E29-400M22S User Manual

PAN3031 433/470MHz SMD Wireless Module

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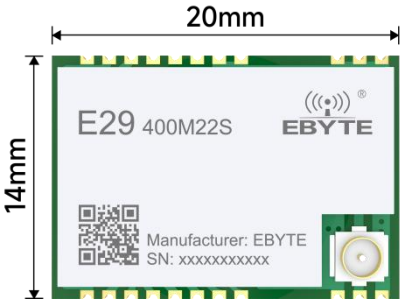
Chapter 1 Overview

1.1 Introduction

Based on PANCHIP's RF chip PAN3031, the E29-400M22S is a SMD ChirpIoT™ wireless module with ultra-small size and suitable for 433MHz, 470MHz.



By using chip PAN3031 in the module, the anti-interference performance and communication distance have been further improved. Because PAN3031 adopts the new ChirpIoT™ modulation technology, its anti-interference performance and communication distance are far superior to the current FSK and GFSK modulation products. This module is mainly for application in smart home, wireless meter reading, scientific research and medical and long-distance wirel

Since the module is a pure RF transceiver module without firmware, you need a MCU driver or a dedicated SPI debugging tool when using it.

1.2 Features

- The measured communication distance can reach 5km;
- Maximum transmission power of 160mW, software multi-level adjustable;
- Support the global license-free ISM 433MHz/470MHz frequency band;
- Support air date rate of 1.04k～20.4kbps in ChirpIoT™ modulation;
- Large FIFO capacity, support 256Byte data cache
- Support SF7~SF9, and support automatic identification of SF factor;
- Support 1.8～3.6V power supply, power supply over 3.3 V can guarantee the best performance;
- Industrial grade standard design, support -40 ~ 85 °C for working over a long time;
- Support 4-wire SPI configuration interface;
- The sleep current is only 400nA, the receiving current is 12.5mA @ DCDC mode, and the transmitting current is 135mA @ 22dBm
- IPEX interface and stamp hole are optional, which is convenient for secondary development and integration.

1.3 Application

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

- Advanced Meter Reading Architecture(AMI);
- Automotive industry applications.

Chapter 2 Specification and Parameter

2.1 RF Parameter

RF parm	Performance			Remark
	Min	Typical	Max	
Operating frequency（MHz）	410	433/470/490	493	Support ISM band
TX power（dBm）	21.5	22	22.5	Adjustable by software, which needs to be developed and set by the user
Receiving sensitivity（dBm）	-	-146	-	Air data rate 0.3kbps
Blocking power（dBm）	-	10	-	Chances of burn is slim when modules are used in short distance
Air data rate（bps）	1.04K	-	20.4K	Controlled via user's programming
Reference distance（Km）	-	5	-	Test condition：clear and open area, antenna gain: 5dBi，antenna height: 2.5m，air data rate: 2.4kbps

2.2 Electrical parameters

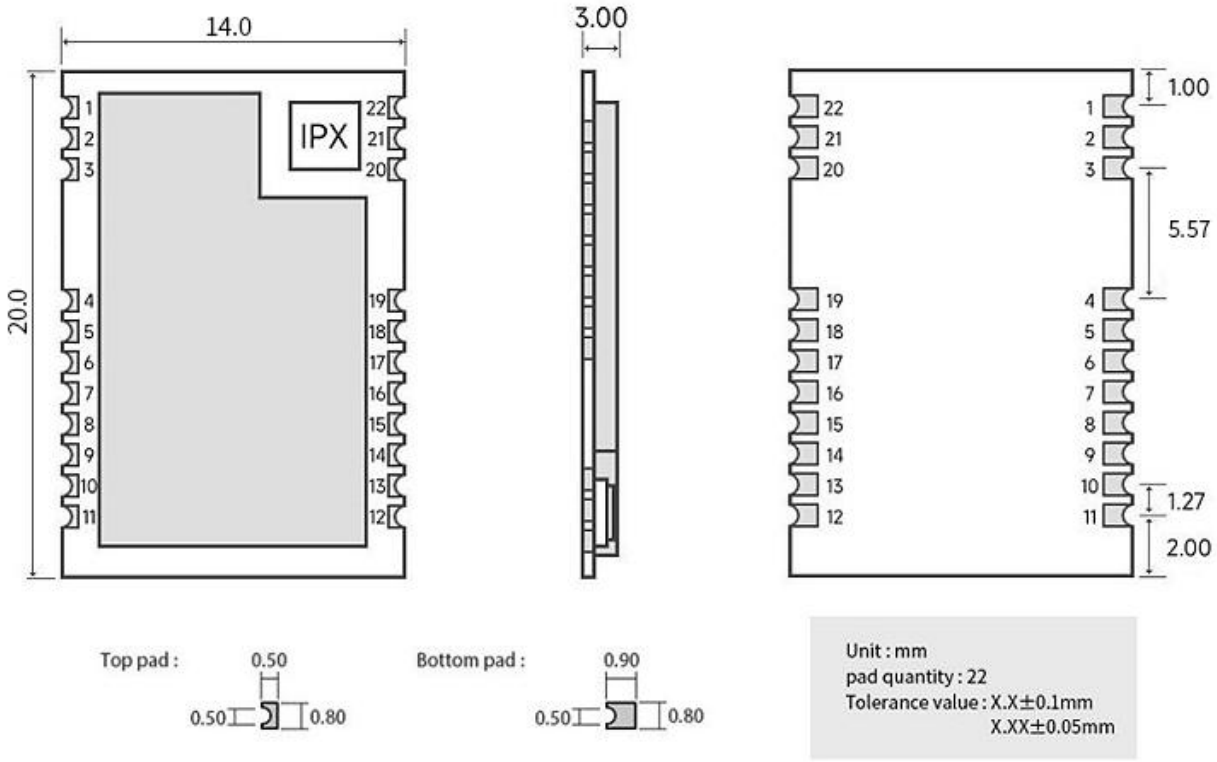
Main parm		Performance			Remark
		Min	Typical	Max	
Operating voltage（V）		1.8	3.3	3.6	≥3V ensures output power, and it will be burn down over 3.6V.
Communication level（V）		-	3.3	-	For 5V TTL, it may be at risk of burning down
Power Consump-tion	TX current（mA）	-	135	-	Instant power consumption
	RX current（mA）	-	12.5	-	
	Sleep current（μA）	-	0.4	-	Software shutdown
Operating temperature（℃）		-40	-	85	Industrial grade

2.3 Hardware Parameters

Hardware parm	Parm value	Remark
Package	SMD	-
FIFO	256Byte	Max. Length for each transmitted package

Crystal frequency	32MHz	Industrial grade high precision crystal oscillator
Modulation	ChirpIoT™	new-generation ChirpIoT™ modulation technology
Interface	Stamp hole	Pitch 1.27mm
Communication Interface	SPI	-
Size	20* 14*2.8 mm	-
Product Weight	1.5g	±0.1g
Antenna Interface	IPEX/Stamp hole	Equivalent impedance about 50Ω

Chapter 3 Size and Pin definition



Pin No.	Pin Name	Pin Direction	Pin Function
1	GND	-	Ground wire, connected to the power reference ground
2	GND	-	Ground wire, connected to the power reference ground
3	GND	-	Ground wire, connected to the power reference ground
4	GND	-	Ground wire, connected to the power reference ground
5	GND	-	Ground wire, connected to the power reference ground
6	RXEN	Output	The RF switch receiving control pin, manually controlled by the internal RF chip, and the high level is effective
7	TXEN	Output	The RF switch transmitting control pin, manually controlled by the internal RF chip, and the high level is effective

8	GPIO11	Output	CAD interrupt output pin
9	VCC	-	Power supply, 1.8~3.6V (It is also recommended to add external ceramic filter capacitor)
10	GND	-	Ground wire, connected to the power reference ground
11	GND	-	Ground wire, connected to the power reference ground
12	GND	-	Ground wire, connected to the power reference ground
13	IRQ	Output	RF interrupt pin
14	NC	-	-
15	NC	-	-
16	MISO	Output	SPI data output pin
17	MOSI	Input	SPI data input pin
18	SCK	Input	SPI clock input pin
19	NSS	Input	Module selected pin, used to start an SPI communication Ground wire, connected to power reference ground
20	GND	-	Ground wire, connected to the power reference ground
21	ANT	-	Antenna interface, stamp hole (50 ohm characteristic impedance)
22	GND	-	Ground wire, connected to the power reference ground

Chapter 4 Basic operation

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;

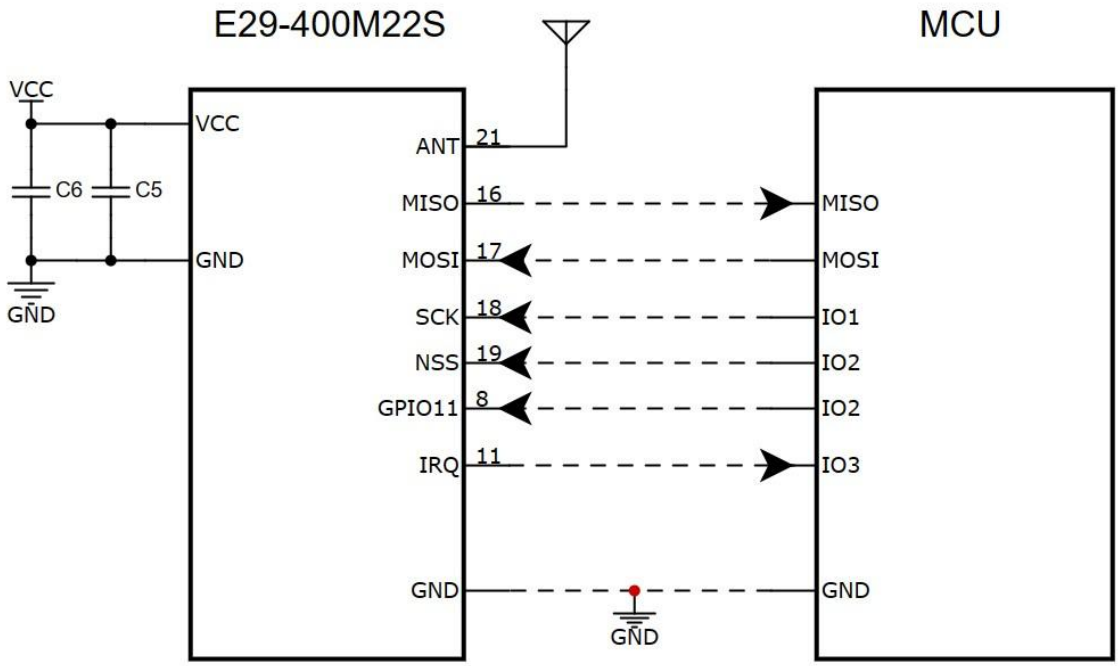
- Assume that there are traces with large electromagnetic interference (high-frequency digital, high-frequency analog, power traces) around the module that will greatly affect the performance of the module. It is recommended to stay away from the module according to the strength of the interference.If necessary, appropriate isolation and shielding can be done;
- 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);
- 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.
- It is recommended to add a 200R protection resistor to the RXD/TXD of the external MCU.

4.2 Programming

- The built-in RF chip of this module is PAN3031, and its driving method is completely equivalent to that of PAN3031. Users can operate completely according to the PAN3031 chip manual;
- Pin TXEN is controlled by RF GPIO1, pin RXEN is controlled by RF GPIO3, users need to configure it by themselves
- After the CAD mode is enabled, the customer needs to set GPIO11 to output mode
- For more details, please refer to the Demo program of E29-400MBL-01.

Chapter 5 Basic application

5.1 basic circuit diagram



Chapter 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 seriously affected when the antenna is near metal object or put in a metal case;
- Power register was set incorrectly or 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 our recommendation, 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 in 1.8V~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 anti-static operation 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

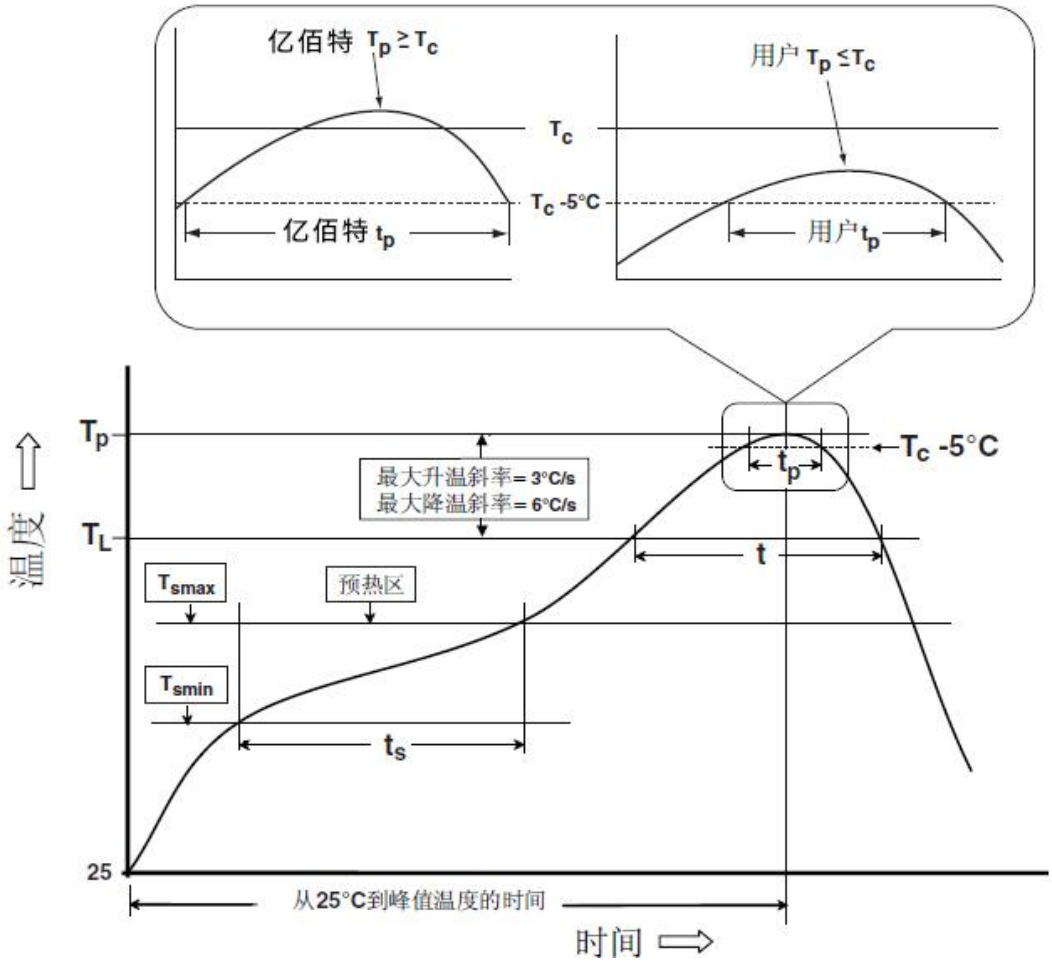
- There are co-channel signal interference nearby, please be away from interference sources or modify frequency and channel to avoid interference;
- The clock waveform on SPI is not standard, check whether there is interference on the SPI line, and the SPI bus line should not be too long;
- Poor power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

Chapter 7 Welding Work Instructions

7.1 Reflow soldering temperature

Reflow Soldering Profile Characteristics		**Sn-Pb Assembly**	**Pb-Free Assembly**
Preheat/keep warm	Min. Temperature（Tsmin）	100℃	150℃
	Max. Temperature（Tsmax）	150℃	200℃
	Time（Tsmin~Tsmin）	60-120s	60-120s
Average ramp-up rate（TL~Tp）		3℃/s, Maximum	3℃/s, Maximum
Liquidous Temperature（TL）		183℃	217℃
Time（tL）Maintained Above		60~90s	60~90s
Package peak temperature Tp		Should not exceed the temperature indicated on the product's label of "Moisture Sensitivity".	Should not exceed the temperature indicated on the product's label of "Moisture Sensitivity".
The time (Tp) within 5°C of the specified classification temperature (Tc), see the figure below		20s	30s
Aveage ramp-down rate（Tp~TL）		6℃/s, Maximum	6℃/s, Maximum
Time from 25℃ to peak temperature		6min，Maximum	8min，Maximum
※The peak temperature (Tp) tolerance definition of the temperature profile is an upper limit for the user			

7.2 Reflow soldering curv



Chapter 8 Retaled series

Model No.	Chip	Frequency Hz	Tx power dBm	Tested Distance km	Package	Size mm	Antenna Interface
E22-400T22S	SX1268	430M 470M	22	4	SMD	16*26	Stamp hole/IPEX
E22-400M30S	SX1268	433M 470M	30	12	SMD	24*38.5	Stamp hole/IPEX
E22-900M30S	SX1262	868M 915M	30	12	SMD	24*38.5	Stamp hole/IPEX
E22-900M22S	SX1262	868M 915M	22	6.5	SMD	14*20	Stamp hole/IPEX
E22-400M22S	SX1268	433M 470M	22	6.5	SMD	14*20	Stamp hole/IPEX

Chapter 9 Antenna recommendation

9.1 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 Hz	nterface	Gain dBi	Height	Cable length cm	Function & Feature
TX433-NP-4310	FPC antenna	433M	SMA-J	2	43.8*9.5mm	-	Embedded FPC soft antenna
TX433-JW-5	Rubber antenna	433M	SMA-J	2	50mm	-	Flexible &omnidirectional
TX433-JWG-7	Rubber antenna	433M	SMA-J	2.5	75mm	-	Flexible &omnidirectional
TX433-JK-20	Rubber antenna	433M	SMA-J	3	210mm	-	Flexible &omnidirectional
TX433-JK-11	Rubber antenna	433M	SMA-J	2.5	110mm	-	Flexible &omnidirectional
TX433-XP-200	Sucker antenna	433M	SMA-J	4	19cm	200cm	Sucker antenna, high gain
TX433-XP-100	Sucker antenna	433M	SMA-J	3.5	18.5cm	100cm	Sucker antenna, high gain
TX433-XPH-300	Sucker antenna	433M	SMA-J	6	96.5cm	300cm	Sucker antenna, super high gain
TX433-JZG-6	Rubber antenna	433M	SMA-J	2.5	52mm	-	Short straight &omnidirectional
TX433-JZ-5	Rubber antenna	433M	SMA-J	2	52mm	-	Short straight &omnidirectional
TX490-XP-100	Sucker antenna	490M	SMA-J	50	12cm	100cm	Sucker antenna, high gain
TX490-JZ-5	Rubber antenna	490M	SMA-J	50	50mm	-	Short straight &omnidirectional

Revision history

Version	Date	Description	Issued by
V1.0	2022/12/20	Initial version	Weng
V1.1	2023/5/12	Modify the connection diagram	Hao
V1.2	2023/6/9	Size diagram update	Hao

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