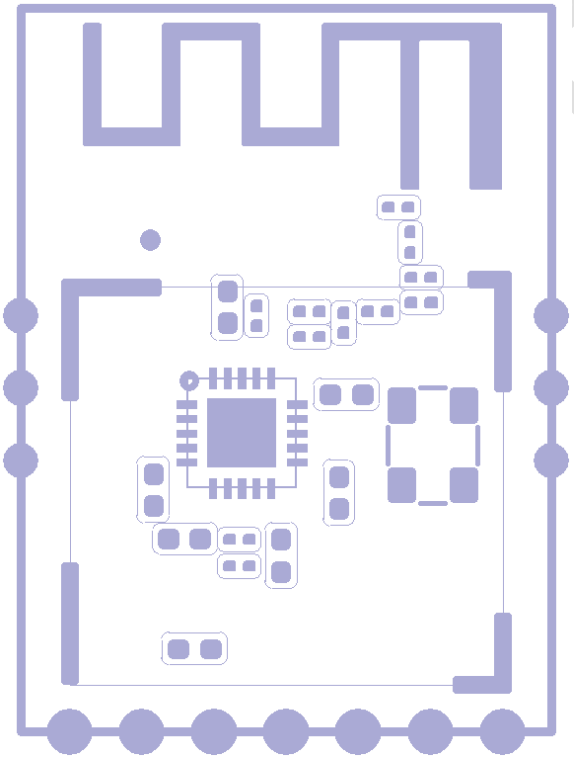
E W N - E P 2 T 2 3 F 1 C A

Datasheet V1.1

BLE Soc Module



APPROVAL
R Q Z
2025-02-13

Contents

1 General Specifications ---------- 3 -

2 Features ---------- 3 -

3 System Block Diagram ---------- 4 -

4 PHY Specification ---------- 4 -

5 Other Specifications ---------- 6 -

6 DC Specifications ---------- 6 -

7 Module configurations ---------- 7 -

8 Pin Definition ---------- 8 -

9 Module Photos ---------- 9 -

10 Key material list ---------- 9 -

11 Reference design ---------- - 10 -

11.1 RF ---------- - 10 -

11.2 Power supply requirement ---------- - 11 -

11.3 Motherboard interference avoidance ---------- - 12 -

11.3.1 Interface interference ---------- - 12 -

11.3.2 The main chip interferes with DDR ---------- - 13 -

12 Revision History ---------- - 15 -

EARDATEK

1 General Specifications

EWN-EP2T23F1CA is Bluetooth LE SoC solution with internal Flash, which combines the features and functions needed for all 2.4 GHz IoT standards into a single SoC.

2 Features

- RF features include:
  - BLE/2.4 GHz RF transceiver embedded, working in worldwide 2.4 GHz ISM band.
  - Bluetooth 5.1 compliant, 1 Mbps, 2 Mbps, Long Range 125 kbps and 500 kbps.
  - 2.4 GHz proprietary 1 Mbps/2 Mbps/250 kbps/500 kbps mode.
  - Support Adaptive Frequency Hopping feature.
  - Support flexible GFSK/FSK modulation index configuration.
  - Support 1-N receiver capability.
- Embedded 32-bit proprietary microcontroller.
- Program memory: Internal 512 KB flash.
- Data memory: 64 KB on-chip SRAM:
  - Up to 32 KB SRAM with retention in deep sleep
  - One 32 KB SRAM without retention in deep sleep

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3 System Block Diagram

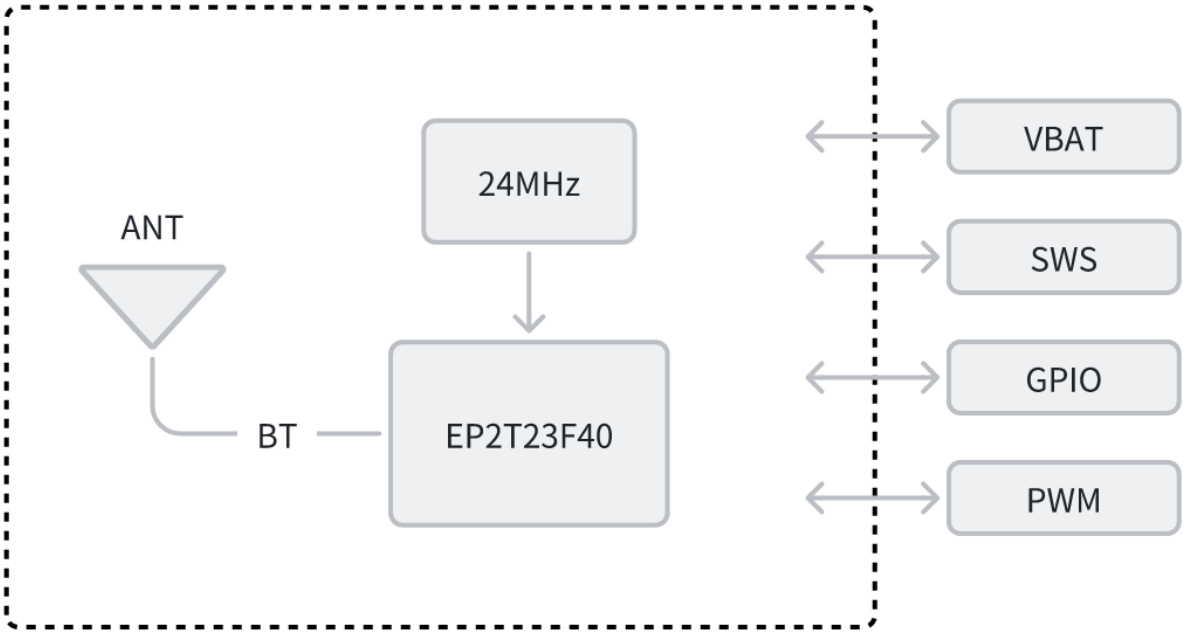

Fig 3-1 EWN-EP2T23F1CA System Block Diagram

4 PHY Specification

Table 4-1 EWN-EP2T23F1CA Bluetooth RF Parameters

Protocol	BLE5.1
Interface	UART、PWM、GPIO
Frequency	2400 MHz ~ 2483.5MHz
Data rate	BLE/2.4G Proprietary 1Mbps, ±250kHz deviation BLE/2.4G Proprietary 2Mbps, ±500kHz deviation BLE 125kbps, ±250kHz deviation BLE 500kbps, ±250kHz deviation 2.4G Proprietary 500kbps, ±125kHz deviation 2.4G Proprietary 250kbps, ±62.5kHz deviation

Table 4-2 RX Performance

Item	Sym.	Min.	Typ.	Max.	Unit	Condition
BLE 1Mbps RF_Rx performance (±250KHz deviation)						
Sensitivity	1Mbps	-	-96	-	dBm	-
Frequency Offset Tolerance		-250	-	+300	KHz	-
Co-channel rejection		-	8	-	dB	Wanted signal at -67dBm
In-band blocking rejection (Equal Modulation Interference)	+1/-1 MHz offset	-	-4/-2	-	dB	Wanted signal at -67dBm
	+2/-2 MHz offset	-	-41/-32	-	dB	
	>=3 MHz offset	-	-42	-	dB	
Image rejection		-	-32	-	dB	Wanted signal at -67 dBm

Table 4-3 TX Performance

Item	Sym.	Min.	Typ.	Max.	Unit	Condition
BLE 1Mbps RF_TX performance						
Output power, maximum setting	-	-	10	-	dBm	-
Output power, minimum setting (resolution)	-	-	-45	-	dBm	-
Programmable output power range	-	55			dB	-
Modulation 20dB bandwidth	-	-	1.4	-	MHz	-

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5 Other Specifications

Table 5-1 other Specifications

Operating Temperature	-40℃~+105℃
Storage Temperature	Module: -40℃~+105℃ Package: -20℃~+70℃
Operating Humidity	RH 95%(Non-Condensing)
Storage Humidity	RH 95%(Non-Condensing)
Humidity level	Level 3

6 DC Specifications

Table 6-1 DC Specifications

Item	Sym.	Min.	Typ.	Max.	Unit	Condition
VDD_3.3V	V_{BAT}	2	3.3	3.6	V	3.3V Supply Voltage
RX current	I_{RX}	-	9.1	-	mA	Whole Chip
TX current	I_{TX}	-	9.5	-	mA	whole chip @ 0dBm with LDO
TX current	I_{TX}	-	30	-	mA	whole chip @ 10dBm with LDO
Deep sleep without SRAM retention	I_{Deep1}	-	0.4	-	uA	Without 32K RC
Deep sleep with 32kB SRAM retention	I_{Deep2}	-	1.5	-	uA	Without 32K RC
Deep sleep with 32kB SRAM retention	I_{Deep3}	-	2.0	-	uA	With 32K RC

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7 Module configurations

Module(Hole-Hole) Dimension (unit : mm)：20.0(±0.2) *14.7(±0.2)*2.6（±0.2）

Module Size (Unit: mm): 20.0(±0.2) *15.0(±0.3)*2.6（±0.2）

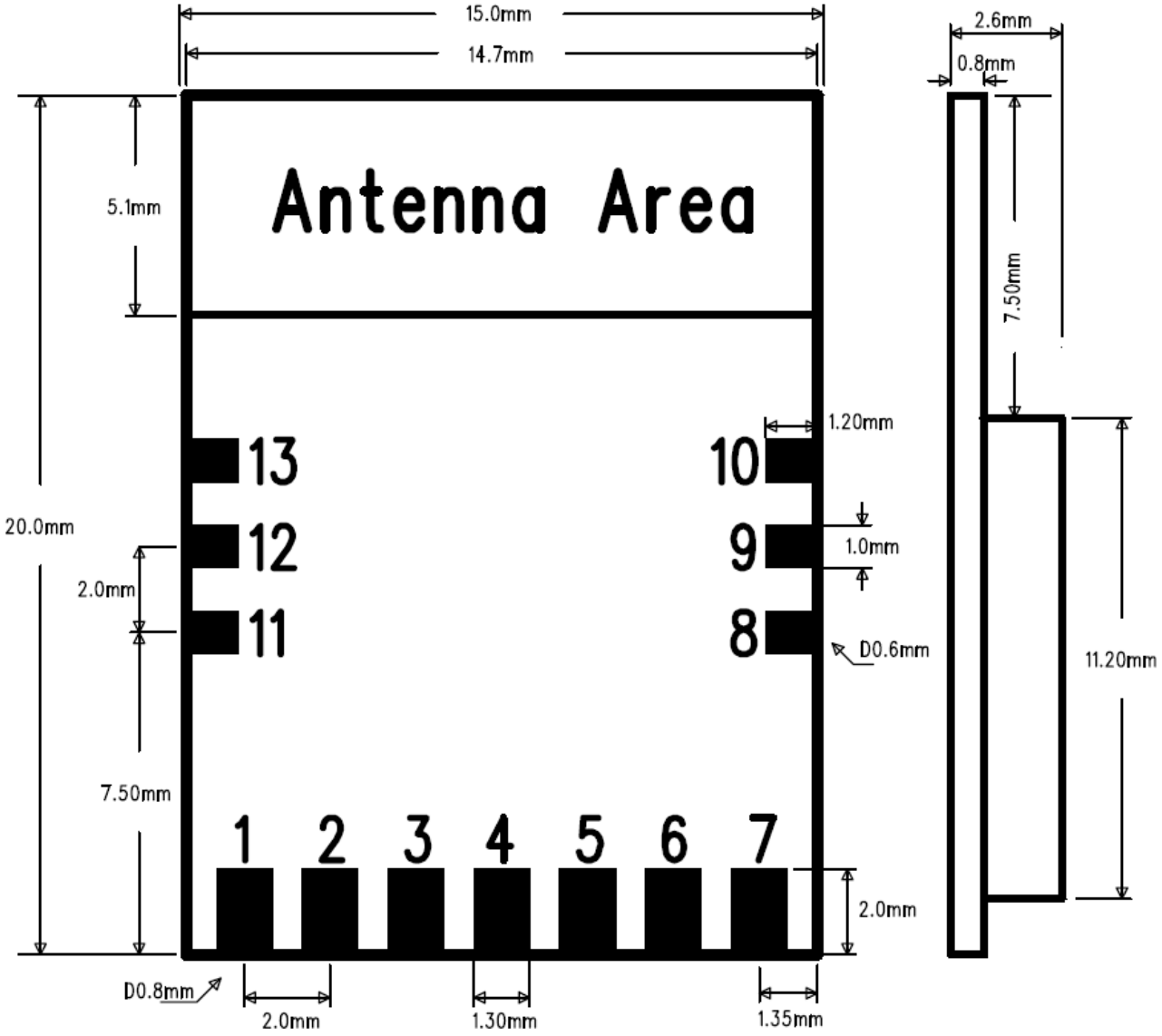

Fig 7-1 EWN-EP2T23F1CA Module Size (TOP VIEW)

8 Pin Definition

Table 8-1 the hardware Pin definition of the module

Table 8-1 EWN-EP2T23F1CA Pin definition

PIN	Definition	Description
1	VBAT	Supply power 2V-3.6V；
2	GND	Module power reference
3	PD2	PWM3、SPI_CN、GPIO
4	PD5	PWM0、PWM0_N、GPIO
5	PA4	PWM2、UART_RTS、CK/SCL、GPIO
6	PB4	PWM4、lc_comp_ain<4>/sar_aio<4>、GPIO
7	PB5	PWM5、lc_comp_ain<5>/sar_aio<5>、GPIO
8	PC3	PWM1、UART_RX、xtl_32k_in、GPIO
9	NC	/
10	RST	Power on reset, active low
11	SWS/PA7	SWS、UART_RTS、GPIO
12	PA0	UART_RX、PWM0_N、PS_PE<0>、GPIO
13	PD7	UART_TX、SPI_CK/SCL、PS_PE<3>、GPIO

Notes:

1. Download Interface use SWS test point.

2. Only SWS interface can be used for debugging firmware.

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9 Module Photos

Fig 9-1 TOP View

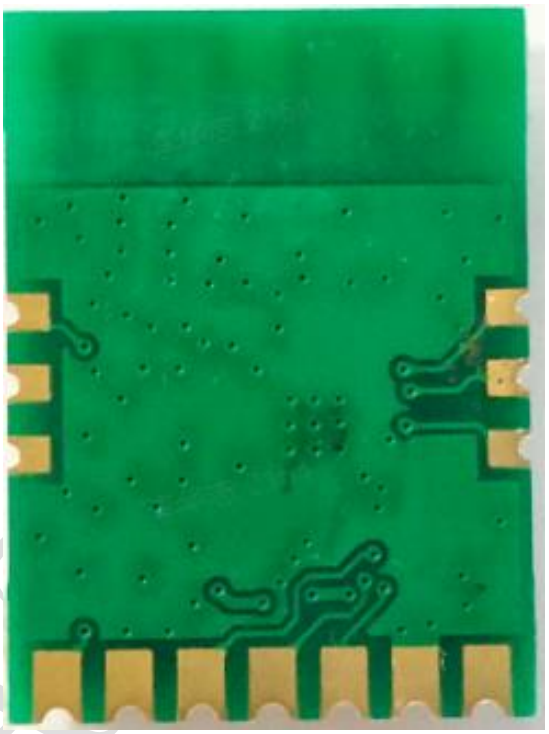

Fig 9-2 Bottom View

10 Key material list

Table 10-1 EWN-EP2T23F1CA Key material list

Type	Model	Footprint	QTY.
Crystal	24MHz 12pF 20ppm	3225	1PCS
IC	EP2T23F40	QFN20	1PCS

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11 Reference design

11.1 RF

a) Under the antenna and in the two directions indicated by the arrow, avoid covering the ground, routing and placing metal components. It is better to directly hollow out the PCB in this area.

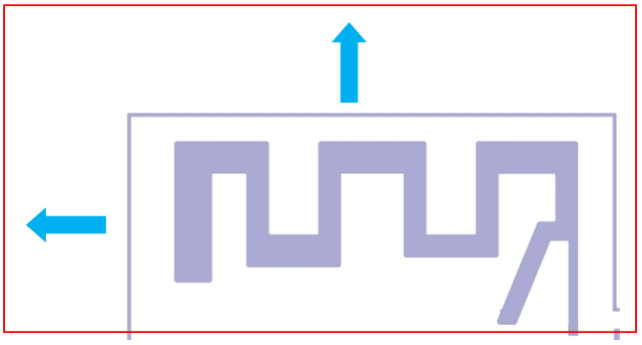


Fig 11-1 Antenna

b) It is recommended not to use any components within 30mm of the module antenna area, and the module baseboard should also avoid wiring and covering the ground as much as possible.

c) It is strongly recommended that the user place the antenna of the Bluetooth module close to the edge of the backplane as far as possible when laying out the PCB, as shown in the figure below, so as to ensure the good performance of the antenna.

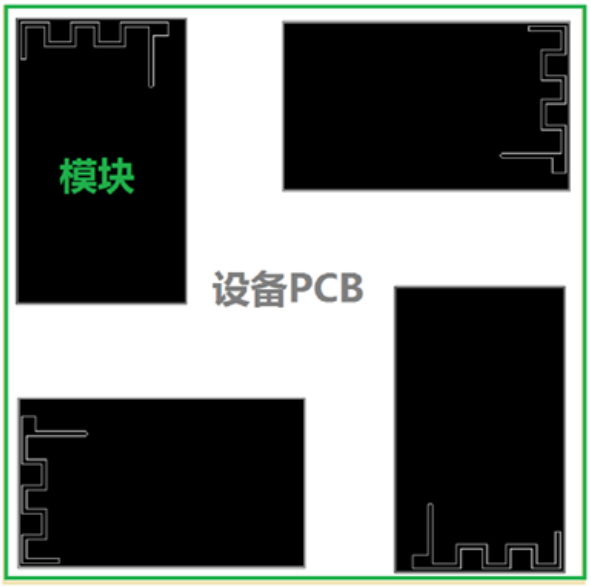
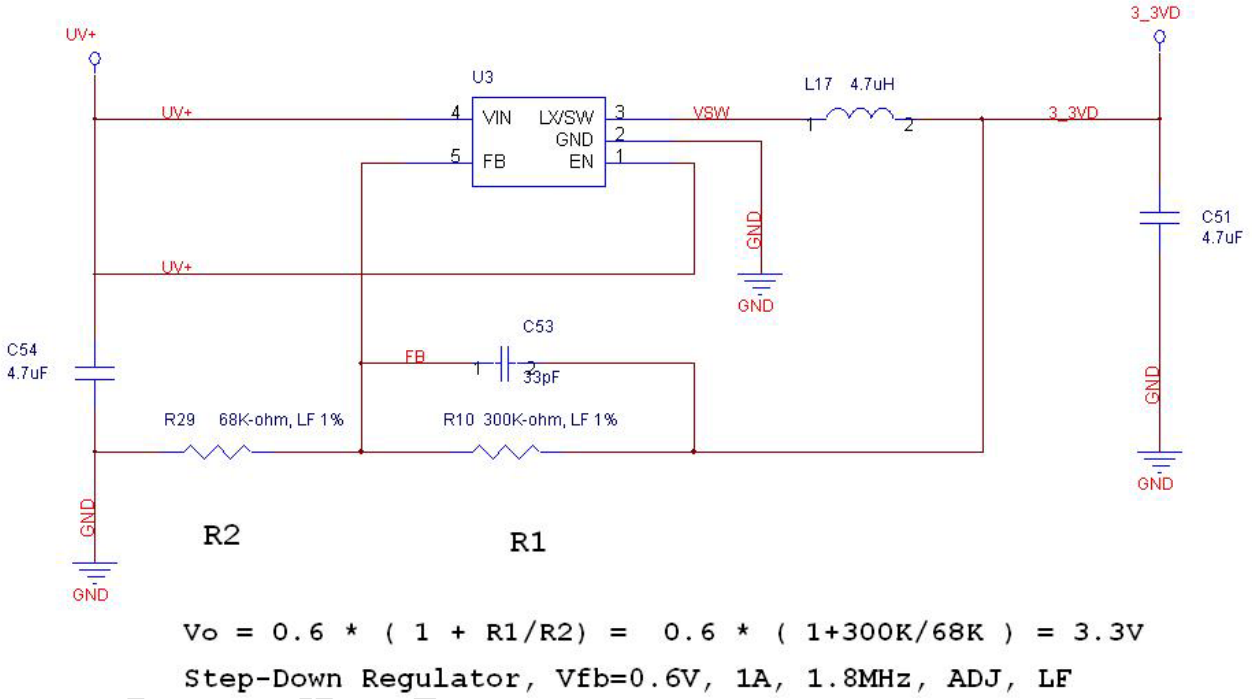


Fig 11-2 Recommended PCB layout

11.2 Power supply requirement

The module power supply voltage is DC+3.3V. The power supply design needs to consider the output current and power interference. The power supply current design needs to reserve **60mA**. To avoid the +3.3V power supply from interfering with other circuits on the motherboard, it is recommended to supply to the module using the regulator circuit alone. the recommended DC-DC circuit structure shown in the figure below. A 4.7uF~10uF capacitor is connected in parallel at 3_3VD output to filter out the interference. A bead is connected in series at 3_3VD output. The bead and capacitor must be placed as close to the module as possible. If you need to share +3.3V with other circuits, consider whether the current of the shared power supply is sufficient.



Vo = 0.6 * (1 + R1/R2) = 0.6 * (1+300K/68K) = 3.3V

Step-Down Regulator, Vfb=0.6V, 1A, 1.8MHz, ADJ, LF

Fig 11-3 Power supply Circuit schematic

11.3 Motherboard interference avoidance

Motherboard interference comes from: high-speed data interface (HDMI), the Operating frequency of main chip, DDR, DC-DC power supply. The method of avoiding interference according to the characteristics of various signals is also different. The main methods of interference avoidance include:

1. keeping away from the source of interference;

2. Adding shields to avoid interference leakage;

3. Reasonable layout to eliminate interference.

11.3.1 Interface interference

When HDMI uses the 74.2MHz frequency, its 33x frequency is in the 2.4G band of BT, which will seriously interfere with the BT signal. If the HDMI frequency is 148.5MHz, although the 16x frequency is not in the BT band, the isolation of the frequency is not good, and the BT signal will be interfered to some extent. If the distance between the HDMI interface and the BT module on the PCB is less than 5cm, the HDMI output display will interfere with the BT signal, resulting in problems such as BT connection failure and throughput drop. Therefore, keep the location of the BT module away from the HDMI port on the hardware layout to avoid interference.

At the same time, if the BT antenna is built-in the motherboard, its placement must also be carefully considered to be far from the interface interference. If the antenna is placed in an incorrect position, even if the module is shielded, the interference signal is coupled through the antenna, which will eventually result in a lower BT throughput. (Note: In addition to interference, the placement of the internal antenna should also evaluate the effect of the metal interface, motherboard, and housing material on the antenna impedance.)

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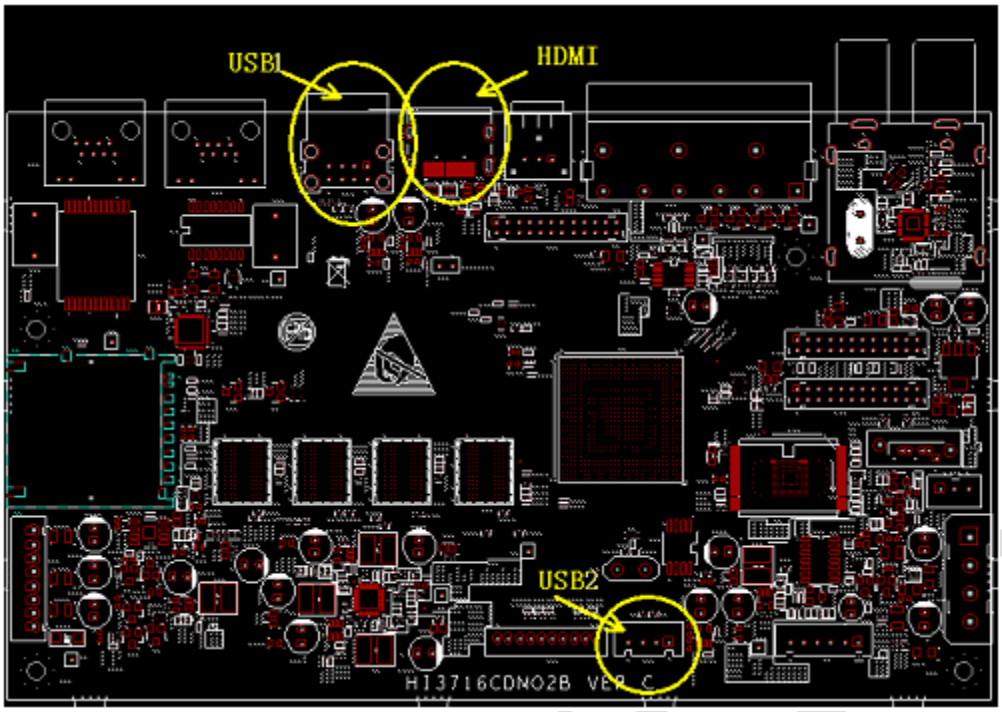

Fig 11-4 HDIM and USB interference

11.3.2 The main chip interferes with DDR

Because the main chips operate at about 800MHz or DDR2 operate at 667MHz, 3x frequency of 800MHz and 4x frequency of 667MHz are near 2.4GHz band. It must to place BT modules and antennas far away from the main chip and DDR. It is strongly recommended that the main chip be isolated from the DDR by a shield. As shown in the figure below.

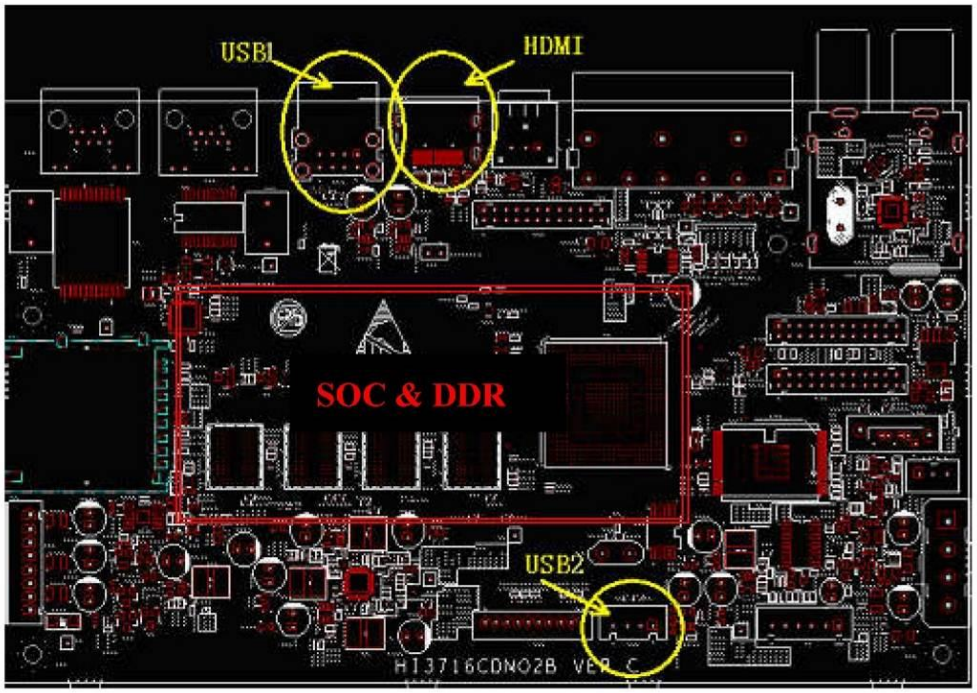

Fig 11-5 Main chip and DDR interference

11.4 Recommended secondary reflux temperature curve

T he number of reflux shall not exceed 2 times, and the tin feeding height of the half hole of the module shall be no less than 1/4.

The lead-free reflux curve requirements of BT module products are shown in figure：

Stage	Note	Pb-free assembly
Average ramp-up rate	T_L to Tp	3 ℃/ second max.
Preheat	Temperature min (T_{smin})	150℃
	Temperature max (Tsmax)	200℃
	Time (t_{smin} to t_{smax})	60 – 120 seconds
Time maintained above	Temperature(T_L)	217℃
	Time (t_L)	60 – 150 seconds
Peak package body temperature (Tp)		Tp must not exceed the specified classification temp(Tc=245℃).
Time(tp) within 5℃ of the specified classification temperature (Tc)		30 seconds
Ramp-down rate (Tp to T_L)		6 ℃ / seconds max.
Time 25℃ to peak temperature		8 minutes max.

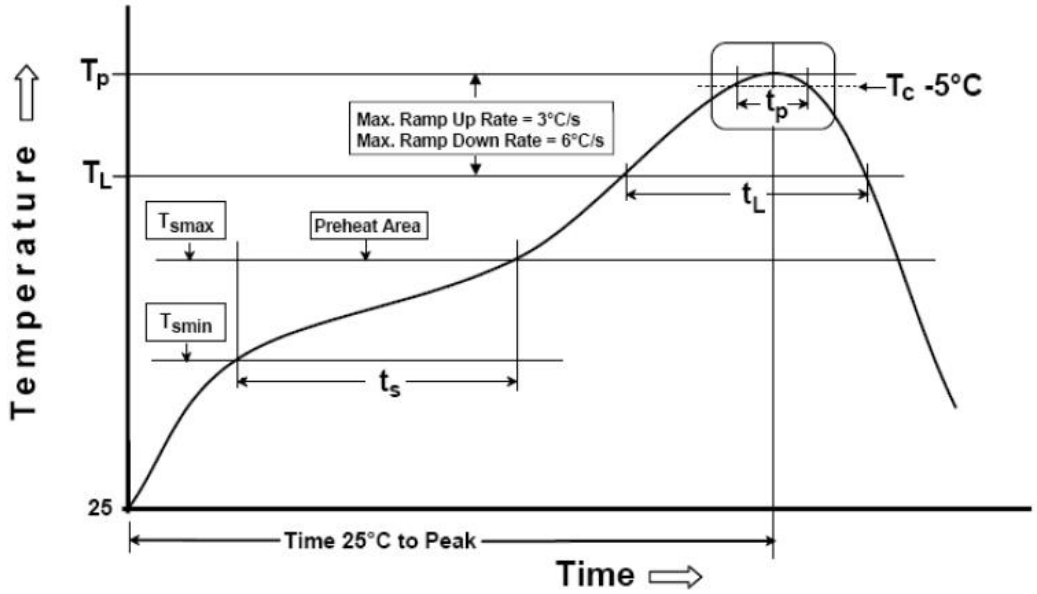

Fig 11-6 Furnace temperature curve

Note:

1. The maximum furnace temperature of the module is 260℃, don't exceed this temperature.

2. The gold plating thickness of the module pad is 2u".

12 Revision History

Vision	Release Date	Summary	Revised By
V1.0	2024-7-10	First release	Lizzie
V1.1	2025-2-13	Updated Module configurations；Add Module Photos；	Huazhi Li

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FCC Warning

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE 1: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or an experienced radio/TV technician for help.

NOTE 2: Any changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction.

"This device complies with Industry Canada's license-exempt RSSs. Operation is subject to the following two conditions:

(1) This device may not cause interference; and
(2) This device must accept any interference, including interference that may cause undesired operation of the device."

« Le pr é sent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence.
L'exploitation est autoris é e aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioelectrique subi, meme sile brouillage est susceptible d'en compromettre le fonctionnement. »

The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction.

L'appareil a été évalué pour répondre aux exigences générales en matière d'exposition aux RF. L'appareil peut être utilisé en condition d'exposition portable sans restriction.

Integration instructions for host product manufacturers according to KDB 996369 D03OEM Manual v01

2.2 List of applicable FCC rules
FCC Part 15 Subpart C 15.247 &15.209 &15.207.

2.3 Specific operational use conditions
The module can be used for mobile applications with a maximum -1.6dBi antenna. The host manufacturer installing this module into their product must ensure that the final composite product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation. The host manufacturer has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

2.4 Limited module procedures
The device is a Single module and complies with the requirement of FCC Part 15.212.

2.5 Trace antenna designs
Not applicable, The module has its own antenna, and doesn't need a host sprinted board micro strip trace antenna etc

2.6 RF exposure considerations
The module must be installed in the host equipment, can be used in portable exposure condition without restriction.; and if RF exposure statement or module layout is changed, then the host product manufacturer required to take responsibility of the module through a change in FCC ID or new application The FCC ID of the module cannot be used on the final product In these circumstances, the host manufacturer will be responsible for re-evaluating the end product (including the transmitter)and obtaining a separate FCC authorization

2.7 Antennas
Antenna Specification are as follows:
Type of antenna: PCB Antenna
Gain of antenna: -1.6dBi Max.
This device is intended only for host manufacturers under the following conditions: The transmitter module may not be co-located with any other transmitter or antenna;
The module shall be only used with the internal antenna(s) that has been originally tested and certified with this module. The antenna must be either permanently attached or employ a "unique" antenna coupler
As long as the conditions above are met, further transmitter test will not be required However, the host manufacturer is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc)

2.8 Label and compliance information
Host product manufacturers need to provide a physical or e-label stating " Contains FCC ID: 2AKGT-EP2T23F1CA"with their finished product

2.9 Information on test modes and additional testing requirements
Host manufacturer must perform test of radiated & conducted emission and spurious emission, e.t.c according to the actual test modes for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product. Only when all the test results of test modes comply with FCC requirements, then the end product can be sold legally.

2.10 Additional testing, Part 15 Subpart B disclaimer
The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.247 &15209
&15.207 and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuit), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed