MXCHIP®

Datasheet

EMC6270-E Wi-Fi 6/BLE IoT Module

Built-in Wi-Fi6 Combo SoC

2.4G Hz IEEE 802.11 b/g/n/ax, BLE 5.2, ultra-high integration, rich peripherals

Version：0.2 Date：2024-08-22 Number：DS0237EN

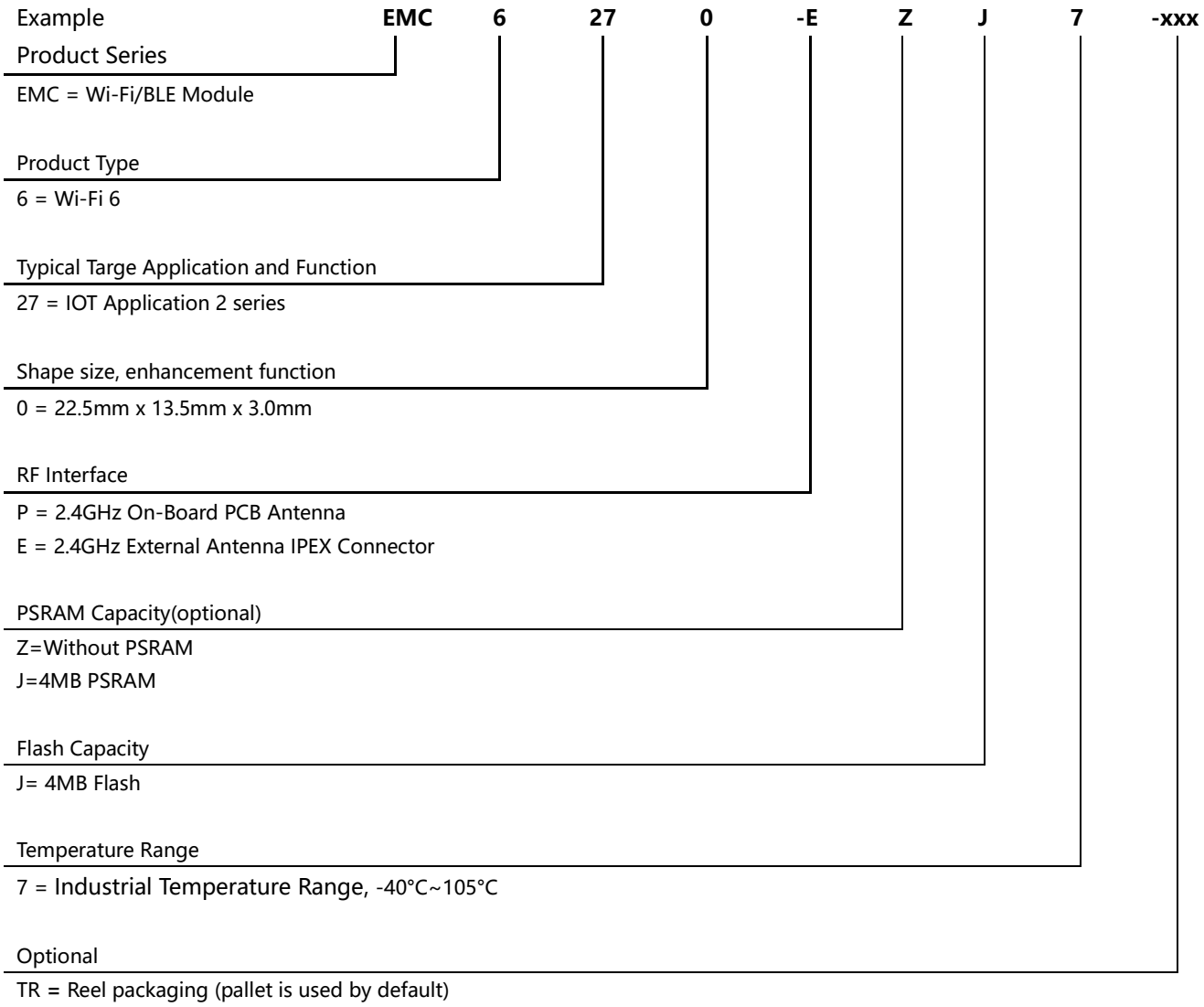
Abstract

- **Input： 3.0V~3.6V**
- **Operating temperature：-40℃ to +105℃**
- **32-bit RISC-V MCU**
  - Main frequency up to 320MHz.
  - With double-precision floating point unit (FPU).
  - Provide memory protection unit (MPU).
  - UART supporting download and debugging.
- **Memory**
  - 512KB SRAM
  - 64KB ROM
  - 4MB XIP Flash
  - 32Byte eFuse
  - 8Kbit OTP
  - 256bit eFuse
- **Wi-Fi**
  - IEEE 802.11 b/g/n/ax 1T1R .
  - Support 20/40MHz Channel bandwidth, 2.4GHz single frequency.
  - Transmitting power up to+18dBm, receiving sensitivity - 99dBm.
  - Support working mode： STA、 AP、 Direct , Concurrency AP+STA.
  - Support WPA/WPA2/WPA3.
  - Integrated BT/WLAN coexistence（PTA）.
- **Bluetooth**
  - Support BLE 5.2 Standard.
  - Support low power consumption (LE) 1 Mbps, 2 Mbps and long distance (125 kbps and 500 kbps)
  - Support Advertising Extension function.
  - Wi-Fi and BLE share the same PA and antenna, time-sharing multiplexing.
  - Support Bluetooth slave mode, which can be used for Bluetooth distribution network.
- **Rich Peripherals**
  - 13 x GPIO
  - 1 x SPI
  - 5 x PWM
  - 2 x UART

- **Interface and Size**
  - Maintain pin compatibility with similar packaging modules.
  - External antenna with IPEX connector.
  - 22.5mm x 13.5mm x 3.0mm, stamp hole
- **Rich Supporting Software**
  - Support MXOS autonomous operating systems.
  - Provide access SDK and AT instructions for major cloud platforms.
  - Provide mass-produced firmware for various typical applications.
- **Typical Application**
  - Smart appliances
  - Intelligent electrician
  - Industrial automation
- **Order code**

Code	Direction
EMC6270-EZI7	External Antenna with IPEX connector

Order Code



For a list of all relevant features (such as packaging, minimum order quantity, etc.) and other information, please contact the nearest MXCHIP sales point and agent.

Parts

Order Code	Direction
MXKIT-Base	Development board motherboard, applicable to all EMC6270 modules.
MXKIT-Core-6270	The development board core board for EMC6270, including the EMC6270-E module. Used with MXKIT-Base.
FX-6270	EMC6270 production fixture, including accompanying plate: MXKIT-Base, MXKIT-Core-6270.

Version Update

Date	Version	Update
2024-07-18	0.1	Initial Version.
2024-08-22	0.2	Add Power consumption parameter.

Copyright Notice

Datasheet lower than 1.0 are for reference only and may be modified before mass production.

Catalog

Figure

Table

1. Introduction

EMC6270 series modules are mainly used for data communication of the Internet of Things. The module realizes data acquisition and device control through rich peripheral interfaces. It can not only communicate directly with mobile devices through low-power Bluetooth, but also connect to the Internet of Things cloud service platform through Wi-Fi network connection to realize the interconnection of everything. This series of modules are applied to a wide range of Internet of Things applications through various external dimensions, interface forms, antenna interfaces and temperature ranges.

The EMC6270 module is built with an ultra-high integration Wi-Fi/BLE Combo SOC chip, providing the necessary computing power and stable Wi-Fi/BLE connectivity of IOT data terminals. The chip integrates:

- RISC-V architecture processor with main frequency up to 320MHz.
- 512K Byte SRAM.
- 4M Byte XIP Flash.
- 2.4GHz Wi-Fi controller conforming to IEEE 802.11 b/g/n/ax standard.
- Low-power Bluetooth controller conforming to BLE5.2 BQB specification.

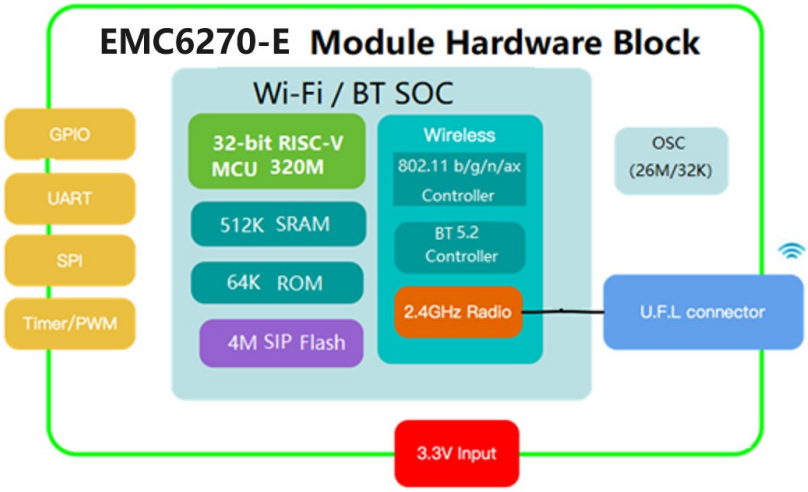
EMC6270 module is powered by 3.3V single power supply and supports the stamp hole SMT installation mode, which is applicable to various smart home appliance application scenarios.

MXCHIP provides the MXOS software platform to support the development of the EMC6270 series modules, and provides an efficient development environment, access protocol stacks for major Internet of Things cloud services, rich sample programs and various typical applications.

The following figure is the hardware block diagram of the EMC6270 module, mainly including:

- Wi-Fi microcontroller
- On-board or external antenna
- Power supply and communication interface
- Peripheral interface units

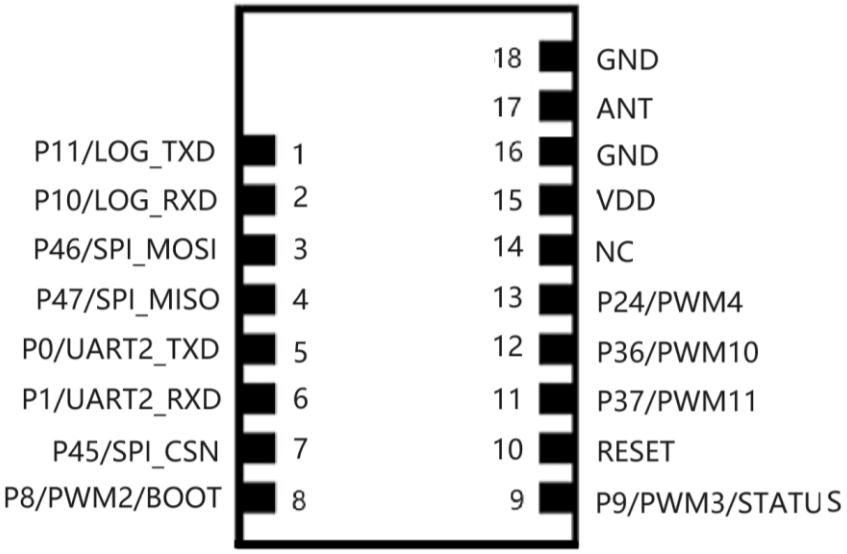
Figure 1 Hardware Block Diagram



2. Pin Definition

2.1. Pin Arrangement

Figure 2 Pin Arrangement



2.2. Pin Definition

Table 1 Pin Definition

Pin No.	Name	I/O 类型	推荐使用方式
1	P11	I/O	LOG_TXD
2	P10	I/O	LOG_RXD
3	P46	I/O	SPI/MOSI
4	P47	I/O	SPI_MISO
5	P0	I/O	UART2_TXD
6	P1	I/O	UART2_RXD
7	P45	I/O	SPI_CSN
8	P8	I/O	PWM2 BOOT：工作模式状态引脚，参见表 2
9	P9	I/O	PWM3 STATUS：工作模式状态引脚，参见表 2
10	RESET	I/O	RESET：复位引脚
11	P37	I/O	PWM11
12	P36	I/O	PWM10
13	P24	I/O	PWM4
14	NC	I/O	NC
15	VDD	P	DC 3.3V 电源
16	GND	GND	地
17	ANT	RFIO	天线引脚
18	GND	GND	地

Description:

1. P represents power supply pin; I/O represents input and output pins. RFIO represents antenna pin.

Attention:

- Pin1 and Pin2 are used for the UART serial port firmware downloading function. Please do not use them in the design and try to provide a convenient way to export to facilitate the download operation.
- RESET pin is an enable reset pin, which is effective at low level. If it is not used, it can remain suspended or be pulled up 3.3V.
- The processing of chip pins inside the module is as follows:
  - RESET: 100K pull-up resistance and 22nF capacitance to ground.
- Module working mode selection signal. During the startup phase, the module detects the voltage levels of these pins and enters a specific working state. The corresponding relationship between voltage level and working mode is shown in Table 2:

Table 2 Selection of Working Modes

Working Mode		**P8 (BOOT) Default: 1**	**P9 (STATUS) Default: 1**
ISP Program Mode		No Detection	No Detection
Normal	QC	0	0
	ATE	0	1
	APP	1	No Detection

1. The QC, ATE, and APP modes are determined by the firmware provided by MXCHIP, and the detection conditions and functions can be adjusted by modifying the firmware.
2. ISP Program Mode can program the module's Flash through LOG_TXD and LOG-RXD (P11, P10).
3. After startup, the processor enters the corresponding working mode by detecting the pin status of BOOT and STAT3 when running the firmware provided by MXCHIP. Among them:
   - QC mode is used to perform self-inspection on hardware during production and generate QC information for production equipment to check the quality of modules.
   - In ATE mode, a series of serial commands are provided to put the RF in a specific transmit and receive mode, allowing the instrument to be tested and calibrated.
   - APP is the normal working mode for running application programs.

3. Electrical Parameters

3.1. Operation Voltage and Current

Table 3 Operation Voltage and Current

Parameter	**Description**	**Min.**	Typ.	Max	Unit
V_{DD}	Operating Voltage	3	3.3	3.6	V
V_{IL}	IO Low Voltage Input	-	-	0.8	V
V_{IH}	IO High Voltage Input	2	-	3.6	V
V_{OL}	IO Low Voltage output	-	-	0.4	V
V_{OH}	IO High Voltage output	2.4	-	-	V
I_{max}	IO Driver Current	-	-	16	mA

3.2. Typical Application Power

The module current test environment is based on VDD=3.3V and is tested in the ordinary office application environment (the values measured in different test environments will be different).

Table 4 Typical Application Power

Parameter	**Condition**	**Min.**	**Typ.**	**Max**	**Unit**
Active Mode					
RX Current	11b: 11 Mbps DSSS	-	63	-	mA
	11g: 54 Mbps OFDM	-	69	-	mA
	11n: MCS7, HT20	-	69	-	mA
	11n: MCS7, HT40	-	70	-	mA
	11ax: MCS7, HE20	-	71	-	mA
TX Current	11b: 11 Mbps DSSS @ 17 dBm	-	280	-	mA
	11g: 54 Mbps OFDM @ 15 dBm	-	250	-	mA
	11n: MCS7, HT20 @ 14 dBm	-	250	-	mA
	11n: MCS7, HT40 @ 14 dBm	-	248	-	mA
	11ax: MCS7, HE20 @ 14 dBm	-	247	-	mA
Network Connecting Mode					
Working Current	When connecting to AP	-	-	450	mA
Standby Mode					
Normal Standby	-	-	3.0	-	mA
Low Voltage Standby	-	-	150	-	μA
Deep Sleep Mode					
Deep Sleep	-	-	15	-	μA
Shutdown Mode					
Shutdown	-	-	2.0	-	μA

3.3. Temperature

Table 5 Storage Temperature and operation temperature

Symbol	Ratings	Max	Unit
T_{STG}	Storage temperature	–55 to +125	℃
T_{work}	Ambient Operating Temperature	-40 to +85	℃
T_{Jun}	Junction Temperature	0 to +125	℃

3.4. Electrostatic discharge

Table 6 Electrostatic discharge

Symbo	Description	Name	Level	Max	Unit
V_{ESD}(HBM)	Electrostatic discharge voltage (manikin)	TA= +25 °C following JESD22-A114	2	2000	V
V_{ESD}(CDM)	Electrostatic discharge voltage (Discharge equipment model)	TA = +25 °C following JESD22-C101	II	500	

3.5. RF Parameter

3.5.1. Wi-Fi RF Parameter

Table 7 RF Basic Parameter

Item	Specification
Operating Frequency	2.412~2.484GHz
Channel BW	20M/40MHz
Antenna Interface	1T1R, Single stream
Wi-Fi Standard	IEEE 802.11b/g/n/ax
Modulation Type	11b: DBPSK, DQPSK, CCK for DSSS 11g: BPSK, QPSK, 16QAM, 64QAM for OFDM 11n: MCS0~7, OFDM 802.11ax: MCS0~7, OFDM
Data Rates	802.11b: 1, 2, 5.5 and 11Mbps 802.11g: 6, 9, 12, 18, 24, 36, 48 and 54 Mbps 802.11n: MCS0~7, up to 72.2Mbps
Antenna type	One U.F.L connector for external antenna

Note: The following typical values of Tx test data are recorded for about 20s under normal temperature.

Transmitting performance

Table 8 Output power

TX Characteristics	Min.	Typical	Max.	Unit
Power@11Mbps, 802.11b	14	16.5	18	dBm
Power@54Mbps, 802.11g	13	14.5	16	dBm
Power@HT20, MCS7,802.11n	11	12.5	14	dBm
Power@HT40, MCS7,802.11n	10	11.5	14	dBm
Power@HE20, MCS7,802.11ax	11	12.5	14	dBm

Table 9 Frequency error

TX Characteristics	Min.	Typical	Max.	Unit
Frequency Error	-15	-5	+15	ppm

Table 10 EVM

TX Characteristics	Min.	Typical	Max.	Unit
EVM@11Mbps, 802.11b	-	-18	-10	dB
EVM@54Mbps, 802.11g	-	-28	-25	dB
EVM@HT20, MCS7,802.11n	-	-29	-27	dB
EVM@HT40, MCS7,802.11n	-	-28	-27	dB
EVM@HE20, MCS7,802.11ax	-	-28	-27	dB

Receiving performance

Table 11 Receiving sensitivity.

RX Characteristics	Min.	Typical	Max.	Unit
Minimum Input Level Sensitivity				
PER≦8%@11Mbps,802.11b	-87	-	-	dBm
PER≦10%@54Mbps,802.11g	-73	-	-	dBm
PER≦10%@HT20, MCS7, 802.11n	-71	-	-	dBm
PER≦10%@HT40, MCS7, 802.11n	-68	-	-	dBm
PER≦10%@HE20, MCS7, 802.11ax	-68	-	-	dBm

3.5.2. Bluetooth RF Parameter

Table 12 Bluetooth TX/RX Characteristic

Item	Data Rate	Min	Typical	Max	Unit
General					
Frequency Range	-	2402	-	2480	MHz
Data Rates	Bluetooth LE 1 Mbps, 2 Mbps				
TX Characteristics					
POWER_AVERAGE	LE_1M	4	6	10	dBm
Frequency Drift Error	LE_1M	-50	10	50	KHz
POWER_AVERAGE	LE_2M	4	6	10	dBm
Frequency Drift Error	LE_2M	-50	10	50	KHz
Carrier frequency offset and drift at NOC:					
ΔFn max	LE_1M	-150	15	150	KHz
|F0-Fn|	LE_1M	0	10	50	KHz
|F1-F0|	LE_1M	0	10	20	KHz
|Fn-Fn5|	LE_1M	0	10	20	KHz
ΔFn max	LE_2M	-150	15	150	KHz
|F0-Fn|	LE_2M	0	10	50	KHz
|F1-F0|	LE_2M	0	10	20	KHz
|Fn-Fn5|	LE_2M	0	10	20	KHz
Modulation characteristics:					
ΔF1avg	LE_1M	225	250	275	KHz
ΔF2avg	LE_1M	185	235	275	KHz
ΔF2avg/ΔF1avg	LE_1M	0.8	1	2	KHz
ΔF2max	LE_1M	185	225	275	KHz
ΔF1avg	LE_2M	225	250	275	KHz
ΔF2avg	LE_2M	185	235	275	KHz
ΔF2avg/ΔF1avg	LE_2M	0.8	1	2	KHz
ΔF2max	LE_2M	185	225	275	KHz
RX Characteristics					
Minimum Sensitivity PER ≤30.8%	LE_1M	-	-96	-	dBm
Minimum Sensitivity PER ≤30.8%	LE_2M	-	-93	-	dBm

4. Antenna Information

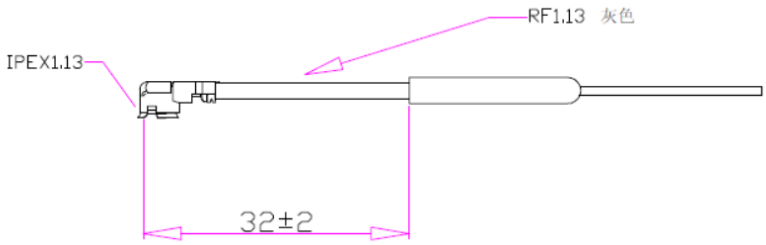
EMC6270-E adopts external antenna. Please order according to the order code. Better RF performance can be obtained by connecting external antenna through IPEX connector.

4.1. External Antenna Parameters and Usage

Users can select 2.4G antennas with different dimensions and gain no more than 2dBi according to the application environment.

The following is a copper tube antenna with IPEX connector commonly used by MXCHIP.

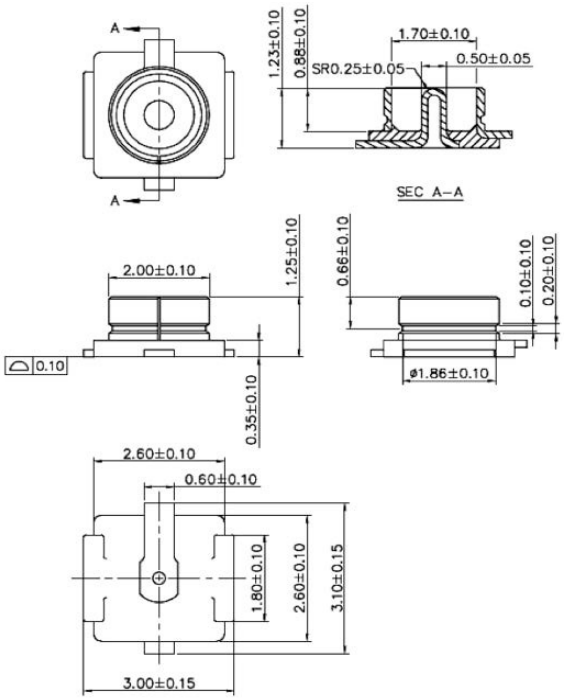
Figure 3 Dimensions of copper tube antenna (unit: mm)



- Frequency range: 2400-2500 MHz
- Input impedance: 50 Ohm
- SWR:<2.0
- Gain: 2.0dBi
- Polarization: vertical
- Directionality: omnidirectional
- Copper pipe: 4.4 * 23mm
- Wire: 1.13 gray line L-82mm

Dimension Diagram of External Antenna Connector.

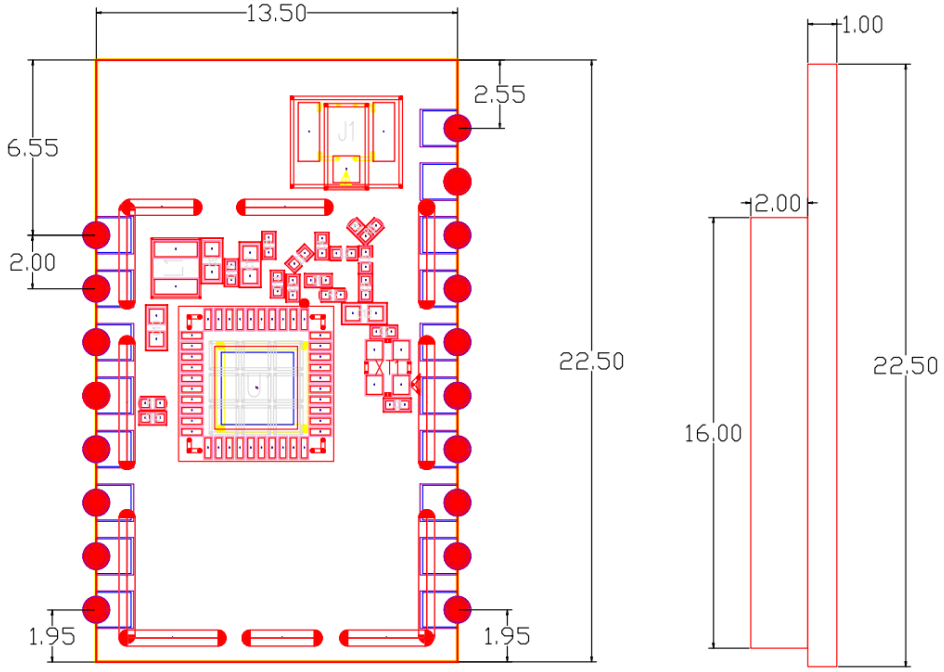
Figure 4 Dimension Diagram of External Antenna Connector



5. General Assembly Size and PCB Package

5.1. General Assembly Size

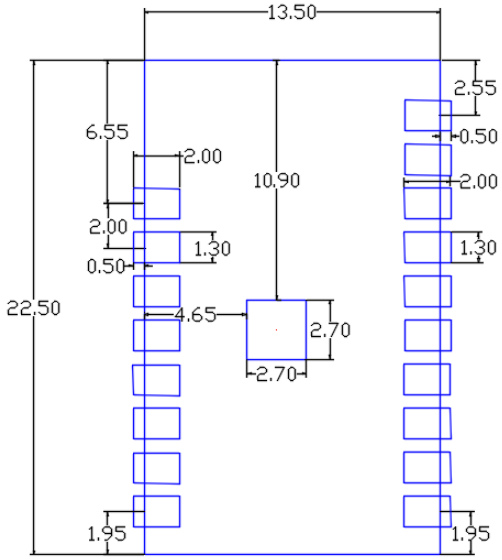
Figure 5 General assembly dimension drawing (unit: mm, error ± 0.1, external dimension error ± 0.2)



5.2. Recommended Package Diagram

The size of resistance welding window and pad is the same. SMT recommends that the thickness of steel mesh be 0.12mm-0.14mm.

Figure 6 Stamp hole package size (installation pad, unit: mm， error ± 0.1, external dimension error ± 0.2)



6. Production Guidelines

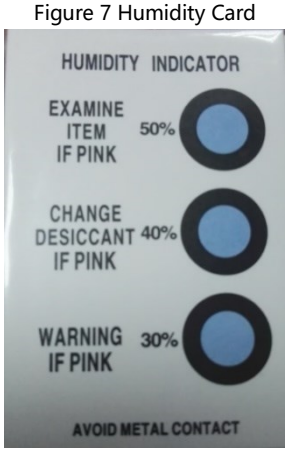
MXCHIP stamp port packaging module must be SMT machine patches, module humidity sensitivity grade MSL3, after unpacking more than a fixed time patches to bake module.

- SMT patches require instruments.
  - Reflow bonding machine.
  - AOI detector
  - 6-8mm suction nozzle
- Baking requires equipment:
  - Cabinet oven
  - Anti-static, high temperature tray
  - Antistatic and heat resistant gloves.

The storage conditions of MXCHIP module are as follows:

- Moisture-proof bags must be stored in an environment with temperature < 30 degree C and humidity < 85% RH.
- A humidity indicator card is installed in the sealed package.

Figure 7 Humidity Card



After the module is split, if the humidity card shows pink, it needs to be baked.

The baking parameters are as follows:

- The baking temperature is 120℃±5℃ and the baking time is 4 hours.
- The alarm temperature is set to 130℃.
- SMT patches can be made after cooling < 36℃ under natural conditions.
- Drying times: 1 time.
- If there is no welding after baking for more than 12 hours, please bake again.

If the disassembly time exceeds 3 months, SMT process is forbidden to weld this batch of modules,

because PCB gold deposition process, over 3 months, pad oxidation is serious, SMT patch is likely to lead to virtual welding, leak welding, resulting in various problems, our company does not assume the corresponding responsibility.

Before SMT patch, ESD (Electrostatic Discharge, Electrostatic Release) protection should be applied to the module.

SMT patches should be made according to the reflow curve. The peak temperature is 250 C. The reflow temperature curve is shown in Chapter 9, Figure 9.

In order to ensure the qualified rate of reflow soldering, 10% of the first patches should be taken for visual inspection and AOI testing to ensure the rationality of furnace temperature control, device adsorption mode and placement mode, and 5-10 patches per hour are recommended for visual inspection and AOI testing in subsequent batch production.

6.1. Precautions

- Operators of each station must wear static gloves during the entire production process;
- Do not exceed the baking time when baking;
- It is strictly forbidden to add explosive, flammable or corrosive substances during baking;
- When baking, the module uses a high temperature tray to be placed in the oven to keep the air circulation between each module while avoiding direct contact between the module and the inner wall of the oven;
- When baking, please close the oven door to ensure that the oven is closed to prevent temperature leakage and affect the baking effect.
- Try not to open the door when the oven is running. If it must be opened, try to shorten the time for opening the door;
- After baking, the module should be naturally cooled to <36°C before wearing the static gloves to avoid burns;
- When operating, strictly guard against water or dirt on the bottom of the module;

The temperature and humidity control level of MXCHIP factory module is Level3, and the storage and baking conditions are based on IPC/JEDEC J-STD-020.

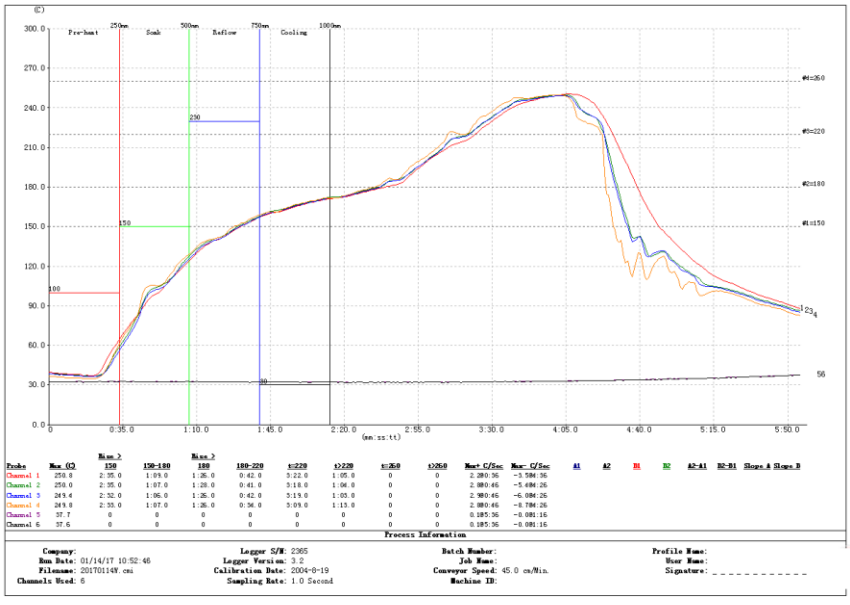
6.2. Storage Condition

Figure 8 Storage Conditions Diagram

6.3. Secondary Reflux Temperature Curve

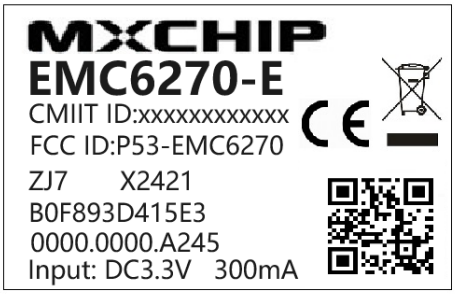
We recommend solder paste model: SAC305, lead-free. No more than 2 reflux times.

Figure 9 Reference Secondary Reflux Temperature Curve



7. Label Information

Figure 10 Module Label Diagram



1. MXCHIP: Company Logo.
2. EMC6270-E: Product Main Type.
3. CMIIT ID: SRRC Authority ID.
4. FCC ID: FCC Authority ID.
5. ZI7: Product Sub model.
6. X2421: Production Serial Number.
7. B0F893D415E3: Module MAC Address.
8. 0000.0000.A245: Software version.
9. QR code: MAC Address.

Note: Due to the production batch and version, the above label schematic diagram is for reference only, please refer to the real object.

8. FCC Warning

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

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.

The device has been evaluated to meet general RF exposure requirement.

9. Radiation Exposure Statement

Radiation Exposure Statement Changes or modifications not expressly approved by the party responsible for compliance could void the user’ s authority to operate the equipment. 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 modular complies with FCC RF radiation exposure limits set forth for an uncontrolled environment.

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

The module is limited to OEM installation only The OEM integrator is responsible for ensuring that the end-user has no manual instructions to remove or install module If the FCC dentification 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 Transmitter Module FCC ID: P53-EMC6270.

When the module is installed inside another device, the user manual of the host must contain below warning statements.

1.1 List of applicable FCC rules

FCC Part 15 Subpart C 15.247 & 15.209

1.2 Specific operational use conditions

The module is a BLE Module

2.4GHz Wi-Fi/BLE Module	**Operation Frequency**	**Number of Channel**	**Modulation**	**Antenna Spec.**
BLE	2402~2480MHz	40	GFSK	External IPEX Connector Antenna 2dBi Max
WLAN	2402~2480MHz	13	DSSS,OFDM	

The module can be used for mobile applications with antenna up to 2dBi. The host manufacturer installing this module into their product must ensure that the final composit product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation. The host manufacturer has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

1.3 Limited module procedures Not applicable. The module is a Single module and complies with the requirement of FCC Part 15.212.

1.4 Trace antenna designs Not applicable.

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

1.5 RF exposure considerations

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

1.6 Antenna

Antenna Specification are as follows:

Type: Single External antenna Gain: 2dBi . This device is intended only for host manufacturers under the following conditions: The transmitter module may not be co-located with any other transmitter or antenna; The module shall be only used with the internal antenna(s) that has been originally tested and certified with this module. The antenna must be either permanently attached or employee ‘unique’ antenna coupler. As long as the conditions above are met, further transmitter test will not be required. However, the host manufacturer is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

1.7 Label and compliance information

Host product manufacturers need to provide a physical or e-label stating “Contains FCC ID: P53-EMC6270” with their finished product.

1.8 Information on test modes and additional testing requirements Operation Frequency: 2402-2480MHz

Number of Channel: 40、13

Modulation: GFSK，DSSS, OFDM

Host manufacturer must perform test of radiated & conducted emission and spurious emission, etc. according to the actual test modes for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product. Only when all the test results of test modes comply with FCC requirements, then the end product can be sold legally.

1.9 Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.247 & 15.209 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.

10. Sales and Technical Support Information

If you need to consult or purchase this product, please call Shanghai MXCHIP Information Technology Co., Ltd. during office hours.

Office hours: Monday to Friday morning: 9:00-12:00, afternoon: 13:00-18:00

Contact Tel: +86-21-52655026

Address: 9th Floor, Building B, 2145 Jinshajiang Road, Putuo District, Shanghai

Zip code: 200333

Email: sales@mxchip.com