User Manual of BWCADAPTER

BWCADAPTER

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Revision History

Date	Version	Details of change	Author	Reviewers
23-Nov-20	1.0	Initial draft	Bradford White	Julian

Table 1: Revision History

1 INTRODUCTION

1.1 Purpose

This document describes the Bradford White' BWCADAPTER commercial and residential IoT Gateway. Targeted for controlling water heaters and boilers placed in Buildings and Industries. Core features are its Hardware Design with Radio Connectivity such as Wi-Fi and BLE. Apart from the radio connectivity options, the BWCADAPTER is also capable of standard industrial interfaces like micro SATA, RS-485, and MODBUS.

This document mainly describes BWCADAPTER from a Hardware point of view, there are separate software development manuals that can be also consulted.

For any further support contact Bradford White support services at iot.app@bradfordwhite.com

1.2 Scope

The scope of this document is to detail out aspects of BWCADAPTER design, specifications, Features, etc.

This document, henceforth, is to be used as a direct reference by end customers that use this product. Bradford White's team will also use this document to review, approve, and accept the product design for showcase purposes.

1.3 Acronyms & Abbreviations

Terms	Definition
SoC	System on Chip
CPU	Central Processing Unit
BLE	Bluetooth Low Energy
IoT	Internet of things
RST	Reset
UART	Universal asynchronous receiver-transmitter
LED	Light Emitting Diode
GPIO	General Purpose Input/output
TBD	To Be Determined
Etc	Et Criteria

Table 2: Acronyms & Abbreviations

1.4 References

Sr No	Reference Document Title	Provided by	Remarks
1	Schematics design	Bradford White	Primary reference
2	Layout design	Bradford White	N/A

Table 3: References

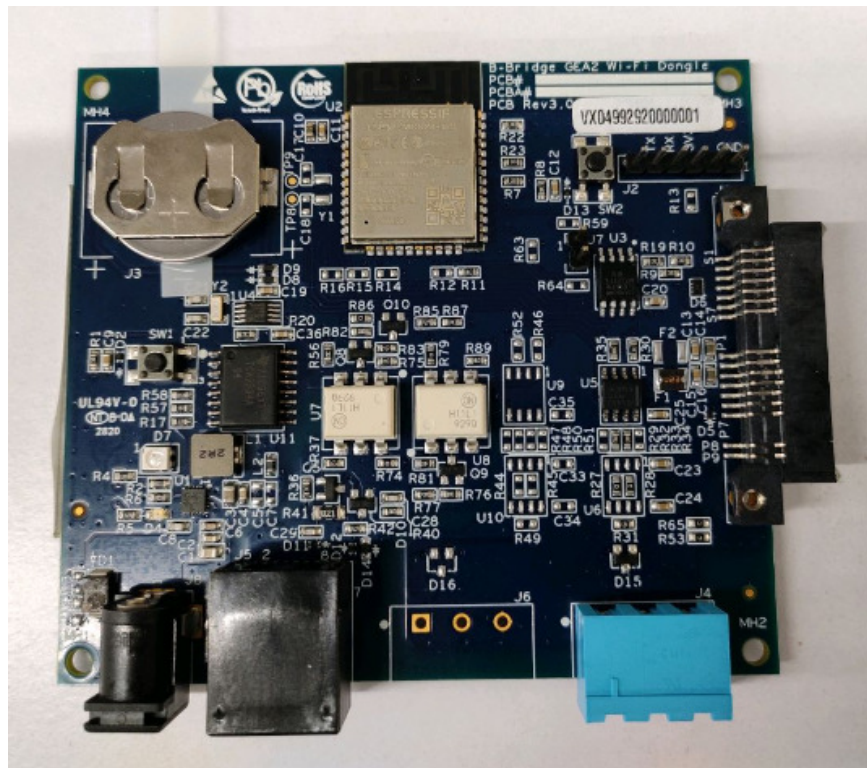## 2 PRODUCT OVERVIEW

Figure 1 BWCADAPTER

Figure 2 BWCADAPTER PCBA

The BWCADAPTER system is a smart home/commercial system that will enable residential and commercial water heaters and boilers to be smart, which means the user can control the heater, monitor the energy consumption, and receive alerts whenever the heater runs into any flaw, specifications are as follows,

- GEA2 and Modbus RTU connectivity to Water heater/boilers
- Wi-Fi connectivity to the Ayla cloud
- BLE connectivity for provisioning and local debugging/maintenance
- Robust, reliable, and low-cost product design and development with FCC, IC, UL, and Wi-Fi Alliance certifications
- CTA/CEA-2045-A compliant solution using SkyCentrics or e-Radio DC UCM module (Note: CEA/CTA-2045-A is the latest and supersedes earlier versions)
- IP51 compliant enclosure for residential usage
- End-to-end product development and validation
- Efficient Program/Account Management and Communication with the flexibility of On-Site support
- Best Value' proposition for Quality Technical Solution, Cost, Capabilities, Program Management, Support & Service and Sound Financial Health

The BWCADAPTER device integrates Espressif systems radio module having FCC ID : 2AC7Z-ESP32WROOM32D   for radio communication. The module is integrated to this product as per the module integration rule and integration details has been taken into account for the determination of the delta test scope.

➢ Installation

Before installation of the Bradford White Connect Adapter, verify that the water heater is fully installed. Bradford White recommends installation is done by a plumbing professional. Additionally, download the Bradford White Connect App onto your mobile device. The following are installation guidelines for the Adapter:

○ Mount the Adapter onto a wall near the water heater using supplied screws or directly onto the heater itself using the supplied interlocking strips. Please do not screw the Adapter onto the water heater.

○ Plug one end of an Ethernet cable into the RJ45 port on the Adapter and another into the RJ45 port on the water heater. Supplied with the Bradford White Connect Adapter is a 10ft Ethernet cable. Please use either this cable or a similar one up, to a length of _____.

○ Plug Power Supply into 120V voltage source. At this point, the indicator light should turn amber.

○ Open the Bradford White Connect App and log in using your email and password. To sign up, click the Homeowner sign up in the bottom left corner of the screen and follow the on-screen instructions. Once logged in, begin the pairing process by clicking Add Water Heater and following the on-screen instructions.

○ To Discover the Adapter, first hold the action button on the Adapter for 3 seconds. This will begin the Bluetooth pairing mode, indicated by a flashing blue LED light on the Adapter. Your Adapter will now be discoverable by your mobile device.

○ Select the Adapter from the Discover screen, the mobile device will prompt you for a 4 digit code. Plug in the last four digits of your Adapter's serial number, which can be found on the front label of the Adapter. This step is for multifactor authentication and is for security purposes.

○ Once your Adapter and mobile device are connected via Bluetooth, your mobile device will prompt you to select a local wireless network. Select the network of your choosing and enter the password using your mobile device.

○ If your Adapter is successfully able to connect to the wireless network, you will see this screen. If empty, type in the serial number of the water heater or click the box to scan the barcode on the side of the heater. If your installing contractor uses the Bradford White Connect App, this step may already be complete. Click next on the Congratulations page to complete the installation.

➤ Control & Monitor

○ The system allows the user to control the heater's temperature from the mobile application using iOS or Android mobile phone. The user can also monitor the energy consumed by the heater using the mobile application.

➤ Alert

○ The system will alert the homeowner about any fault that the heater encounters and using the mobile application, the homeowner can contact the contractor and can get the heater fixed.

2.1 System Block Diagram
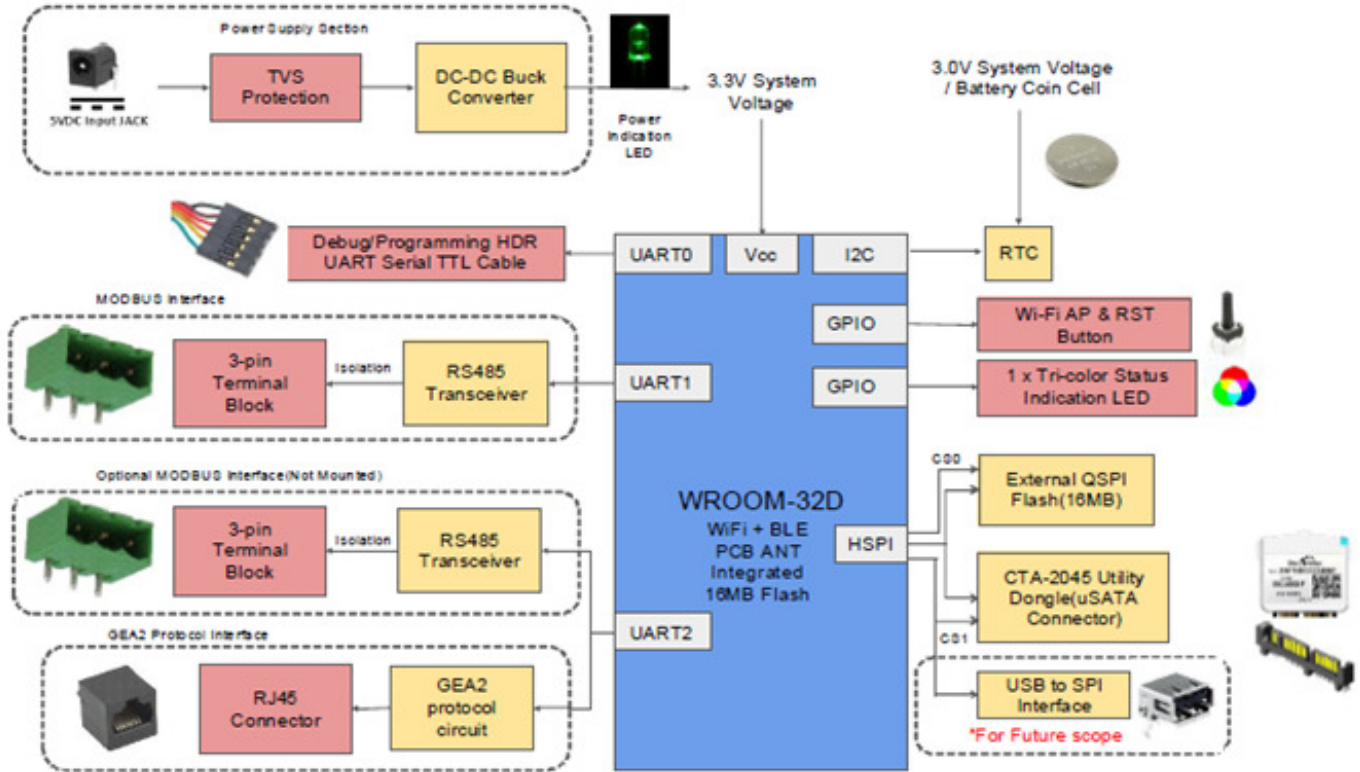
Figure 3 System Block Diagram of BWCADAPTER

2.2 Features and Functionality

The table below lists the major features and functions of the BWCADAPTER.

	Block	Feature Parameter	Specification
1	CPU	Core & Frequency	ESP32-D2WD
2	Memory	Integrated Flash	16MB(128 Mb)
		External Flash	16MB(128 Mb)
3	Interfaces	Ethernet	1 x GEA2
		SPI	1 x Flash memory
			1 x micro SATA for CTA-2045 Dongle
		Wi-Fi + BLE	BLE 4.2, Wi-Fi 802.11 b/g/n
		Serial Communication	RS485
4	User Interface/ IO	Switch	1x user-configurable switch
		LEDs	1x power LED
			1x Wi-Fi/BLE connection configuration
		Debug Port	1x UART port for debugging

Table 4 Features and Functions of BWCADAPTER

3 MAJOR COMPONENTS ON BWCADAPTER

Sr No	Processor Series	ESP-WROOM-32D
1	Mfg. Part	ESP32-WROOM-32D (16MB)
2	Core	ESP32-D2WD
3	Maximum Clock Frequency	240 MHz
4	Memory Type	Flash
5	Applications	Consumer/ Industrial products
6	Peripherals	18 x 25.5 mm Module
		Consumer: -40 to 85 °C
		SPI x 4
		I2S X 2
		I2C X 2
		SD/eMMC/SDIO HOST X 1
		SDIO/SPI SLAVE X 1
		ETH MAC X 1
		CAN X 1
		UART X 3
		ADC 8-bit X 2
		GPIO X 34

Table 5 Applications Processor Details

3.1 Wireless Connectivity

BWCADAPTER has on-board ESP-WROOM-32D wireless module. Below are major features of wireless peripheral. More information regarding the wireless module can be obtained from their respective websites and data-sheets.

The BWCADAPTER device integrates Espressif systems radio module having FCC ID : 2AC7Z-ESP32WROOM32D for radio communication. The module is integrated to this product as per the module integration rule and integration details has been taken into account for the determination of the delta test scope.

3.2 Wi-Fi + Bluetooth Combo Module

The BWCADAPTER uses an ESP-WROOM-32D Wi-Fi + Bluetooth combo module. ESP32 is a single 2.4 GHz Wi-Fi and Bluetooth combo chip designed with the TSMC ultra-low-power 40nm technology. It is designed to achieve the best power and RF performance, showing robustness, versatility, and reliability in a wide variety of applications and power scenarios.

3.3 Power Supply

The BWCADAPTER has only one power option:

- **DC Jack**: Uses a 5V, 1.2A DC power adaptor.

3.4 Antenna details

Sr	Radio	Description	Manufacturer	Part No	Gain
1	Wi-Fi/BLE	2.4 GHz	Espressif Systems	ESP-WROOM-32D	3.7 dBi

Table 6 Antenna Details

BWCADATPER works on different protocol with different power level as per below data;

Protocol	Power (dBm)	Antenna gain (dBi)
Wi-Fi	17.92	3.7
BT	1.90	3.7
BLE	-11.47	3.7

4 PERIPHERAL INTERFACES

This section describes the interfaces of BWCADAPTER. The below figure shows the available interfaces of BWCADAPTER. Figure 4 describes the peripheral interfaces of BWCADAPTER pictorially.
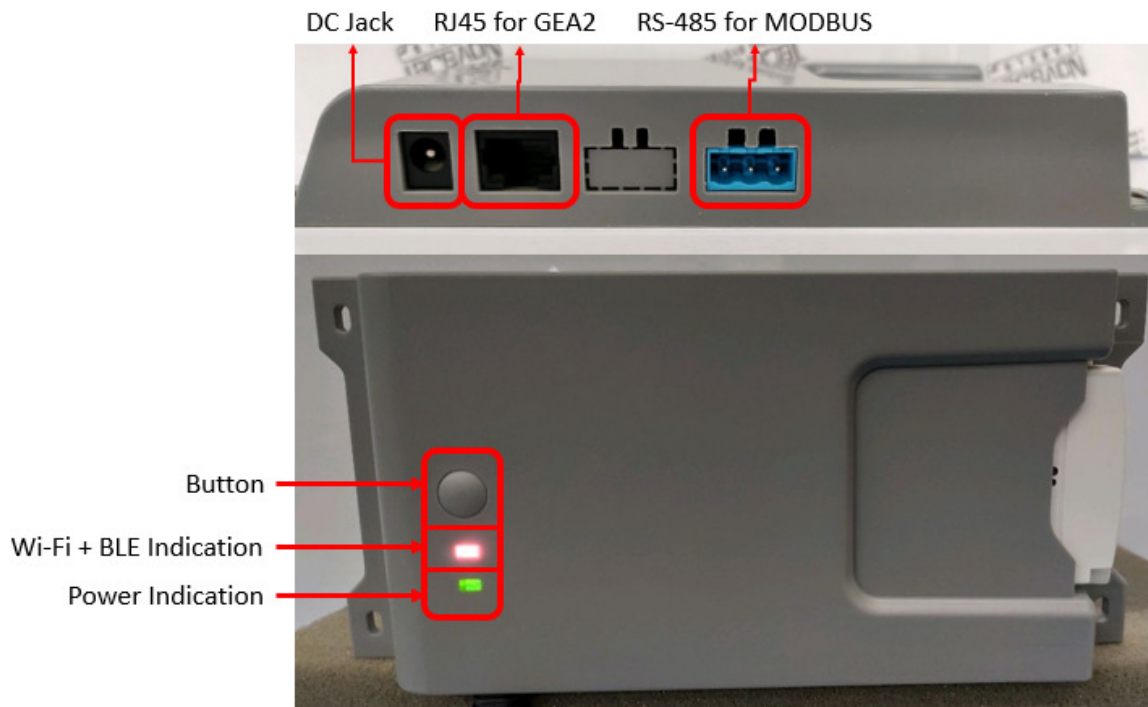

Figure 4 Interfaces on BWCADAPTER

4.1 Ethernet

The BWCADAPTER has 1 x RJ45 Ethernet port for GEA2 protocol to connect the water heater control unit.

4.2 Serial Ports

The BWCADAPTER supports RS-485 ports. Serial port access is possible through a terminal block connector on the top front end side of the BWCADAPTER unit.

4.3 Debug Port

The BWCADAPTER has an inbuilt debug UART port with six pins. Debug is only possible if the user can access BWCADAPTER PCBA. It is to be noted that the UART signaling occurs at 3.3V logic levels and the pins are not 5V tolerant. A user can enter the debug prompt on a PC/Mac using a normal 3.3V logic USB to UART converter.

These are the parameters to establish a debug UART connection with BWCADAPTER:

- Baud rate: 115200
- Data bits: 8
- Parity: None
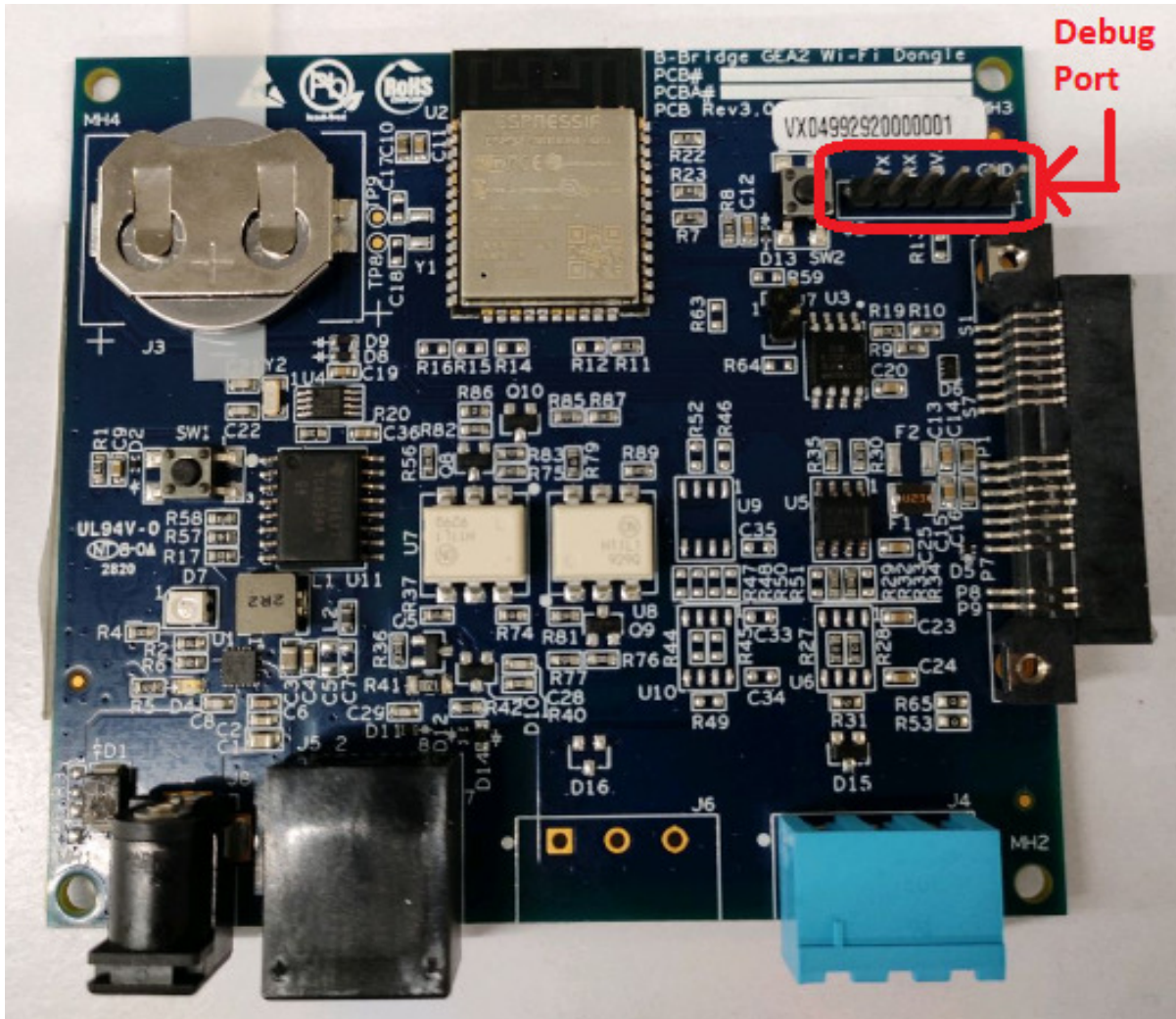- Stop bits: 1
- Flow control: None

Figure 5 Debug Port

4.4 Switch

The BWCADAPTER has one push-button switch on the front panel. This switch is completely user-configurable and users can use it as per their use case. Figure 6 describes the switch on BWCADAPTER.
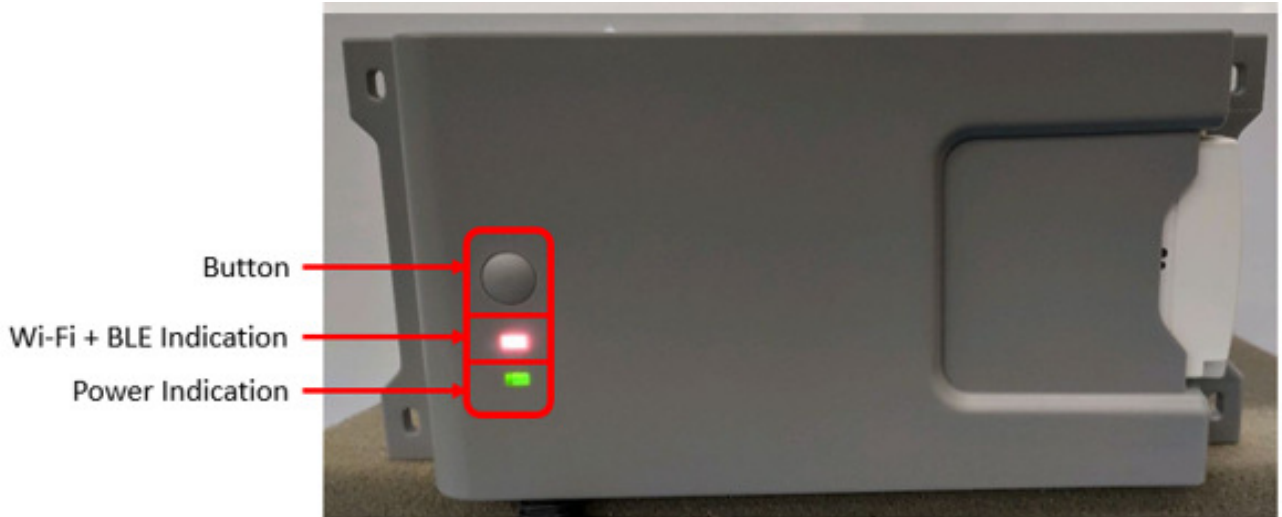

Figure 6 User Configurable Switch

4.5 LED's

The BWCADAPTER has two inbuilt LED's. One LED is used to indicate whether the BWCADAPTER is powered ON or OFF and the remaining one is to indicate the Wi-Fi and BLE connectivity. Figure 7 shows the location of these LEDs on the BWCADAPTER.
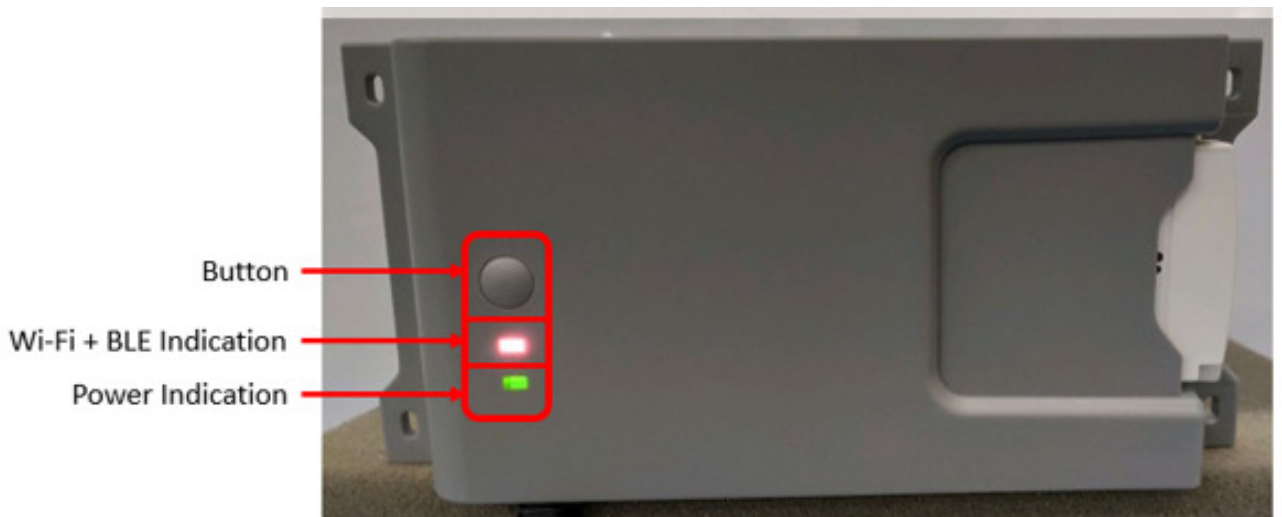
Figure 7 LED's on BWCADAPTER

Sr No	LED	LED Colour	Function
1	PWR	Green	ON: BWCADAPTER powered ON
			OFF: BWCADAPTER powered OFF
2	Status LED	Tri-color	Status : Wi-Fi + BLE

Table 7 LED's

5 ELECTRICAL THERMAL & ANTENNA RANGE CHARACTERISTICS

5.1 Recommended Operating Conditions

Sr No	Description	Value			Unit
		Minimum	Typical	Maximum	
1	Operating voltage	4.75	5	5.5	V
2	Current consumption	-	-	1.2	A
3	Operating temperature range (ambient)	-20	25	65	°C

Table 8 Recommended Operating Conditions

6 MECHANICAL DIMENSIONS

The dimensions of BWCADAPTER are 184.3 x 88 x 26.5 mm (L x W x H). The figure shows the dimensions in more detail.

Note: All dimensions are in millimeters (mm) unless otherwise specified.
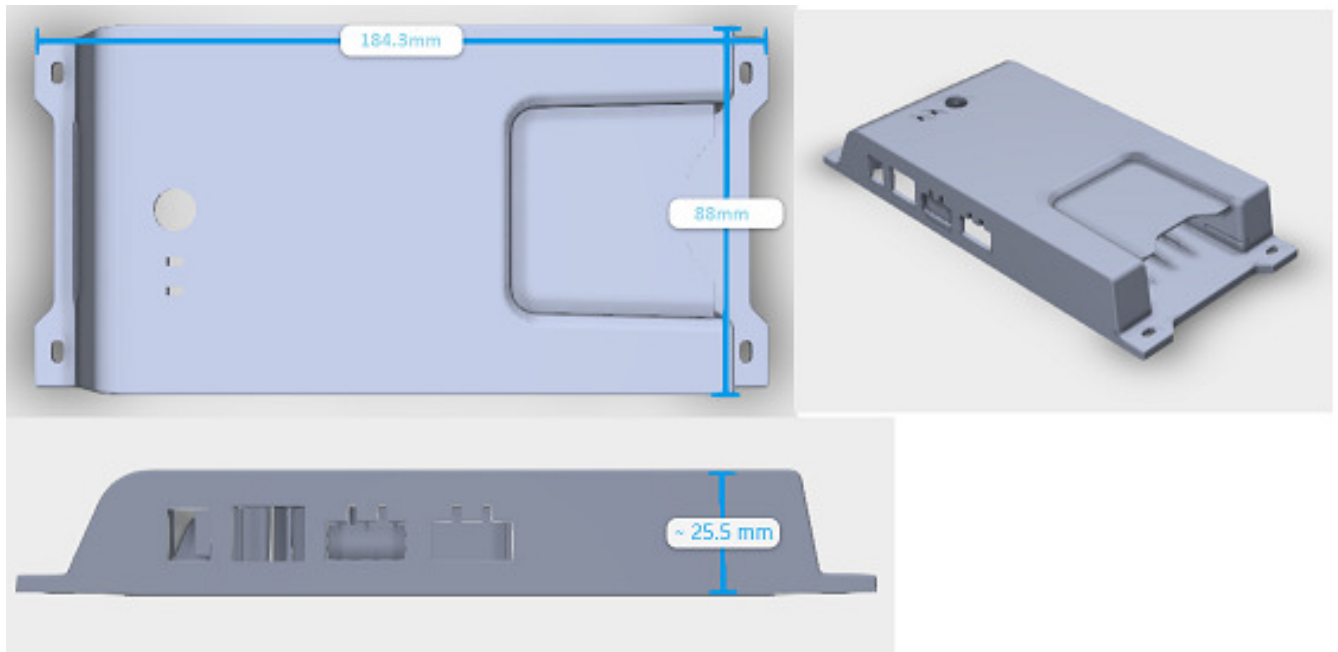

Figure 8 BWCADAPTER Dimensions

7 APPLICATION NOTES

Safety Precautions

These specifications are intended to preserve the quality assurance of products as individual components.

Before use, check, and evaluate the module's operation when mounted on your products. Abide by these specifications when using the products. These products may short-circuit. If electrical shocks, smoke, fire, and/or accidents involving human life are anticipated when a short circuit occurs, then provide the following fail-safe functions as a minimum:

1. Ensure the safety of the whole system by installing a protection circuit and a protection device.

2. Ensure the safety of the whole system by installing a redundant circuit or another system to prevent a single fault causing an unsafe status.

Design Engineering Notes

1. Heat is the major cause of shortening the life of the modules. Avoid assembly and use of the target equipment in conditions where the product's temperature may exceed the maximum allowable.

2. Failure to do so may result in the degrading of the product's functions and damage to the product.

3. If pulses or other transient loads (a large load applied in a short time) are applied to the products, before use, check and evaluate their operation when assembled onto your products.

4. These products are not intended for other uses, other than under the special conditions shown below. Before using these products under such special conditions, check their performance and reliability under the said special conditions carefully, to determine whether or not they can be used in such a manner.

5. In liquid, such as water, saltwater, oil, alkali, or organic solvent, or in places where liquid may splash. Indirect sunlight, outdoors, or in a dusty environment. In an environment where condensation occurs. In an environment with a high concentration of harmful gas (ex. salty air, HCl, Cl2, SO2, H2S, NH3, and NOx).

6. If an abnormal voltage is applied due to a problem occurring in other components or circuits, replace these products with new products because they may not be able to provide normal performance even if their electronic characteristics and appearances appear satisfactory.

7. Mechanical stress during assembly of the board and operation must be avoided.

8. Pressing on parts of the metal cover or fastening objects to the metal cover is not permitted.

Storage Conditions

1. The module must not be stressed mechanically during storage.

2. Do not store these products in the following conditions or the performance characteristics of the product, such as RF performance, may well be adversely affected:
   - Storage in salty air or an environment with a high concentration of corrosive gas, such as Cl2, H2S, NH3, SO2, or NOx.
   - Storage (before an assembly of the end product) for more than one year after the date of the date of
     delivery even if all the above conditions have been met, should be avoided.

8 COMPLIANCE STATEMENT

8.1 Federal Communications Commission (FCC)

Compliance Statements:

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, an interference that may cause undesired operation.

Caution Statements:

- Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.
- This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

8.2 Industry Canada (IC) Compliance Statement

Compliance Statements:

This device complies with Industry Canada license-exempt RSS standard(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.

Déclarations de conformité:

Le présent appareil est conforme aux CNR d'Industrie 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, et
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Caution Statements:

- This equipment complies with radio frequency exposure limits set forth by Industry Cananda for an uncontrolled environment.
- This equipment should be installed and operated with a minimum distance of 20 cm between the device and the user or bystanders.

Déclarations de mise en garde:

- Cet équipement est conforme aux limites d'exposition aux radiofréquences defines par Indstrie Canada pourun environment non contrôlé.
- Cet équipement doit être installé et utilisé aven un minimum de 20 cm de distance dispositif et l'utilisateur ou des tiers.

INFORMATION TO THE USER

For Class A and Class B digital devices, information to the user is required to include the following Statements (Section 15.105):

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.