



E76-868M20S User Manual

EFR32 868MHz SMD Wireless Module



1. Product Overview

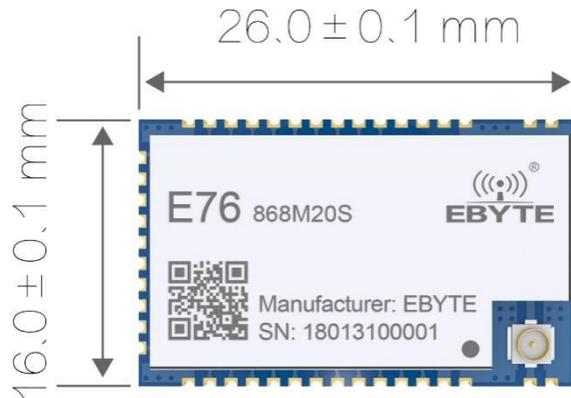
1.1 Brief Introduction

The E76-868M20S is a independently developed 868MHz SMD wireless module based on EFR32 manufactured by Silicon Labs.

Internal integration of 32-bit ARM microcontroller and high-performance wireless transceiver. This series of products use high precision wide temperature crystal and 40MHz industrial grade high precision low temperature drift active crystal oscillator to ensure its industrial characteristics and stability. The module brings out all the IO ports of the microcontroller. The chip comes with a high-performance 32-bit ARM® Cortex®-M4 core,

integrated internal power amplifier, powerful peripherals and up to 31 GPIOs for multi-faceted development. EFR32 has great potential to become the preferred wireless controller for future intelligent furniture, Internet of Things transformation and industrial automation. We used a 40MHz high precision low temperature drift active crystal.

Because this module is a pure hardware SoC module, users need to program it before they can use it.



1.2 Feature

- Communication distance tested is up to 2.5km;
- Maximum transmission power of 100mW, software multi-level adjustable;
- Support for the global license-free ISM 868MHz band;
- Support air data rate of 0.1kbps ~ 2Mbps;
- Built-in high performance low power Cortex-M4 processor;
- Rich resources, 256KB FLASH, 32KB RAM;
- Support 1.85V~3.8V power supply, more than 3.3V power supply can guarantee the best performance;
- Industrial grade standard design, support -40 ~ 85 °C for working over a long time;
- IPEX and stamp hole are optional, which is convenient for secondary development and integration.

1.3 Application

- Smart Home and Industrial Sensors;
- Security system, positioning system
- Building automation solutions;

- Wireless remote control, UAV;
- Wireless Game Remote Controller;
- Healthcare products;
- Wireless voice, wireless headphones;
- Advanced Meter Reading Architecture(AMI);
- Automotive industry applications.

2. Specification and parameter

2.1 Limit parameter

Main parameter	Performance		Remark
	Min.	Max.	
Power supply (V)	0	3.8	Voltage over 3.8V will cause permanent damage to module
Blocking power (dBm)	-	10	Chances of burn is slim when modules are used in short distance
Operating temperature (°C)	-40	85	

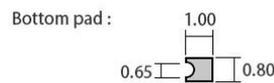
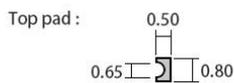
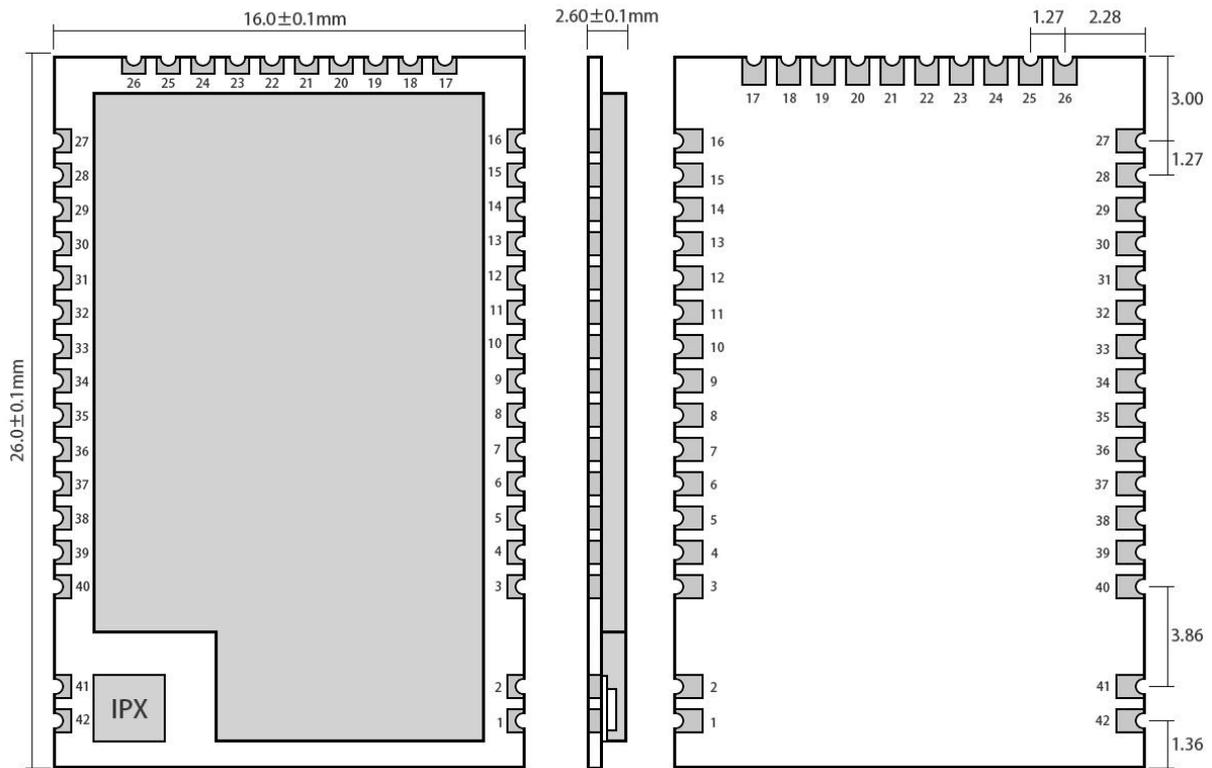
2.2 Operating parameter

Main parameter	Performance			Remark
	Min.	Typ.	Max.	
Operating voltage (V)	1.85	3.3	3.8	≥3.3V ensures output power
Communication level (V)		3.3		For 5V TTL, it may be at risk of burning down
Operating temperature (°C)	-40	-	85	Industrial design
Operating frequency (GHz)	863	-	875	Support ISM band
Power consumption	TX current (mA)	98		Instant power consumption
	RX current (mA)	17		
	Sleep current (μA)	1		Software is shut down
Max Tx power (dBm)	19.6	20.0	20.5	
Receiving sensitivity (dBm)	-106.5	-107	-108	Air data rate is 1kbps
Air data rate (bps)	0.1k	-	2M	Controlled via user's programming

Main parameter	Description	Remark
Distance for reference	2500m	Test condition: clear and open area, antenna gain: 5dBi, antenna height: 2.5m, air data rate: 1kbps
Crystal frequency	40MHz	

Modulation	GFSK(recommended)	
Package	SMD	
Connector	1.27mm	Stamp hole
IC name	EFR32FG1P131F256GM48	
FLASH	256 KB	
RAM	32 KB	
kernel	Cortex-M4	
Size	16 * 26 mm	
Antenna Interface	Stamp hole / IPEX	50 ohm impedance

3. Size and pin definition



Pad quantity : 42
Unit: mm

No.	Name	Direction	Function
1	GND	Input/Output	Ground wire, connected to the power reference ground
2	GND	Input/Output	Ground wire, connected to the power reference ground
3	GND	Input/Output	Ground wire, connected to the power reference ground
4	RESETN	Input	Reset pin

5	PD9	Input/Output	Configurable universal IO port (see EFR32 manual for details)
6	PD10	Input/Output	Configurable universal IO port (see EFR32 manual for details)
7	PD11	Input/Output	Configurable universal IO port (see EFR32 manual for details)
8	PD12	Input/Output	Configurable universal IO port (see EFR32 manual for details)
9	PD13	Input/Output	Configurable universal IO port (see EFR32 manual for details)
10	PD14	Input/Output	Configurable universal IO port (see EFR32 manual for details)
11	PD15	Input/Output	Configurable universal IO port (see EFR32 manual for details)
12	PA0	Input/Output	Configurable universal IO port (see EFR32 manual for details)
13	PA1	Input/Output	Configurable universal IO port (see EFR32 manual for details)
14	PA2	Input/Output	Configurable universal IO port (see EFR32 manual for details)
15	PA3	Input/Output	Configurable universal IO port (see EFR32 manual for details)
16	GND	Input/Output	Ground wire, connected to the power reference ground
17	PA4	Input/Output	Configurable universal IO port (see EFR32 manual for details)
18	PA5	Input/Output	Configurable universal IO port (see EFR32 manual for details)
19	PB11	Input/Output	Configurable universal IO port (see EFR32 manual for details)
20	PB12	Input/Output	Configurable universal IO port (see EFR32 manual for details)
21	PB13	Input/Output	Configurable universal IO port (see EFR32 manual for details)
22	PB14	Input/Output	Configurable universal IO port (see EFR32 manual for details)
23	PB15	Input/Output	Configurable universal IO port (see EFR32 manual for details)
24	PC6	Input/Output	Configurable universal IO port (see EFR32 manual for details)
25	PC7	Input/Output	Configurable universal IO port (see EFR32 manual for details)
26	PC8	Input/Output	Configurable universal IO port (see EFR32 manual for details)
27	GND	Input/Output	Configurable universal IO port (see EFR32 manual for details)
28	PC9	Input/Output	Configurable universal IO port (see EFR32 manual for details)
29	PC10	Input/Output	Configurable universal IO port (see EFR32 manual for details)
30	PC11	Input/Output	Configurable universal IO port (see EFR32 manual for details)
31	PF0	Input/Output	Configurable universal IO port (see EFR32 manual for details)
32	PF1	Input/Output	Configurable universal IO port (see EFR32 manual for details)
33	PF2	Input/Output	Configurable universal IO port (see EFR32 manual for details)
34	PF3	Input/Output	Configurable universal IO port (see EFR32 manual for details)
35	PF4	Input/Output	Configurable universal IO port (see EFR32 manual for details)
36	PF5	Input/Output	Configurable universal IO port (see EFR32 manual for details)
37	PF6	Input/Output	Configurable universal IO port (see EFR32 manual for details)
38	PF7	Input/Output	Configurable universal IO port (see EFR32 manual for details)
39	VCC	Input/Output	power supply positive reference, voltage range is 1.8V-3.8V.
40	GND	Input/Output	Ground wire, connected to the power reference ground
41	ANT	Input/Output	Antenna interface, stamp hole (50 ohm characteristic impedance)
42	GND	Input/Output	Ground wire, connected to the power reference ground

4. Basic Operation

4.1 Hardware Design

- It is recommended to use DC stabilized power supply to supply power to the module. The power supply ripple coefficient 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. If the reverse connection is connected, the module may be permanently damaged.
- 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, the voltage can not be significantly frequent.
- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the margin, and 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 traces, high-frequency analog traces, and power traces 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(All copper-covered and well grounded), and must be close to the digital part of the module and routed in the Bottom Layer.
- Assuming the module is soldered or placed in the Top Layer, it is also wrong to randomly route the Bottom Layer or other layers, which will affect the module's spurs and receiving sensitivity to varying degrees.
- Assuming that there are devices with large electromagnetic interference around the module, the performance of the module will also be greatly affected. According to the intensity of the interference, it is suggested to stay away from the module appropriately. If circumstances permit, appropriate isolation and shielding can be done.
- Assume that there are traces with large electromagnetic interference around the module (high-frequency digital, high-frequency analog, power trace), which 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 and also have a 2.4GHz TTL protocol, for example: USB3.0
- The antenna mounting structure 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 of the case.
- The antenna must not be installed inside the metal case, which will greatly reduce the transmission distance.

4.2 Software Programming

- The core of this module is EFR32, Its driving mode is exactly the same as EFR3. Users can operate according to EFR32 chip datasheet.
- Burning program: The module is SoC with its own GPIO port, uses the J-LINK special downloader for program download
- Program download interface definition:

E76 pin	J-LINK interface
VCC	VCC
PF0	SWCLK
PF1	SWDIO
GND	GND

5. FAQ

5.1 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.
- The signal will be affected when the antenna is near metal object or put in a metal case.
- 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.

5.2 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.

5.3 High bit error rate

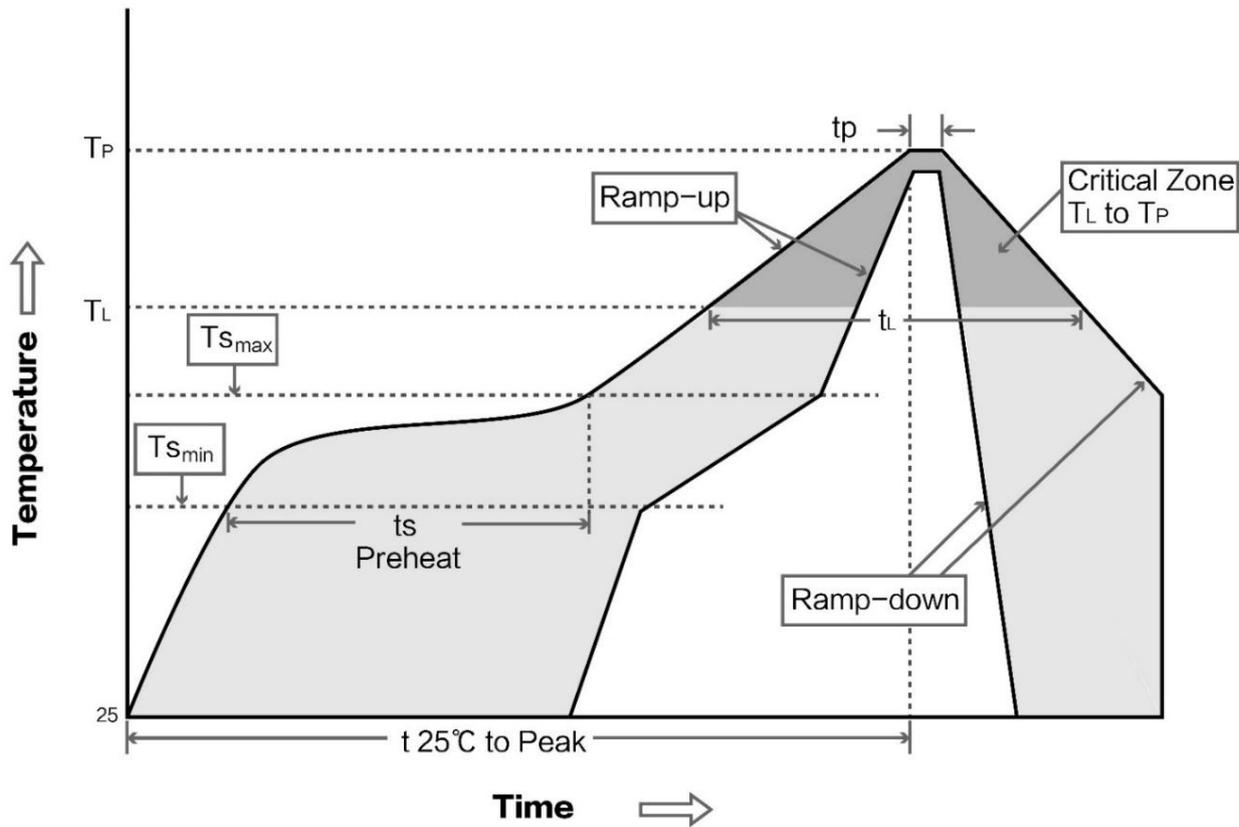
- There are co-channel signal interference nearby, keep away from interference sources or modify frequency, channel to avoid interference.
- Unsatisfactory power supply may also cause garbled characters, and ensure the reliability of the power supply.
- If the extension cable or feeder is of poor quality or too long, the bit error rate will be high.

6. Welding operation guidance

6.1 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 (T _{smin})	Minimum preheating temperature	100°C	150°C
Preheat temperature max (T _{smax})	Maximum preheating temperature	150°C	200°C
Preheat Time (T _{smin} to T _{smax})(t _s)	Preheating time	60-120 sec	60-120 sec
Average ramp-up rate(T _{smax} to T _p)	Average rising rate	3°C/second max	3°C/second max
Liquidous Temperature (T _L)	Liquid phase temperature	183°C	217°C
Time(t _L)Maintained Above(T _L)	Time above liquidus	60-90 sec	30-90 sec
Peak temperature(T _p)	Peak temperature	220-235°C	230-250°C
Average ramp-down rate(T _p to T _{smax})	Average descent rate	6°C/second max	6°C/second max
Time 25°C to peak temperature	Time of 25 ° C to peak temperature	6 minutes max	8 minutes max

6.2 Reflow Soldering Curve



7. Related Model

Model	Chip	Frequency Hz	Transmit power dBm	Test distance km	Air Data rate	Packaging	Size mm	Antenna Type
E76-2G4M20S	EFR32	2.4G	20	2.5	0.1k~2M	SMD	17.5 * 28.7	PCB/IPEX
E76-868M20S	EFR32	868M	20	2.5	0.1k~2M	SMD	16 * 26	Stamp hole/IPEX
E76-915M20S	EFR32	915M	20	2.5	0.1k~2M	SMD	16 * 26	Stamp hole/IPEX
E76-433M20S	EFR32	433M	20	2.5	0.1k~2M	SMD	16 * 26	Stamp hole/IPEX

8. Antenna Type

8.1 Antenna recommendation

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

Product	Type	Frequency Hz	Interface	Gain dBi	Size	Feeder	Features
TX868-XP-100	Sucker antenna	868M	SMA-J	3.5	29cm	100cm	High Gain
TX868-JK-20	Rubber antenna	868M	SMA-J	3	200mm	-	Flexible, Omnidirectional
TX868-JZ-5	Rubber antenna	868M	SMA-J	2	50mm	-	Ultra short straight, Omnidirectional

Revision history

Version	Date	Description	Issued by
1.00	2018/8/30	Original version	huaa
1.10	2018/9/28	Model No. split	huaa

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