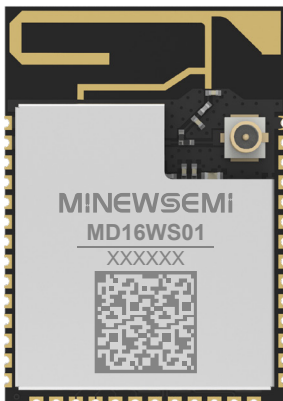


Wi-Fi Module

MD16WS01



Datasheet
V 1.0.0



Version Note

Version	Details	Contributor(s)	Date	Notes
1.0.0	First edit	Vincle	2025.09.11	

Part Number

Model	Hardware Code
MD16WS01	-

Click the icon to view and download the latest product documents electronically.
https://en.minewsemi.com/file/MD16WS01_Datasheet_K_EN.pdf



MD16WS01-ESP32C5

Low-Power, Dual-band 2.4G+5G, WiFi 6+BLE 6.0, Ultra Large Memory Space, Support ZigBee and Thread

The MD16WS01 is a high-performance, ultra-low-power, and cost-effective wireless WiFi 6 + BLE 6.0 combination module based on the ESP32-C5 SoC. It features a dual-core 32-bit RISC-V processor operating at up to 240 MHz. Additionally, it includes 8MB of external FLASH program space, 4MB of PSRAM, integrated 2.4GHz and 5GHz transceivers, and other powerful supporting resources, providing a perfect solution for short-range connectivity needs. The MD16WS01 supports BLE, BLE Mesh, Zigbee and Thread protocols, with a maximum data rate of 150Mbps.

FEATURES



Dual-core 32-bit RISC-V, high performance



Support BLE 6.0



Ultra Large memory space 4MB PSRAM, 8MB Flash



Supports BLE 6.0, BLE Mesh 1.1, Zigbee 3.0 and Thread 1.4 protocols



Dual-band 2.4G+5G, WiFi 6(802.11b/g/n ax)

KEY PARAMETER

MD16WS01			
Chip Model	ESP32-C5	Antenna	PCB/u.FL
Module Size	25.5×18×2.6mm	GPIO	22
Flash	8MB	RAM	4MB+384KB
Receiving Sensitivity	-98dBm	Transmitting Power	0~ +20dBm
Emission Current	397mA	Receiving Current	120mA

APPLICATION



Smart Home



Consumer Electronics



Smart Healthcare



Security Equipment



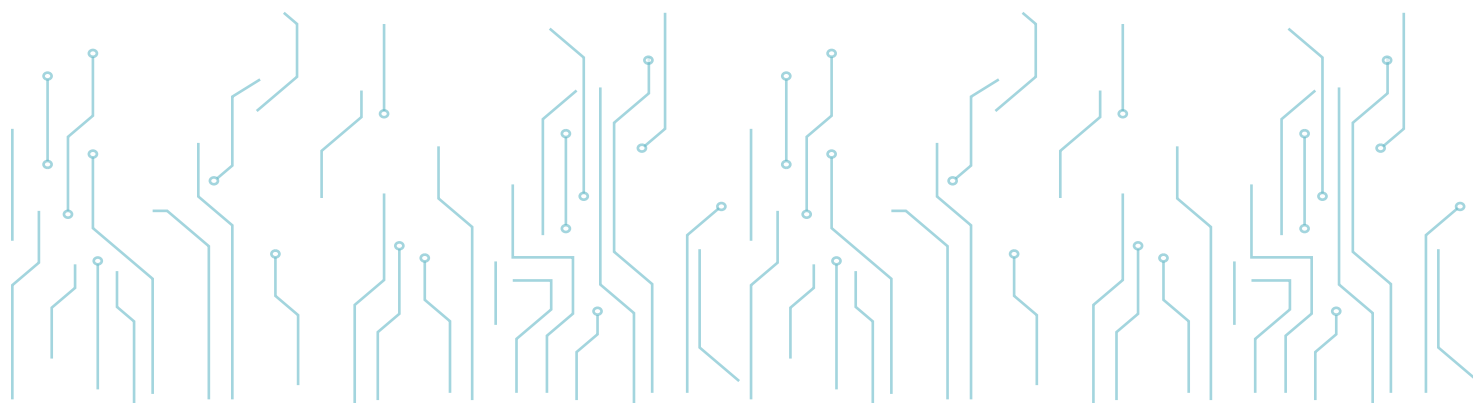
Fitness Equipment

CERTIFICATION

Certifications Pending (e.g., CE, FCC)

INDEX

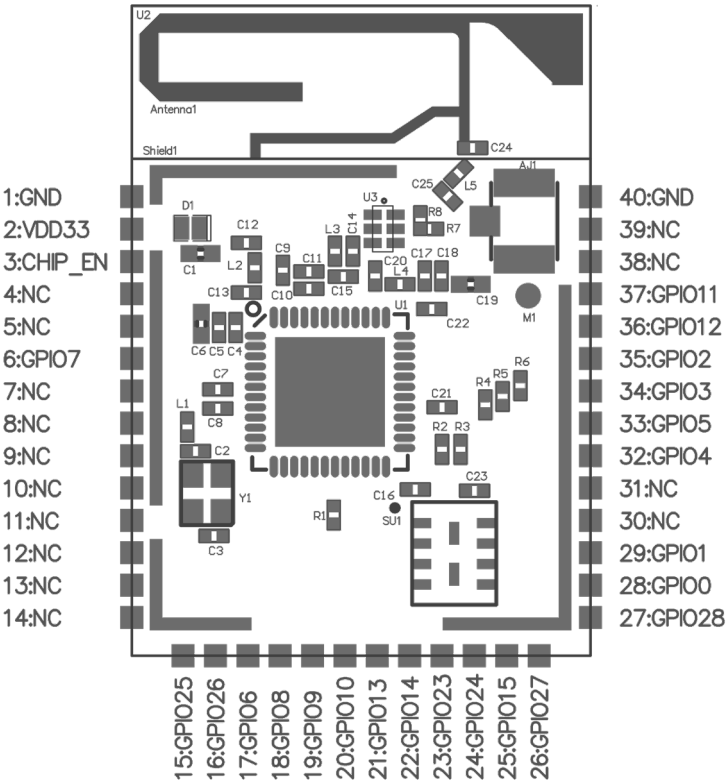
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1 ELECTRICAL SPECIFICATION

Parameter	Values	Notes
Operating Voltage	3.0V-3.6V	To ensure RF work, it is recommended that the supply voltage should not be lower than 3.3V.
Operating Temperature	-40℃~+85℃	Storage temperature is -40℃~+125℃
Transmission Power	0 ~ +20dBm	Configurable
Receiving Current	120mA	Maximum transmit power
Emission Current	397mA	Maximum transmit power
Module Dimension	25.5*18*2.6mm	
Quantity of IO Port	22	UART,SPI,GPIOs

2 PIN DESCRIPTION



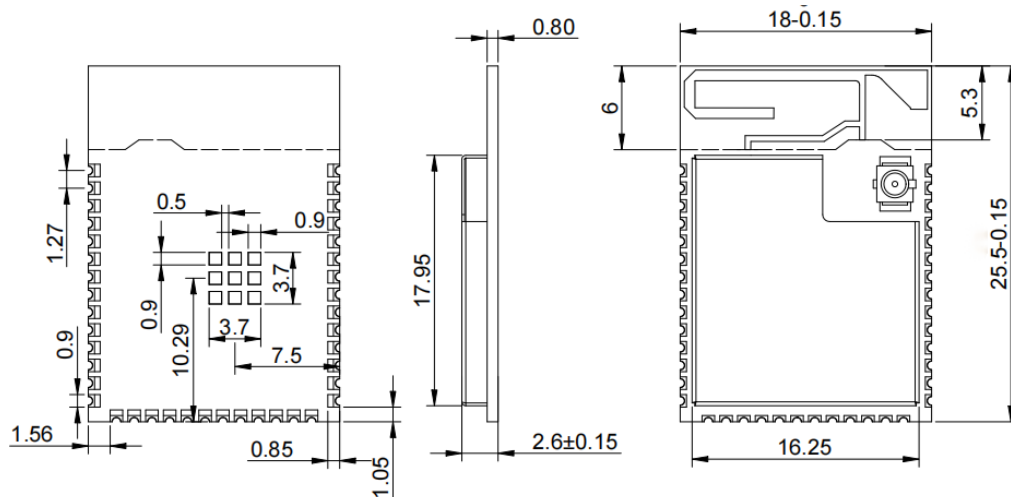
3 PIN DEFINITION

Pin Number	Symbol	Type	Definition
1	GND	Grounding	Negative pole of power supply
2	VCC	Power	Power supply 3.0V-3.6V, use this pin to power, standard voltage 3.3V
3	CHIP_EN	Enable	High level: chip enable (power on); Low level :chip disabled (power off); Notice: Note: Do not leave the CHIP_EN pin floating.
4	NC	NC	Empty pin
5	NC	NC	Empty pin
6	GPIO7	Digital I/O	General IO port, SDIO_DATA1,FSPID
7	NC	NC	Empty pin
8	NC	NC	Empty pin
9	NC	NC	Empty pin
10	NC	NC	Empty pin
11	NC	NC	Empty pin
12	NC	NC	Empty pin
13	NC	NC	Empty pin
14	NC	NC	Empty pin
15	GPIO25	Digital I/O	General IO port
16	GPIO26	Digital I/O	General IO port
17	GPIO6	Digital I/O	General IO port, ADC1_CH5, FSPICLK
18	GPIO8	Digital I/O	General IO port, SDIO_DATA0
19	GPIO9	Digital I/O	General IO port, SDIO_CLK
20	GPIO10	Digital I/O	General IO port, SDIO_CMD
21	GPIO13	Digital I/O	General IO port, SDIO_DATA3
22	GPIO14	Digital I/O	General IO port, SDIO_DATA2
23	GPIO23	Digital I/O	General IO port
24	GPIO24	Digital I/O	General IO port
25	GPIO15	Digital I/O	General IO port
26	GPIO27	Digital I/O	General IO port
27	GPIO28	Digital I/O	General IO port



Pin Number	Symbol	Type	Definition
28	GPIO0	Digital I/O	General IO port, XTAL_32K_P, LP_UART_DTRN
29	GPIO1	Digital I/O	General IO port, XTAL_32K_N, ADC_CH0, LP_UART_DSRN
30	NC	NC	Empty pin
31	NC	NC	Empty pin
32	GPIO4	Digital I/O	General IO port, MTCK, FSPIHD, LP_UART_RXD, ADC1_CH3
33	GPIO5	Digital I/O	General IO port, MTDO, FSPIWP, LP_UART_TXD, ADC1_CH4
34	GPIO3	Digital I/O	General IO port, MTDI
35	GPIO2	Digital I/O	General IO port, MTMS, FSPIQ
36	GPIO12	Digital I/O	General IO port, U0RXD
37	GPIO11	Digital I/O	General IO port, U0TXD
38	NC	NC	Empty pin
39	NC	NC	Empty pin
40	GND	Grounding	Power Supply Negative

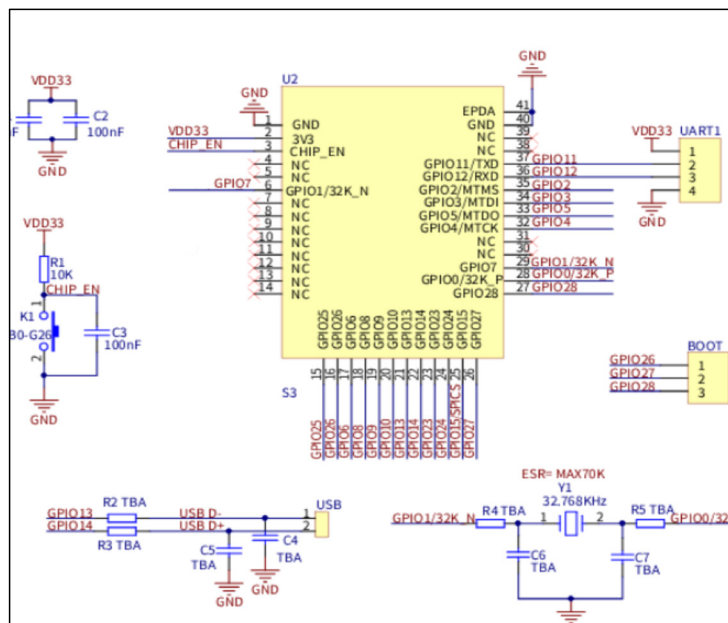
4 MECHANICAL DRAWING



Default unit: mm Default tolerance: ±0.15

5 REFERENCE DESIGN

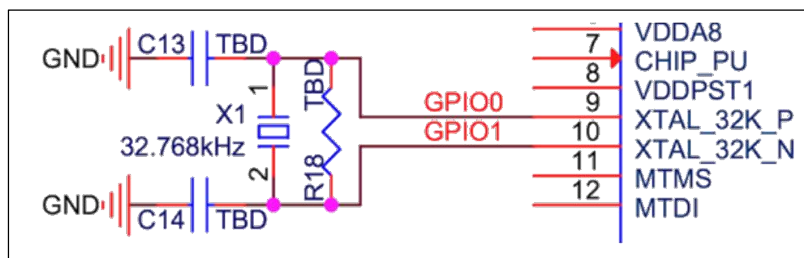
7.1 This is the typical application circuit of the module connected with peripheral components (for example, power supply, antenna, reset button,, and UART interface).



Soldering the EPAD to the ground of the base board is not a must, however, it can optimize thermal performance. If you choose to solder it, please apply the correct amount of soldering paste. Too much soldering paste may increase the gap between the module and the baseboard. As a result, the adhesion between other pins and the baseboard may be poor.

To ensure that the power supply to the ESP32-C5 chip is stable during power-up, it is advised to add an RC delay circuit at the EN pin. The recommended setting for the RC delay circuit is usually $R = 10\text{ k}\Omega$ and $C = 1\text{ }\mu\text{F}$. However, specific parameters should be adjusted based on the power-up timing of the module and the power-up and reset sequence timing of the chip. For ESP32-C5's power-up and reset sequence timing diagram, please refer to the power supply section of the ESP32-C5 chip datasheet.

7.2 ESP32-C5 supports an external 32.768 kHz crystal to act as the RTC clock. The external RTC clock source enhances timing accuracy and consequently decreases average power consumption, without impacting functionality. Figure below shows the schematic circuit of the ESP32-C5 for a 32.768 kHz crystal oscillator.



Please note the requirements for the 32.768 kHz crystal:

Equivalent series resistance (ESR) $\leq 70\text{ k}\Omega$.

Load capacitance at both ends should be configured according to the crystal's specification.

The parallel resistor R is used for biasing the crystal circuit ($5\text{ M}\Omega < R \leq 10\text{ M}\Omega$).

In general, you do not need to populate the resistor.

If the RTC clock source is not required, then the pins for the 32.768 kHz crystal can be used as GPIOs.

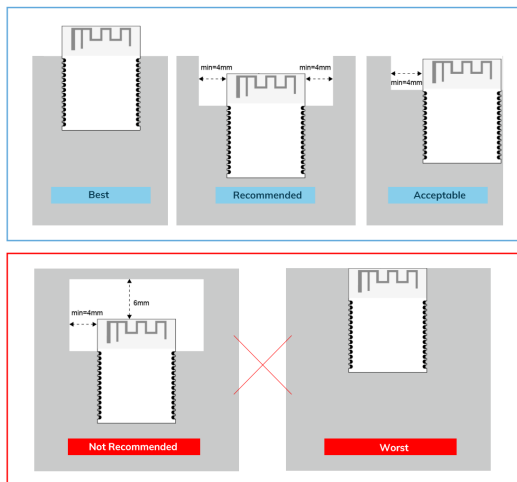
6 PCB LAYOUT

There should be no GND plane or metal cross wiring in the module antenna area, and no components should be placed nearby. It is best to make a hollow or clear area, or place it on the edge of the PCB board. The reference example is as follows:



Notice: It is strongly recommended to use the first design method. The module antenna design is debugged according to the first wiring.

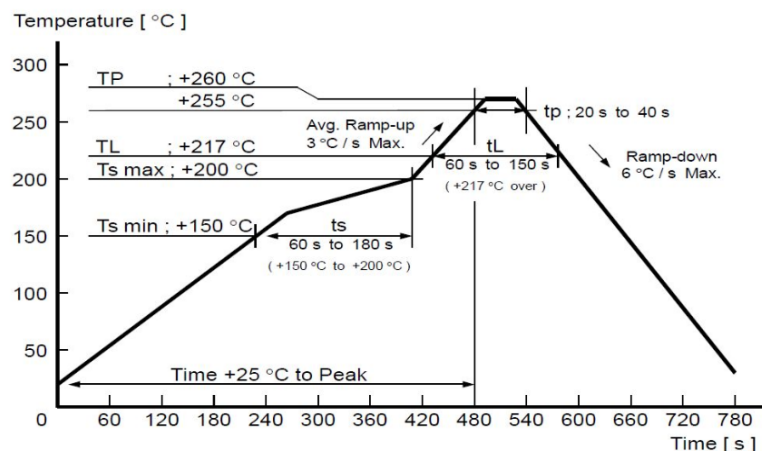
Layout Notes:



- 1) The module's antenna area should be completely clear of any metal obstructions to avoid affecting antenna performance (as shown in the diagram).
- 2) Outside the module's antenna area, try to maintain a solid copper pour to minimize interference from the mainboard signal lines or other sources.
- 3) A clear area of at least 4mm should surround the module's antenna (including its casing) to reduce interference with the antenna.
- 4) Ensure good grounding for components to minimize parasitic inductance.
- 5) Do not place copper under the module's antenna to prevent interference with signal radiation, which could affect transmission distance.
- 6) The antenna should be kept away from other circuits to maintain radiation efficiency and avoid impacting the normal operation of other circuits.
- 7) Position the module as close to the edge of the circuit board as possible, away from other circuitry.
- 8) It is recommended to use a ferrite bead for isolation when connecting the module to the power supply.

7 REFLOW AND SOLDERING

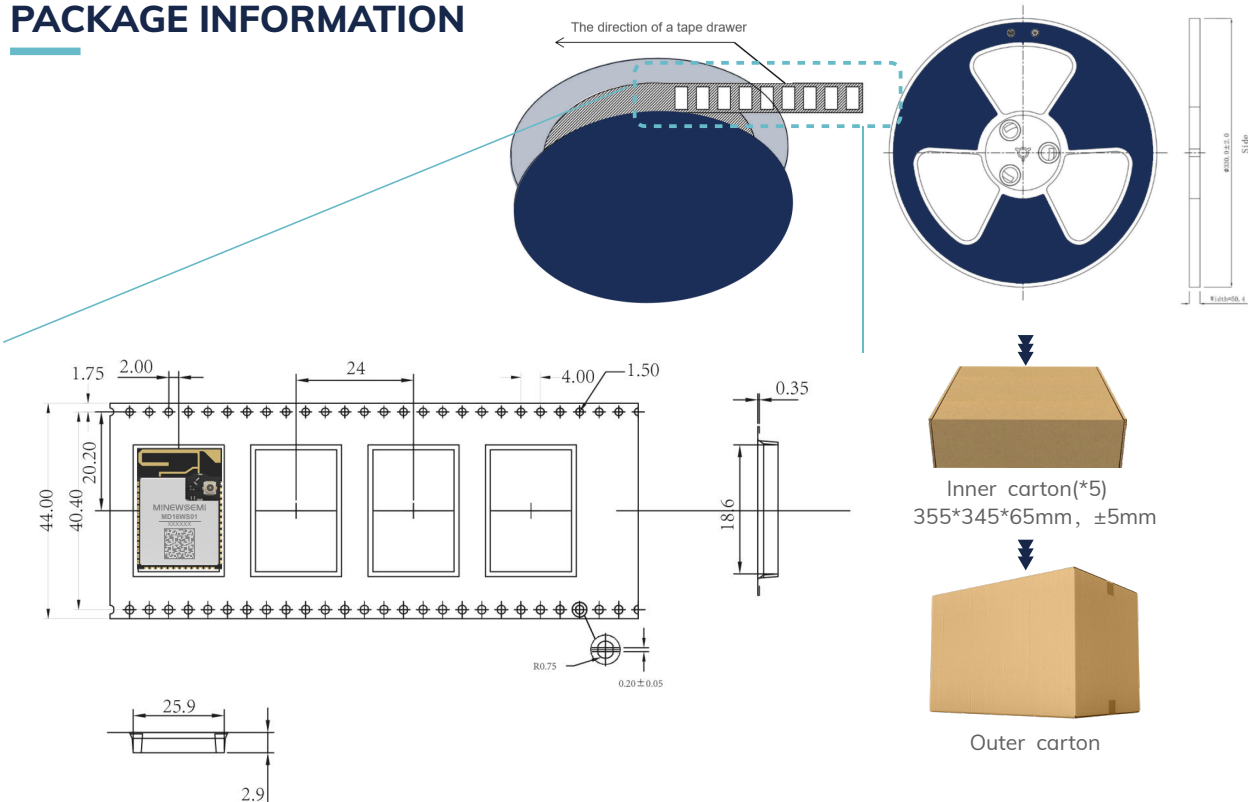
- 1) Perform SMT according to the reflow oven temperature profile provided below, with a maximum temperature of 260°C;
- 2) Follow IPC/JEDEC standards; Peak temperature: < 260°C; Number of reflows: ≤2 times; For SMT involving double-sided placement, it is recommended that the module side undergoes reflow soldering only once. For any special processes, please contact our company.



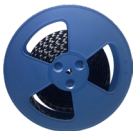
- 3) Module SMT is recommended to make the thickness 0.13-0.15mm, and then the pin length is expanded 1-1.3mm;
- 4) After opening, if the entire package is not used at once, it should be stored in a vacuum to prevent long-term exposure to air, which can cause moisture absorption and pad oxidation. If there is a gap of 7 to 30 days before reuse, it is recommended to bake the tape at 65-70°C for 24 hours without unrolling it before returning to SMT.
- 5) ESD protection measures should be implemented before using SMT.

8

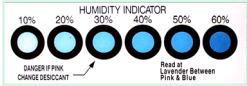
PACKAGE INFORMATION



Remarks
General material list for FCL packaging:



Carrier tape packaging tray



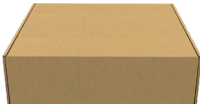
Humidity Indicator
(1 pcs/bag)



Desiccant
(placed in a vacuum bag)



Vacuum bag



Inner carton(*5)
355*345*65mm, ±5mm



Outer carton
370*358*350mm, ±10mm

Other:

Moisture-proof label (attached to the vacuum bag)

Certification label (attached to the vacuum bag)

Outer box label



Default unit: mm Default tolerance: ±0.1

Packing detail	Specification	Net weight	Gross weight	Dimension
MD16WS01	900PCS	1458g	2245.2g	W=44mm, T=0.35mm



Note: Default weight tolerance all are within 10g (except the special notes)

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.

9 FCC WARNING:

Any 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. This equipment complies with FCC 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.

Requirement per KDB996369 D03

2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.³

Explanation: This module meets the requirements of FCC part 15C(15.247)and 15E (15.407) .

2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions.

If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in Explanation: The EUT has a PCB Antenna, , and the antenna use a permanently attached antenna which is not replaceable.

2.4 Limited module procedures

If a modular transmitter is approved as a "limited module," then the module manufacturer is responsible for approving the host environment that the limited module is used with.

The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

Explanation: The module is not a limited module.

2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces.

The integration information shall include for the TCB review the integration instructions for the following aspects: layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

- a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);
- b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
- c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;
- d) Appropriate parts by manufacturer and specifications;
- e) Test procedures for design verification; and
- f) Production test procedures for ensuring compliance.

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

Explanation: Yes, The module with trace antenna designs, and This manual has been shown the layout of trace design,, antenna, connectors, and isolation requirements.

2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

Explanation: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment, This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body." This module is designed to comply with the FCC statement, FCC ID is:2ABU6-MD16WS01

2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions.

For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an “omni-directional antenna” is not considered to be a specific “antenna type”)).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: The EUT has a PCB Antenna, , and the antenna use a permanently attached antenna which is unique.

2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating “Contains FCC ID” with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation: The host system using this module, should have label in a visible area indicated the following texts:
"Contains FCC ID: 2ABU6-MD16WS01

2.9 Information on test modes and additional testing requirements

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter.

This can greatly simplify a host manufacturer's determination that a module as installed in a host complies with FCC requirements.

Explanation: Topband can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

10 STORAGE CONDITIONS

- Please use this product within 6 months after signing the receipt.
 - This product should be stored without opening the package at an ambient temperature of 5~35°C and a humidity of 20~70%RH.
 - This product should be left for more than 6 months after receipt and should be confirmed before use.
 - The product must be stored in a non-corrosive gas (Cl₂, NH₃, SO₂, NO_x, etc.).
 - To avoid damaging the packaging material, do not apply any excessive mechanical shocks, including but not limited to sharp objects adhering to the packaging material and product dropping.
- This product is suitable for MSL2 (based on JEDEC standard J-STD-020).
 - After opening the package, the product must be stored at ≤30°C/≤60%RH. It is recommended to use the product within 3-6 months after opening the package.
 - When the color of the indicator in the package changes, the product should be baked before welding.
- Baking is not required for one year if exposure is limited to <30°C and 60%RH. Refer to MSL2 for exposure criteria for moisture sensitivity level. If exposed to (≥168h@85°C/60%RH) conditions or stored for more than one year, recommended baking conditions.
 1. 120 ±5/-5°C, 8 hours, 1 timeProducts must be baked individually on heat-resistant trays because the materials (base tape, reel tape, and cover tape) are not heat-resistant, and the packaging material may be deformed at temperatures of 120 °C;
 2. 90 °C ±8/-0 °C, 24hours, 1timesThe base tape can be baked together with the product at this temperature. Please pay attention to the uniformity of heat.

11 HANDLING CONDITIONS

- Be careful in handling or transporting products because excessive stress or mechanical shock may break products.
- Handle with care if products may have cracks or damages on their terminals. If there is any such damage, the characteristics of products may change. Do not touch products with bare hands that may result in poor solder ability and destroy by static electrical charge.

12 QUALITY

Cognizant of our commitment to quality, we operate our own factory equipped with state-of-the-art production facilities and a meticulous quality management system. We hold certifications for ISO9001, ISO14001, ISO27001, OHSA18001, BSCI.

Every product undergoes stringent testing, including transmit power, sensitivity, power consumption, stability, and aging tests. Our fully automated module production line is now in full operation, boasting a production capacity in the millions, capable of meeting high-volume production demands.

13 COPYRIGHT STATEMENT

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14 RELATED DOCUMENTS

- MinewSemi_Product_Naming_Reference_Manual
https://en.minewsemi.com/file/MinewSemi_Product_Naming_Reference_Manual_EN.pdf
- MinewSemi_Connectivity_Module_Catalogue
https://en.minewsemi.com/file/MinewSemi_Connectivity_Module_Catalogue_EN.pdf



For product change notifications and regular updates of Minewsemi documentation, please register on our website: www.minewsemi.com

MINEWSEMI
Innovative IoT Module Expert



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