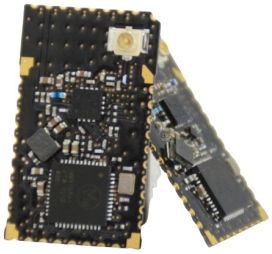

MegaChips MBWM000002 IEEE Sub 1 GHz WiFi HaLow Module User Guide

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User Guide

Contents

MBWM000002 IEEE Sub 1 GHz WiFi HaLow Module

CAUTION

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   To minimize risk of damage or injury to persons or property arising from a malfunction in a device, customer must incorporate sufficient safety measures in its design, such as redundancy, fire-containment, and anti-failure features.

   (If the customer intends to use the devices for applications other than those specified between the customer and MCC, please contact MCC sales representative before such use.)

4. **Restriction on use**

   MCC provides no warranty relating to the use of the devices, where there is risk of serious damage, environmental pollution, loss of life, injury or damage to property, or where reliability or special quality is essential, such as life support, military use, or space exploration.

5. **Radiation-proof design**

   This device has not been designed to be radiation-resistant.

6. **Export restriction**

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7. **No prior notice of revision**

   These specifications are based on materials dated 01/12/2022, and MCC reserves the right to revise these specifications without any prior notice. For mass production planning, please reference the latest version of the specifications.

Product Overview

1.1. Introduction

MegaChips provides a complete Wi-Fi HaLow connectivity solution. The MBWMO000002 is a fully integrated Wi-Fi HaLow® modules with long-range, low-power consumption and superior RF performance, featuring the MM6108 Wi-Fi HaLow SoC.

The MBWMO000002 is designed in compliance with the IEEE 802.11ah standard, supporting data rates up to 32.5 Mbps with programmable operation between 850 MHz and 950 MHz.

This module includes ultra-long-reach PA, high linearity LNA, T/R switch, 32 MHz crystal oscillator and it has been designed for a simplified Wi-Fi HaLow connection to an external host for applications in which a customer wants to merely replace their prior RF technology with a Wi-Fi HaLow connection while leveraging the latest WPA3 security protocol.

Battery-operated applications are supported by a combination of features which are inherently supported by the module. The IEEE 802.11ah standard provides for extended sleep times for battery-operated Stations (STAs or client devices), with longer duration than other prior |IEEE 802.11a/b/g/n/ac generations.

It also allows longer extended maximum idle times for clients to conserve energy without being removed from the access point's (AP's) list of associated devices.

1.2. Features

Ultra-long-range, low-power Wi-Fi HaLow module for IoT Applications:

- Module Variants
  - o MBWMO000002: 1/2/4/8 MHz channel bandwidth
- Single-stream max data rate of 32.5 Mbps @8MHz or 15 Mbps @4MHz channel.
- Radio supporting Sub-1 GHz frequency bands
  - o Frequency Range: 850-950 MHz
  - o Max output power: 21 dBm
- 802.11ah OFDM PHY supporting WFA HaLow certification
  - o BPSK & QPSK, 16-QAM & 64-QAM Modulation
  - o Automatic frequency & gain control
  - o Packet detect & channel equalization
  - o Forward Error Correction (FEC) coding & decoding
  - o Support for Modulation and Coding Scheme (MCS) rates MCS 0-7 and MCS 10
  - o Support for 1 MHz and 2 MHz duplicate modes
  - o Support for Traveling Pilots
- 802.11ah MAC supporting WFA HalLow certification
  - o Support for STA and AP roles
  - o Listen-Before-Talk (LBT) access with energy detect
  - o 802.11 power save
  - o 802.11 fragmentation and de-fragmentation
  - o Power-Saving Target Wake Time (TWT) support for long battery life
  - o Automatic and manual MCS rate selection
- Support for various interface options
  - o SDIO 2.0 compliant host/slave interface
  - o 2 x UARTs
  - o S8PI Slave interface
  - o I2 C Master/Slave interface
  - o 4-channel PWM
- Power Management Unit (PMU) for various modes of operation
  - o Power-down (interrupt driven wake)
  - o Hibernate mode (internal / external wake)
  - o Target Wake Time mode
  - o Active Receive / Transmit mode
  - o integrated DC-DC converter supports a wide supply voltages, from 3.0 V to 3.6 V
- Wide spectrum of Security features
  - o AES encryption engine
  - o Hardware support for SHA1 and SHA2 hash functions (SHA-256, SHA-384, SHA-512)
  - o WPAS including protected management frames (PMF)
  - o Opportunistic Wireless Encryption (OWE)

1.3. Applications

For Internet of Things (IoT) and Machine-to-Machine (M2M) applications such as:

• Surveillance Cameras and Sensors • Cloud Connectivity • Low-power Sensor Networks • Building Automation Systems (BAS) • Asset Tracking and Management • Machine Performance Monitors & Sensors • Building Access Control & Security • Drone Video and Navigation Communications • Connected Toys and Games • Rural Internet Access • Agricultural and Farm Networks • Utility Smart Meter and Intelligent Grid • Proximity Sensors • Industrial Automation Controls • Smart Home Automation	• EV Car Chargers • Appliances • Construction Site Con • Smart Signs and Kiosl • Retail Point-of-Sale Te • Vehicle-to-Vehicle Cor • IP Sensor Networks • Bio metric IDs and Ke • Warehouse Connectiv • intelligent Lighting Co • BT/Zig Bee(™)/Z-Wav • Wi-Fi to Wi-Fi HaLow • Wi-Fi HaLow Client Ac • Smart City Networks

Pin Descriptions

The MBWMO000002 has 38-pins, which are described in this section.
The following illustration shows the top view of the module pin Diagram.

Figure 1: Pin Diagram (Top View)

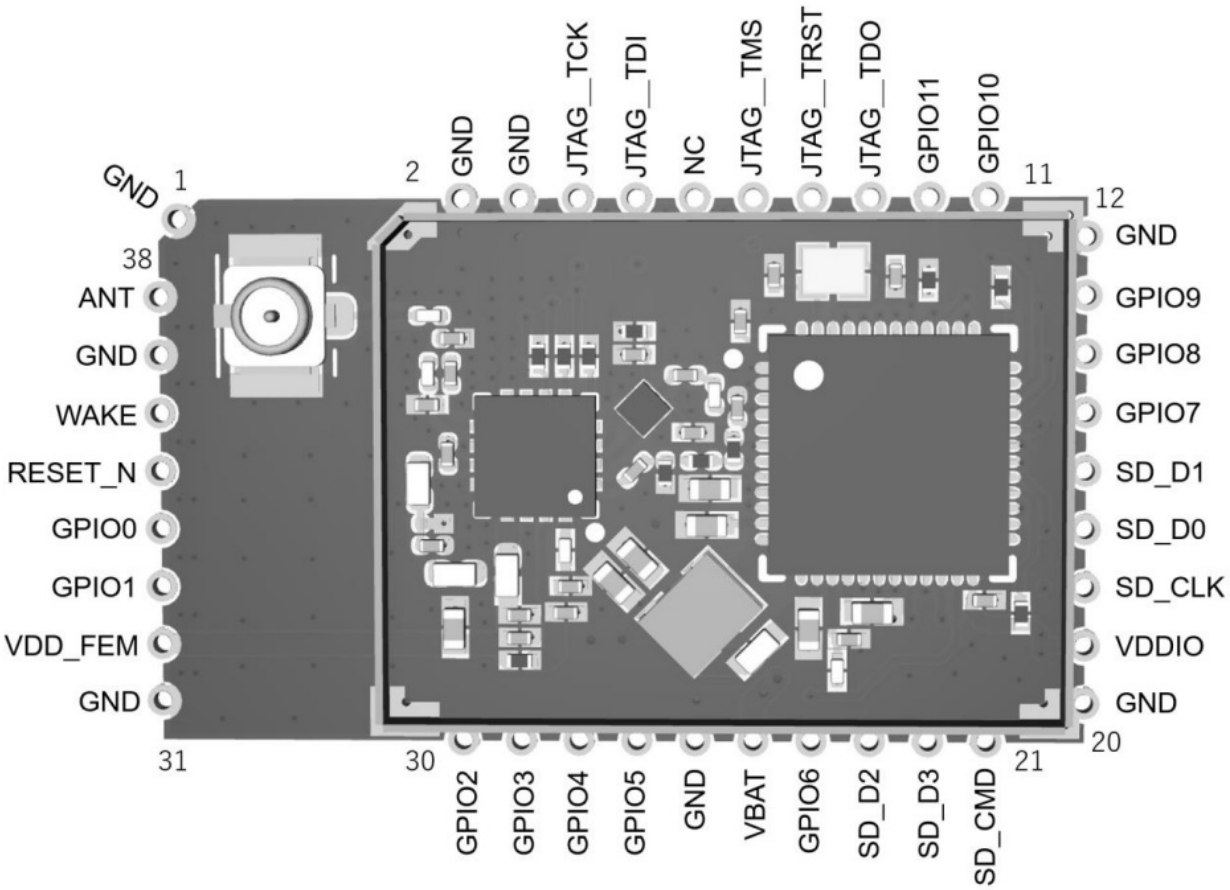


Table 2: Pin Diagram

Pin	Name	Type	Primary Function	Alternate Function(s)

1	GND	Power	Ground	
2	GND	Power	Ground	
3	GND	Power	Ground	
4	JTAG_TCK	I	JTAG Clock	
5	JTAG_TDI	I	JTAG Data In	
6	NC	NC	Do Not Connect	
7	JTAG_TMS	I	JTAG Mode Select	
8	JTAG_TRST	I	JTAG Reset	
9	JTAG_TDO	O	JTAG Data Out	
10	GPIO11	I/O	General Purpose IO11	
11	GPIO10	I/O	General Purpose IO10	
12	GND	Power	Ground	
13	GPIO9	I/O	General Purpose IO9	
14	GPIO8	I/O	General Purpose IO8	
15	GPIO7	I/O	General Purpose IO7	
16	SDIO_D1	I/O	SDIO D1	
17	SDIO_D0	I/O	SDIO D0	
18	SDIO_CLK	I/O	SDIO Clock	
19	VDD_IO	Power	3.3V VDD_IO Supply	
20	GND	Power	Ground	
21	SDIO_CMD	I/O	SDIO Command	
22	SDIO_D3	I/O	SDIO D3	
23	SDIO_D2	I/O	SDIO D2	
24	GPIO6	I/O	General Purpose IO6	
25	VBAT	Power	3.3V VBAT Supply	
26	GND	Power	Ground	
27	GPIO5	I/O	General Purpose IO5	
28	GPIO4	I/O	General Purpose IO4	
29	GPIO3	I/O	General Purpose IO3	
30	GPIO2	I/O	General Purpose IO2	

31	GND	Power	Ground	
32	VDD_FEM	Power	3.3V Front end Module Supply	
33	GPIO1	I/O	General Purpose IO1	
34	GPIO0	I/O	General Purpose IO0	
35	RESET_N	I	System Reset	
36	WAKE	I	Wake	
37	GND	Power	Ground	
38	ANT	Analog	Antenna	

Functional Description

The following sections describe the functions of the MBWMO000002 device.

3.1. Power Management

Module power is derived from a 1.8 to 3.6 V supply provided on pin VBAT. A 3.3V supply is provided on pin VDD_FEM to power the on-board ultra-long-range PA.

VDDIO sets the 10 voltage of the MM6108 and should be connected to the same power supply as the host MCU.

3.2. Digital Interfaces

All unused digital IO pins must be pulled up or down to ensure they do not float. Failure to do so, will result in a higher leakage current on the VDDIO supply.

Please refer to the MM6108 chip datasheets for a description of the supported peripheral interfaces.

Electrical Characteristics

4.1. Absolute Max ratings

Stress beyond absolute maximum ratings may cause permanent damage to the module. Functional operation is guaranteed for recommended operation conditions only. Operation of the device outside of recommended conditions may result in reduced lifetime and/or reliability problems even if the absolute maximum ratings are not exceeded.

Parameter	Min	Max	Unit
VBAT voltage	-0.3	4.3	V
VDD_FEM voltage	-0.3	4.3	V
Voltage on digital I/O pin	-0.3	4.3	V
Voltage on analog/RF pin	-0.3	1.2	V
Storage Temperature	-40	125	°C
RF Input Power (CW)	–	6	dBm

4.2. Immunity

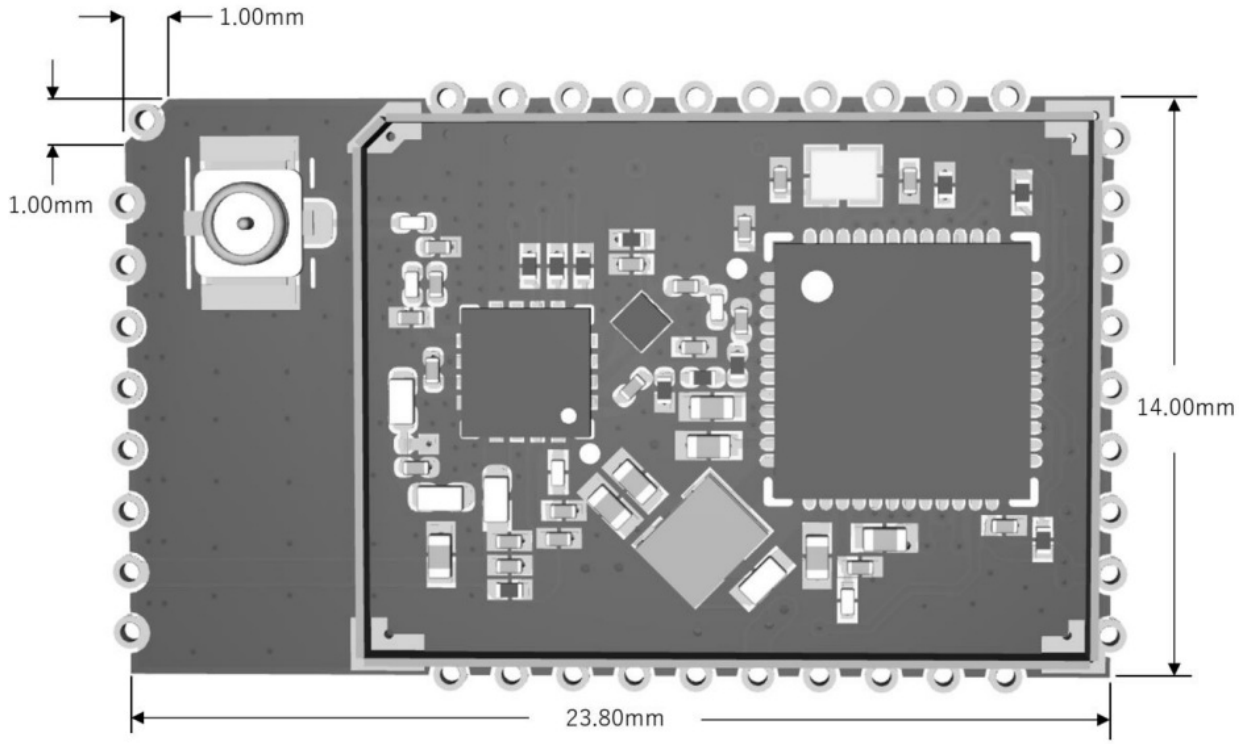
Parameter			Min	Max	Unit
Electrostatic discharge (ESD) performance	Human body model (HBM), per ANSI / ESDA / JEDEC JS001	All pins	TBD	TBD	V
	Charged device model (CDM), per JESD22-C101	All pins	TBD	TBD	V

4.3. Recommended Operating Conditions

Parameter	Min	Typ	Max	Unit
Ambient Temperature	-40	27	85	°C
VBAT	3.0	3.3	3.6	V
VDD_FEM	3.0	3.3	3.6	V
VDDIOa	1.8	3.3	3.6	V
Digital I/O voltage	0	3.3	VDDIO	V

Performance specifications are achieved under typical operating conditions, unless otherwise specified.

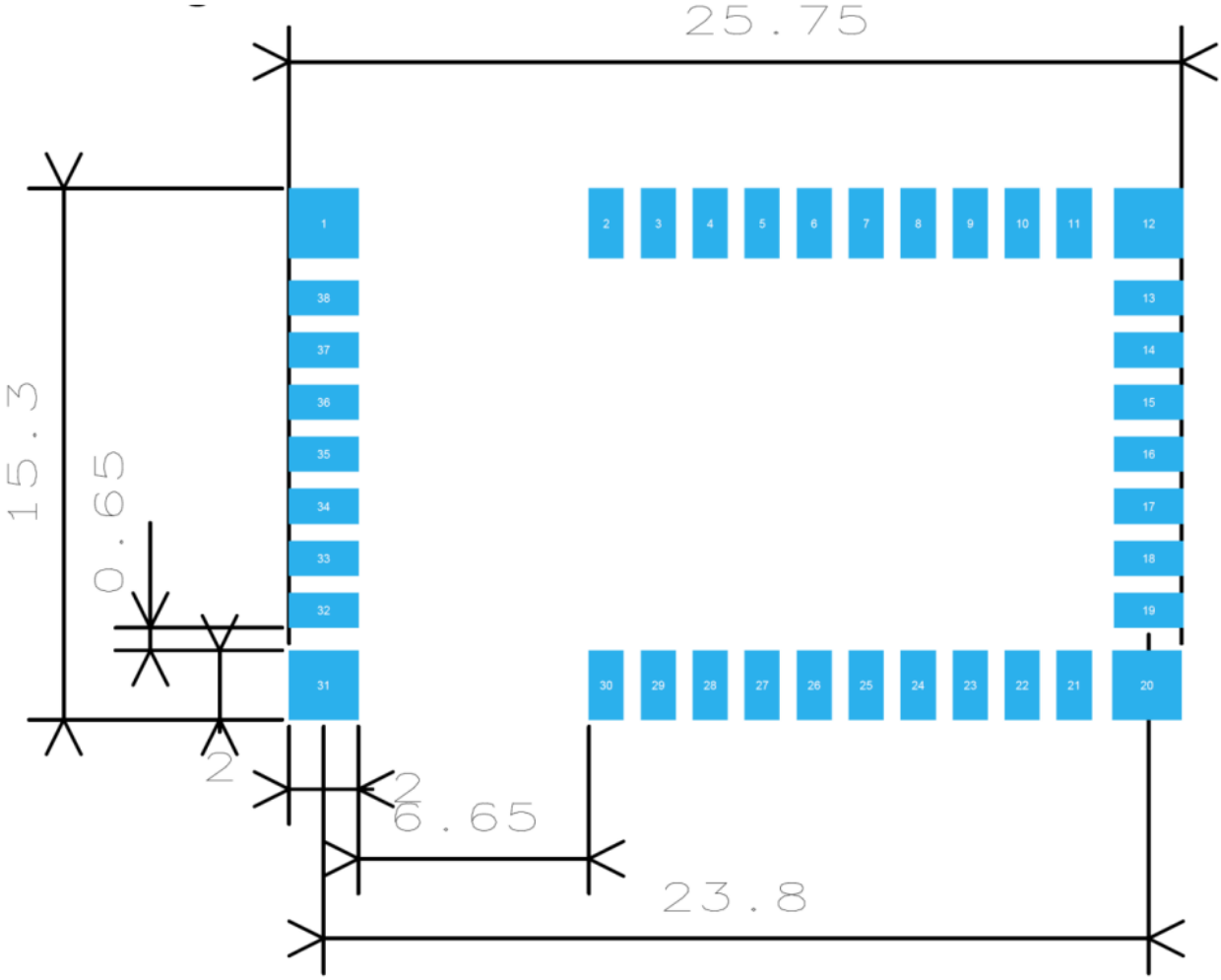
4.4. Physical Specification



Recommended Antenna Information

Ant.	Port	Brand	Model Name	Antenna Type	Connector	Gain(dBi)
1	1	Pulse Larsen	W 1063	Dipole		1

Recommended PCB Foot Print (Top View)



Certification

7.1. FCC

The host manufacturer should reference KDB Publication 996369 D04 Module Integration Guide.

Federal Communication Commission Interference Statement

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 use is encouraged to try to correct the interference by one 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.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this 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.
2. This device must accept any interference received, including interference that may cause undesired operation.

IMPORTANT NOTE:

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance 20cm between the radiator & your body.

IMPORTANT NOTE:

This module is intended for OEM integrators. This module is only FCC authorized for the specific rule parts 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. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Additional testing and certification may be necessary when multiple modules are used.

USERS MANUAL OF THE END PRODUCT:

In the user's manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user must be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied.

The end user must also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

This device complies with Part 15 of 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.

LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following:

"Contains TX FCC ID: 2AGYI-MRF61FI".

This device complies with Part 15 of 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.

7.2. ISED

This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. his device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

This device and its antenna(s) must not be co-located with any other transmitters except in accordance with IC multi-transmitter product procedures.

Referring to the multi-transmitter policy, multiple-transmitter(s) and module(s) can be operated simultaneously without reassessment permissive change.

This radio transmitter (IC: 29836-MRF61FI) 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.

IMPORTANT NOTE:

IC Radiation Exposure Statement:

This equipment complies with IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

USERS MANUAL OF THE END PRODUCT:

In the user's manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the IC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied.

The end user must also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment. 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.

LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following

" Contains IC: 29836-MRF61FI ".

The Host Model Number (HMN) must be indicated at any location on the exterior of the end product or product packaging or product literature which shall be available with the end product or online.

Part Number and Ordering Information

8.1. Part Ordering Information

Part Number	Packing Type	Pins	Size (mm)	Description
MBWM000002	Tray	38	15.3 x 25.75 x 3.0	IEEE 802.11ah Sub-1 GHz 1/2/4/8 MHz Wi-Fi HaLow Module

Handling and Storage

The MM610x-MF08251 class of modules are a moisture sensitive device rated at Moisture Sensitive Level 3 (MSL3) per IPC/JEDEC J-STD-20.

After opening the moisture sealed storage bag, modules that will be subjected to re flow solder or other high temperature processes must be:

1. Mounted to a circuit board within 168 hours at factory conditions (<30°C and <60% RH)

   OR
2. Continuously stored per IPC/JEDEC J-STD-033

Modules that have been exposed to moisture and environmental conditions exceeding packaging and storage conditions MUST be baked before mounting according to IPC/JEDEC J-STD-033. Failure to meet packaging and storage conditions will result in irreparable damage to modules during solder re flow.

Revision History

Date:	01/12/2022	Version:	1.0	Detail:	

Head Office: 1-1-1, Miyahara, Yodogawa-ku, Osaka, 532-0003, JAPAN
TEL: +81-6-6399-2884
FAX: +81-6-6399-2886
Tokyo Office: 17-6, Ichibancho, Chiyoda-ku, Tokyo, 102-0082, JAPAN
TEL: +81-3-3512-5083
FAX: +81-3-3262-3358
MegaChips LSI USA Corporation
910 E Hamilton Ave, Suite 120, Campbell, CA 95008, U.S.A
TEL: +1-408-570-0555
FAX: +1-408-570-0567
Web: http://www.megachips.co.jp/

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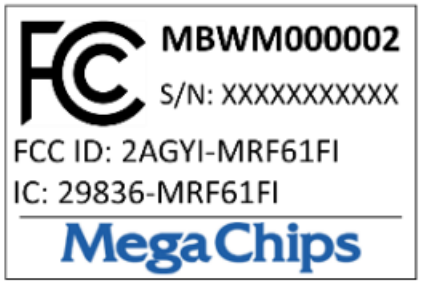

(1.0cm x 1.5 cm)

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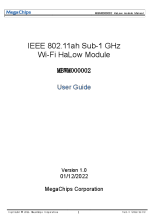
Documents / Resources

	MegaChips MBWM000002 IEEE Sub 1 GHz WiFi HaLow Module [pdf] User Guide MRF61_FI, 2AGYI-MRF61FI, 2AGYIMRF61FI, mrf61fi, MBWM000002, IEEE Sub 1 GHz WiFi HaLow Module, MBWM000002 IEEE Sub 1 GHz WiFi HaLow Module, Sub 1 GHz WiFi HaLow Module, WiFi HaLow Module, HaLow Module, Module

Manuals+,