

# WBE01EH

## Datasheet

V1.2

2022-07-12

INNOTECH Alexa Connect Kit (ACK) module

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## Revision History

| Date       | Version | Release notes              |
|------------|---------|----------------------------|
| 2021-7-23  | V1.0    | First release              |
| 2021-8-5   | V1.1    | Update RF Characteristics  |
| 2022-07-12 | V1.2    | Delete chapter 8 packaging |
|            |         |                            |

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# 1. MODULE OVERVIEW


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## 1.1 Features

### MCU

- 32-bit RISC-V single-core processor up to 160 MHz
- 400KB of SRAM
- 384KB of ROM
- 8KB SRAM in RTC

### Wi-Fi

-  IEEE 802.11b/g/n
- Supports 20 MHz, 40 MHz bandwidth in 2.4 GHz band
- 1T1R mode with data rate up to 150 Mbps
- Wi-Fi Multimedia (WMM)
- TX/RX A-MPDU, RX A-MSDU

### Bluetooth®

- Bluetooth LE: Bluetooth 5, Bluetooth mesh
- Advertising extensions
- Multiple advertisement sets
- Channel selection algorithm #2

### Hardware

- Interfaces: 1 × UART (Connection to the host), 1 × I<sup>2</sup>C, 5 × PWMs, 1 × ADC
- 40 MHz crystal oscillator
- 4 MB Embedded Flash
- Operating voltage/Power supply: 3.0 ~ 3.6 V
- Operating temperature range: -40 ~ 105 °C
- Dimensions: 18.5 × 18.5 mm

### Certification

- Bluetooth certification: BQB
- RF certification:
  - FCC
  - IC
- REACH/RoHS compliance

## 1.2 Description

The WBE01EH is a module that is based on ESP32-C3FH4. It provides complete Wi-Fi and Bluetooth® functionalities with embedded 32-bit RISC-V single-core processor. The module integrates a 4 MB embedded flash.

At the core of this module is the ESP32 chip, which is a single 2.4 GHz Wi-Fi and Bluetooth combo chip. WBE01EH integrates all peripheral components seamlessly, including a crystal oscillator, flash, filter capacitors and RF matching links in one single package. It is ultra-small in size, with a metal pin antenna, robust performance, and low energy consumption.

WBE01EH is a module for Alexa Connect Kit (ACK), a managed service that makes it easy to integrate Alexa into your products. With WBE01EH and its default firmware, you can connect your devices or system to Alexa and the Internet without worrying about managing cloud services, writing an Alexa Skill, or developing complex networking and security firmware.

## 1.3 Application:

- LED Light Bulbs

## 2. BLOCK DIAGRAM

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Figure 1: WBE01EH Block Diagram

## 3. PIN DEFINITIONS

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### 3.1 Pin Layout

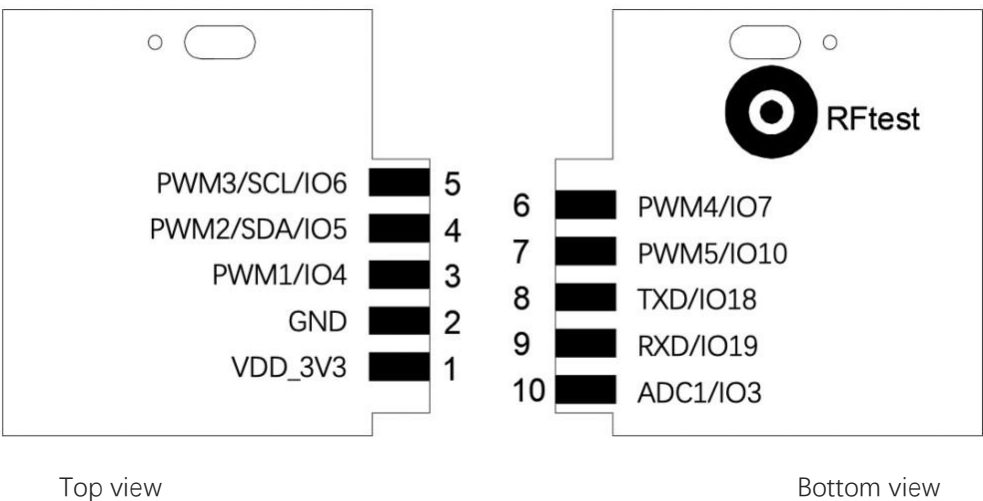


Figure 2: Pin Layout of WBE01EH

## 3.2 Pin Description

Table 1: Pin Definitions

| Name     | No. | Type | Function                             |
|----------|-----|------|--------------------------------------|
| VDD_3V3  | 1   | P    | Power supply (3.0-3.6V)              |
| GND      | 2   | P    | Ground                               |
| PWM1     | 3   | I/O  | PWM output1, GPIO4                   |
| PWM2/SDA | 4   | I/O  | PWM output2, GPIO5<br>I2C data line  |
| PWM3/SCL | 5   | I/O  | PWM Output3, GPIO6<br>I2C clock line |
| PWM4     | 6   | I/O  | PWM Output4, GPIO7                   |
| PWM5     | 7   | I/O  | PWM Output5, GPIO10                  |
| TXD      | 8   | I/O  | UART TX, connect to host RX, GPIO18  |
| RXD      | 9   | I/O  | UART RX, connect to host TX, GPIO19  |
| ADC1     | 10  | I/O  | ADC input, GPIO3                     |

## 4. ELECTRICAL CHARACTERISTICS

### 4.1 Absolute Maximum Ratings

Stresses beyond the absolute maximum ratings listed in the table below may cause permanent damage to the device. These are stress ratings only, and do not refer to the functional operation of the device that the recommended operating conditions.

Table 2: Absolute Maximum Ratings

| Symbol             | Parameter            | Min  | Max | Unit |
|--------------------|----------------------|------|-----|------|
| VDD_3V3            | Power supply voltage | -0.3 | 3.6 | V    |
| T <sub>store</sub> | Storage temperature  | -40  | 105 | °C   |

### 4.2 Recommended Operating Conditions

Table 3: Recommended Operating Conditions

| Symbol           | Parameter                                  | Min | Type | Max | Unit |
|------------------|--|-----|------|-----|------|
| VDD_3V3          | Power supply voltage                       | 3.0 | 3.3  | 3.6 | V    |
| I <sub>VDD</sub> | Current delivered by external power supply | 0.5 | --   | --  | A    |
| T <sub>A</sub>   | Operating temperature                      | -40 | --   | 105 | °C   |
| Humidity         | Humidity condition                         | --  | --   | 85  | %RH  |

### 4.3 DC Characteristics (3.3V, 25°C)

Table 4: DC Characteristics (3.3V, 25°C)

| Symbol                | Parameter   | Min      | Type | Max        | Unit |
|-----------------------|---|----------|------|------------|------|
| C <sub>IN</sub>       | Pin capacitance   | -        | 2    | -          | pF   |
| V <sub>IN</sub>       | High-level input voltage  | 0.75*VDD | -    | VDD+0.3    | V    |
| V <sub>IL</sub>       | Low-level input voltage   | -0.3     | -    | 0.25*VDD   | V    |
| I <sub>IH</sub>       | High-level input current  | -        | -    | 50         | nA   |
| I <sub>IL</sub>       | Low-level input current   | -        | -    | 50         | nA   |
| V <sub>OH</sub>       | High-level output voltage   | 0.8VDD   | -    | -          | V    |
| V <sub>OL</sub>       | Low-level output voltage  | -        | -    | 0.1*VDD    | V    |
| I <sub>OH</sub>       | High-level source current (VDD = 3.3V, V <sub>OH</sub> ≥ 2.64V, PAD_DRIVER = 3) | -        | 40   | -          | mA   |
| I <sub>OL</sub>       | Low-level sink current (VDD = 3.3V, V <sub>OL</sub> = 0.495V, PAD_DRIVER = 3)   | -        | 28   | -          | mA   |
| R <sub>PU</sub>       | Resistance of internal pull-up resistor   | -        | 45   | -          | kΩ   |
| R <sub>PD</sub>       | Resistance of internal pull-down resistor                                       | -        | 45   | -          | kΩ   |
| V <sub>IL_N_RST</sub> | Low-level input voltage of CHIP_PU to power off the chip                        | -0.3     | -    | 0.25 × VDD | V    |

## 4.4 Current Consumption Characteristics

With the use of advanced power-management technologies, ESP32 can switch between different modes.

**Table 5: Current Consumption Characteristics**

| Work mode  | Description |                                   | Peak(mA)    |
|--|-------------|-----------------------------------|-------------|
| Active<br>(RF working)   | TX          | 802.11b, 20 MHz, 1 Mbps, @21 dBm  | 350 pending |
|  |             | 802.11g, 20 MHz, 54 Mbps, @19 dBm | 295 pending |
|  |             | 802.11n, 20 MHz, MCS7, @18.5 dBm  | 290 pending |
|  |             | 802.11n, 40 MHz, MCS7, @18.5 dBm  | 290 pending |
|  | RX          | 802.11b/g/n, HT20                 | 82 pending  |
|  |             | 802.11n, HT40                     | 84 pending  |
| Note:  |             |                                   |             |
| <ul style="list-style-type: none"><li>• The current consumption measurements are taken with a 3.3 V supply at 25 °C of ambient temperature at the RF port. All transmitters' measurements are based on a 100% duty cycle.</li><li>• The current consumption figures for in RX mode are for cases when the peripherals are disabled and the CPU idle.</li></ul> |             |                                   |             |

**Table 6: Current Consumption De on Work Modes**

| Work mode  | Description   |         | Current consumption (Type) | Unit |
|--|---|---------|----------------------------|------|
| Modem-sleep  | The CPU is Powered on                                 | 160 MHz | 20                         | mA   |
|  |   | 80 MHz  | 15                         | mA   |
| Light-sleep  | -   |         | 130                        | μA   |
| Deep-sleep   | RTC timer + RTC memory                                |         | 5                          | μA   |
| Power off  | CHIP_PU is set to low level, the chip is powered off. |         | 1                          | μA   |
| Note:  |   |         |                            |      |
| <ul style="list-style-type: none"><li>• The current consumption figures in Modem-sleep mode are for cases where the CPU is powered on and the cache idle.</li><li>• When Wi-Fi is enabled, the chip switches between Active and Modem-sleep modes. Therefore, current consumption changes accordingly.</li></ul> |   |         |                            |      |



- In practice, software can adjust CPU's frequency according to CPU load to reduce current consumption.

## 4.5 Wi-Fi Characteristics

### 4.5.1 Wi-Fi RF Standards

Table 7: Wi-Fi RF Standards

| Name   |        | Description  |
|--|--------|--|
| Center frequency range of operating channel  |        | 2412 ~ 2484 MHz  |
| Wi-Fi wireless standard  |        | IEEE 802.11b/g/n   |
| Data rate  | 20 MHz | 11b: 1, 2, 5.5 and 11 Mbps<br>11g: 6, 9, 12, 18, 24, 36, 48, 54 Mbps<br>11n: MCS0-7, 72.2 Mbps (Max) |
|  | 40 MHz | 11n: MCS0-7, 150 Mbps (Max)  |
| Antenna type   |        | Metal pin antenna  |
| Note:  |        |  |
| <ul style="list-style-type: none"> <li>• Device should operate in the center frequency range allocated by regional regulatory authorities. Target center frequency range is configurable by software.</li> </ul> |        |  |

### 4.5.2 Wi-Fi Transmitter Characteristics

Table 8: TX Power with Spectral Mask and EVM Meeting 802.11 Standards

| Parameter  | Rate            | Type | Unit |
|--|-----------------|------|------|
| TX Power   | 11b, 1 Mbps     | 17.1 | dBm  |
|  | 11g, 6 Mbps     | 18.5 |      |
|  | 11n, HT20, MCS0 | 17.8 |      |
|  | 11n, HT40, MCS0 | 17.2 |      |
| Note:  |                 |      |      |
| <ul style="list-style-type: none"><li>Target TX power is configurable based on device or certification requirements.</li></ul> |                 |      |      |

### 4.5.3 Wi-Fi Receiver Characteristics

Table 9: Wi-Fi Receiver Characteristics

| Parameter      | Rate     | Type  | Unit |
|----------------|----------|-------|------|
| RX Sensitivity | 1 Mbps   | -97.6 | dBm  |
|                | 2 Mbps   | -96.0 |      |
|                | 5.5 Mbps | -93.0 |      |
|                | 11 Mbps  | -88.4 |      |

| Parameter                  | Rate            | Type  | Unit |
|----------------------------|-----------------|-------|------|
|                            | 6 Mbps          | -92.6 |      |
|                            | 9 Mbps          | -91.8 |      |
|                            | 12 Mbps         | -90.0 |      |
|                            | 18 Mbps         | -88.0 |      |
|                            | 24 Mbps         | -85.0 |      |
|                            | 36 Mbps         | -81.0 |      |
|                            | 48 Mbps         | -77.0 |      |
|                            | 54 Mbps         | -76.0 |      |
|                            | 11n, HT20, MCS0 | -92.6 |      |
|                            | 11n, HT20, MCS1 | -90.0 |      |
|                            | 11n, HT20, MCS2 | -88.0 |      |
|                            | 11n, HT20, MCS3 | -84.4 |      |
|                            | 11n, HT20, MCS4 | -81.0 |      |
|                            | 11n, HT20, MCS5 | -77.0 |      |
|                            | 11n, HT20, MCS6 | -75.6 |      |
|                            | 11n, HT20, MCS7 | -74.2 |      |
|                            | 11n, HT40, MCS0 | -90.0 |      |
|                            | 11n, HT40, MCS1 | -87.0 |      |
|                            | 11n, HT40, MCS2 | -84.8 |      |
|                            | 11n, HT40, MCS3 | -81.8 |      |
|                            | 11n, HT40, MCS4 | -78.0 |      |
|                            | 11n, HT40, MCS5 | -74.0 |      |
|                            | 11n, HT40, MCS6 | -72.6 |      |
|                            | 11n, HT40, MCS7 | -71.2 |      |
| RX Maximum Input Level     | 11b, 1 Mbps     | 5     | dBm  |
|                            | 11b, 11 Mbps    | 5     |      |
|                            | 11g, 6 Mbps     | 5     |      |
|                            | 11g, 54 Mbps    | 0     |      |
|                            | 11n, HT20, MCS0 | 5     |      |
|                            | 11n, HT20, MCS7 | 0     |      |
|                            | 11n, HT40, MCS0 | 5     |      |
|                            | 11n, HT40, MCS7 | 0     |      |
| Adjacent Channel Rejection | 11b, 1 Mbps     | 35    | dB   |
|                            | 11b, 11 Mbps    | 35    |      |
|                            | 11b, 6 Mbps     | 31    |      |
|                            | 11g, 54 Mbps    | 14    |      |
|                            | 11n, HT20, MCS0 | 31    |      |
|                            | 11n, HT20, MCS7 | 13    |      |
|                            | 11n, HT40, MCS0 | 19    |      |
|                            | 11n, HT40, MCS7 | 8     |      |

## 4.6 Bluetooth LE Characteristics

### 4.6.1 Bluetooth LE Receiver Characteristics

Table 10: Bluetooth Receiver Characteristics – Bluetooth LE 1 Mbps

| Parameter                           | Conditions                             | Min | Type | Max | Unit |
|-------------------------------------|--|-----|------|-----|------|
| Sensitivity @30.8% BER              | -                                      | -   | -96  | -   | dBm  |
| Maximum received signal @30.8% BER  | -                                      | -   | 10   | -   | dBm  |
| Co-channel C/I                      | -                                      | -   | 8    | -   | dB   |
| Adjacent channel selectivity C/I    | $F = F_0 + 1 \text{ MHz}$              | -   | -4   | -   | dB   |
|                                     | $F = F_0 - 1 \text{ MHz}$              | -   | -3   | -   | dB   |
|                                     | $F = F_0 + 2 \text{ MHz}$              | -   | -32  | -   | dB   |
|                                     | $F = F_0 - 2 \text{ MHz}$              | -   | -36  | -   | dB   |
|                                     | $F \geq F_0 + 3 \text{ MHz}^{(1)}$     | -   | -    | -   | dB   |
|                                     | $F \leq F_0 - 3 \text{ MHz}$           | -   | -39  | -   | dB   |
| Image frequency                     | -                                      | -   | -29  | -   | dB   |
| Adjacent channel to image frequency | $F = F_{\text{image}} + 1 \text{ MHz}$ | -   | -38  | -   | dB   |
|                                     | $F = F_{\text{image}} - 1 \text{ MHz}$ | -   | -34  | -   | dB   |
| Out-of-band blocking performance    | 30 MHz ~ 2000 MHz                      | -   | -9   | -   | dBm  |
|                                     | 2000 MHz ~ 2400 MHz                    | -   | -18  | -   | dBm  |
|                                     | 2500 MHz ~ 3000 MHz                    | -   | -16  | -   | dBm  |
|                                     | 3000 MHz ~ 12.5 GHz                    | -   | -6   | -   | dBm  |
| Intermodulation                     | -                                      | -   | -44  | -   | dBm  |

<sup>1</sup> Refer to the value of Adjacent channel to image frequency when  $F = F_{\text{image}} - 1 \text{ MHz}$ .

**Table 11: Bluetooth Receiver Characteristics – Bluetooth LE 2 Mbps**

| Parameter                           | Conditions                             | Min | Type | Max | Unit |
|-------------------------------------|--|-----|------|-----|------|
| Sensitivity @30.8% BER              | -                                      | -   | -93  | -   | dBm  |
| Maximum received signal @30.8% BER  | -                                      | -   | 0    | -   | dBm  |
| Co-channel C/I                      | -                                      | -   | 10   | -   | dB   |
| Adjacent channel selectivity C/I    | $F = F_0 + 2 \text{ MHz}$              | -   | -7   | -   | dB   |
|                                     | $F = F_0 - 2 \text{ MHz}$              | -   | -7   | -   | dB   |
|                                     | $F = F_0 + 4 \text{ MHz}$              | -   | -    | -   | dB   |
|                                     | $F = F_0 - 4 \text{ MHz}$              | -   | -34  | -   | dB   |
|                                     | $F \geq F_0 + 6 \text{ MHz}^{(1)}$     | -   | -39  | -   | dB   |
|                                     | $F \leq F_0 - 6 \text{ MHz}$           | -   | -39  | -   | dB   |
| Image frequency                     | -                                      | -   | -27  | -   | dB   |
| Adjacent channel to image frequency | $F = F_{\text{image}} + 2 \text{ MHz}$ | -   | -39  | -   | dB   |
|                                     | $F = F_{\text{image}} - 2 \text{ MHz}$ | -   | -    | -   | dB   |
| Out-of-band blocking performance    | 30 MHz ~ 2000 MHz                      | -   | -17  | -   | dBm  |
|                                     | 2000 MHz ~ 2400 MHz                    | -   | -19  | -   | dBm  |
|                                     | 2500 MHz ~ 3000 MHz                    | -   | -16  | -   | dBm  |
|                                     | 3000 MHz ~ 12.5 GHz                    | -   | -22  | -   | dBm  |
| Intermodulation                     | -                                      | -   | -40  | -   | dBm  |

<sup>1</sup> Refer to the value of Image frequency

<sup>2</sup> Refer to the value of Adjacent channel to image frequency when  $F = F_0 + 2 \text{ MHz}$ .

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## 4.6.2 Bluetooth LE Transmitter Characteristics

Table 14: Bluetooth LE Transmitter Characteristics – General

| Parameter              | Min | Type | Max   | Unit |
|------------------------|-----|------|-------|------|
| RF transmit power      | -   | 0    | -     | dBm  |
| Gain control step      | -   | 3    | -     | dB   |
| RF power control range | -   | -    | 10.34 | dBm  |

Table 15: Bluetooth Transmitter Characteristics – Bluetooth LE 1 Mbps

| Parameter                  | Conditions                                      | Min | Type   | Max | Unit |
|----------------------------|---|-----|--------|-----|------|
| In-band emissions          | $F = F_0 \pm 2 \text{ MHz}$                     | -   | -37.62 | -   | dBm  |
|                            | $F = F_0 \pm 3 \text{ MHz}$                     | -   | -41.95 | -   | dB   |
|                            | $F = F_0 \pm > 3 \text{ MHz}$                   | -   | -44.48 | -   | dBm  |
| Modulation characteristics | $\Delta f_{1\text{avg}}$                        | -   | 245.00 | -   | KHz  |
|                            | $\Delta f_{2\text{max}}$                        | -   | 208.00 | -   | KHz  |
|                            | $\Delta f_{2\text{avg}}/\Delta f_{1\text{avg}}$ | -   | 0.93   | -   | -    |
| Carrier frequency offset   | -   | -   | -9.00  | -   | KHz  |
| Carrier frequency drift    | $ f_0 - f_n _{n=2,3,4,\dots,k}$                 | -   | 1.17   | -   | KHz  |
|                            | $ f_1 - f_0 $                                   | -   | 0.30   | -   | KHz  |
|                            | $ f_n - f_{n-5} _{n=6,7,8,\dots,k}$             | -   | 4.90   | -   | KHz  |

**Table 16: Bluetooth Transmitter Characteristics – Bluetooth LE 2Mbps**

| Parameter                  | Conditions                                      | Min | Type   | Max | Unit |
|----------------------------|---|-----|--------|-----|------|
| In-band emissions          | $F = F_0 \pm 4 \text{ MHz}$                     | -   | -43.55 | -   | dBm  |
|                            | $F = F_0 \pm 5 \text{ MHz}$                     | -   | -45.26 | -   | dB   |
|                            | $F = F_0 \pm > 5 \text{ MHz}$                   | -   | -47.00 | -   | dBm  |
| Modulation characteristics | $\Delta f_{1\text{avg}}$                        | -   | 497.00 | -   | KHz  |
|                            | $\Delta f_{2\text{max}}$                        | -   | 398.00 | -   | KHz  |
|                            | $\Delta f_{2\text{avg}}/\Delta f_{1\text{avg}}$ | -   | 0.95   | -   | -    |
| Carrier frequency offset   | -   | -   | -9.00  | -   | KHz  |
| Carrier frequency drift    | $ f_0 - f_n _{n=2,3,4,\dots,k}$                 | -   | 0.46   | -   | KHz  |
|                            | $ f_1 - f_0 $                                   | -   | 0.70   | -   | KHz  |
|                            | $ f_n - f_{n-5} _{n=6,7,8,\dots,k}$             | -   | 6.80   | -   | KHz  |

**Table 17: Bluetooth Transmitter Characteristics – Bluetooth LE 125Kbps**

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**Table 18: Bluetooth Transmitter Characteristics – Bluetooth LE 500 Kbps**



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## 5. MODULE SCHEMATICS

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This is the reference design of the module.

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Figure 3: WBE01HE Module Schematics



## 6. PHYSICAL DIMENSIONS AND PCB LAND PATTERN

### 6.1 Physical Dimensions

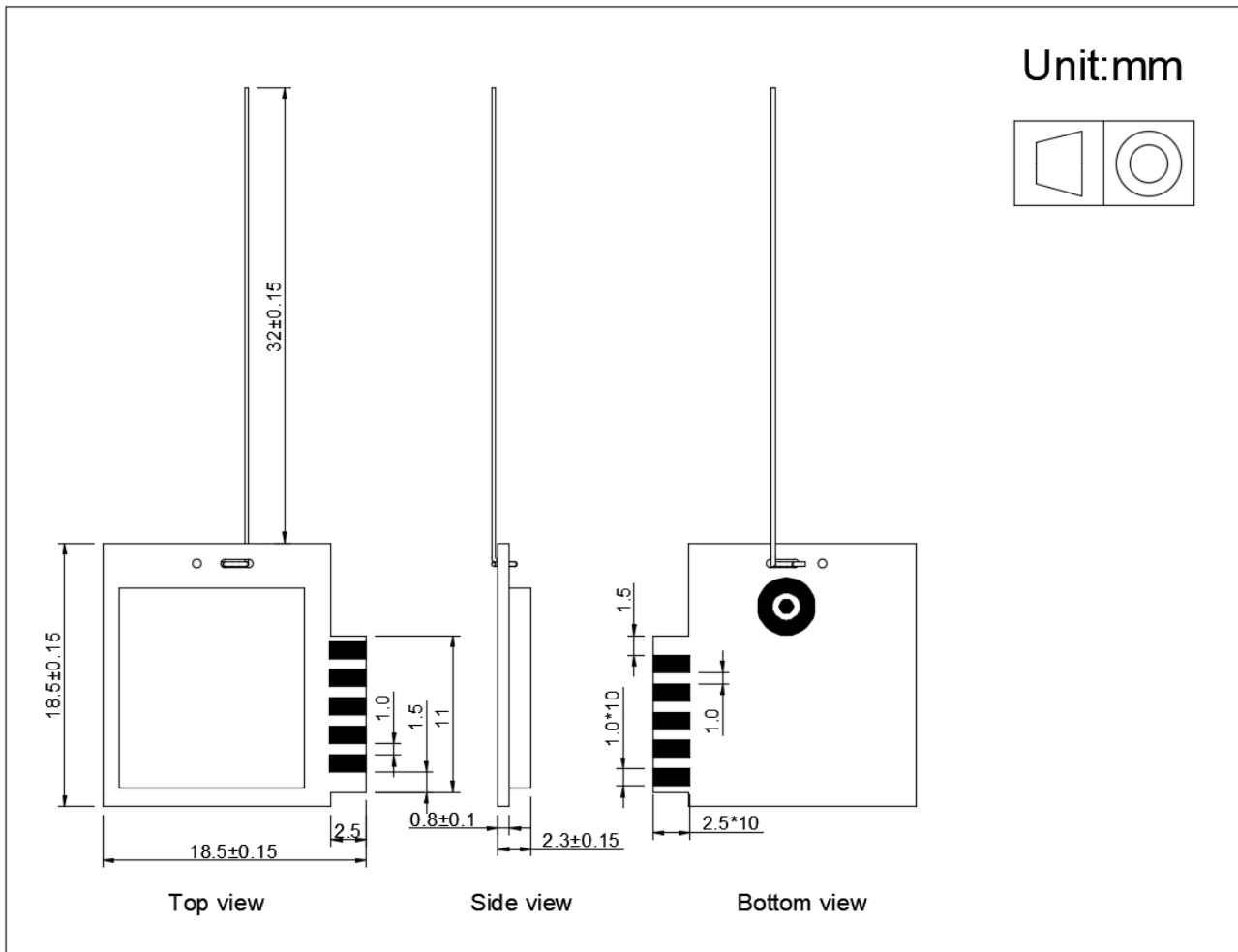


Figure 4: Physical Dimensions

# 6.2 Recommended PCB Land Pattern

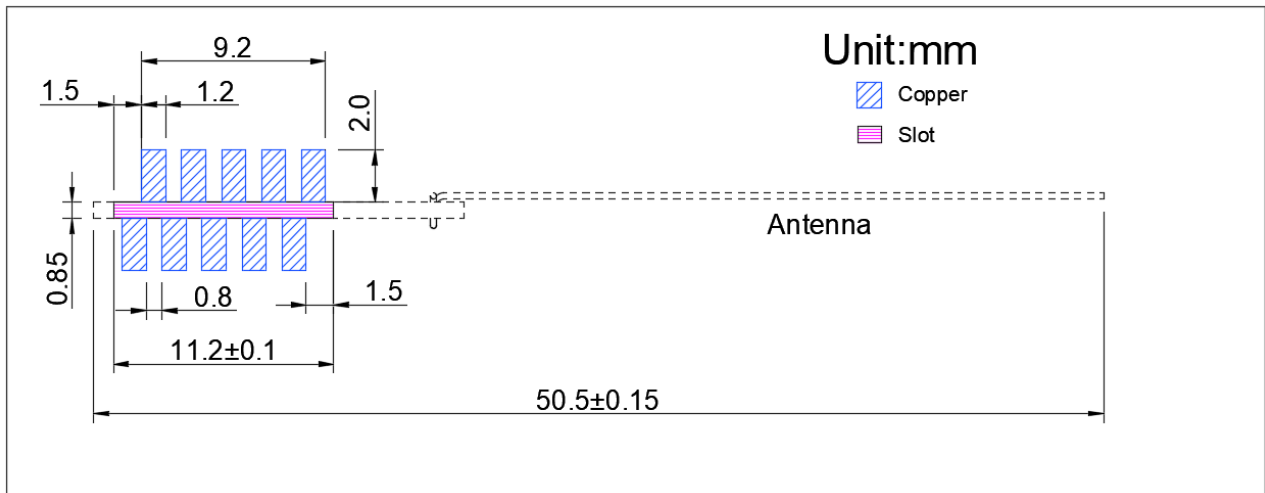


Figure 5: Recommended PCB Land Pattern

## 7. PRODUCT HANDLING

### 7.1 Storage Condition

The products sealed in Moisture Barrier Bag (MBB) should be stored in a noncondensing atmospheric environment of  $< 40^{\circ}\text{C}/90\% \text{ RH}$ .

The module is rated at moisture sensitivity level (MSL) 3.

After unpacking, the module must be soldered within 168 hours with factory conditions  $25 \pm 5^{\circ}\text{C}$  and 60% RH. The module needs to be baked if the above conditions are not met.

### 7.2 ESD

- Human body model (HBM): 2000 V
- Charged-device model (CDM): 500 V
- Air discharge: 6000 V
- Contact discharge: 4000 V

### 7.3 DIP Type Product Pass Wave Solder Graph

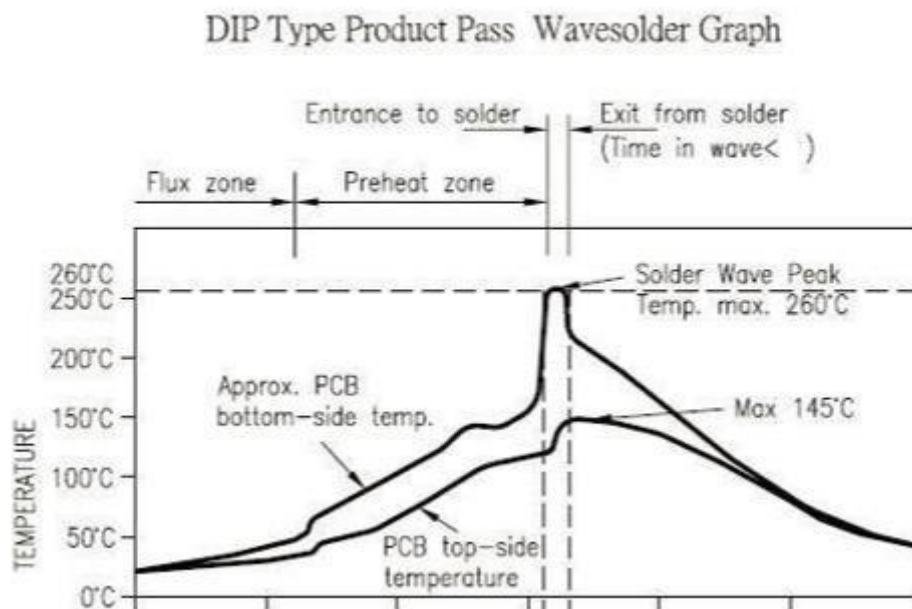


Figure 6: DIP Type Product Pass Wave Solder Graph

Table 19: Bluetooth Transmitter Characteristics – Bluetooth LE 500Kbps

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| Suggestions for wave soldering furnace temperature curve |          | Manual soldering temperature recommendations |            |
|--|----------|--|------------|
| pre-heat temperature                                     | 80-130°C | Welding temperature                          | 360°C±20°C |
| Preheat time   | 75-100S  | Welding time                                 | < 3S/point |
| Peak contact time  | 3-5S     | N/A  | N/A        |
| Tin tank temperature                                     | 260±5°C  | N/A  | N/A        |
| Ramp rate  | ≤2°C/S   | N/A  | N/A        |
| Cooling slope  | ≤6°C/S   | N/A  | N/A        |

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## 8 Requirement of FCC KDB 996369 D03 for module certification:

### 8.1 List of applicable FCC rules:

The module complies with FCC Part 15.247,

### 8.2 Summarize the specific operational use conditions:

The module has been certified for Fix/Mobile applications. The host product operating conditions must be such that there is a minimum separation distance of 20 cm (or possibly greater than 20 cm) between the antenna radiating structures and nearby persons. The host manufacturer is obligated to confirm the use conditions of the host product to ensure that distance specified in the instructions is met. In this case the host product is classified as either a mobile device or a fixed device for RF exposure purposes. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

### 8.3 Limited module procedures:

Not applicable.

### 8.4 Trace antenna designs:

Not applicable.

### 8.5 RF exposure considerations:

This equipment complies with FCC's RF radiation exposure limits set forth for an uncontrolled environment. The antenna(s) used for this transmitter must be installed and operated to provide a separation distance of at least 20 cm from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter. Installers must ensure that 20cm separation distance will be maintained between the device and users.

Note: the OEM product manuals must include a statement in order to alert the users of FCC RF exposure compliance.

### 8.6 Antennas:

| Type         | Gain     | Impedance | Application | Min Separation |
|--------------|----------|-----------|-------------|----------------|
| Wire Antenna | 1.66 dBi | 50Ω       | Fixed       | 20 cm          |

The antenna is permanently attached, can't be replaced.

### 8.7 Label and compliance information:

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.

NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications or changes to this equipment. Such modifications or changes could void the user's authority to operate the equipment.

Warning: Changes or modifications to this unit 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.

The system integrator must place an exterior label on the outside of the final product housing the WBE01EH Module. Below is the contents that must be included on this label.

OEM Labeling Requirements:

NOTICE: The OEM must make sure that FCC labeling requirements are met. This includes a clearly visible exterior label on the outside of the final product housing that displays the contents shown in below:

|   |
|---|
| Model : WBE01EH<br>Contains FCC ID: 2AO4G-WBE01EH |
|---|

#### 8.8 Information on test modes and additional testing requirements:

When testing host product, the host manufacture should follow FCC KDB Publication 996369 D04 Module Integration Guide for testing the host products. The host manufacturer may operate their product during the measurements. In setting up the configurations, if the pairing and call box options for testing does not work, then the host product manufacturer should coordinate with the module manufacturer for access to test mode software. For wireless LAN, the product under test is set into a link/association with a partnering WLAN device, as per the normal intended use of the product. To ease testing, the product under test is set to transmit at a high duty cycle, such as by sending a file or streaming some media content. Alternatively, a Wi-Fi test set may be used. Simultaneously transmitting modules installed in the host should be all active.

#### 8.9 Additional testing, Part 15 Subpart B disclaimer:

The modular transmitter is only FCC authorized for the specific rule parts (FCC Part 15.247) list 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 when contains digital circuitry

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## 9 Requirement of IC ID:

This device contains licence-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) This device may not cause interference. (2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : 1) L'appareil ne doit pas produire de brouillage; 2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This equipment complies with FCC's and IC's RF radiation exposure limits set forth for an uncontrolled environment. The antenna(s) used for this transmitter must be installed and operated to provide a separation distance of at least 20 cm from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter. Installers must ensure that 20cm separation distance will be maintained between the device (excluding its handset) and users.

Cet appareil est conforme aux limites d'exposition au rayonnement RF stipulées par la FCC et l'IC pour une utilisation dans un environnement non contrôlé. Les antennes utilisées pour cet émetteur doivent être installées et doivent fonctionner à au moins 20 cm de distance des utilisateurs et ne doivent pas être placées près d'autres antennes ou émetteurs ou fonctionner avec ceux-ci. Les installateurs doivent s'assurer qu'une distance de 20 cm sépare l'appareil (à l'exception du combiné) des utilisateurs.

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