

LK8720 BLE Module Manual

Ver.: 1.0.0

Linkiing

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Version update instructions:

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1、Brief Introduction

LK8720 Module is mainly designed for Bluetooth MESH application IoT products, based on Telink TLSR8250 design, supporting Bluetooth Low Energy(up to Bluetooth 5.3)

and Bluetooth MESH, with first-class RF performance, rich peripheral interfaces, and temperature levels suitable for operation under harsh conditions, meeting high performance and reliability requirements.

Mainly applied in fields such as smart homes, interconnected lighting, building automation and safety, and factory automation.

2、Main features

Table 1: main features

feature	Para	Specifics
蓝牙协议	BLE	Support Bluetooth Low Energy 5.3 (Bluetooth 5.3)
		Data rates support 125Kbps, 500Kbps, 1Mbps, 2Mbps.
	Bluetooth mesh	Support flexible mesh control,e.g.N-to-1 and N-to-M
		Compatible with Bluetooth SIG Mesh specification 1.1
		Supports real time status update for over 200 nodes.
CPU&Memory	CPU	TLSR8250 Soc 32-bit
	SRAM	48K
	FLASH	512K
RF	Tx output power	up to +10dBm.
		-101dBm@BLE 125Kbps
		-99dBm@BLE 500Kbps
		-96dBm@BLE 1Mbps
Antenna	Type	-93dBm@BLE 2Mbps
		Antenna PCB/IPX
		GFSK
Power	RX mode	10mA (Whole chip @0dBm with DCDC)
	TX mode	115mA (Whole chip @0dBm with DCDC)
	TX mode	121mA (Whole chip @10dBm with DCDC)
Interface	UART	TX & RX
	GPIO	Input/Output
Working Env	Power supply	1.8~3.6V
	TEMP range	-40~85 °C

3、Module model

According to the different types of antennas, there are two models of modules, as shown in Table 2.

Table 2: module model

Model	IC	FLASH	SRAM	Power	Antenna	GPIO	TEMP range
LK8720PA	TLSR8250F512ET32	512KB	48KB	10dBm	PCB	3	-40—85℃
LK8720PB	TLSR8250F512ET32	512KB	48KB	10dBm	IPX	3	-40—85℃

4、Pin layout



Pic 4: Pin assignment for LK8720

Table 3: Pin functions for LK8720

No.	Pin Name	Type	Note.
1	PB<7>/SDM_N1 / SPI_DO / UART_RX / Ic_comp_ain<7>/sar_aio<7>	Digital I/O	RX
2	PC<2>/ PWM0/7816_TRX(UART_TX)/I2C_SDA/XC32K_O/PGA_P1	Digital I/O	TX
3	PC<4> / PWM2/UART_CTS/PWM0_N/sar_aio<8>/BIAS	Digital I/O	
4	RESET	RESET	Reset
5	PA<7> / SWS / UART_RTS	Digital I/O	SWS
6	GND	Ground	GND
7	VCC	VCC	VCC

5、Key Electrical Specifications

7.1 Absolute maximum ratings

Table 4: Absolute Maximum Ratings

Characteristics	Sym.	Min.	Typ.	Max	Unit	Note.
Supply Voltage	VDD	-0.3	—	3.6	V	
Voltage on Input Pin	VIn	-0.3	—	VDD+0.3	V	
Output Voltage	VOut	0	—	VDD	V	
Storage TEMP Range	TStr	-65	—	150	°C	
Soldering Temperature	TSld	—	—	260	°C	

7.2 Recommended operating condition

Table 5: Recommended Operating Condition

Item	Sym.	Min.	Typ.	Max	Unit	Note.
Power-supply voltage	VDD	1.8	3.3	3.6	V	
Voltage on Input Pin	VIn	-0.3	—	VDD+0.3	V	
Operating TEMP range	TOpr	-40	—	85	°C	

7.3 RF frequency

Table 6: RF Frequency(VDD=3.3V, T=25℃)

Item	Sym.	Min.	Typ.	Max	Unit	Note.
RF frequency range	Frang	2380	—	2500	MHZ	

7.4 DC&AC characteristics

Table 7: DC /AC Characteristics(VDD=3.3V, T=25℃)

Item	Sym.	Min.	Typ.	Max	Unit	Note.
RX mode	I _{Rx}	—	5.3	—	mA	Whole chip @0dBm with DCDC
TX mode	I _{Tx}	—	4.8	—	mA	
TX mode	I _{Tx}	—	24.7	—	mA	Whole chip @10dBm with DCDC
Input high voltage	V _{IH}	0.7VDD		VDD	V	AC
Input low voltage	V _{IL}	VSS		0.3VDD	V	
Output high voltage	V _{OH}	0.9VDD		VDD	V	
Output low voltage	V _{OL}	VSS		0.1VDD	V	

7.5 Module power consumption

Table 8: Sleep Power(No external devices,VDD=3.3V, T=25℃, RF POWER: 3 dBm)

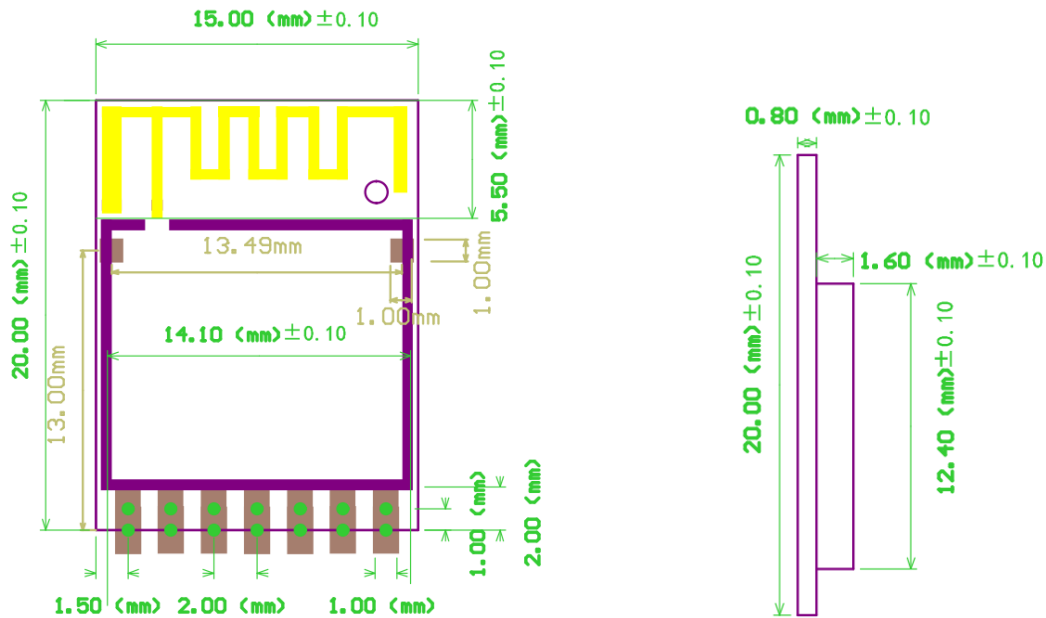
Item	Sym.	Min.	Typ.	Max	Unit	Note.
Adv-interval	50ms	—	2890	—	uA	
	100ms		1400		uA	
	200ms		730		uA	
	300ms		488		uA	
	400ms		363		uA	
	500ms		300		uA	
	1000ms		140		uA	
	1500ms		95		uA	
Conn-interval	50ms		685		uA	
	100ms		328		uA	
	200ms		162		uA	
	300ms		110		uA	
	400ms		85		uA	
	500ms		74		uA	
	1000ms		45		uA	
	1500ms		29		uA	

Table 9: Normal Power(No external devices,VDD=3.3V,T=25℃, RF POWER: 3 dBm)

Item	Sym.	Min.	Typ.	Max	Unit	Note.
Adv-interval	50ms	—	5.23	—	mA	
	400ms		3.13		mA	
	1500ms		2.91		mA	
Conn-interval	50ms		3.38		mA	
	400ms		3.35		mA	
	1500ms		2.91		mA	

6、Layout reference guide

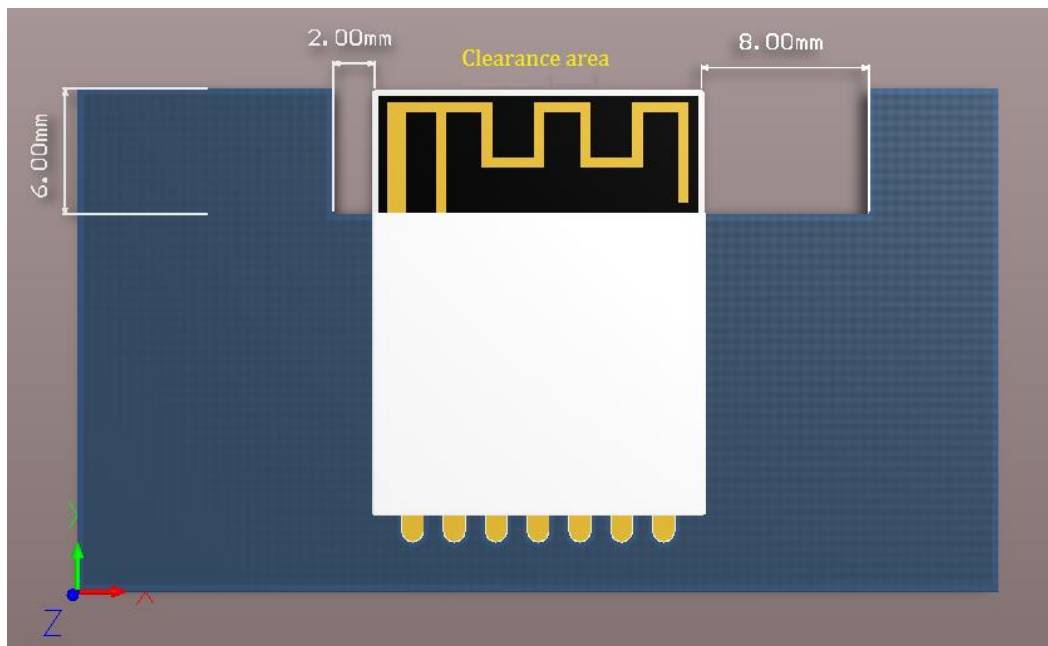
8.1 Module size for LK8720PA



Pic 6: Front/side view of packaging for LK8720PA

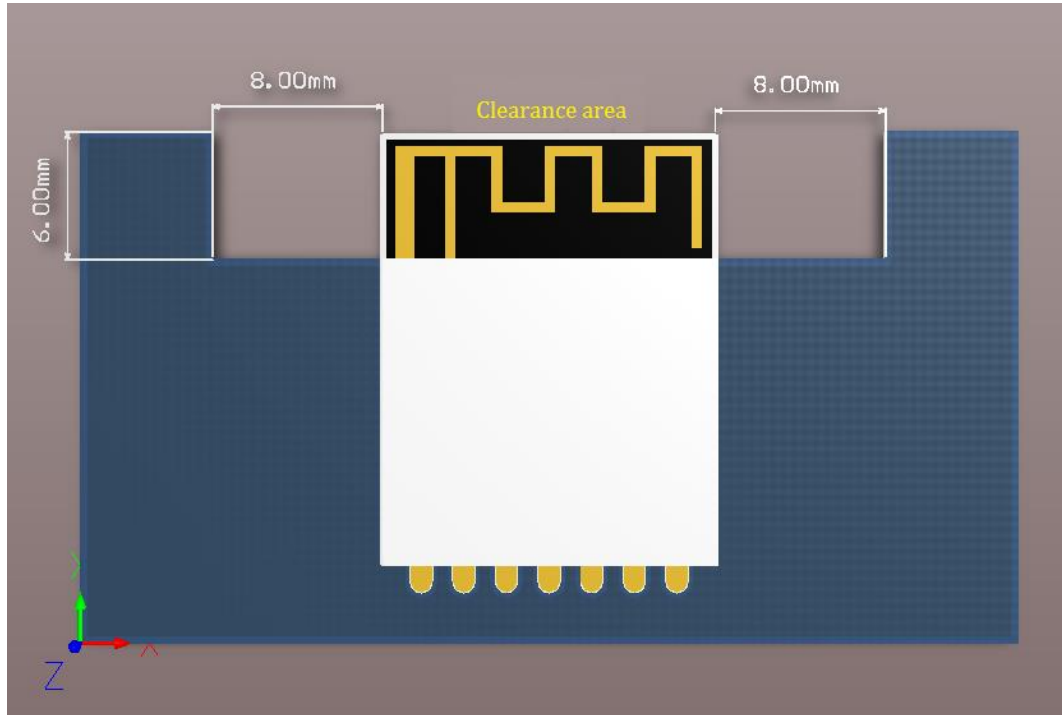
8.2 Module LK8720PA placement requirements

- 1) Small signal and low current leads can be used at the bottom of the module packaging. If conditions permit, it is recommended to lay all copper wires. The PCB antenna area (6.0mm high and 15.0mm wide from the top edge) is not allowed to be laid, and can only be treated as full copper or clearance.
- 2) PCB antennas are used on the module. In order to ensure reliable and stable transmission and reception of Bluetooth data, it is required that the antenna area on the module be placed as close to the edge and corner as possible on the motherboard, and leave a clear space, as shown as Pic7.

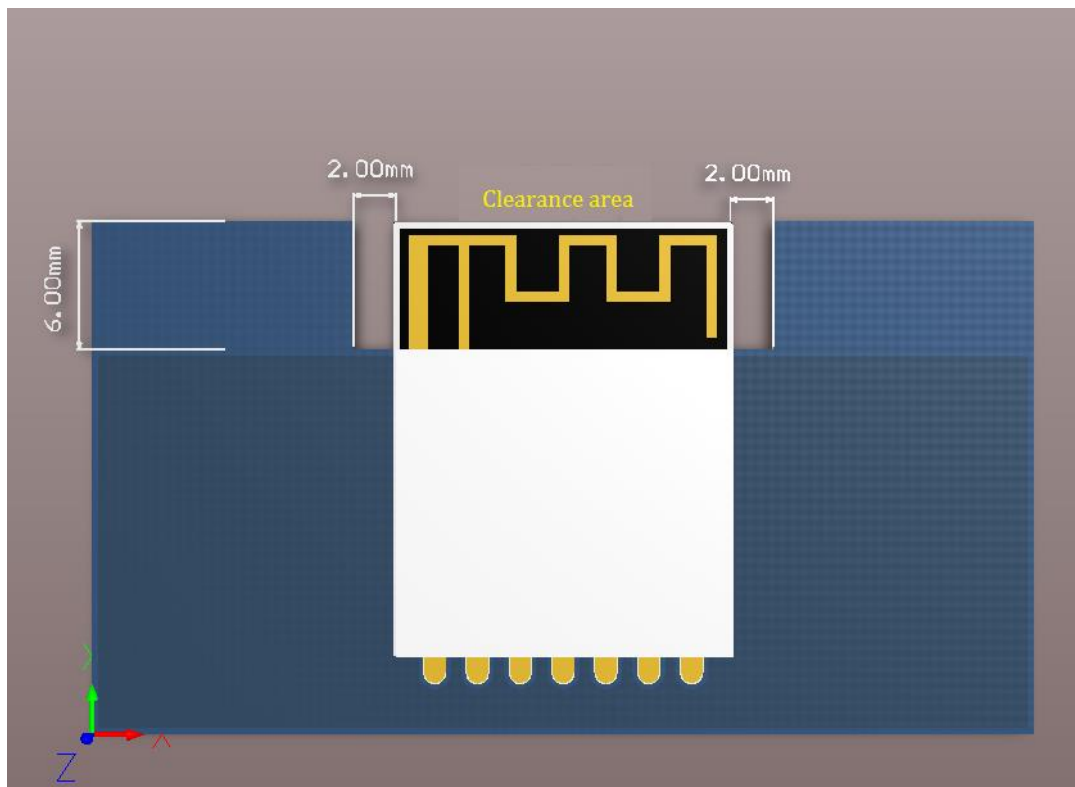


Pic7: Layout diagram of LK8720PA next to the edge (clearance treatment)

- 3) When there is metal near the antenna, the antenna clearance distance is 8mm, as shown as Pic8.
- When there is no metal near the antenna, the antenna clearance distance can be shortened to 2mm, as shown as Pic9.

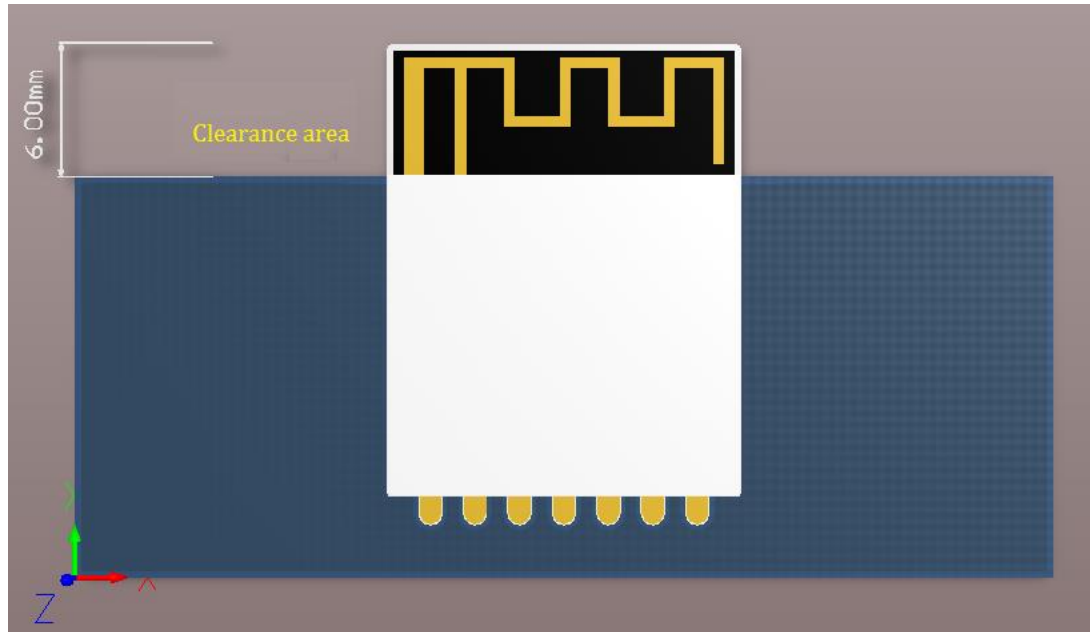


Pic8: Layout diagram of metal around LK8720PA (clearance treatment)



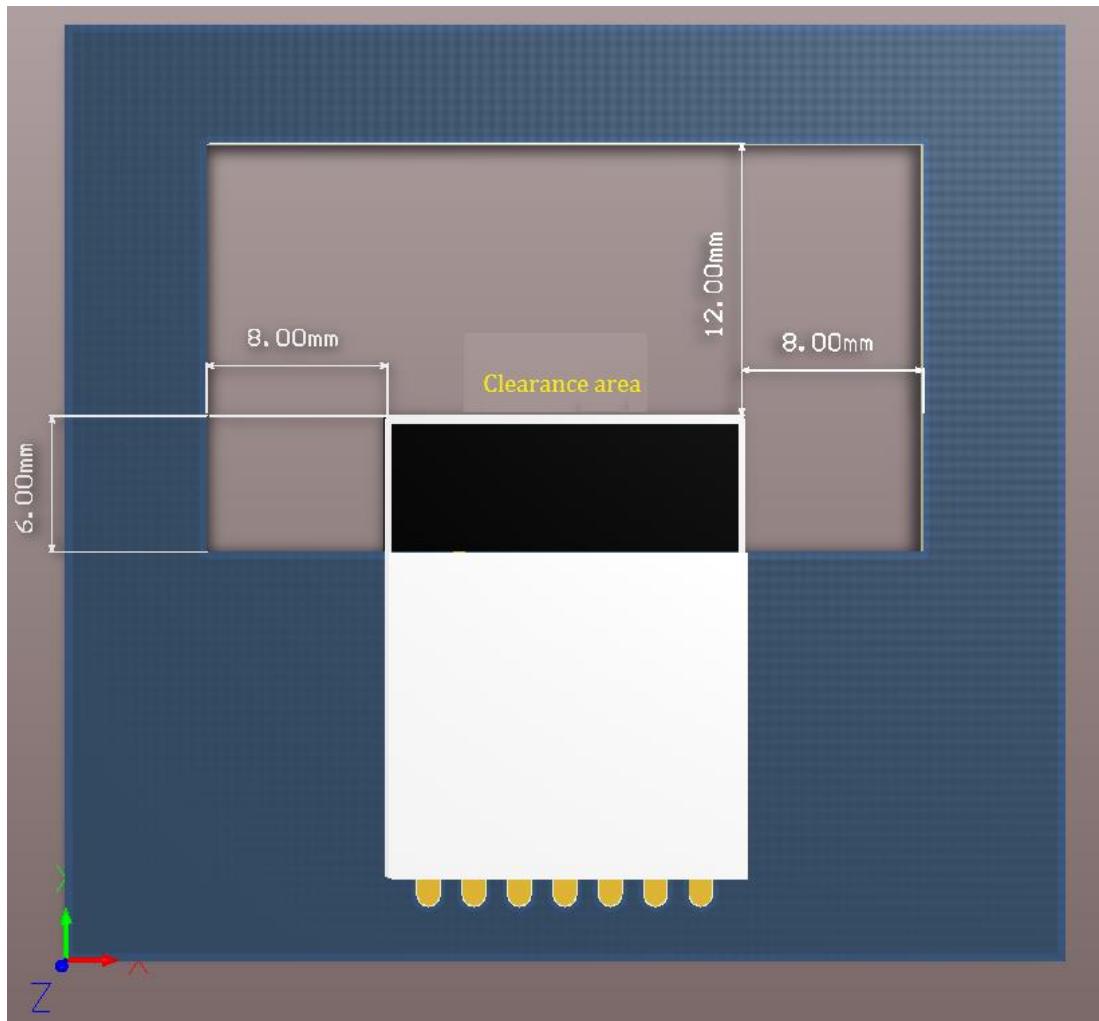
Pic9: Layout diagram of LK8720PA without metal around (clearance treatment)

4) If conditions permit, the module antenna can be installed suspended above the motherboard, as shown as Pic10.



Pic10: Hanging arrangement diagram of LK8720PA module antenna(clearance treatment)

- 5) In practical applications, due to layout limitations, it must be placed in the center or non edge area of the motherboard. In this case, it is required to leave a clear space on the corresponding motherboard corresponding to the three sides (left, upper, and right) of the module PCB antenna, as shown as Pic11.



Pic11: Central layout diagram of LK8720PA module antenna motherboard (clearance treatment)

- 6) The general principle for module placement is to keep the module board away from high current areas, metal casings, and strong magnets. For the PCB antenna area on the module, sufficient RF signal incidence surface and clearance space should be ensured. When the application product is a metal framed plastic shell, placing the Bluetooth module in the non edge area of the motherboard is a better choice. When the application product is a full plastic shell, it is recommended to choose the corner placement scheme.

8.3 Module size for LK8720PB

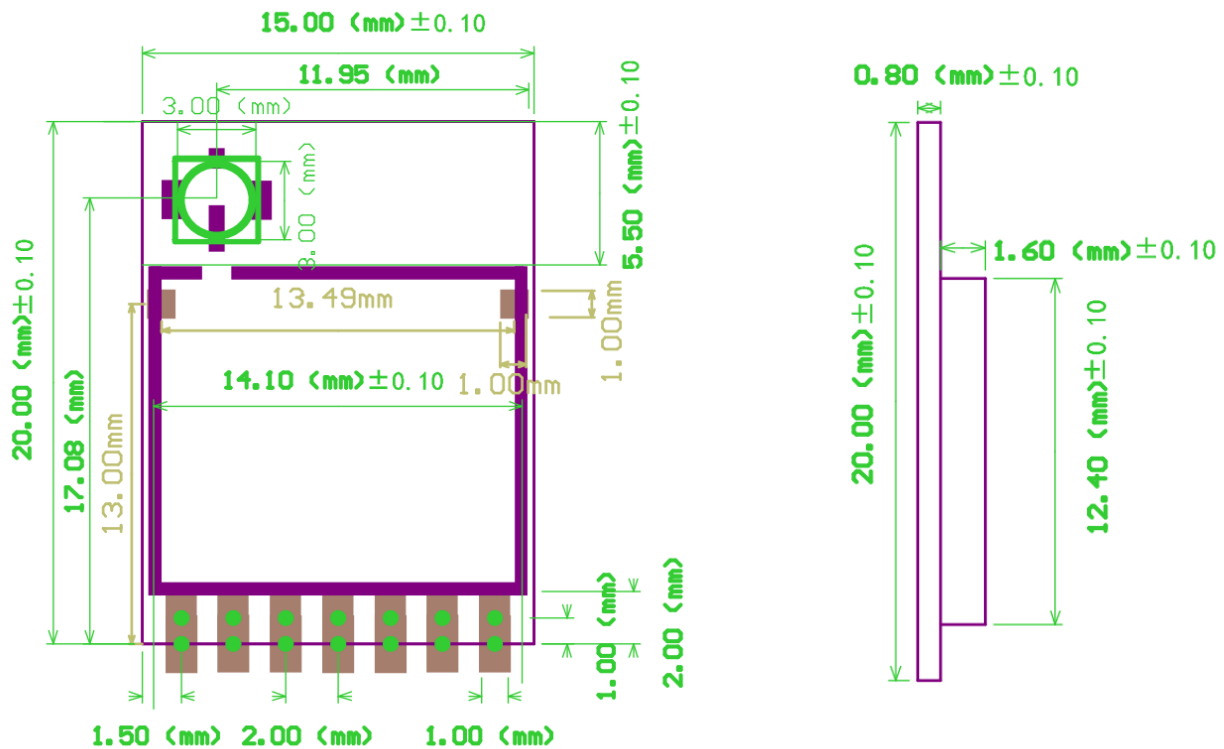


图 12: Front/side view of packaging for LK8720PB

8.4 Module LK8720PA placement requirements

see Article 2 of Chapter 8;

8.5 Hardware Layout Design

- 1) The power supply should not exceed the absolute maximum rated value, otherwise it may cause permanent damage to the module.
- 2) The power supply uses a DC stabilized power supply, and AC power can cause permanent damage to the module.
- 3) Before power supply, check the positive and negative poles. Reverse connection may cause permanent damage to the module.
- 4) The power supply should be stable, and significant voltage fluctuations can affect the use of the module. Ripple should be controlled within 50mV.
- 5) The installation structure of the antenna has a significant impact on the wireless radio frequency signal. It is recommended to ensure that the antenna is exposed as much as possible, and if conditions permit, the antenna can be vertically upwards. When the module is installed inside the casing, it is possible to consider using high-quality antenna extension cables to extend the antenna to the outside of the casing.
- 6) Due to the fact that Bluetooth modules need to be paired with existing systems and placed in the casing, the metal casing has a strong shielding effect on wireless RF signals. It is recommended to Do not install in a metal casing.
- 7) The module should be kept away from high current areas, metal casings, and strong magnetism, otherwise it will greatly affect the performance of the module. If there is significant interference and conditions permit,

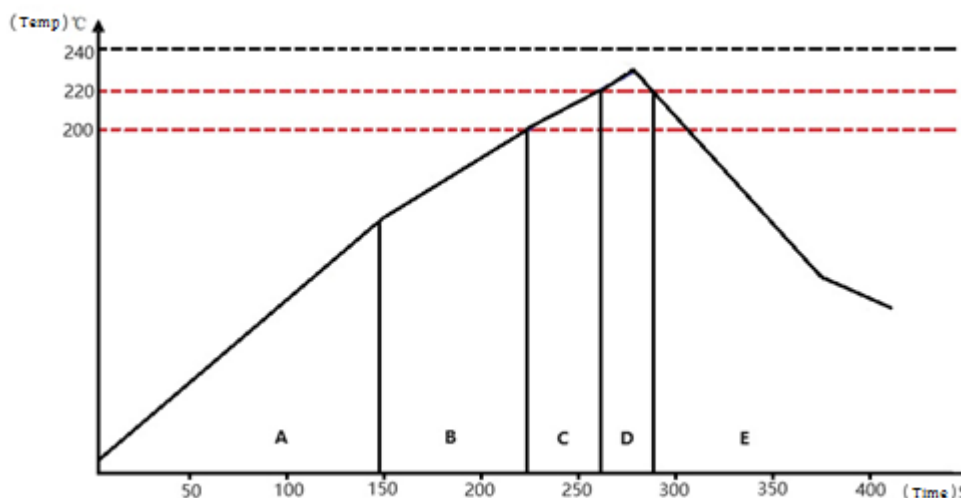
appropriate isolation and shielding can be done.

- 8) High frequency digital wiring, high frequency analog wiring, and power wiring should be avoided below the module, otherwise it will affect the performance of the module. If it is unavoidable, assuming the module is welded to the Top Layer, the top layer in the module contact area must be covered with copper (all covered with copper and well grounded), and it must be close to the digital part of the module and wired to the Bottom Layer. The impact caused should be evaluated based on the actual environment.
- 9) It is recommended to create a 0.5mm prohibited copper laying area under the corresponding module foot position on the bottom plate to prevent short circuits in the foot position caused by poor production welding process.
- 10) Suggest spreading white oil on the bottom plate within the size range of the module to prevent process issues from causing short circuits between the module and the control bottom plate.

8.6 Other precautions

- ◆ The usage environment and wireless signal application of Bluetooth are greatly affected by the surrounding environment, such as trees, metals, and other obstacles that can absorb wireless signals to a certain extent. Therefore, in practical applications, the distance of data transmission is affected to a certain extent.

7、Temperature control for secondary reflow soldering



Pic13: reflow profile

Heating zone (A): temperature: 25-150 °C, time: 80-150 s, heating rate: 1-3 °C/S;

Constant temperature zone (B): temperature: 150-200 °C, time: 40-120s;

Balance zone (C): Temperature: 200-220 °C, Time: 20-30 seconds;

Reflux zone (D): temperature: 220 °C~peak~220 °C, time: 25-70s, peak: 220~245 °C;

Cooling zone (E): peak value~120, cooling rate -1~5 °C/S;

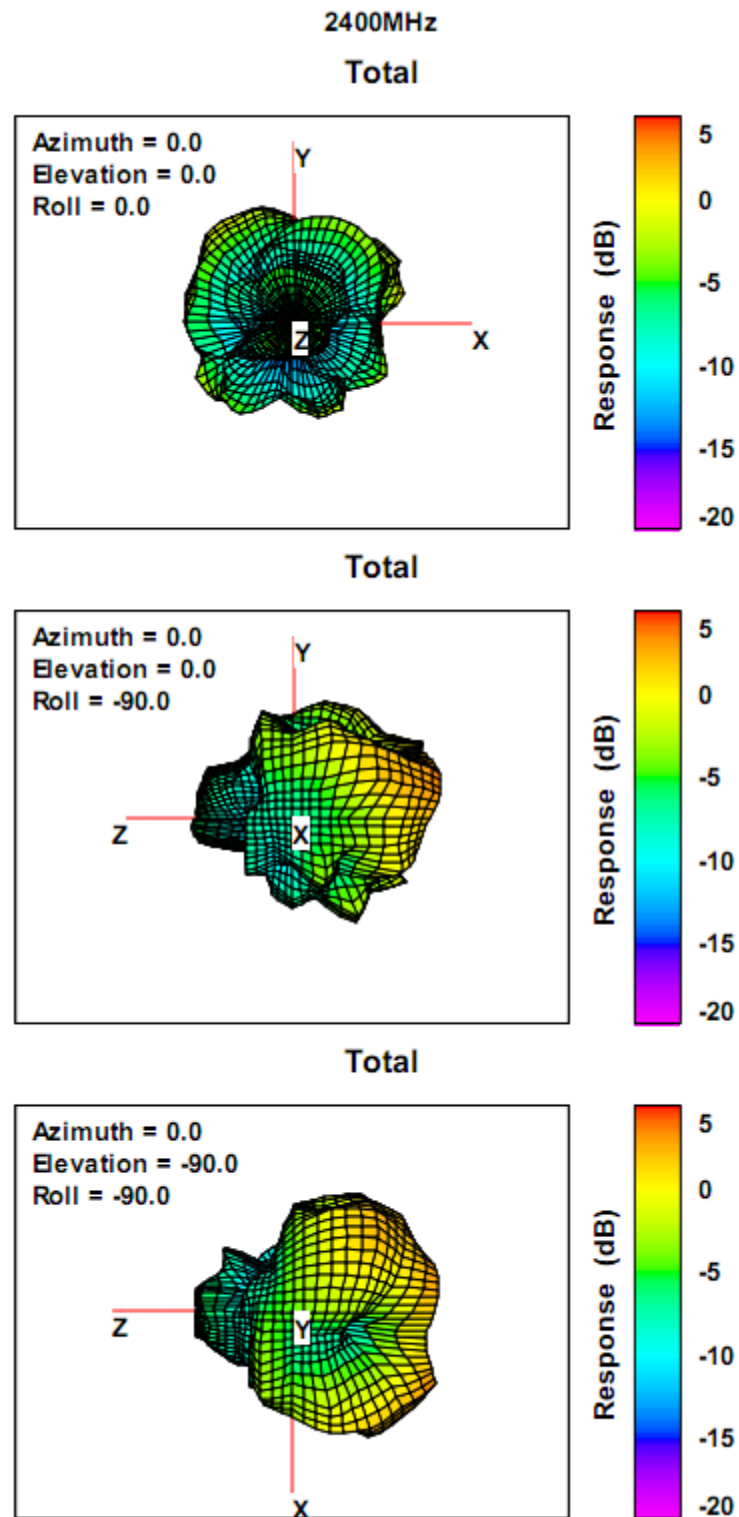
8、 Characteristics of antenna

10.1 3D Antenna Gain-Free Space

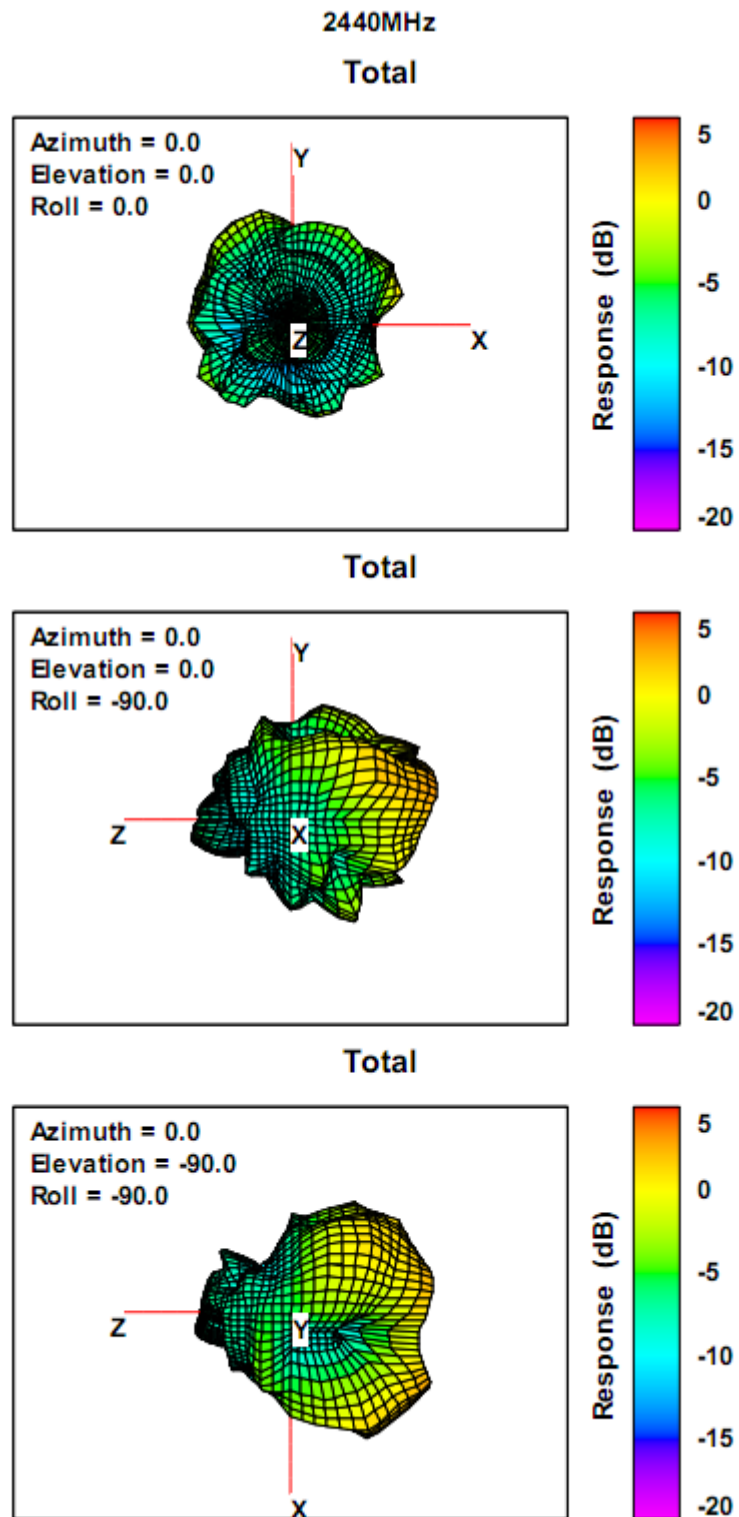
Table10: 3D Antenna Gain-Free Space

Model	Frequency (MHz)	Directivity (dBi)	Efficiency (dB)	Efficiency (%)	Gain (dBi)
LK8720PA	2400	7.60	-3.73	42.35	3.87
	2410	7.68	-4.15	38.42	3.52
	2420	7.72	-4.18	38.16	3.54
	2430	7.80	-4.38	36.52	3.42
	2440	7.79	-4.52	35.34	3.27
	2450	7.80	-4.65	34.29	3.16
	2460	7.84	-4.94	32.06	2.90
	2470	7.84	-4.96	31.88	2.88
	2480	7.80	-5.16	30.45	2.63
	2490	7.82	-5.42	28.71	2.40
	2500	7.94	-5.97	25.28	1.97

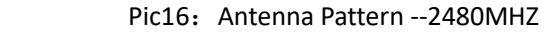
10.2 Antenna Pattern



Pic14: Antenna Pattern --2400MHZ



Pic15: Antenna Pattern --2440MHZ



9、ESD characteristics

Table11: HBM Test

Model	Pin Combinations	ESD Sensitivity Pass: +/-2KV	V Class:2
HBM	IO vs VSS(+)	+2KV	ESDA/JEDEC JS-001-2017 Class-0A:0V-<125V Class-0B:125V-<250V Class-1A:250V-<500V Class-1B:500V-<1000V Class-1C:1000V-<2000V Class-2:2000V-<4000V Class-3A:4000V-<8000V Class-3B: >=8000V
	IO vs VSS(-)	-2KV	
	IO vs VDD(+)	+2KV	
	IO vs VDD(-)	-2KV	
	IO vs IO(+)	+2KV	
	IO vs IO(-)	-2KV	
	VDD vs VSS(+)	+2KV	
	VDD vs VSS(-)	-2KV	

Table12: CDM Test

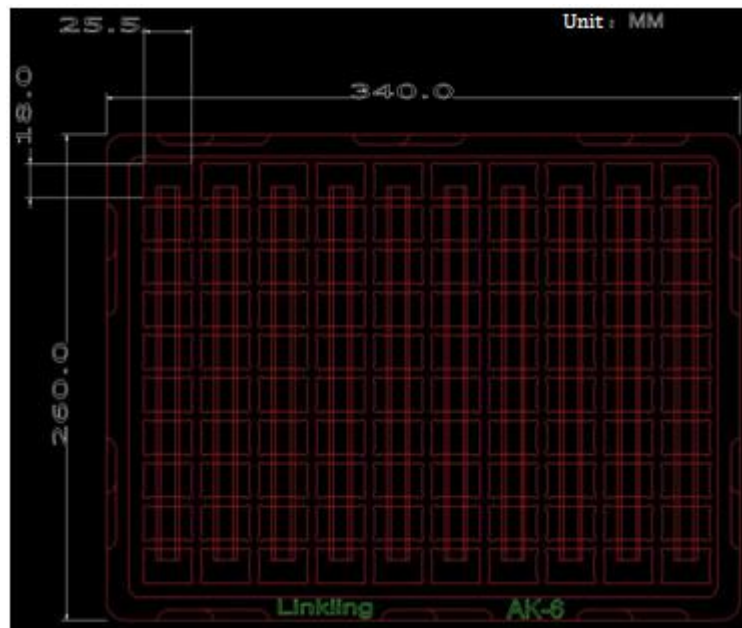
Model	Pin Combinations	ESD Sensitivity Pass: +/-2KV	V Class:2
CDM	ALL Pin(+)	+500V	ESDA/JEDEC JS-002-2014 C0A:0V-<125V C0B:125V-<250V C1:250V-<500V C2A:500V-<750V C2B:750V-<1000V C3:>=1000V
	ALL Pin(-)	-500V	

Note: This module is a device sensitive to static electricity. Please do not operate or store it near strong electrostatic fields. Take appropriate anti-static measures.

10、 Packaging and storage

12.1 Package size

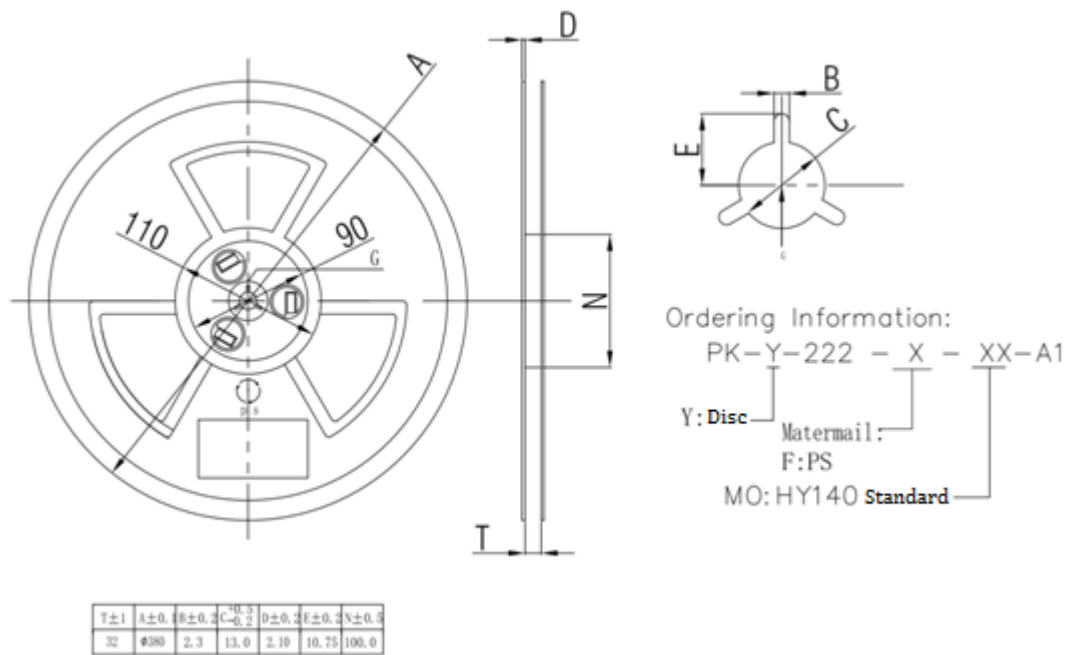
1、 Pallet packaging



Pic17: Dimensional drawing of plastic tray

- Pic17 shows a plastic tray with a size of 34 * 26cm, each tray can hold 100 modules.
- The tray is wrapped in anti-static film and placed in a vacuum anti-static bag.
- Put one package of desiccant and one humidity detection card into each anti-static bag.
- The shipping volume and size of the outer packaging box vary. Taking 5K as an example, the box size is 36 * 28 * 20cm.

2、Braided materials



Pic18: Dimensional diagram of braided disc

- Pic18 shows the size diagram of the ribbon disk, which can accommodate 1000 modules per disk.
- Insert the disc into a vacuum anti-static bag.
- Put one package of desiccant and one humidity detection card into each anti-static bag.
- The shipping volume and size of the outer packaging box vary. Taking 5K as an example, the box size is 39 * 39 * 31cm.

12.2 Storage conditions

1、Put it in a sealed anti-static bag and store it in a non condensing atmospheric environment of <30 °C/90% RH, with a shelf life of 12 months.

2、After opening the vacuum bag:

- It needs to be used up within 72 hours at 30 °C and 60% RH, otherwise it needs to be baked;
- If the 10% color of the humidity detection card inside the packaging changes, the module needs to be baked;
- Baking conditions: see Article 1 of Chapter 13;

11、 Notes on module production process

- 1、 Before production, check the materials. If there is any moisture, it needs to be baked to remove moisture. The baking conditions are:
 - a) The palletized material tray cannot withstand high temperatures above 40 °C. The module needs to be removed from the transportation tray and baked in a constant temperature oven of $120\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}/4\text{H}$;
 - b) Baking constant temperature oven for rolled materials: $60\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}/8\text{H}$;
- 2、 Steel mesh engraving requirements, internal cutting and external expansion: In principle, the effective welding surface of the module is in the bottom area and side. Internal cutting is to prevent bottom tin connection, and generally internal cutting is 0.2mm. External expansion is to strengthen the welding strength of the side. Generally, the external expansion range on three sides is between 0.3mm-0.8mm, depending on the size of the solder pad. It is recommended to expand 0.3mm on both sides and 0.8mm on the external side.
- 3、 Printing requirements, solder paste storage temperature/shelf life: 2-8 °C/6 months, thawing time: 4 hours, stirring time: 5 minutes, usable time: 4-6 hours. Use solder paste with good activity, such as Qianzhu solder paste or solder paste containing 3-4 grams of silver per kilogram.
- 4、 Reflow soldering requirements, RoHS process furnace temperature setting: Normal peak temperature 242-245 °C for 10 seconds, Between: 160-217 °C for 80-95 seconds, Over: 220 °C for 50-65 seconds, Upward: 1-3 °C /second.

Federal Communication Commission Interference Statement

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.

This device 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.

FCC Caution:

- Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
- The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
- The country code selection is for non-US model only and is not available to all US model.

► RF Exposure Information (SAR)

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not 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 authorization.

End Product Labeling : The final end product must be labeled in a visible area with the following:
Contains FCC ID: 2A8JX-LK8720PA

To be provided at a later date

Manual Information to the End User : 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.

Industry Canada statement

- ❶ This device complies with Industry Canada license-exempt RSS standard(s). 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.
- ❶ Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:
 - 1) l'appareil ne doit pas produire de brouillage, et
 - 2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.
- ❷ This Class B digital apparatus complies with Canadian ICES-003.
- ❷ Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.
- ❸ This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter, except tested built-in radios.
- ❸ Cet appareil et son antenne ne doivent pas être situés ou fonctionner en conjonction avec une autre antenne ou un autre émetteur, exception faites des radios intégrées qui ont été testées.

- ④ The County Code Selection feature is disabled for products marketed in the US/ Canada.
- ④ La fonction de sélection de l'indicatif du pays est désactivée pour les produits commercialisés aux États-Unis et au Canada.

FOR DEVICE (>20cm from body / low power)

Radiation Exposure Statement:

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

The final end product must be labelled in a visible area with the following: The Industry Canada certification label of a module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labelled to display the Industry Canada certification number of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as follows:

Contains transmitter module IC: 3221-LK8720PA

This End equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body. Cet équipement devrait être installé et actionné avec une distance minimum de 20 centimètres entre le radiateur et votre corps.

The thisThe end user manual shall include all required regulatory information/warning as shown in this manual.

Contact us

SHENZHEN LINKIING TECHNOLOGY CO.,LTD

Address: 2nd Floor, Building 5, Lihe Industrial Park, Xili Street, Nanshan District, Shenzhen

E-mail: Dylan.xia@linkiing.com

Mobile: (+86)13510925951

Tel: (+86)755-86718235

Net: www.linkiing.com