

Datasheet

HomeBridge 200

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Revision History

Version	Date	Details of change	Author	Reviewer	Approver
1	18-May-22	Initial draft	YP	YP,ND	YP,--
2	15-July-22	Updated the Format , Font size and all the tables	JP	ND	ND

Table 1 : Revision History

1 INTRODUCTION

1.1 Purpose

The purpose of developing this document is to provide Introduction, key features, design platform, Architecture and interfaces setup of HomeBridge 200 series gateway. It is intended for the users who are configuring this product and using this product.

This document presents the detailed architecture for HomeBridge 200, identifies various modules and gives detailed analysis of interfaces between them. It identifies the parameters for selected component selection and presents calculations used in designing the circuit.

1.2 Scope

The scope of this document is to detail out aspect of HomeBridge 200 product design, specifications, Features etc.

This document, henceforth, is to be used as a direct reference by end customers that uses this product. HomeBridge 200 team will also use this document to review, approve and accept the product design for showcase purpose.

1.3 Acronyms & Abbreviations

Terms	Definition
SoC	System on Chip
CPU	Central Processing Unit
BLE	Bluetooth Low Energy
IoT	Internet of things
HW	Hardware
UART	Universal asynchronous receiver-transmitter
LED	Light Emitting Diode
GPIO	General Purpose Input/output
TBD	To Be Determined
Etc	Et Criteria
HomeBridge 200	HomeBridge 200 series of gateways

Table 2 : Acronyms & Abbreviations

1.4 References

Reference Document Title	Provided by	Remarks
Schematics design	ACL Digital	Primary reference
Layout design	ACL Digital	N/A
Requirements PPT, HDD	ACL Digital	N/A

Table 3 : References

1.5 Copyright Info

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1.6 WARRANTY

For details on the ACL Digital HomeBridge warranty policy, please Email us on :-
HomeBridge@volansystech.com

2 OVERVIEW

The “HomeBridge 200” is a IoT gateway for smart home automation. It consists a combination of gateway and end devices. End devices are Lighting bulbs, Door sensors, Motion sensors. It is most commonly used for the home automation, building automation etc. It consists of Wi-Fi with Zigbee or Wi-Fi with BLE interfaces.

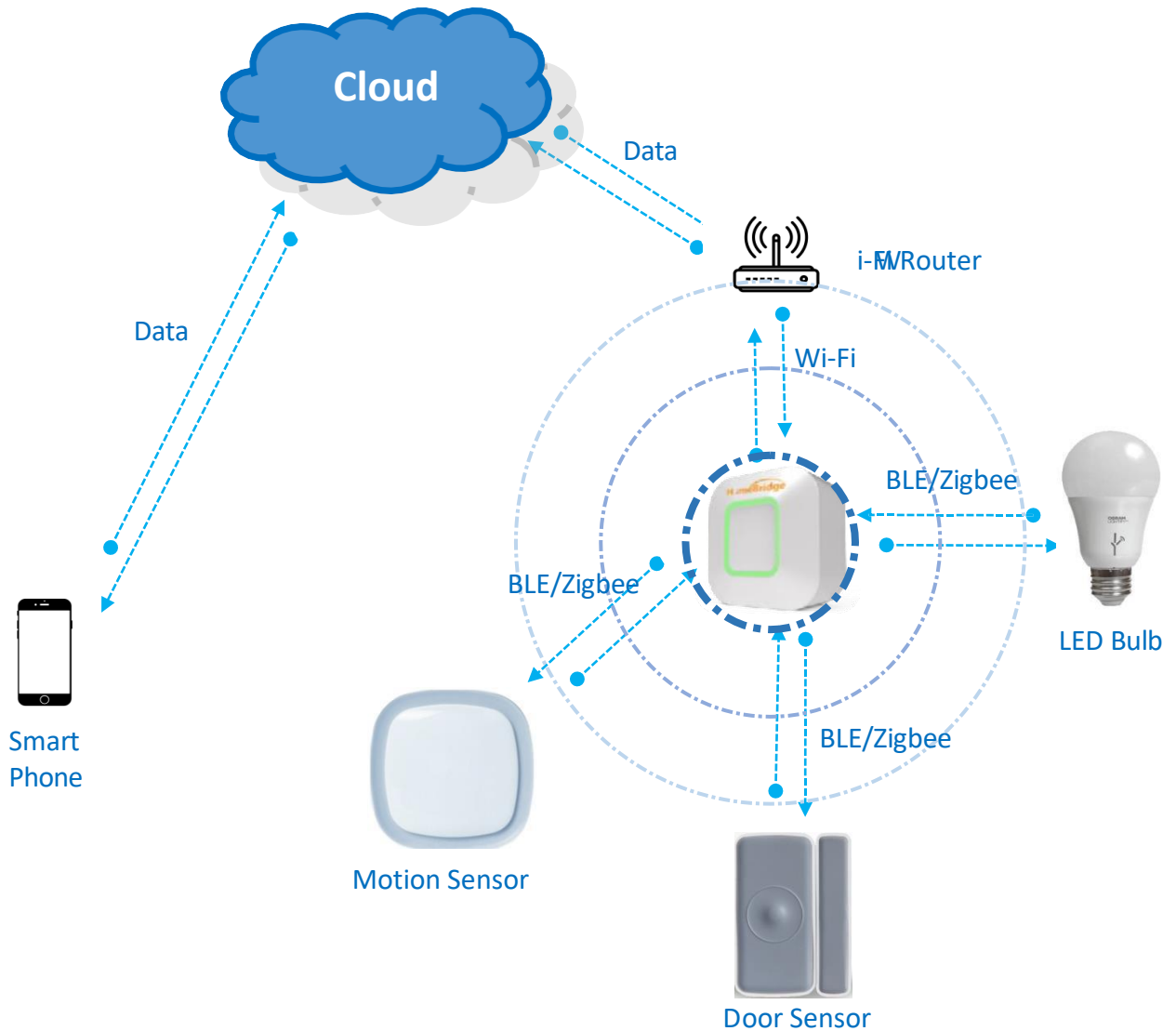


Figure 1 : Detailed Block Diagram

HomeBridge mobile app is connected with cloud via internet connection. HomeBridge 200 is connected with router via Wi-Fi connection. Mobile app send the command and HomeBridge will pass the same command to the end devices.

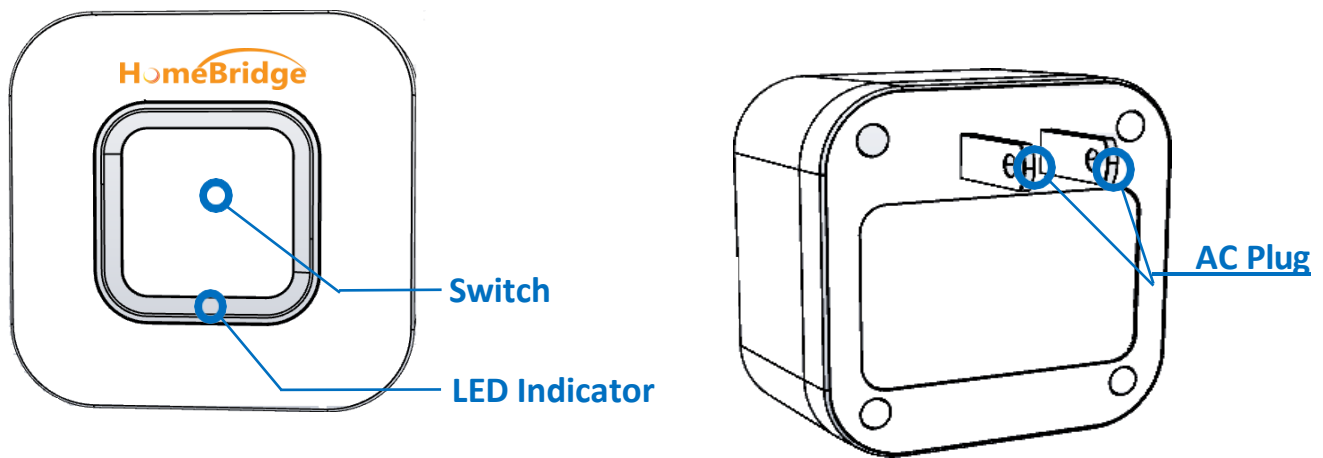
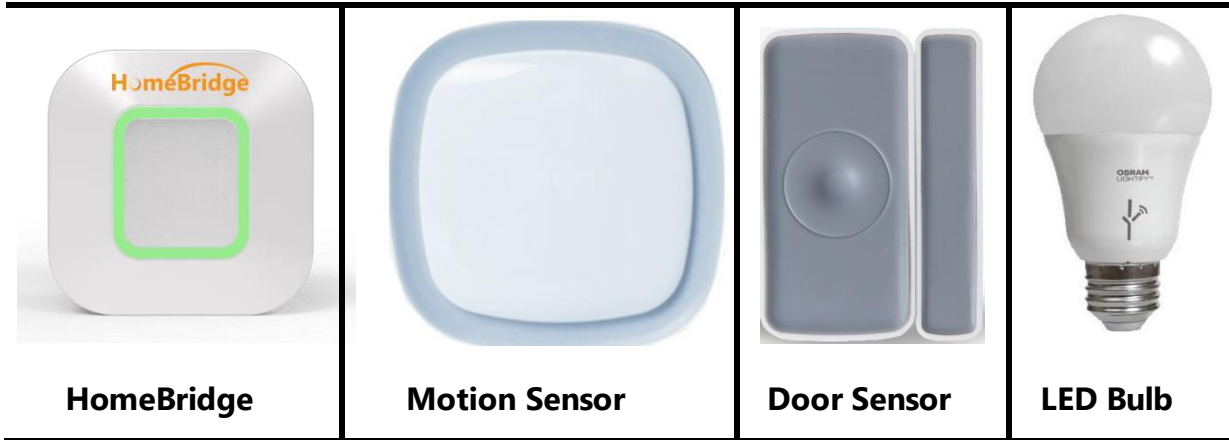


Figure 2 : LED, Switch And AC Pins

Motion Sensor is the end device that notices moving objects. A motion sensor is frequently connected with the HomeBridge gateway and routinely detect a motion and alert to the gateway. These sensors form a very important component of security, home control, energy efficiency, automated lighting control, and other helpful systems. The main principle of motion sensor is to sense a motion and send an alert to mobile app.

Door Sensor is used to detect the opening and closing of the door. It is located on the entrance and exit place of the home. The main principle of door sensor is to detect the status of door, number of time opening and closing door, and store the log into the HomeBridge gateway with time stamp.

LED Bulb is the lighting bulb which is controlled by the mobile application. Using mobile app we can control the brightness of the bulb, Color of the bulb, scene and schedule function of the bulb etc.

Architectural block diagram for HomeBridge 200 is given as below. It majorly contains three part Wi-Fi, RF module and Power supply section. Wi-Fi is the main MCU for HomeBridge 200. RF module is the Host. Currently, added three modules namely as JN5179, MDBT42Q and MGM12P. At a time only one module mounted on the CPU board. JN5179 and MDBT42Q is directly mounted on the CPU Board and MGM12P required extra carrier board.

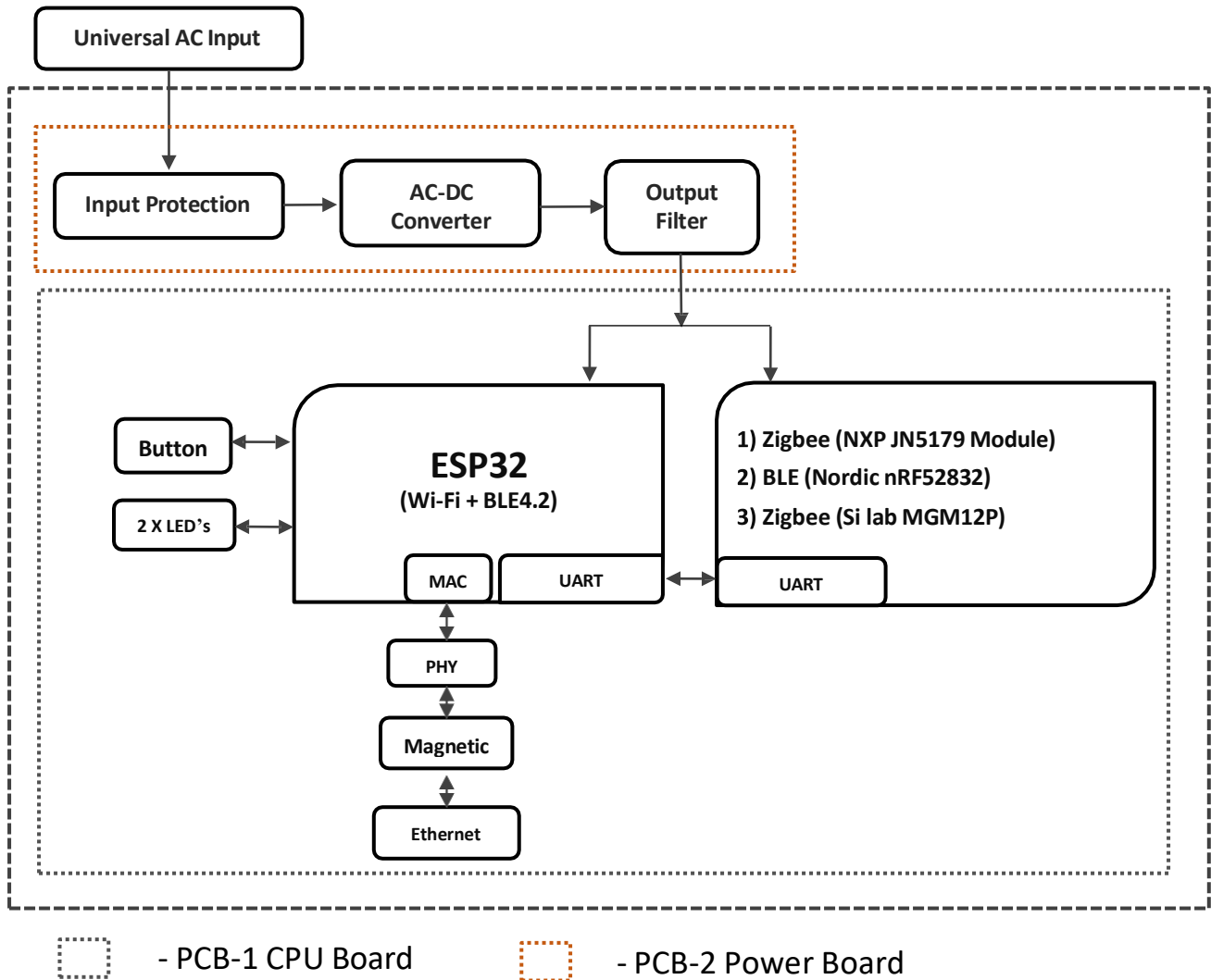


Figure 3: HomeBridge 200 CPU and Power Board Diagram

2.1 HomeBridge 200 Features

HomeBridge 200 contain single board solutions with Wi-Fi, BLE and Zigbee as mentioned in the block diagram. Below are the features of HomeBridge 200 board.

- Operating Temp. -20°C to +60 °C
- Package size (L x W x H) : 55x55x55 mm³
- Inbuilt Ethernet interface
- Inbuilt 16 MB flash for storage
- Contains Push button for user interaction
- Contains LED's for indication
- Operating in universal power range from 100 VAC to 240 VAC
- Inbuilt Wi-Fi with Zigbee or Wi-Fi with BLE interface.
- OTA Support for firmware upgrade
- Dual Core high speed ten Xtensa 32-bit LX6 microprocessors
- Wi-Fi support for b/g/n

2.2 HomeBridge 200 Wireless Connectivity

The HomeBridge 200 has on board ESP32 (Wi-Fi) and JN5179 (Zigbee) / nrf52832 (BLE) / MGM12P (Zigbee + BLE + Thread) wireless connectivity modules. At a time only one RF module is connected with ESP32. Below are major features of each wireless connectivity. Furthermore, details can be found in their respective data sheets.

2.2.1 Wi-Fi

The ESP32 is highly integrated low power WLAN Micro-controller SOC. The WLAN subsystem integrates WLAN MAC, base band and direct-conversion RF radio with integrated PA, LNA. ESP32 modules works on 3.3V supply. It have Wi-Fi b/g/n and BLE4.2 inbuilt. Specification for Wi-Fi is given as below.

Sr#	Parameter	Value	
1	Mfg. By	Espressif	
2	MCU Family	ESP32	
3	Core Processor	Xtensa 32-bit LX6 microprocessors	
4	Protocol support	BLE4.2/Wi-Fi b/g/n	
5	Core Size	32-bit	
6	Clock	24.0MHz	
7	Memory	RAM//flash	520KB//16MB
		ROM	448KB
		I2C	1
		UART	1
		JTAG	Yes
		Ethernet MAC	Yes
9	Power	2.2V – 3.6V	
10	Wi-Fi Max Transmit Power	21 dBm	
11	BLE 4.2 Power	+9 dBm	
12	Antenna	PCB Antenna	

Table 4: Wi-Fi Comparison

2.2.2 ZigBee & BLE controller

Homebridge 200 series has an option of adding BLE/Zigbee module on the boards. The gateway contains 3 different types of module support.

2.2.2.1 HomeBridge 200 CPU board with JN5179 Module

The HomeBridge 200 has on board NXP's JN5179 Zigbee module, which is an ultra-low-power, high-performance wireless micro controller, optimized as a platform for Zigbee 3.0 applications in Smart Home and Smart Lighting networks.

JN5179 features

- ARM Cortex M3 (32MHz) MCU with 512kB flash, 32kB RAM and 4kB EEPROM
- Compliant with 2.4GHz IEEE 802.15.4
- On-board PCB antenna
- Output power: +10 to +20dBm
- RX Sensitivity: -96 dBm to -100 dBm
- JN5179 used as host controller interface

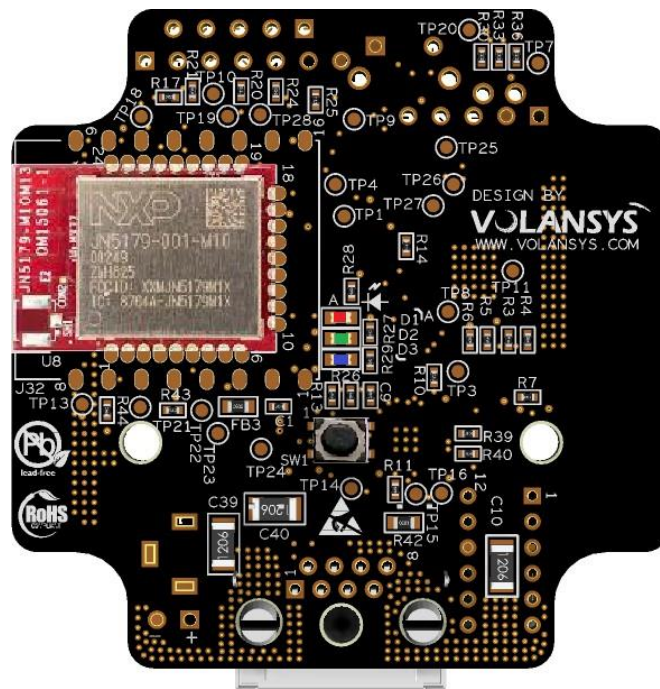


Figure 4 : JN5179 Carrier board

2.2.2.2 HomeBridge 200 CPU board with Silab MGM12P Module

The HomeBridge 200 has Silab's MGM12P module, which is a powerful, highly flexible ultra-low power multi protocol SoC ideally suited for Bluetooth low energy, Zigbee and Thread for IOT.

- High Performance 32-bit 40 MHz ARM Cortex-M4 with DSP instruction and floating-point unit for efficient signal processing
- 1024 kB flash program memory
- 256 kB RAM data memory

- 2.4 GHz radio operation
- TX power up to +17 dBm
- Bluetooth Low Energy (Bluetooth 5)
- Zigbee
- Thread

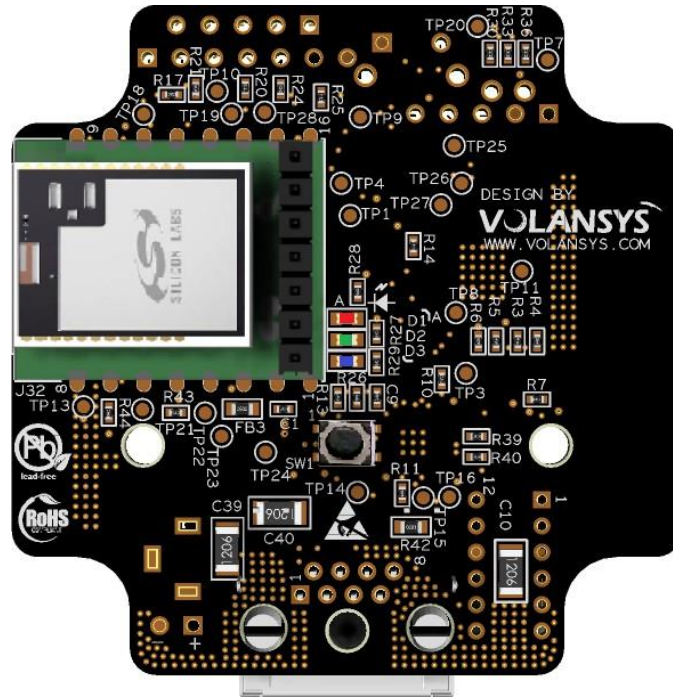


Figure 5 : MGM12P Carrier board with CPU board

2.2.2.3 HomeBridge 200 CPU board with MDBT42Q Module

The HomeBridge 200 has on board Nordic's nrf52832 based MDBT42Q Bluetooth Module which is a powerful, highly flexible ultra-low power multi protocol SoC ideally suited for Bluetooth low energy, ANT and 2.4GHz ultra low-power wireless applications for IOT.

- Single chip, highly flexible, 2.4 GHz multi protocol SoC
- 32-bit ARM Cortex-M4F Processor
- 512kB flash + 64kB RAM
- Supports concurrent Bluetooth low energy/ANT protocol operation
- Up to +4dBm output power
- -96dBm sensitivity, Bluetooth low energy
- Thread safe and run-time protected
- On air compatible with nRF24L and nRF24AP series
- AES HW encryption
- UART used as host controller interface

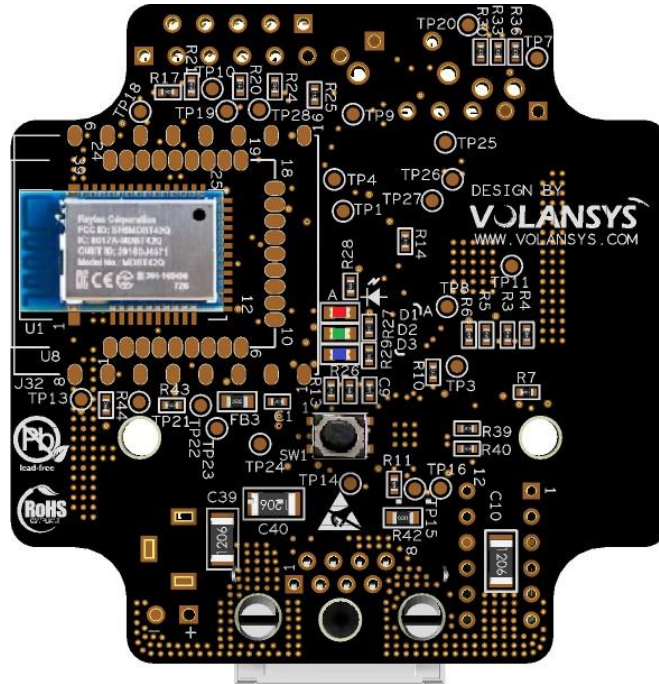


Figure 6 : MDBT42Q Carrier board

Specification of all the modules used in the HomeBridge 200 is given as below.

Parameter	MDBT42Q (BLE)	MGM12P32F1024GA (Zigbee)	JN5179-M10 (Zigbee) ⁽¹⁾
Mfg	Raytac	Silicon Lab	NXP
Core CPU	32-bit ARM M4F	32-bit ARM Cortex M4 core	ARM Cortex-M3 CPU
RAM	64kB	256 kB	32 kB
Flash	512kB	1 MB	512 kB
BLE Specification	BLE 4.2	BLE, Zigbee, Thread	Zigbee
Tx/rx max power	Up to +4dBm/ -96dBm	+17 dBm/-95 dBm	+10 dBm/-96 dBm ⁽¹⁾
Power Supply	1.7v to 3.6v	1.8 V to 3.8 V	2.0 V to 3.4 V
Frequency (Mhz)	2400 - 2483.5 MHz	2400 - 2483.5 MHz	2400 - 2483.5 MHz
Operating Temp.	-40 to +125	-40 to +85 C	-40 to +85 C
Certification	FCC, CE, TELEC, SRRC, IC, NCC, KC	CE, FCC	FCC
Power consumption	- 13 mA RX at 2.4 GHz - 11.5 mA RX at 2.4 GHz	- 10.3 mA RX at 2.4 GHz - 10.8 mA RX at 2.4 GHz - 10 mA TX @ 0 dBm	- TX 114 mA at 21 dBm - RX 19 mA @ -110 dBm
Antenna Type	Chip and PCB	Chip and UFL	PCB and uFL
Sleep current	1.2 uA	2.1 uA	0.64 uA

Table 5: Zigbee & BLE specification

⁽¹⁾ See table 8 for more detail

2.2.3 Ethernet PHY Controller

The HomeBridge 200 has one 10/100Mbps RJ45 Ethernet port. ESP 32 is connected with the LAN8720 using RMII interface. The LAN8720A/LAN8720Ai is a low-power 10BASE-T/100BASE-TX physical layer (PHY) transceiver with variable I/O voltage that is compliant with the IEEE 802.3-2005 standards. The LAN8720A/LAN8720Ai supports communication with an Ethernet MAC via a standard RMII interface. It contains a full-duplex 10-BASE-T/100BASE-TX transceiver and supports 10Mbps (10BASE-T) and 100Mbps (100BASE-TX) operation. The LAN8720A/LAN8720Ai implements auto negotiation to automatically determine the best possible speed and duplex mode of operation. HP Auto-MDIX support allows the use of direct connect or cross-over LAN cables.

- Compliant with IEEE802.3/802.3u (Fast Ethernet)
- Compliant with ISO 802-3/IEEE 802.3 (10BASE-T)
- Loop-back modes
- Auto-negotiation
- Automatic polarity detection and correction
- Link status change wake-up detection
- Vendor specific register functions
- Supports the reduced pin count RMII interface Power and I/Os
- Various low power modes
- Integrated power-on reset circuit
- Two status LED outputs
- Latch-Up Performance Exceeds 150mA per EIA/JESD 78, Class II
- used with a single 3.3V supply

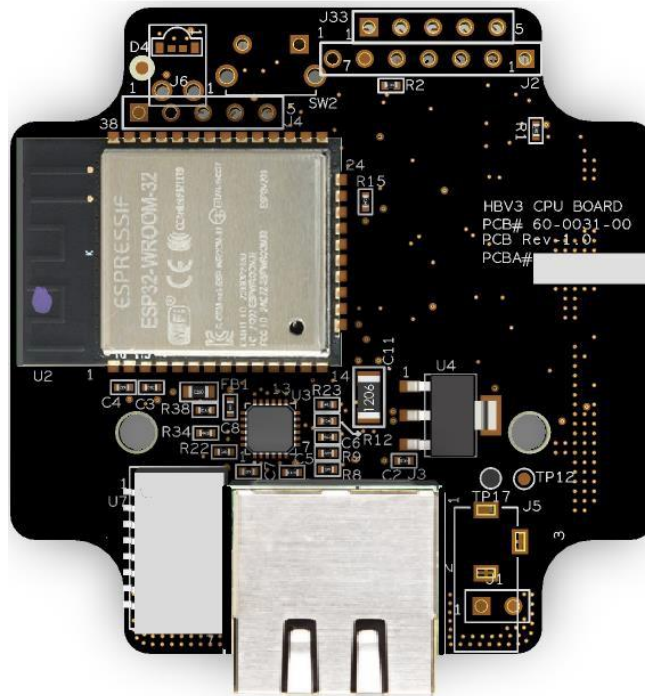


Figure 7 : CPU Board with ESP32 WiFi and Ethernet

Sr	Parameter	LAN8720A
1	Mfg	Microchip
2	Interface	RMII
3	Standard	10/100 Ethernet
4	Number of Drivers/Receivers	1/1
5	Voltage - Supply	1.8V to 3.3V
6	Temperature	-40°C to +85°C

Table 6: Ethernet bridge controller comparison

2.3 HomeBridge 200 Variants

HomeBridge 200 contain single board solutions with Wi-Fi, BLE and Zigbee as mentioned in the block diagram. Below are the variants of HomeBridge 200 board.

Sr.	Product variants	Wi-Fi (ESP32)	Ethernet (10/100)	BLE	Zigbee	Adapter	Power board
1	HB-200-V0-E0-PB0	✓	X	✓ESP	X	✓	X
2	HB-200-V1-E0-PB0	✓	X	✓Nordic	X	✓	X
3	HB-200-V2-E0-PB0	✓	X	X	✓(MGM12P)	✓	X
4	HB-200-V3-E0-PB0	✓	X	X	✓(JN5179)	✓	X
5	HB-200-V0-E1-PB0	✓	✓	✓ESP	X	✓	X
6	HB-200-V1-E1-PB0	✓	✓	✓Nordic	X	✓	X
7	HB-200-V2-E1-PB0	✓	✓	X	✓(MGM12P)	✓	X
8	HB-200-V3-E1-PB0	✓	✓	X	✓(JN5179)	✓	X
9	HB-200-V0-E0-PB1	✓	X	✓ESP	X	X	✓
10	HB-200-V1-E0-PB1	✓	X	✓Nordic	X	X	✓
11	HB-200-V2-E0-PB1	✓	X	X	✓(MGM12P)	X	✓
12	HB-200-V3-E0-PB1	✓	X	X	✓(JN5179)	X	✓
13	HB-200-V0-E1-PB1	✓	✓	✓ESP	X	X	✓
14	HB-200-V1-E1-PB1	✓	✓	✓Nordic	X	X	✓
15	HB-200-V2-E1-PB1	✓	✓	X	✓(MGM12P)	X	✓
16	HB-200-V3-E1-PB1	✓	✓	X	✓(JN5179)	X	✓

Table 7 HomeBridge 200 Variants

2.4 HomeBridge 200 RF Power Amplifier detail for modules

Sr.	Module	Mfg	Soc	Protocol	Tx Power	Rx Power	LNA	Voltage
1	ESP32	ESP	D0WDQ6	Wi-Fi	-20 to +12	-89 to -98	✓	2.7V - 3.6V
2	ESP32	ESP	D0WDQ6	BLE4.2	-12 to +9	-97	✓	2.7V - 3.6V
3	JN5179-001-M10 (PCB Antenna)	NXP	JN5179	Zigbee	0 to +10	-96	✓	2V - 3.6V
4	JN5179-M13 (uFL Antenna)	NXP	JN5179	Zigbee	0 to +10	-96	✓	2V - 3.6V
5	JN5179-M16 (PCB + uFL Antenna)	NXP	JN5179	Zigbee	0 to +21	-100	✓	2V - 3.6V
6	MDBT42Q (PCB/CHIP Antenna)	Raytek	nRF5283 2	BLE4.2	-92 to +4	-92	✓	1.7 - 3.6V
7	MGM12P (CHIP/uFL Antenna)	Si Lab	EFR32M G12P	Zigbee	0 to +17	-95 to -105	✓	2.4 - 3.8V

Table 8: HomeBridge 200 RF Power amplifier details

HomeBridge 200 CPU Board designed with different modules. Above table shows the Transmit power, receiver sensitivity, LNA support contain single board solutions with Wi-Fi, BLE and Zigbee as mentioned in the block diagram.

2.5 Regulatory & Safety Considerations

HomeBridge 200 contains blow mentioned 4 modules. Certification for the same is as given blow. (Whole product regulatory compliance is pending)

Parameter	MDBT42Q	MGM12P	ESP32	JN5179
Certification	FCC, CE, TELEC, SRRC, IC, NCC, KC	CE, FCC	FCC, IC, NCC, CE, ETSI	FCC

Table 9: Module certification

2.6 Indications & User Controls

2.6.1 LED Indications

There are 3 high brightness red, green, blue LED's in HomeBridge 200. LED's are located on the center of the CPU board. Indication of each LED is configured by software. Complete LED matrix is given as below. Front side tricolor RGB right angle LED is selected for future customers requirements.

Sr No	LED Color	LED state	Represents
1	Red & Green	OFF	HomeBridge 200 Power off
2	Red	Blink with 100 ms ON and 100 ms Off	Wi-Fi connection available / Ready for Wi-Fi commissioning
3	Red	Blink with 100 ms ON and 400 ms Off	Connecting to cloud
4	Red	Solid Red	Running Factory reset operation
5	Green	Blink with 200 ms ON and 200 ms Off	End device Commission window is On
6	Green	Solid Green	Connected with Cloud

Table 10 : LED Indication Matrix

3 POWER BOARD SYSTEM PARTITIONING & ARCHITECTURE

Architectural block diagram for HomeBridge 200 Power Board is given as below. It majorly contains AC-DC module and its peripheral components. This module comes in small size, CE certified, low cost, easily available.

3.1 HomeBridge 200 Power Board Features

HomeBridge 200 Power Board contain single board solutions for 100VAC to 240VAC input voltage range and +3.3VDC @500 mA current output.

- Operating Temp. -20°C to +60 °C
- Package size (L x W x H) : 52x52x20 mm³
- Global universal input voltage (110VAC - 240VAC)
- Low-power, green, no-load loss <0.1W
- Low ripple, low noise
- Good output short circuit and over current protection and self recovery
- High efficiency
- Input and output isolation voltage 3000V
- 100% full load aging and testing
- High reliability, long life design, continuous working time is greater than 100,000 hours
- Meet UL, CE requirements product design to meet EMC and safety testing requirement
- Using high-quality environmentally friendly plastic potting, moisture, vibration proof

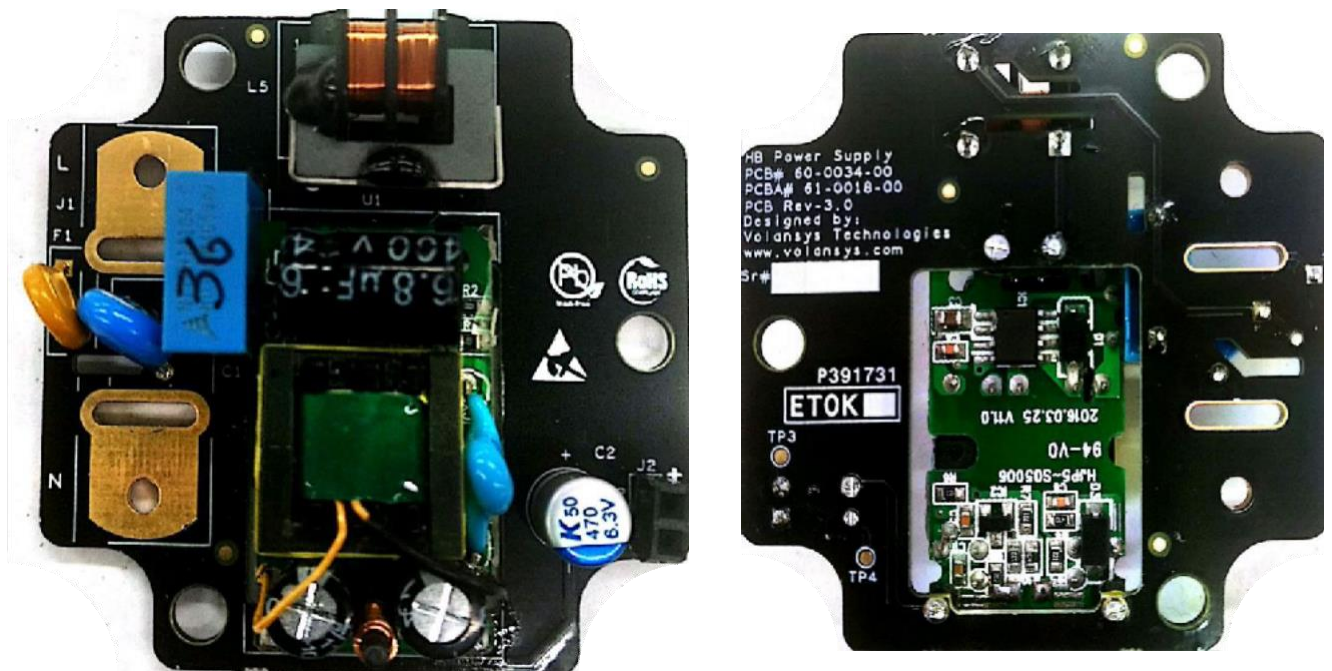
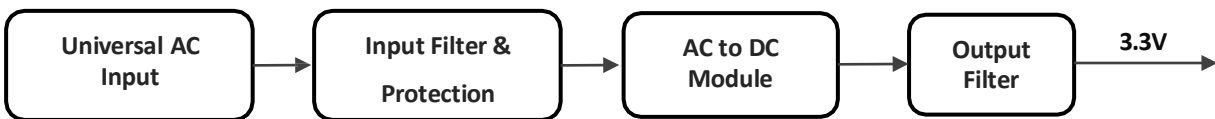


Figure 8: HomeBridge 200 Power Board Architecture Diagram & Images

4 ENVIRONMENT CHARACTERISTIC & INPUT CHARACTERISTIC

4.1 Environment characteristics

Below table gives the environment conditions for the HomeBridge 200 Power board

Sr no	Project name	Technical indicators	Unit	Notes
1)	Working temperature	-25 to +60	°C	
2)	Storage temperature	-40 to +80	°C	
3)	Relative humidity	5 to 95	%	
4)	Thermal methods	Natural cooling		
5)	Atmospheric pressure	80 to 106	Kpa	
6)	Altitude	≤2000	m	Pending
7)	Vibration	Vibration coefficient 10~500Hz,2G 10min./1cycle, 60min.each along X,Y,Z axes	G	Meet the second-class road Transport requirement (Pending)

Table 11: Environment characteristics

4.2 Input characteristics

Below table gives the input characteristic for the HomeBridge 200 Power board

Sr no	Project Name	Parameter Value	Unit	Notes
1)	Rated input voltage	110-240	VAC	
2)	Input voltage range	85-265	VAC	Or 70-350Vdc
3)	The maximum input current	≤0.02	A	
4)	Input inrush current	≤10	A	
5)	The maximum input voltage	≤270	VAC	
7)	Rated input voltage	110-240	VAC	
8)	Input soft start	≤50	ms	
9)	Long-term reliability	MTBF≥100,000	H	

Table 12: Input characteristics

4.3 Working environment and Storage environment

Working temperature for power board is -20°C to +60 °C. and storage temperature is -40°C to +80°C.

4.4 Regulatory (Pending)

HomeBridge 200 Power Board contains blow mentioned modules. Certification for the same is as given blow.

Parameter	AC-DC Module
Certification	CE, UL

Table 13: Certification requirements

4.5 Safety (Pending)

- Design of Input end fulfills the 0.5A security of UL certification
- PCB is double-sided copper clad plate, the material fireproof rating 94-V0 level
- Safety standard in line with UL1012, EN60950, UL60950
- Insulation Voltage I/P-O/P:2500VAC
- Insulation Resistor I/P-O/P>100M Ohms/500Vdc 25 °C 70% RH
- Conductivity and Radiation meet EN55011, EN55022 (CISPR22)
- Electrostatic discharge IEC/EN 61000-4-2 level 4.8kV/15kV RF Radiation Immunity meet the standard IEC/EN 61000-4-3 (Check details in Application Notes)

4.6 Temperature (Pending)

The maximum temperature rise of the power supply and other inner surfaces at room temperature does not exceed 90 °C. The maximum temperature rise of the shell surface does not exceed 60 °C.

4.6.1 HomeBridge 200 Power Board module Specification

Find the below table for power supply module specification.

Sr#	Specification/Feature	Value
1	AC Voltage Input	100-240VAC
2	I/P Freq.	50-60 Hz
3	Load rated O/P Voltage	3.3Vdc
4	Max. O/P Current	>500 mA
5	Safety Compliance	UL1012, EN60950, UL60950
6	Op. Temperature	-20°C to +60 °C
7	Protection	SCP, Overload
8	Certification	Meet UL, CE requirements

Table 14 : Component selection

5 MECHANICAL DIMENSIONS

This section describes the preliminary size and dimensions of HomeBridge 200 enclosure.

5.1 Enclosure parts detail

HomeBridge 200 Enclosure dimensions are given as below.

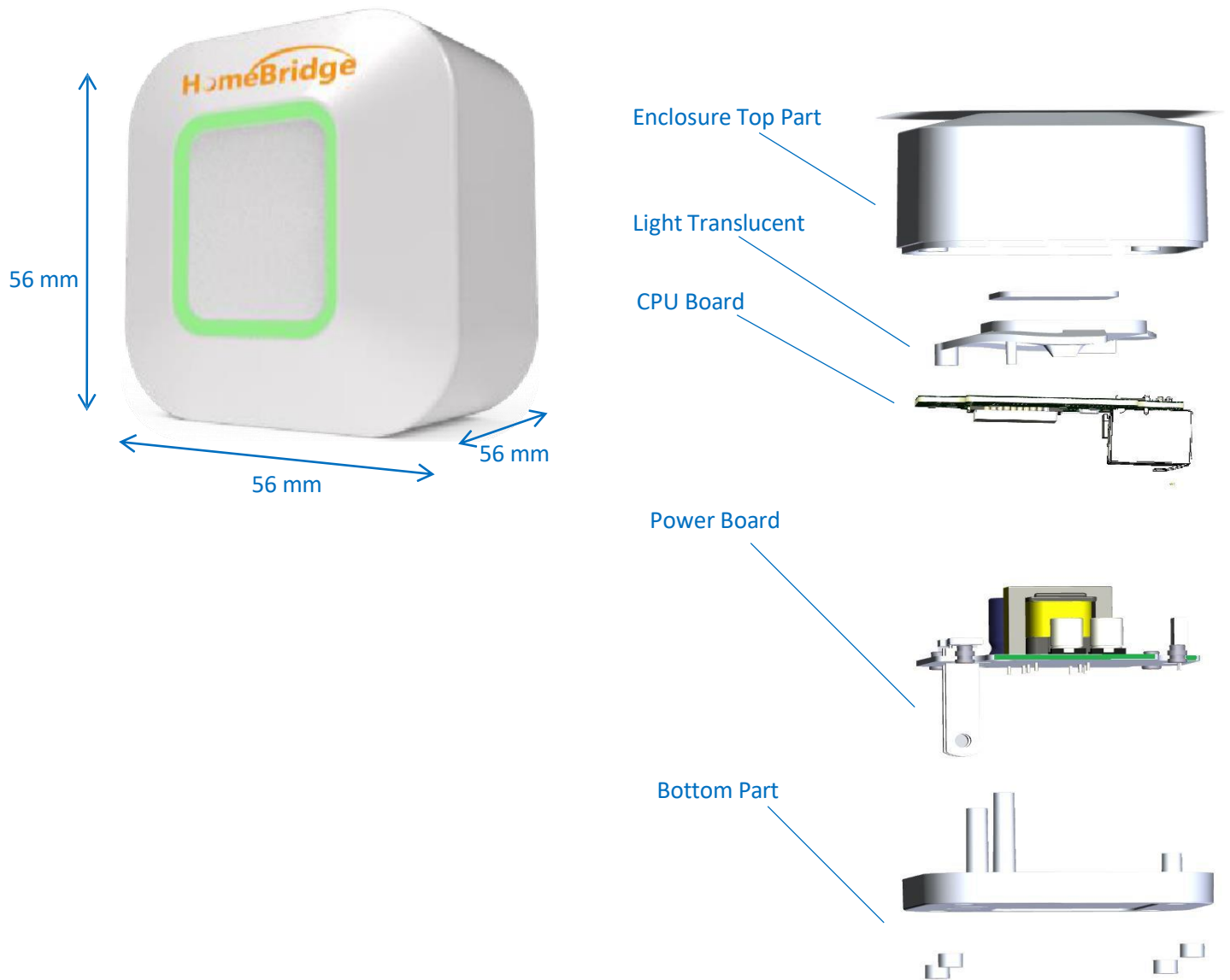


Figure 9: HomeBridge 200 Enclosure part details & Images