

Smart home gateway  
(**PROJECT HOTSPRING**)  
**PRODUCT REQUIREMENTS DEFINITION**  
(**PRD**)



## Revision History

Rev.	Author	Change Description	Date	Status
1.0	Dipankar Sarkar	Initial Draft	04/09/2015	Unreleased
1.1	Dipankar Sarkar	Second Draft	04/09/2015	Unreleased
2.0	Dipankar Sarkar	Updated enclosure information in section 6.1.1 Corrected section 6.5 Updated altitude and humidity specifications in section 8.1 Corrected sections 3.1.2.3, 4.2 & item-3 in section 9.2 Corrected section 10.1	04/27/2015	Unreleased
2.1	Wade Lindsey	Multiple corrections	06/11/2015	Unreleased
2.2	Dipankar Sarkar	Added memory capacity information in section 3.1.1 Added document number Updated approver list in section 1.1	06/23/2015	Unreleased

**Table I Revision History**

# TABLE OF CONTENTS

<b>1.</b>	<b>DOCUMENTATION CONVENTIONS AND APPROVALS.....</b>	<b>5</b>
1.1.	APPROVALS.....	5
1.2.	DOCUMENTATION CONTROL AND REVISIONS.....	6
1.2.1.	<i>The document will undergo revision for the following reasons:.....</i>	6
1.2.2.	<i>Document Revision Process:.....</i>	6
1.3.	PRODUCT REQUIREMENT CONVENTIONS USED IN THIS DOCUMENT .....	6
1.4.	LIST OF APPLICABLE DOCUMENTS .....	6
<b>2.</b>	<b>SCOPE AND PURPOSE.....</b>	<b>7</b>
2.1.	GLOSSARY OF TERMS AND ACRONYMS .....	7
<b>3.</b>	<b>TECHNICAL OVERVIEW .....</b>	<b>8</b>
3.1.	MAIN PCB.....	8
3.1.1.	<i>Processor and Memory .....</i>	8
3.1.2.	<i>Radios .....</i>	8
<b>4.</b>	<b>DETAILED PRODUCT SPECIFICATIONS.....</b>	<b>9</b>
4.1.	DESIGN PRACTICES .....	9
4.2.	POWER SUPPLY.....	9
4.3.	HOST PROCESSOR CHIPSET AND MEMORY .....	9
4.3.1.	<i>Processor.....</i>	10
4.3.2.	<i>Chipset DRAM .....</i>	10
4.3.3.	<i>Chipset Flash .....</i>	10
4.4.	PROGRAMMING .....	10
4.5.	EXTERNALLY ACCESSIBLE CONNECTORS, SWITCHES AND INDICATORS .....	10
4.5.1.	<i>2-wire terminal block .....</i>	10
4.5.2.	<i>LED Indicators .....</i>	10
4.5.3.	<i>WPS Button .....</i>	10
4.5.4.	<i>Reset Button .....</i>	11
<b>5.</b>	<b>ANTENNA SYSTEM DESIGN AND RF PERFORMANCE.....</b>	<b>11</b>
5.1.1.	<i>Simulation .....</i>	11
<b>6.</b>	<b>MECHANICAL REQUIREMENTS.....</b>	<b>11</b>
6.1.	MECHANICAL DESIGN FEATURES .....	11
6.1.1.	<i>Enclosure.....</i>	11
6.1.2.	<i>Chemical Resistance.....</i>	14
6.1.3.	<i>UV Stability .....</i>	14
6.2.	ENCLOSURE DESIGN SPECIFICATIONS.....	14
6.3.	REAR PANEL DESIGN SPECIFICATIONS.....	14
6.4.	ENCLOSURE MECHANICAL DESIGN DETAILS .....	14
6.5.	THERMAL SPECIFICATIONS .....	14
6.6.	LABEL SPECIFICATIONS .....	15
6.7.	LOGO SPECIFICATIONS.....	15
6.8.	BOARD DIMENSIONS & MOUNTING [PR-026].....	15
<b>7.</b>	<b>INDUSTRIAL DESIGN .....</b>	<b>15</b>
<b>8.</b>	<b>ENVIRONMENTAL SPECIFICATIONS AND PARAMETERS .....</b>	<b>15</b>
8.1.	OPERATIONAL ENVIRONMENTAL ENVELOPE [PR-028] .....	15
8.2.	NON-OPERATIONAL ENVIRONMENTAL ENVELOPE [PR-029].....	16
8.3.	VERTICAL DROP CHASSIS ENDURANCE [PR-030].....	16
8.4.	CHASSIS IMPACT [PR-031] .....	16
8.5.	CHASSIS STATIC LOAD [PR-032] .....	17
8.6.	SHIPPING VIBRATION [PR-033] .....	17
<b>9.</b>	<b>SYSTEM PERFORMANCE METRICS AND RELIABILITY .....</b>	<b>17</b>
9.1.	LONG-TERM STABILITY .....	17

9.2.	LIST OF CRITICAL COMPONENTS .....	18
<b>10.</b>	<b>AGENCY AND INDUSTRY CONFORMANCE REQUIREMENTS.....</b>	<b>18</b>
10.1.	SAFETY COMPLIANCE .....	18
10.2.	SYSTEM IMMUNITY.....	18
10.3.	EMI COMPLIANCE.....	18
10.4.	ROHS COMPLIANCE.....	19
<b>11.</b>	<b>SUMMARY OF TECHNICAL HARDWARE SPECIFICATIONS .....</b>	<b>19</b>
11.1.	UNIT ARCHITECTURE COMPLIANCE MATRIX.....	19
<b>Statemtets.....</b>	<b>.....</b>	<b>21</b>

## 1. DOCUMENTATION CONVENTIONS AND APPROVALS

### 1.1. APPROVALS

Prepared by Dipankar Sarkar \_\_\_\_\_  
(Author)

Date: \_\_\_\_\_

Haedoo Choi \_\_\_\_\_  
Sr. Director, HVS Connectivity Product Management

Date: \_\_\_\_\_

Wade Lindsey \_\_\_\_\_  
Product Manager

Date: \_\_\_\_\_

Jonathan Scruggs \_\_\_\_\_  
Director, Program Management

Date: \_\_\_\_\_

Released Via ECO: \_\_\_\_\_

Date: \_\_\_\_\_

## 1.2. DOCUMENTATION CONTROL AND REVISIONS

### 1.2.1. THE DOCUMENT WILL UNDERGO REVISION FOR THE FOLLOWING REASONS:

- Product architecture, specification, and / or feature changes
- New requirements added or deleted per customer request
- Technical corrections to the previous revision of the document

### 1.2.2. DOCUMENT REVISION PROCESS:

- Document revision number shall be changed per each new release
- After release, all revisions of this document and the revision history will be stored in the PLM system
- All changes and new releases must be approved through the ECO process

## 1.3. PRODUCT REQUIREMENT CONVENTIONS USED IN THIS DOCUMENT

The requirements are classified into the following categories ideally:

- **Mandatory** - denoted by the words “Shall” or “Must” or “Will”
- **Suggested** – denoted by the word “Should”
- **Optional** – denoted by the word “May”
- **Or Equivalent** – requirements totally met by alternate solution

## 1.4. LIST OF APPLICABLE DOCUMENTS

The following is a partial list of documents datasheets are applicable to this specification:

IEEE 802.11: 2007 AMD 3 2008	06-Nov-2008	INFORMATION TECHNOLOGY - TELECOMMUNICATIONS AND INFORMATION EXCHANGE BETWEEN SYSTEMS - LOCAL AND METROPOLITAN AREA NETWORKS - SPECIFIC REQUIREMENTS - PART 11: WIRELESS LAN MEDIUM ACCESS CONTROL (MAC) AND PHYSICAL LAYER (PHY) SPECIFICATIONS
IEEE 802.11n: 2009 AMD 5	29-Oct-2009	INFORMATION TECHNOLOGY - TELECOMMUNICATIONS AND INFORMATION EXCHANGE BETWEEN SYSTEMS - LOCAL AND METROPOLITAN AREA NETWORKS - SPECIFIC REQUIREMENTS - PART 11: WIRELESS LAN MEDIUM ACCESS CONTROL (MAC) AND PHYSICAL LAYER (PHY) SPECIFICATIONS: AMENDMENT: ENHANCEMENTS FOR HIGHER THROUGHPUT
FCC part 15: 2-16-06	16-Feb-2006	FCC part 15 - Federal Communications Commission Regulations for Radio Frequency Devices
FCC Part 15.247		Rules for Radio Systems Using Digital Modulation
ZigBee Cluster Library Specification	5/29/2012	Definition of the ZigBee Cluster Library
ZigBee Home Automation Public Application Profile	2/8/2010	Definition of the ZigBee Home Automation Profile

## 2. SCOPE AND PURPOSE

This document defines the product requirements specifications for a Smart home that gateway enables user control and error status access of a Rinnai Tankless Water Heater through a WiFi based cloud application.

The purpose of this document is to sufficiently define the product requirements so that the engineering team can create the technical specifications for the specific product design. This specification is a higher level document that defines specific features, functions, user experience, "look and feel" etc. Once this document is approved, the specific design specifications will be written based on these requirements. The detailed technical architecture of the product is not generally defined in this specification, unless it is necessary from a product feature point of view.

Specific implementation details that are not covered by this document shall be at the discretion of the PR engineering / management team, and should generally follow common industry practices, standards, and procedures to insure a reliable product that meets the customer's requirements. Many of the specific implementation details will be defined in the technical specifications.

### 2.1. GLOSSARY OF TERMS AND ACRONYMS

The following abbreviations and acronyms are used throughout this document:

AP	Wireless Access Point (may also have wired connections)
CMF	Color, Materials, Finishes refers to the types of exterior appearances and textures the user interfaces to; typically related to the plastics.
FR4	Epoxy printed circuit board material, meeting UL94V0 flammability requirements
GigE	Giga Bit Ethernet
I2C	Two wire interface used to transfer low speed data
IR	Infrared
IML	In-mold labeling is a technique used to add graphics to plastic parts
LED	Light Emitting Diode
MII	Media Independent Interface
NFF	No Fault Found
PCB	Printed Circuit Board
PSU	System power supply
PMIC	Power management integrated circuit
RTC	Real Time Clock
SPI	Serial Peripheral Interface (used to transfer medium speed data)
TFT	Thin Film Transistor
UART	Serial communications link (low speed) based on bidirectional TTL levels
USB	Universal Serial Bus
WiFi	Wireless technology used for data transfer in the 2.4GHz and 5.8GHz ISM bands
ZigBee	Wireless technology used for mesh networking on the 2.4Ghz or 900MHz bands

### 3. TECHNICAL OVERVIEW

The Smart home gateway consists of the following major assemblies:

1. Main PCB
2. Enclosure (Housing)

#### 3.1. MAIN PCB

The main PCB is a multi-layer epoxy FR4 board (dimensions TBD) that contains all of the circuitry, including WiFi and ZigBee radios. A functional description of each circuit block is provided in the following sections. Refer to the following block diagram which defines each included circuit block.

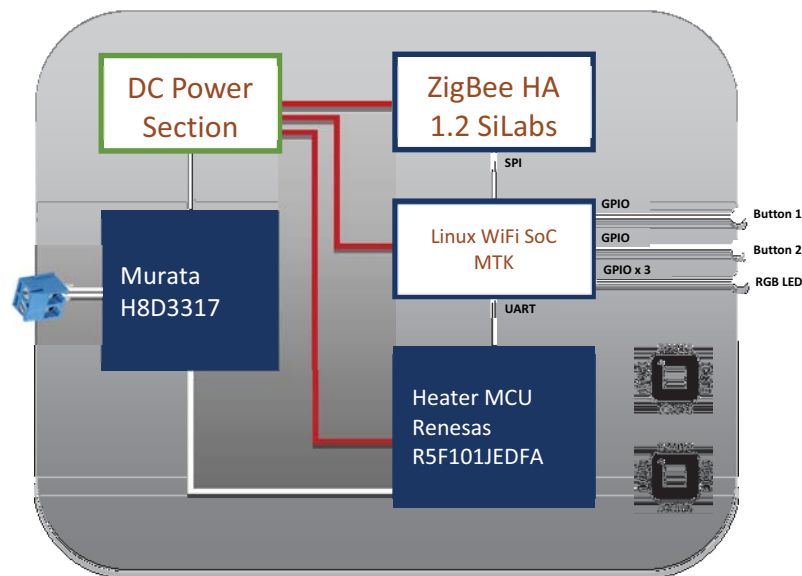


Figure 1 Module Hardware Block Diagram

##### 3.1.1. PROCESSOR AND MEMORY

The Host Processor shall be a MIPS24KEc embedded within the MediaTek MT7620A SoC **[PR-001]**. It will support 256MB of DDR RAM and 256MB of NAND Flash.

##### 3.1.2. RADIOS

The following radios will be used in the Smart home gateway **[PR-002]**

Type	Freq.	Vendors	Interface	Comments
WiFi	2.4GHz	MediaTek	UART	MT7620A
ZigBee	2.4GHz	Silicon Labs	SPI	EM357

Table 2 Module Radio



#### **3.1.2.1. WiFi MODULE**

The WiFi module shall be an 802.11n module in 1x1 antenna configuration embedded within the MediaTek MT7620A SoC [PR-003]

#### **3.1.2.2. ZIGBEE / RADIO**

The ZigBee radio will utilize the Silicon Labs EM357 [PR-004]

#### **3.1.3. COMMUNICATION PROPRIETARY INTERCONNECT**

The water heater communication interconnect uses a 2-wire physical interface which shall be using the Murata H8D3317 custom IC. (See example schematic in Appendix-1)

#### **3.1.4. POWER CONNECTION**

12 volt DC power for this module will be provided from the water heater on the two wires used for the water heater communication (See example schematic in Appendix-1). Surge suppressors must be incorporated on the input power lines for protection from conducted power surges.

#### **3.1.5. HOST PROCESSOR**

The Host Processor shall be a MIPS24KEc (580 MHz) with 64 KB I-Cache and 32 KB D-Cache embedded in the MediaTek MT7620A SoC

#### **3.1.6. APPLICATION PROCESSOR**

The Application Processor shall be the Renesas R5F101JEDFA

### **4. DETAILED PRODUCT SPECIFICATIONS**

This section provides more detailed information for the Smart home gateway design.

#### **4.1. DESIGN PRACTICES**

Industry standard design practices shall be used for this design consistent with a commercial consumer product. [PR-005]

#### **4.2. POWER SUPPLY**

The Smart home gateway shall receive power via the power/interconnect cable connecting this module with the water heater. The custom Murata chip (H8D3317) will be used to split the DC power and the serial communications signals provided by the water heater over the power/interconnect cable. The incoming DC power shall be appropriately regulated in the DC Power section for use by this module. [PR-006]

#### **4.3. HOST PROCESSOR CHIPSET AND MEMORY**

The description of the host processor and associated memory is defined in the following subsections.

#### 4.3.1. PROCESSOR

The processor shall be the MIPS24KEc operating at a clock speed of 580MHz, embedded in the MediaTek chipset. This processor has 64 KB I-Cache and 32 KB D-Cache. In addition this processor supports multiple IO interfaces, including GPIO, I2C, I2S, SPI, PCM, UART, etc. [PR-007]

#### 4.3.2. CHIPSET DRAM

The Smart home gateway shall be designed to support 256MB of 16-bit DDR-2 memory, which must be compatible for operation with the host processor. Final production boards may use 64MB or 128MB of DDR-2 memory if the software image is compatible with the smaller memory size. [PR-008]

#### 4.3.3. CHIPSET FLASH

The Smart home gateway design will incorporate 128MB of NAND Flash to maintain the code image and bootloader. [PR-009]

#### 4.4. PROGRAMMING

The main board shall include the capacity to download code into any programmable parts. Headers for JTAG, UART, and/or equivalent shall be included for this purpose. Programming headers may or may not be populated for production. [PR-010]

#### 4.5. EXTERNALLY ACCESSIBLE CONNECTORS, SWITCHES AND INDICATORS

The Smart home gateway must provide a terminal block for a 2-wire connection.

The Module must provide the following external accessible switches and indicators: [PR-011]

1. 1 Tri-color status indicator LED
2. WiFi Configuration button
3. System Reset button

##### 4.5.1. 2-WIRE TERMINAL BLOCK

The 2-wire terminal block will be used for power/communication connection to the water heater.

##### 4.5.2. LED INDICATORS

The Tri-color LED indicator will be used to designate the following functions: [PR-012]

Color	Function	Description
Red	Error condition	Error condition
Blue	Connected	Blinking = WiFi connection; Solid = Internet connection
Green	Pairing mode active	Pairing mode active

Table 3 LED definitions

##### 4.5.3. WiFi CONFIGURATION BUTTON

The Smart home gateway shall incorporate a GPIO-connected WiFi Configuration button to assist the user in the wireless set-up process. [PR-013]

#### **4.5.4. SYSTEM RESET BUTTON**

The Module shall provide a RESET button connected to the system reset lines for the MediaTek, Silicon Labs and Renesas SoCs to reset all application processes. [PR-014]

### **5. ANTENNA SYSTEM DESIGN AND RF PERFORMANCE**

Since the Smart home gateway contains two 2.4GHz radios, coexistence between the radios is a critical performance issue. Most of the coexistence issues are due to the antenna design. For this reason, commercially available chip antennas shall be utilized, with suitable placement/positioning to maximize antenna isolation. A full simulation and analysis must be done to optimize the design and placement of the antennas to provide optimum performance and reduce degradation due to insufficient antenna isolation. [PR-015]

#### **5.1.1. SIMULATION**

As part of the design process, each of the proposed antenna placements shall be simulated, and modified as required to optimize the performance of the system. The simulation shall measure the radiation pattern and isolation of each antenna. If design changes are necessary, this specification will be revised. The simulation must also calculate the in-band and the out-of-band energy into each receiver, to ensure that the maximum input levels (as specified by the transceiver manufacturer) are not exceeded (exceeding the maximum input can result in receiver damage). It shall be up to the discretion of the design team to include band pass filters into the design to protect the receivers from excessive input level. [PR-016]

### **6. MECHANICAL REQUIREMENTS**

The industrial and mechanical design of the Smart home gateway will be developed in conjunction with the ME team, to optimize aesthetics, cost and manufacturability. The design will follow the Rinnai guidelines and requirements. Specific mechanical design features and attributes are the decision of the implementation team, but the final design must be reviewed and approved by the customer.

#### **6.1. MECHANICAL DESIGN FEATURES**

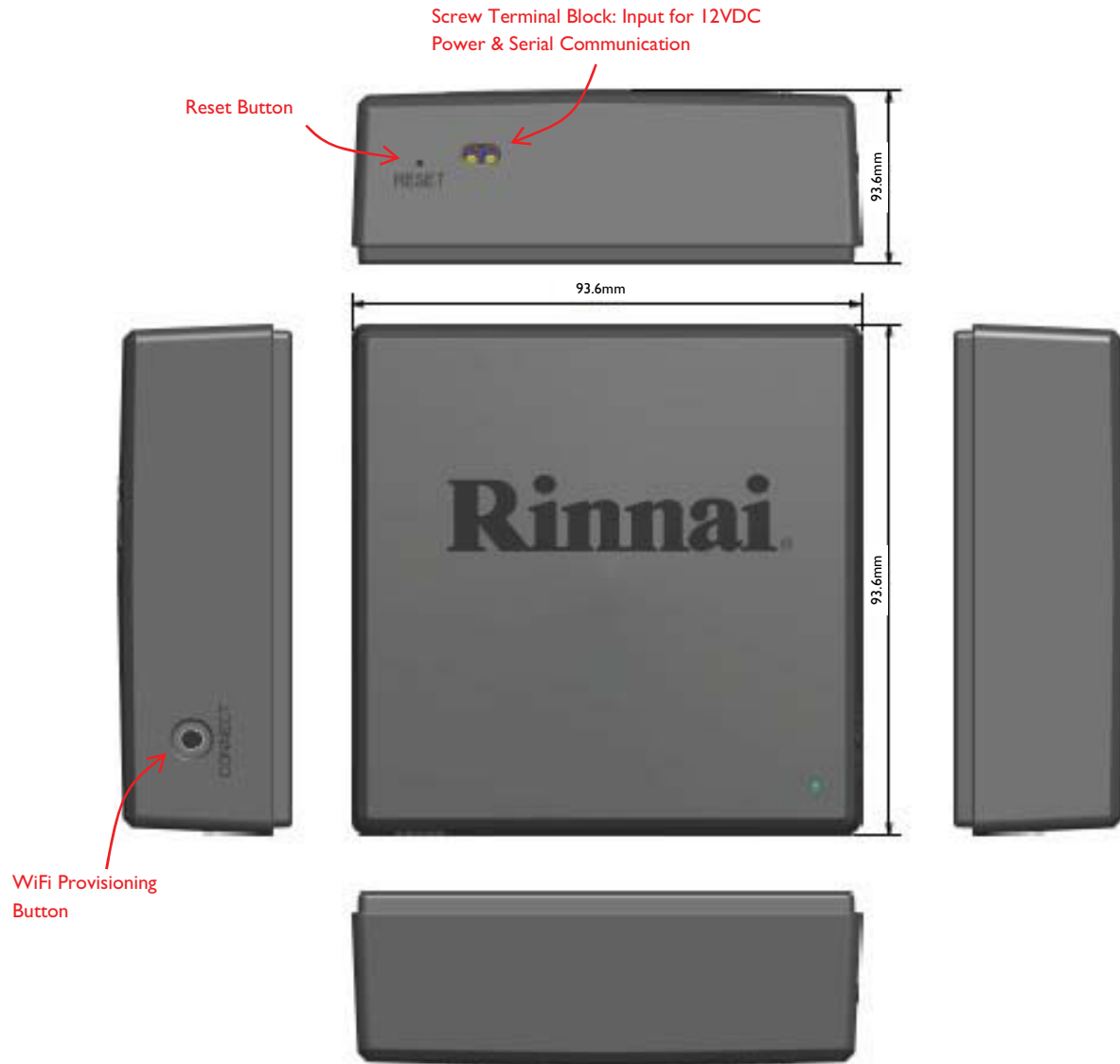
The mechanical design shall consist of:

##### **6.1.1. ENCLOSURE**

The Smart home gateway enclosure shall consist of a base and a cover made of injection molded plastic (ABS or PC-ABS).

The Industrial Design shall adhere to the following enclosure concept design examples and guidelines shown below.

The unit is expected to be mounted on the wall or on the water heater. The base of the unit shall incorporate keyhole slots and magnets for ease of mounting. **[PR-017]**



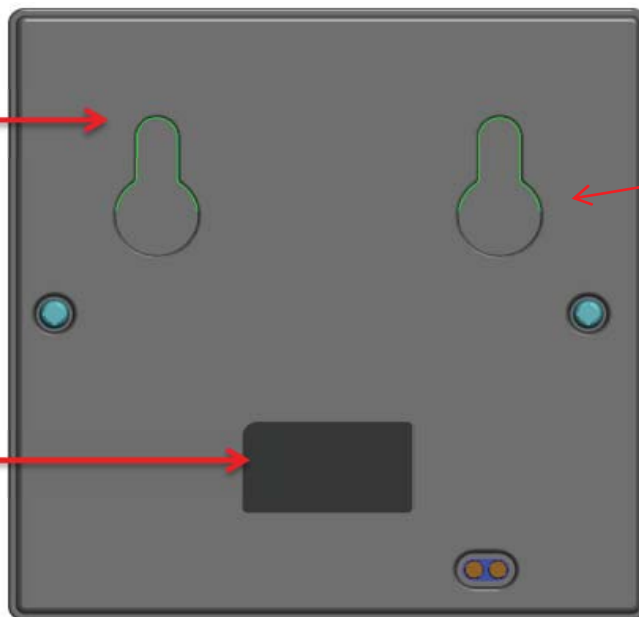


Front Cover  
Material: ABS  
Color: Black  
MT11010 &  
high Polished  
on logo

LED lens  
Material: PMMA  
Color:  
Transparent  
Polished

Material:  
ABS  
Color: Black  
MT11015

Product label  
Material: Paper  
Color: black  
Fog treatment  
in surface



Keyhole Feature  
for Wall Mount

The design should accommodate the fact that the unit is expected to be mounted on a wall or on a large metal plate (the water heater), which will cause near-field obstruction. The PCBA mounting should increase the distance between the antenna and any near-field obstruction, to improve the performance of the antenna(s).

### 6.1.2. CHEMICAL RESISTANCE

The mechanical design shall demonstrate chemical resistance to short-term exposure to common household cleaning agents applied to the exterior of the product, as well as any substance commonly found on the human hand. [PR-018]

### 6.1.3. UV STABILITY

UV resistance per ASTM 4674 Method 1: Delta E<1.4: Irradiance level of 2806 W-h/m<sup>2</sup>. No degradation of the material is allowed, but color changes are acceptable. In the event of a color change, the change shall result in a delta-E of 1.4 or less for HB for ABS material or 1.7 or less for PC material. [PR-019]

## 6.2. ENCLOSURE DESIGN SPECIFICATIONS

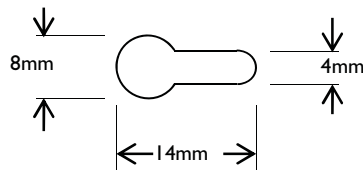
The enclosure is a simple box structure consisting of a rear panel or base and a top or front cover with front face and side walls.

The front face shall accommodate the Rinnai logo, as shown in the example ID, and the status LED as defined in section # 4.5.2 [PR-020]

The top cover shall have holes/cutouts, as shown in the example ID, to accommodate the terminal block and the two buttons (Reset & WPS) defined in section # 4.5

## 6.3. REAR PANEL DESIGN SPECIFICATIONS

The rear panel shall be designed with two key-hole slots for wall mounting, according to the keyhole dimensions shown below. The depth of the slot shall be 5mm and shall accommodate a screw head thickness of 3mm. The plastic design shall block direct access into the enclosure through the keyhole slot.



The rear panel design shall also have design features to install one or more magnets, to enable the unit to be magnetically mounted on the water heater. [PR-021]

## 6.4. ENCLOSURE MECHANICAL DESIGN DETAILS

The maximum enclosure dimensions and approximate weight shall be: [PR-022]

- Width: 100 mm MAX
  - Length : 100 mm MAX
  - Thickness: 35 mm MAX
  - Weight: TBD lbs. MAX
- Note: all dimensions are approximate

## 6.5. THERMAL SPECIFICATIONS

The operating and storage temperature ranges shall be: [PR-023]

- The Smart home gateway shall be designed to operate without any performance degradation throughout the temperature range of the device. (0 to 40 deg. C)
- Storage temperature shall be -10 to +60 deg. C

## 6.6. LABEL SPECIFICATIONS

The mechanical design shall provide labeling areas as follows: [PR-024]

- Product identification
  - Serial Number
  - MAC Address
  - Ayla DSN
- Warnings
  - "Class-2 Low Voltage connection only"
- Agency-required labels
  - FCC
  - IC

## 7. INDUSTRIAL DESIGN

The industrial design of the Smart home gateway (ID) shall follow the example provided in section # 6.1.1 [PR-027]

## 8. ENVIRONMENTAL SPECIFICATIONS AND PARAMETERS

This section describes the operational and non-operational environment the Smart home gateway shall be designed to operate in. For the purposes of this section, the following definitions apply:

- **Functional failure:** Permanent loss of functionality or degradation in performance below specified limits, not including cosmetic failures.

### 8.1. OPERATIONAL ENVIRONMENTAL ENVELOPE [PR-028]

Table 4 - Operational Environmental Envelope

<i>Parameter</i>	<i>Min</i>	<i>Typical</i>	<i>Max</i>	<i>Unit</i>
Operating Temperature @ sea level <sup>1</sup> @ max altitude	0		40 35	°C
Operating Humidity <sup>2</sup>	8		95	%RH
Operating Altitude, relative to Mean Sea Level (MSL)			3100	M
Operational Temperature Ramp			20	°C/hr
Notes: 1. Sea-level testing is performed at a nominal altitude of 0-300 m. 2. Non-condensing.				

**Table 5 Operational Environment Envelope**

## 8.2. NON-OPERATIONAL ENVIRONMENTAL ENVELOPE [PR-029]

These specifications cover the product after it has been removed from its retail packaging.

**Table 6 - Storage Environment Specifications**

<i>Parameter</i>	<i>Min</i>	<i>Max</i>	<i>Unit</i>
Temperature (External ambient) <sup>1</sup>	-10	60	°C
Temperature Ramp Rate <sup>2</sup>		10	°C/minute
Relative Humidity <sup>3,8</sup>	5	95	%
Relative Humidity Ramp Rate <sup>4</sup>		30	%/hour
Wet-Bulb Temperature <sup>5</sup>		40	°C
Altitude, relative to Mean Sea Level (MSL) <sup>6</sup>	-382 (106)	13600 (15.0)	m (kPa)
Pressure Ramp Rate <sup>7</sup>		10	kPa/minute
Notes: 1. These limits were derived from <a href="#">ETSI 300 019-2-7</a> , T7.3 & <a href="#">SAE J1455</a> . 2. This limit comes from ETSI <a href="#">300 019-2-7</a> , T7.3. 3. This limit comes from guidance found in IEC <a href="#">60068-2-30</a> & previous testing experience. 4. This limit comes from information gathered in other electronic devices' specifications. 5. This specification comes from <a href="#">ETSI 300 019-2-7</a> , T7.3 and IEC <a href="#">60068-2-13</a> . 6. This limit is based upon guidance found in IEC <a href="#">60068-2-13</a> .  Condensation is not permitted under any circumstances.			

**Table 7 Non-Operational Environment Envelope**

## 8.3. VERTICAL DROP CHASSIS ENDURANCE [PR-030]

The Smart home gateway MUST be operational within specifications after being dropped once on any side without its shipping carton from a height of 75 cm onto a concrete floor.

The Smart home gateway MUST NOT develop any openings or other deformations that could introduce the risk of an electrical shock.

## 8.4. CHASSIS IMPACT [PR-031]



The Smart home gateway MUST withstand a 1.3 meter (51 in) free-fall drop of a 51 mm (2 in) sphere weighing 535 grams (1.18 lb) resulting in an absence of distortion in the chassis that would create any contact between the chassis and an electrically active circuit, or expose any openings that would create a risk of electrical shock or high energy current levels.

#### **8.5. CHASSIS STATIC LOAD [PR-032]**

The Smart home gateway chassis MUST NOT incur any damage or visible deformation after the Smart home gateway has been subjected to a static load of 45 kg for 1 minute without its shipping carton.

#### **8.6. SHIPPING VIBRATION [PR-033]**

The Smart home gateway MUST be fully operational within specifications after exposure without its shipping carton to a swept frequency vibration applied in each of the three (3) mutually perpendicular planes with a peak displacement of 2.5 mm (5 mm total excursion) each side of resting point, in each plane.

*Note: The frequency of vibration will be varied uniformly from seven (7) to thirty (30) cycles and back to seven (7) cycles per second three (3) times over a period of thirty (30) minutes.*

### **9. SYSTEM PERFORMANCE METRICS AND RELIABILITY**

#### **9.1. LONG-TERM STABILITY**

The Smart home gateway incorporates digital logic and multiple radio subsystems. As with any machine with similar performance, each piece of logic and each digital bus has a small, but finite probability of an error occurring. Since not all errors are trapped, there exists a small but finite probability that the system will crash if it runs long enough. This is a soft failure, since the user can reboot the device and it will operate normally, hence this metric is expressed as a Mean Time Between Failures or MTBF.

Long-term stability is defined as the capability of Smart home gateway to operate continuously, without crashing, for extended periods of time. Since crashes are probabilistic by nature, this metric shall be defined as the reciprocal of the number of random crashes occurring per device hour of operation. For purposes of this test, an application that taxes all major subsystems of the device shall be run continuously on a population of devices for an extended period of time.

In service MTBF calculations MUST be in hours as per the following formula:

$$MH = TT / TF$$

Where:

MH = Mean Time Between Failures in Hours

TT = Cumulative service hours

TF = Total Failures during TT

The Smart home gateway Annualized Failure Rate ( AFR) MUST NOT exceed 2% of the installed units per current year.

- MTBF of 438,000 hours @ 25 °C [PR-034]
- MTBF of 100,000 hours @ 50 °C. [PR-035]

The Smart home gateway MUST NOT exceed 2% failure rate over the projected service life of the products of 5 years during any period and quantity of units over any interval analyzed. [PR-036]

## **9.2. LIST OF CRITICAL COMPONENTS**

In order to maintain high levels of product reliability, the quality and function of certain components is critical. In addition, some components impact safety and EMI certifications.

Deviation from the AML for critical components cannot be made without engineering approval. The list of components is as follows:

1. Main Processor and WiFi Module
2. ZigBee Transceiver
3. Rinnai custom Murata chip H8D3317
4. Rinnai customized Renesas microprocessor R5F101JEDFA
5. DDR Memory
6. Flash Memory
7. Power Supply Regulators
8. Connector

## **10.AGENCY AND INDUSTRY CONFORMANCE REQUIREMENTS**

### **10.1. SAFETY COMPLIANCE**

The external power supply in the water heater used to power the App Enablement Module shall comply with the agency requirements of: (as a minimum) [PR-037]

1. ANSI Z21.10.3CSA 4.3

### **10.2. SYSTEM IMMUNITY**

The App Enablement Module shall comply with ESD immunity test per ETSI /ESD standard. [PR-038]

### **10.3. EMI COMPLIANCE**

The App Enablement Module shall be designed to comply with the EMI standards listed below, for unintentional emissions. [PR-039]

The device shall fulfill the requirements of:

- (IC) Industry Canada Interference-Causing Equipment Standard ICES-003
- FCC part 15 class B for unintentional emissions (Residential)

- (FCC) 47 CFR 15, 'Title 47 – Telecommunication. Chapter I – Federal Communications Commission. Part 15 - Radio frequency devices', Class B for ZigBee and WiFi intentional emissions.

#### 10.4. RoHS COMPLIANCE

The Smart home gateway shall meet the EU directive for removal of hazardous substances (RoHS) as shown in the following table: **[PR-040]**

Item	Region	Requirement	Standard
1	EU NA Environmental Materials & Process	RoHS Certificates of Compliance	Reduction of Hazardous Substances Directive 2002/95/EC of the European Parliament and Council of 27-Jan-2003
2	EU NA Materials Recycling	Documented WEEE System and Processes	Waste Electrical & Electronic Equipment Directive 2002/96/EC,

**Table 8 RoHS Compliance**

### 11. SUMMARY OF TECHNICAL HARDWARE SPECIFICATIONS

The following tables provide a convenient summary of the product technical specifications for the Smart home gateway and a compliance matrix to validate specifications have been met.

#### 11.1. UNIT ARCHITECTURE COMPLIANCE MATRIX

PRD. Number	Specification	MRD Compliance
[PR-001]	The main processor shall be a MIPS 24KEc embedded within the MediaTek MT7620A SoC	
[PR-002]	The following radios Shown in table 3.1.2 will be used in the Smart home gateway	
[PR-003]	WiFi module shall be based on the MediaTek MT7620A integrated radio chipset	
[PR-004]	The Zigbee radio shall utilize the Silicon Labs EM357 transceiver	
[PR-005]	PCB design practices compliant with section 4.1	
[PR-006]	Onboard power supply design compliant with section 4.2	
[PR-007]	Processor must support clock speed up to 580MHz	
[PR-008]	Unit designed for 256MB / 128MB / 64MB of DDR2 RAM	
[PR-009]	Unit designed for 128MB of NAND flash	
[PR-010]	Headers / other mechanisms provided to program all programmable parts	

[PR-011]	External connectors, buttons & indicators provided per table 4.5	
[PR-012]	LED indicators provided and function per table 4.5.2	
[PR-013]	User button for WiFi setup per 4.5.3	
[PR-014]	User button for input to SoC per 4.5.4	
[PR-015]	Antenna types compliant with section 5	
[PR-016]	Antenna performance will be optimized by simulation	
[PR-017]	Both wall and heater mounting supported	
[PR-018]	Unit enclosure resistant to household chemicals	
[PR-019]	Unit enclosure is UV stable per section specifications	
[PR-020]	Front panel will accommodate LEDs	
[PR-021]	Enclosure shall have keyhole slots and magnetic mounting features per section 6.3	
[PR-022]	Enclosure dimensions shall comply with section 6.4	
[PR-023]	Unit meets thermal specifications in section 6.5	
[PR-024]	Labels will be provided per section 6.6	
[PR-025]	Enclosure logos provided per section 6.7	
[PR-026]	Board dimensions compliant with section 6.8	
[PR-027]	Industrial design per section 6.1.1	
[PR-028]	Operational environmental envelope compliant with section 8.1	
[PR-029]	Storage environmental envelope compliant with section 8.2	
[PR-030]	Vertical Drop Chassis Endurance specifications in Section 8.3	
[PR-031]	Chassis Impact specifications in Section 8.4	
[PR-032]	Chassis Static Load specifications in Section 8.5	
[PR-033]	Shipping Vibration specification in Section 8.6	
[PR-034]	MTBF of 438,000 hours @ 25 °C in Section 9.1	
[PR-035]	MTBF of 100,000 hours @ 50 °C in Section 9.1	
[PR-036]	Failure Rate MUST NOT exceed 2% failure rate over 5 years in Section 9.1	
[PR-037]	External power supply will meet UL and CSA safety standards	
[PR-038]	Unit will meet ESD immunity per ETSI specifications	
[PR-039]	Unit will meet applicable FCC and CSA EMI standards	
[PR-040]	Unit will be designed for RoHS compliance	

**Table 9 Requirement Compliance Matrix**

## Statements

### FCC Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates 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 device complies with Part 15 of 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 to this equipment. Such modifications could void the user's authority to operate this equipment. Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### IC Statement

This device complies with Industry Canada's license-exempt RSSs. 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.

Cet appareil est conforme aux CNR exemptes de licence d'Industrie Canada . Son fonctionnement est soumis aux deux conditions suivantes :

- ( 1 ) Ce dispositif ne peut causer d'interférences ; et
- ( 2 ) Ce dispositif doit accepter toute interférence , y compris les interférences qui peuvent causer un mauvais fonctionnement de l'appareil.

### RF exposure warning

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. User should avoid un-intended operation of usage when it is collocated with other transmitters or antenna. The distance between user and products should be no less than 20cm.

La distance entre l'utilisateur et de produits ne devrait pas être inférieure à 20cm