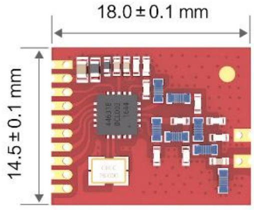
SI4463 Wireless Module

E10 Series

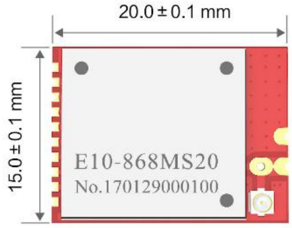
User Manual

Version	Date	Description	Issued by
1.00	2017/10/27	Initial version	huaa

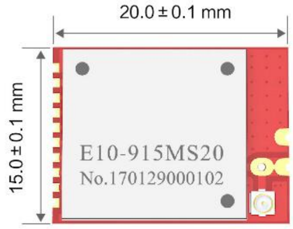
Brief Introduction



E10-433MS

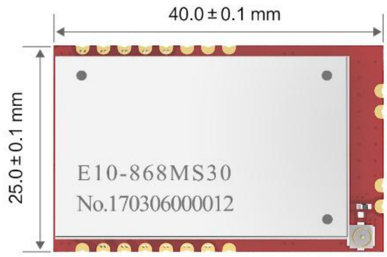


E10-868MS20

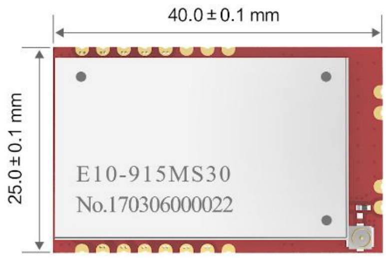


E10-915MS20

E10-433MS1W



E10-868MS30



E10-915MS30

Based on originally imported RF IC SI4463 form Silicon Labs, E10 series are small size Sub-1GHz SMD wireless transceiver module, with SPI interface and 26M crystal oscillator, developed by Chengdu Ebyte. The 30dBm module with PA and LNA, the communication stability and distance are largely improved.

E10 series strictly stick to the design rules home and abroad of FCC, CE, CCC and meet the related RF certifications and export standards. As hardware platform,, users need to carry out secondary development.

Model	Antenna	Packing	Transmitting power	Distance
E10-433MS	Stamp hole	SMD	20dBm	2000m
E10-433MS1W	Stamp hole	SMD	30dBm	6000m
E10-868M20	Stamp hole/IPX	SMD	20dBm	2000m
E10-868M30	Stamp hole/IPX	SMD	30dBm	6000m
E10-915M20	Stamp hole/IPX	SMD	20dBm	2000m
E10-915M30	Stamp hole/IPX	SMD	30dBm	6000m

Contents

1. Technical Parameter

1.1. General Parameter

Model	Core IC	Size	Net Weight	Operating Temperature	Operating Humidity	Storage Temperature
E10-433MS	SI4463	14.5 * 18.5 mm	0.8±0.1g	-40 ~ 85°C	10% ~ 90%	-40 ~ 125°C
E10-433MS1W	SI4463	25 * 37 mm	5.0±0.1g	-40 ~ 85°C	10% ~ 90%	-40 ~ 125°C
E10-868MS20	SI4463	15*20 mm	1.5±0.1g	-40 ~ 85°C	10% ~ 90%	-40 ~ 125°C
E10-868MS30	SI4463	25*40 mm	5.0±0.1g	-40 ~ 85°C	10% ~ 90%	-40 ~ 125°C
E10-915MS20	SI4463	15*20 mm	1.5±0.1g	-40 ~ 85°C	10% ~ 90%	-40 ~ 125°C
E10-915MS30	SI4463	25*40 mm	5.0±0.1g	-40 ~ 85°C	10% ~ 90%	-40 ~ 125°C

1.2. Electrical Parameter

1.2.1. Transmitting current

Model	Min	Typ	Max	Unit	Remarks
E10-433MS	76.4	83.0	91.3	mA	●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 current at the instant of transmitting may be high, but the total energy consumed may be lower due to very short transmitting time; ●When using external antenna, the impedance matching degree at different frequency points between antenna and module may affect the transmitting current value at different levels.
E10-433MS1W	607.2	660.0	726.0	mA	
E10-868MS20	87.4	95.0	104.5	mA	
E10-868MS30	672.5	731.0	804.1	mA	
E10-915MS20	90.2	98.0	107.8	mA	
E10-915MS30	692.8	753.0	828.3	mA	

1.2.2. Receiving current

Model	Min	Typ	Max	Unit	Remarks
E10-433MS	14.7	16.0	17.6	mA	●The current consumed when the RF chip is only working at receiving mode is called as receiving current, the tested receiving current may be higher for some RF chips with communication protocol or the developers have loaded their own protocol to the whole module; ● The current at pure receiving mode will be mA level, users can realize μA level of receiving current through firmware development.
E10-433MS1W	20.2	22.0	24.2	mA	
E10-868MS20	14.7	16.0	17.6	mA	
E10-868MS30	18.4	20.0	22.0	mA	
E10-915MS20	14.7	16.0	17.6	mA	
E10-915MS30	18.4	20.0	22	mA	

1.2.3. Turn-off current

Model	Min	Typ	Max	Unit	Remarks
E10-433MS	0.3	0.6	2.1	μA	● The turn-off current means the current consumed by CPU, RAM, Clock and some registers which remain operating. SoC is at very low power consumption status; ● The turn-off current is always lower than the current consumed when the power supply source of the whole module is at no-load status.
E10-433MS1W	2.5	5.0	6.5	μA	
E10-868MS20	0.2	0.4	1.9	μA	
E10-868MS30	2.5	5.0	6.5	μA	
E10-915MS20	0.2	0.4	1.9	μA	
E10-915MS30	2.5	5.0	6.5	μA	

1.2.4. Voltage supply

Model	Min	Typ	Max	Unit	Remarks
E10-433MS	1.8	3.3	3.6	V DC	●If the module stays at maximum voltage for a long time, it may be damaged; ●The power supply pin has certain surge-resistance ability, but the potential pulse is higher than the maximum power supply voltage; ●The power supply is not advisable to be below 3.0V, or the RF parameters will be influenced at different degree. ● For max 30dBm, voltage is no less than 4.75V， or RF parameters will be affected to different extend.
E10-433MS1W	4.8	5.0	5.5	V DC	
E10-868MS20	1.8	3.3	3.6	V DC	
E10-868MS30	4.8	5.0	5.5	V DC	
E10-915MS20	1.8	3.3	3.6	V DC	
E10-915MS30	4.8	5.0	5.5	V DC	

1.2.5. Communication level

Model	Min	Typ	Max	Unit	Remarks
E10-433MS	1.8	3.3	3.6	V DC	●If the module stays at maximum communication level for a long time, it may be damaged; ●There are various ways to switch communication level, but it will affect the whole power consumption to a large extend.
E10-433MS1W	1.8	3.3	3.6	V DC	
E10-868MS20	1.8	3.3	3.6	V DC	
E10-868MS30	1.8	3.3	3.6	V DC	
E10-915MS20	1.8	3.3	3.6	V DC	
E10-915MS30	1.8	3.3	3.6	V DC	

1.3. RF Parameter

1.3.1. Transmitting power

Model	Min	Typ	Max	Unit	Remarks
E10-433MS	19.6	20.0	20.5	dBm	● Due to the error of the materials, each LRC component has ±0.1% error, so error accumulation will occur since multiple LRC components are used in the whole RF circuit, and the transmitting currents will be different at different modules; ● The power consumption can be lowered by lowering the transmitting power, but the efficiency of the internal PA will be decreased by lowering transmitting power due to various reasons; ● The transmitting power will be lowered by lowering the power supply voltage.
E10-433MS1W	29.6	30.0	30.5	dBm	
E10-868MS20	19.6	20.0	20.5	dBm	
E10-868MS30	29.6	30.0	30.5	dBm	
E10-915MS20	19.6	20.0	20.5	dBm	
E10-915MS30	29.6	30.0	30.5	dBm	

1.3.2. Receiving Sensitivity

Model	Min	Typ	Max	Unit	Remarks
E10-433MS	-121.0	-122.0	-124.0	dBm	● The sensitivity is tested under the air data rate 1.3kbps; ● Due to the error of the materials, each LRC component has ±0.1% error, so error accumulation will occur since multiple LRC components are used in the whole RF circuit, and the transmitting currents will be different at different modules; ●The receiving sensitivity will be reduced and communication range will be shortened while increasing the air data rate.
E10-433MS1W	-122.0	-123.0	-125.0	dBm	
E10-868MS20	-121.0	-122.0	-124.0	dBm	
E10-868MS30	-122.0	-123.0	-125.0	dBm	
E10-915MS20	-121.0	-122.0	-124.0	dBm	
E10-915MS30	-122.0	-123.0	-125.0	dBm	

1.3.3. Recommended operating frequency

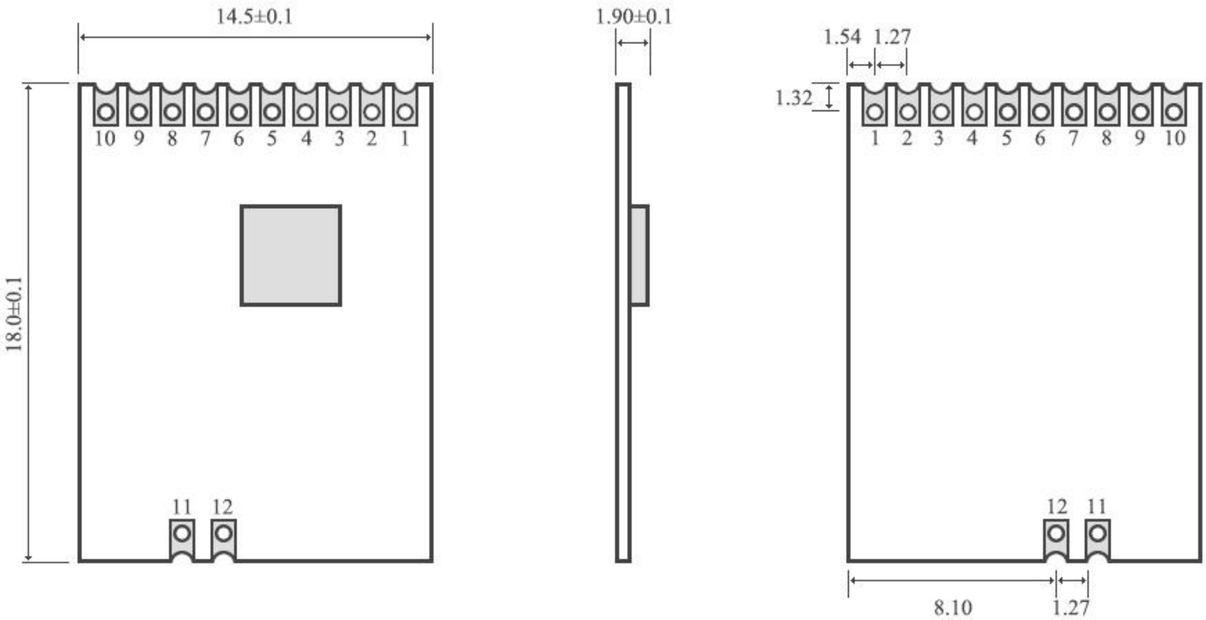
Model	Min	Typ	Max	Unit	Remarks
E07 (M1101S)	387	433	464	MHz	● To work within the recommended frequency can assure the modules to meet all the parameters; ● It is recommended to avoid the crowded integral frequency such as 433.0MHz, 868.0MHz, 915MHz etc.
E07 (868MS10)	850	868	880.5	MHz	
E07 (915MS10)	900	915	925.5	MHz	
E07 (433M20S)	425	433	450.5	MHz	
E07 (M1101D-TH)	387	433	464	MHz	
E07 (M1101D-SMA)	387	433	464	MHz	

1.4. Tested Distance

Model	Min	Typ	Max	Unit	Remarks
E07 (M1101S)	900	1000	1100	m	● The external antenna used is of 2.5dBi gain and vertical polarization. The height is 2.5 meters; ● The interval between each data packet is 2s, sending 100 packets with 30 bytes in each packet, the range at data lose rate of lower than 5% is valid range; ● In order to obtain meaningful and reproducible results, we conducted the tests in clear air with little electromagnetic interference at suburb areas； ● Distance may be shorter with interference or obstacles.
E07 (868MS10)	900	1000	1100	m	
E07 (915MS10)	900	1000	1100	m	
E07 (433M20S)	900	1000	1100	m	
E07 (M1101D-TH)	540	600	660	m	
E07 (M1101D-SMA)	900	1000	1100	m	

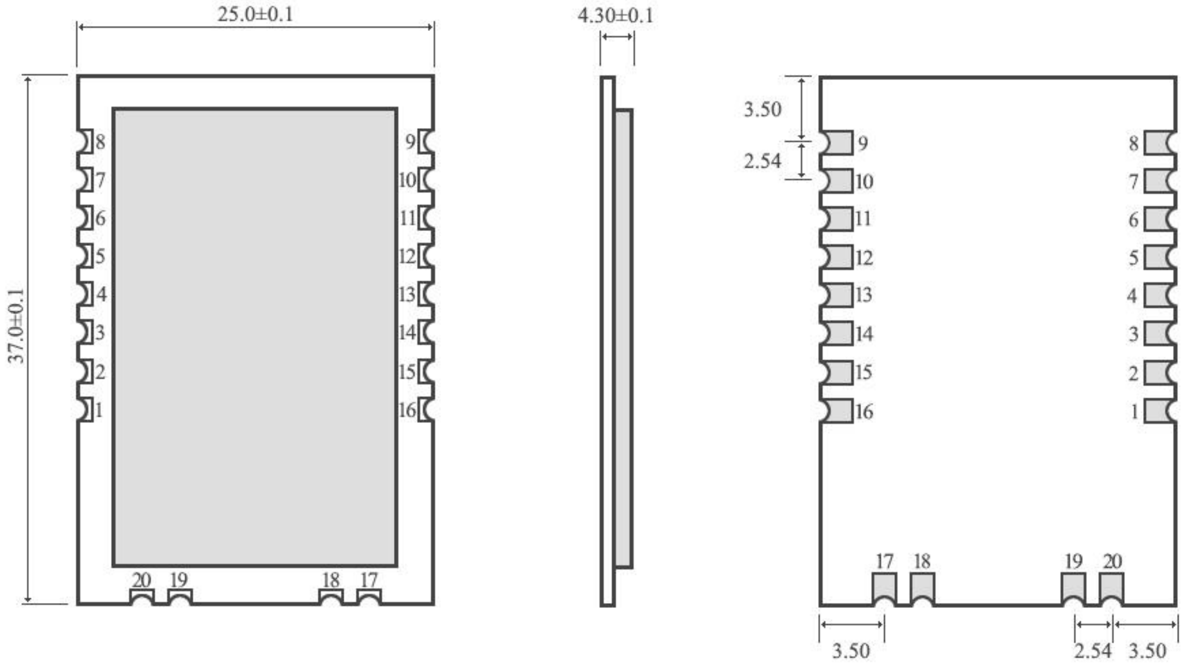
2. Mechanical Characteristics

2.1. E10-433MS



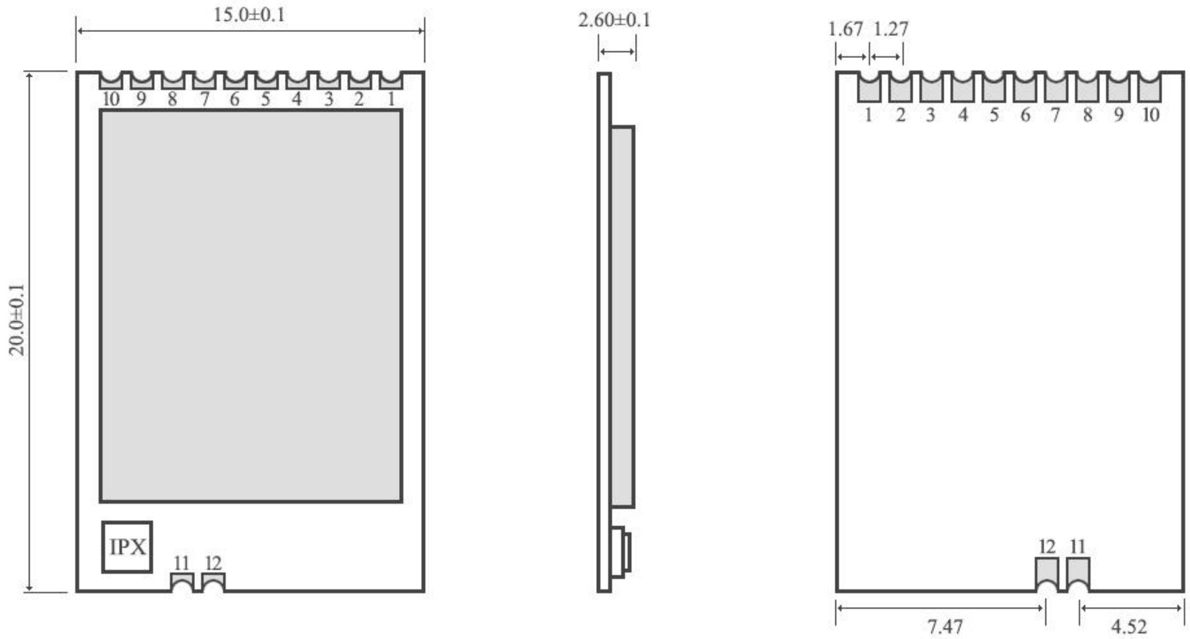
Pin No.	Pin item	Pin direction	Pin application
1	GND		Ground
2	VCC		Power supply 1.8V~3.6V DC
3	GPIO0	Output	GPIO of SI4463
4	GPIO1	Output	GPIO of SI4463
5	IRQ	Output	Interrupt request
6	SCK	input	Clock pin
7	MISO	Output	SPI master input slave output
8	MOSI	input	SPI master output slave input
9	nSEL	input	SPI Chip select
10	SDN		The module working enable control the pin, its low level when working (See SI4463 manual for more details)
11	ANT		Antenna
12	GND		Ground
★ Find more details on《SI4463 Datasheet》 from Silicon Labs. ★			

2.2. E10-433MS1W



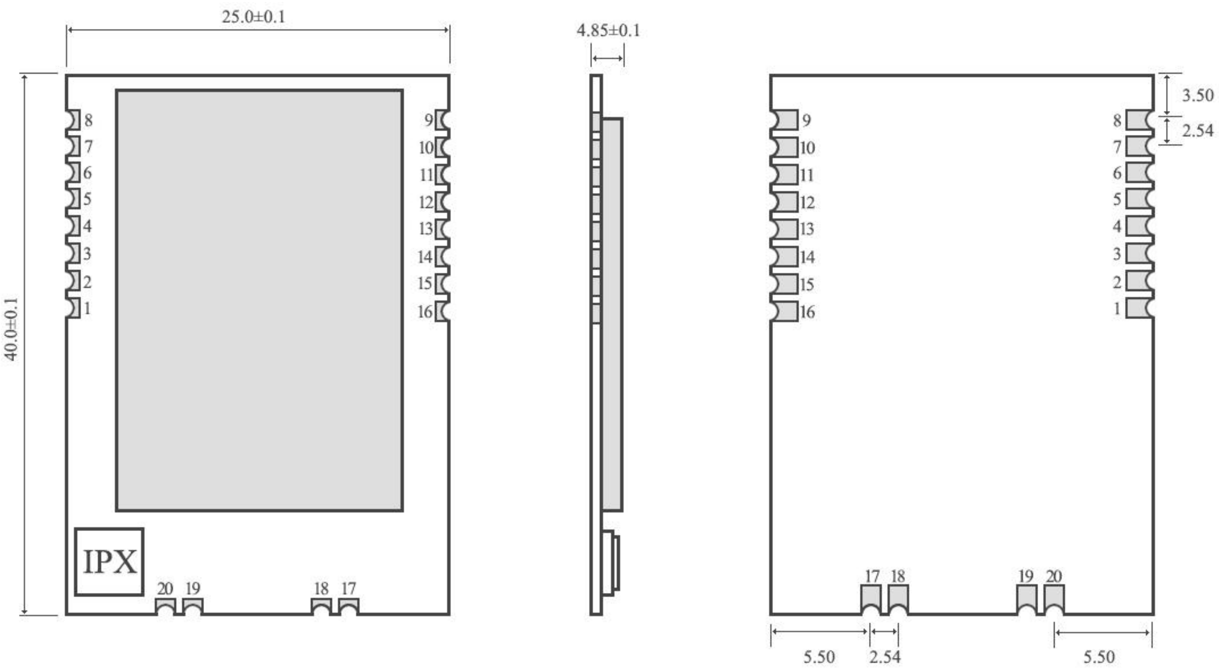
Pin No.	Pin item	Pin direction	Pin application
1	GND	Input	Ground
2	SDN	Input	The module working enable control the pin, its low level when working (See SI4463 manual for more details)
3	GPIO3	Output	GPIO of SI4463
4	GPIO2	Output	GPIO of SI4463
5	nSEL	Input	SPI Chip select
6	MOSI	Input	SPI master input slave output
7	MISO	Output	SPI master output slave input
8	ENT	Input	Clock enable (high-level effective)
9	SCK	Output	SPI master input slave output
10	IRQ	Output	Interrupt request
11	GPIO1	Output	Output pin
12	GPIO0	Output	Output pin
13	VCC	Input	Power supply 3.3V~5.5V DC (Recommend 4.75~5.25V)
14	GND	Input	Ground
15	ENP	Input	PA power enable (High-level effective)
16	GND	Input	Ground
17	GND	Input	Ground
18	GND	Input	Ground
19	GND	Output	Ground
20	ANT	Output	Antenna
★ Find more details on《SI4463 Datasheet》 from Silicon Labs. ★			

2.3. E10-868MS20/ E10-915MS20



Pin No.	Pin item	Pin direction	Pin application
1	GND		Ground
2	VCC		Power supply 1.8V~3.6V DC 3.3V and external ceramic filter capacitor are recommended
3	GPIO0	Output	Configurable GPIO
4	GPIO1	Output	Configurable GPIO
5	IRQ	Output	SPI interrupt request
6	SCK	Input	Serial Clock Input
7	MISO	Output	SPI master input slave output
8	MOSI	Input	SPI master output slave input
9	nSEL	Input	SPI Chip select for starting SPI communication
10	SDN		Shutdown Input Pin. It is low level when working (See SI4463 manual for more details)
11	ANT		Antenna
12	GND		Ground
★ Find more details on《SI4463 Datasheet》 from Silicon Labs ★			

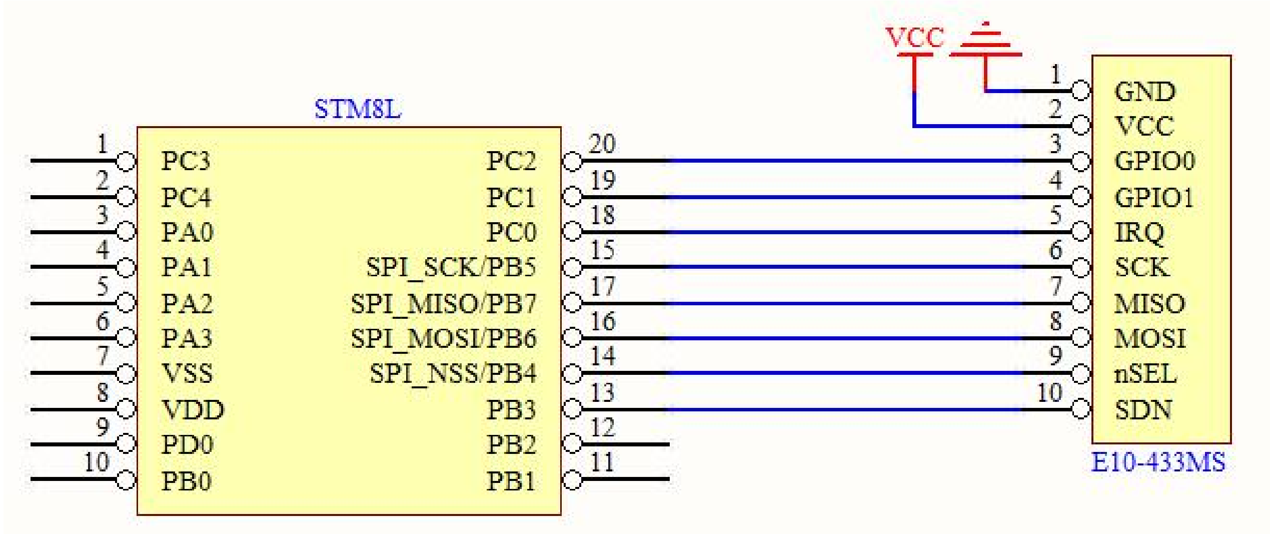
2.4. E10-868MS30/ E10-915MS30



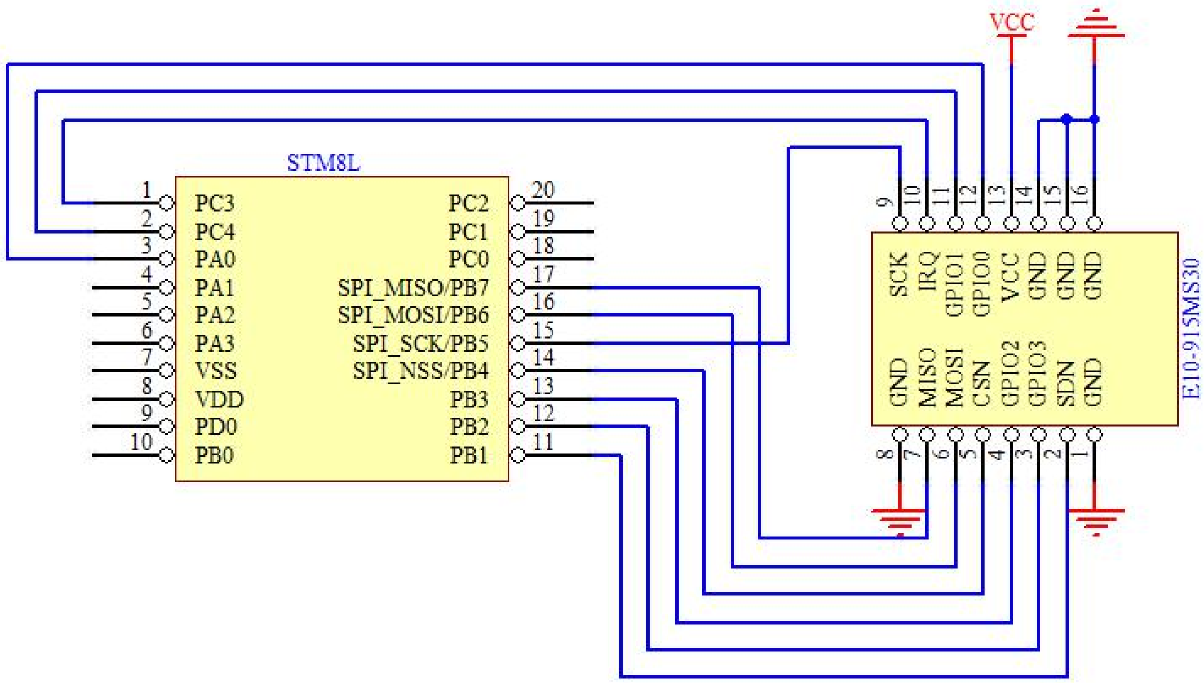
Pin No.	Pin item	Pin direction	Pin application
1	GND		Ground, connecting to power supply reference ground
2	SDN	Input	Module operation enabling control pin, low level in operation (refer to SI4463 Datasheet for details)
3	GPIO3	Output	Connecting to the internal RF switch transmission, can be disconnected, controlled by SI4463 intelligently
4	GPIO2	Output	Connecting to the internal RF switch receiving, can be disconnected, controlled by SI4463 intelligently
5	CSN	Input	Module chip selection pin, used to start a SPI communication
6	MOSI	Input	Module SPI data input pin
7	MISO	Output	Module SPI data output pin
8	GND		Ground, connecting to power supply reference ground
9	SCK	Output	Module SPI clock pin
10	IRQ	Output	Module interrupt pin
11	GPIO1	Output	Module data output pin (refer to SI4463 datasheet)
12	GPIO0	Output	Module data output pin (refer to SI4463 datasheet)
13	VCC		Power supply must be 5.0 ~ 5.5V DC (voltage higher than 6V is forbidden)
14	GND		Ground, connecting to power supply reference ground
15	GND		Ground, connecting to power supply reference ground
16	GND		Ground, connecting to power supply reference ground
17	GND		Ground, connecting to power supply reference ground
18	GND		Ground, connecting to power supply reference ground
19	GND		Ground, antenna port reference ground
20	ANT	output	Antenna port (high-frequency signal output pin)
★ Refer to“SI4463 Datasheet” of Silicon Labs for more details ★			

3. Recommended Circuit Diagram

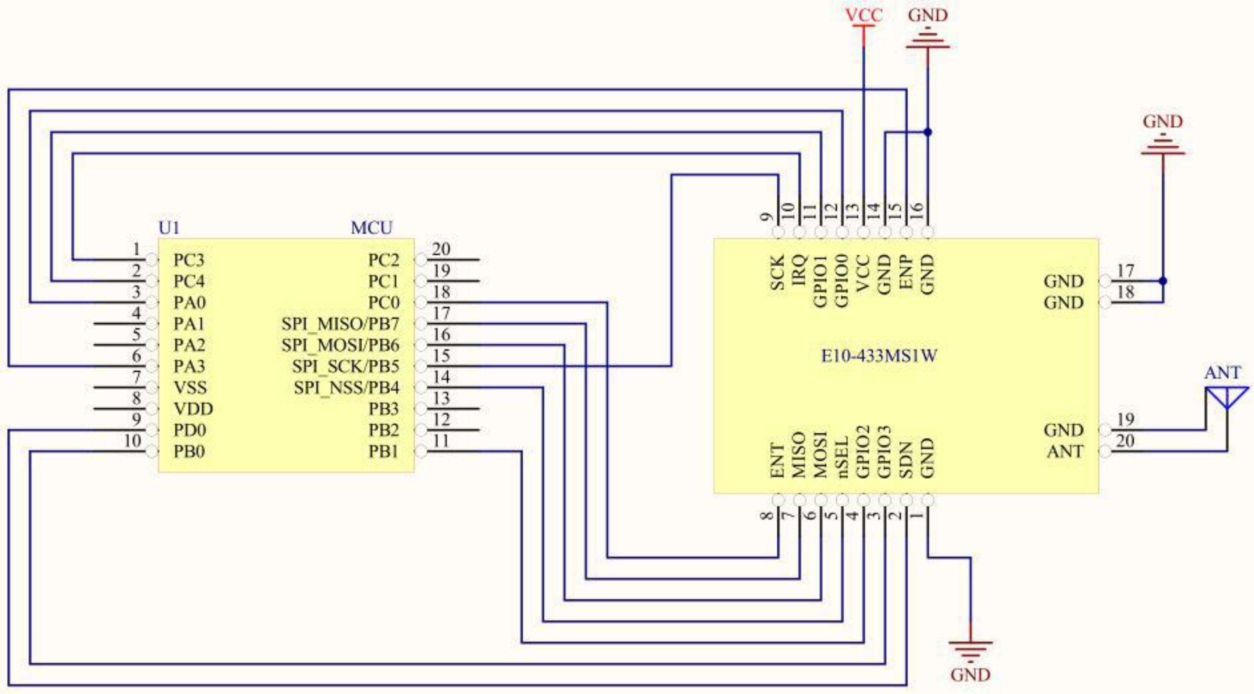
3.1. E10-433MS/ E10-868MS20/E10-915MS20



3.2. E10-868MS30/ E10-915MS30



3.3. E10-433MS1W



4. Notes

- GPIO0 \ GPIO1 \ GPIO2 \ GPIO3 is general I/O, available for various functions. Please refer to SI4463 datasheet, they can be floated when free。
- IRQ can be unconnected, the interrupt status can be acquired via SPI check mode, but it is recommended to connect with external MCU.
- Make it ground well with large space for grounding and small power ripple. Filter capacitor is necessary and make sure it is close to pin VCC and GND.
- Air data rate for SPI shall not be too high, 1Mbps is recommended.
- Please refer to "Operating Modes and Timing" for status switch of SI4463, the switch between TX and RX must go through Ready, cannot be switched directly.
- One can reinitialize register setting when IC is free for better stability.
- For external control of GPIO2 , GPIO3, status is as below:

  When transmitting: GPIO2 = 0; GPIO3 = 1;

  When receiving: GPIO2 = 1; GPIO3 = 0;

  To control via SI4463, in the program initialization one can set pins as below:

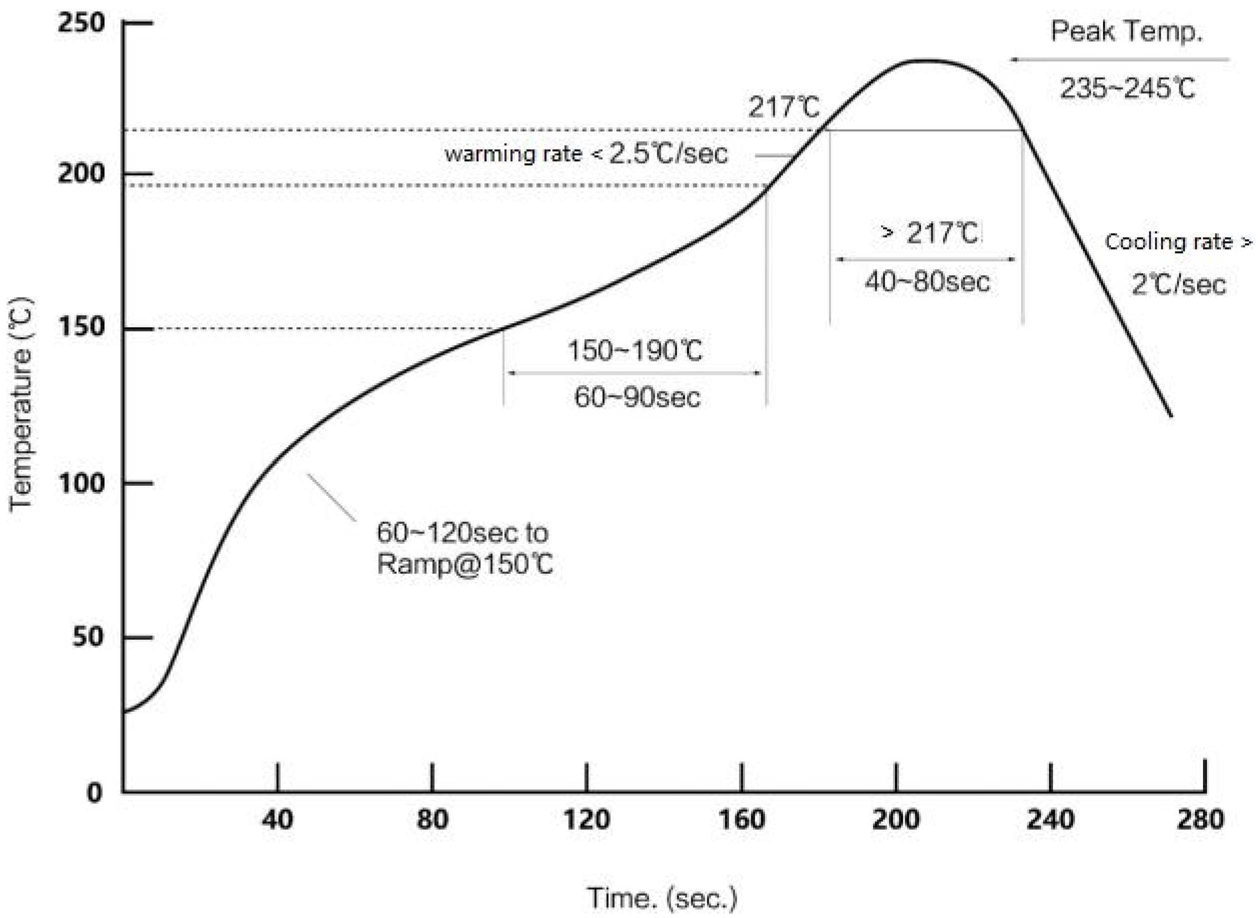
  SI44XX_GPIO_CONFIG(0, 0, 32|0x40, 33|0x40, 0, 0, 0);

5. Production Guidance

5.1. 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

5.2. Reflow Curving 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.
- 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).
- The power supply low voltage under room temperature is lower than the recommended value, 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 within the recommended value, voltage higher than that 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.

7. Important Notes

- All rights to interpret and modify this manual belong to Ebyte.
- This manual will be updated based on the upgrade of firmware and hardware, please refer to the latest version.
- Please refer to our website for new product information

8. About Us

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