MXCHIP®

Datasheet

EMC6069 Wi-Fi/BLE IoT Module

Built-in Wi-Fi 6 Combo SoC

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

Version：0.1　　Date：2023-01-28　　Number：DS0213EN

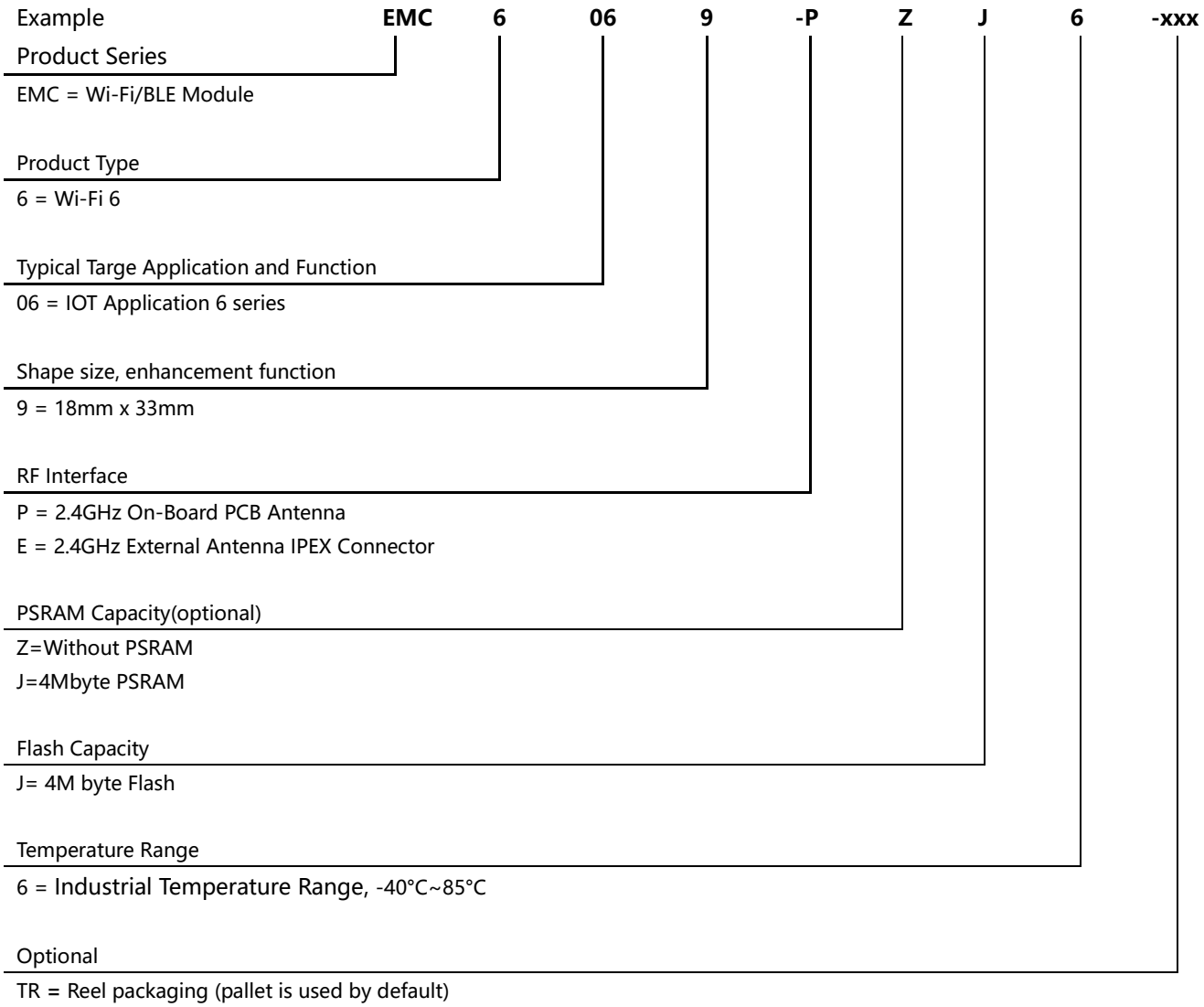
概　要

- **Input:　3.0V~3.6V**
- **Operating temperature：-40℃ to +85℃**
- **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
- **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**
  - 19 x GPIO
  - 1 x SPI
  - 9 x PWM
  - 2 x UART

- **Interface and Size**
  - Maintain pin compatibility with similar packaging modules.
  - On-board PCB antenna or external antenna with IPEX connector.
  - 18mm x 33mm, stamp hole
- **Rich supporting software**
  - Support AliOS and 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
EMC6069-PZJ6	On-Board PCB Antenna
EMC6069-EZJ6	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 EMC6069 modules.
MXKIT-Core-6069	The development board core board for EMC6069, including the EMC6069-P module. Used with MXKIT-Base.
FX-6069	EMC6069 production fixture, including accompanying plate: MXKIT-Base, MXKIT-Core-6069.

Version Update

Date	Version	Update
2023-01-28	0.1	Initial Version

Copyright Notice

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

Catalog

Figure

Table

1. Introduction

EMC6069 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 EMC6069 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.

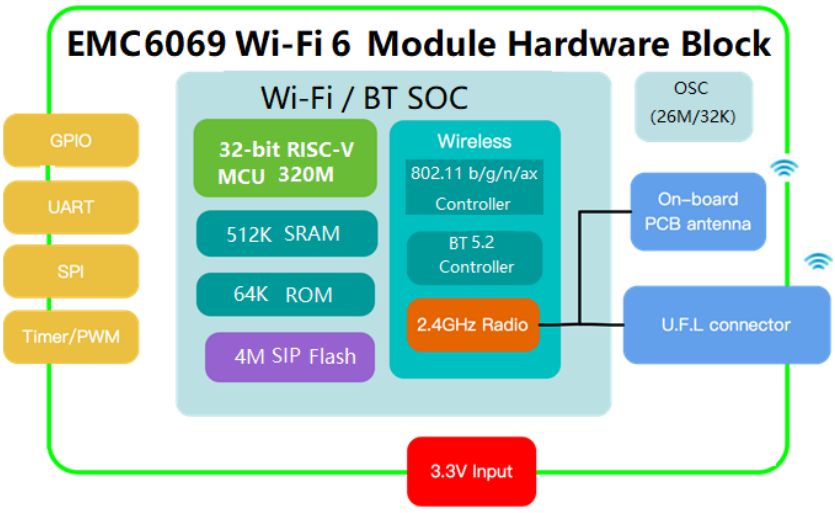
EMC6069 module is powered by 3.3V single power supply and supports the stamp hole SMT installation mode, which is applicable to various smart home appliance application scenarios.

MXCHIP provides the MXOS software platform to support the development of the EMC6069 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 EMC6069 module, mainly including:

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

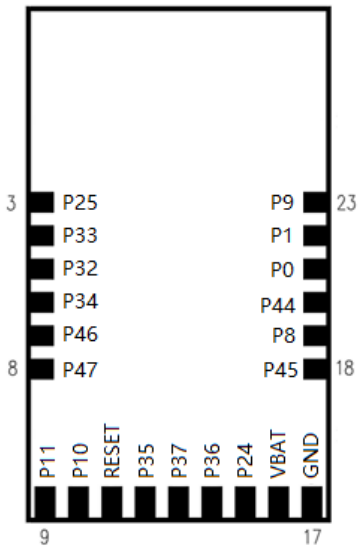
Figure 1 Hardware Block Diagram



2. Pin Definition

2.1. Pin Arrangement

Figure 2 Pin Arrangement



2.2. Pin Definition

Table 1 Pin Definition

Pin No.	Name	I/O Type	Recommended Function
3	P25	I/O	PWM5
4	P33	I/O	PWM7
5	P32	I/O	PWM6
6	P34	I/O	PWM8
7	P46	I/O	MOSI
8	P47	I/O	MISO
9	P11	I/O	UART1_TXD，USER_UART
10	P10	I/O	UART1_RXD，USER_UART
11	RESET	I/O	RESET
12	P35	I/O	PWM9
13	P37	I/O	PWM11
14	P36	I/O	PWM10
15	P24	I/O	PWM4
16	VBAT	P	VBAT
17	GND	P	GND
18	P45	I/O	CSN
19	P8	I/O	PWM2/ELINK
20	P44	I/O	SCK
21	P0	I/O	LOG_TXD, debugging and download serial port
22	P1	I/O	LOG_RXD, debugging and download serial port
23	P9	I/O	PWM3/STATUS

Description:

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

Attention:

- Pin21 and Pin22 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.

3. Electrical Parameters

3.1. Operation Voltage and Current

Table 2 Operation Voltage and Current

Parameter	Min.	Typical	Max.	Unit
CIN Pin capacitance		2		pf
VIH High-level input voltage	0.7vdd		vdd	V
VIL Low-level input voltage	0		0.3vdd	
IIH High-level input current	-10		10	uA
IIL Low-level input current	-10		10	uA
VOH High-level output voltage	0.9vdd			V
VOL Low-level output voltage			0.1vdd	V

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 3 Typical Application Power

Mode	Average	Max.	Unit	Note
Wi-Fi Shut down	TBD	TBD	mA	CPU Active
Wi-Fi Shut down	TBD	TBD	mA	CPU Sleep
Wi-Fi Init	TBD	TBD	mA	CPU Active. After Wi-Fi initialization, and in standby state
Keep Wi-Fi Connect	TBD	TBD	mA	Close Wi-Fi 和 MCU Low power mode
Keep Wi-Fi Connect	TBD	TBD	mA	Open Wi-Fi Low power mode，Close MCU Low power mode，DTIM=1
Keep Wi-Fi Connect	TBD	TBD	mA	Open Wi-Fi Low power mode，Close MCU Low power mode，DTIM=3
Keep Wi-Fi Connect	TBD	TBD	mA	Open Wi-Fi Low power mode，Close MCU Low power mode，DTIM=1
Keep Wi-Fi Connect	TBD	TBD	mA	Open Wi-Fi Low power mode，Close MCU Low power mode，DTIM=13
SoftAP Mode	TBD	TBD	mA	SoftAP Connected State
Monitor Mode	TBD	TBD	mA	Network Configuring process, in RX state
Iperf Mode	TBD	TBD	mA	Close Wi-Fi 和 MCU low power mode，and send at full speed via iperf

3.3. Temperature

Table 4 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 5 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 6 RF Basic Parameter

Item	Specification
Operating Frequency	2.412~2.484GHz
Channel BW	20MHz
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
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 PCB printed ANT (Reserve)

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

Transmitting performance

Table 7 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

Table 8 Frequency error

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

Table 9 EVM

TX Characteristics	Min.	Typical	Max.	Unit
EVM@11Mbps, 802.11b	-	-20	-10	dB
EVM@54Mbps, 802.11g	-	-29	-25	dB
EVM@HT20, MCS7,802.11n	-	-31	-27	dB

Receiving performance

Table 10 Receiving sensitivity

RX Characteristics	Min.	Typical	Max.	Unit
Minimum Input Level Sensitivity				
PER≦8%@11Mbps,802.11b	-	-84	-	dBm
PER≦10%@54Mbps,802.11g	-	-72	-	dBm
PER≦10%@HT20, MCS7, 802.11n	-	-69	-	dBm

3.5.2. Bluetooth RF Parameter

Table 11 Bluetooth TX/RX Characteristic

Item	DataRate	Min	Typical	Max	Unit
POWER_AVERAGE	LE_1M	6	8	10	dBm
Frequency Drift Error	LE_1M	-50	-5	50	KHz
Carrier frequency offset and drift at NOC:					
ΔFn max	LE_1M	-150	6.1	150	KHz
|F0-Fn|	LE_1M		2.37	50	KHz
|F1-F0|	LE_1M		2.1	20	KHz
|Fn-Fn5|	LE_1M		0.89	20	KHz
Modulation characteristics:					
ΔF1avg	LE_1M	225	249	275	KHz
ΔF2avg	LE_1M	185	238	275	KHz
ΔF2avg/ΔF1avg	LE_1M	0.8	0.96		KHz
ΔF2max	LE_1M	185	245		KHz
In-Band Emissions					
OFFSET_-2	LE_1M		-44.3	-20	dBm
OFFSET_-3	LE_1M		-46.6	-30	dBm
OFFSET_-4	LE_1M		-46.5	-30	dBm
OFFSET_-5	LE_1M		-50.6	-30	dBm
OFFSET_2	LE_1M		-46.1	-20	dBm
OFFSET_3	LE_1M		-45.7	-30	dBm
OFFSET_4	LE_1M		-44.4	-30	dBm
OFFSET_5	LE_1M		-50.2	-30	dBm
RX Characteristics					
Minimum Sensitivity PER ≤30.8%	LE_1M	-	-98	-97	dBm

4. Antenna Information

EMC6069 has two specifications: PCB antenna and external antenna. Please order according to the order code. IPX antenna connector is not welded on the module using PCB antenna. Better RF performance can be obtained by connecting external antenna through IPX connector.

4.1. PCB Antenna Parameter and Usage

4.1.1. On-board PCB Antenna

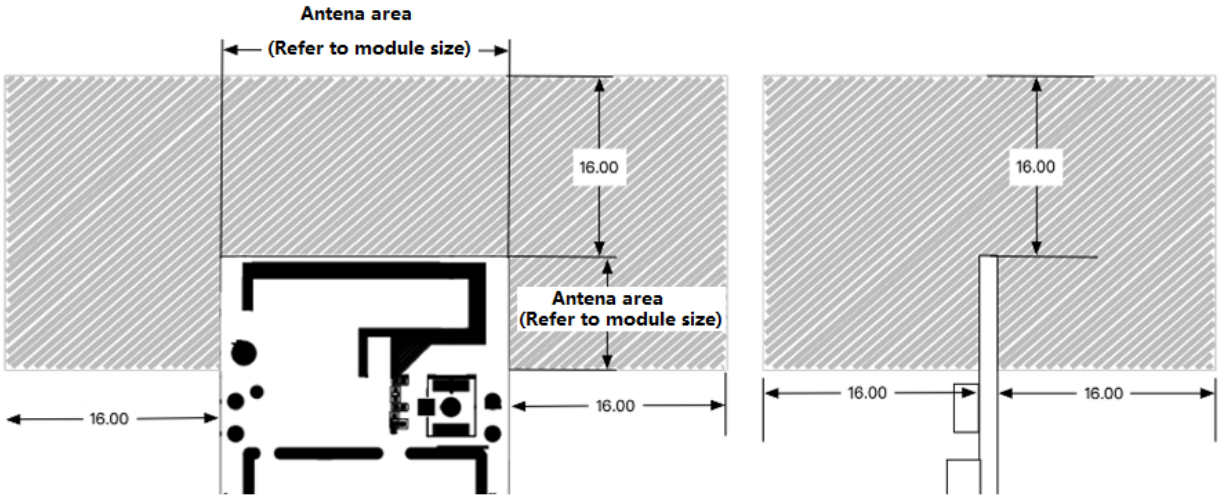
Table 12 PCB Antenna Parameter

Item	Min.	Typical	Max.	Unit
Frequency	2400		2500	MHz
Impedance		50		Ω
VSWR			2	
Gain	≤2dBi			
Efficiency	>70% or >-1.54dB			

4.1.2. PCB Antenna Clearance

When using PCB antenna in WIFI module, it is necessary to ensure that PCB and other metal devices are at least 16 mm away from the motherboard. The shaded areas in the figure below need to be far away from metal devices, sensors, interference sources and other materials that may cause signal interference.

Figure 3 PCB Antenna Minimum Clearance（unit: mm)

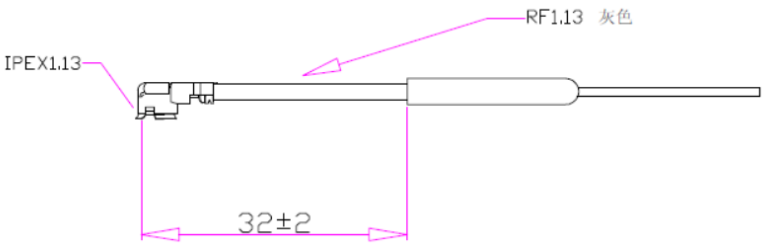


4.2. External antenna parameters and use

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.

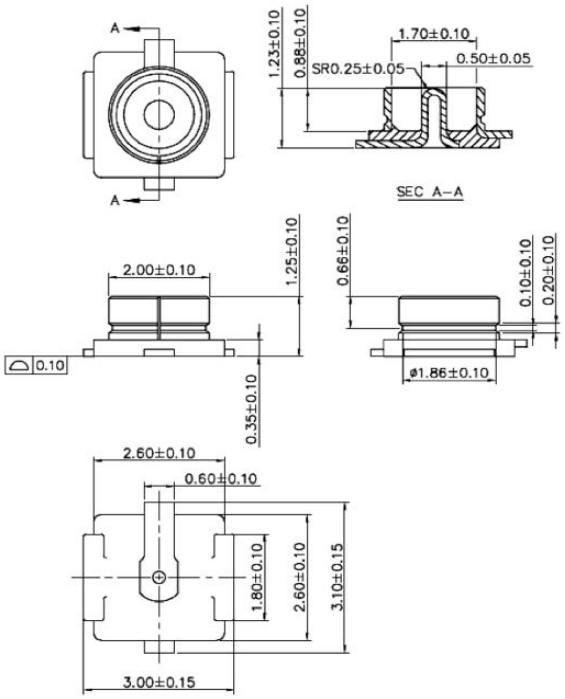
Figure 4 Dimensions of copper tube antenna (unit: mm)



- 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.

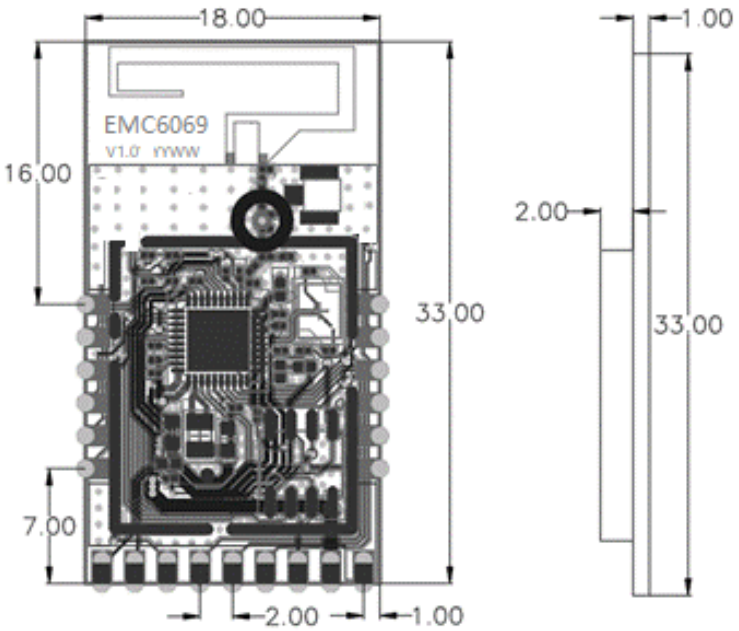
Figure 5 Dimension Diagram of External Antenna Connector



5. General Assembly Size and PCB Package

5.1. General Assembly Size

Figure 6 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 7 Stamp hole package size (installation pad, unit: mm)

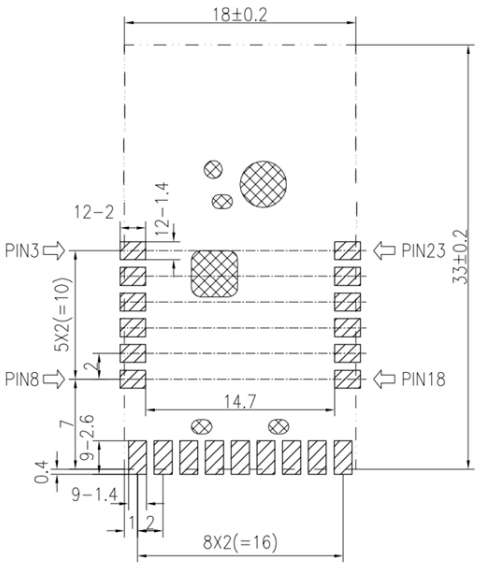
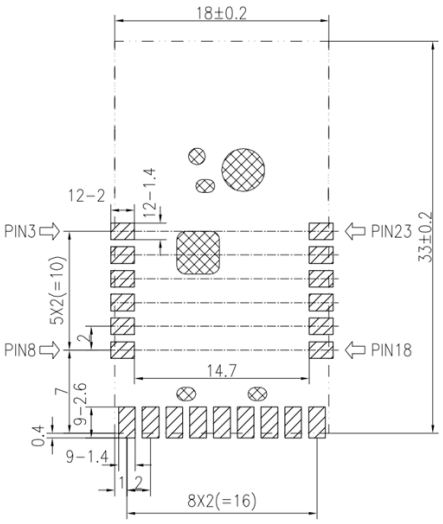


Figure 8 Stamp hole package size (without pad, unit: mm)



Description:

1. Figure 7 and Figure 8 show the outline of the module. Components cannot be arranged on the main board within the outline.

2. The diagonal shadow in Figure 7 shows the mounting pad of the module on the main board, and the size of the mounting position of the module on the main board.

3. The mesh wire frame in Figure 8 indicates the place where the pad cannot be placed on the main board and indicates the position and size where the pad cannot be placed on the main board.

6. Production Guidelines

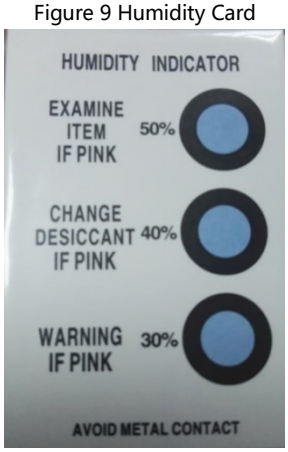
MXCHIP stamp port packaging module must be SMT machine patches, module humidity sensitivity grade MSL3, after unpacking more than a fixed time patches to bake module.

- 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 9 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 11.

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.

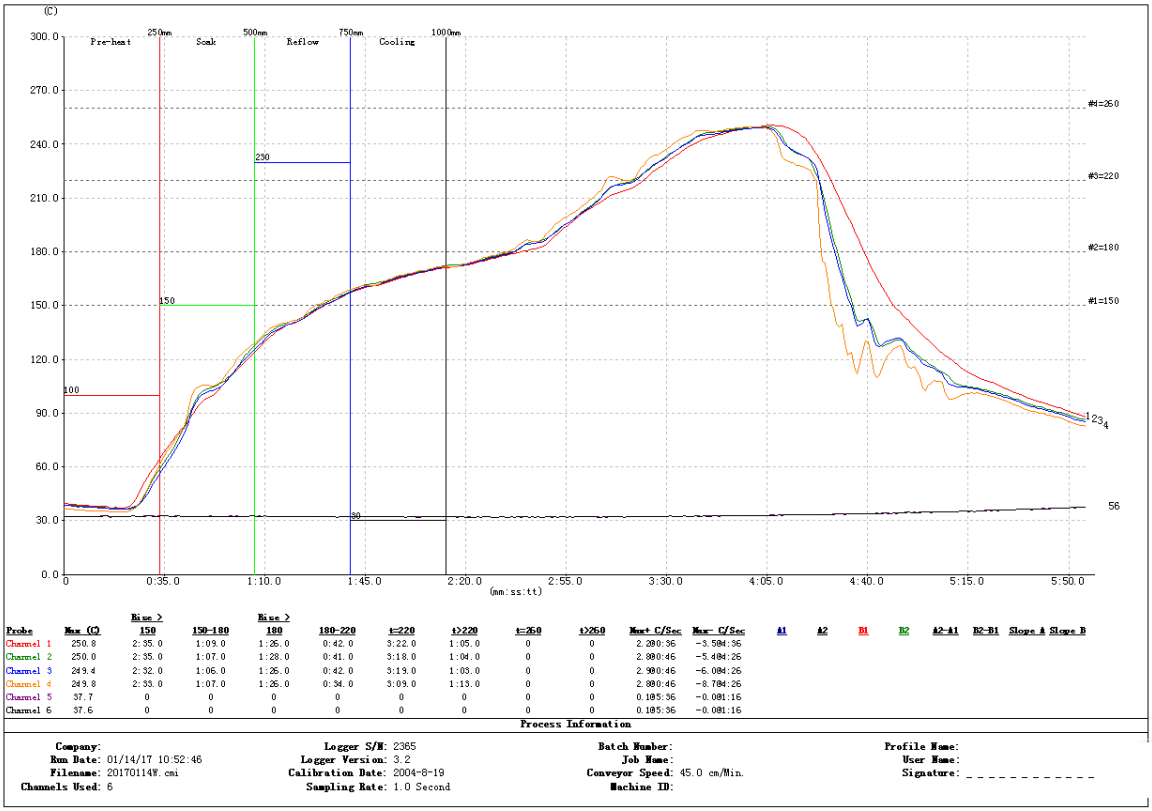
6.2. Storage Condition

Figure 10 Storage Conditions Diagram

6.3. Secondary Reflux Temperature Curve

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

Figure 11 Reference Secondary Reflux Temperature Curve



Probe	Max (C)	Rise > 150	150-180	Rise > 180	180-220	t=220	t>220	t=260	t>260	Max+ C/Sec	Max- C/Sec	A1	A2	B1	B2	A2-A1	B2-B1	Slope A	Slope B
Channel 1	250.8	2:35.0	1:09.0	1:26.0	0:42.0	3:22.0	1:05.0	0	0	2.200:36	-3.504:36								
Channel 2	250.0	2:35.0	1:07.0	1:28.0	0:41.0	3:18.0	1:04.0	0	0	2.800:46	-5.404:26								
Channel 3	249.4	2:32.0	1:06.0	1:26.0	0:42.0	3:19.0	1:03.0	0	0	2.900:46	-6.004:26								
Channel 4	249.8	2:33.0	1:07.0	1:26.0	0:34.0	3:09.0	1:13.0	0	0	2.800:46	-8.704:26								
Channel 5	37.7	0	0	0	0	0	0	0	0	0.105:36	-0.001:16								
Channel 6	37.6	0	0	0	0	0	0	0	0	0.105:36	-0.001:16								

Process Information

Company:
Run Date: 01/14/17 10:52:46
Filename: 20170114W.cmi
Channels Used: 6

Logger S/N: 2365
Logger Version: 3.2
Calibration Date: 2004-8-19
Sampling Rate: 1.0 Second

Batch Number:
Job Name:
Conveyor Speed: 45.0 cm/Min.
Machine ID:

Profile Name:
User Name:
Signature: _ _ _ _ _ _ _ _ _ _ _ _

7. Label Information

Figure 12 Module Label Schematic Diagram

1. MXCHIP: Company Logo.
2. EMC6069-P: Product Main Type.
3. CMIIT ID: SRRC ID.
4. ZJ6: Product Sub model.
5. X2301: Production Serial Number.
6. B0F893D32C91: MAC Address.
7. 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. 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

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Email: sales@mxchip.com