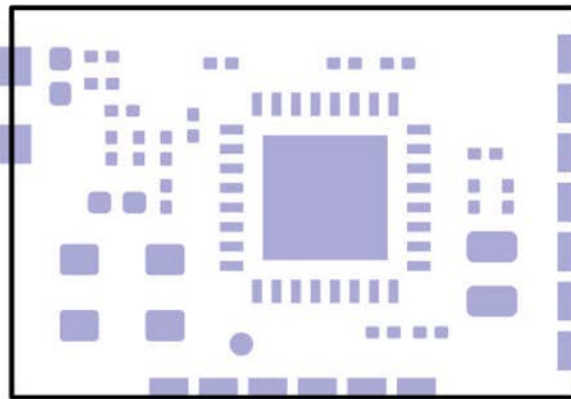


# 825X-LA Series

Datasheet V1.0

BT Mesh Soc Module



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## 1 General Specifications

825X-LA Series is Bluetooth LE Soc solution with internal flash. It combines the radio frequency, digital processing, protocols stack software, profiles for Bluetooth Low Energy (up to Bluetooth 5) and Genie Mesh into a single Soc.

The series includes the following four models :

EWN-8250FET1LA/EWN-8250FGT1LA/EWN-8258FET1LA/EWN-8258FAT1LA

## 2 Features

- ❖ Bluetooth 5 Compliant
- ❖ 2Mbps LE
- ❖ Long Range 125Kbps and 500Kbps support Tmall Genie Mesh
- ❖ Support BLE and Tmall Genie Mesh into a single SoC without the requirement for an external DSP
- ❖ BLE transceiver embedded
- ❖ Embedded hardware acceleration for Elliptical curve cryptography (ECC) used in BLE 4.2 and above
- ❖ Program memory: internal 512kB Flash(EWN-8250FET1LA/EWN-8250FGT1LA)  
1MB Flash (EWN-8258FET1LA/EWN-8258FAT1LA).
- ❖ Data memory: 48kB on-chip SRAM (EWN-8250FET1LA/EWN-8250FGT1LA)  
64kB on-chip SRAM (EWN-8258FET1LA/EWN-8258FAT1LA)
- ❖ Write protect all or portions of memory
- ❖ Multi firmware encryption methods for anti-cloning protection
- ❖ Embedded hardware AES and AES-CCM
- ❖ Multiple stage power management to minimize power consumption
- ❖ SWS independent Download and Debug interface
- ❖ I/O : PWM、GPIO
- ❖ Operating Temperature : -40~85°C (EWN-8250FET1LA/ EWN-8258FET1LA)  
-40~105°C (EWN-8250FGT1LA /EWN-8258FAT1LA)

### 3 System Block Diagram

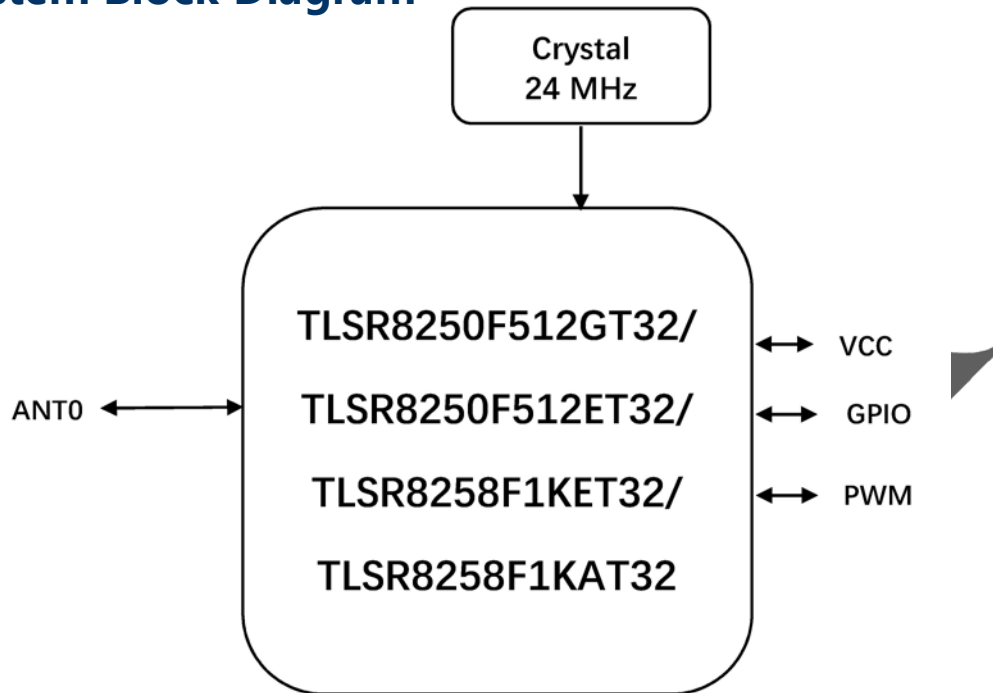


Fig 1 825X-LA Series System Block Diagram

### 4 PHY Specification

Table 1 825X-LA Series Bluetooth RF Parameters

<b>Protocol</b>	BT5.0
<b>Interface</b>	UART
<b>Frequency</b>	2402 MHz ~ 2480MHz
<b>Data rate</b>	BLE 1Mbps, ±250KHz deviation

Table 2 RX Performance

Item	Sym.	Min.	Typ.	Max.	Unit	Condition
<b>BLE 1Mbps RF_Rx performance (<math>\pm 250</math>KHz deviation)</b>						
<b>Sensitivity</b>	1Mbps		-95		dBm	
<b>Frequency Offset Tolerance</b>		-250		+300	KHz	
<b>Co-channel rejection</b>			-11		dB	Wanted signal at -67dBm
<b>Image rejection</b>			37		dB	Wanted signal at -67dBm
<b>In-band blocking rejection (Equal Modulation Interference)</b>	+1/-1 MHz offset		1/3		dB	Wanted signal at -67dBm
	+2/-2 MHz offset		37/39		dB	
	$\geq 3$ MHz offset		42		dB	

Table 3 TX Performance

Item	Sym.	Min.	Typ.	Max.	Unit	Condition
<b>BLE 1Mbps RF_TX performance</b>						
<b>Output power, maximum setting</b>			10		dBm	
<b>Output power, minimum setting</b>			-45		dBm	
<b>Programmable output power range</b>			55		dB	
<b>Modulation 20dB bandwidth</b>			2.5		MHz	

## 5 Other Specifications

Table 4 other Specifications

<b>Operating Temperature</b>	-40~85°C (EWN-8250FET1LA/ EWN-8258FET1LA) -40~105°C (EWN-8250FGT1LA /EWN-8258FAT1LA)
<b>Storage Temperature</b>	Module: -40~85°C (EWN-8250FET1LA/ EWN-8258FET1LA) -40~105°C (EWN-8250FGT1LA /EWN-8258FAT1LA) Package: -20°C~+70°C
<b>Operating Humidity</b>	RH 95%(Non-Condensing)
<b>Storage Humidity</b>	RH 95%(Non-Condensing)
<b>Humidity level</b>	Level 3

## 6 DC Specifications

Table 5 DC Specifications

Item	Sym.	Min.	Typ.	Max.	Unit	Condition
<b>VDD_3.3V</b>	V <sub>BAT</sub>	1.8	3.3	3.6	V	3.3V Supply Voltage
<b>RX current</b>	I <sub>RX</sub>	-	5.3	-	mA	whole chip
<b>TX current</b>	I <sub>TX</sub>	-	4.8	-	mA	whole chip @0dBm with DCDC
<b>TX current</b>	I <sub>TX</sub>	-	20	-	mA	whole chip @10dBm with DCDC
<b>Deep sleep with</b>	I <sub>deep1</sub>		1		uA	8kB SRAM retention
			1.2		uA	16kB SRAM retention
			1.4		uA	32kB SRAM retention
	I <sub>deep2</sub>		0.4		uA	without SRAM retention

## 7 Module configurations

Module (hole - hole) Size (Unit: mm): 14.50(±0.2) \*10.0(±0.2)\*1.65(±0.2)

Module Size (Unit: mm): 14.50(±0.2) \*10.15(±0.3)\*1.65(±0.2)

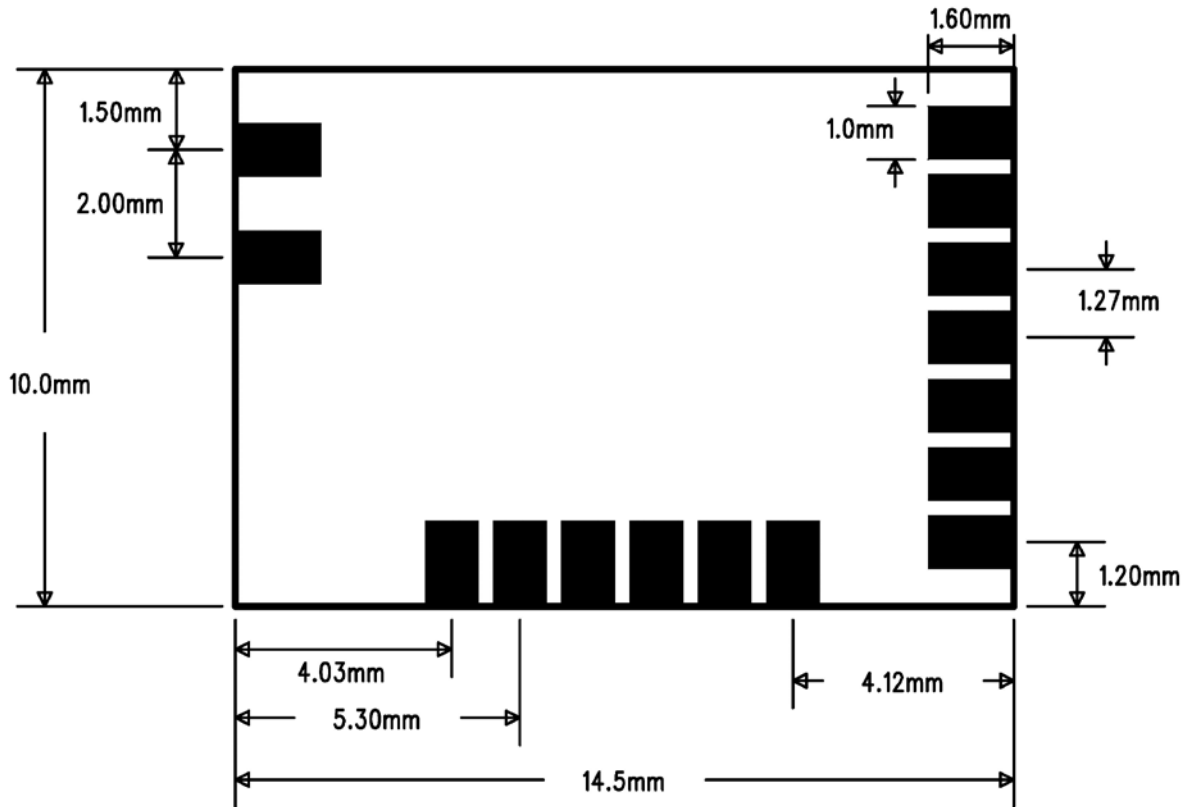


Fig 2 825X-LA Series Top View Module Size

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## 8 Pin Definition

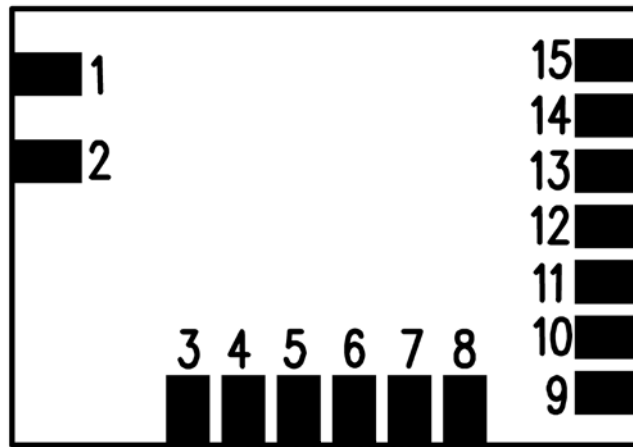


Fig 3 Top view

Table 6 the hardware Pin definition of the module

Table 6 825X-LA Series Pin definition

PIN	Definition	IC Pin	Description
1	Ant	/	BT
2	GND	/	Module power reference
3	ADC	PB1	<b>SAR ADC input</b> /UART_TX / GPIO PB[1]
4	SWS	PA7	Single wire slave
5	UART_TX	PD7	<b>7816_TRX(UART_TX)</b> / SPI clock (I2C_SCK) / GPIO PD[7]
6	UART_RX	PA0	<b>UART_RX</b> /PWM0 inverting output / GPIO PA[0]
7	Int_A	PC0	GPIO PC[0]/ I2C serial data / PWM4 inverting output / UART_RTS
8	Int_B	PC2	GPIO PC[2]/ PWM0 output / 7816_TRX(UART_TX) / I2C serial data/ (optional) 32kHz crystal output
9	VBAT	/	Supply power 1.8V-3.3V ;
10	GND	/	Module power reference
11	PWM0	PC1	<b>PWM0 output</b> / I2C serial clock / PWM1 inverting output / GPIO PC[1]
12	PWM1	PC3	<b>PWM1 output</b> / UART_RX / I2C serial clock / (optional)32kHz crystal input / GPIO PC[3]
13	PWM2	PC4	<b>PWM2 output</b> / UART_CTS / PWM0 inverting output / SAR ADC input / GPIO PC[4]
14	PWM4	PB4	<b>PWM4 output</b> /SAR ADC input / GPIO PB[4]
15	PWM5	PB5	<b>PWM5 output</b> / SAR ADC input / GPIO PB[5]



**Notes:**

1. Download Interface use SWS test point on bottom view.
2. Only SWS interface can be used for debugging firmware.

## 9 Module Photos



Fig 4 Top View

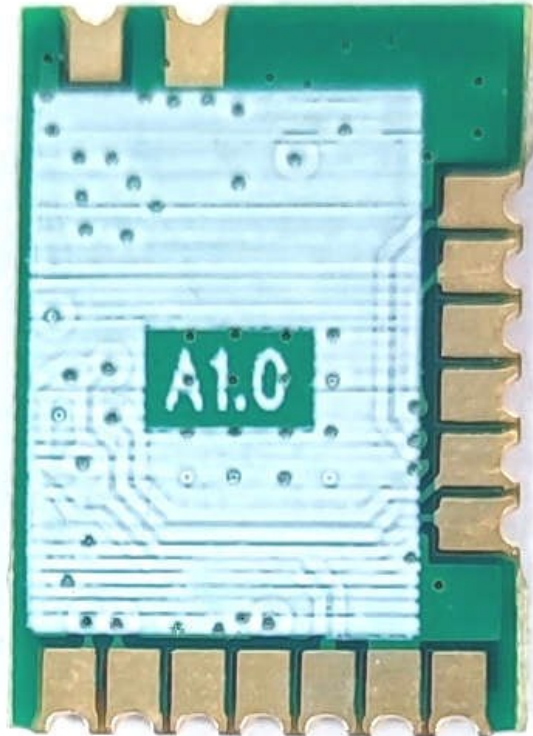


Fig 5 Bottom View

## 10 Key material list

Type	Model	Footprint	QTY.
Crystal	Table 7 EWN-8250FET1LA Key material list 24MHz 12pF 20ppm	3225	1PCS
Inductance	10uH	0805	1PCS
IC	TLSR8250F512GT32/ TLSR8250F512ET32/ TLSR8258F1KET32/ TLSR8258F1KAT32	QFN32	1PCS

# 11Package Information

Carrier dimension: ( Unit : mm )

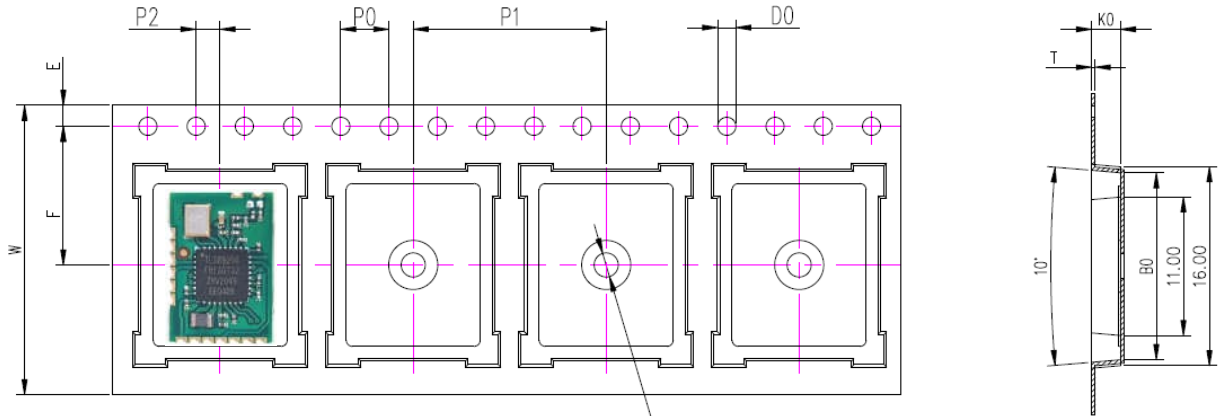


FIG 6 Carrier size

Reel dimension : D=38cm 1900PCS Modules Per Reel

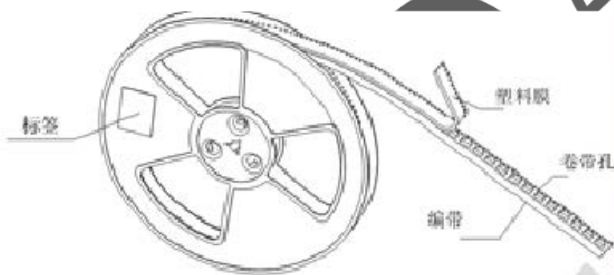


FIG 7 Reel

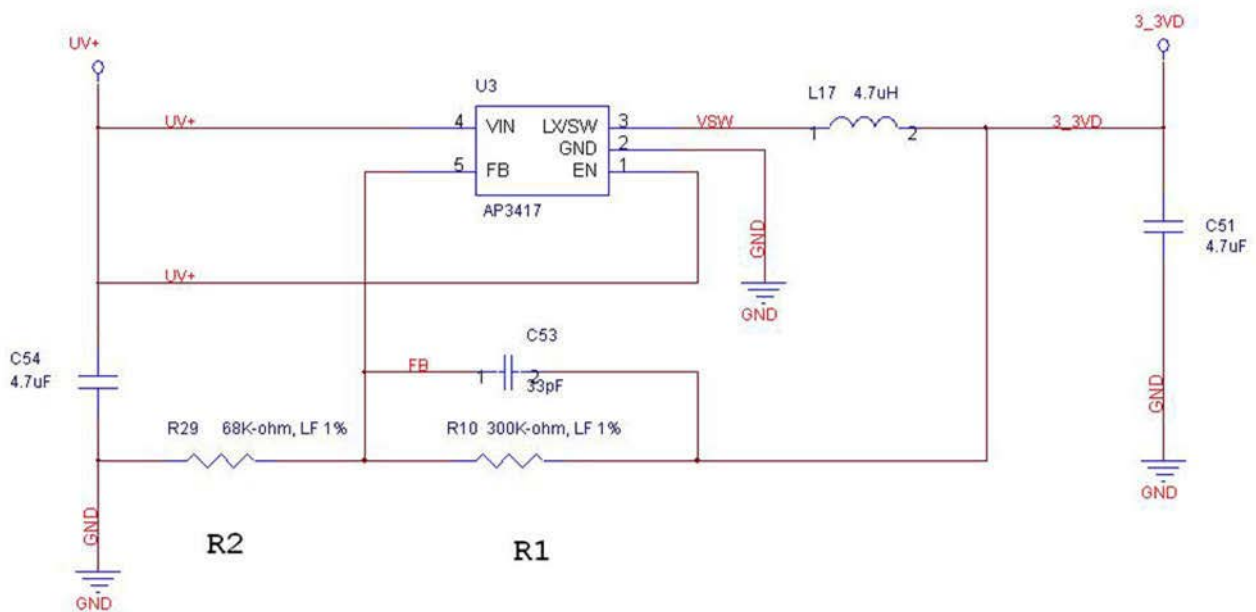


FIG 8 Reel figure

## 12 Reference design

### 12.1 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 **50mA**. 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.



$$V_o = 0.6 * ( \frac{R10 + R29}{R10} ) = 3.3V$$

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

## 12.2 RF circuit

Due to the SMD package, the RF port impedance must be offset after the module is soldered to the motherboard. In order to achieve the best performance, it is recommended to add a PI-type matching network to the motherboard, as shown below (C11, R21, C6). The value of the PI type matching network needs to be debugged according to the actual motherboard to match RF port impedance to 50 Ohm.

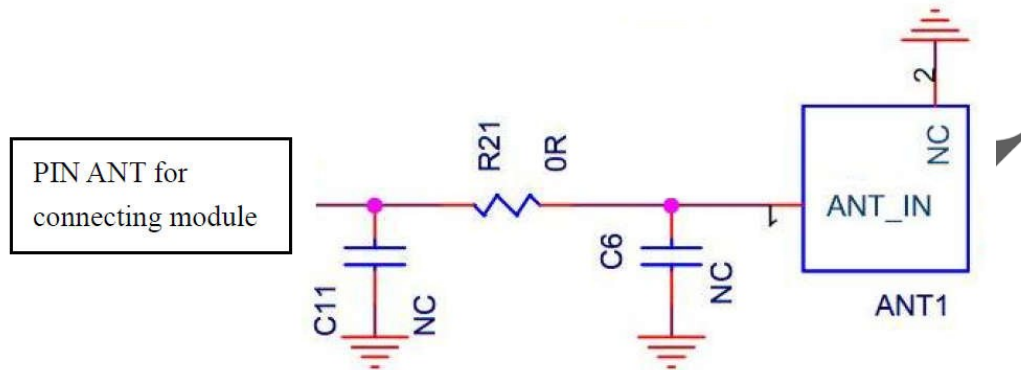


FIG 10 Connect 50 Ohm matching antenna reference circuit

The antenna ANT1 in the figure above must be 50 Ohm. If the antenna is not matched, it is recommended to add a set of PI type matching network at the front of the antenna to match the antenna. Generally, the antenna manufacturers will give Suggestions on matching parameters.

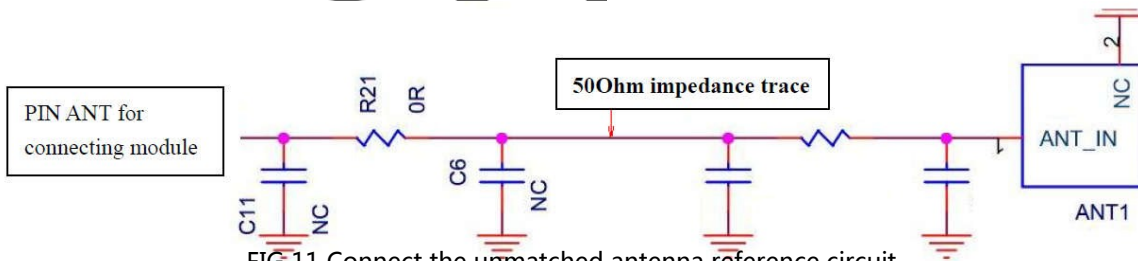


FIG 11 Connect the unmatched antenna reference circuit

The RF line layout should be matched according to 50ohm. The line impedance is related to the plate, plate thickness, line width and copper spacing. Professional software can be used to calculate the line width. Note: for multilayer plates, the plate thickness should calculate the distance from RF routing layer to GND of the next layer. There are RF lines Layout principles:

1. RF line layout needs to match 50 ohms. The line width can be calculated by professional software. (Note: If it is a multi-layer board, the board thickness should calculate the distance from the RF trace layer to the next ground layer.)
2. The RF line must be surrounded by ground copper and ground holes.

3. The PI-type matching circuit for adjusting the impedance of the module is placed close to the module. The PI type matching circuit for matching the antenna is placed close to the antenna.

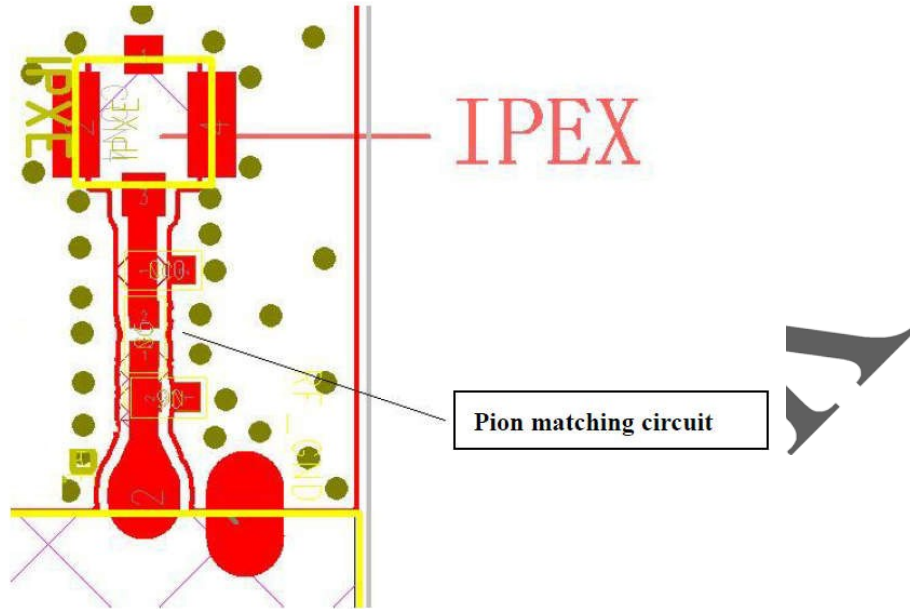


FIG 12 The PI type matching circuit Layout

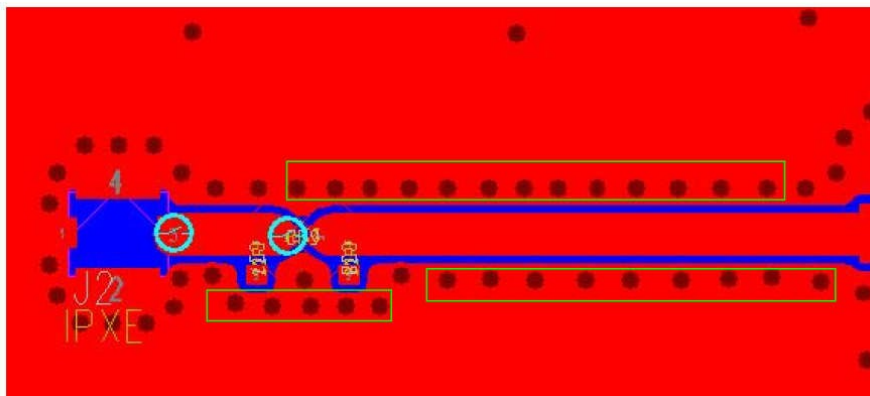


FIG 13 The RF line Layout

## 12.3 Motherboard interference avoidance

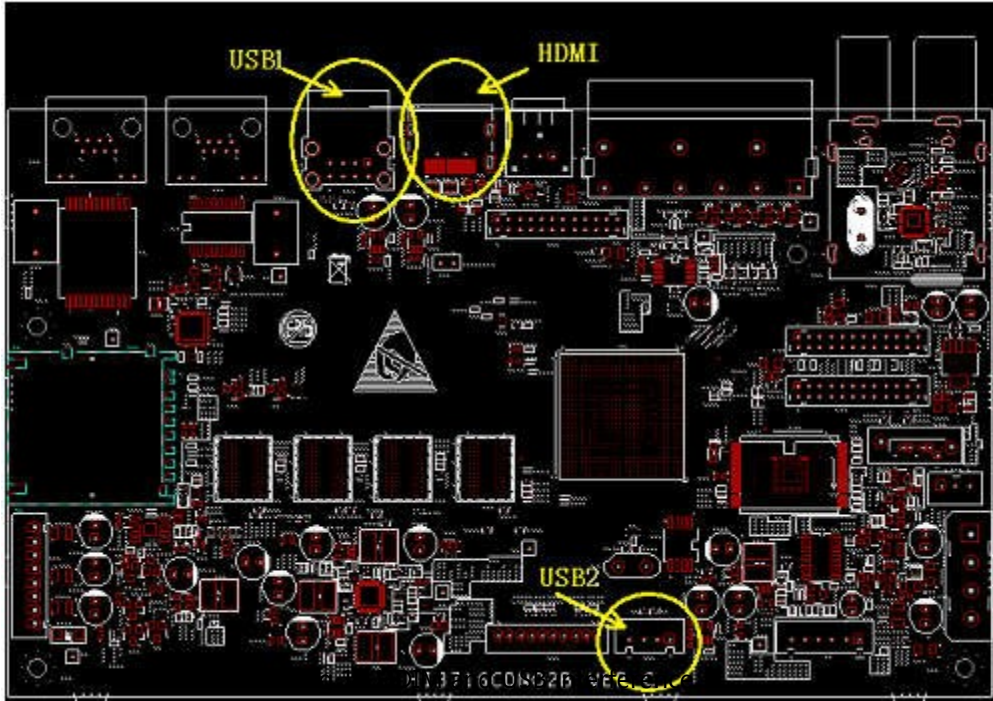
Motherboard interference comes from: high-speed data interface (HDMI), the Operating frequency of main chip, DDR, DC-DC power supply. The method of avoiding interference according to the characteristics of various signals is also different. The main methods of interference avoidance include:

1. keeping away from the source of interference;
2. Adding shields to avoid interference leakage;
3. Reasonable layout to eliminate interference.

### 12.3.1 Interface interference

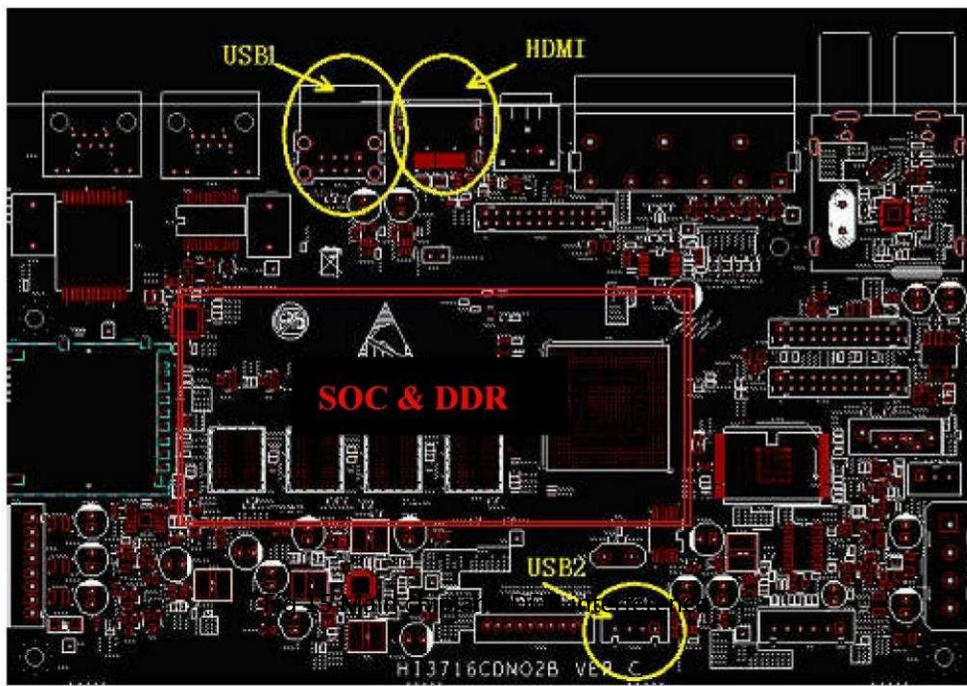
When HDMI uses the 74.2MHz frequency, its 33x frequency is in the 2.4G band of BT, which will seriously interfere with the BT signal. If the HDMI frequency is 148.5MHz, although the 16x frequency is not in the BT band, the isolation of the frequency is not good, and the BT signal will be interfered to 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.)



**12.3.2 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.



## 12.4 Recommended secondary reflux temperature curve

The 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 16 :

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

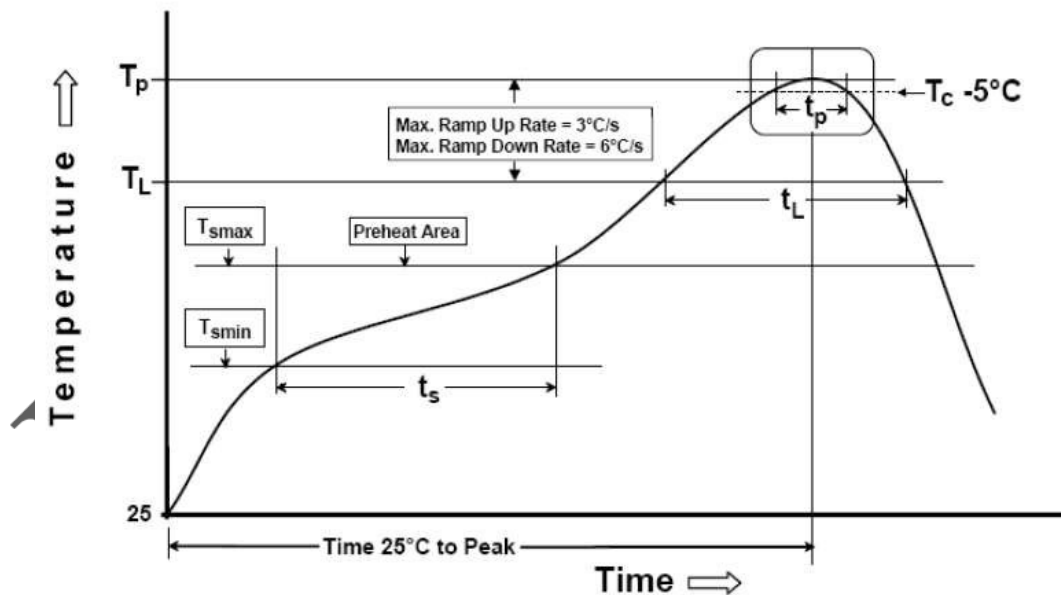


Fig 16 Furnace temperature curve

**Note:**

1. The maximum furnace temperature of the module is 260°C, don't exceed this temperature.
2. The gold plating thickness of the module pad is 2u".



## 13WARNING

### **Federal Communication Commission Statement (FCC, U.S.)**

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 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.

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.

### **FCC Caution:**

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

### **IMPORTANT NOTES**

#### **Co-location warning:**

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

**OEM integration instructions:**

This device is intended only for OEM integrators 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 external antenna(s) that has been originally tested and certified with this module.

As long as the conditions above are met, further transmitter test will not be required. However, the OEM integrator 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.).

**Validity of using the module certification:**

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC/IC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID/IC of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC/IC authorization.

**End product labeling:**

The final end product must be labeled in a visible area with the following:

“Contains Transmitter Module FCC ID: 2AMM6-825X1LA. Contains IC: 26313- 825X1LA.”

**Information that must be placed in the end user manual:**

The OEM integrator 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.

## **Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01**

### **2.2 List of applicable FCC/IC rules**

FCC Part 15 Subpart C 15.247 & 15.207 & 15.209& RSS GEN&RSS 247

### **2.3 Specific operational use conditions**

The module is a BLE module with BLE 2.4G function.

Operation Frequency: 2402~2480MHz

Number of Channel: 40

Modulation: GFSK

Type: Copper tube Antenna

Gain: 0 dBi Max.

The module can be used for mobile or applications with a maximum 0dBi antenna. The host manufacturer installing this module into their product must ensure that the final composite product complies with the FCC/IC requirements by a technical assessment or evaluation to the FCC/IC 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**

Applicable. The module is a Limited module and complies requirement.

### **2.5 Trace antenna designs**

Not applicable. The module has its own antenna, and doesn't need a host's printed board microstrip trace antenna etc.

### **2.6 RF exposure considerations**

The module must be installed in the host equipment such that at least 20cm is maintained between the antenna and users' body; 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/IC or new application. The FCC ID/IC 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/IC authorization

## 2.7 Antennas

Antenna Specification are as follows:

Type: Copper tube Antenna

Gain: 0dBi

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: 2AMM6-825X1LA. Contains IC: 26313- 825X1LA." with their finished product.

## 2.9 Information on test modes and additional testing requirements

Operation Frequency: 2402~2480MHz

Number of Channel: 40

Modulation: GFSK

Host manufacturer must perform test of radiated & conducted emission and spurious emission, etc. 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

The modular transmitter is only FCC/IC authorized for FCC Part 15 Subpart C 15.247 & 15.207 & 15.209 & RSS GEN&RSS 247 and that the host product manufacturer is responsible for compliance to any other FCC/IC 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/ICES 003 compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B/ ICES 003 compliance testing with the modular transmitter installed.

*This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:*

*(1) This device may not cause interference.*

*(2) This device must accept any interference, including interference that may cause undesired operation of the device.*

Cet appareil contient des émetteurs/récepteurs exempts de licence qui sont conformes aux RSS exemptés de licence d'Innovation, Sciences et Développement économique Canada.

L'exploitation est soumise aux deux conditions suivantes :

(1) Cet appareil ne doit pas provoquer d'interférences.

(2) Cet appareil doit accepter toute interférence, y compris les interférences susceptibles de provoquer un fonctionnement indésirable de l'appareil.

EARDATEK

## 14Revision History

Revision	Release Date	Summary	Revised by
V1.0	2021-8-30	First release	RUAN

EARDATEK