

EVB-034-C OPERATIONAL DESCRIPTION

1. Overview

This equipment is a water treatment valve controller. It can control valves for multiple types of water treatment appliances, such as a water softener or a backwashing water filter. This controller incorporates Bluetooth in order to give the end user the ability to connect to the valve controller from a convenient interface on their phone or other type of smart device. This gives the user easy access to view operation and change settings.

2. Operational Details

The valve control board has a Nordic nRF52840 microcontroller and radio transceiver as well as a nRF21540 Front End Module (FEM) which contains a power amplifier (PA) and a low noise amplifier (LNA). The FEM is used to increase range over what the transceiver by itself could accomplish. The board has an integral trace antenna with an antenna gain of -4.35 dBi. The board is powered by a 12VDC wall plug power supply and also makes provision for connecting a 9VDC battery. The battery allows for time keeping and water metering backup in case of power loss and, if necessary, can move the motor to a location that is not wasting water when power loss occurs. When the board is powered from the wall plug power supply it will advertise its presence via Bluetooth (version 5 or greater). If a user chooses to connect to the controller, they will use an app on their smart device that will arbitrate a Bluetooth connection and will transmit data about the controller and its associated water treatment appliance. Our software is set up to only connect using the Bluetooth Low Energy mode. When connected, the user's app will communicate with the valve once a second, keeping the connection alive and updating any data that has changed on either the valve controller side or on the app side. Once the user closes the app the connection will be terminated, and the valve controller will return to advertising mode. Our (Chandler Systems, Inc.) initial release of firmware for this device is designated as "C6.01" and will numerically increase with future firmware updates. Any firmware updates would make operational improvements of the ability of the equipment to accomplish its functions as a water treatment appliance, and update the Bluetooth Softdevice provided by Nordic Semiconductor.

2.1 Regulation reference

FCC 15.247

2.2 Nominal transmit frequency

2402-2480 MHz

Transmit frequency is controlled by a 32.00 MHz crystal oscillator, X2

The maximum tolerance is +/- 20ppm.

The RF transmitter IC U2 (nRF52840) has a built-in phase locked loop circuit. The frequency of X2 is multiplied using the phase locked circuit, and then amplified for transmission.

2.3 Modulation scheme

This controller uses a modulation scheme that is in accordance with the Bluetooth Core specification, specifically, any active version 5.0 or greater.

The core specification can be found at

<https://www.bluetooth.com/specifications/specs/>

This is controlled by a Bluetooth SIG approved Softdevice controller provided by Nordic Semiconductor. As of this writing, we are using the Softdevice provided in the nRF Connect SDK v2.6.1.

We are only using the Bluetooth Low Energy modes (1 and 2 Mbps).

2.4 Maximum RF output power:

37 mW