L-FKMIB01-G0BP4

BG22 platform first generation 2.4G wireless communication module

L-FKMIB01-G0BP4 wireless module is a wireless module designed based on Silicon Labs RF integrated chip EFR32BG22C224F512GM32. It is a high-performance IoT wireless transceiver. The module adopts PCB antenna. The overall design is compact and small in size. It can be widely used in various occasions in the field of short-range IoT wireless communications. It has the characteristics of small size, low power consumption, fast transmission rate, strong anti-interference ability, low cost, and can support private 2.4G protocol.

Product relationship description L-RFOIS01-04364-01 and L-RFOIS01-04364-02 are product forms with specific software functions for this hardware module. The following product performance characteristics and other indicators are also applicable to L-RFOIS01-04364-01 and L-RFOIS RFOIS01-04364-02 product.

Features

•Working frequency

- Working frequency band 2400 ~ 2483.5MHz

•Various modulation methods

-Support 2FSK, GFSK, MSK, OQPSK and other modulation methods

•Ultra low power consumption

- Support 1.8V to 3.8V power supply
- Transmit mode current 6.5mA (@1dBm transmit power, DC-DC mode, whole machine current)
- Receive mode current 5mA (DC-DC mode, whole machine current)
- 1.5uA sleep current

•High link budget

- Sensitivity -103dBm±1dBm(@250kbps, 125kHz dev)
- 6dBm(typ.)Transmit power Max. 6dBm(typ.)

•Size

- 17.3*28.0*2.3mm

•Transmission distance

- Reliable transmission distance greater than 15m@250kbps 62.5KHz DEV 2FSK

•Supporting agreement

- Can support private 2.4G protocol, users can customize development

Applicable scene

- Industrial remote sensing, telemetry communication
- Smart home
- Home wireless security alarm system
- Consumer electronics wireless applications, wireless mouse and keyboard, etc.

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Conformity

FCC regulatory conformance :

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.

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

NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

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ORIGINAL EQUIPMENT MANUFACTURER (OEM) NOTES

The OEM must certify the final end product to comply with unintentional radiators (FCC Sections 15.107 and 15. 109) before declaring compliance of the final product to Part 15 of the FCC rules and regulations. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change.

The OEM must comply with the FCC labeling requirements. If the module's label is not visible when installed, then an additional permanent label must be applied on the outside of the finished product which states: "Contains transmitter module FCC ID:**N82-KOHLER051**". Additionally, the following statement should be included on the label and in the final product's user manual: "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 interferences, and
(2) this device must accept any interference received, including interference that may cause undesired operation."

The module is installed in portable, mobile or fixed applications. Separate approval is required for all other operating configurations, including portable configuration with respect to Part 2.1093 and different antenna configurations.

A module or modules can only be used without additional authorizations if they have been tested and granted under the same intended end - use operational conditions, including simultaneous transmission operations. When they have not been tested and granted in this manner, additional testing and/or FCC application filing may be required. The most straightforward approach to address additional testing conditions is to have the grantee responsible for the certification of at least one of the modules submit a permissive change application. When having a module grantee file a permissive change is not practical or feasible, the following guidance provides some additional options for host manufacturers. Integrations using modules where additional testing and/or FCC application filing(s) may be required are: (A) a module used in devices requiring additional RF exposure compliance information (e.g., MPE evaluation or SAR testing); (B) limited and/or split modules not meeting all of the module requirements; and (C) simultaneous transmissions for independent collocated transmitters not previously granted together.

This Module is full modular approval, it is limited to OEM installation ONLY.
Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change. (OEM) Integrator has to assure compliance of the entire end product include the integrated Module. Additional measurements (15B) and/or equipment authorizations (e.g. Verification) may need to be addressed depending on co- location or simultaneous transmission issues if applicable. (OEM) Integrator is reminded to assure that these installation instructions will not be made available to the end user

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.3

Explanation: This module meets the requirements of FCC part 15C (15.249).

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 PCB Antenna, and the antenna use a permanently attached antenna which is not replaceable.

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; and
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:** Yes, The module with trace antenna designs, and this manual has been shown the layout of trace design, antenna, connectors, and isolation requirements.

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 – xx 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 of the module through a change in FCC ID (new application).
Explanation: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This module is designed to comply with the FCC statement, FCC ID is: N82-KOHLER051.

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 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.

Explanation: The EUT has a PCB Antenna, and the antenna use a permanently attached antenna which is unique.

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:N82-KOHLER051, Contains IC:4554A-KOHLER051"

2.9 Information on test modes and additional testing requirements5

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: Top band can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

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 should be evaluated by the FCC Subpart B.

RF Exposure

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

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IC labeling requirement for the final end product:

The final end product must be labeled in a visible area with the following "Contains IC:4554A-KOHLER051 "

The Host Marketing Name (HMN) must be indicated at any location on the exterior of the host product or product packaging or product literature, which shall be available with the host product or online.

This radio transmitter [IC:4554A-KOHLER051] has been approved by Innovation, Science and Economic Development 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.

Frequency range	Manufacturer	Peak gain	Impedance	Antenna type
2400-2483.5MHz	KOHLER CO.	-3.8dBi	50Ω	PCB Antenna

IC regulatory conformance
This device complies with CAN ICES-003 (B)/NMB-003(B).
This device complies with Industry Canada licence-exempt RSS standard(s). 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.
Cet appareil est conforme à la norme CAN ICES-003 (B)/NMB-003 (B).
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.

RF Exposure

Cet équipement est conforme aux limites d ' exposition aux rayonnements de la IC établies pour unenvironnement non contrôé.

Revision Histories

Revision	Date	Change Description
Rev01	2022-03-23	Initial Revision
Rev02	2022-04-20	Supplement FCC&IC warning
Rev03	2022-09-09	Modifying the PCB Antenna Layout
Rev04	2022-10-28	The manufacturer information is updated to Kohler

1 Specification Parameter

Form 1-1 Module limit parameters

Major Parameter	Performance		备注
	Min. Value	Max. Value	
Working Voltage (V)	-0.5	+3.8	
Maximum RF input power（dBm）	-	+10	
Working Temperature (℃)	-40	+85	

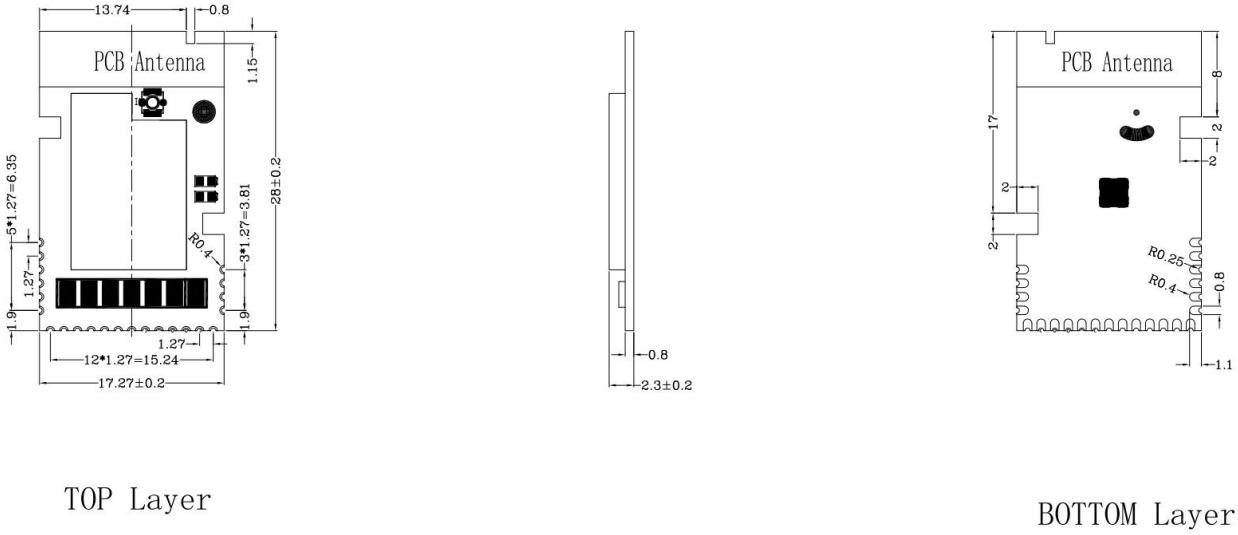
Form 1-2 Module Working Parameter

Major Parameter		Performance[1]			备注
		Min.	Typical	Max.	
Working Voltage（V）		1.8	3.3	3.8	
Working Temperature（℃）		-40	-	85	
Initial Frequency Deviation(KHz)		-27	-	+27	
Working Frequency Range(MHZ)		2400		2483.5	The customer can customize the working frequency
Power	TX(mA)	-	6.5	8.5	DC-DC mode, 1dBm transmit, module current
	RX(mA)	-	5	6.5	DC-DC mode, module current
	Sleep(uA)	-	1.5	3	module current
Transmit power (dBm)			1	6	The customer can customize the transmit power
Receiving sensitivity(dBm)		-104	-103	-102	@FSK modulation,BER <0.1%; Deviation:125KHz, Data rate: 250kbps
Data rate FSK（bps）		-	-	2M	User programmable customization
Modulation		GFSK/2FSK/MSK/OQPSK			User programmable customization
Interface Type		Stamp holes			1.27 mm pitch
Overall dimensions（mm）		（Refer to Drawing 2-1 for more information）			–

Dimension accuracy	Grade GB / T 1804-C	In conformity with the requirements of dimensional tolerance Grade C

2 Dimensional Drawing and Interface Description

2.1 Module Dimensional Drawing



Drawing 2-1 Dimensional Drawing for L-FKMIB01-G0BP4 PCBA (Unit: mm)

2.2 Real Module Drawing

Figure 2-2 Physical map of the module TOP side

Figure 2-3 Physical map of the module BOTTOM side

3 Interface Description

3.1 Pin Definition

Form 3-1 Pin Definition

Pin	Function	Remarks
P1	VCC	Power supply
P2	SWCLK	Programmed
P3	SWDIO	Programmed

P4	RESETn	Reset pin, active low
P5	GND	Ground
P6	GND	Ground
P7	PB00	General I/O port, user-defined function, see chip manual for details
P8	PA00	General I/O port, user-defined function, see chip manual for details
P9	PA03	General I/O port, user-defined function, see chip manual for details
P10	PA04	General I/O port, user-defined function, see chip manual for details
P11	PA05	General I/O port, user-defined function, see chip manual for details
P12	PA06	General I/O port, user-defined function, see chip manual for details
P13	PC00	General I/O port, user-defined function, see chip manual for details
P14	PC01	General I/O port, user-defined function, see chip manual for details
P15	PC02	General I/O port, user-defined function, see chip manual for details
P16	PB01/RX	UART RX, can be used as general I/O port, user-defined function, see chip manual for details
P17	PB02/TX	UART RX, can be used as general I/O port, user-defined function, see chip manual for details
P18	PC03	General I/O port, user-defined function, see chip manual for details
P19	GND	Ground
P20	GND	Ground
P21	GND	Ground
P22	GND	Ground
P23	VCC	Power supply

3.2 Other Pin Definitions

Form 3-2 Other pin definitions

Function	Pin Definition	Remarks
LED（Red）	PC04	Pull high to enable
LED（Green）	PC05	Pull high to enable

Note: LED is only controlled internally by MCU, not module stamp hole interface. After the LED is lit, the current consumption is about 4~5mA.

4 Basic Operation

This module is an integrated chip of MCU and radio frequency. Users can use the software to call the API interface to control the radio frequency to realize wireless data transmission and reception, and use the MCU resources to complete the corresponding application functions. For details, please refer to the latest version of the EFR32BG22C224F512GM32 data sheet and application manual.

4.1 Hardware Layout Considerations

1. Clearance is required around the PCB antenna, leaving at least a 5mm clearance area.
2. Pay attention to the grounding amount, and it is best to ensure a large area of ground.
3. Keep away from high-voltage circuits and high-frequency switching circuits.
4. Refer to "RF PCB LAYOUT Design Rules (for sub-1GHZ and Bluetooth modules)" in the application document for layout and wiring;

5 Notation of Annexes

5.1 The module cannot communicate at close range

• Confirm that the configuration on both sides of sending and receiving is inconsistent, and the different configurations cannot communicate normally.
• Abnormal voltage, if the voltage is too low, it will cause abnormal transmission.
• Low battery power, low battery voltage will be pulled down when sending, resulting in abnormal sending.
• Antenna welding abnormal RF signal does not reach the antenna or π circuit welding error.

5.2 Abnormal power consumption of the module

• The module is damaged due to static electricity and other reasons, resulting in abnormal power consumption.
• When doing low-power reception, the timing configuration is incorrect, so that the power consumption of the module does not achieve the expected effect.
• The single test module or MCU is normal, but the power consumption is abnormal in the joint debugging. This is because the connection pins between the MCU and the RF module are not handled properly.
• The working environment is harsh, and the power consumption of the module will fluctuate in extreme environments such as high temperature, high humidity, and low temperature.

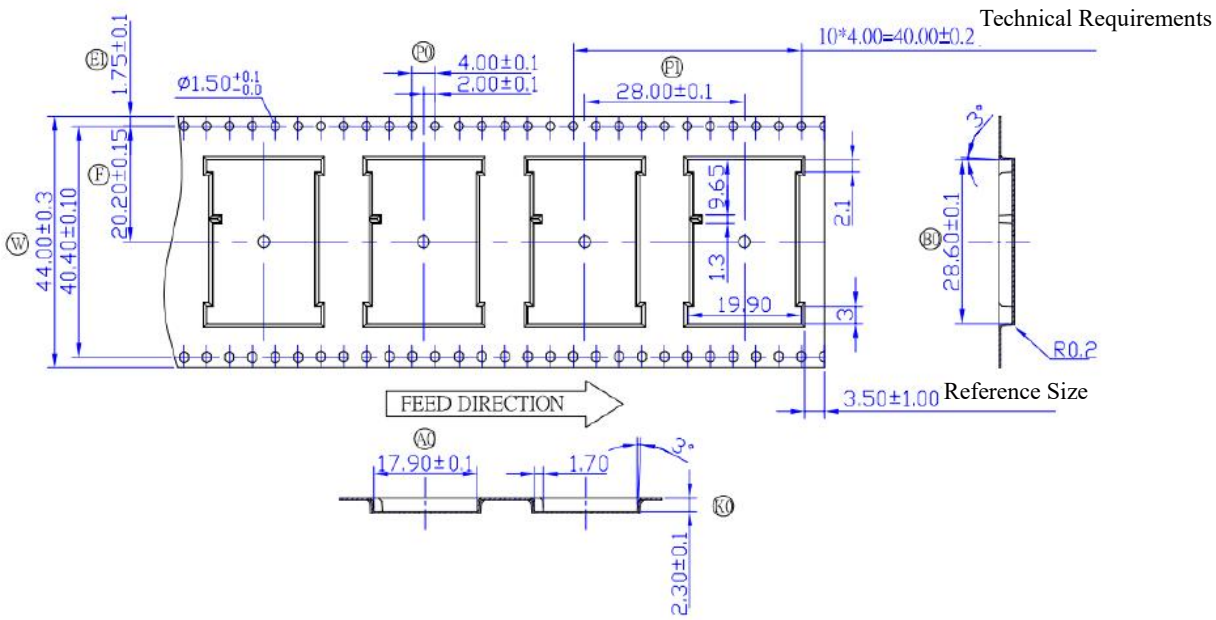
5.3 The communication distance of the module does not meet expectations

• Antenna impedance matching is not done well, resulting in very small transmitted power.
• There are objects such as metal around the antenna or the module inside the metal causes serious signal attenuation.
• There are other interfering signals in the test environment, which cause the communication distance of the module to be close.
• The module transmit power is abnormal due to insufficient power supply.
• The test environment is harsh, and the signal is attenuated greatly.
• The module communicates with the other end after passing through the wall and other environments. The wall and the like attenuate the signal greatly, and most of the signals are diffracted through the wall and the signal is attenuated greatly.
• The module is too close to the ground to be absorbed and reflected, resulting in poor communication.

6 Packing

6.1 Ways of Packing

■ Roll ☐ Foam ☐ ESD bag



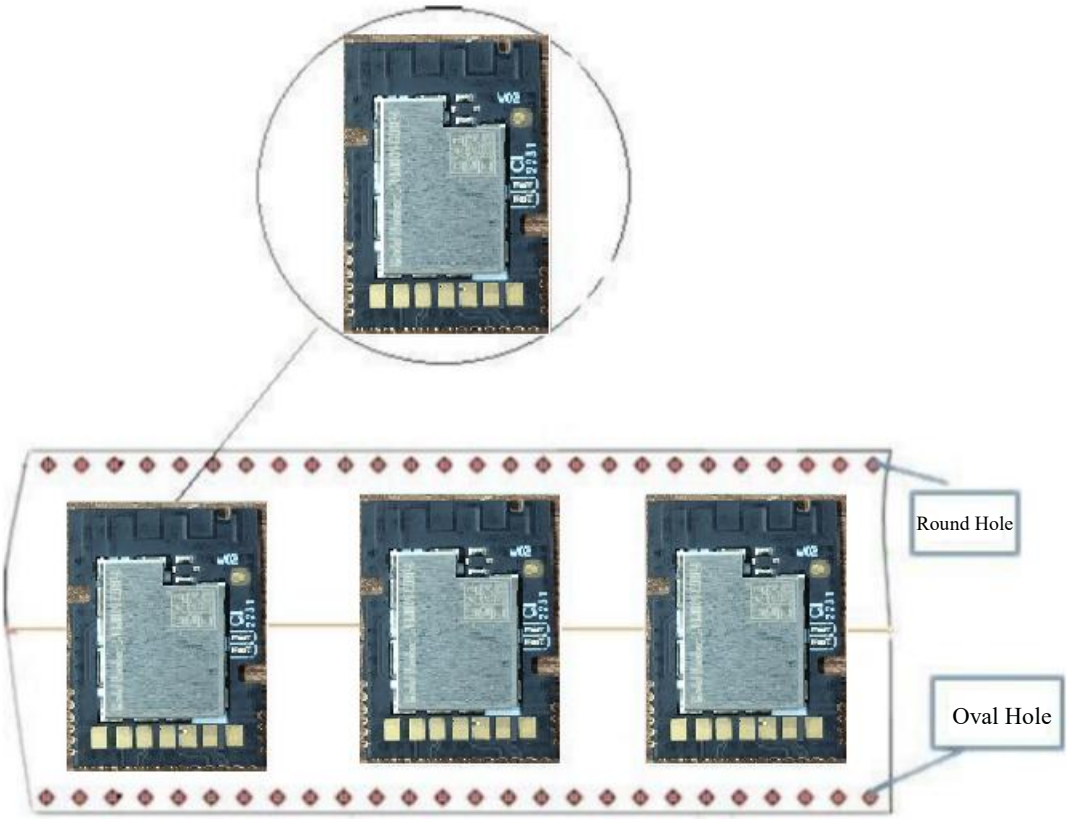
W	44.00±0.3
E1	1.75±0.1
F	20.20±0.15
P0	4.00±0.1
P1	28.00±0.1
A0	17.90±0.1
B0	28.60±0.1
K0	2.30±0.1

Technical requirements

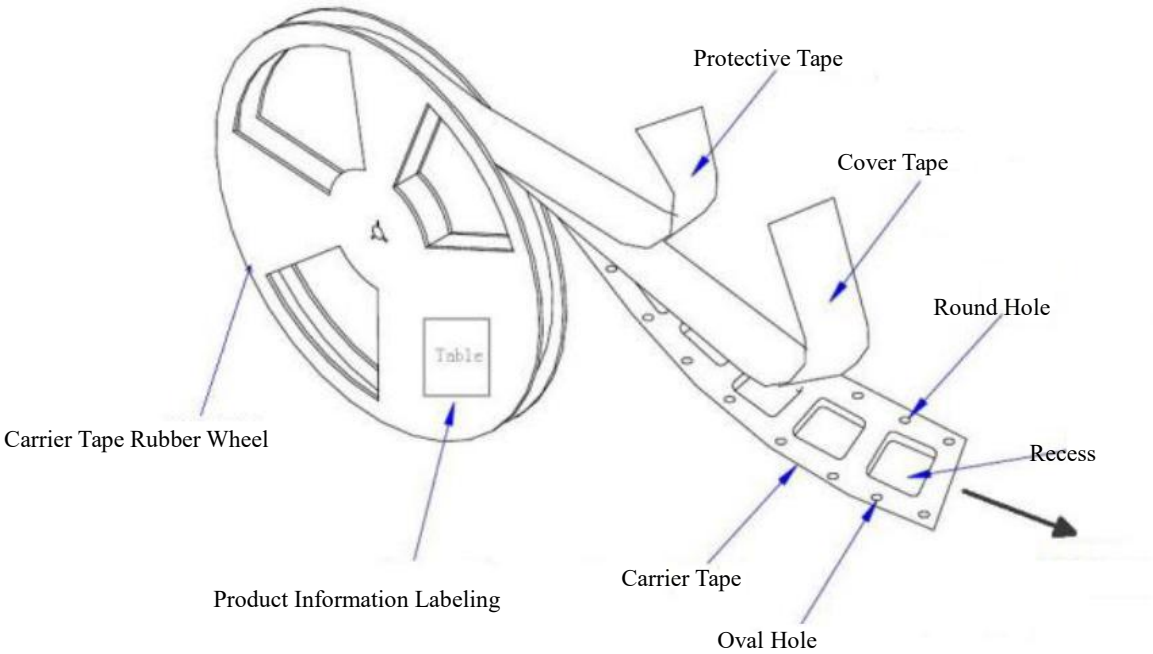
1. The accumulative error per 10 drive holes should be within±0.2;
2. The inner bending of 250MM shall not be higher than 1;
3. Loaded with the materials: black PS and thickness: 0.30±0.05;
4. Surface impedance ranges from 10^6 to 10^{11} Ohm;
5. 23.5m per reel and packed in 13" plastic tray; the number of elements accommodated:800 Pcs;
6. A0 and B0 shall be subject to the measurement made at the place 0.3mm away from the lowest bottom inside the cavity, K0 is the inner depth and R angle unmarked is 0.3;
7. The product complies with Standard EIA-481 ;
8. Product requirements comply with "ROHS".

Drawing 6-1 Roll Dimensional Drawing

The diagram of roll wrapping module placement direction is as follows:



Drawing 6-2 Schematic Diagram of Module Placement



Drawing 6-3 Packaging Diagram

7 Contact Us

The company always aims to provide customers with the most timely and comprehensive services. If you have any product use problems, please send an email or scan the code to contact us directly!