

LL8258-P Product Manual

Version: 1.3

Release Date: January 21, 2025

1. Product Overview

The LL8258-P is a low-power embedded Bluetooth module developed by LinknLink. It primarily consists of a highly integrated Bluetooth chip (TLSR8258) and a small number of peripheral circuits, featuring a built-in Bluetooth network communication protocol stack and rich library functions.

The module includes a low-power 32-bit MCU, Bluetooth 5.0/2.4G Radio, 512KB Flash, 48KB SRAM, and 7 multiplexed I/O ports.

1) Features

- a. Built-in low-power 32-bit MCU, which can also serve as an application processor.
- b. Supports a main frequency of 2402-2480MHz.
- c. Operating voltage: 3.0V–3.6V.
- d. Peripherals: 5x PWM, 1x I2C, 1x UART.
- e. Bluetooth RF Characteristics:
 - a) Bluetooth 5.0
 - b) Data transfer rate: Up to 2Mbps
 - c) Transmit power: Up to +7dBm
 - d) Receiver sensitivity: -96dBm @ Bluetooth 1Mbps
 - e) Built-in hardware AES encryption
 - f) Onboard PCB antenna
 - g) Operating temperature: -40°C to +85°C

2) Key Application Areas

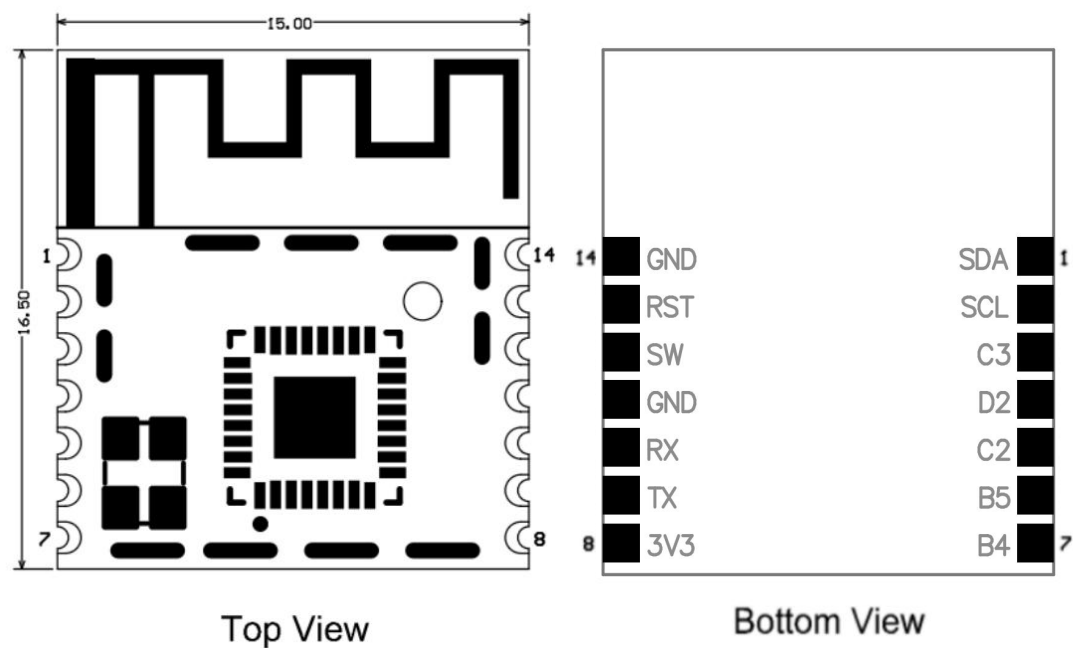
- a. Smart LED
- b. Smart home
- c. Low-power smart sensors

2. Module Interfaces

2.1 Dimensions and Package

The LL8253-P has 2 rows of pins with a pitch of 1.5mm.

Dimensions: $15\pm0.35\text{mm}$ (W) $\times$ $16.5\pm0.35\text{mm}$ (L) $\times$ $2.85\pm0.15\text{mm}$ (H), with a PCB thickness of $0.8\pm0.1\text{mm}$. The package is as shown in the diagram.



2.2 Pin Definitions

No.	Symbol	I/O Type	Function
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1	SDA	I/O	Corresponds to chip PC<0>, I2C data line pin
2	SCL	I/O	Corresponds to chip PC<1>, I2C clock line pin
3	C3	I/O	Corresponds to chip PC<3>, general-purpose I/O
4	D2	I/O	Corresponds to chip PD<2>, general-purpose I/O
5	C2	I/O	Corresponds to chip PC<2>, general-purpose I/O

No.	Symbol	I/O Type	Function
6	B5	I/O	Corresponds to chip PB<5>, general-purpose I/O
7	B4	I/O	Corresponds to chip PB<4>, general-purpose I/O
8	3.3V	P	Module power input pin.
9	TX	I/O	Corresponds to chip PB<1>, UART transmit pin
10	RX	I/O	Corresponds to chip PB<7>, UART receive pin
11	GND	P	Module power ground reference pin.
12	SW	I/O	Corresponds to chip SWS, Bluetooth chip programming pin.
13	RST	I	Corresponds to chip RESETB, module reset pin with internal pull-up resistor.
14	GND	P	Module power ground reference pin.

Note: "P" denotes power pins, "I/O" denotes input/output pins.

3. Module Interfaces

3.1 Absolute Electrical Parameters

Parameter	Description	Min	Max	Unit
Ts	Storage temperature	-65	150	°C
VCC	Supply voltage	-0.3	3.9	V
ESD voltage (HBM)	Human Body Model, TAMB = 25°C	—	2	kV
ESD voltage (MM)	Machine Model, TAMB = 25°C	—	0.5	kV

3.2 Operating Conditions

Parameter	Description	Min	Typ	Max	Unit
Ta	Operating temperature	-40	—	85	°C
VCC	Operating voltage	3.0	3.3	3.6	V
VIL	I/O low-level input	VSS	—	VCC × 0.3	V
VIH	I/O high-level input	VCC × 0.7	—	VCC	V
VOL	I/O low-level output	VSS	—	VCC × 0.1	V
VOH	I/O high-level output	VCC × 0.9	—	VCC	V

3.3 Power Consumption in Operating Modes

Symbol	Condition	Typ	Peak (Typ)	Unit
I _{tx}	Continuous transmission, 10dBm output power	16.8	18.4	mA
I _{tx}	Continuous transmission, 0dBm output power	6.3	8.8	mA
I _{rx}	Continuous reception	6.3	8.9	mA
I _{DC}	Network configuration state	6.8	32	mA
I _{DC}	Network-connected state	6.8	32	mA

4. RF Parameters

4.1 Basic RF Characteristics

Parameter	Description
Operating frequency	2.4GHz ISM Band
Wireless standard	Bluetooth 5.0
Data transfer rate	1Mbps, 2Mbps
Antenna type	Onboard PCB antenna

4.2 RF Output Power

Parameter	Min	Typ	Max	Unit
RF average output power	-22	10	7	dBm
20dB modulation bandwidth (1Mbps)	—	2500	—	kHz
20dB modulation bandwidth (2Mbps)	—	2600	—	kHz

4.3 RF Receiver Sensitivity

Parameter	Min	Typ	Max	Unit
RX sensitivity (1Mbps)	—	-94.5	—	dBm
RX sensitivity (2Mbps)	—	-90	—	dBm

Parameter	Min	Typ	Max	Unit
Frequency offset error (1Mbps)	-300	—	+300	kHz
Frequency offset error (2Mbps)	-200	—	+200	kHz
Co-channel interference rejection	—	-7	—	dB

5. Antenna Information

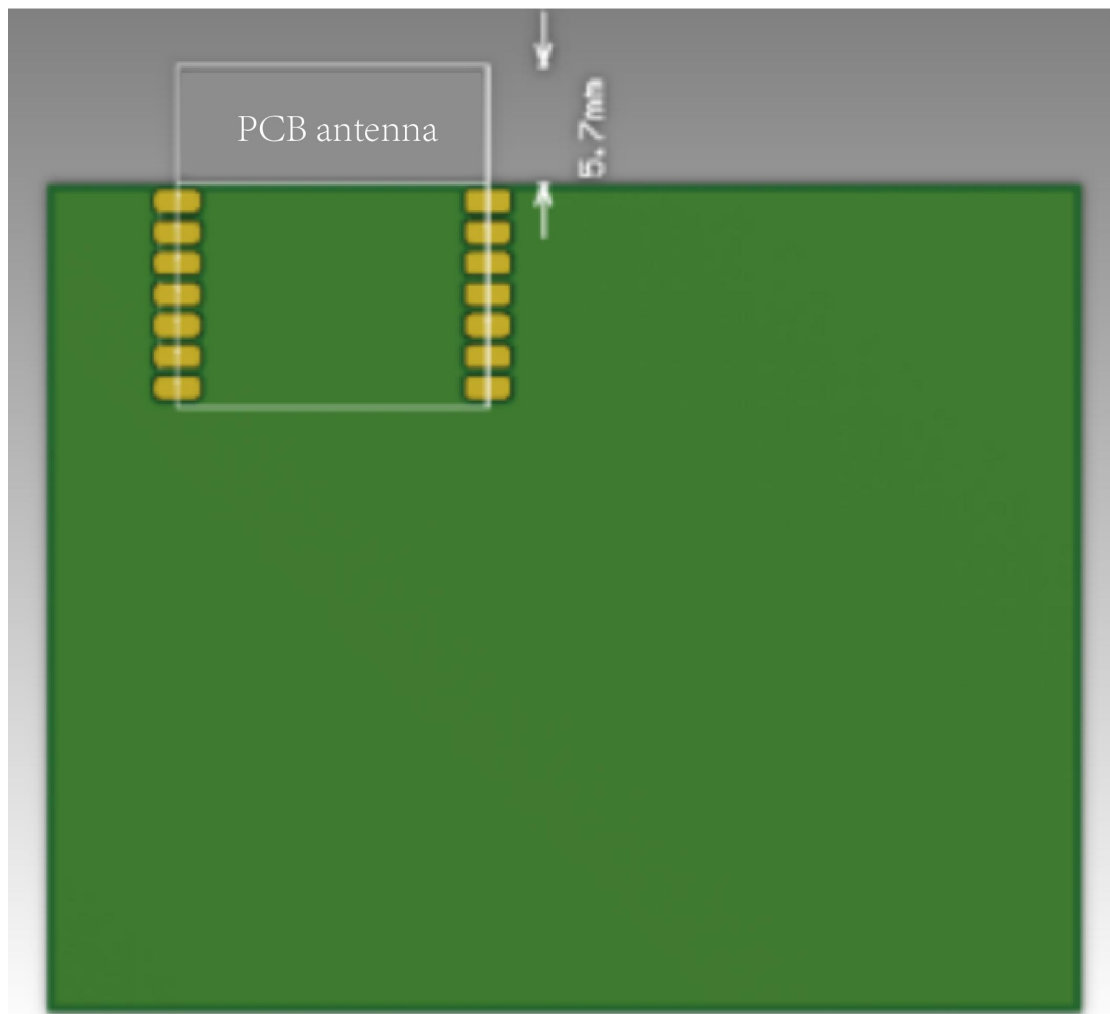
5.1 Antenna Type

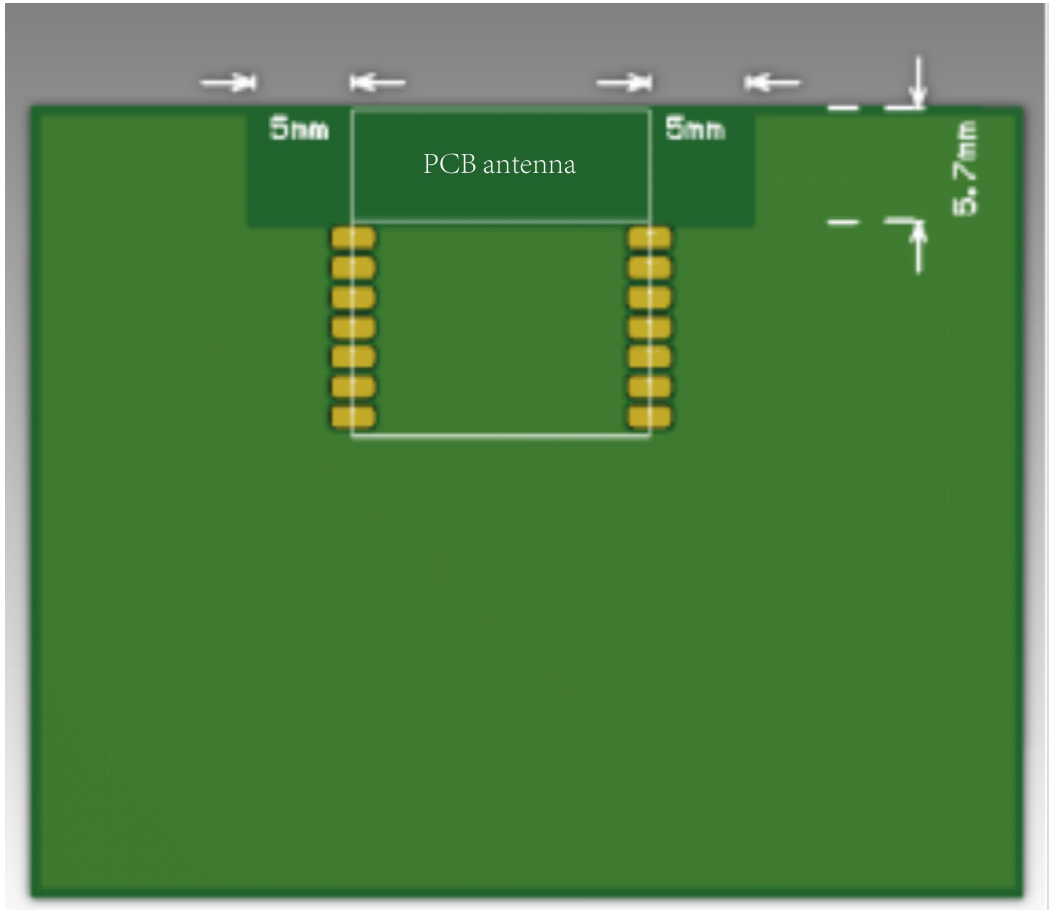
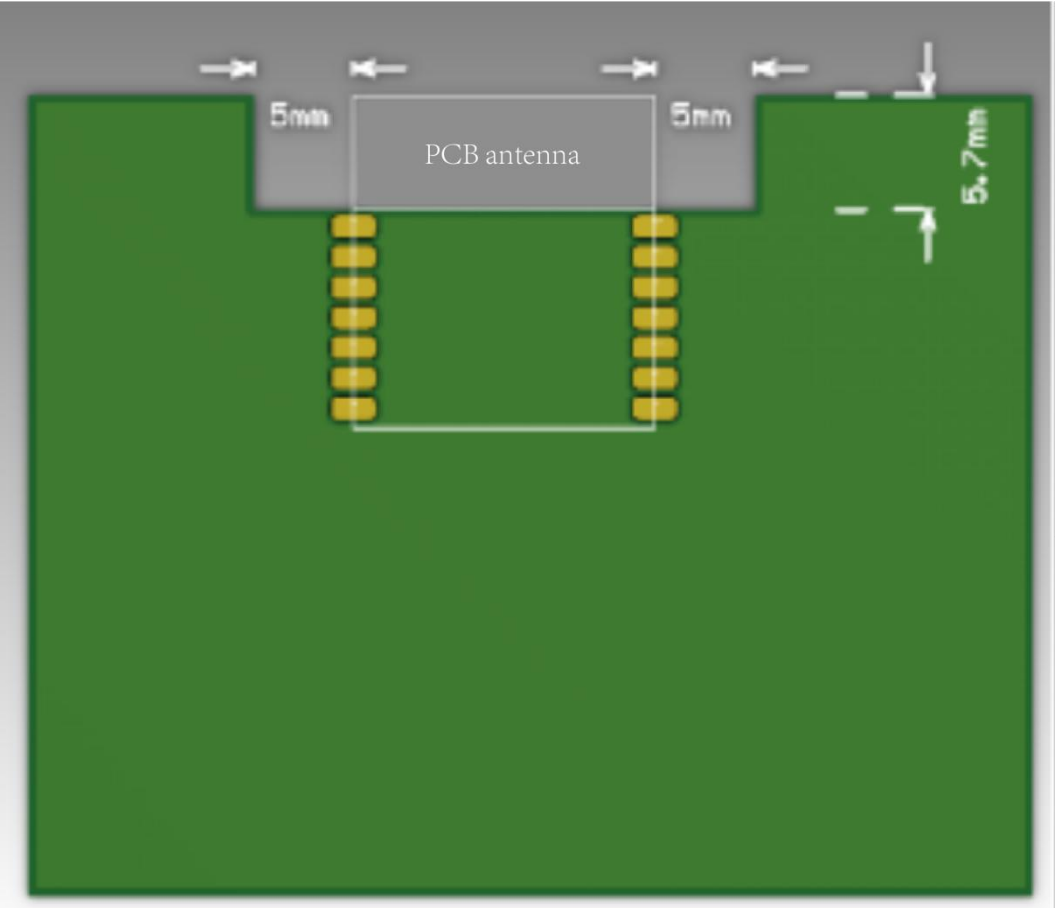
The LL8258-P uses an onboard PCB antenna.

5.2 Reducing Antenna Interference

To ensure optimal RF performance, maintain a minimum distance of 15mm between the antenna area and other metal components. Avoid routing traces or placing copper layers on the PCB in the antenna region. Key layout guidelines:

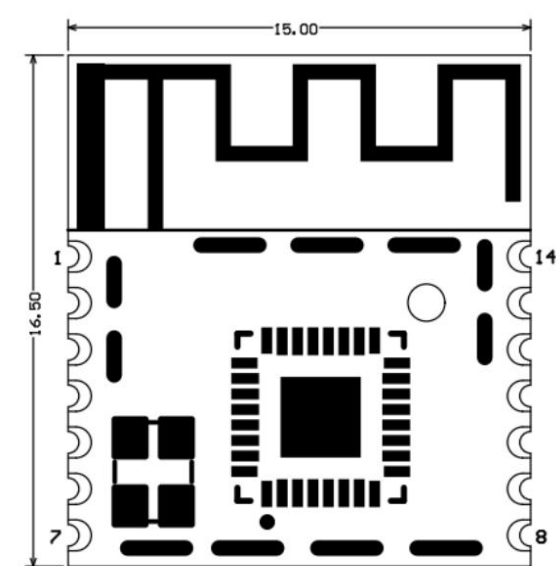
- Ensure no substrate material is directly above or below the printed antenna.
- Keep the antenna area clear of surrounding copper to maximize radiation efficiency.



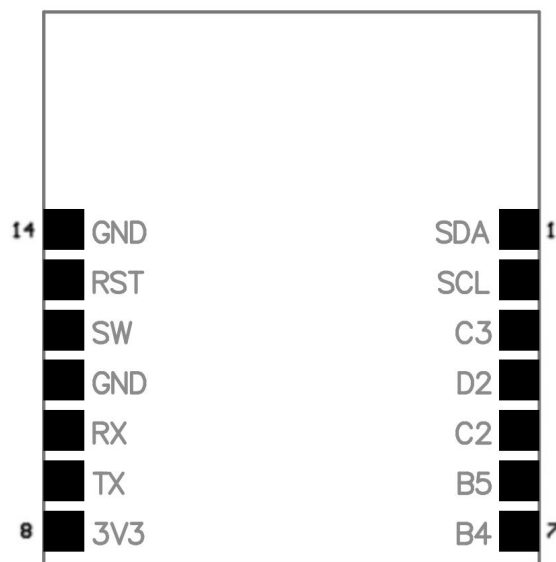


6. Package Information and Production Guidelines

6.1 Mechanical Dimensions and Backside Pad Dimensions

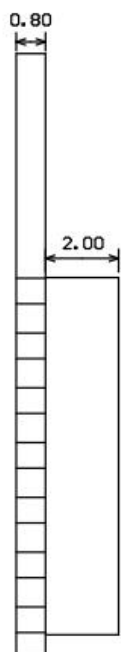


Top View



Bottom View

Unit: mm



单位: mm

模组外形公差: $\pm 0.35\text{mm}$

板厚公差: $\pm 0.1\text{mm}$

屏蔽盖高度公差: $\pm 0.05\text{mm}$

Unit: mm

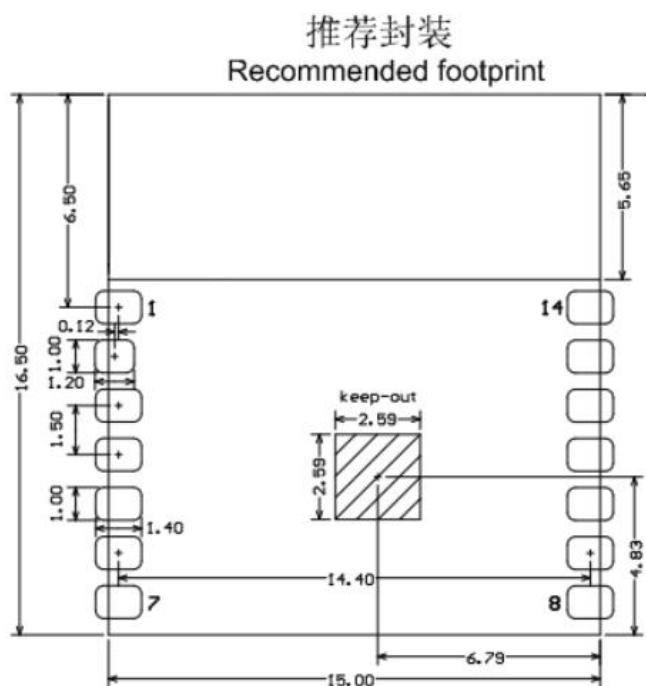
Module form factor tolerance: $\pm 0.35\text{mm}$

PCB thickness tolerance: $\pm 0.1\text{mm}$

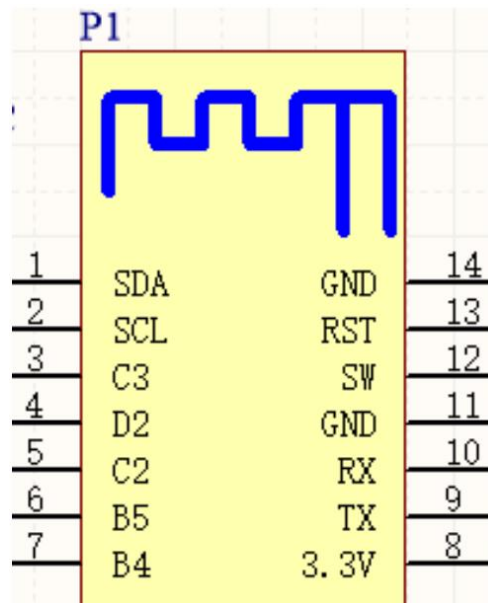
Shield cover height tolerance: $\pm 0.05\text{mm}$

Side View

Recommended packaging:



Explanation: The keep-out area indicated in the above figure should not be soldered and no traces should be routed through it.



6.3 Production Guidelines

1. SMT Assembly:

- LinknLink's SMT-packaged modules should be mounted using SMT equipment. After opening the package, complete soldering within 24 hours.
- Unused modules should be stored in a dry cabinet (<10% RH) or resealed in vacuum packaging with exposure time recorded. Total exposure time must not exceed 168 hours.

a. Required SMT Equipment:

- Pick-and-place machine
- SPI (Solder Paste Inspection)
- Reflow oven
- Oven temperature profiler
- AOI (Automated Optical Inspection)

b. Baking Requirements:

- Oven with anti-static, high-temperature trays and gloves.

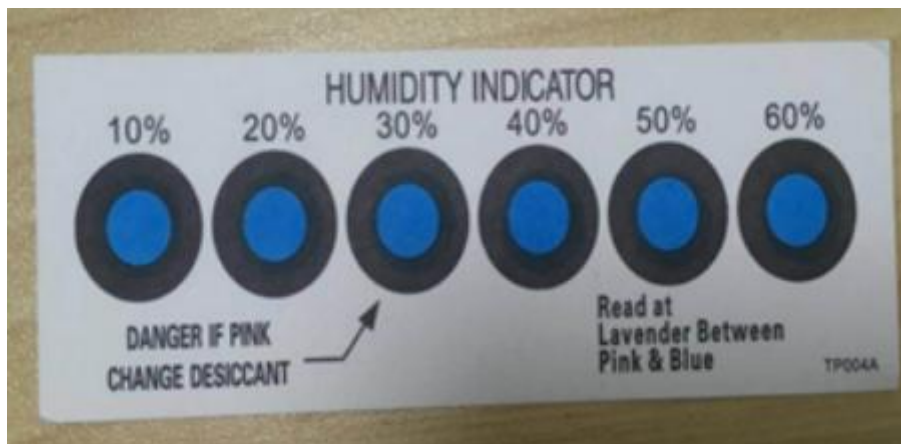
2. Storage Conditions:

- Moisture barrier bags must be stored at <40°C and <90% RH.

- Shelf life: 12 months from the date of sealing.

3. Modules must be baked if:

- Vacuum packaging is damaged before opening.
- No humidity indicator card is found inside.
- Humidity indicator shows $\geq 10\%$ pink (indicating moisture).
- Total exposure time exceeds 168 hours.
- Exceeds 12 months from the original sealing date.



4. **Baking Parameters:**

- **Reel packaging:** 40°C, $\leq 5\%$ RH, 168 hours.
- **Tray packaging:** 125°C, $\leq 5\%$ RH (using high-temperature trays), 12 hours.
- Alarm temperature: 50°C (reel) / 135°C (tray).
- Cool naturally to $< 36^\circ\text{C}$ before production.
- If exposure time exceeds 168 hours after baking, rebake before use. Modules are MSL-3; exceeding exposure limits without baking may cause soldering defects.

5. **ESD Protection:** Implement ESD safeguards throughout production.

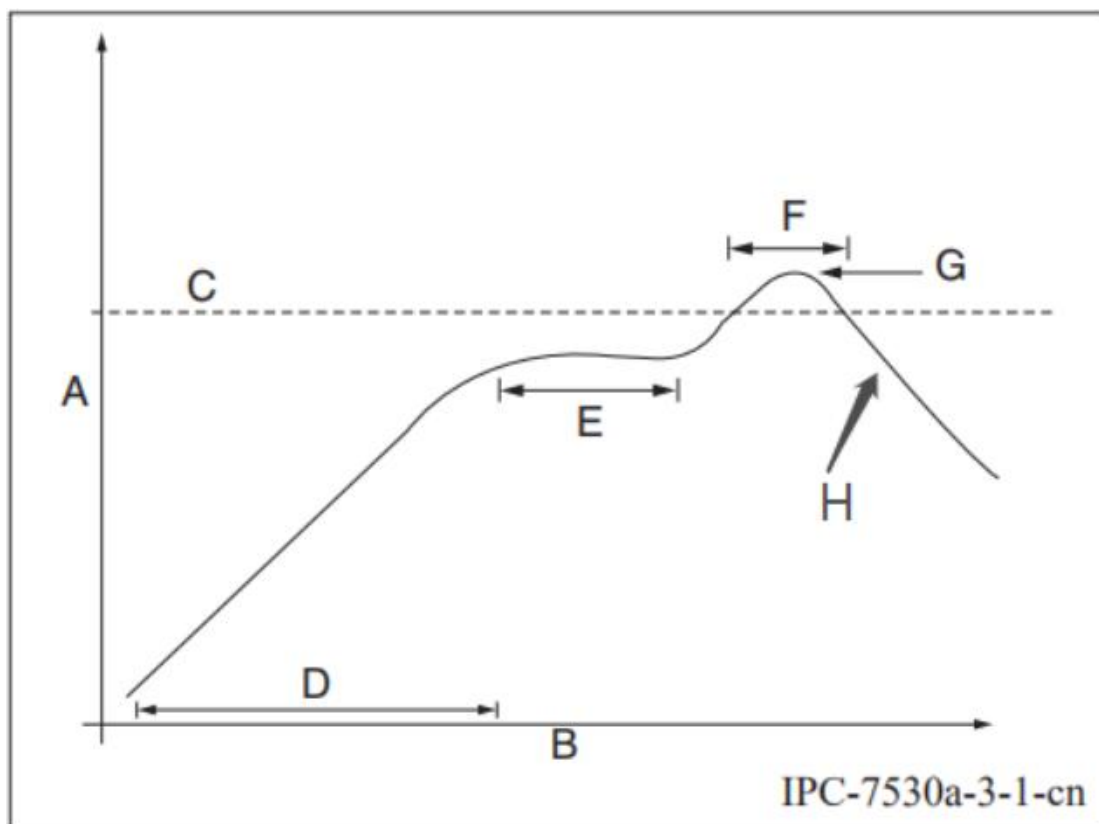
6. **Quality Control:** Use SPI and AOI to monitor solder paste printing and placement quality.

6.4 Recommended Reflow Profile

Set the reflow oven according to the temperature curve below (example for SAC305

solder paste):

- **Peak temperature:** 245°C
- **Key parameters:**
- Alloy liquidus: 217–220°C
- Heating slope: 1–3°C/s
- Soak time: 60–120s (150–200°C)
- Time above liquidus: 50–70s
- Cooling slope: As per solder paste specifications.



Note: Adjust for other solder alloys based on their datasheets.

FCC Warning

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01r01

2.2 List of applicable FCC rules

FCC Part 15 Subpart C 15.247 & 15.207 & 15.209& 15.205

2.3 Specific operational use conditions

This transmitter/module and its antenna(s) must not be co-located or operating in conjunction with any transmitter. This information also extends to the host manufacturer's instruction manual.

2.4 Limited module procedures

Not applicable

2.5 Trace antenna designs

If trace antenna designs are applicable, full-detail design specifications are required per D02 Module Q&A Question 11.

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects: layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.⁴

- a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);
- b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
- c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;
- d) Appropriate parts by manufacturer and specifications;
- e) Test procedures for design verification;
- f) Production test procedures for ensuring compliance.

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

Explanation: The module with PCB antenna designs, See antenna report for antenna details.

2.6 RF exposure considerations

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This compliance to FCC radiation exposure limits for an uncontrolled environment, and minimum of 20cm separation between antenna and body.

The host product manufacturer would provide the above information to end users in their end-product manuals.

2.7 Antennas

For Part 15 and licensed CMRS Client devices a list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an “omni-directional antenna” is not considered to be a specific “antenna type”).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

Licensed (non-client station) Modules for a base, fixed station can be stated as conducted, and antenna data is not required when it is clear that the licensee is responsible for the applicable limits under the rules and or license.

Explanation: The EUT has PCB antenna. See antenna report for antenna details. The antenna Max Gain is 3.65dBi and the Impedance is 50Ohm.

2.8 Label and compliance information

The end product must carry a physical label or shall use e-labeling followed KDB 784748 D01 and KDB 784748 stating “Contains Transmitter Module FCC ID: 2A9BE-LL8258.

2.9 Information on test modes and additional testing requirements

The working voltage range of the module is: DC 3.0V~3.6V

If the module experiences overvoltage or undervoltage, or if the temperature is too low or too high, it will stop working, There is no risk of interference.

Radio Technology	: Bluetooth V5.0 LE
Operation frequency	: 2402-2480MHz
Channel No.	: 40 channels
Channel Separation	: 2MHz
Data rate	: 1Mbps/2Mbps
Modulation	: GFSK
Antenna Type	: PCB antenna, Maximum Gain is 3.65dBi.

The test mode can be the worst mode in the original report: GFSK 1Mbps 2402MHz.

Note: The maximum power of the module is 6 ± 1 dBm. The product uses a fixed onboard antenna and does not involve antenna replacement.

2.10 Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only FCC authorized for the specific rule parts (FCC Part 15.247) listed on the grant, 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. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed when contains digital circuitry.

2.11 Note EMI Considerations

Note that a host manufacture is recommended to use D04 Module Integration Guide recommending as "best practice" RF design engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties

2.12 How to make changes

Since only Grantees are permitted to make permissive changes, it is recommended that module manufactures provide contact information and some guidance to host providers in the integration instructions if they expect their module will be used differently than granted.

Module manufacturer contact: Hangzhou LinknLink Technology Co., Ltd.

Tel: 15868110860

E-mail: yujing.chen@linklink-iot.com

FCC Statements

(OEM) Integrator has to assure compliance of the entire end-product incl. the integrated RF Module. For 15 B (§15.107 and if applicable §15.109) compliance, the host manufacturer is required to show compliance with 15 while the module is installed and operating.

Furthermore the module should be transmitting and the evaluation should confirm that the module's intentional emissions (15C) are compliant (fundamental / out-of-band). Finally the integrator has to apply the appropriate equipment authorization (e.g. Verification) for the new host device per definition in §15.101.

Integrator is reminded to assure that these installation instructions will not be made available to the end-user of the final host device.

The Integrator will be responsible to satisfy SAR/ RF Exposure requirements, when the module integrated into the host device.

NOTE: 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

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.

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.