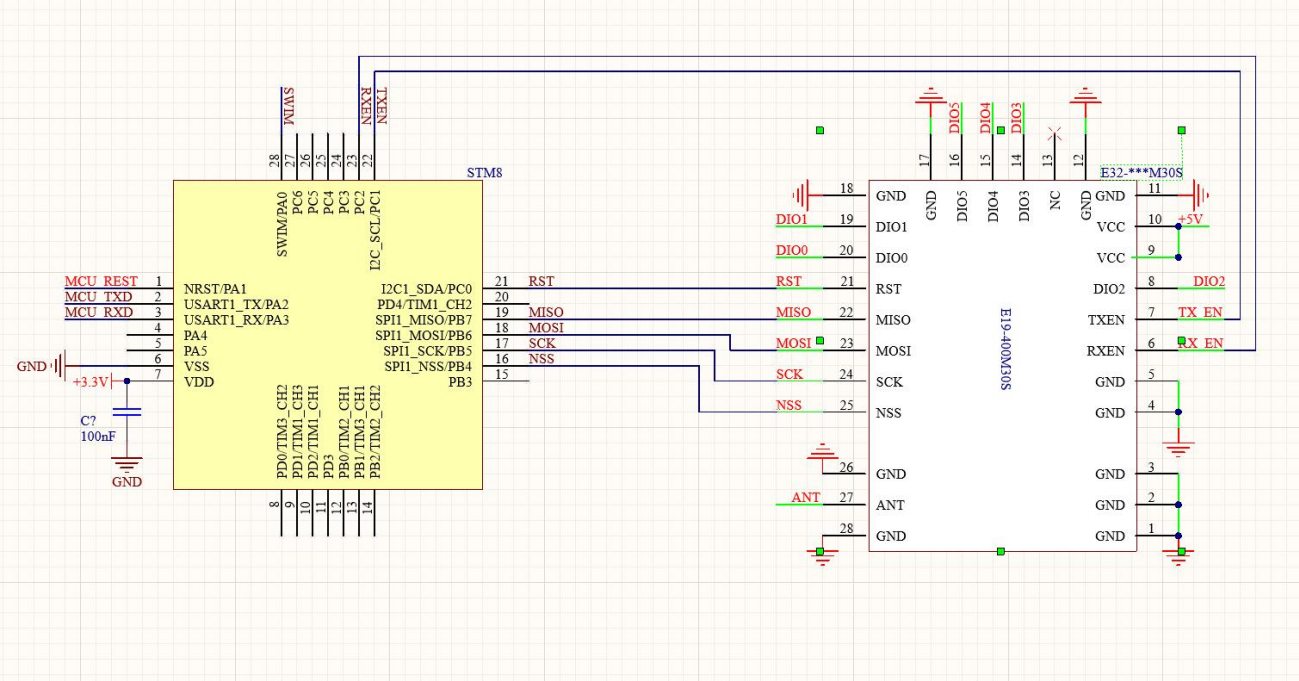
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- NRST, TXEN and RXEN pins must be connected, wherein NRST controls the reset of the chip, TXEN and RXEN pins control the RF switch;
- Pay attention to good grounding, large area of ground, small ripple of power supply, filter capacitor should be added and close to module VCC and GND pins as far as possible;
- SPI communication rate should not be set too high, usually 1Mbps is recommended;
- When transmitting, set DIO_7 pin to high level and DIO_13, DIO_14 pins to low level;When receiving, set DIO_7 pin to low level and DIO_13, DIO_14 pins to high level;Before turning off, set DIO_7, DIO_13, DIO_14 pins to low;
- The register configuration can be reinitialized when the chip is idle for greater stability.

5 Basic application

5.1 Hardware design and circuit schematic 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;

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- 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;
- SPI clock waveform is not standard, check whether there is interference on the SPI line, SPI bus wiring 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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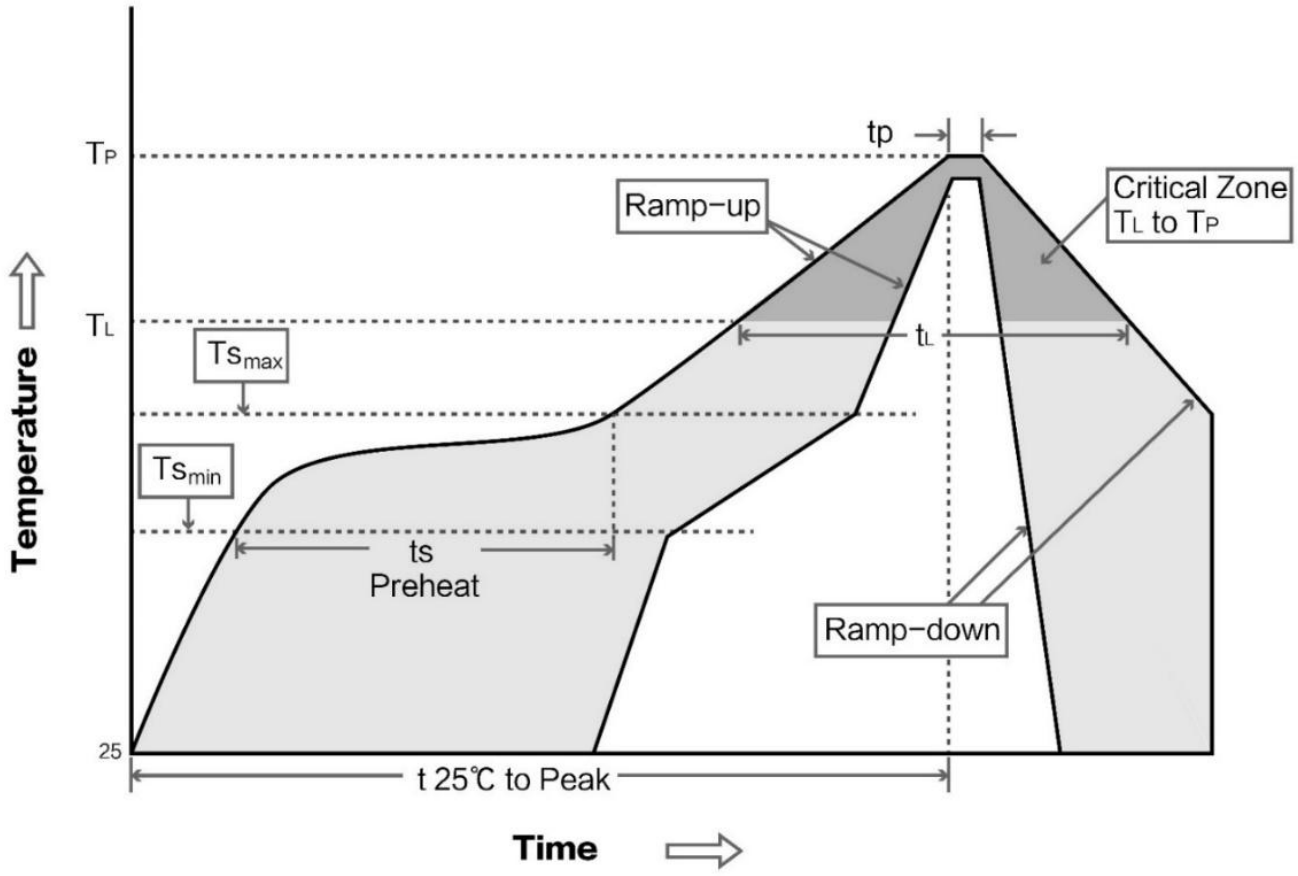
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7 Production guidance

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 E32 series

Model No.	IC	Frequency	Tx power	Distance	Package	Antenna
		Hz	dBm	km		
E32-400T20S	SX1278	433M	20	3	SMD	IPEX/Sample hole
E32-900T20D	SX1276	868/915M	20	5.5	DIP	SMA-K
E32-433T30D	SX1278	433M	30	8	DIP	SMA-K
E32-433T20DC	SX1278	433M	20	3	DIP	SMA-K

9 Antenna recommendation

The antenna is an important role in the communication process. A good antenna can largely improve the communication system. Therefore, we recommend some antennas for wireless modules with excellent performance and reasonable price.

Model No.	Type	Frequency	Gain	Hright	Cable	Interface	Function feature
		Hz	dBi	mm	cm		
TX915-JZ-5	Rubber antenna	915M	2.0	50	-	SMA-J	Short straight &omnidirectional
TX915-JK-11	Rubber antenna	915M	2.5	110	-	SMA-J	Flexible &omnidirectional
TX915-JK-20	Rubber antenna	915M	3.0	200	-	SMA-J	Flexible &omnidirectional
TX915-XPL-100	Sucker antenna	915M	3.5	290	100	SMA-J	High gain

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Version	Date	Description	Issued by
1.0	2024-9-20	Initial version	LAU
1.1	2024-7-10	Modify the enthusiastic description	LAU

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