\documentclass[letterpaper, 10pt]{article}

\usepackage{fullpage}

\usepackage{textcomp}

\usepackage{multirow}

\usepackage{vhistory}

\usepackage[utf8]{inputenc}

% TODO

% PRD ERD

% Retail Cost Cost/BOM

% Lifespan Cycles of critical components

% After purchase service requirements Features to enable repair

\title{BRIDGE PRD}

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\date{April 2018}

\begin{document}

\maketitle

% Start of the revision history table

\begin{versionhistory}

\vhEntry{0.0.1}{12.04.2018}{MS}{Created}

\vhEntry{0.0.2}{12.04.2018}{MS|SS}{Revised table formatting}

\vhEntry{0.0.3}{12.04.2018}{MS}{Added information to \S 1.2}

\vhEntry{0.0.4}{12.04.2018}{MS}{Changed author names to `First Last' from `Last, First'}

\vhEntry{0.0.5}{13.04.2018}{MS}{Added \S 5 and \S 6}

\vhEntry{0.0.6}{15.04.2018}{MS}{Added temperature reporting to \S 1, edited range in \S 2.2, clarified \S 5.1.3, and removed requirement to label the button}

\end{versionhistory}

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\tableofcontents

\pagebreak

\section{Overview}

The Guardian Bridge is a device that can communicate to a single valve controller over Guardian RF and to a security panel over wire, or a Z-Wave hub. This allows a security panel or Z-Wave hub to open/close the valve controller and be alerted if a leak is detected.

\subsection{Key Features}

\begin{itemize}

\item GuardianRF, RelayLink\textsuperscript{TM}, Z-Wave

\item USB or 12V power

\end{itemize}

\subsection{Communication}

\subsubsection{GuardianRF}

The Guardian Bridge will be able to send the following commands to the valve controller:

\begin{itemize}

\item Open the valve

\item Close the valve

\end{itemize}

The Guardian Bridge will receive the following events from the valve controller:

\begin{itemize}

\item At least one sensor is wet

\item All sensors are dry

\item Valve opened

\item Valve Closed

\item Lowest temperature reported by any connected device

\end{itemize}

\subsubsection{RelayLink\textsuperscript{TM}}

The Guardian Bridge will be able to send the following information over RelayLink\textsuperscript{TM}

\begin{itemize}

\item At least one sensor is wet

\item All sensors are dry

\end{itemize}

OR

\begin{itemize}

\item Valve is open

\item Valve is closed

\end{itemize}

\subsubsection{Z-Wave}

The Guardian Bridge will be able to send the following information over Z-Wave:

\begin{itemize}

\item At least one sensor is wet

\item All sensors are dry

\item Valve is open

\item Valve is closed

\item Lowest Temperature reported by any connected device

\end{itemize}

\section{Specifications}

This section describes the requirements and scope of the Guardian Bridge

\subsection{Environmental Specifications}

\begin{center}

\begin{tabular}{|| p{5cm} | p{5cm} ||}

\hline

Feature & Description \\ [0.5ex]

\hline\hline

Operating Temperature Range & 0\textdegree C to 70\textdegree C \\

\hline

Operating Humidity Range & 5\% to 90\% RH Non Condensing \\

\hline

Storage Temperature Range & -40\textdegree C to 75\textdegree C - capable of operation after a 20 minute transition from storage to operating temperature \\

\hline

Storage Humidity Range & 0\% to 95\% RH - capable of operation after a 20 minute transition from storage to operating humidity \\

\hline

Vibration & All axes, amplitude: 2mm, frequency: 1Hz - 20,000Hz \\

\hline

Mechanical Shock (Drop) & 1m \\ [1ex]

\hline

\end{tabular}

\end{center}

\subsection{Performance Specifications}

\begin{center}

\begin{tabular}{|| p{4cm} | p{6cm} ||}

\hline

Feature & Description \\

\hline \hline

Range & 1000+ ft line of sight (Guardian RF) \newline 450+ ft line of sight (Z-Wave) \\

\hline

Life Expectancy & 10 years \\

\hline

Reliability & 1st year 99\% \newline 5 years 95\% \\

\hline

\end{tabular}

\end{center}

\subsection{Hardware Specifications}

\subsubsection{Bridge Specifications}

\begin{center}

\begin{tabular}{|| p{5cm} | p{8cm} ||}

\hline

Item & Description and Specifications \\

\hline \hline

RF module & SX1276IMLTRT, IC RF TXRX 802.15.4 28VQFN \\

\hline

Z-Wave Module & ZM5101 \\

\hline

Input voltage & \\

\hline

GuardianRF Receive sensitivity & \\

\hline

Z-Wave Receive sensitivity & \\

\hline

GuardianRF TX power & \\

\hline

Operation current & \\

\hline

Maximum current & \\

\hline

LEDs & 3x White, same as valve controller\\

\hline

OTA & Support remote FW upgrade (All MCUs)\\

\hline

\end{tabular}

\end{center}

\subsection{Mechanical Specifications}

The 3D CAD shall be modeled on nominal dimensions and shall be the primary source of dimensional information.

\begin{center}

\begin{tabular}{|| p{5cm} | p{5cm} ||}

\hline

Item & Description and Specifications \\

\hline \hline

Type & Plastic \\

\hline

Resin & Blue:3005U; \\

\hline

Finish & Same as valve controller \\

\hline

\end{tabular}

\end{center}

\subsubsection{Tooling}

Tooling shall be good for over 300,000 injections.

\subsubsection{Fit and Finish}

\begin{itemize}

\item Flash allowance shall not to exceed 0.13 mm (0.005in). Flash applies to parting lines, ejector pins, ejector blades and ejection sleeves

\item Parting line mismatch shall not exceed 0.13 mm (0.005 in)

\item Gate \& Ejector pin scar/vestige shall be sub-flush unless otherwise specified

\item Cosmetic surfaces shall be free of nicks, scratches, or tooling marks

\item The finish and color shall be similar to the Guardian valve controller. Non-visible surfaces may not be textured

\item Guardian logo, power, Z-Wave, and Guardian RF icons will be pad printed white

\end{itemize}

\section{Functional Requirements}

The Guardian Bridge translates communication from GuardianRF to either RelayLink\textsuperscript{TM} or Z-Wave.

\subsection{LEDs}

The power and GuardianRF LEDs on the front of the Guardian Bridge will behave the same as the Guardian. The Z-Wave LED will be off when not paired to a Z-Wave hub, blinking (same pattern as WiFi light on valve controller when hotspot is on) and on when paired to the hub.

\subsubsection{LED Behavior}

\begin{center}

\begin{tabular}{|| p{4cm} | p{4cm} | p{5cm} ||}

\hline

LED & Behavior & Events \\

\hline \hline

\multirow{2}{\*}{1\textsuperscript{st} LED (Power)} & LED is ON & Bridge is powered on \\

\cline{2-3}

& LED is OFF & Bridge is powered off \\

\hline

\multirow{3}{\*}{2\textsuperscript{nd} LED (Z-Wave)} & LED is ON & Bridge is included in a Z-Wave network \\

\cline{2-3}

& LED is double-blinking & Bridge is in inclusion/exclusion mode \\

\cline{2-3}

& LED is off & Bridge is not included in a Z-Wave network \\

\hline

3\textsuperscript{rd} LED (GuardianRF) & LED blinks & Bridge has sent/received a GuardianRF transmission \\

\hline

\end{tabular}

\end{center}

\subsection{Button}

The single button will on the back will be used to pair the Bridge with a valve controller or a Z-Wave hub. A single press will be used to pair the Bridge to a valve controller (like shaking the leak detector). A triple press (3 presses in under 2 seconds) will put the bridge in Z-Wave inclusion mode if it has not been included yet, or in exclusion mode if it is currently included.

The button will also be used for factory reset. To factory reset, the button will be held for 10 seconds.

\subsection{Power}

The Bridge will come with a plug-in 5V adapter with a micro-USB connector. The power supply will have a non-removable wire of 4-6 feet. It will be gray and include the matching Guardian velcro strap. If sourcing a gray power supply will cause delays or too much added expense, a black power supply can be used and the Guardian velcro strap can be omitted.

\subsection{Guardian App and Device Pairing}

The Bridge can be connected to the Guardian App if the user has a valve controller. There can be only one Bridge connected to each valve controller.

\subsubsection{Guardian App}

The settings and information displayed to the user are TBD

\subsection{Firmware Upgrades}

The Bridge will be capable of OTA firmware updates. The GuardianRF MCU will be updated over GuardianRF, the Z-Wave module will be updated over Z-Wave. In case an OTW firmware update is required during development and testing the device will be designed in such a way that the firmware can be updated without complete disassembly.

\subsection{GuardianRF}

When any leak sensor is triggered the valve controller will send a message over GuardianRF to the bridge that one of the sensors is wet. Once all of the sensors are dry, the valve controller will send a message to the bridge that all sensors are dry

When the Bridge receives a command to open or close the valve from Z-Wave or RelayLink™, an open or close command will be sent to the valve controller via GuardianRF.

\subsection{RelayLink\textsuperscript{TM}}

RelayLink™ is an revolutionary, innovative new communication protocol developed by Elexa Consumer Products to be faster and easier to use than current standards. Please see the RelayLink™ Specification Document for more information

\section{Z-Wave}

When the Bridge receives a ‘leak detected’ message it will inform the Z-Wave hub if it is paired. It will also inform the hub when an ‘all sensors dry’ message is received. The hub will also be able to send ‘open valve’ and ‘close valve’ messages to the bridge to relay to the valve controller.

When included in the Z-Wave network, the Bridge will appear as two devices:

\begin{itemize}

\item An On/Off Switch

\item A Leak Sensor

\item A temperature sensor (see \S 4.4.1)

\end{itemize}

\subsection{Z-Wave Inclusion}

The Bridge will enter inclusion mode when first powered on (if not already included in a Z-Wave network) and will stay in inclusion mode for 30 seconds. After 30 seconds, if the Bridge is not included, pressing the button on the device 3 times in less than 2 seconds will put it back in inclusion mode for 30 seconds.

When in inclusion mode, the Z-Wave LED will double blink. After successful inclusion the Z-Wave LED will remain solid.

\subsection{Z-Wave Exclusion}

If the hub is in exclusion mode and the Bridge is included in the Z-Wave network, a triple press of the Bridge button will put the device in exclusion mode. Upon successful exclusion the Z-Wave LED will turn off.

\subsection{NWI}

The Bridge will support NWI -Network Wide Inclusion

\subsection{Z-Wave Specifications}

\subsubsection{Association Groups (AGs)}

\begin{center}

\begin{tabular}{|| p{3cm} | p{10cm} ||}

\hline

Association Group & Description \\

\hline \hline

01 & Lifeline \newline

This AG sends Binary Report when valve is opened or closed,

Supports Device Reset Locally.

When any leak sensor is wet, the device will send a leak notification. When all sensors are dry, the device will send a `leak cleared' notification.

\\

\hline

02 & This AG is sent an Open/Close Basic Report \\

\hline

03 & Sensor Multilevel Report containing the temperature information every 60 minutes \\

\hline

\end{tabular}

\end{center}

\pagebreak

\subsubsection{Compatible Command Classes}

\begin{center}

\begin{longtable}{|| p{6cm} | p{9cm} ||}

\hline

Command Class & Notes \\

\hline \hline

COMMAND CLASS VERSION V2 (86) & Returned Value: 03 04 3D 01 01 01 00\newline Z-Wave Library Type: 03 (Enhanced Slave)\newline Protocol Version: 04 3D\newline Protocol Sub-Version: 01 01\newline Application Version: 01\newline Application Sub-Version: 00 \\

\hline

COMMAND CLASS BASIC V1 (20) & - \\

\hline

COMMAND CLASS SWITCH BINARY V1 (25) &

Binary Switch commands will open/close the valve. Reports are used to communicate valve opening/closing Valve Open\newline

FF Valve Closed: 00

\\

\hline

COMMAND CLASS SENSOR MULTILEVEL V11 (31) & The Multilevel CC is used to communicate the temperature recorded by the Valve Controller in the Guardian system. This is only reported to association group 3.\newline

Returned Value: 01 XX XX\newline

Sensor Type: 01 (Temperature)\newline

Precision/Scale/Size (Celsius): 01 (Precision = 000; Scale = 00; Size = 001)\newline

Precision/Scale/Size (Farenheit): 01 (Precision = 000; Scale = 00; Size = 001)\newline

Sensor Data: 00 ~ FF (-125 ~ 125 in Degrees Fahrenheit or Celsius)\\

\hline

COMMAND CLASS MULTI CHANNEL V4 (60) & The Multi Channel Command Class is used to distinguish commands to/from the Valve Controller endpoint (endpoint 1) and the Leak Detector endpoint (endpoint 2).\\

\hline

COMMAND CLASS MULTI CHANNEL V4 (60) & The Multi Channel Command Class is used to distinguish commands to/from the Valve Controller endpoint (endpoint 1) and the Leak Detector endpoint (endpoint 2).\\

\hline

COMMAND CLASS ASSOCIATION V2 (85) & Group 1 Group 1 is the “Lifeline” group, which can hold five devices.\\

\hline

COMMAND CLASS ASSOCIATION GRP INFO V3 (59) & -\\

\hline

COMMAND CLASS MANUFACTURER SPECIFIC V2 (72) & Returned Value: 02 1F 01 02 03 04\newline

Manufacturer ID: 02 1F\newline

Product Type: 01 02\newline

Product ID: 03 04\\

\hline

COMMAND CLASS DEVICE RESET LOCALLY V1 (5A) & -\\

\hline

COMMAND CLASS POWERLEVEL V1 (73) & -\\

\hline

COMMAND CLASS SUPERVISION V1 (6C) & -\\

\hline

COMMAND CLASS FIRMWARE UPDATE MD V4 (7A) & -\\

\hline

COMMAND CLASS CONFIGURATION V1 (70) & See Configuration Command Class Parameters\\

\hline

COMMAND CLASS NOTIFICATION V8 (71) & The Guardian Bridge sends a notification report to association group 1 when any Leak Detector in the system senses moisture.\newline

Returned Value: 00 00 00 FF 05 XX 00 00\newline

V1 Alarm Type 00 (Unsupported)\newline

V1 Alarm Level 00 (Unsupported)\newline

Notification Status: FF (Unsolicited Reporting is Enabled)\newline

Notification Type: 05 (Water Alarm)\newline

Leak Detected Event: 02 (Water Leak Detected, Unknown Location)\newline

Leak Removed Event: 00 (Event Inactive)\newline

Sequence/Reserved/Event Parameters: Length 00\newline

Notification Event Parameters: 00 (No Event Parameters)\\

\hline

COMMAND CLASS ZWAVE PLUS INFO V2 (5E) & Returned Value: 01 05 00 15 00 15 00\newline

Z-Wave Plus Version: 01\newline

Role Type: 05\newline

Node Type: 00\newline

Installer Icon Type: 15 00\newline

User Icon Type: 15 00 \\

\hline

\end{longtable}

\end{center}

\section{RelayLink\textsuperscript{TM}}

RelayLink\textsuperscript{TM} provides power and two way communication between an ancient security panel and the Guardian Bridge, one bit at a time.

\subsection{Pinout}

\begin{center}

\centering

\begin{tabular}{||l||l|l|l|l|l|l|l||}

\hline

Group & \multicolumn{2}{l|}{Power} & \multicolumn{2}{l|}{Input} & \multicolumn{3}{l||}{Output} \\

\hline

Pin Number & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ \hline

Label & +12V & GND & IN & GND & NO & COM & NC \\ \hline

\end{tabular}

\end{center}

\subsubsection{Power Group}

Pins 1 and 2 are used to supply power from a 12V security panel.

\subsubsection{Input Group}

Pins 3 and 4 are a configurable input. With the Guardian App the Bridge can be set to send an open or close command to the valve controller. Details are TBD

\subsubsection{Output Group}

Pins 5, 6, and 7 are the outputs. The Guardian App can be used to configure the output to be indicate:

\begin{itemize}

\item Valve open

\item Valve closed

\end{itemize}

OR

\begin{itemize}

\item At least one leak sensor is wet

\item All sensors are dry

\end{itemize}

\section{Pad Printing}

Pad printing will be done in white, black, or gray (TBD).

\subsubsection{Required Logos/Labels}

The following must be printed on the Bridge:

\begin{itemize}

\item Guardian logo on top

\item Power symbol on 1\textsuperscript{st} LED

\item Z-Wave symbol on 2\textsuperscript{nd} LED

\item GuardianRF symbol on 3\textsuperscript{rd} LED

\item RelayLink\textsuperscript{TM} pin numbers

\end{itemize}

\section{Packaging and Labels}

\section{Validation and Testing}

\section{Certifications}

\end{document}