WIFI Module
DBOX-IOT16 Specification

Version V1.0

Document resume

Version	Date	Develop/revise content	Edition	Approve
V1.0		Initial release		

Content

1. Product Overview

DBOX-IOT16 is a dual-frequency Wi-Fi module based on RTL8720DN. DBOX-IOT16 supports dual-frequency (2.4ghz or 5ghz) WLAN; it integrates ARM V8 (compatible with Cortex-M4F) high-performance MCU,ARM V8M (compatible with Cortex-M0) low-power MCU,WLAN(802.11 a / b / g / n), MAC,and RF baseband) and provides a set of configurable GPIO ports for the control of different peripherals.

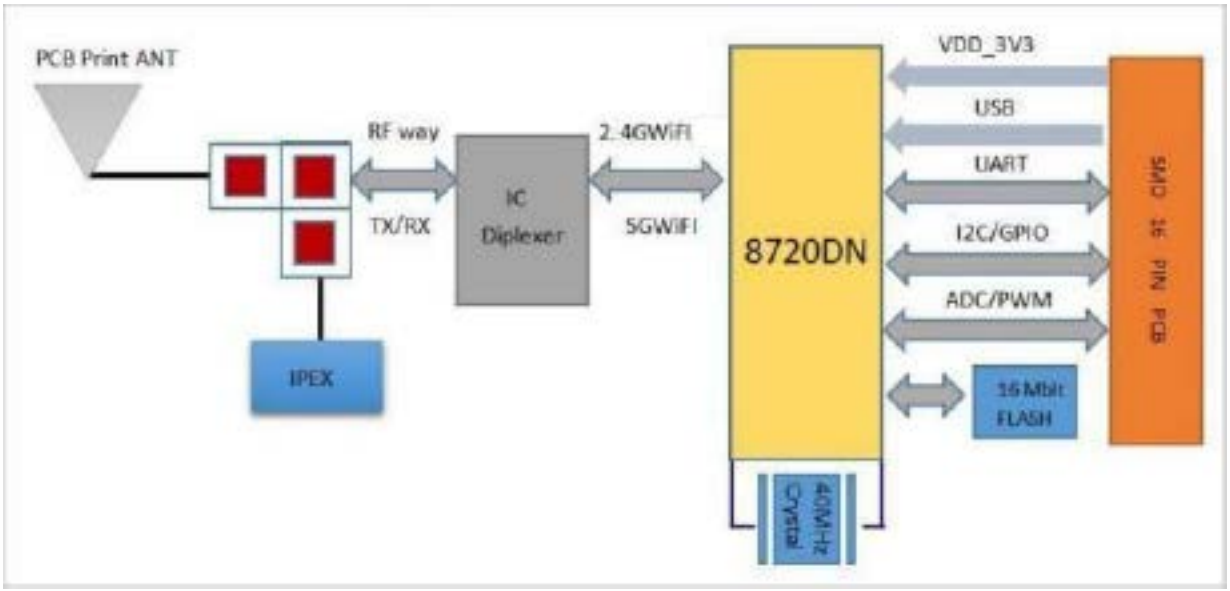

Figure 1 Main chip architecture diagram

1.1. Features

- Support for either 802.11a/b/g/n, 2.4GHz or 5GHz
- Supports the HT 20 / HT 40 mode
- Supports low power beacon listening mode, low power receiving mode and low power hanging mode
- Built-in AES / DES / SHA hardware engine
- Support TrustZone-M and support safe startup
- Supports the SWD debug port access protection and disabled modes
- Wi-Fi and Bluetooth share the same antenna
- Support the STA / AP / STA + AP mode and confounding mode
- Support for Android, iOS Simple Config (App) Wi-Fi one-click distribution network
- Support for serial port local upgrade and remote firmware upgrade (FOTA)
- Support secondary development, support programming in Linux and Windows environments
- Support for Arduino development

2. Main Parameters

Table 1 Main Parameter

Model	DBOX-IOT16
Package	SMD-16
Dimension	24*16*3(±0.2)MM
Antenna	Dipole Antenna
Frequency	2400~2483.5MHz & 5150~5250&5725~5850MHz
Operating Temperature	-40 ℃~85 ℃
Store Temperature	-40 ℃~125 ℃，<90%RH
Power Supply Voltage	3.0V~3.6V, I>500mA
Interface	UART/GPIO/ADC/PWM/IIC/SPI/IR/SWD/USB
Available GPIO	13
UART Baud rates	110~ 6000000 bps，Default 115200bps
Wireless Security	WAPI, WEP, WPA/WPA2/WPA3-PSK, WPA/WPA2/WPA3-EAP
SPI Flash	Default 4MB (Optional 2MB, 8MB, 16MB)

2.1. Electrical parameter

DBOX-IOT16 module is an electrostatic sensitive device, which needs special ES precautions.When usd ESD protective devices should be added. The correct ESD processing and packaging must be adopted in the transportation, operation and use of DBOX-IOT16 modules. Do nottouch the module by hand or weld with a non-antistatic soldering iron to avoid damage to the module.

Figure 2 ESD Warning Logo

2.2. Electrical parameter

Table 2 Electric Characteristic

Parameter	Min	Typical	Max	Unit
DC 3.3V (with internal regulator and integration CMOS PA)	3.0	3.3	3.6	V
Figure I/O supply voltage	1.76	1.8~3.3	3.3	V
DC_IO_33 (3.3V I / O rated current)	-	-	50	mA
Electrostatic protection (VESD)	-	-	2000	V

2.3. Wi-Fi Radio Performance

Table 3 Wi-Fi Radio Performance

Description	Typical			Unit
Operating Frequency	2400~2483.5 and 5150~5250&5725~5850			MHz
Output Power				
Mode	**Min**	**Typical**	**Max**	**Unit**
11a mode，PA output power	6	8	9.5	dBm
11n mode 2.4G，PA output power	13	14.5	16.5	dBm
11n mode 5G，PA output power	6	8	10	dBm
11g mode，PA output power	12.5	14.5	16.5	dBm
11b mode，PA output power	14	15	16	dBm
Rx Sensitivity				
Mode	**Min**	**Typical**	**Max**	**Unit**
CCK，1Mbps	-	≤-90	-	dBm
CCK，11Mbps	-	≤-85	-	dBm
6Mbps（1/2 BPSK）	-	≤-88	-	dBm
54Mbps（3/4 64-QAM）	-	≤-70	-	dBm
HT20（MCS7）	-	≤-67	-	dBm

3. Appearance & Package

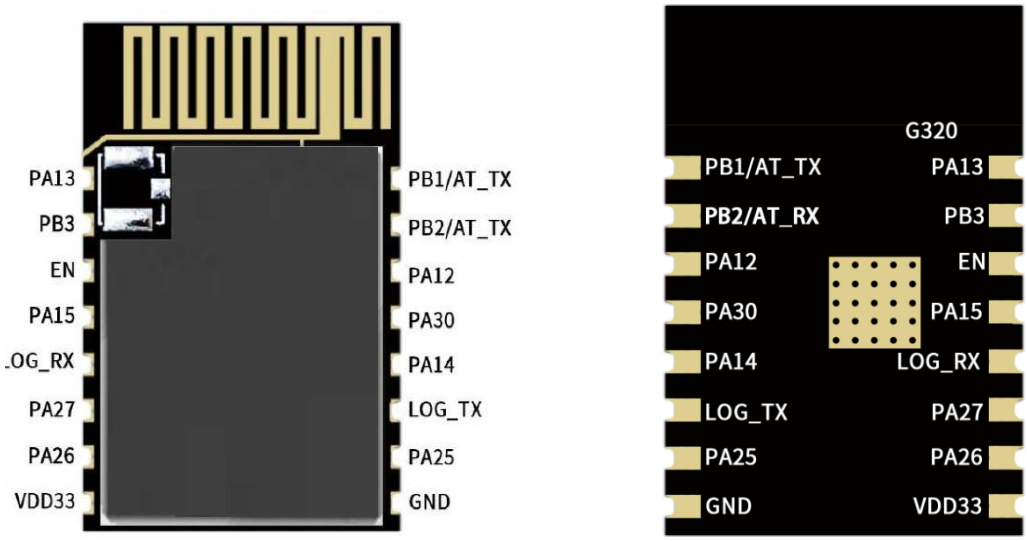

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Figure 3 Appearance

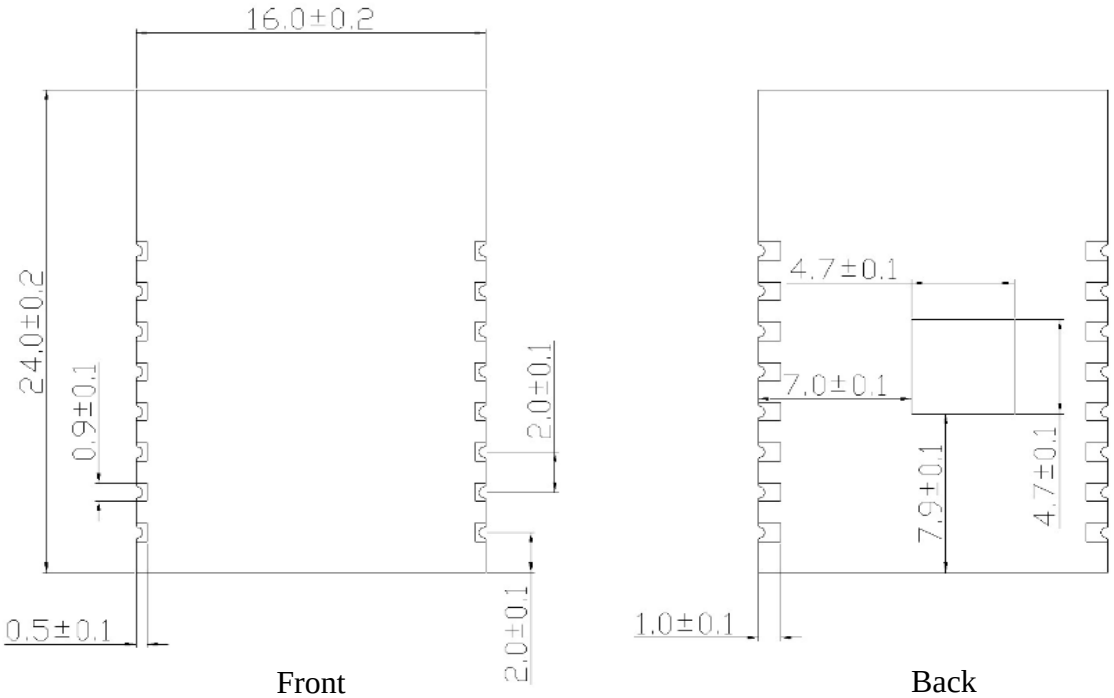

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Figure 4 Package

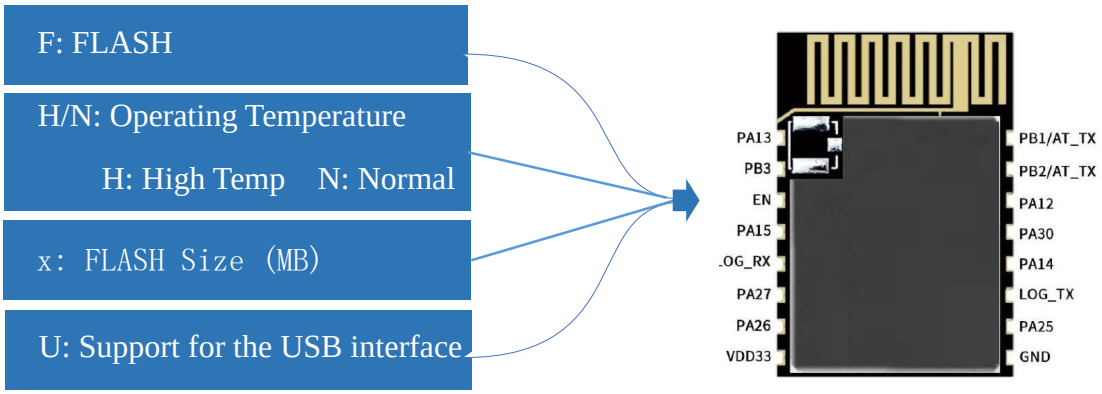

Figure 5 Order Information

4. Pin Definitions

DBOX-IOT16 has 16 interface，refer to following Pin diagram ， Table 2.2 is definition of interfaces.

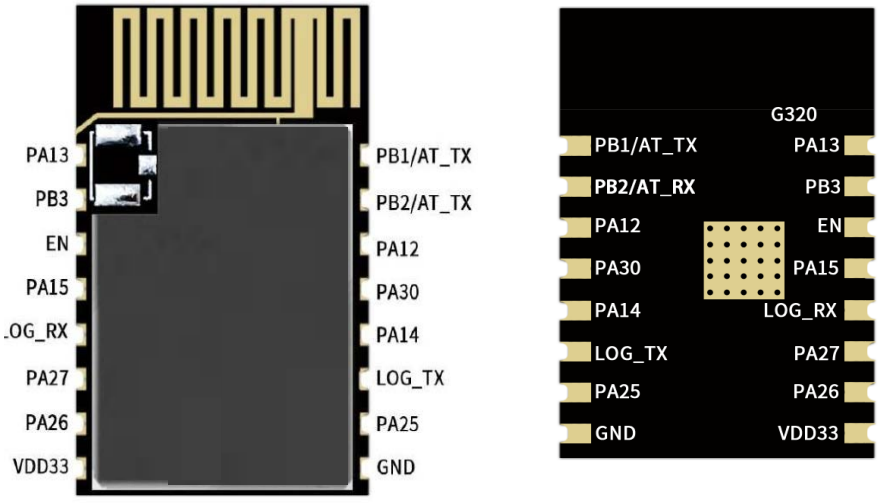

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Figure 6 Pin out Diagram

Table 5 Pin definitions

No	Name	Description
1	PA13	LP_PWM1/SPI1_MISO
2	PB3	ADC/SWD_CLK
3	CHIP_EN	Chip Enabled
4	PA15	SPI1_CS
5	PA8	UART_LOG_RXD
6	PA27	SWD_DATA
7	PA26	LP_I2C_SDA/LP_PWM5
8	VDD_3V3	3.3V（VDD）
9	GND	Ground
10	PA25	LP_I2C_SCL/LP_PWM4/HSDM
11	PA7	UART_LOG_TXD
12	PA14	SPI1 CLK
13	PA30	LP_PWM1
14	PA12	SPI1_MOSI/LP_PWM0
15	PB2	LP_UART_RXD
16	PB1	LP_UART_TXD
Note: 1. When the LOG _ TX moment is low, the module enters the burning mode; When the moment is high, the module starts normally and the internal pull up by default.		

6. Design Guideline

6.1. Application Circuit

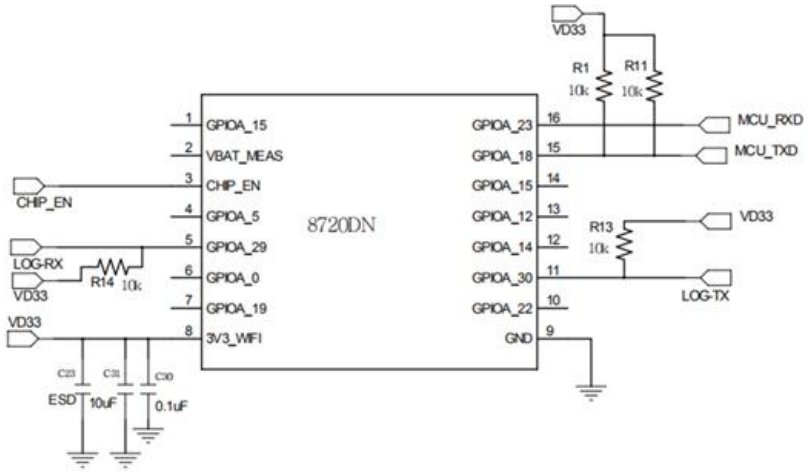

Figure 8 Application Circuit

Note:

- LOG _ TX is the starting control foot in normal operating mode at high level and burning firmware mode at low level. Internal chip default high level.

6.2. Recommend PCB Package

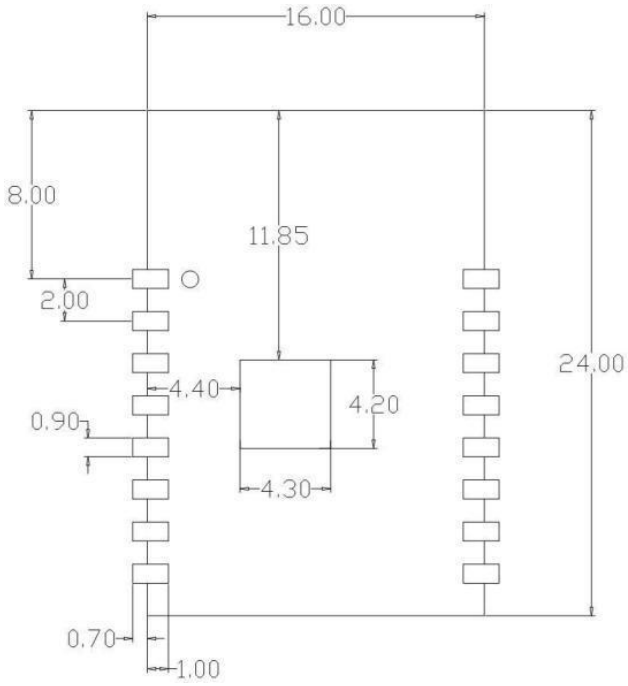

Figure 9 Recommend PCB Package

6.3. Antenna Layout Requirements

- Installation position on the main board，advise for following two ways:
- The module is placed on the edge of the main board, and the antenna area is extended out of the edge of the main board. 2.In order to meet the performance of the on-board antenna, metal parts are prohibited from being placed around the antenna.

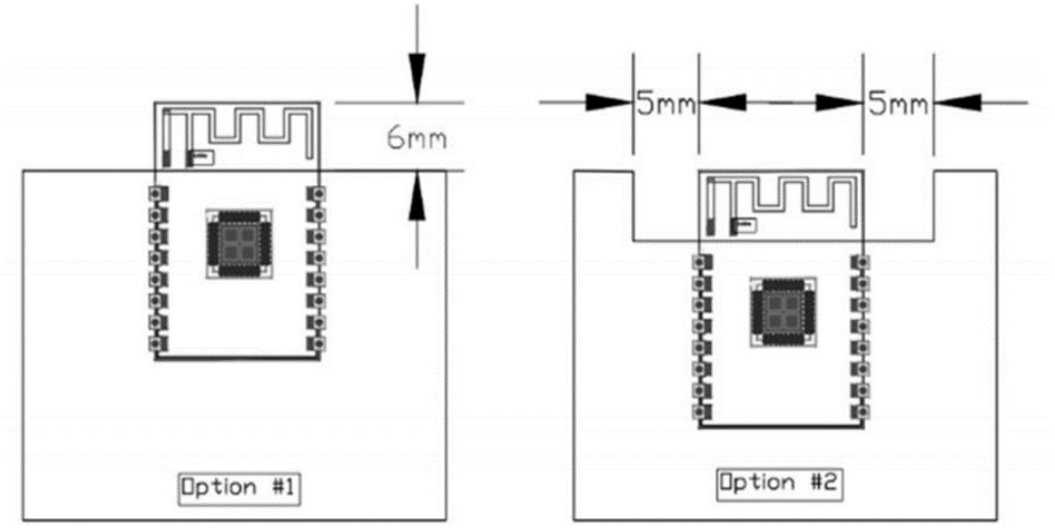

Figure 10 Schematic diagram of Antenna layout

6.4. Power Supply Requirements

- Recommended voltage 5V, Peak:Current over 500mA .
- It is recommended to use the LDO power supply；If DC-DC is used, the ripple is controlled within 30 mV.
- DC-DC power supply circuit is recommended to reserve the position of the dynamic response capacitor, and the output ripple can be optimized when the load change is large.
- Proposed addition of ESD Devices to 5V Power supply Interface.
- For 3.3V application, if the power up slew rate from 1.5V to 3.0V is slower than 15ms, The wide range VCC Flash is needed or add reset IC.
- In the process of power off to power on, if the power off voltage can't be guaranteed to drop below 0.3v and power on again, reset IC should be added.

6.5. GPIO

- At the periphery of the module, some GPIO ports are led out, and a resistance of 10-100 ohms can be connected in series on the IO port for use. This suppresses overshoot and is more stable on both sides. Help for both EMI and ESD.
- For the up-and-down drawing of the special io-port, reference will be made to the use description of the specification, which will affect the start-up configuration of the module.
- The IO port of the module is 3.3 v. If the main control does not match the io-level of the module, it is necessary to increase the level conversion circuit.
- If the IO interface is directly connected to the peripheral interface, or the pins and other terminals, it is recommended to reserve the ESD device near the terminal at the IO trace.

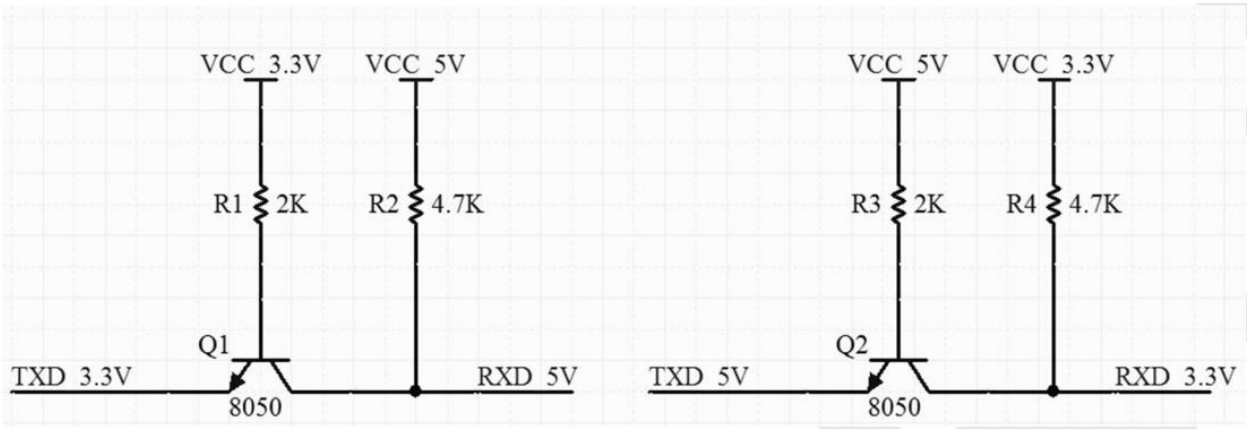

Figure 11 switching circuit

7. ROLLING OF Reflow soldering

Products sealed in a moisture-proof bag shall be stored in a non-condensing atmosphere of <40℃ / 90% RH.

The moisture sensitivity grade MSL of the module is level 3.

After the vacuum bag is unsealed, it must be used within 168 hours at 25 ± 5℃ / 60% RH, otherwise it needs to be baked before the secondary launch.

8. ROLLING OF Reflow soldering

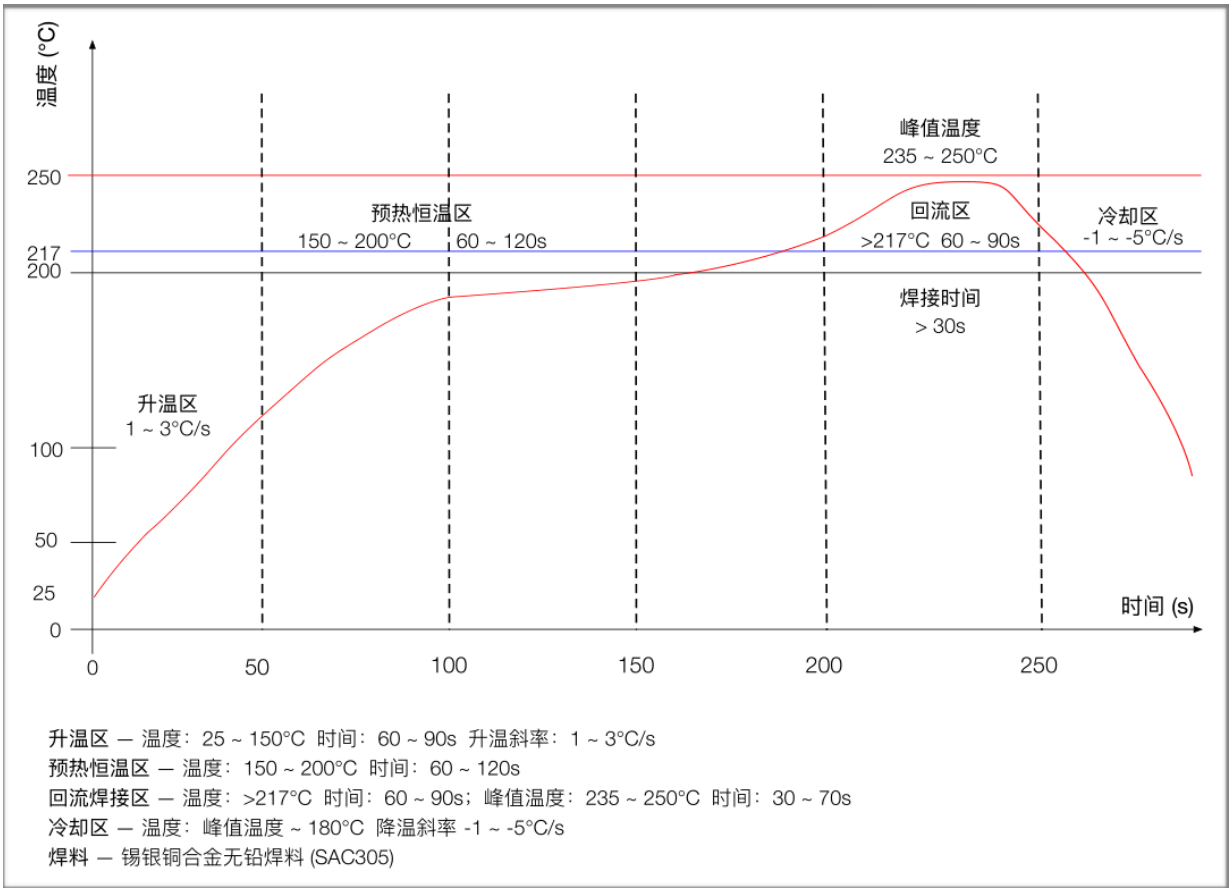

Figure12 ROLLING OF Reflow soldering

9. Package Information

DBOX-IOT16 module is packaged with 800 pcs / disk. As shown in the figure below:

Figure 13 packing ribbon diagram

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ISED Warning

This device contains licence-exempt transmitter(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 maycause undesired operation of the device.

The device for operation in the band 5150–5250 MHz is only for indoor use

The module is tested for standalone mobile RF exposure use conditions. The distance between user and products should be no less than 20cm.

Any other usage conditions such as co-location with other transmitter(s) or in a portable condition will need to be separate reassessment through ISED rules or new certification.

If the IC number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains IC: 35639-DBOXIOT16"

This equipment must be installed and operated in accordance with provided instructions, and the antenna(s) used for this transmitter must not be collocated or operating in conjunction with any other antenna or transmitter. End-users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance. ISED : Cet appareil contient des émetteurs exempts de licence qui sont conformes aux RSÉ exempts de licence d'Innovation, Sciences et Développement économique Canada. Son utilisation est soumise aux deux conditions suivantes :

1.Cet appareil ne doit pas causer d'interférences.
2.Cet appareil doit accepter toutes les interférences, y compris celles pouvant provoquer un fonctionnement indésirable de l'appareil.
L'appareil destiné à fonctionner dans la bande 5150–5250 MHz est uniquement destiné à un usage en intérieur
Le module est testé pour des conditions d'exposition RF mobiles autonomes. La distance entre l'utilisateur et les produits ne doit pas être inférieure à 20 cm.
Toutes les autres conditions d'utilisation, telles que le co-emploi avec d'autres émetteurs ou en condition portable, nécessiteront une réévaluation distincte conformément aux règles ISED ou une nouvelle certification.
Si le numéro IC n'est pas visible lorsque le module est installé à l'intérieur d'un autre appareil, l'extérieur de l'appareil dans lequel le module est installé doit également afficher une étiquette faisant référence au module intégré. Cette étiquette extérieure peut utiliser une formulation telle que : « Contient IC : 35639-DBOXIOT16 »
Cet équipement doit être installé et utilisé conformément aux instructions fournies, et l'(les) antenne(s) utilisée(s) pour cet émetteur ne doivent pas être co-localisées ou fonctionner conjointement avec d'autres antennes ou émetteurs. Les utilisateurs finaux et les installateurs doivent recevoir des instructions d'installation de l'antenne et des conditions de fonctionnement de l'émetteur pour garantir la conformité à l'exposition RF.

This radio transmitter [Contient IC : 35639-DBOXIOT16] has been approved by Innovation, Science and EconomicDevelopment Canada to operate with the antenna types listed below, with the maximum permissible gain indicated.Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.
Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used withthe transmitter indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.
Antenna manufacturer: Kunshan Jinkang Electronics Co., LTD
Antenna model: KC-DBOX16 Antenna Type: External Antenna
Antenna gain: 2.4G:3.0dBi 5G Band1:2.75dBi; 5G Band4:2.00dBi;

Basic FCC Compliance 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 (2) This device must accept any interference received, including interference that may cause undesired operation.

FCC WARNING

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

Note: This device has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful radio frequency interference when operated in a commercial environment. This device 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 device does cause harmful interference to radio or television reception, which can be determined by turning the device 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 device and receiver.
- Connect the device 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.

RF Radiation Exposure Requirement (Per KDB996369 D03)

2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required. Explanation: This module meets the requirements of FCC part 15C(15.247、15.407).

2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or

compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.
Explanation: The EUT has a external antenna, Antenna support 2.4GHz WIFI and 5GHz WIFI,The module have an unique antenna connector, 2.4G antenna gain is 3dBi.5GHz WIFI antenna gain is U-NII 1: 2.75dBi U-NII 3: 2.00dBi

2.4 Limited module procedures

If a modular transmitter is approved as a "limited module", then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

Explanation: The module is not a limited module.

2.5 Trace antenna designs

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. 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: Not applicable

2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile portable - 20 cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals.

If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility for the module through a change in FCC ID (new application).

Explanation: The module must be installed in the host equipment such that at least 20cm is maintained between the antennaand users' body; and if RF exposure statement or module layout is changed, then the host product manufacturerrequired to take responsibility of the module through a change in FCC ID or new application. The FCC ID of themodule cannot be used on the final product. In these circumstances, the host manufacturer will be responsiblefor re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization

2.7 Antennas

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 an "omnidirectional 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 a 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.

Explanation: The EUT has a external antenna, Antenna support 2.4GHz WIFI and 5GHz WIFI,The module have an unique antenna connector, 2.4G antenna gain is 3dBi.5GHz WIFI antenna gain is U-NII 1: 2.75dBi U-NII 3: 2.00dBi

2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating "Contains FCC ID" with their finished product. See Guidelines for Labeling and User Information for RF Devices - KDB Publication 784748.

Explanation: The host system using this module should have label in a visible area indicated the following texts: "Contains FCC ID: 2BV7U-DBOXIOT16"

2.9 Information on test modes and additional testing requirements

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.
The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host. Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer's determination that a module as installed in a host complies with FCC requirements.
Explanation: The OEM integrator is responsible for ensuring that the end-user has no manual instruction to remove or install module.
The module is limited to installation in mobile application, a separate approval is required for all other operating configurations, including portable configurations with respect to §2.1093 and difference antenna configurations.

2.10 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) 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. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), 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.
Explanation: The module without unintentional-radiator digital circuity, so the module does not require an evaluation by FCC Part 15 Subpart B. The host shoule be evaluated by the FCC Subpart B.

2.11 Note EMI Considerations

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 noncompliantlimits due to module placement to host components or properties.

2.12 How to make changes

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmittingcondition or different operational conditions for a stand-alone modular transmitter in a host, hostmanufacturer have to consult with module manufacturer for the installation method in end system. Accordingto the KDB 996369 D02 Q&A Q12, that a host manufacture only needs to do an evaluation (i.e., no C2PCrequired when no emission exceeds the limit of any individual device (including unintentional radiators) as acomposite. The host manufacturer must fix any failure.If you need to do C2PC, please contact Shanghai Quicktron Automation Technology Co., Ltd.
Email:certificate@quicktron.com.cn