

# User manual of WHM320A

## 1. Introduction

The WHM320A uses the new Wi-Fi standard IEEE 802.11ah, which uses the Sub 1 GHz license-exempt band. It has long range, low power and high permeability and is optimized for IoT modules.

The WHM200A on the WHM320A board includes an RF switch and internal PA on the SoC, increasing transmit power up to 28 dBm.

## 2. Hardware Architecture:

### 2.1 Main Chipset Information

Item	Vendor	Part Number
IEEE802.11ah WLAN	NEWRACOM	NRC7394

### 2.2 Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
Temp	Operating	-40 to 85	°C
TSTG	Storage Temperature	-40 to 125	°C

## 3. Operational Description

The WHM320A is a long range, high-performance module for wireless communication. The module is solder-able like a SMD component and can easily be mounted on a simple carrier board with a minimum of required external connections.

### 3.1 Features

- ▲ Compact M.2 module 30 x 22 x 3.3mm. (Typ.)
- ▲ Full IEEE 802.11ah compatibility with enhanced performance
- ▲ AP and STA, mesh network support
- ▲ UART and SPI support for host interface
- ▲ Low-Power Long Range Transceiver operating in the sub-1GHz ISM band
- ▲ RF interface optimized to 50 Ω
- ▲ -107 dBm minimum receive sensitivity (MCS10)

### 3.2 CPU

- ▲ ARM® Cortex-M3 for IEEE 802.11ah WLAN and application
- ▲ Clock frequencies for processor (Max 32MHz)
- ▲ For IF and RF frequency, a crystal(32MHz) is a clock reference.

### 3.3 Memory

▷ 32KB Boot ROM ▷ 1,088KB system SRAM ▷ 192KB Key Memory for security ▷ 16KB cache for XIP	▷ 32Mbit External Flash Memory

### 3.4 WIFI Transmission

- ▲ Based on the industry proven direct conversion transceiver architecture
- ▲ Includes a complete radio front-end part, which consists of a Tx power amplifier and an LNA
- ▲ Integrated LDOs
- ▲ Radio calibration interfaces for digital baseband
- ▲ Internal temperature sensing and battery voltage monitoring
- ▲ Low supply current: RX 15mA @ 3.3V, TX 500mA @ 3.3V (+21 dBm Pout)
- ▲ Modulation bandwidth: 1/2/4 MHz
- ▲ RX noise figure < 6dB
- ▲ RX gain range: > 100dB
- ▲ RX IIP3: -17dBm (@ LNA max. gain)
- ▲ TX gain range: > 30 dB
- ▲ EVM < -30 dB @ +21 dBm (w/ 64 QAM, DPD)
- ▲ Integrated RF PLL phase error < 0.7 degree.

### 3.5 Product Details

#### ▲ Data Modulation

OFDM with BPSK, QPSK, 16QAM, 64QAM

#### ▲ Frequency : 902 ~ 928 MHz

Country Code	BandWidth	CF	Max Power	USE
US	1 MHz	902.5 MHz	-	Not Use
	1 MHz	903.5 MHz	23dBm ± 2dB	USE
	1 MHz	904.5 MHz	23dBm ± 2dB	USE
	1 MHz	905.5 MHz	23dBm ± 2dB	USE
	1 MHz	906.5 MHz	23dBm ± 2dB	USE
	1 MHz	907.5 MHz	23dBm ± 2dB	USE
	1 MHz	908.5 MHz	23dBm ± 2dB	USE
	1 MHz	909.5 MHz	23dBm ± 2dB	USE
	1 MHz	910.5 MHz	23dBm ± 2dB	USE
	1 MHz	911.5 MHz	23dBm ± 2dB	USE
	1 MHz	912.5 MHz	23dBm ± 2dB	USE
	1 MHz	913.5 MHz	23dBm ± 2dB	USE
	1 MHz	914.5 MHz	23dBm ± 2dB	USE
	1 MHz	915.5 MHz	23dBm ± 2dB	USE
	1 MHz	916.5 MHz	23dBm ± 2dB	USE
	1 MHz	917.5 MHz	23dBm ± 2dB	USE
	1 MHz	918.5 MHz	23dBm ± 2dB	USE
	1 MHz	919.5 MHz	23dBm ± 2dB	USE
	1 MHz	920.5 MHz	23dBm ± 2dB	USE
	1 MHz	921.5 MHz	23dBm ± 2dB	USE
	1 MHz	922.5 MHz	23dBm ± 2dB	USE
	1 MHz	923.5 MHz	23dBm ± 2dB	USE
	1 MHz	924.5 MHz	23dBm ± 2dB	USE
	1 MHz	925.5 MHz	23dBm ± 2dB	USE
	1 MHz	926.5 MHz	23dBm ± 2dB	USE
	1 MHz	927.5 MHz	-	Not Use
	2 MHz	903.0 MHz	-	Not Use
	2 MHz	905.0 MHz	23dBm ± 2dB	USE
	2 MHz	907.0 MHz	23dBm ± 2dB	USE
	2 MHz	909.0 MHz	23dBm ± 2dB	USE
	2 MHz	911.0 MHz	23dBm ± 2dB	USE
	2 MHz	913.0 MHz	23dBm ± 2dB	USE
	2 MHz	915.0 MHz	23dBm ± 2dB	USE
	2 MHz	917.0 MHz	23dBm ± 2dB	USE
	2 MHz	919.0 MHz	23dBm ± 2dB	USE
	2 MHz	921.0 MHz	23dBm ± 2dB	USE
	2 MHz	923.0 MHz	23dBm ± 2dB	USE
	2 MHz	925.0 MHz	23dBm ± 2dB	USE
	2 MHz	927.0 MHz	-	Not Use
	4 MHz	906.0 MHz	21dBm ± 2dB	USE
	4 MHz	910.0 MHz	23dBm ± 2dB	USE
	4 MHz	914.0 MHz	23dBm ± 2dB	USE
	4 MHz	918.0 MHz	23dBm ± 2dB	USE
	4 MHz	922.0 MHz	23dBm ± 2dB	USE
	4 MHz	926.0 MHz	-	Not Use

This module ensures frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation

## 4. Antenna Trace Design for Host devices

### 4-1 Trace layout and dimensions including specific designs for each type:

#### 1) Layout of trace design, parts, antenna, connectors, and isolation requirements;

All RF traces must be designed with a characteristic impedance of 50 ohms to ensure signal integrity.

UFL Receptacle-type connectors must be used for all RF ports.

Approved antennas are as follows:

- **WSMN-165 manufactured by Gemtek Technology Co.,Ltd.**

But, you must not give to access to antenna connector to user when you install this module into devices to be compliance with FCC section 15.203.

#### 2) Boundary limits of size, thickness, length, width, shape(s), dielectric constant, and impedance must be clearly described for each type of antenna;

Antenna should be used only WSMN-165 manufactured by Gemtek Technology Co.,Ltd.

#### 3) Different antenna length and shapes affect radiated emissions, and each design shall be considered a different type; e.g., antenna length in multiple(s) of frequency wavelength and antenna shape (traces in phase) can affect antenna gain and must be considered;

### 4-2 Appropriate parts by manufacturer and specifications.

#### 1) For the antenna, the WSMN-165(Gemtek)

### 4-3 Test procedures for design verification.

The manufacturer should verify that the antenna trace design on the PCB board is compliance with this Antenna Trace Design documents.

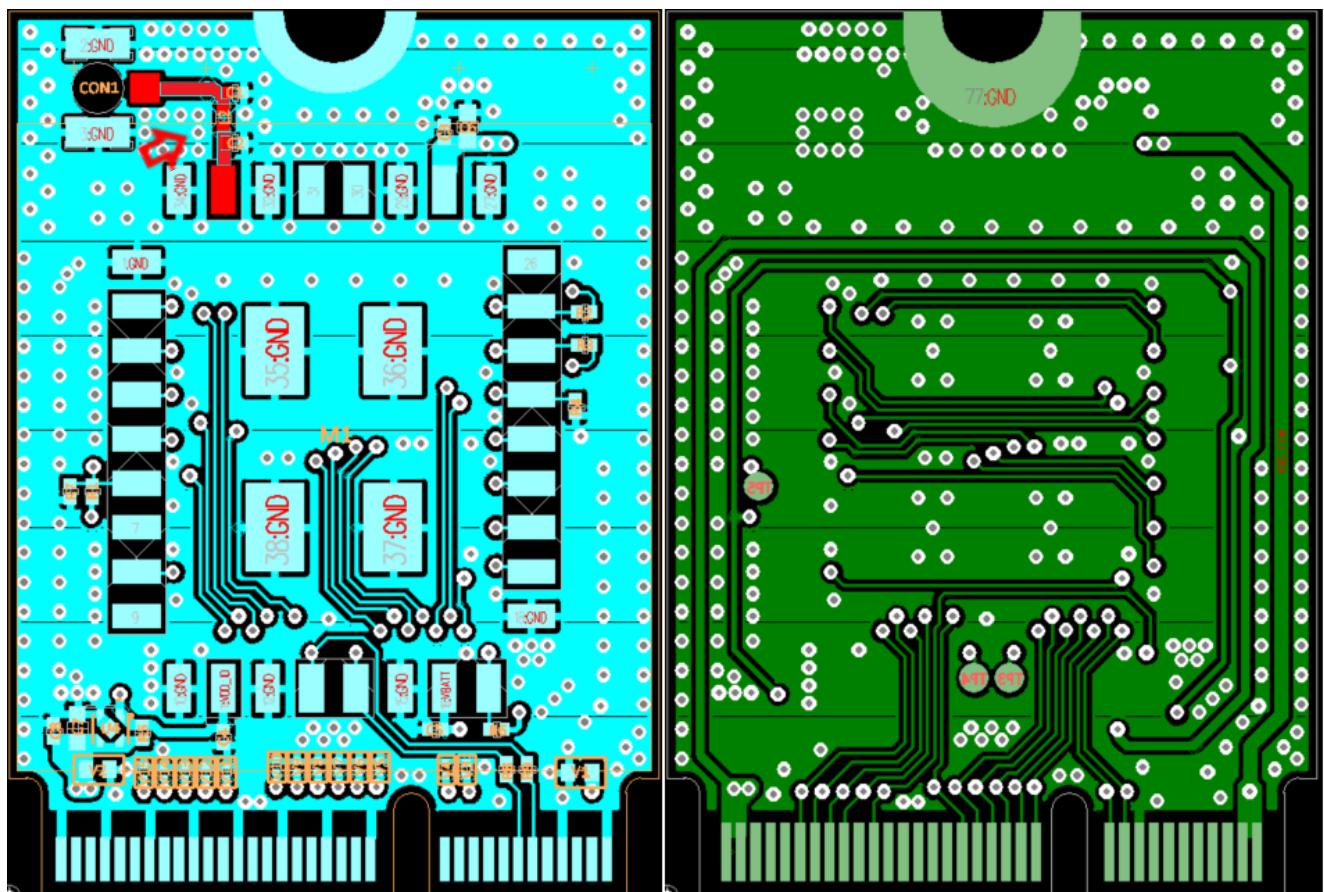
You connect the antenna connector of the device to the input of a measurement instrument. And you set the measurement instrument to the proper options for each frequency bands and conduct the test to get the output power from the antenna connector. The permissible output power range is in below table to verify the antenna trace design is appropriate for this documents.

BAND	Output power	Tolerance
WIFI-HaLow US	+23dBm	+2/-2dB

### 4-4 Production test procedures for ensuring compliance.

The host product itself is required to comply with all other applicable FCC equipment authorization regulations, requirements.

4-5 The above data is to be provided by a Gerber file (or equivalent) for PCB layout.



: 50 ohm matching Transmission Line

[PCB Top]

[PCB Bottom]

### 1) Application PCB information

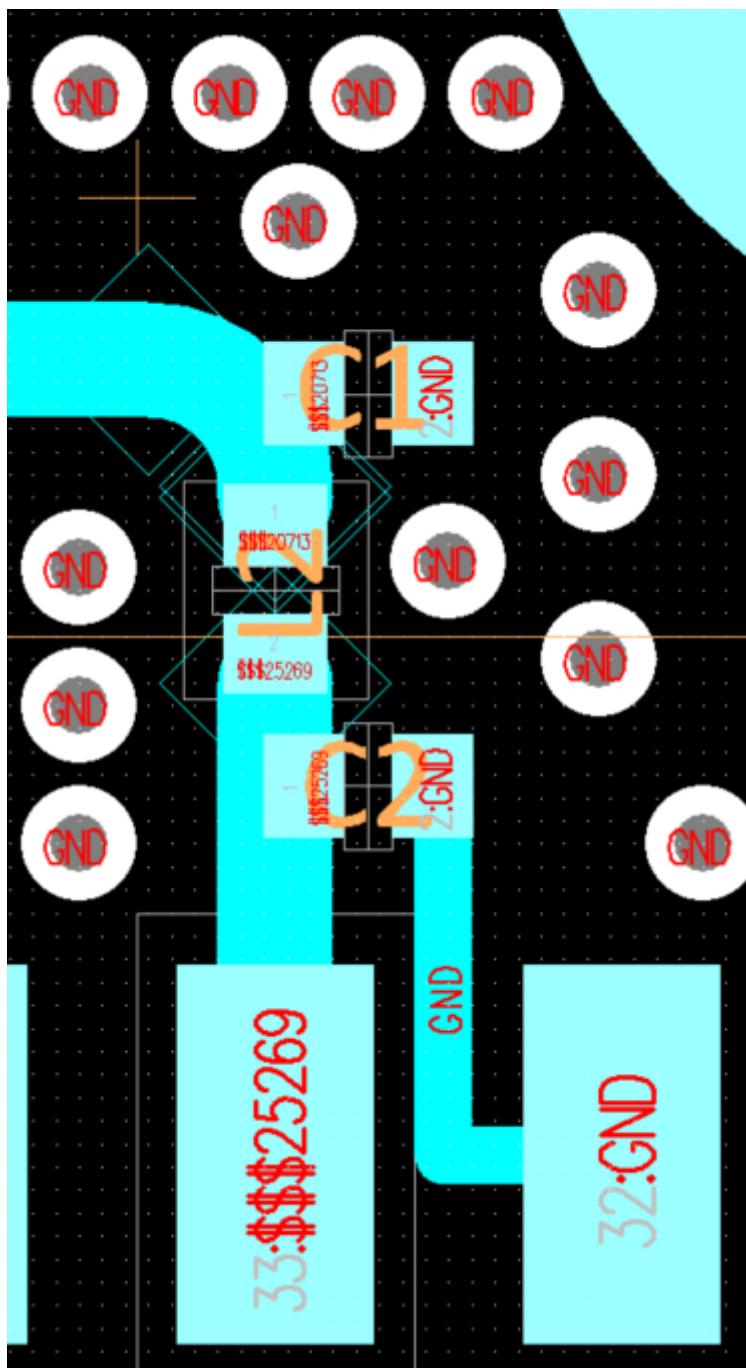
- PCB : 2-layer 0.8T
- Size : 30 x 22 mm
- RF Transmission line width : 0.5mm
- Clearance : 0.15mm
- FR4 PCB  $\epsilon_r = 4.3$

2) Antenna Matching value]

C1 : NC

L2 : 4.7nH

C2 : NC



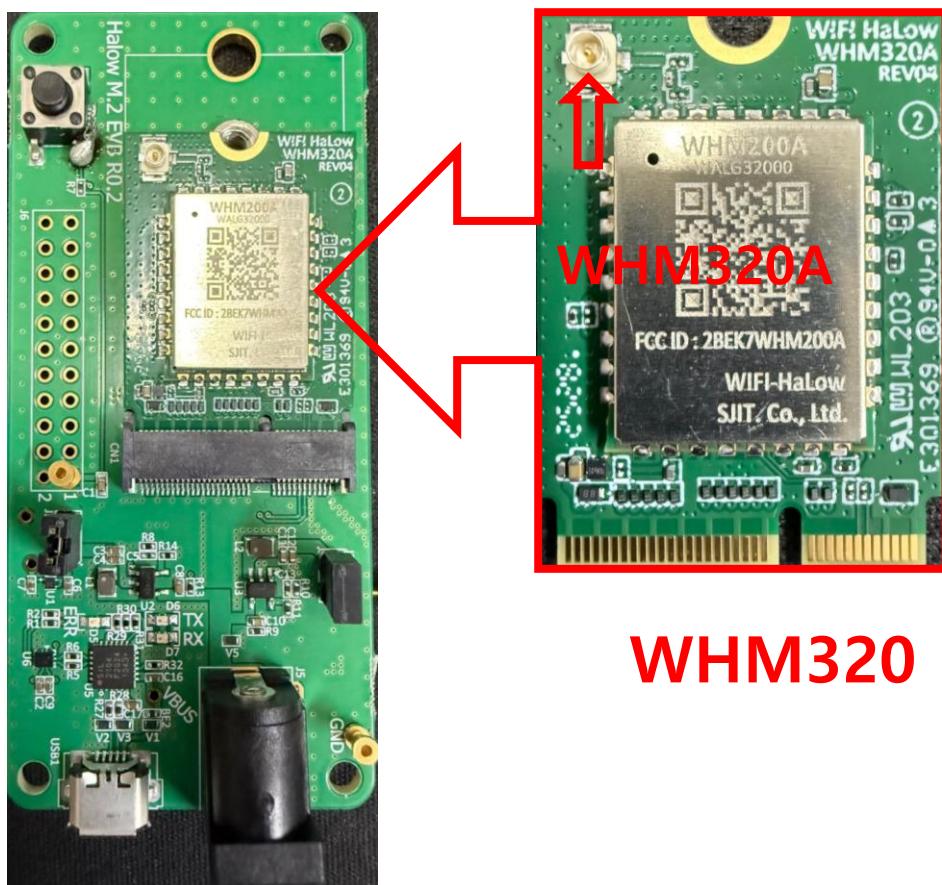
## 5. Installation Guide

### - Contents

This module is used by mounting it on a main board that includes an external antenna.

### - InstallationFigure

**Antenna P/N**  
- WSMN-165\_Hallow\_Ant\_Vp00



## 6. Contact Address

54-11, Dongtanhana 1-gil, Hwaseong-si, Gyeonggi-do, 18423, Republic of Korea.

## 7. Manufacturer

SJIT CO.,LTD

## 5. FCC & IC Statement

FCC & IC Statement	
1. FCC Part 15.19 Statements:	<p>This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:</p> <p>(1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.</p>
Industry Canada Statement	<p>This device complies with RSS-247 of the Industry Canada 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.</p> <p>Ce dispositif est conforme à la norme CNR-247 d'Industrie Canada applicable aux appareils radio exempts de licence. Son fonctionnement est sujet aux deux conditions suivantes: (1) le dispositif ne doit pas produire de brouillage préjudiciable, et (2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.</p>
2. FCC Part 15.105 statement(Class B)	<p>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.</p> <p>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:</p> <ul style="list-style-type: none"> <li>- Reorient or relocate the receiving antenna.</li> <li>- Increase the separation between the equipment and receiver.</li> <li>- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.</li> <li>- Consult the dealer or an experienced radio/TV technician for help.</li> </ul>
3. FCC Part 15.21 statement	<p>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 must not be co-located or operating in conjunction with any other antenna or transmitter.</p>
4. Responsible Party	<p style="text-align: center;">Supplier's Declaration of Conformity 47 CFR § 2.1077 Compliance Information</p> <p style="text-align: center;">Unique Identifier: (e.g., Trade Name, Model Number) Responsible Party – U.S. Contact Information</p> <p>1. Company Name: Sea Slug Labs LLC Street Address Sea Slug Labs 19806 Maverick Creek Ln Cypress City, State: Texas Zip Code: 77433 Telephone number or internet contact information: +6827778293 / <a href="mailto:jorge@seasluglabs.io">jorge@seasluglabs.io</a></p> <p>2. Company Name: Treetop Technical Products LLC Street Address 1776 Broadway, Unit 7 Raynham Massachusetts City, State: Massachusetts Zip Code: 02767 Telephone number or internet contact information: +15082383133/ <a href="mailto:sales@treetoptech.com">sales@treetoptech.com</a></p>

<p><b>5. Modular Approval Statement</b></p>	<p>Regulatory notice to host manufacturer according to KDB 996369 D03 OEM Manual</p> <p>This module has been granted modular approval as below listed FCC rule parts.  <b>-FCC Rule parts 15C(15.247)</b></p> <p>Summarize the specific operational use conditions</p> <p>-The OEM integrator should use equivalent antennas which is the same type and equal or less gain than an antenna listed below this instruction manual.</p> <p>-<b>This module supports one antenna, the Gemtek WSMN-165.</b></p> <p>Strict adherence to the module integration guidelines is required.</p> <p>Host integration compliance for this module is limited to host adaptation designs identical to the SJIT reference design.</p> <p>Host integration using an adaptation design different from the SJIT reference design requires a Class 2 permit change to this module approval or a separate host approval with a different FCC ID.</p> <p><b>Limited module procedures</b></p> <p>This module does not have its own power supply regulation. Therefore, Host product in which this module is installed must have the capability to provide the rated power supply as described in installation manual. And it should be followed the testing guide lines for this power supply regulation below.</p> <p>- Measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.</p> <p><b>RF exposure considerations</b></p> <p>-The module has been certified for integration into products only by OEM integrators under the following condition:</p> <ul style="list-style-type: none"> <li>-The antenna(s) must be installed such that a minimum separation distance of at least <b>20 cm</b> is maintained between the radiator (antenna) and all persons at all times.</li> <li>-The transmitter module must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product procedures.</li> <li>-Mobile use</li> </ul> <p>As long as the three conditions above are met, further transmitter testing will not be required. OEM integrators should provide the minimum separation distance to end users in their end-product manuals.</p> <p><b>Antennas list</b></p> <p>This module is certified with the following integrated antenna.</p> <ul style="list-style-type: none"> <li>- <b>Max. Antenna gain: 2.1 dBi</b></li> <li>- <b>Ant. Type:</b>  <b>External dipole antennas (the Gemtek "WSMN-165")</b></li> </ul> <p>Any new antenna type, higher gain than listed antenna should be met the requirements of FCC rule 15.203 and 2.1043 as permissive change procedure.</p> <p><b>End Product Labeling</b></p> <p>The module is labeled with its own FCC ID. If the FCC ID are 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. In that case, the final end product must be labeled in a visible area with the following:  <b>"Contains FCC ID: 2BEK7WHM200A</b></p>
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5. Modular Approval Statement	<p>Information on test modes and additional testing requirements -OEM integrator 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, additional transmitter in the host, etc.).</p> <p>Additional testing, Part 15 Subpart B disclaimer -The final host product also requires Part 15 subpart B compliance testing with the modular transmitter installed to be properly authorized for operation as a Part 15 digital device.</p>
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