E41-400M20S Usermanual

433MHz /470MHz SMD wireless module



Chengdu Ebyte Electronic Technology Co.,Ltd.

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1 Overview

1.1 Brief introduction



E41-400M20S is an ultra-high cost-effective wireless data transmission module launched by Ebyte. It is based on AMICCOM's A7139 radio frequency chip, and it has the characteristics of small size and low power consumption.

E41-400M20S works in 425MHz ~ 470MHz, it supports the maximum 20dbm transmission power, users can set lower output power, so as to save power. At the same time, this module is especially suitable for battery power supply. In 433MHz frequency band, the power consumption of RX mode can be reduced to 3.8ma. This module adopts SPI interface.

Since this module is a pure RF transceiver module, it needs an external MCU to drive and a dedicated SPI debugging tool.

1.2 Features

- The measured communication distance can reach 2km;
- Maximum transmit power is 20dBm, software multi-level adjustable;
- Support the ISM 433MHz frequency band;
- Support data transmission rate of 2 kbps～250 kbps;
- Ultra-low receiving current 3.8mA, suitable for battery power supply;
- Support advanced ultra-narrowband GFSK modulation mode;
- Support 2.1V～3.6V power supply;
- Industry standard design, support long-term use at -40 ~ 85 ℃;
- Support stamp hole and IPEX interface, users can choose to use according to their own needs.

1.3 Application

- Smart home and industrial sensors, etc.;
- Security system, positioning system;
- Wireless remote control, UAV;
- Wireless game remote control;
- Medical health products;
- Wireless voice, wireless headset;
- Application in the automotive industry.

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2 Parameters

2.1 Limit parameter

Table 2-1 Limit parameter table

Parameter	Performance		Remark
	Min.	Max.	
Power supply (V)	2.5	3.6	Over 3.6V, the module will be burned
Working temperature (℃)	-40	+85	Industrial grade

2.2 Working parameter

Table 2-2 Working parameter table

Parameter		Performance			Remark
		Min.	Typical	Max.	
Working Voltage (V)		2.1	3.3	3.6	Over 3.6V, the module will be burned,⩾3.3V can guarantee the output power
Communication level (V)		-	3.3	-	-
Working temperature (℃)		-40	-	+85	Industrial grade
Working frequency（MHz）		425	433	470	-
Power consumption	TX current (mA)	-	126	-	Instantaneous value @ 20dBm
	RX current (mA)	-	3.8	-	-
	Sleep current (mA)	-	2.0	-	Sleep status
Max TX power (dBm)		-	20	-	-
Receiving sensitivity (dBm)		-113	-114	-115	Air rate @ 2 kbps

Parameter	Description	Remark
Reference distance	2 km	Clear and open environment, antenna gain 5dBi, antenna height 2.5m, air rate 2kbps
Crystal frequency	12.8 MHz	-
Package	SMD	-
Chip model	A7139/QFN24	-
Communication Interface	SPI	-
Dimensions	20*14 mm	-
RF interface	IPEX/Stamp hole	Impedance is 50 Ω
Weight	1.3±0.1g	-

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3 Dimensions and pin definition

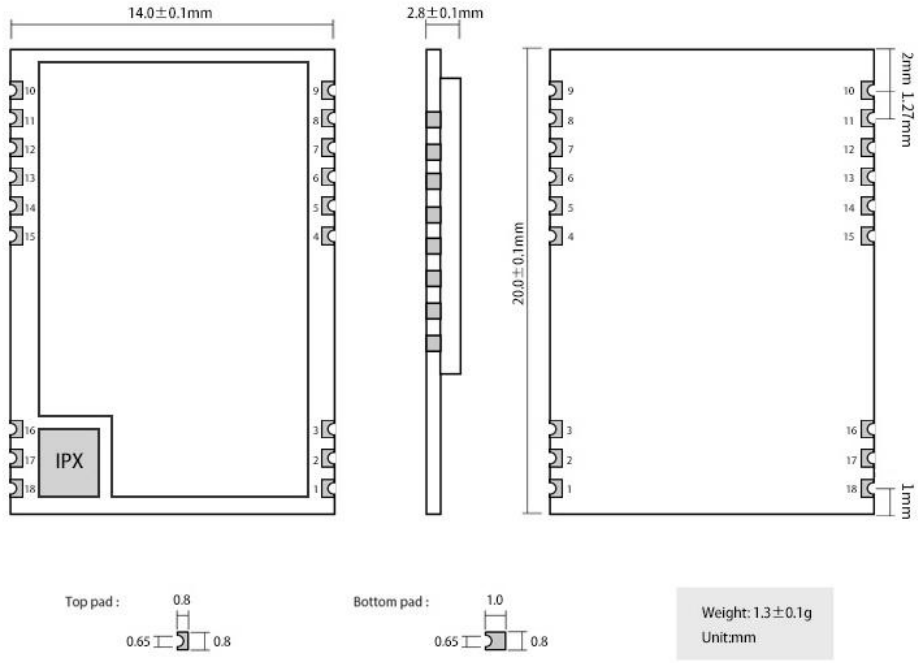


Figure 3-1 Dimensions and pin definitions

Table 3 Pin definition table

No.	Pin	Direction	Description
1	GND	-	Ground
2	GND	-	Ground
3	GND	-	Ground
4	GND	-	Ground
5	GND	-	Ground
6	SCS	DI	SPI chip select pin
7	SCK	DI	SPI clock pin
8	SDIO	DI/O	SPI data pin
9	GND	-	Ground
10	GND	-	Ground
11	VCC	-	Power supply, connects to power supply +3.3V
12	GPIO1	DI/O	Configurable multi-function IO port (see A7139 manual for details)
13	GPIO2	DI/O	Configurable multi-function IO port (see A7139 manual for details)
14	GND	-	Ground
15	GND	-	Ground
16	GND	-	Ground
17	ANT	-	Antenna stamp hole interface, impedance is 50Ω
18	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 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.

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4.2 Programming

- This module is based on chip A7139, and its driving mode is SPI, users can operate in full accordance with A7139 datasheet;
- GPIO1/GPIO2 is a general-purpose I/O port, please refer to the A7139 manual for details.

5 Basic application

5.1 Basic circuit

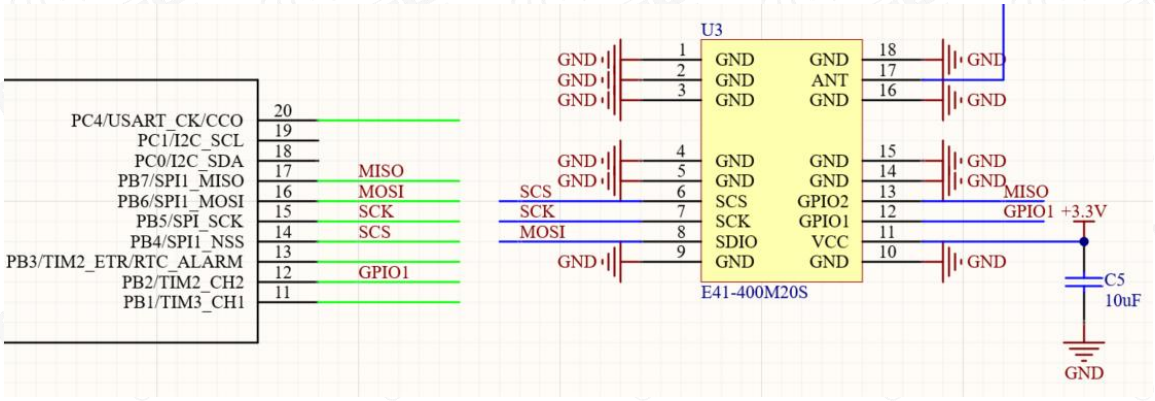


Figure 5-1 Basic circuit diagram

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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.
- 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;

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7 Soldering guidance

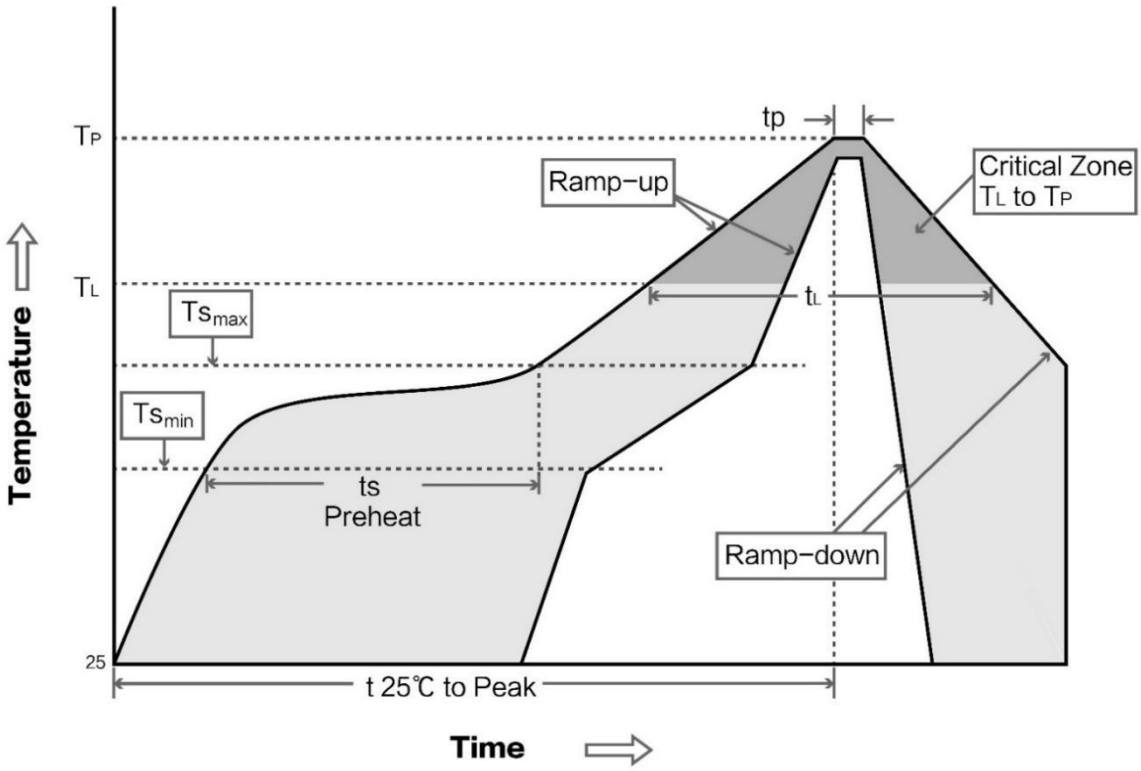
7.1 Reflow Soldering Temperature

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

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7.2 Reflow Soldering Curve



8 Antenna guide

8.1 Antenna recommendation

Antennas are an important role in the communication process. Inferior antennas will greatly affect the communication system, so we recommend some antennas with excellent antenna performance and reasonable price.

Part number	Type	Fre.	Gain	Size	Cable	Interface	Feature
		Hz	dBi	mm	cm		
TX433-JW-5	Rubber	433M	2	50mm	-	SMA-J	Bendable, omnidirectional
TX433-JWG-7	Rubber	433M	2.5	75mm	-	SMA-J	Bendable, omnidirectional
TX433-JK-20	Rubber	433M	3	210mm	-	SMA-J	Bendable, omnidirectional
TX433-JK-11	Rubber	433M	2.5	110mm	-	SMA-J	Bendable, omnidirectional
TX433-XP-200	Sucker	433M	4	19cm	200cm	SMA-J	Sucker antenna, high gain
TX433-XP-100	Sucker	433M	3.5	18.5cm	100cm	SMA-J	Sucker antenna, high gain
TX433-XPH-300	Sucker	433M	6	96.5cm	300cm	SMA-J	Sucker antenna, high gain
TX433-JZG-6	Rubber	433M	2.5	52mm	-	SMA-J	Short, omnidirectional
TX433-JZ-5	Rubber	433M	2	52mm	-	SMA-J	Short, omnidirectional

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TX490-XP-100	Sucker	490M	50	12cm	100cm	SMA-J	Sucker antenna, high gain
TX490-JZ-5	Rubber	490M	50	50mm	-	SMA-J	Short, omnidirectional

Revision history

Version	Date	Description	Issued by
1.0	2020-05-20	Initial version	Ren
1.1	2023-11-28	Content revision	Bin
1.2	2023-12-13	Content revision	Bin

About us

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