E23-433M13S User Manual

SX1212 433MHz 20mW SPI Wireless Module



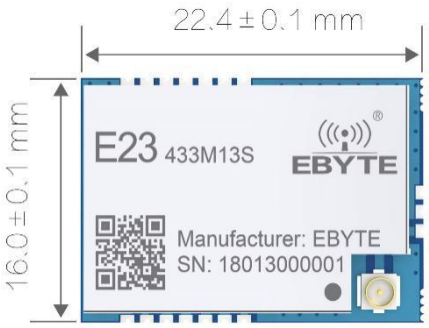
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1. Product Overview

1.1 Brief Introduction

E23-433M13S is a 20mW wireless transceiver module, operating at 433MHz with IPX RF interface. Module features ultra-low receiving current (Only 3mA) and adopts 12.8MHz crystal oscillator.



E23-433M13S is based on the originally imported RF chip SX1212 from Semtech. It features industrial class components, lead-free process, stable performance. It applies SMD with professional hardware design. It is convenient for all kinds of embedded development. The receiving power consumption is ultra low around 3mA which makes various applications possible.

E23-433M13S is without factory firmware, users need to conduct a secondary development based on their own demands.

1.2 Feature

- Ultra low receiving current of 3mW, good for low power development;
- Ultra small size of 16x22.4mm;
- Maximum transmitting power of 20mW, good for battery powered application.
- Communication distance tested is up to 800m;
- Support the global license-free 433MHz;
- Support air date rate of 2k～500kbps;
- Independent FIFO of 64bytes for transmitting and receiving
- Support 2.1V~3.6V power supply, power supply over 3.3V can guarantee the best performance;
- Industrial grade standard design, support -40 ~ +85 °C for working over a long time;
- PCB and IPEX antenna, good for secondary and embedded development;
- Anti-interference and good neighboring channel selectivity are good for application in dense environment.

1.3 Application

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

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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	-

2.2 Operating parameter

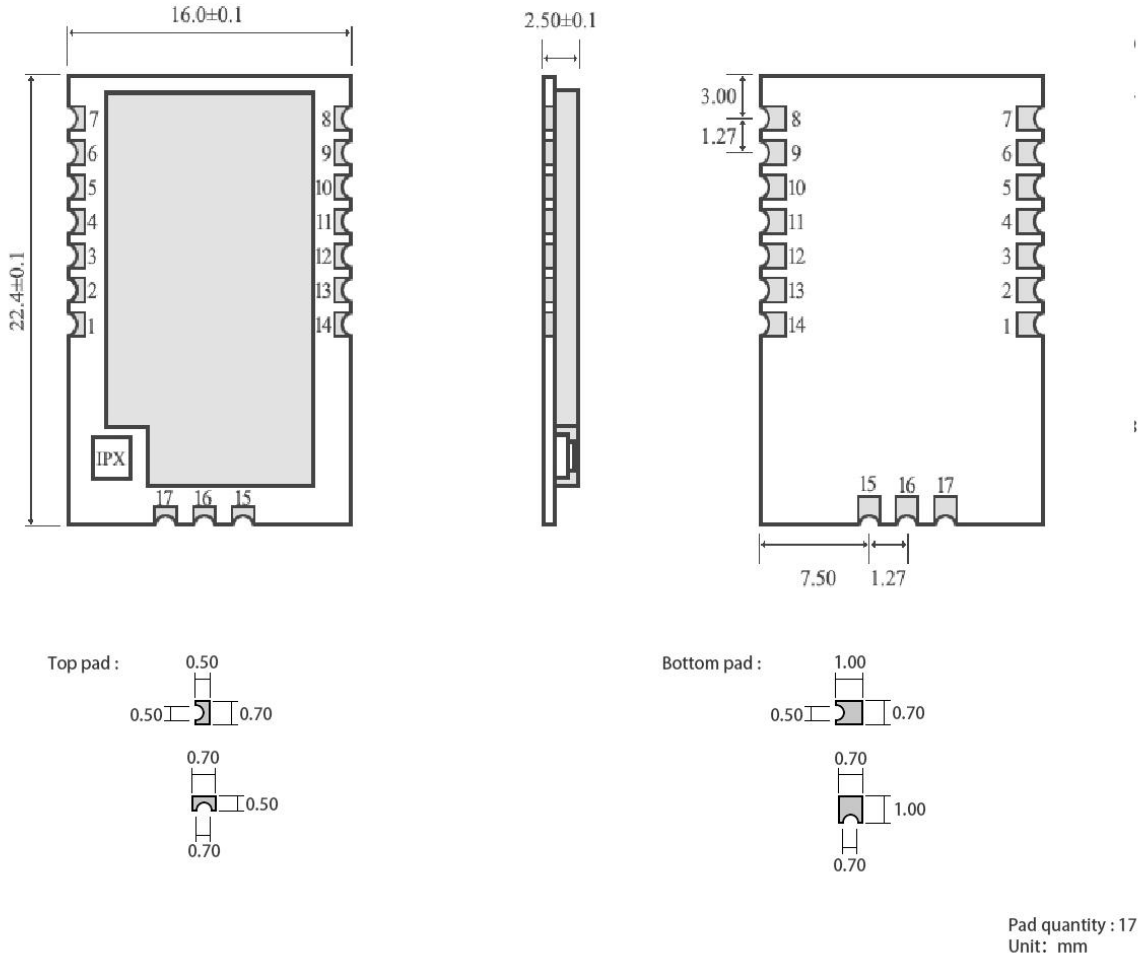
Main parameter	Performance			Note
	Min	Typ	Max	
Voltage supply [V]	2.1	3.3	3.6	≥3.3 V ensures output power
Communication level [V]		3.3		For 5V TTL, it may be at risk of burning down
Operating temperature [℃]	-40	-	+85	-
Frequency [MHz]	410	433	438	ISM band
Transmitting current [mA]		35		Instant power consumption
Receiving current [mA]		3		
Turn-off current [μA]		4		Software is shut down
Transmitting power [dBm]	12	13	14	
Receiving sensitivity [dBm]	-102	-104	-106	Air rate 1kbps
Air rate [bps]	2k	-	500k	Controlled via user's programming

Main parameter	Description	Note
Distance	800m	Test condition：clear and open area, antenna gain: 5dBi，antenna height: 2.5m，air data rate: 2kbps
FIFO	64Byte	Max. Transmitting length per packet
Crystal oscillator	12.8MHz	
Modulation	GFSK	Recommend
Package	SMD	
Connector	1.27mm	Stamp Hole
Interface	SPI	0~10Mbps
Size	16*22.4mm	
Antenna	Stamp Hole/IPEX	50Ω Impedance
Net weight	2.3g	

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3. Dimension and Pin definition



No.	Item	Direction	Application
1	VCC		Power supply 2.1~3.6V DC
2	PLL_LOCK	Output	PLL lock
3	IRQ_1	Output	Interrupt request 1
4	IRQ_0	Output	Interrupt request 0
5	DATA	Input/Output	NRZ data input/output (continuous mode)
6	CLKOUT	Output	Programmable clock output
7	GND		Ground
8	GND		Ground
9	TEST8	Input/Output	P0R
10	NSS_CFG	Input	Enable SPI configuration
11	NSS_DATE	Input	Enable SPI date
12	MISO	Output	SPI master input slave output
13	MOSI	Input	SPI master output slave input

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14	SCK	Input	SPI clock
15	GND		Ground
16	GND		Ground
17	ANT		Antenna

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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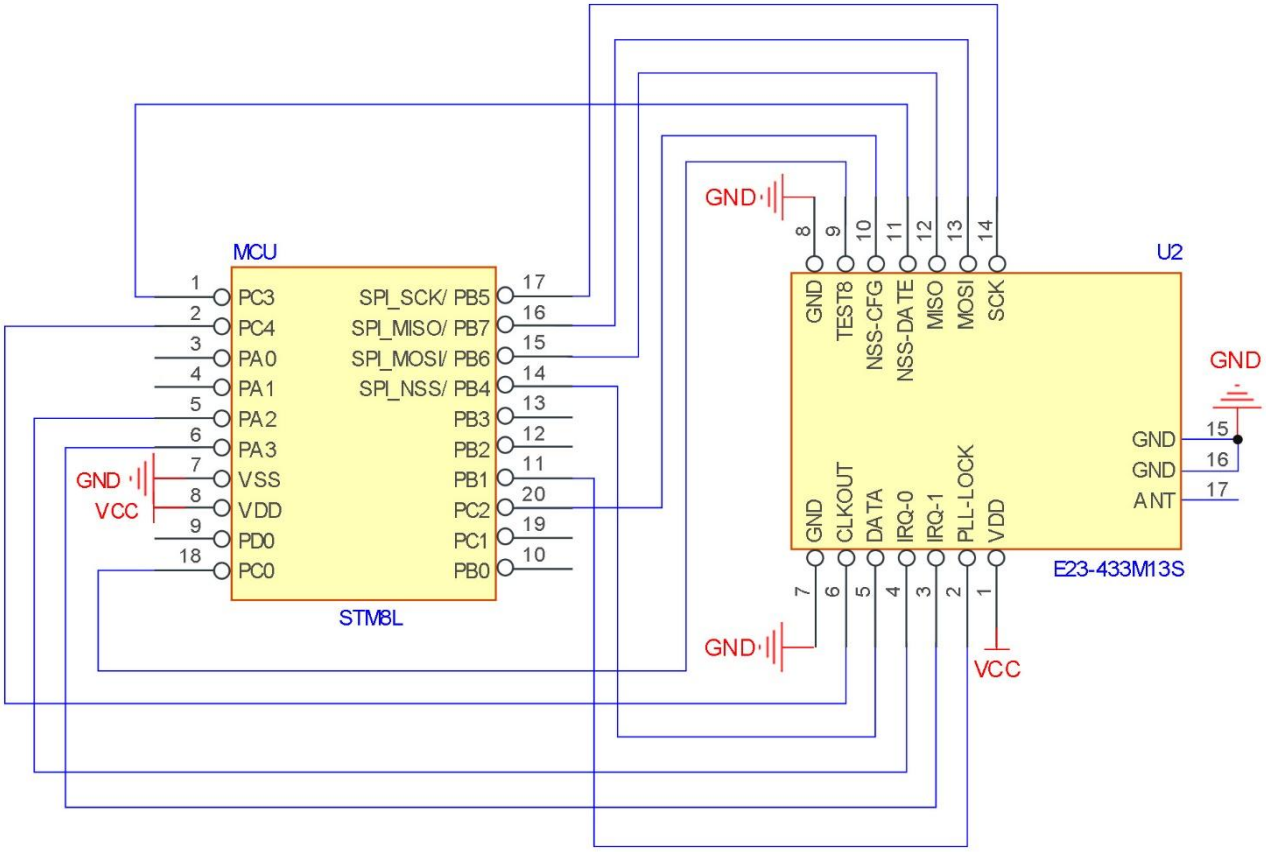
4.2 Software editing

- The driving mode of this module is exactly the same as SX1212, please refer to *SX1212 datahseet* for operation guidance;
- GDO0 is a GPIO, see more from the SX1212 datasheet;
- 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 connect MCU to interrupt;
- After SX1212 restores the IDLE mode or be configured to sleep mode, it is recommended to reinitialize the power configuration table.

5. Recommended 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.

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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.

7. Production Guidance

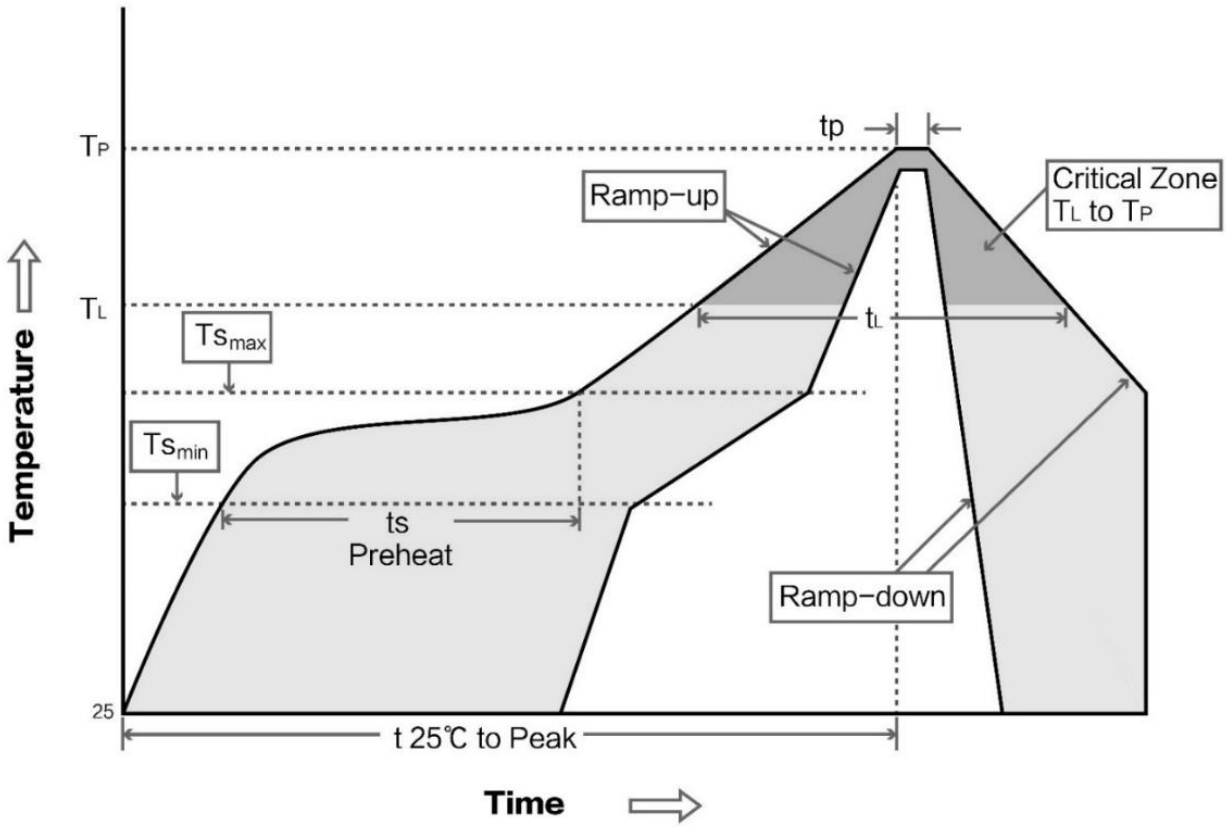
7.1 Reflow Soldering Temperature

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

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7.2 Reflow Soldering Curve



8 E23 Series

Model	IC	Frequency	Power	Distance	Package	Interface
		Hz	dBm	m		
E23-433M13S	SX1212	433M	13	800	SMD	SPI
E33-433T13S	SX1212	433M	13	800	DIP	UART

9 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.

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Model	Type	Frequency	Gain	Size	Feeder	Interface	Feature
		Hz	dBi	mm	cm		
TX433-NP-4310	FPC	433M	2.0	10x43	-	Welding	FPC antenna
TX433-JZ-5	Rubber	433M	2.0	52	-	SMA-J	Straight antenna,ultra short,omnidirectional
TX433-JZG-6	Rubber	433M	2.5	62	-	SMA-J	Straight antenna,ultra short,omnidirectional
TX433-JW-5	Rubber	433M	2.0	52	-	SMA-J	Fixed bending antenna，omnidirectional
TX433-JWG-7	Rubber	433M	2.5	70	-	SMA-J	Fixed bending antenna，omnidirectional
TX433-JK-11	Rubber	433M	2.5	110	-	SMA-J	Flexible antenna，omnidirectional
TX433-JK-20	Rubber	433M	3.0	200	-	SMA-J	Flexible antenna，omnidirectional
TX433-XPL-100	Sucker	433M	3.5	185	100	SMA-J	Small sucker antenna，cost effective
TX433-XP-200	Sucker	433M	4.0	190	200	SMA-J	Big sucker antenna，low loss
TX433-XPH-300	Sucker	433M	6.0	965	300	SMA-J	Small sucker antenna，high gain

History

Version	Date	Explain	Operator
1.0	2017-10-16	Initial Version	huaa
1.1	2018-5-23	Content added	huaa
1.2	2018-9-26	Series manual separation	huaa
1.3	2019-1-27	Content added	Ray
1.4	2025-3-4	Picture modification	LAU

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