CC2620/2630/2640/2650

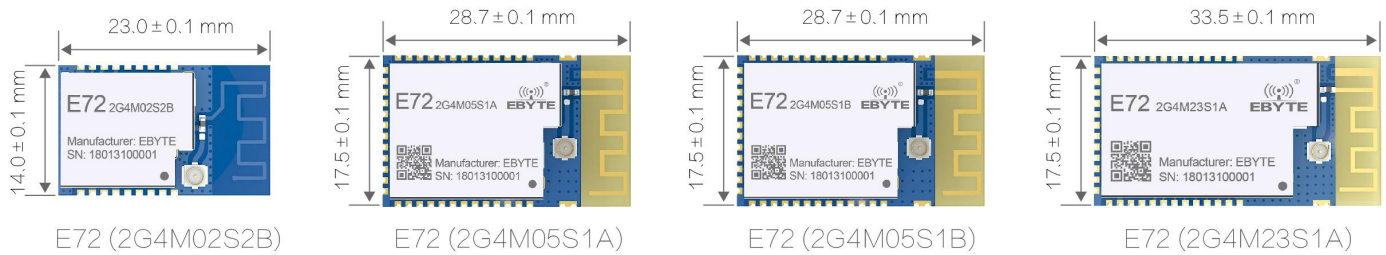# E72 Series

User Manual

Version	Date	Description	Issued by
1.00	2017-10-11	Initial version	Wu
1.10	2018-02-05	Name changed	huaa
1.20	2018-05-23	More content	Huaa

Brief Introduction

23.0±0.1 mm	28.7±0.1 mm	28.7±0.1 mm	33.5±0.1 mm

E72 (2G4M02S2B)   E72 (2G4M05S1A)   E72 (2G4M05S1B)   E72 (2G4M23S1A)

The E72-2G4M05S series and the E72-2G4M23S series are 2.4GHz small-size chip RF modules designed and manufactured by Ebyte

Thanks to the CC26XX series Pin to Pin compatibility, users can select the E72-2G4M05S series module with the 7*7 mm package in the CC2620, CC2630, CC2640, and CC2650 as the core, the output power is 5dBm. And can also select E72-2G4M23S with the added CC2592 range expander, the output power is 23dBm. The E72-2G4M05S series and the E72-2G4M23S series can be Pin to Pin compatible. Users can balance the ultra-low power consumption and long distance.

The CC26XX series chip integrates 128KB of in-system programmable flash memory and 8KB of cached static RAM (SRAM) and different 2.4GHz wireless communication protocols. It also has a rich set of peripherals. Because of its unique ultra-low-power sensor controller, it's ideal for connecting external sensors, and it is also suitable for autonomous collection of analog and digital data while the rest of the system is in sleep mode.

Model	ZigBee	RF4CE	6LoWPAN	Bluetooth 4.2	Bluetooth 5.0	Power	Distance（PCB/IPX）
E72 (2G4M05S1A)	√		√			5dBm	150m/500m
E72 (2G4M05S1B)				√		5dBm	150m/500m
E72 (2G4M02S2C)				√	√	5dBm	150m/500m
E72 (2G4M05S1D)	√	√	√	√		5dBm	150m/500m
E72 (2G4M23S1A)	√		√			23dBm	500m/1500m
E72 (2G4M02S2B)				√		23dBm	500m/1500m

E72-2G4M05S series and E72-2G4M23S series are hardware platform, users need to carry out secondary development. E72-2G4M02S2B is UART module.

1

Contents

1. Technical Parameters

1.1. General parameters

Model	IC	Dimension	Net weight	Temperature	Humidity	Storage temperature
E72 (2G4M05S1A)	CC2630	17.5 * 28.7 mm	1.8±0.1g	-40 ~ 85°C	10% ~ 90%	-40 ~ 125°C
E72 (2G4M05S1B)	CC2640	17.5 * 28.7 mm	1.8±0.1g	-40 ~ 85°C	10% ~ 90%	-40 ~ 125°C
E72 (2G4M02S2C)	CC2640R2F	17.5 * 28.7 mm	1.8±0.1g	-40 ~ 85°C	10% ~ 90%	-40 ~ 125°C
E72 (2G4M05S1D)	CC2650	17.5 * 28.7 mm	1.8±0.1g	-40 ~ 85°C	10% ~ 90%	-40 ~ 125°C
E72 (2G4M23S1A)	CC2630 + CC2592	17.5 * 33.5 mm	2.1±0.1g	-40 ~ 85°C	10% ~ 90%	-40 ~ 125°C
E72 (2G4M02S2B)	CC2640 + CC2592	17.5 * 33.5 mm	2.1±0.1g	-40 ~ 85°C	10% ~ 90%	-40 ~ 125°C

1.2. Internal resources

Model	IC	FLASH	RAM	Core
E72(2G4M05S1A)	CC2630F128RGZR	128 kb	28 kb	Cortex-M3 + Cortex-M0
E72(2G4M05S1B)	CC2640F128RGZR	128 kb	28 kb	Cortex-M3 + Cortex-M0
E72(2G4M05S1C)	CC2640R2FRSMR	128 kb	28 kb	Cortex-M3 + Cortex-M0
E72(2G4M05S1D)	CC2650F128RGZR	128 kb	28 kb	Cortex-M3 + Cortex-M0
E72 (2G4M23S1A)	CC2630F128RGZR	128 kb	28 kb	Cortex-M3 + Cortex-M0
E72 (2G4M02S2B)	CC2640F128RSMR	128 kb	28 kb	Cortex-M3 + Cortex-M0

1.3. Electronic parameters

1.3.1. Transmitting current

Model	Min	Typ	Max	Unite	Remarks
E72 (2G4M05S1A)	9.3	9.1	12.3	mA	● When designing the power supply circuit for the module, it is recommended to reserve more than 30% margin, and the whole device is conducive to long-term stable operation； ● The current required to transmit an instant is large but because of the very short emission time, the total energy consumed may be less； ● When the customer uses an external antenna, the impedance matching degree between the antenna and the module at different frequency points will affect the emission current to a different extent.
E72 (2G4M05S1B)	9.3	9.1	12.3	mA	
E72 (2G4M02S2C)	8.1	9.1	11.1	mA	
E72 (2G4M05S1D)	8.1	9.1	12.3	mA	
E72 (2G4M23S1A)	164.6	182.5	200.1	mA	
E72 (2G4M02S2B)	162.1	180.1	198.3	mA	

1.3.2. Receiving current

Model	Min	Typ	Max	Unite	Remarks
E72 (2G4M05S1A)	5.8	6.1	7.2	mA	● The current consumed when the radio frequency chip is in the pure receiving state is called the receiving current. Some RF chips with communication protocols or developers have loaded some of the self-developed protocols on the entire unit, which may cause the receiving current of the test to be large；
E72 (2G4M05S1B)	5.8	6.1	7.2	mA	
E72 (2G4M02S2C)	5.6	6.1	6.9	mA	
E72 (2G4M05S1D)	5.6	6.1	7.2	mA	
E72 (2G4M23S1A)	10.3	11.1	12.4	mA	

| E72 (2G4M02S2B) | 9.6 | 10.1 | 11.7 | mA | ● Currents in the purely receiving state are often mA level. The μA-level "receiving current" requires the developer to process the software. |

1.3.3. Turn-off current

Model	Min	Typ	Max	Unit	Remarks
E72 (2G4M05S1A)	1.0	1.2	2.7	μA	● Turn-off current is often referred to as CPU, RAM, clock, and some registers are reserved. Current consumed by SoC in very low power state;
E72 (2G4M05S1B)	1.0	1.2	2.7	μA	
E72 (2G4M02S2C)	1.0	1.2	2.7	μA	
E72 (2G4M05S1D)	1.0	1.2	2.7	μA	● Turn-off current is often much less than the current consumed by the power supply of the complete machine when it is unloaded. It need not be overly demanding.
E72 (2G4M23S1A)	1.2	1.4	3.1	μA	
E72 (2G4M02S2B)	1.2	1.4	3.1	μA	

1.3.4. Power supply voltage

产品型号	Min	Typ	Max	Unit	Remarks
E72 (2G4M05S1A)	1.8	3.3	3.8	V DC	● When the power supply voltage is at a maximum value for a long period of time and there is a risk of burnout;
E72 (2G4M05S1B)	1.8	3.3	3.8	V DC	
E72 (2G4M02S2C)	1.8	3.3	3.8	V DC	● The power supply pin has a certain surge immunity, but it needs to deal with pulses that are higher than the maximum supply voltage;
E72 (2G4M05S1D)	1.8	3.3	3.8	V DC	
E72 (2G4M23S1A)	1.8	3.3	3.8	V DC	● The power supply voltage is not recommended to be less than 3.0V, or the RF parameters will be affected to varying degrees.
E72 (2G4M02S2B)	1.8	3.3	3.8	V DC	

1.3.5. Communication level

Model	Min	Typ	Max	Unit	Remarks
E72 (2G4M05S1A)	2.4	3.0	3.3	V DC	● When the communication level is higher than the maximum value of the module communication level, there is a relatively large risk of burnout module;
E72 (2G4M05S1B)	2.4	3.0	3.3	V DC	
E72 (2G4M02S2C)	2.4	3.3	3.3	V DC	
E72 (2G4M05S1D)	2.4	3.3	3.3	V DC	
E72 (2G4M23S1A)	2.4	3.3	3.3	V DC	● Although the communication level can be converted in many ways, it will greatly affect the overall power consumption.
E72 (2G4M02S2B)	2.4	3.3	3.3	V DC	

1.4. RF Parameters

1.4.1. Transmitting power

Model	Min	Typ	Max	Unit	Remarks
E72 (2G4M05S1A)	4.6	5.0	5.5	dBm	● The components themselves have certain errors. A single LRC component has an error of ±0.1%. Multiple LRC components are used in the entire RF loop. This results in the accumulation of errors, makes differences in the transmitting power of different modules;
E72 (2G4M05S1B)	4.6	5.0	5.5	dBm	
E72 (2G4M02S2C)	4.5	5.0	5.4	dBm	
E72 (2G4M05S1D)	4.5	5.0	5.5	dBm	● Reducing transmitting power can reduce power consumption to a certain extent, but for many reasons that will reduce the efficiency of internal PAs;
E72 (2G4M23S1A)	22.6	23.0	23.2	dBm	
E72 (2G4M02S2B)	22.5	23.0	23.1	dBm	● Transmitting power will decrease with decreasing supply voltage.

1.4.2.　Receiving sensitivity

Model	Min	Typ	Max	Unit	Remarks
E72 (2G4M05S1A)	-98.5	-99.0	-100.5	dBm	● The components themselves have certain errors. A single LRC component has an error of ±0.1%. Multiple LRC components are used in the entire RF loop. This results in the accumulation of errors, makes differences in the receiving sensitivity of different modules；
E72 (2G4M05S1B)	-98.5	-99.0	-100.5	dBm	
E72 (2G4M02S2C)	-98.5	-99.0	-100.5	dBm	
E72 (2G4M05S1D)	-98.5	-99.0	-100.5	dBm	
E72 (2G4M23S1A)	-100.5	-102.0	-103.5	dBm	● After raising the module's air data speed, the receiving sensitivity will be reduced, resulting in the drop of communication distance.
E72 (2G4M02S2B)	-100.5	-102.0	-103.5	dBm	

1.5.　Range test

1.5.1.　On board PCB antenna range test

Model	Min	Typ	Max	Unit	Remarks
E72 (2G4M05S1A)	130	150	170	m	● On-board PCB antenna has a gain of about 1.5dBi with strong directionality；
E72 (2G4M05S1B)	130	150	170	m	
E72 (2G4M02S2C)	120	150	160	m	● Each packet of data interval 2s, send 100 packets of data, each packet of data 30 bytes, packet loss rate is less than 5%, is the effective communication range；
E72 (2G4M05S1D)	130	150	170	m	
E72 (2G4M23S1A)	420	500	550	m	● In order to get meaningful and reproducible test results, we chose to go to suburbs and conduct tests in sunny weather to almost no electromagnetic interference；
E72 (2G4M02S2B)	400	500	520	m	● When there are obstacles and electromagnetic interference, communication range will have different degrees of attenuation.

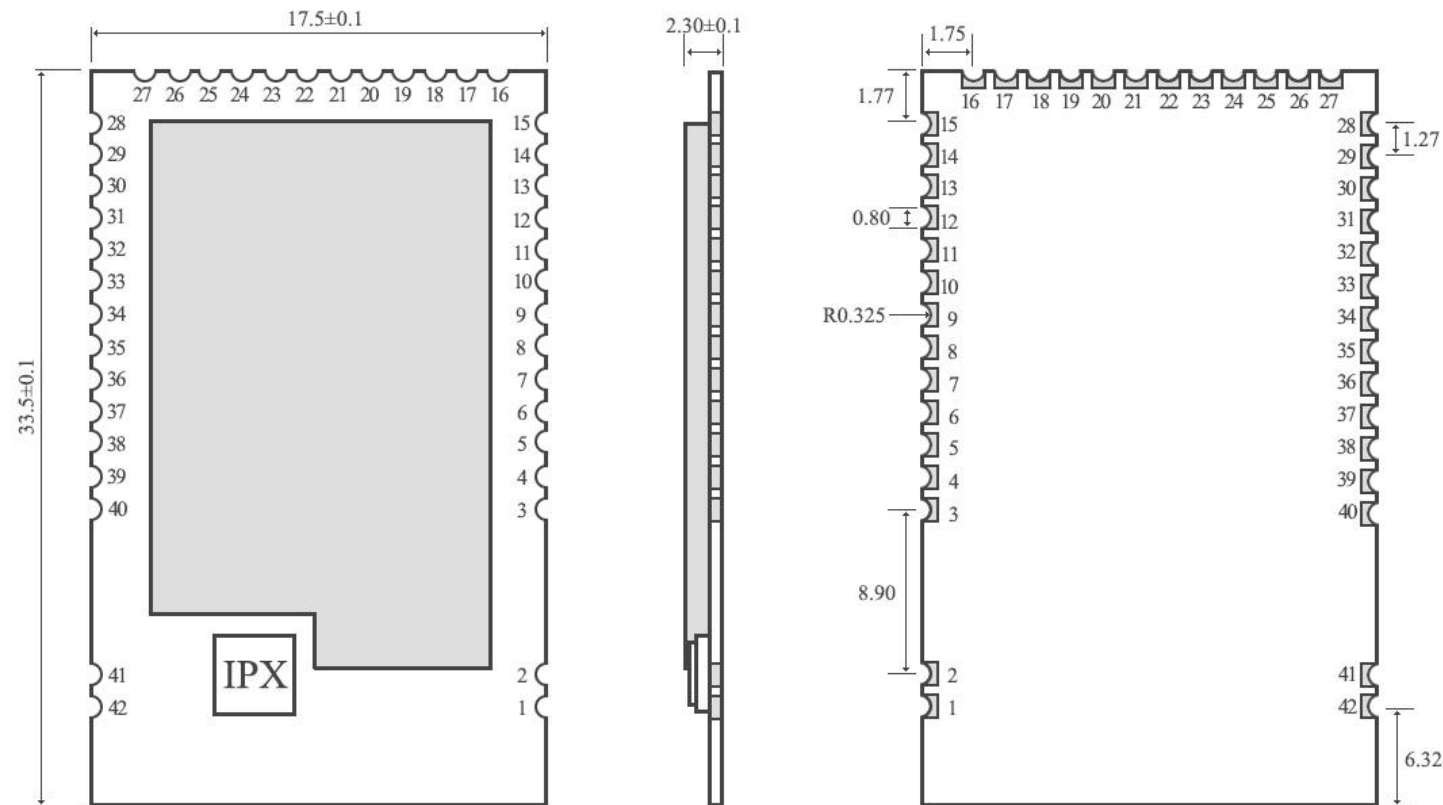### 1.5.2.　External sucker antenna range test

Model	Min	Typ	Max	Unit	Remarks
E72 (2G4M05S1A)	450	500	570	m	● The external sucker antenna has a gain of 5 dBi with vertical polarization；
E72 (2G4M05S1B)	450	500	570	m	
E72 (2G4M02S2C)	430	500	550	m	● Each packet of data interval 2s, send 100 packets of data, each packet of data 30 bytes, packet loss rate is less than 5%, is the effective communication range；
E72 (2G4M05S1D)	450	500	570	m	
E72 (2G4M23S1A)	1270	1500	1760	m	● In order to get meaningful and reproducible test results, we chose to go to suburbs and conduct tests in sunny weather to almost no electromagnetic interference；
E72 (2G4M02S2B)	1180	1500	1580	m	● When there are obstacles and electromagnetic interference, communication range will have different degrees of attenuation.

2. Mechanical properties
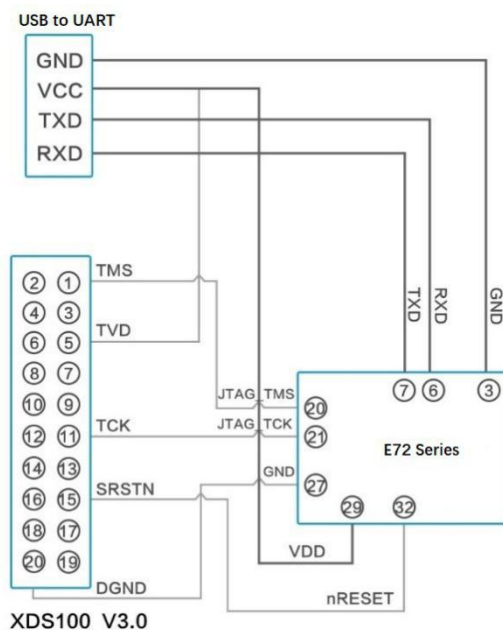
2.1. E72-2G4M05S

2.2. E72-2G4M23S

2.3. Pin distribution

No.	Pin item	Pin direction	Application
1、2、3	GND	Input/Output	Ground electrode, connect to reference ground of power
4	DIO_0	Input/Output	MCU GPIO
5	DIO_1	Input/Output	MCU GPIO
6	DIO_2	Input/Output	MCU GPIO
7	DIO_3	Input/Output	MCU GPIO
8	DIO_4	Input/Output	MCU GPIO
9	DIO_5	Input/Output	Highly-driven GPIO
10	DIO_6	Input/Output	Highly-driven GPIO
11	DIO_7	Input/Output	Highly-driven GPIO
12	DIO_8	Input/Output	MCU GPIO
13	DIO_9	Input/Output	MCU GPIO
14	DIO_10	Input/Output	MCU GPIO
15	DIO_11	Input/Output	MCU GPIO
16	DIO_12	Input/Output	MCU GPIO
17	DIO_13	Input/Output	MCU GPIO
18	DIO_14	Input/Output	MCU GPIO
19	DIO_15	Input/Output	MCU GPIO
20	JTAG_TMS	Input/Output	JTAG_TMSC, Highly-driven
21	JTAG_TCK	Input/Output	JTAG_TCKC, Highly-driven
22	DIO_16	Input/Output	Highly-driven GPIO, JTAG_TDO
23	DIO_17	Input/Output	Highly-driven GPIO, JTAG_TDI
24	DIO_18	Input/Output	MCU GPIO
25	DIO_19	Input/Output	MCU GPIO
26	DIO_20	Input/Output	MCU GPIO
27	GND		Ground electrode, connect to reference ground of power
28	DIO_21	Input/Output	MCU GPIO
29	VDD		Power supply 1.8 ~ 3.6V DC
30	DIO_22	Input/Output	MCU GPIO
31	DIO_23	Input/Output	MCU GPIO
32	nRESET	Input	Reset
33	DIO_24	Input/Output	MCU GPIO
34	DIO_25	Input/Output	MCU GPIO
35	DIO_26	Input/Output	MCU GPIO
36	DIO_27	Input/Output	MCU GPIO
37	DIO_28	Input/Output	MCU GPIO
38	DIO_29	Input/Output	MCU GPIO
39	DIO_30	Input/Output	MCU GPIO
40、41、42	GND		Ground electrode, connect to reference ground of power
★ For more details, please refer to《CC26xx Datasheet》★			

★   Note: The E72-2G4M05S and E72-2G4M23S can be pin-compatible, and the two modules are only different in length near the side of the antenna.
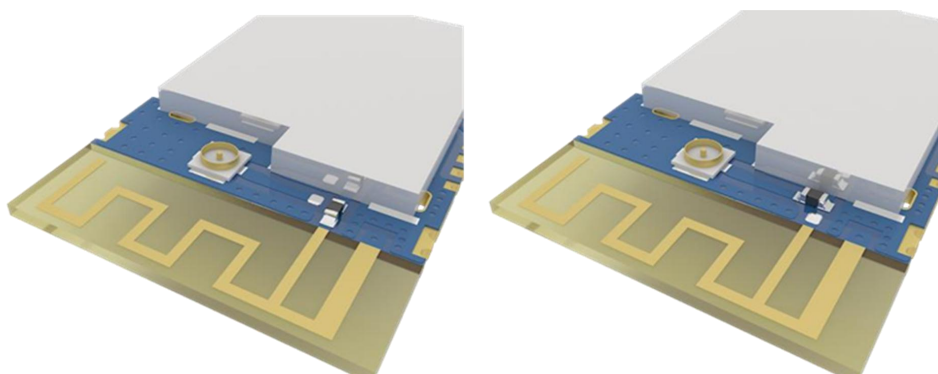
3. Usage

3.1.   Connection with the emulator

1)   TMS, TCK, reset, and ground need to be connected between the emulator and the module, and an additional 3.3V power supply is required for the emulator;

2)   Using USB to UART module to connect with the module, UART ports and IO ports are multiplexing, customers can set by themselves.

3)   Pay attention to be well grounded. When there is a large area of grounding, the ripple of the power supply is small, the filter capacitor should be increased and placed as close as possible to the VCC and GND pins of the module.
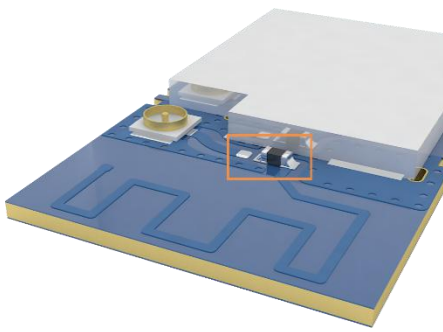
3.2.   Antenna selection
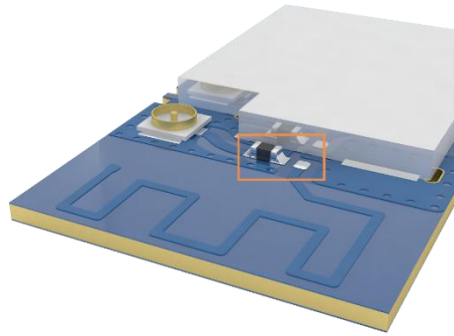
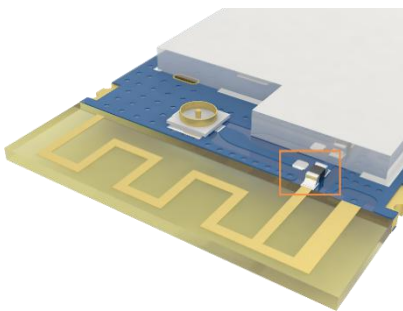### 3.2.1.   E72 (2G4M05S1A)/E72 (2G4M05S1B)

The onboard PCB antenna is enabled by default at the factory, and the 0R resistor is shown in the figure above (left)；

If users enable the IPEX antenna, change the 0R resistor to the above figure (right).

3.2.2.   E72 (2G4M02S2B)

The onboard PCB antenna is enabled by default at the factory, and the 0R resistor is shown in the figure above (left)
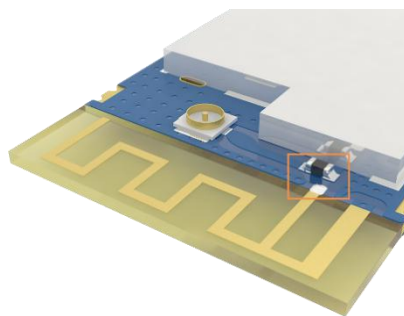
If users enable the IPEX antenna, change the 0R resistor to the above figure (right).

3.2.3.   E72 (2G4M23S1A)

The onboard PCB antenna is enabled by default at the factory, and the 0R resistor is shown in the figure above (left)

If users enable the IPEX antenna, change the 0R resistor to the above figure (right).

4. Software programming

The Code Composer Studio (CCS) Integrated Development Environment (IDE) for wireless connection is recommended.

Code Composer Studio is an integrated development environment (IDE) that supports TI's microcontrollers and embedded processor products. Code Composer Studio includes a comprehensive set of tools for developing and debugging embedded applications. It contains a C/C++ compiler, source editor, project build environment, debugger, descriptor, and many other features for optimization. The intuitive IDE provides a single user interface that helps you complete each step of the application development process. Familiar tools and interfaces enable users to get started faster than ever before. Code Composer Studio combines the advantages of the Eclipse software framework with TI's advanced embedded debugging capabilities to provide embedded developers with a compelling and feature-rich development environment.
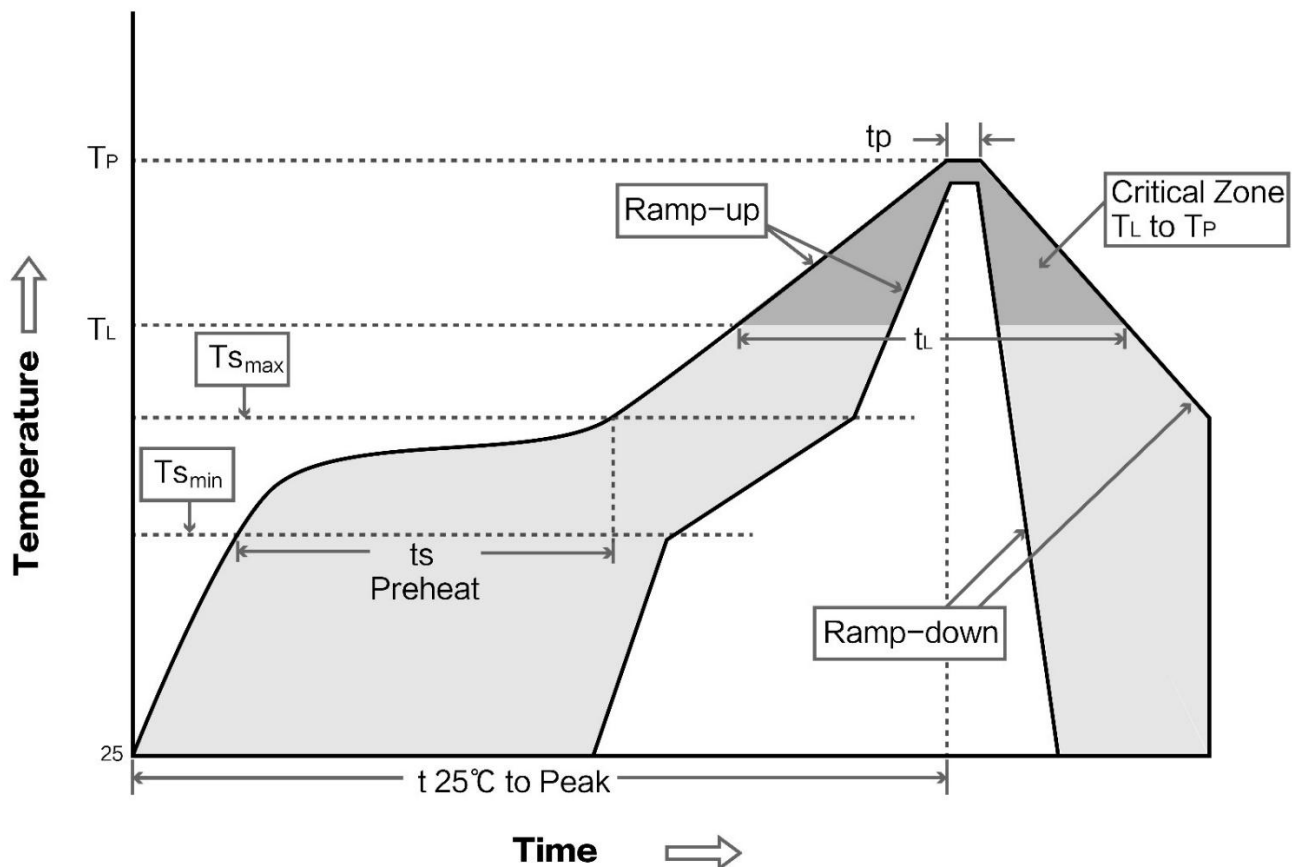
1)   When transmitting, set DIO_7 pin high, DIO_13, DIO_14 pin low；

2)   When receiving, set DIO_7 pin low, DIO_13, DIO_14 pin high；

3)   Before turning off, set the DIO_7, DIO_13, and DIO_14 pins to low level；

4)   The register configuration can be reinitialized when the chip is idle for greater stability.

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 Soldering Curve

6. FAQ

6.1. Communication range is very close

- When there is a linear communication obstacle, the communication range will be correspondingly attenuated.
- Temperature, humidity, and co-channel interference will increase the packet loss rate of communications.
- The performance is poor when there is ground absorption, radio wave reflection, and testing near the ground.
- Seawater has a very strong ability to absorb radio waves, so the seashore test is poor.
- There is a metal object near the antenna, or it is placed inside the metal shell, the signal attenuation will be very serious.
- The power register is set incorrectly and the air speed setting is too high (the higher the air speed, the closer the distance).
- The power supply voltage is lower than 2.5V at room temperature, the lower the voltage is, the lower the power is.。
- The poor matching of antenna and module or the quality of the antenna itself.

6.2. Easy to damage

- Please check the power supply to ensure that the maximum value between the recommended values, if it is exceeded the module will be permanently damaged.
- Please check the stability of the power supply, the voltage can not fluctuate frequently and frequently.
- Please ensure that the anti-static operation of the installation process, high-frequency devices have electrostatic sensitivity
- Please ensure that the humidity during installation and using should not be too high. Some components are humidity-sensitive devices.
- If there is no special requirement, it is not recommended to use at too high or too low temperatures.

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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