![AW-LAKE PROCESS FLOW MEASUREMENT]

▶ **The EDGE Flow Sensor with Bluetooth**

Installation, Operating & Maintenance Manual

Table of Contents

Overview

AW-Lake's EDGE sensor family is an all-in-one sensor. The EDGE will mount on most of our flow meters and has 3 different output types available. We have equipped the board with an easy-to-use USB-C connector which allows users to connect to our free computer toolkit for programming and real time flow updates. An optional Bluetooth feature is available on most versions with no extra cost, which allows users to use the mobile app to setup the sensor and view real time outputs with their smart devices. The sensor comes equipped with an integrated linearizer for voltage and current outputs. This unit will be replacing most of our legacy sensors and should be a simple, more cost-effective solution. The new design is RoHS-compliant and utilizes surface mount components and a more up-to-date circuit design.

**Please note that some features and specifications are model specific.*

Technical Specifications

Supply Voltage Range
12-24VDC ±10%
Max current draw 40-100mA
(model-specific, contact factory)

Analog Output Options
4-20mA & 0-10V - Default
0-5V, 1-5V & 2-10V - Available
through PC Toolkit or mobile app

Standard Max Output
+2.5% of max scaling (20.5mA/5.125V /10.25V)

Error Indication
+10% of max scaling (22mA/5.5V/11V)

Analog Output Resolution
16 bit

Analog Output Update Time
100mSec minimum

Ambient Temperature
-40°F to 185°F (-40°C to 85°C)

Pulse/Frequency Output:
Push/Pull output - default
Sinking or Sourcing optional.
Easy setup through PC Toolkit.

Bluetooth
Contains Bluetooth Transmitter Module
FCC ID:12208A-01

MATERIALS OF CONSTRUCTION

Housing	Anodized Aluminum
Pickup	303ss body w/ Zytel cap
Seal	Chloroprene Rubber (CR)
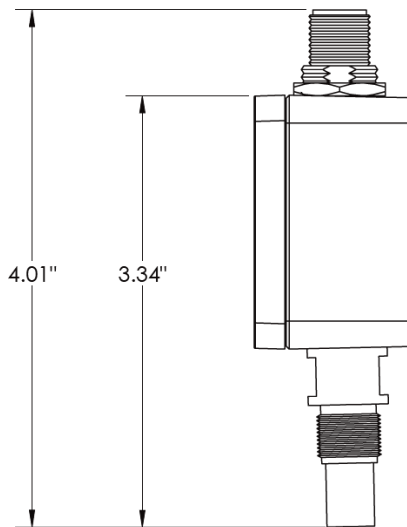
EDG1&3   **EDG2**
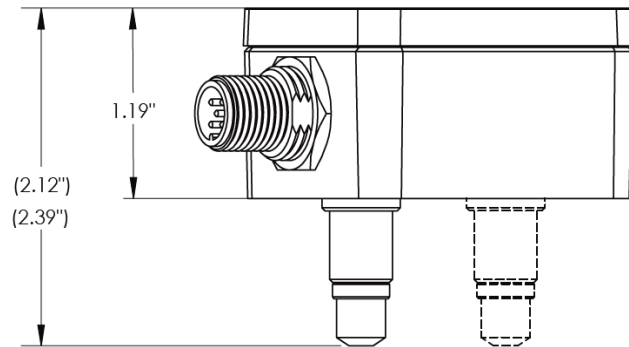
INDUSTRY STANDARD M12-A CONNECTORS

PULSE OUTPUT

5 PIN

1: 12-24VDC
2: GROUND
3: FREQ OUT 1
4: FREQ OUT 2
5: N/C

ANALOG + PULSE

1: 12-24VDC
2: GROUND
3: mA OUT
4: V OUT
5: FREQ OUT 1

ANALOG + PULSE + MODBUS

8 PIN

1: 12-24VDC
2: GROUND
3: FREQ OUT 1
4: FREQ OUT 2
5: mA OUT
6: V OUT
7: MODBUS +
8: MODBUS -

Signal Outputs

Frequency

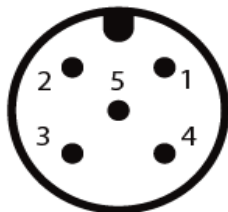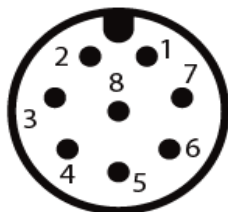Each model of sensor comes equipped with a frequency output. Single pulse versions need to be specified as Sinking or Sourcing when ordered. For all others, frequency out can be set to 3 different output types; Push-Pull, Sinking, and Sourcing. Push-pull is the default setting, and all other options can be set using the Bluetooth app or computer toolkit.

Analog

Current Output – The EDGE currently offers a sourced 4-20 mA output that can be scaled via the Bluetooth app or computer toolkit. Current output is referenced to supply ground.

Voltage Output – The EDGE offers 4 types of Voltage outputs; 0-5, 1-5, 0-10, 2-10 Volts. Default output is 0-10V and can be changed via the Bluetooth app and computer toolkit. Voltage output is referenced to supply ground.

Input Source

For versions with dual pick-ups, the EDGE sensor offers 5 different choices on the frequency output lines; Signal 1, Signal 2, Signal 1+2, Direction, and Limits.

Signal 1 – Outputs frequency from pick-up 1 (leads signal 2 by 90° phase shift)

Signal 2 – Outputs frequency from pick-up 2 (trails signal 1 by 90° phase shift)

Signal 1+2 – Outputs 2x the frequency. Users using this output must multiply the k-factor by 2

Direction – Outputs a high or low signal based on the flow direction. In forward direction, sensor will output a high signal equal to the supply voltage. In reverse flow direction, sensor will output a low signal.

Limits – Outputs a high or low signal based off the selected limit source, Total or Rate.

Test Mode

The EDGE sensor comes equipped with a push button that allows the sensor to output a set frequency on the signal output lines. There are 3 modes of operation, indicated by the green LED on the board. (D2 for frequency boards and D4 for analog and Modbus)

Mode 1 – Standard operating mode indicated with 1 green LED that blinks every 3 seconds

Mode 2 – Outputs 10 Hz frequency. For dual sensor versions, it outputs on both signal outs with signal 1 leading signal 2 by a 90 degree phase shift.

Mode 3 – Outputs 50 Hz frequency. For dual sensor versions, it outputs on both signal outs with signal 2 leading signal 1 by a 90 degree phase shift.

Bluetooth Application

EDGE App Overview

This product offers a Bluetooth app for Android and Apple devices (Android 10 or newer operating systems) that allows scaling of the analog output wirelessly. The application can be found on the AW-Lake website or on the Google Play store.

Figure 2: Location Permission
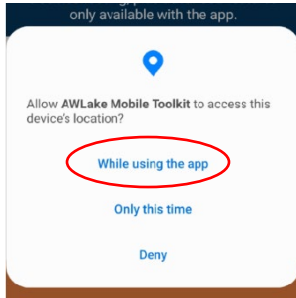
Allow device location for the app, or devices will not appear in search list.
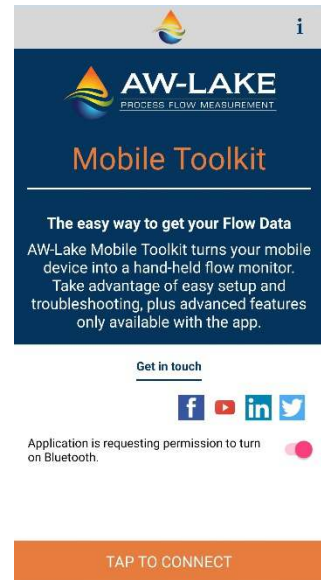
Figure 2: Device Menu

Getting Started

Download and open the application. It will ask to turn on Bluetooth, if not already on. Press orange button at the bottom to scan for devices *(Figure 1).* The default name of the device will be the same as the serial number on the outside of the device. Tap on the name to connect. Once connected the device name will appear at the top of the display with flow rate, Voltage output, and Current output. *(Figure 2)*

Menu Navigation

Press the three lines in the top right corner to access the setup menu *(Figure 3)*

System Settings: Adjust K-factor, Filter, Flow Units, Flow Time Base, Max Flow Rate, Max Flow Units, Max Time Base, and Bluetooth name

Output Settings: Where outputs can be forced to certain values or output type can be selected (Voltage type only)

Output Calibration: Calibrate analog outputs *(consult factory)*

Linearizer Table: Allows user to select custom K-factors for different points in the flow range

Diagnostics: Shows raw input frequency

About Bluetooth Device: Displays device type, Bluetooth name, firmware version, and serial number

Factory Reset: Defaults all user settings back to factory settings

Disconnect: Used to disconnect from device

Exit: Closes application

System Settings

This menu allows users to scale the EDGE to output correct analog signal and display correct flow rate in the desired units and time base. It will also allow for filtering of the output. *(Figure 4)*

*After any option is changed press **SET** for it to take effect.*
Use back button on phone to return to main screen.

K-Factor: The flow meter scaling factor in pulses/gal (found on calibration sheet)

Digital Filter: Smooth out erratic input frequency. Only effects analog signals. There are four options to choose from:

- o **Off:** No filtering
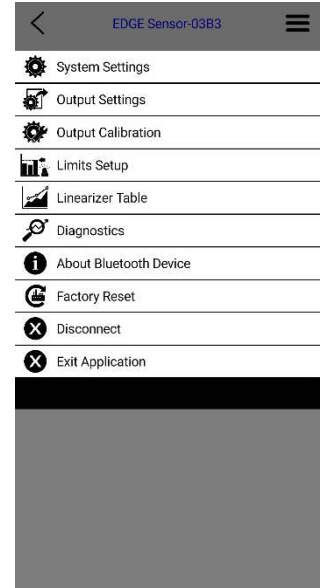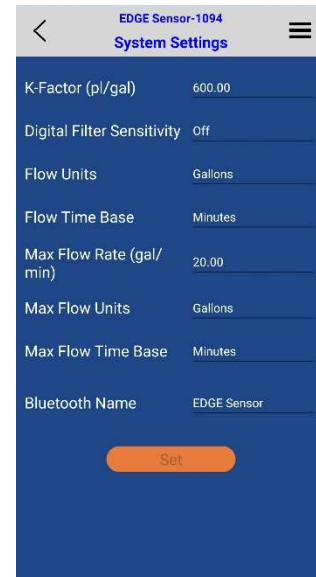
- **Low:** Most filtered, low sensitivity. (Corner frequency ¼ Hz)

- **Medium:** Medium sensitivity. (Corner frequency 1 HZ)

- **High:** least filtered, High sensitivity. (Corner frequency 10 Hz)

Flow Units: Real time flow rate units

Flow Time Base: Real time flow time base unit

Max Flow Rate: The flow rate at which the analog output should be at its max.

Max Flow Units: Selects what unit to scale flow in.

*Flow units will affect **Max Flow Rate**. Verify both after changing flow units.*

Max Flow Time Base: Can be set to Sec, Min, Hours, and Days.

*Time base will affect the **Max Flow Rate**. Verify max flow rate is correct after changing time base.*

Bluetooth Name: The name that will appear when searching for the device. Connection will be lost after changing the Bluetooth name and will require reconnection. Name is limited to 19 characters. Some characters on the phone are invalid to use. Examples: $, %, ^ symbols.

Output Settings

Forced outputs

Figure 5: Output Settings

This menu will provide the option to force one or both outputs to a certain value. Along with this ability, Voltage output type will also be selectable. *(Figure 5)*

To activate, Move the slider to the right. Enter in desired forced output and press **SET** to store information.

*Note: Forced output will not output a value when only being powered by USB. Information will not be stored until **SET** is pressed and forced value will revert back to previous value or state if output value is outside of the range.*

Forced output limitations: When forcing an output, it must be in between the analog out specifications and will go to the third decimal place.

Ex. 4-20mA output Forced output: 6.25mA
*   0-10V output   Forced output: 7.5V*

Digital Output Settings

Input Source – User can choose between 5 digital input sources depending on EDGE version. Input sources include: Signal 1, Signal 2, Signal 1+2, Direction, and Limit. See page 16 for further descriptions.

Output Mode – User has the option to select the output type of the signal. The 3 options include: Push-Pull, Sinking (NPN), and sourcing (PNP). See Page 17 for further descriptions.

Output Calibration

WARNING: Modifying these outputs could result in inaccurate analog signals.
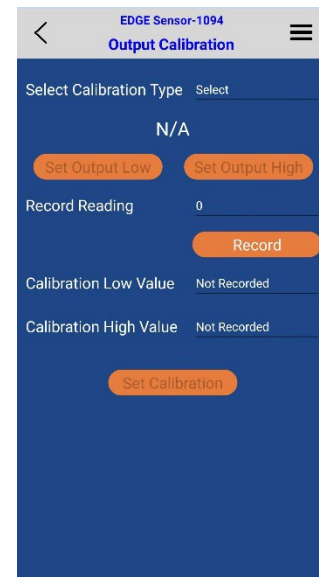
This menu is provided to adjust the EDGE analog output to correspond correctly with the analog output of the input device.

* This menu is intended for use with slight output differences between the EDGE output and customer input device. These values are factory calibrated before shipping to match meters that are calibrated annually.

Select Calibration Type: From this menu both mA and Voltage outputs may be calibrated. *(Figure 6)*

Figure 6: Output Calibration

1. Select which output type to be calibrated; mA or Voltage
2. Press **Set Output Low,** then enter in the value on user's device into **Record Reading**
   a. Ex. If EDGE is being calibrated to a multimeter, enter in reading from multimeter to **Record Reading**
3. Press **Record** button
4. Now press **Set Output High** to calibrate the high end of the output
5. Enter in High reading from input device to **Record Reading**
6. Press **Record** button
7. Verify both Calibration high and low values are correct and press **Set Calibration**

8. Use back button on phone to navigate to the main menu

Warning do not do 2 calibrations in a row. After calibration is finished, exit the app and restart the device.

Limits

The limit screen is used to set the parameters that trigger the outputs. To use this function, set the Input Source on the Output Settings menu to Limit. The limit has 4 types of triggers: Rate, Total, Grand Total, and Cycle Output.

Rate – Output will go high when flow rate is within the given parameters and low when it goes outside. Select a threshold/ target rate, then select the percentage the flow rate that is allowed to drift from that threshold. *Example: a 10% bound on a threshold of 20 gpm would give a rate range of 18-22 gpm.*

Total – Output will go high when Total goes above the threshold value.

Grand Total - Output will go high when Grand Total goes above the threshold value.

Cycle Output – Output will change state between high and low every time the threshold total is reached. To achieve one pulse per desired output, divide that value by 2. For example, to get 1 pulse per gallon set threshold to 0.5 gallons.

Cycle Output limited to 5Hz or 300 pulses per minute

Linearizer

The linearizer function is designed to correct for devices that will vary in a nonlinear way as a device changes in flow/frequency. It can take nonlinear input and change it to a more linear analog output. *(Figure 8)*

Ex. Looking at a meter that has a range of 0.5-2 GPM. If at 0.5 GPM (=100HZ) it has a K-factor of 1800, at 1.5 GPM (=200Hz) it has a K-factor of 1850, and at 2.0 GPM (=300Hz) it has a K-factor of 1900. Using a linearizer would ensure the most accurate results over the full range of flow.

Turn On Linearizer: Press the slider to turn the linearizer On and Off. The Slider will turn pink to indicate it is On. Press the **Set** button for selection to take place.

Changing Values: To change values in the table, press on the desired data point that needs changing. Enter in new values and press the **Set** button to save the changes.

Entering New Values: To enter in values to the linearizer, press the **(+)** button. This will bring up the option to type in a desired frequency and corresponding K-factor. After values are entered, press **Add**, this should input the values into the table. Continue to the next Row and repeat the process for each additional value needed. There are 10 rows available, but it is not required to fill them all. When desired amount of points are entered, press **SET** to save the changes.

Deleting Values: To Remove a value, press the slider next to the row that needs to be delete. The slider will turn Pink to indicate the row is selected. When all desired rows are selected, press the **(-)** button to remove them. Press **Set** to save the changes.

Computer Toolkit

Figure 9: AW-Lake Application
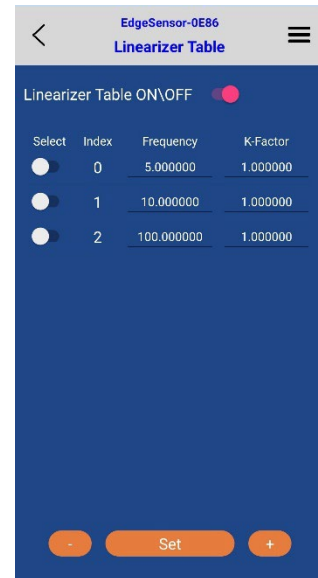
The EDGE toolkit was designed to allow users to connect to a PC and have access to scaling and monitoring of the Sensor. This program will allow users to input Flow Units, Time Base, Max Flow Rates, and K-Factors. It will also allow the user to view real time flow, force analog outputs to specific values, and set up a linearizer table.
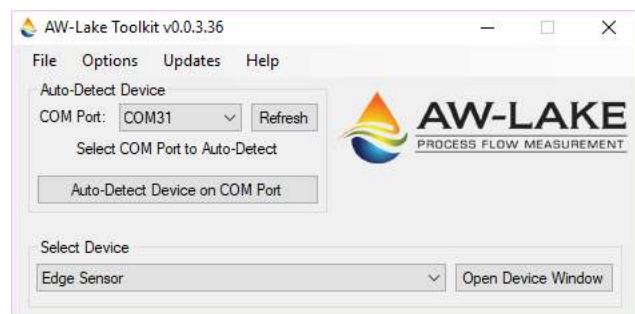
A USB-C cable is required to connect to the device. This cable powers the unit and no extra power supply is needed for Communication. However, forced outputs and sensors do not function unless externally powered.

Getting Started

First thing that must be done is to download the toolkit from the AW-Lake website which can be found at this link. (https://aw-lake.com/downloads/software/) Once downloaded, double click the icon to open the application. (Figure 9.) Unscrew the lid of the sensor to gain access to the USB-C connector on the sensor. Plug cable into the EDGE unit and a USB port on the computer. Select the **COM Port** that the device is on. If the device's COM port does not appear, click the Refresh button. Next click **Auto-Detect Device on COM Port** to bring up the toolkit.

Toolkit Overview

The AW-Lake Toolkit is designed to help users access all aspects of the EDGE sensor, from selecting output modes, scaling analog outputs, setting up a linearizer, and viewing real time flow data. Depending on the version of sensor, the Toolkit may look different. The Toolkit reads the version of the sensor and brings up all available options. *(Figure 10)*

Communication Status

In the top right corner of the Toolkit is a status bar to show communication status of the unit. There are 4 different messages it will display.
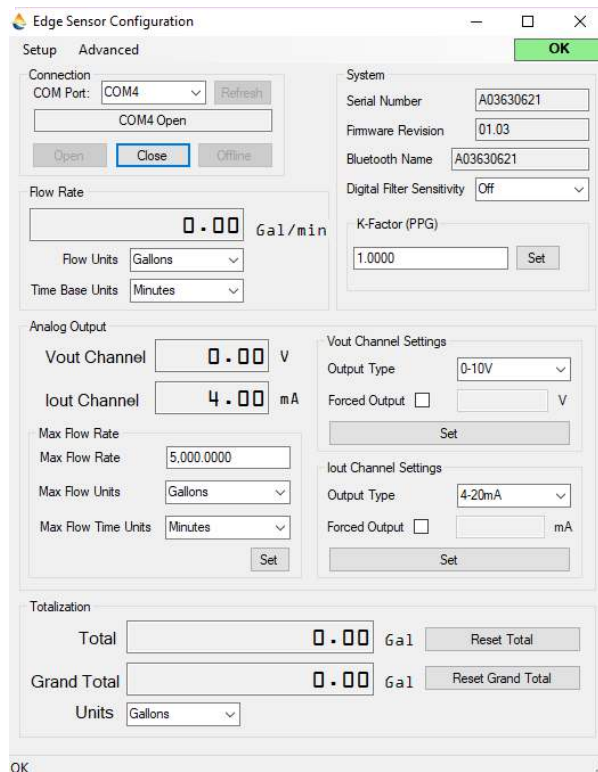
OK - Indicates device is working properly

Unsaved - Indicates a field has been modified but changes have not been saved

Error - Indicates the toolkit is not communicating with the device

Disconnected - Appears when manually disconnected from the device
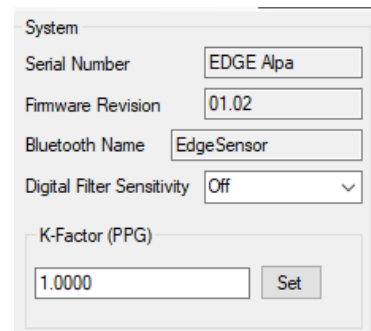
K-Factor

To scale the sensor to the flow meter, a K-factor must be entered. The K-factor can be found on the meter's calibration sheet. Enter in the K-factor in pulses per gallon. *(Figure 11)*

Digital Filter

The Digital filter smooths out erratic input frequency and only affects the analog output signal. Four options include:

- o **Off:** No filtering
- o **Low:** Most filtered, low sensitivity. (Corner frequency ¼ Hz)
- o **Medium:** Medium sensitivity. (Corner frequency 1 HZ)
- o **High:** Least filtered, high sensitivity. (Corner frequency 10 Hz)

Scaling Analog Outputs *(Figure 12)*

Figure 12: Analog Scaling

Warning: First program in K-factor of the meter

Max Flow Rate: is the flow rate at which the analog output should be at its max. Click **Set** for changes to take place.

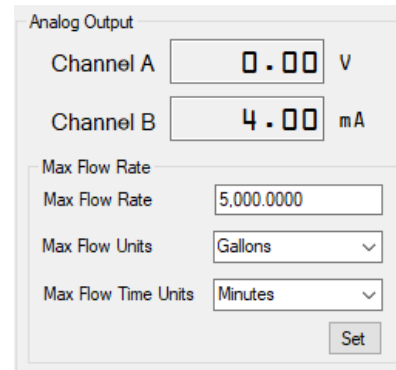**Ex. If max flow rate is set to 20 gpm, unit will output 20 mA when unit reads 20 gpm*

Max Flow Units: Selects what unit to measure flow in.

Flow units will affect both the **K-factor and **Max Flow Rate**. Verify both after changing flow units.*

Max Flow Time Unit: Can be set to Sec, Min, Hours, and Days.

Time base will affect the **Max Flow Rate. Verify max flow rate is correct after changing time base.*

Analog Output Type and Forced Outputs

(Figure 13)

The Toolkit allows the user to select different Voltage output ranges. This is done by selecting the pulldown menu and choosing between the four options available. Click **Set** after selection is made.

- 0-5V
- 1-5V
- 0-10V
- 2-10V

The toolkit also allows the user to force one or both analog outputs. This is done by checking the box and entering in the desired value. Click **Set** when done to have outputs take effect.

*Note: Forced output will not output a value when only being powered by USB. External power is needed to read forced outputs.

Analog Output Calibration

Warning: Modifying these outputs could result in inaccurate analog outputs.

This menu is provided to adjust the EDGE analog output to correspond correctly with the analog output of the input device.

* It is intended for use with slight output differences. These values are factory calibrated before shipping to match meters that are calibrated annually.

In the top left corner of the Toolkit is the **Setup** tab. This is where the analog output **Calibration** is located. *(Figure 14)*

Channel A – Voltage Output

Channel B – mA Output

1. Select which output type to be calibrated: mA or Voltage
2. This will prompt a warning to verify calibration wants to be done, click **Next**.
3. Enter in low reading from input device that FAC is being calibrated to *(Figure 15)*
   a. Ex. If EDGE is being calibrated to a multimeter, enter in reading from multimeter to **Current Readout**
4. Click **Next**
5. Enter in High reading from input device to **Current Readout** *(Figure 15)*
6. Click **Next**
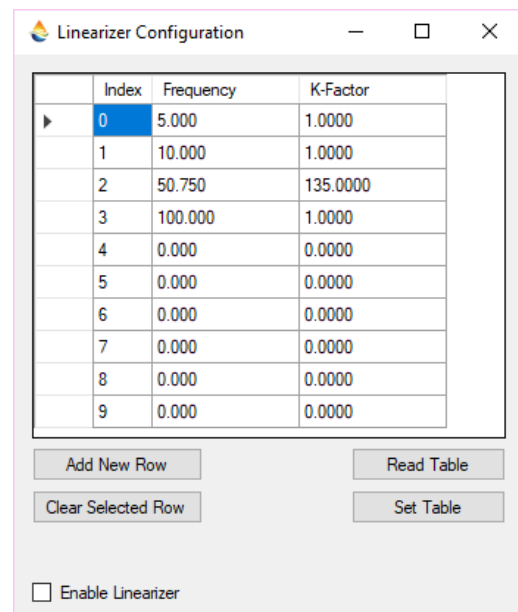7. Calibration is now complete

Figure 15: Output Calibration
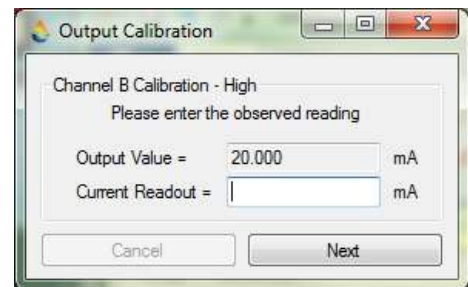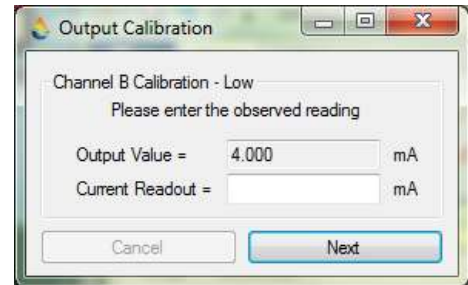
Linearizer

Figure 16: Linearizer Table

The linearizer function is designed to correct for devices that will vary in a nonlinear way as a device changes in flow/frequency. It can take nonlinear input and change it to a more linear analog output.

Ex. Looking at a meter that has a range of 0.5-2 GPM. If at 0.5 GPM (=100HZ) it has a K-factor of 1800, at 1.5 GPM (=200Hz) it has a K-factor of 1850, and at 2.0 GPM (=300Hz) it has a K-factor of 1900. Using a linearizer would ensure the most accurate results over the full range of flow.

To access the Linearizer Table, click on the **Setup** tab, followed by **Linearizer Table.** This will bring up the table as pictured *(Figure 16)*. Enable the linearizer function by clicking the **Enable Linearizer** box at the bottom left of the window. The values in the table cannot be modified. Rows can only be Added or Removed to change the table.

Proceed by clicking **Add New Row** and entering in desired K-factor and corresponding frequency. Continue doing this until all desired values are in. To remove a row, click on the column to the left of the row and followed by **Clear Selected Row** button. Remember to click **Set Table** after to apply changes.

Note: there are 10 spots available but not all rows need to be filled in. Put values in desired amount of rows and leave the rest at 0.

Bluetooth Settings

In the **Setup** tab is the option to change the Bluetooth settings. Click **Bluetooth settings**, which will bring up a separate Bluetooth window *(Figure 17)*. Enter in desired name of the device and click **Set**. A success message should appear, click **OK**.

Figure 17: Bluetooth Name

Bluetooth Pin

This allows a user to setup a password to access the sensor via the Bluetooth app. To Enable, check the box and enter in a 4-digit code followed by **Set Pin.**

Digital I/O and Limits

This menu is used to select the signal type to output on the frequency channels. For amplitudes of the signals, see *Output Mode*.

Figure 18: Digital I/O and Limits

Input Sources

Signal 1 – Directly outputs signal from pickup sensor 1

Signal 2 – Directly outputs signal from pickup sensor 2

Signal 1 + 2 – Outputs a 2x frequency signal for more resolution

Direction – Outputs a high signal in forward flow and a low signal in reverse

Limit – Outputs a high or a low signal based off the limit parameter.

Limits

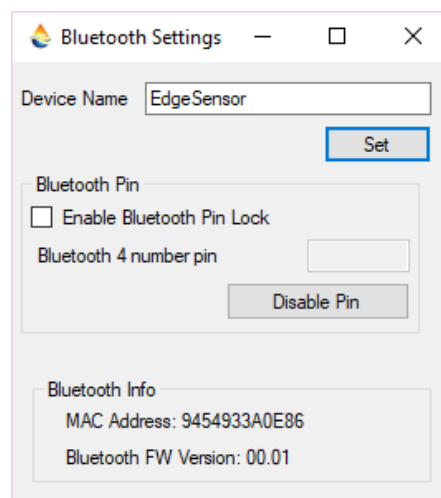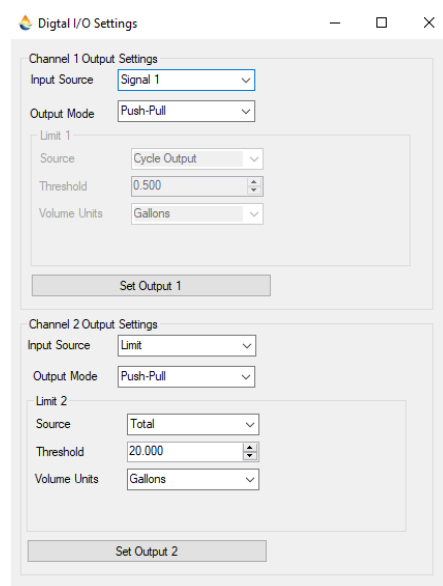**Rate** – Output will go high when flow rate is within the given parameters and low when it goes outside. Select a threshold/target rate, then select the percentage the flow rate is allowed to drift from that threshold.
Example: a 10% bound on a threshold of 20 gpm would give a rate range of 18-22 gpm.

Total – Output will go high when Total goes above the threshold value.

Grand Total – Output will go high when Grand Total goes above the threshold value.

Figure 19: Limit

Cycle Output – Output will change state between high and low every time the threshold total is reached. To achieve one pulse per desired output divide that value by 2. For example. To get 1 pulse per gallon set threshold to 0.5 gallons.

**Cycle Output limited to 5Hz or 300 pulses per minute*

Output Mode

Push-Pull – (Most common / recommended) A sourcing output that pulls the signal high, equal to the supply voltage, and back down to ground, 0 volts.

Sinking – (Open Drain / (Low Side Driver)/(Open Collector) / (NPN) This output type requires a pullup resistor to achieve user selected amplitude.

Sourcing – (Open Source / (High Side Driver)/(Open Emitter) / (PNP) This output provides amplitude equal to the supply voltage for the output, but requires a pull down resistor to get the signal to return to 0 Volts

Figure 20: Ex. Sinking (NPN) Connection
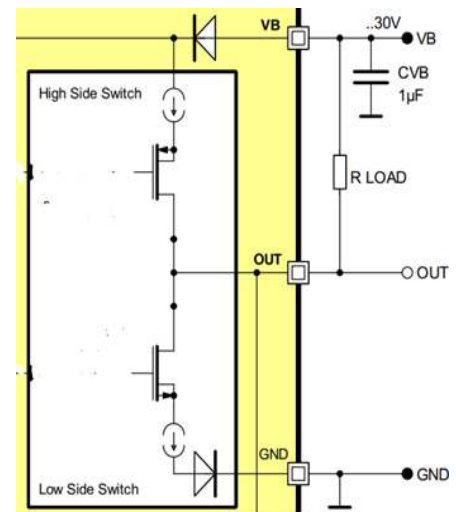
Output Power Limitations

Guaranteed sink/source Current:

1. Low Side Driver (Sinking/NPN): 200uA
2. High Side Driver (Sourcing/PNP): -200uA

Short-circuit sink/source internal Current limit:

1. Low Side Driver (Sinking/NPN): MAX 450uA
2. High Side Driver (Sourcing/PNP): MAX -450uA

Leakage current: Max +/- 100uA

Saturation voltage:

1. Low Side Driver (Sinking/NPN)
   a. 1.6V at Iout = 100mA
   b. 2.2V at Iout = 200mA

2. High Side Driver (Sourcing/PNP)
   a. -1.6V at Iout = -100mA
   b. -2.2V at Iout = -200mA

Upgrading the EDGE

The new EDGE is equiped with a bootloader which means that any updates to the firmware of the device can be done without sending the device back to the factory.

In the **Advance** tab at the top left corner of the window will be an option to **Upgrade Mainboard Firmware.** After clicking this selection a new window will open *(Figure 21)*.

Figure 21: Firmware Upgrade
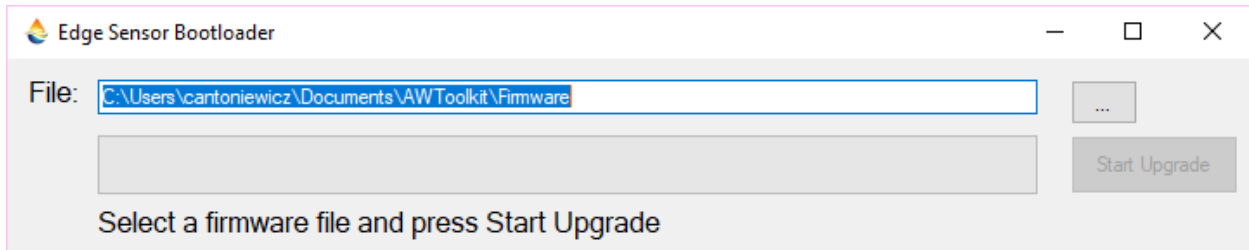
The newest Firmware version should automatically appear in the File selection. Click on **Start Upgrade**. After it is done, a successful message should appear *(Figure 22)*. Click OK and the device will restart automatically.

Figure 22: Firmware Upgrade
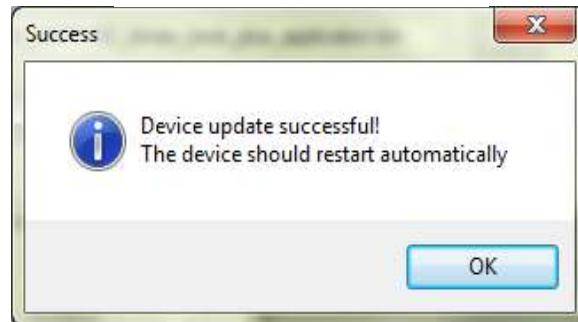
EDGE Sensor Modbus Registers

RS485 Settings

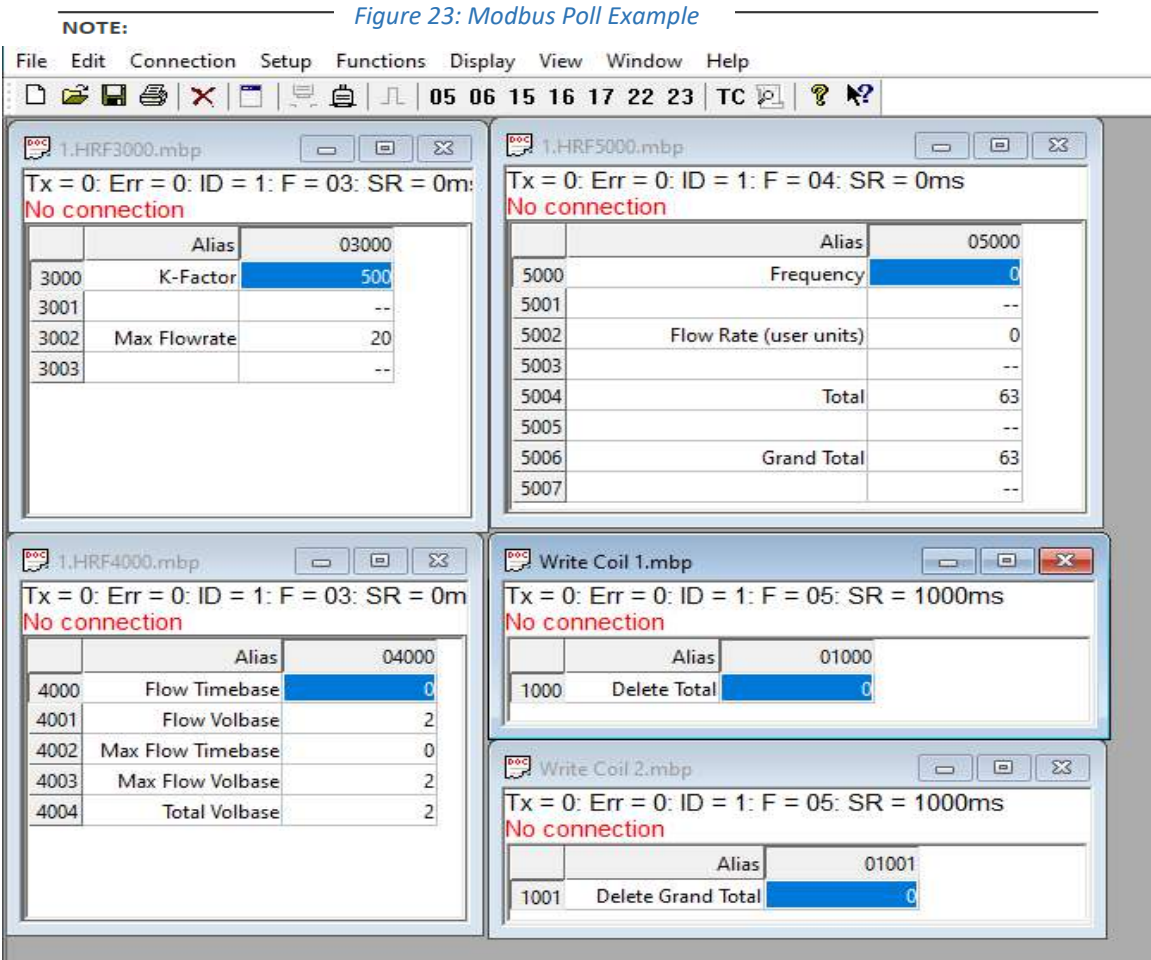- 1 Start Bit
- 8 data Bit
- No Parity Bit
- 1 Stop Bit
- 9600 Baud Rate

Example of Use

Below is a screenshot of the Modbus registers in Modbus Poll. 32-bit float registers are being read in Big-Endian. Integers (Int) are set up as Signed values. And the total resets are set up as single write coils.

Figure 23: Modbus Poll Example

Name	Register Start Address	Register Count	Value type	Value Units/Description
Holding Registers (read-write register addresses, read function byte 0x03, write function byte 0x06 for single or 0x10 for multiple registers)				
K-Factor	3000	2	32 Bit Float	
Max Flowrate	3002	2	32 Bit Float	
Flow Rate Time Base	4000	1	Int	0- Seconds 1- Minutes 2- Hours 3- Days
Flow Rate Volume Unit	4001	1	Int	0- Pulses 1- Ounces 2- Gallons 3- Barrels (Oil) 4- Cubic Centimeters 5-Cubic Meters 6- Milliliters 7- Liters
Max Flow Time Base	4002	1	Int	0- Seconds 1- Minutes 2- Hours 3- Days
Max Flow Volume Unit	4003	1	Int	0- Pulses 1- Ounces 2- Gallons 3- Barrels (Oil) 4- Cubic Centimeters 5-Cubic Meters 6- Mili-Liters 7- Liters
Total Volume Units	4004	1	Int	0- Pulses 1- Ounces 2- Gallons 3- Barrels (Oil) 4- Cubic Centimeters 5-Cubic Meters 6- Mili-Liters 7- Liters

Input Registers (read-only register addresses, read function byte 0x04)				
Raw Frequency Input	5000	2	32 Bit Float	(Hz)
Flow Rate (Users units)	5002	2	32 Bit Float	User Selected
Total (Users Units)	5004	2	32 Bit Float	User Selected
Grand Total (Users units)	5006	2	32 Bit Float	User Selected
Write Coils (Write coil addresses, read function byte 0x05 or 0x0ff00) Single Coil functions only				
Reset Total	1000	1	Bool	0 - False - Normal Mode 1- True - Reset (0x0ff00)
Reset Grand Total and Total	1001	1	Bool	0 - False - Normal Mode 1- True - Reset (0x0ff00)