

EMC3020 Wi-Fi/BLE IoT Module

Datasheet

Built-in 32-bit Soc, 2.4G Hz IEEE 802.11 b/g/n, Bluetooth 5.0
ultra-high integration, rich peripherals

version: 1.2

Date: 2021-05-07

Number: DS0177EN

Abstract

- **Input Voltage:** 3.0V~3.6V
- **Operating Temperature:** -30°C to +85°C
- **Processor: TG7100C Wi-Fi/BLE Combo SoC**
 - Main frequency up to 192MHz
 - JTAG simulation debugger interface
- **Memory**
 - 276K bytes SRAM
 - 128K bytes ROM
 - 1kbit eFuse
 - 2M bytes XIP Flash
- **Wi-Fi**
 - IEEE 802.11 b/g/n 1T1R 2.4GHz Single Frequency
 - Support HT20, up to 65Mbps@MCS7
 - Support WPA/WPA2 Personal/WPA2 Enterprise/WPA3
 - Support STA, SoftAP and Monitor
- **Bluetooth**
 - Comply with BLE 5.0, slave mode
 - Support BLE 5.0 Channel slection#2
 - Not support 2M PHY/coding PHY/ADV extension
 - Wi-Fi and BLE time division multiplexing, sharing the same PA and antenna
 - Set Wi-Fi network parameter
- **Peripherals**
 - 16 x GPIO
 - 1 x SPI, 1 x I2C
 - 5 x PWM
 - 2 x UART
 - 1 x SDIO
 - PIR (passive infrared) detection
 - IR remote hardware accelerator
 - 10-Bit DAC/12-Bit ADC/2 x ACOMP



- **Interface and Dimension**
 - Stamp hole
 - Maintain pin compatibility with similar package modules
 - On-board PCB antenna or IPEX connector, 18mm x 20mm
 - Provide 5V UART pinboard
- **Application Functions**
 - Support AliOS and MXOS operating system
 - Mass production firmware for typical
 - Access Tmall Genie quickly
- **Typical application**
 - smart home appliances
 - smart electric equipment
 - Industrial automation
- **Order Code**

Order code	Description
EMC3020-PZI5	On-board PCB board
EMC3020-EZI5	External antenna IPEX connector
EMC3020-PZI5-T11	5V power supply, UART interface, on-board PCB antenna
EMC3020-EZI5-T11	5V power supply, UART interface, external antenna IPEX connector

Order Code

Example	EMC	3	02	0	-P	Z	I	5	-xxx
Product serial									
EMC=IoT Wi-Fi/BLE Module									
Product type									
3=Welding type wireless module									
Typical target applications and features									
02 = IOT Application 2 Series									
Dimensions, enhancements									
0 = 2 x 9 + 9 pins 1.5 spacing, stamp hole									
RF Interface									
P = 18mm x 20 mm, 2.4GHz on-board PCB antenna									
E = 18mm x 20 mm, 2.4GHz IPEX external connector									
PSRAM capacity (optional)									
Z = no PSRAM									
Flash Capacity									
I = 2M bytes of flash storage									
Temperature range									
5 = Industrial grade temperaturerange-30°C~85°C									
Option									
TR = tape reel package (default package is tray)									
T11 = The module is soldered to the T11 switching board (provide 5V UART socket).									
T11B0 = The module is soldered to the T11 switching board (provide 5V UART socket), spray glue									
T11B1 = The module is soldered to the T11 switching board (5V UART socket provided), mounted in the glue box, and then glued.									
T11B2 = The module is soldered to the T11 motherboard (5V UART socket provided), mounted in the pouring glue box, and then pouring glue.									

For a list of all relevant features (e.g. packaging, minimum order quantity, etc.) and other information, please contact your nearest MXCHIP point of sale or distributor.

Accessories

Order Code	Description
MXKIT-Base	Development board for all EMC3020 modules
MXKIT-Core-3020	The development board core board for the EMC3020, used with MXKIT-Base
FX-3020	EMC3020 production fixture with accompanying test board: MXKIT-Base, MXKIT-Core-3020

Release Note

Date	Version	Updates
2020-08-11	0.1	Initial version
2020-08-21	0.2	added information about the T11 conversion board, added recommended split chart
2020-09-09	0.3	Update order code information
2020-09-11	0.4	Updated T11 adapter drawing information
2020-10-15	1.0	Increase of order code letters and electrical parameters
2020-10-29	1.1	Add T11 switching board side view dimension
2021-05-07	1.2	Update pin definition

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1. Introduction

EMC302x series modules are mainly used in Tmall Genie ecological products. The module realizes data collection and device control through a rich peripheral interface, and can be connected to the Tmall Genie platform through Wi-Fi network to realize voice control and remote control of APP of Tmall Genie. The module also integrates a BLE 5.0 transceiver, which can be used to configure the parameters of the equipment, simplify the network access process and improve the end-user experience. This series of modules can be applied to a wide range of smart home products with different sizes, interface forms, antenna interfaces and temperature ranges.

The EMC3020 module includes an ultra-highly integrated Wi-Fi/BLE Combo microcontroller that provides essential computing power and stable Wi-Fi/BLE connectivity for IoT data terminals. The chip integrates:

- ARM cores up to 192MHz main frequency
- 276K bytes SRAM
- 2-Mbyte SPI Flash
- 2.4GHz Wi-Fi controller that complies with IEEE 802.11 b/g/n
- low power Bluetooth controller that complies BT 5.0 standard

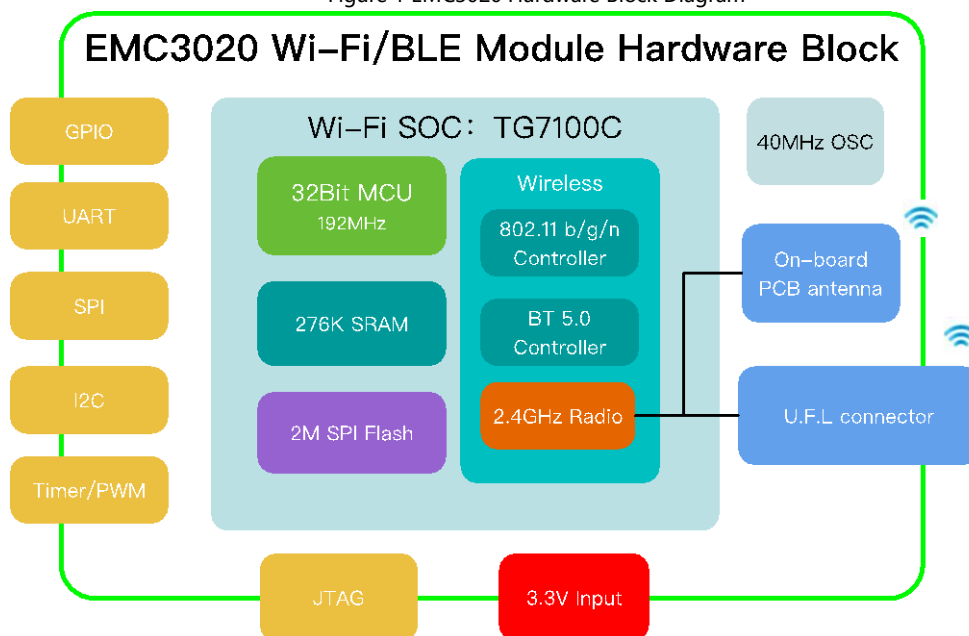
EMC3020 module is powered by a single 3.3V power supply and supports stamp hole installation, which is suitable for various smart home application scenarios.

The MXOS software platform provided by MXCHIP supports the development of EMC3020 series modules, and provides an efficient development environment, abundant sample programs and a variety of typical applications to help customers quickly build Tmall Genie ecological products.

The following diagram shows the hardware block diagram of the EMC3020 module, which mainly includes:

- Wi-Fi microcontroller
- On-board or IPEX antenna
- power supply and COM port

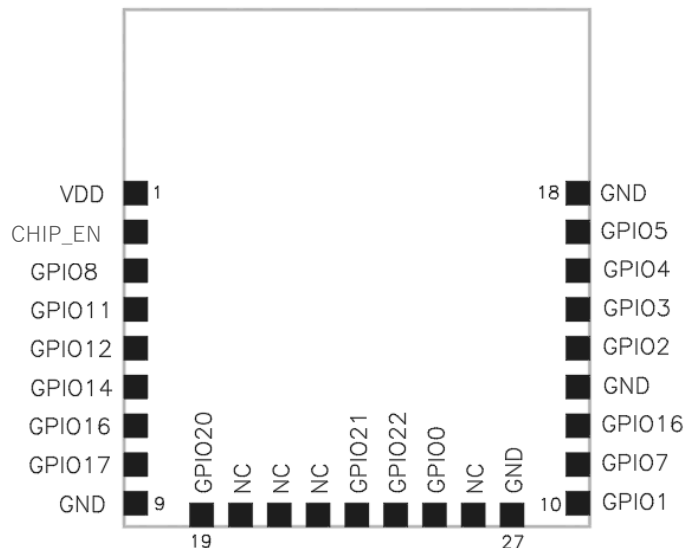
Figure 1 EMC3020 Hardware Block Diagram



2. Pin Definition

2.1. Pin Arrangement

Figure 2 Pin arrangement



2.2. Pin Definition

Table 1 Pin definition

No.	Name	Type	GPIO	SPI	I2C	UART	PWM	AUXADC	SDIO	Function	
										Recommended function 1 JTAG simulation debugging + application UART + Log UART	Recommended function 2 Compatible mode with other modules of the same size, does not support JTAG simulation debugging
1	VDD	Power								3.3 V supply (VDD), a maximum output current of 500 mA and above is recommended for the external power supply.	
2	CHIP_EN	I								Chip enable	
3	GPIO_08	I/O								ISP, If it is high at start-up, it enters ISP programming mode, refer to Table 2.	
4	GPIO_11	I/O								JTAG_TDO, JTAG Simulation Debug Interface	
5	GPIO_12	I/O								JTAG_TMS, JTAG Simulation Debug Interface	UART_RXD, for data transfer
6	GPIO_14	I/O								JTAG_TCK, JTAG Simulation Debug Interface	UART_TXD, for data transfer
7	GPIO_16	I/O								BOOT, mode selection, refer to Table 2 LOG_TXD, for debugging information output, do not adjust arbitrarily	
8	GPIO_17	I/O								JTAG_TDI, JTAG Simulation Debug Interface	
9	VSS	Power								GND	
10	GPIO_01	I/O									

11	GPIO_07	I/O								LOG_RXD, for debugging information output, do not adjust arbitrarily
12	GPIO_16	I/O								BOOT, mode selection, refer to Table 2 LOG_TXD, for debugging information output, do not adjust arbitrarily Provide 1K pull-down resistor to ensure that the module is in ATE mode while sending data through LOG_TXD.
13	VSS	Power								GND
14	GPIO_02	I/O								
15	GPIO_03	I/O								
16	GPIO_04	I/O								
17	GPIO_05	I/O								
18	VSS	Power								GND
19	GPIO_20	I/O								STATUS, mode selection, refer to Table 2
23	GPIO_21	I/O								UART_RXD, for data transfer
24	GPIO_22	I/O								UART_TXD, for data transfer
25	GPIO_0	I/O								
27	VSS	GND								GND

Note:

1. Module operating mode selection signal. During the start-up phase, the module detects the level of these pins and enters a specific operating state. The correspondence between the levels and the operating modes is shown in Table 2.

Table 2 Operation mode selection

Operation mode	Pin3 (ISP) Default: 0	Pin12 (BOOT) Default: 1	Pin19 (STATUS) Default: 1
ISP	1	for data transfer	x
QC	0	0	0
ATE	0	0	1
APP	0	1	x

- (1). 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. ISP mode is a hardware fixed function and cannot be modified.
- (2). When the module starts, the hardware and firmware detect the state of ISP, BOOT, and STATUS to enter the corresponding operating modes. Among the followings
 - ISP mode is used for programming via the serial port on-board Flash.
 - QC mode is used to self-test the hardware during production and generate QC information for the production unit to check the quality of the module. the serial port for QC information interaction can be defined in the application and is output by default from the application serial port at a baud rate of 921600. the ATE mode provides a series of commands to keep the RF in a specific transceiver mode.
 - ATE mode provides a series of serial commands to place the RF in a specific transmit and receive mode so that testing and calibration can be performed by the instrument.
 - APP is the normal operating mode for running the application. Debug serial port LOG_UART baud rate is 2000000 by default.

2. LOG_RXD/LOG_TXD is used to debug the input/output of the serial port information, do not use it when designing, and provide a convenient way to lead out as much as possible to facilitate software development.
3. The CHIP_EN pin is Chip enable, low level is valid, if not used can be kept hanging.
4. The internal processing of the chip pins within the module is as follows.
 - CHIP_EN: 33K pull-up resistor.
 - GPIO_08: 33K pull-down resistor.

3. Electric Parameter

3.1. Absolute electric parameter

Operation of the module outside of the absolute maximum rating may result in permanent damage. Also, prolonged exposure to the maximum rating may affect the reliability of the module.

Table 3 Absolute Max Parameter

Parameter	Description	Min	Max	Unit
T _S	storage temp.	-45	135	°C
V _{DD}	supply voltage	-0.3	3.6	V
V _{IN}	Input voltage on any other pin	V _{SS} -0.3	V _{DD} +0.3	V

3.2. Operation Condition

Table 4 Operation Parameter

Parameter	Description	Min	Typical	Max	Unit
T _a	operation temp.	-30	-	85	°C
V _{DD}	operation voltage	3	3.3	3.6	V

3.3. Typical application power consumption

The module current test environment is based on V_{DD}=3.3V, which is tested in common office applications (the measured value will be different in different test environments).

Table 5 Typical application power

Mode		remark	Performance @25°C			
			Min	Typical	Max	Unit
RX	11b			35		mA
	11g			39		
	11n			39		
TX	11b - 11Mbps	Duty 50%		190		
		Duty 99%		310		
	11g - 54Mbps	Duty 50%		145		
		Duty 99%		230		
	11n - MCS7	Duty 50%		130		
		Duty 99%		215		
MCU	Run	Freq@ 192MHz		22		
	Standby	Freq@ <10MHz		2		
Sleep	PDS7	Fast recover		12		uA
Hibernate	HBN	RTC or GPIO		0.5		
Shut down				0.1		

3.4. ESD

Table 6 Electrostatic discharge parameters

Symbol	Name	Name	Level	Max.	Unit
$V_{ESD}(HBM)$	Electrostatic discharge voltage (Human body model)	TA= +25 °C comply with JESD22-A114	2	2000	V
$V_{ESD}(CDM)$	Electrostatic discharge voltage (Discharge equipment model)	TA = +25 °C comply with JESD22-C101	II	500	

3.5. RF Parameter

3.5.1. Wi-Fi

Table 7 Wi-Fi RF 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
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 65Mbps
Antenna type	One U.F.L connector for external antenna PCB printed ANT (Reserve)

Note: The typical values of the following Tx test data are recorded under normal temperature environment and Tx lasts about 20s.

TX 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

Table 9 Frequency error

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

Table 10 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	-	-30	-27	dB

RX performance

Table 11 RX sensitivity

RX Characteristics	Min.	Typical	Max.	Unit
Minimum Input Level Sensitivity				
PER $\leq$ 8%@11Mbps,802.11b	-	-88	-	dBm
PER $\leq$ 10%@54Mbps,802.11g	-	-73	-	dBm
PER $\leq$ 10%@HT20, MCS7, 802.11n	-	-71	-	dBm

3.5.2. Bluetooth RF parameter

Table 12 Bluetooth TX/RX performance

Item	Min	Typical	Max	Unit
TX_AVERAGE	3	6	8	dBm
Frequency Drift Error	-	-4	-	KHz
Modulation characteristics:				
ΔF_{1avg}	-	250	-	KHz
$\Delta F_{2avg}/\Delta F_{1avg}$	-	0.9	-	
ΔF_{2max}	-	220	-	KHz
RX Characteristics				
Minimum Sensitivity	-	-95	-	dBm

4. Antenna Information

The EMC3020 is available in both PCB antenna and external antenna, please refer to the order code. No IPX antenna connector is soldered on the module using the PCB antenna. By connecting an external antenna through an IPX connector, better RF performance can be obtained.

4.1. PCB antenna and usage

4.1.1. On-board PCB antenna parameter

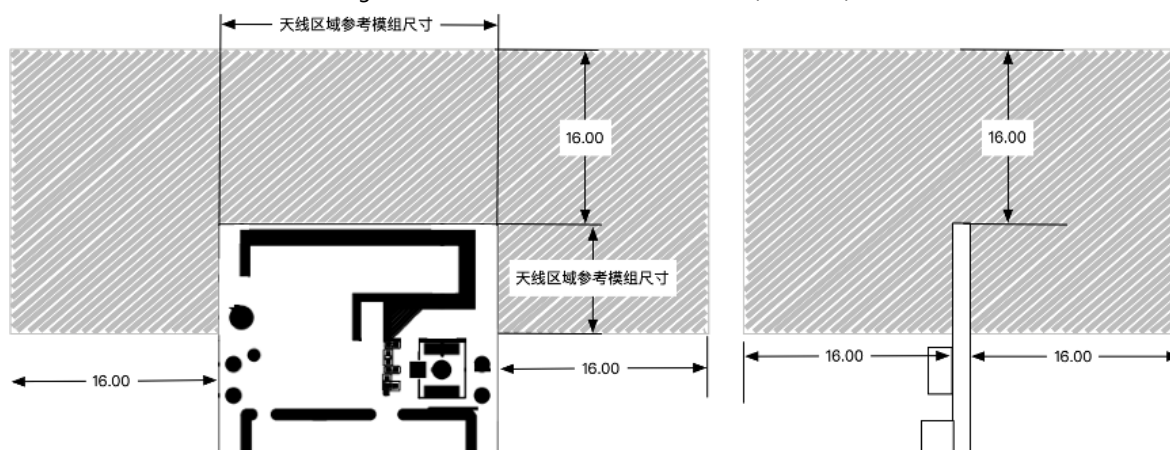
Table 13 on-board PCB antenna parameter

Item	Min.	Typical	Max.	Unit
Frequency	2400		2500	MHz
Impedance		50		Ω
VSWR			2	
Gain	$\leq 2\text{dBi}$			
Efficiency	$>70\%$ or $>-1.54\text{dB}$			

4.1. PCB Antenna Clearance

When using the PCB antenna on the module, you need to make sure that the motherboard PCB is at least 16mm away from other metallic devices, connectors, PCB through-hole, alignment, and copper cladding. The shaded area in the diagram below indicates that the area needs to be kept away from metal devices, sensors, interference sources, and other materials that may cause signal interference.

Figure 3 Antenna minimum clearance area (unit: mm)

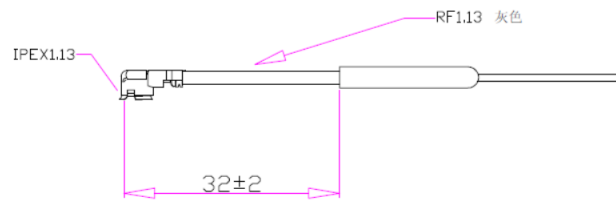


4.2. External antenna parameters and use

Users can choose 2.4G antennas in different form factors with a gain of no more than 2dBi according to the application environment.

The following is a copper antenna for an IPEX connector commonly used by MXCHIP.

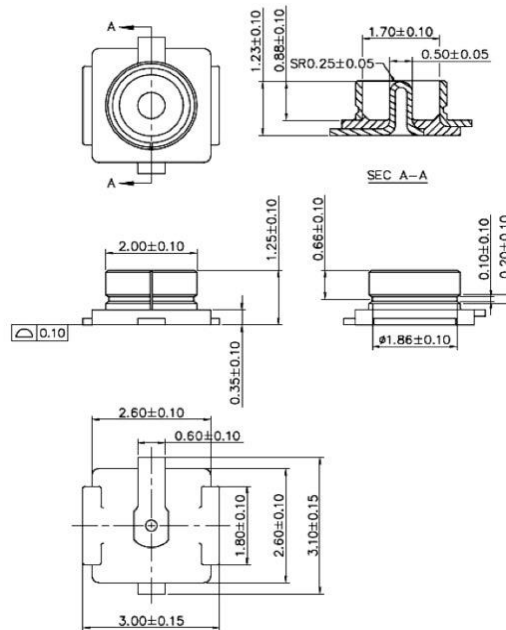
Figure 4 Copper tube antenna size



- Frequency range: 2400-2500 MHz
- Input impedance: 50 OHM
- VSWR: < 2.0
- Gain: 2.0 DBI
- Polarization: vertical
- Directionality: Omnidirectional
- Copper tube: 4.4*23mm
- Wire: 1.13 grey wire L-82mm

External antenna IPEX seat size:

Figure 5 Dimension drawing of external antenna connector



4.2.1. SRRC Important statements

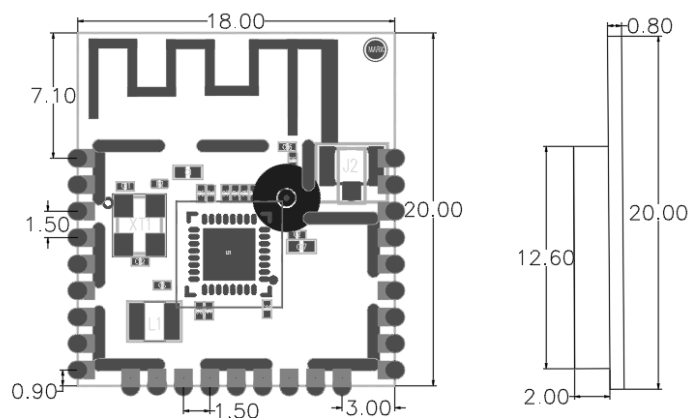
The SRRC type approval number obtained for module models using an external antenna base has the (M) suffix and any module with the (M) suffix is specifically declared as follows.

Type approval of a module does not imply that the end equipment in which the module is embedded or in which it is used complies with the relevant radio regulations or standards, and the end equipment manufacturer is responsible for the conformity of the technical characteristics of the product with the radio regulations or standards.

5. Assembly dimensions and Package dimensions

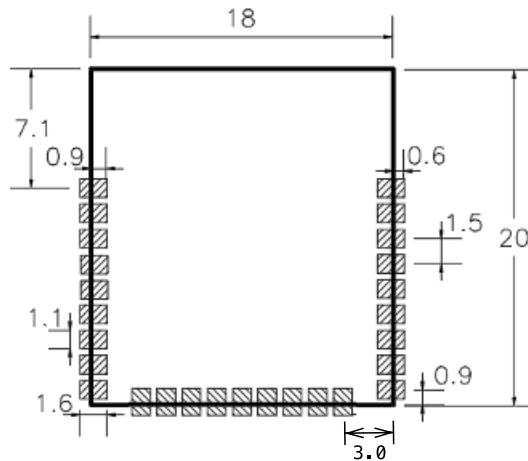
5.1. Assembly dimension

Figure 6 Assembly Dimension Diagram
(unit: mm, tolerance: ± 0.1 , outside tolerance ± 0.2)



5.2. Recommend package dimension

Figure 7 package dimension (unit: mm)
(unit: mm, tolerance: ± 0.1 , outside tolerance ± 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 8 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 $120^{\circ}\text{C} \pm 5^{\circ}\text{C}$ and the baking time is 4 hours.
- The alarm temperature is set to 130°C .
- SMT patches can be made after cooling $< 36^{\circ}\text{C}$ 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.

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 Level 3, and the storage and baking conditions are based on IPC/JEDEC J-STD-020.

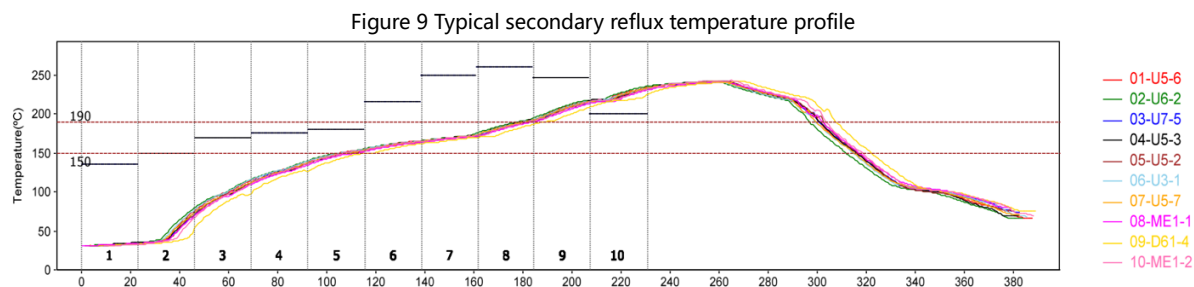
6.2. Secondary reflow temperature curve

Recommended solder paste type: SAC305, lead free. No more than 2 reflow cycles. Peak temperature not to exceed 245°C. The following is a typical furnace temperature profile setting.

Table 14 Typical furnace temperature settings

Furnace settings	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9	Z10
Upper temperature zone setting	135	150	170	175	180	215	250	260	247	200

Lower temperature zone setting	135	150	170	175	180	215	250	260	247	200
--------------------------------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----



- 30°C ~ 150°C preheating temperature rise: 0-3°C/s, typical value: 1.2°C/s
- 150°C ~ 190°C immersion time: 60-100second, typical value: 72second
- Peak temperature: 245°C, typical value: 242°C
- Time above 220°C: 50 sec. to 90 sec. Typical value: 70 sec.
- 217°C cooling speed: -3 ~ 0°C/s, typical value: -2.0°C/s

6.3. Storage Condition

Figure 10 Storage Conditions Diagram

	<u>CAUTION</u> This bag contains MOISTURE-SENSITIVE DEVICES	LEVEL 3 If Blank, see adjacent bar code label
1. Calculated shelf life in sealed bag: 12 months at <40°C and <90% relative humidity (RH) 2. Peak package body temperature: _____ °C If Blank, see adjacent bar code label 3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must a) Mounted within: _____ hrs. of factory conditions If Blank, see adjacent bar code label ≤30°C/60%RH, OR b) Stored at <10% RH 4. Devices require bake, before mounting, if: a) Humidity Indicator Card is > 10% when read at 23 ± 5°C b) 3a or 3b not met. 5. If baking is required, devices may be baked for 48 hrs. at 125±5°C Note: If device containers cannot be subjected to high temperature or shorter bake times are desired, reference IPC/JEDEC J-STD-033 for bake procedure Bag Seal Date: _____ If Blank, see adjacent bar code label Note: Level and body temperature defined by IPC/JEDEC J-STD-020		

7. Solder-free serial port connectivity solutions: T11

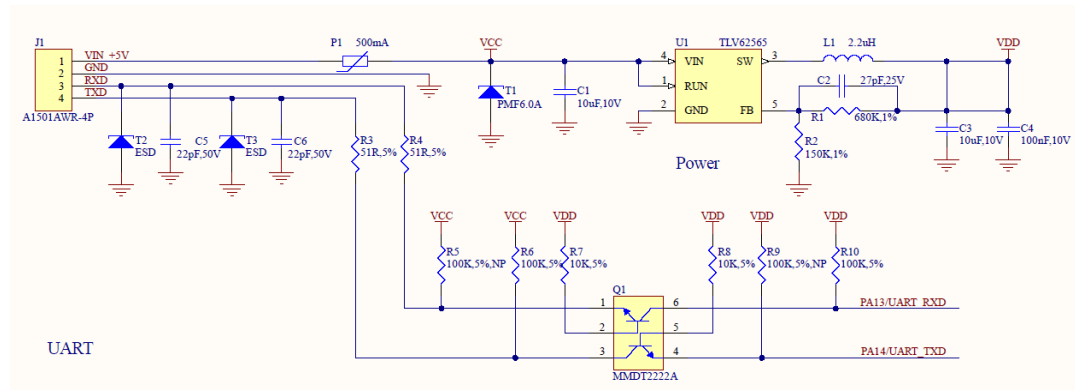
The EMC3020 can be equipped with a dedicated T11 adapter, glue spray box, and glue pouring box to provide a direct cable connection to the serial socket for easy installation.



7.1. DCDC convert circuit

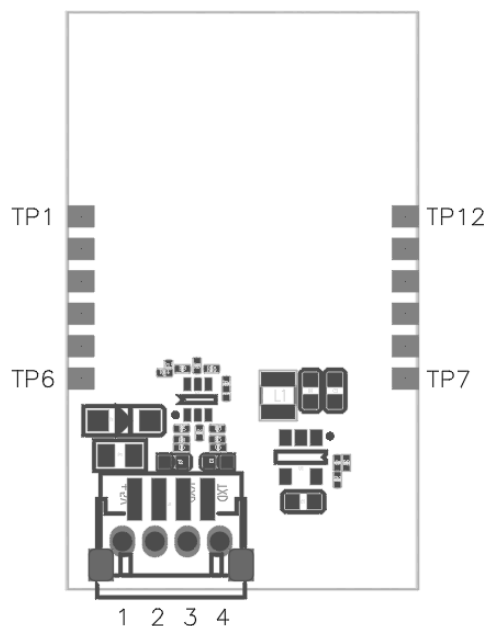
The EMC3020 provides a T11 adapter board with high-efficiency 5V/3.3V DC-DC power conversion and UART level conversion circuitry to accommodate external 5V level signals. The inlet side of the power supply is protected by PTC and TVS, and some devices are subject to actual use. The reference schematic diagram is shown below.

Figure 11 DCDC circuit schematic



7.2. Pin Arrangement of the Switching Board

Figure 12 T11 pin arrangement



7.3. T11 Pin Definition Table

Table 15 T11 pin arrangement

Pin No.	Name	I/O type	Function
1	VDD	Power	5V supply
2	VSS	GND	GND
3	GPIO_21	I/O	UART_RXD
4	GPIO_22	I/O	UART_TXD

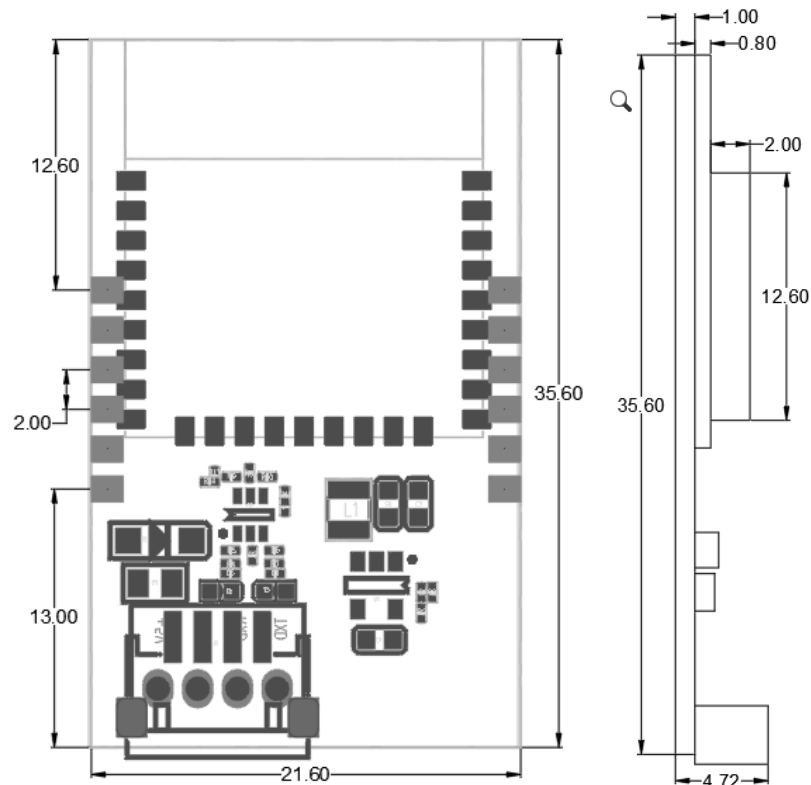
Table 16 T11 test point definition

Pin No.	Name	I/O type	Function
TP1	GPIO_8	I/O	
TP2	GPIO_11	I/O	JTAG_TDO, JTAG stimulation debugging interface
TP3	GPIO_17	I/O	JTAG_TDI, JTAG stimulation debugging interface
TP4	CHIP_EN	I	Chip enable
TP5	VSS	Power	GND
TP6	VSS	Power	GND
TP7	VDD	Power	3.3V input
TP8	VSS	Power	GND
TP9	GPIO_20	I/O	STATUS, mode selection, refer to Table 2

TP10	GPIO_16	I/O	BOOT, mode selection, refer to Table 2 LOG_TXD for debugging information output, do not adjust arbitrarily 1K resistor pull-down is provided to ensure the module is in ATE mode while sending data through LOG_TXD.
TP11	GPIO_07	I/O	LOG_RXD, for debugging information input, do not adjust arbitrarily
TP12	VSS	Power	GND

7.4. Switching board Dimension

Figure 13 Assembly dimension drawing
(unit: mm, tolerance: ± 0.1 , outside size tolerance: ± 0.2)



7.5. Glue spray box dimension

Figure 14 Shell size of glue spray box (unit: mm)

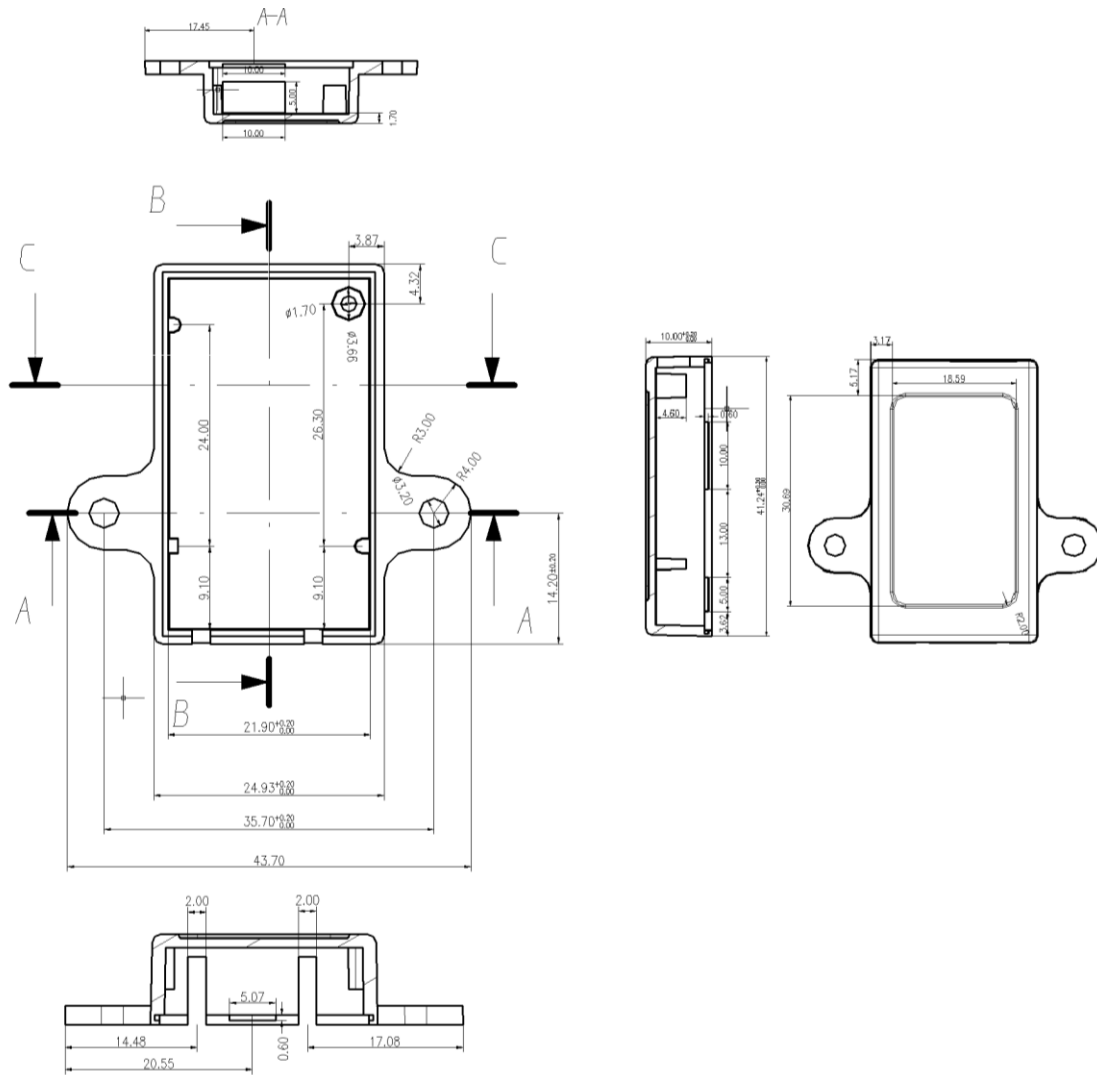
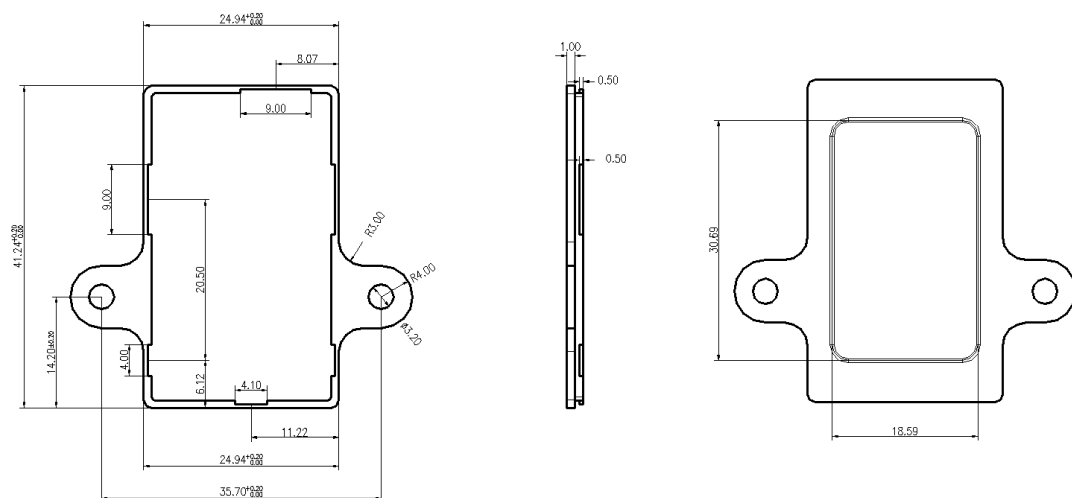
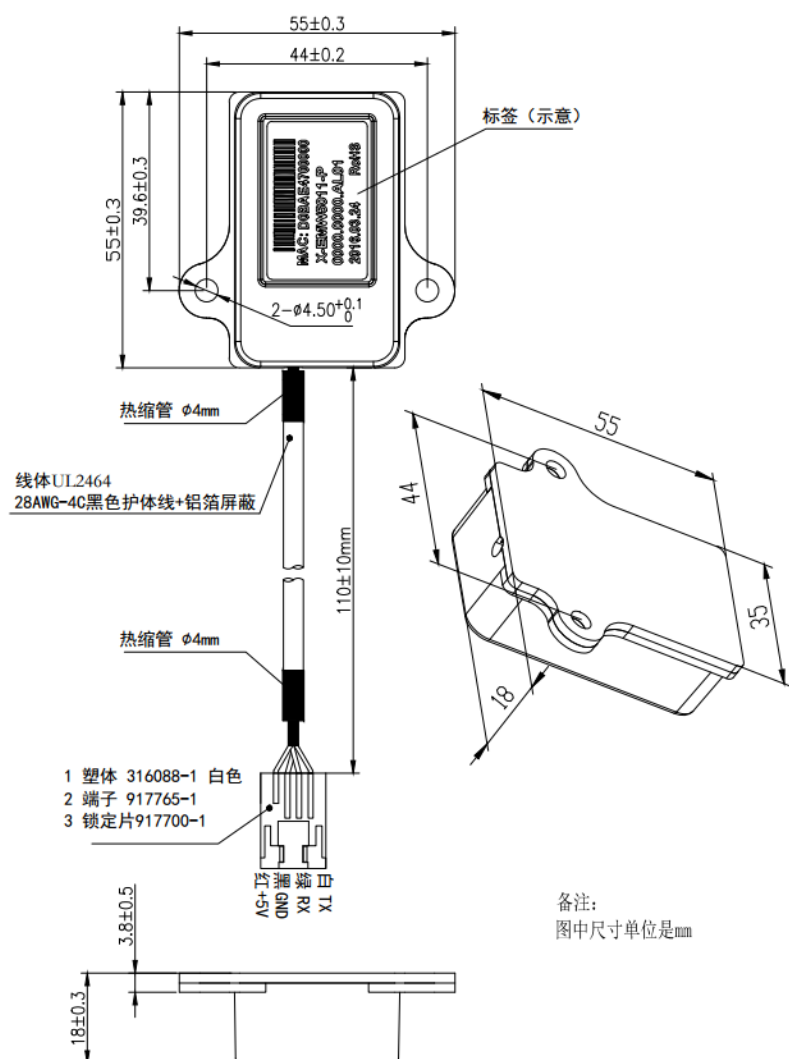


Figure 15 Cover plate size of glue spray box (unit: mm)



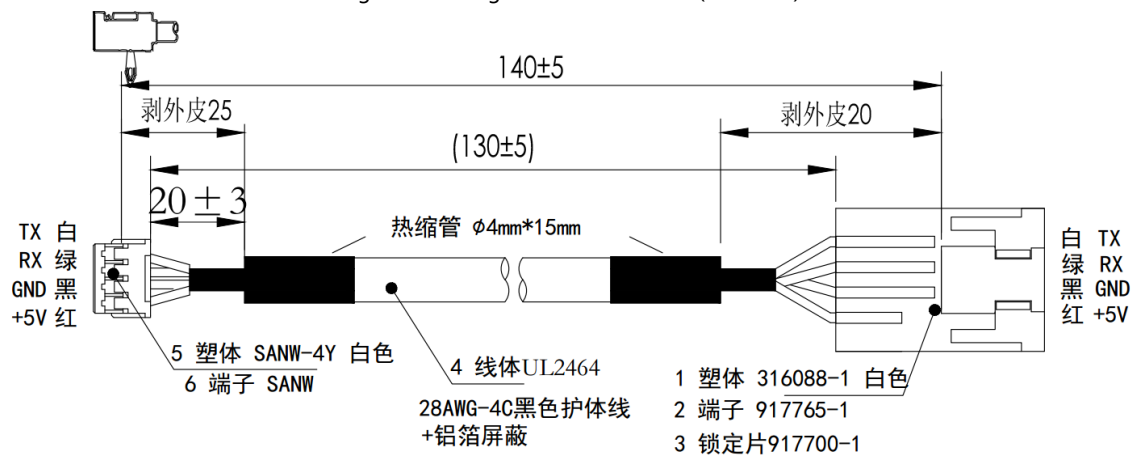
7.6. Glue pouring box dimension

Figure 16 Glue pouring box dimension (unit: mm)



7.7. Wiring harness dimension of Glue spray box

Figure 17 Wiring harness dimension (unit: mm)



8. Label Information

Figure 18 Label diagram



1. MXCHIP: Company Logo
2. CMIIT ID: SRRC Model Authorization ID
3. EMC3020-E: Product Main Type
4. ZI5: Product Auxiliary Model
5. X2023: Production serial number
6. BOF89379A30C: MAC Address

Note: Due to production batch and version and other reasons, the above label diagram is for reference only, please prevail in kind.

9. 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

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