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EMW3166 _Guide For User Design

Abstract

This note lists the matters need attention in each stage of designing and manufacturing while using MXCHIP module. In order to achieve rapid mass production, application designers need learn this note first. Consider and avoid all possible problems which may happen during designing, manufacturing, firmware programming and testing ahead of time.

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Version Record

Date	Version	Update content
9-23-2016	V0.1	Initial version.
9-23-2016	V0.2	Add reference circuit
11-17-2016	V0.3	Update FW download and test method

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1. Introduction

This note lists the matters need attention in each stage of designing and manufacturing while using MXCHIP module. In order to achieve rapid mass production, application designers need learn this note first. Consider and avoid all possible problems which may happen during designing, manufacturing, firmware programming and testing ahead of time.

Applicative module type:

- EMW3166 series

To note stage:

- Hardware designing
- Firmware programming
- Production SMT
- OTA upgrading

Basic features of module:

- Globally unique MAC ID for each module
- Two antenna designing types:
PCB printed antenna and external one using U.F.L RF connector
- Peak current 320mA @ 3.3V
- In-built production test mode
- In-built OTA mode
- Reflow soldering when SMT

EMW3166 top view:



Figure 1 EMW3166 top view



Figure 1 EMW3166 top view

EMW3166 model list:

Module model	Antenna type	Description
EMW3166-P	PCB printed Antenna	Default
EMW3166-E	External antenna to IPX	Optional
EMW3166-B	PIFA antenna	Optional

Antenna Type:

parameter	EMW3166-E	EMW3166-P	EMW3166-B
Antenna Type	IPEX Antenna	PCB Antenna	PIFA Antenna
Frequency	2400-2500(MHz)	2400-2500(MHz)	2400-2500(MHz)
Impedance	50ohm	50ohm	50ohm
VSWR	<2	<2	<2
Antenna gain	2dBI	2dBI	2dBI
Radiation pattern	Omnidirectional	Omnidirectional	Omnidirectional
Polarization	Vertrical	Vertrical	Vertrical

1.2 Pin Designation

EMW3166 owns two groups of pins (1X20 + 1X21). The lead pitch is 1mm.

EMW3166 has half-hole footprint fit for hand-soldering

EMW3166 pinouts:

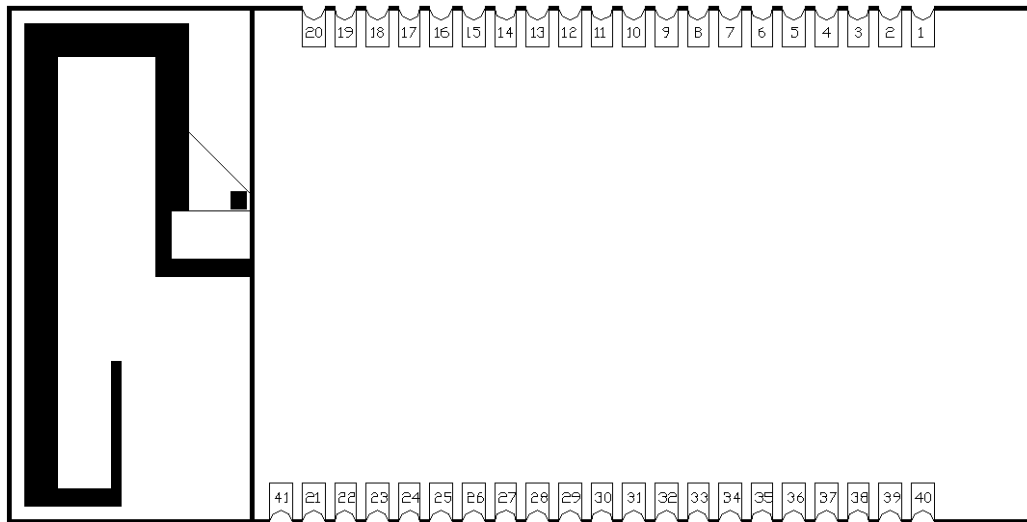


Figure 5 Half-hole package dimension

1.3 Recommended Footprint Design

Recommended footprint (Unit: mm):

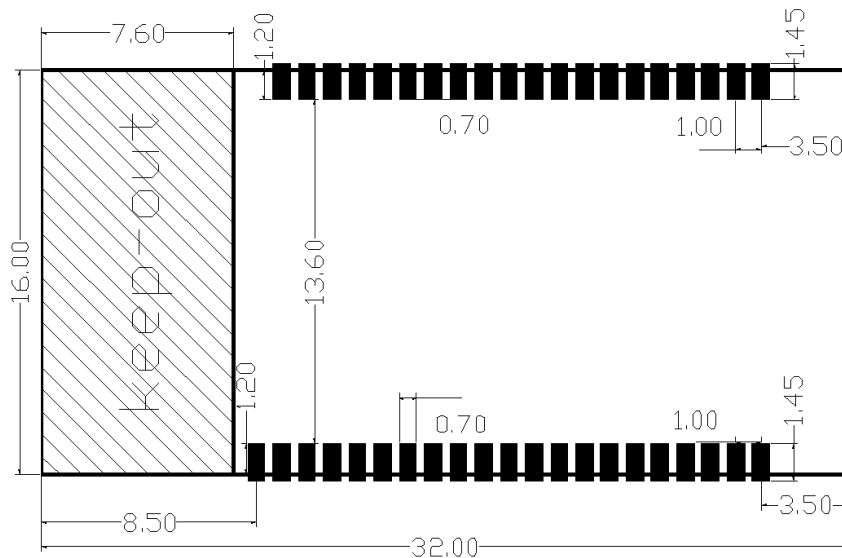


Figure 6 Recommended Footprint

1.4 Pin Arrangement

The general pin description:

Table 1 EMW3166 pin arrangement

Pins	Name	Type	I/O level	Functions				Note
1	-	-	-					NC
2	PB2	I/O	FT	GPIO			BOOT1	√
3	-	-	-					NC
4	PB15	I/O	FT	SPI2_MOSI	GPIO	TIM12_CH2	I2S2_SD	√
5	PB12	I/O	FT	SPI2_NSS	GPIO	CAN2_RX	I2S2_WS	√
6	PB13	I/O	FT	SPI2_SCK	GPIO	CAN2_TX	I2S2_CK	√
7	PB14	I/O	FT	SPI2_MISO	GPIO	TIM12_CH1		√
8	PC6	I/O	FT	UART6_TXD	GPIO	TIM3_CH1	I2S2_MCK	× <i>DEBUG_OUT</i>
9	PA15	I/O	FT	GPIO	JTDI	TIM2_CH1	USART1_TXD	× (EasyLink)
10	VBAT	S	-	VBAT				×
11	-	-	-					NC
12	PC7	I/O	FT	UART6_RXD	GPIO	TIM3_CH2	I2S2_CK	× <i>DEBUG_IN</i>
13	NRST	I/O	FT	RESET				×
14	PC0	I	TC	GPIO			WAKEUP	√
15	-	-	-					NC
16	PC13	I/O	FT	GPIO				√
17	PB8	I/O	FT	I2C1_SCL	GPIO	TIM4_CH3	CAN1_RX	√

Pins	Name	Type	I/O level	Functions				Note
18	PB9	I/O	FT	I2C1_SDA	GPIO	TIM4_CH4	CAN1_TX	√
19	PB10	I/O	FT	GPIO		TIM2_CH3	I2S2_CK	√
20	GND	S	-	GND				×
21	GND	S	-	GND				×
22	-	-	-					NC
23	-	-	-					NC
24	-	-	-					NC
25	PA14	I/O	FT	SWCLK				×
26	PA13	I/O	FT	SWDIO				×
27	PB3	I/O	FT	GPIO		TIM2_CH2	USART1_RXD	√
28	-	-	-					NC
29	PB7	I/O	FT	UART1_RXD	GPIO	TIM4_CH2	I2C1_SDA	√ <i>USER_UART_RX</i>
30	PB6	I/O	FT	UART1_TXD	GPIO	TIM4_CH1	I2C1_SCL	√ <i>USER_UART_TX</i>
31	PB4	I/O	FT	GPIO	JTRST	TIM3_CH1		√
32	-	-	-					NC
33	PA10	I/O	FT	USB_ID	GPIO	TIM1_CH3		√
34	PA5	I/O	TC	GPIO			ADC1_5	√
35	PA11	I/O	FT	USB_DM	GPIO	TIM1_CH4	UART1_CTS	√
36	PA12	I/O	FT	USB_DP	GPIO	TIM1_ETR	UART1_RTS	× (BOOT)

Pins	Name	Type	I/O level	Functions				Note
37	PB0	I/O	FT	GPIO			ADC1_8	× (STATUS)
38	PA4	I/O	TC	GPIO			ADC1_4	√
39	VDD	S	-	3.3V				×
40	VDD	S	-	3.3V				×
41	ANT	-	-	ANT				×

Notes:

1. PIN10, PIN39, PIN40 need connect to VDD 3V3 power and PIN20, PIN21 connects to GND.
2. PIN8 and PIN12 are used for secondary burning, ATE and QC auto detection.
3. PIN29 and PIN30 are used as serial communication port for application.
4. “S” indicates “power supply”, “I” indicates “input pin”, “I/O” indicates “input/output pin”.
5. “FT” indicates the maximum tolerance input voltage is 5V. The maximum tolerance voltage could not be over VCC when configured as analog I/O or RTC.
6. TC=standard 3.6V I/O.
7. PIN4~7 could not be used as the other functions except for the SPI1 interface of on-board flash.
8. Take SWD (PIN25, PIN26) as the replacement of JTAG to debug or download firmware.
9. “√” indicates the pin which could be used for customized applications, while “×” could not be used besides two groups “serial” and one group “SPI”.
10. Please refer to MXCHIP for more support.

Important Note:

- If developers build an application based on MICO system, they can define or modify the function for every pin on EMW3166.
- The pin arrangement of the firmware MXCHIP developed could take the Application Note as a reference.

2. Hardware design attention

2.1 Mechanical dimensions

EMW3166 mechanical dimension of vertical view:

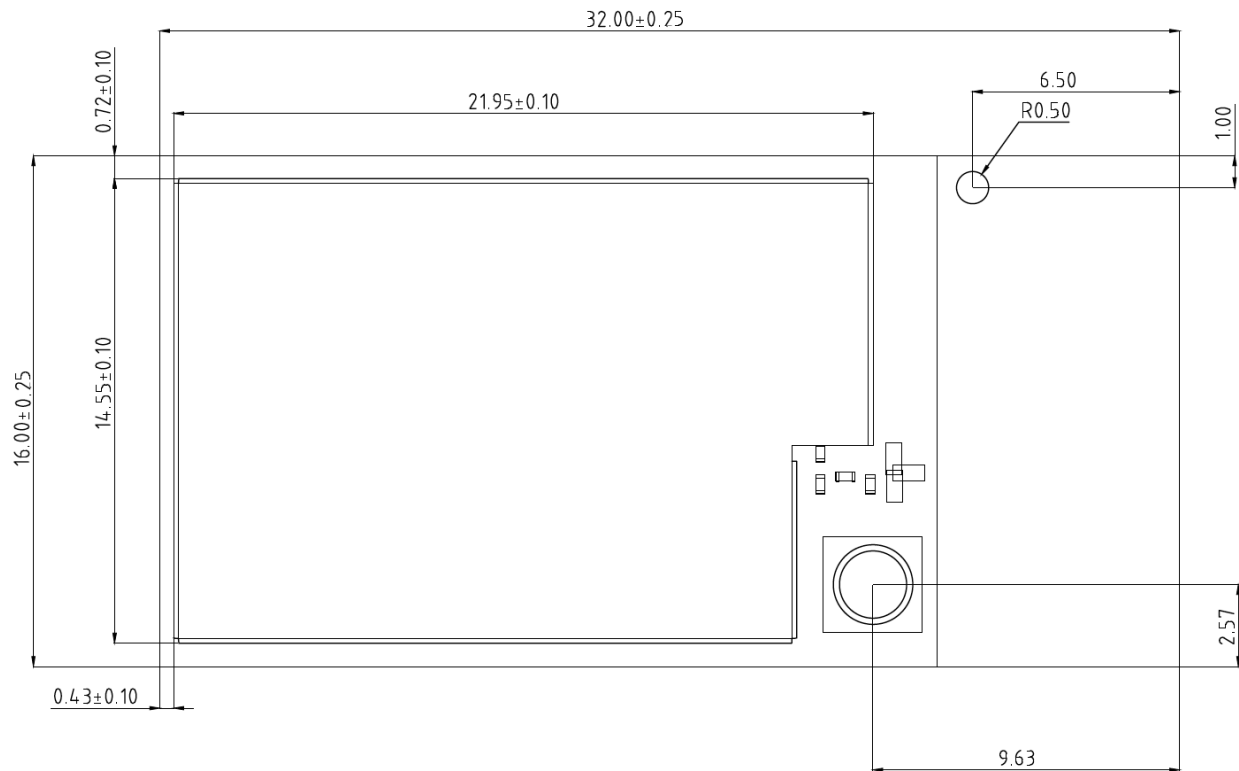


Figure 3 Vertical view

EMW3166 mechanical dimension of side view:

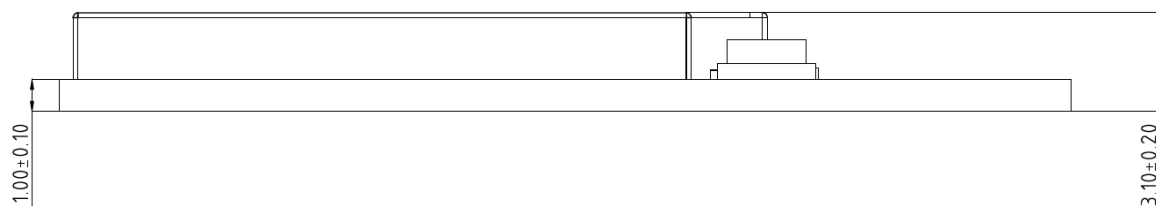


Figure 4 side view

2.2 Recommended package design

The figure followed below is the recommended package design MXCHIP suggested while designing the baseplate. The solder window has the same size of the pad.

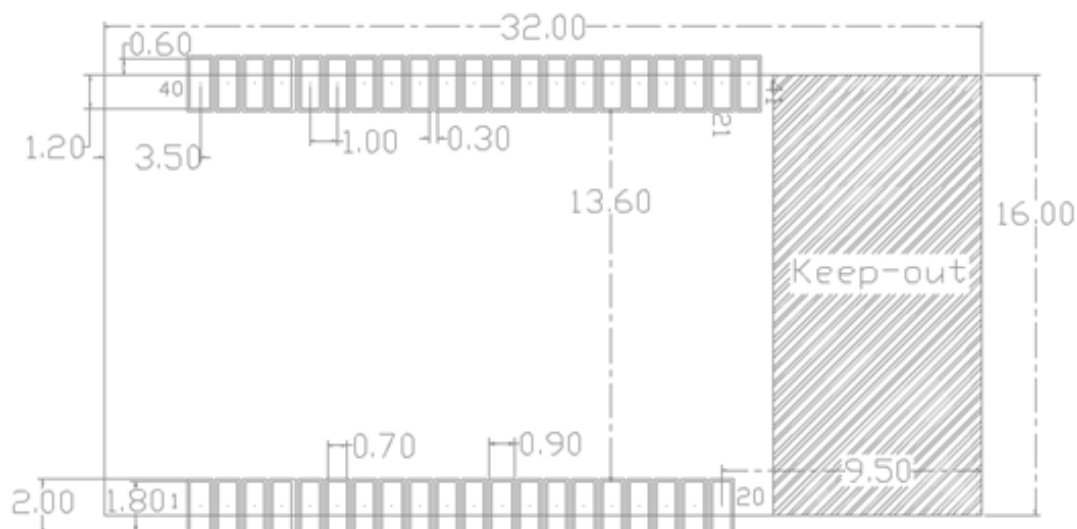


Figure 5 Recommended Package for SMT

2.3 DC power design

Peak current of EMW3166 is about 320mA. The DC/DC power chip MXCHIP recommended should be whose maximum output current is over 600mA. DC/DC gets more superiority on power conversion than LDO.

When using DC/DC power chip, except for the requirements of output voltage (3.3V) and maximum current (600mA), application designer should pay more attention on the arrangement of wires. For instance, device should be compact enough, the ground of input and output should be well connected and the feedback signal should be far away from the inductance and the Schottky diode. Please refer to the datasheet of DC/DC power chip for more information.

When using LDO power chip, application designer need notice on the maximum current (600mA) and heat dissipation.

1.4 Recommended circuit design

Set the GND apart from power supply when designing layout to avoid the instantaneous peak current when power on.

2.5 RF design

2.5.1 PCB antenna design

When integrating the WiFi module with on board PCB printed antenna, make sure the area around the antenna end of the module protrudes at least 15mm from the mother board PCB and any metal enclosure. The area under the antenna end of the module should be keep clear of metallic components, connectors, sensors, traces and other materials that can interfere with the radio signal.

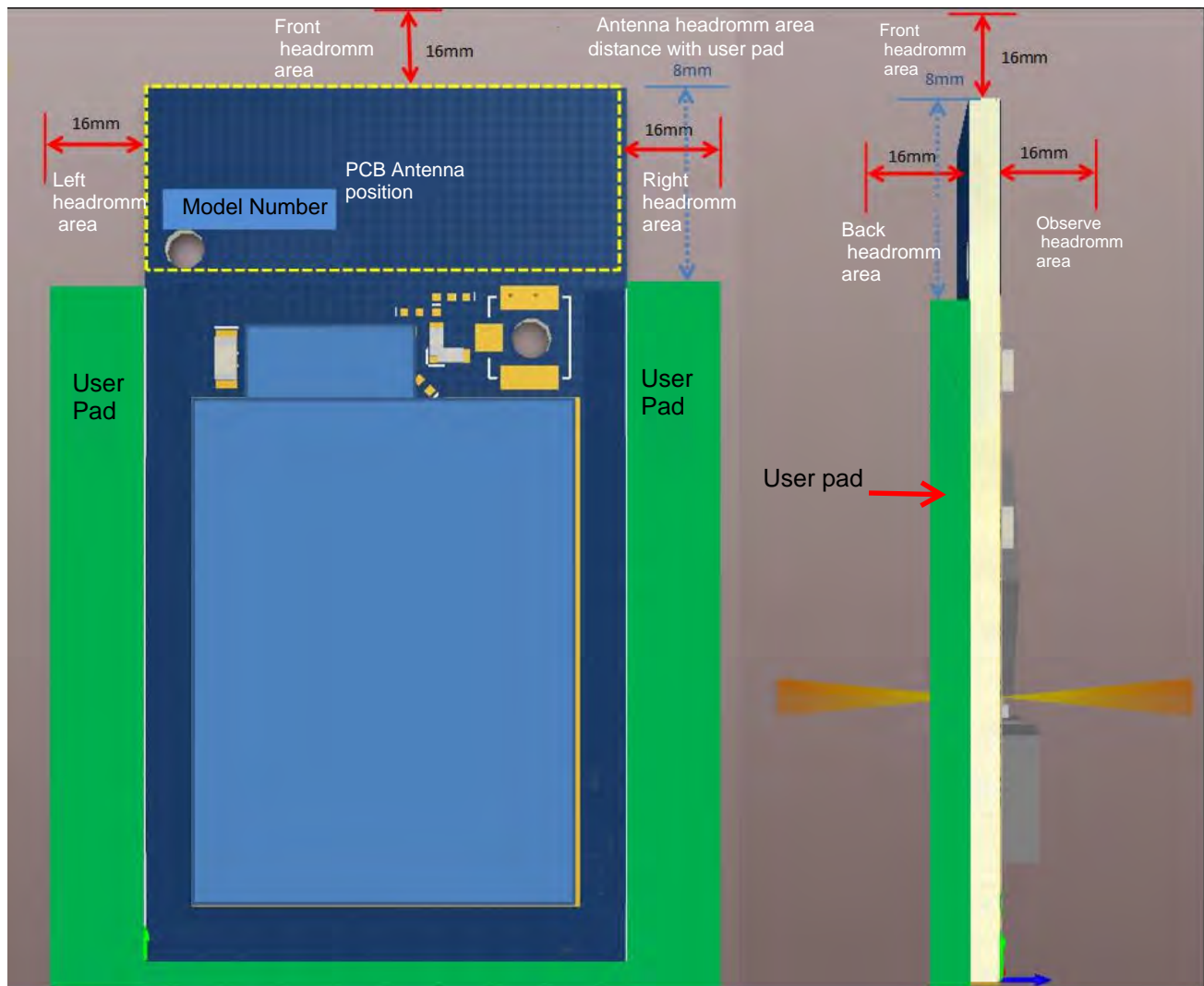


Figure 7 Minimum Size of Keep-out Zone Around Antenna

Areas on the mother board MXCHIP recommended showed below can reduce the noise to PCB antenna and radio signal.

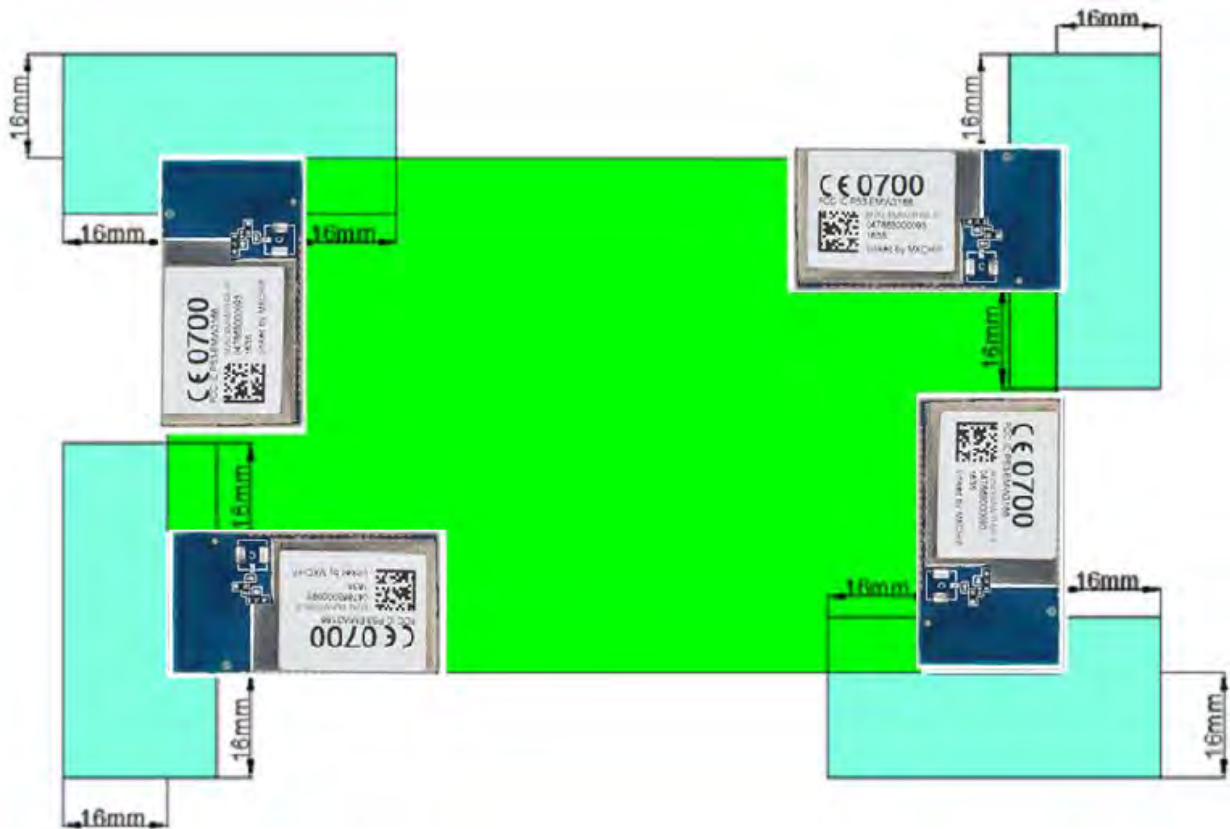


Figure 8 Module Position Recommended on Mother Board

2.5.2 T U.F.L RF Connector

Make sure the connector is matched when choosing the external antenna.

Mechanical dimensions of U.F.L RF connector shows as followed.

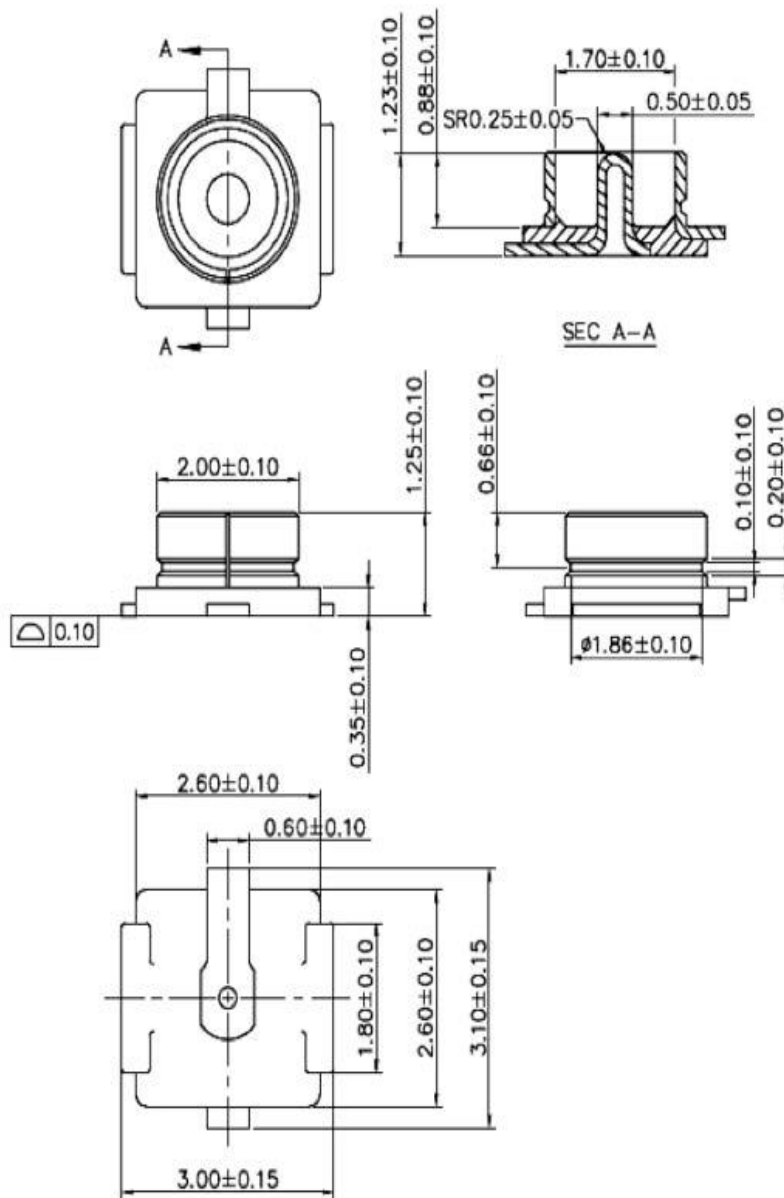


Figure 9 U.F.L Connector Size

2.6 ESD design

ESD grade of module: Human Body Model (HBM) sensitivity is 2000V, Charged Device Model (CDM) sensitivity is 500V. If a higher ESD level is required, the pins that may be connected to the outside should be reserved place for the ESD protection device.

If the module connects the mother board by outside leads, application designers should notice the EMI problems. Using shield cable or reserving the position for common mode choke to solve this problem.

3. Firmware programming and warehousing detection method

3.1 Receiving Inspection Device List

Auxiliary Equipment list shows below:

Table 1 Warehousing Detection Auxiliary Equipment List

Auxiliary Equipment	Quantity
PC	1 (pcs)
Fixture	1 (pcs)
EMWE-3166-A V1.0 Development Board	1 (pcs)

Note: It is not for sale in above the table Auxiliary Equipment.

Application software and firmware:

FT230XS (drivers on PC), download link:

<http://www.ftdichip.com/Drivers/VCP.htm>

Programming firmware should be confirmed by both MXCHIP FAE and guests. Its size is 512kbytes. The set of the three toggle switches on EMWE-3166-A V1.0 development board:



Figure 10 Development Board Switch Settings

3.2 Collection

Connect the fixture to the EMWE-3166-A V1.0 development board by the pin header. Connect the EMWE-3166-A V1.0 development board to PC by USB Mini cable.

Red led lights if connected.

3.3 Warehousing detection

3.3.1 Software setting

Software: Hyper Terminal

Find the COM number where EMW3166 connect with PC in “device manager” .

Set as followed:

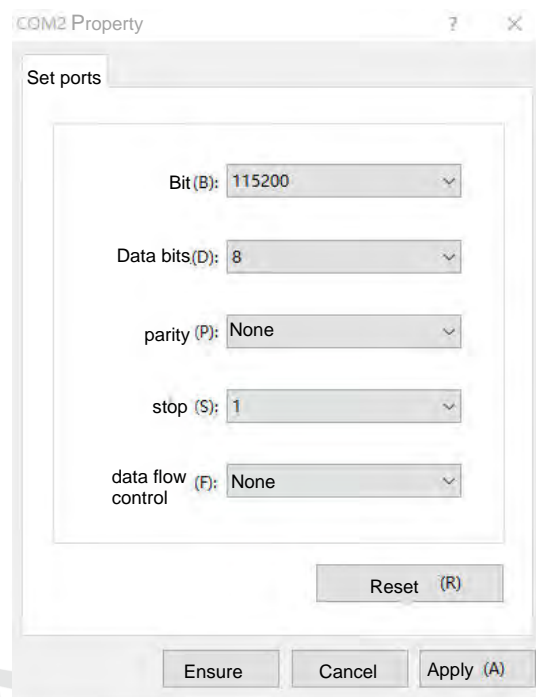


Figure 11 Hyper Terminal Setting Connection

3.3.2 Module testing

Click "connect" in "Hyper Terminal" to connect the PC to EMWE-3166-A V1.0 development board.

Place the module on the fixture.

Press down the handle.

3.3.3 Testing result

It lists the testing result from serial on "Hyper Terminal". The message includes: bootloader version, library version, application version, driver version, MAC address, APs' name and signal strength.

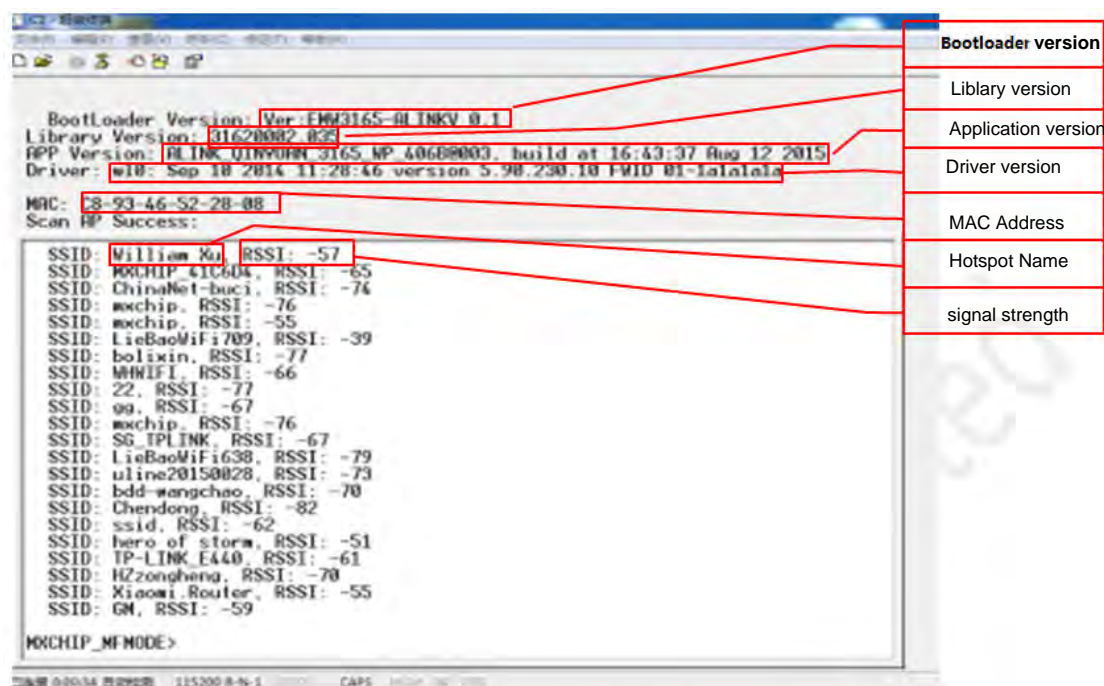


Figure 12 Testing Results

3.4 Statements

- MXCHIP has the obligation to guarantee there is no quality problem for the module delivered at each batch.
- If problems are found while sampling module, customer has the right to require MXCHIP to give a timely replacement.
- If problems are found after welding the module on mother board without any warehousing detection, MXCHIP is only responsible for the compensation of module.
- MXCHIP has the obligation to assist solving various technical problems, without retaining any MVA/BIN file of customer.
- Customer has the obligation to record every firmware version during the firmware developing work and use the proper firmware for production.

4. SMT matters

4.1 Note for stencil aperture

The recommended stencil aperture: 0.12mm (0.1~0.15mm), laser polishing hole.

The recommended solder paste is SAC305 and lead free.

The recommended extend length of welding pad: 0.15mm. It can enhance the adhesive ability of solder as shown below.

It can check the right position of the module by eyes if using SMT line without AOI testing to reduce the risk of cold solder joint.

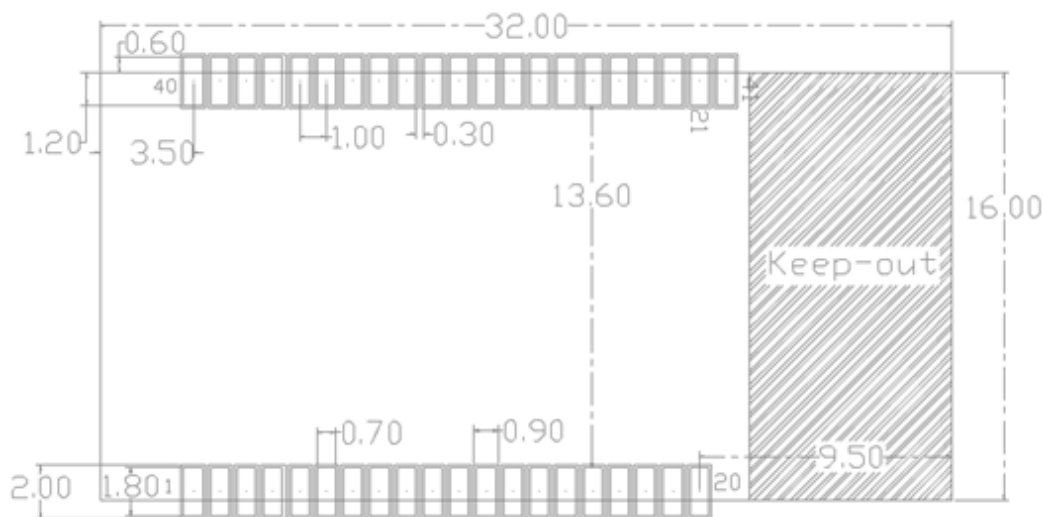


Figure 13 Recommended Stencil Aperture

4.2 Recommended reflow profile

Reflow times ≤ 2 times.

Peak temperature $< 250^{\circ}\text{C}$.

Controlling the temperature according to the temperature curve can reduce the risk of welding.

Recommended reflow profile:

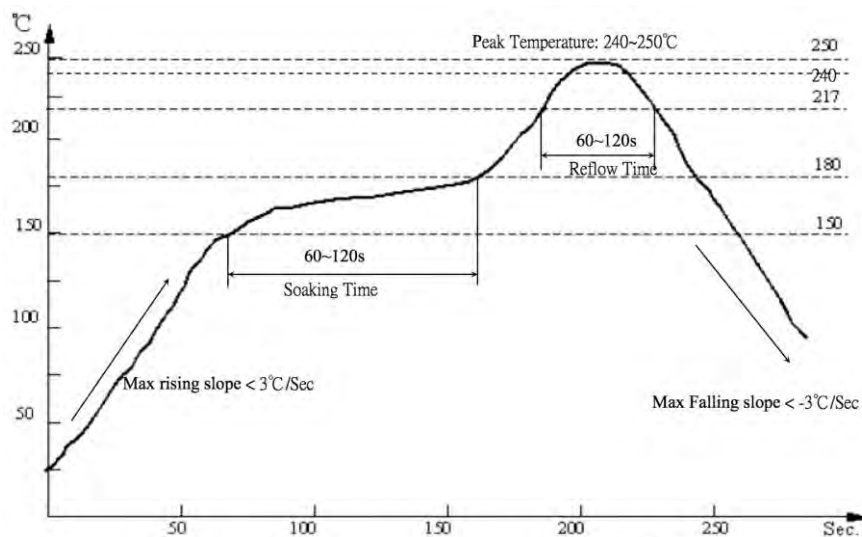


Figure 14 Reflow soldering temperature curve

5. Mass production testing and firmware upgrading

In addition to considering the product features, application designer need to think over how to do test and upgrade firmware when developing.

5.1 Mass production test

Avoid finding problem after installing the PCB boards in machine

5.1.1 EMSP command way

Connect the module to the MCU of the mother board by serial port and use the EMSP command.

Choose one triggering way---- set one combination key, to send the test command from the MCU. The test command could be one EMSP command used to scan the APs around or connect one specified AP. The way can test both of the serial function and the RF function.

5.1.2 Limited development firmware

Connect the module to the MCU of the mother board by serial port. Add the test command in the firmware when developing. The test command could be one command from serial port used to scan the APs and return the results by serial port. The way can test both of the serial function and the RF function by using the same triggering way.

5.1.3 Full development firmware

Full development works for the whole application of the project.

Test method could be flexible in the way. It can set a specific way to test every function of the module. The application determines the specific test details.

5.2 Upgrading

Upgrading by OTA is recommended. OTA-over the air, is one wireless upgrading way.

The upgrading method is offered by MXCHIP. Several application cases are provided as referenced.

Firmware could be upgraded to the latest version by OTA with this upgrading method applied.

6. Firmware encrypt

In order to make sure the firmware could not be modified after programming in the module, firmware must be encrypted with the bootloader drivers and the chip ID MXCHIP offered.

Bootloader driver is used to drive the device in the module and integrated with one AES encryption way. The application part of the firmware must be combined with the bootloader driver to generate one MVA/bin file after adding the chip ID details which can be used to identify MXCHIP module. Check the official website for more information.

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reprint prohibited

7. Sales and technical support information

If you need to buy this product, please call MXCHIP during the working hours.

(Monday ~ Friday : A.M. 9:00~12:00; P.M. 1:00~6:00)

Telephone: +86-021-52655026

Address: 9th Floor, 5# building, Lane 2145, Jinshajiang Road, Putuo District, Shanghai

Post Code: 200333

Email: sales@mxchip.com

Company email: <http://www.mxchip.com>

For the latest information about products, please refer to: <http://www.mxchip.com>

Related technical support please contact:

a. Wireless network technology support:

+86 (21) 52655026-812, Email: support@mxchip.com.

b. Technical support for development tools:

+86 (21) 52655026-822, Email: support@mxchip.com.

8. FCC Statement

FCC identification number is not visible when the device is installed inside another device, then the outside of the device into which the device is installed must also display a label referring to the enclosed device. This exterior label can use wording such as the following: "Contains FCC ID:P53- EMW3166"

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. 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.

Note 1: Compliance of this device in all final host configurations is the responsibility of the Grantee. OEM integrators are responsible to satisfy RF exposure requirements.

Note 2: Any modifications made to the module will void the Grant of Certification, this module is limited to OEM installation only and must not be sold to end-users, end-user has no manual instructions to remove or install the device, only software or operating procedure shall be placed in the end-user operating manual of final products.

Note 3: The device must not transmit simultaneously with any other antenna or transmitter.

Note 4: To ensure compliance with all non-transmitter functions the host manufacturer is responsible for ensuring compliance with the module(s) installed and fully operational. For example, if a host was previously authorized as an unintentional radiator under the Declaration of Conformity procedure without a transmitter certified module and a module is added, the host manufacturer is responsible for ensuring that after the module is installed and operational the host continues to be compliant with the Part 15B unintentional radiator requirements. Since this may depend on the details of how the module is integrated with the host, Shanghai MXCHIP Information Technology Co., Ltd. shall provide guidance to the host manufacturer for compliance with the Part 15B requirements. The transmitter module must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the host product. Shanghai MXCHIP Information Technology Co., Ltd. is responsible for the compliance of the module in all final hosts.

FCC Radiation Exposure Statement

This device 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.

This device must be installed and operated with a minimum distance of 20 cm between the radiator and user body.