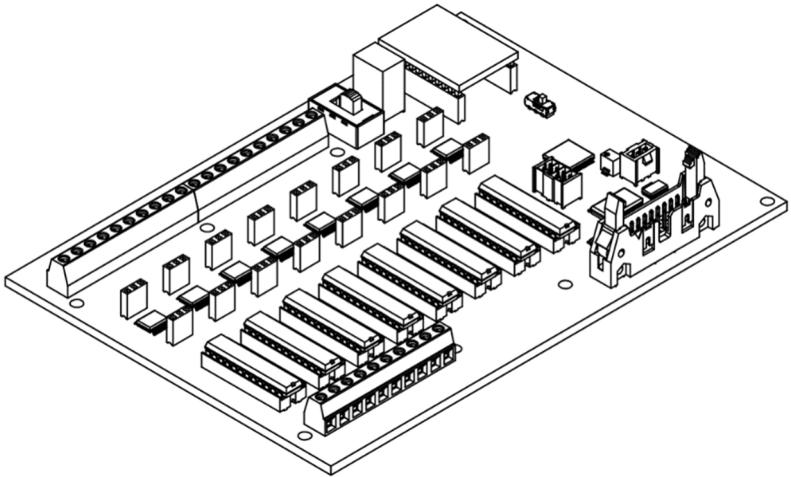


*Integrated Treatment Systems, LLC™*



*WaterFeature8™*  
*A-Series*  
*System Builder Kit*

INSTRUCTION MANUAL



June 2019

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# 1 OVERVIEW

The *WaterFeature8™* A-series circuit board is designed and manufactured by Integrated Treatment Systems, LLC™ to accomplish these objectives:

- Monitor up to eight (8) different water quality sensors at one time;
- Communicate with off-the-shelf EZO™ circuits manufactured by Atlas Scientific, LLC™ in the United States of America;
- Update and display sensor measurement values as in-situ water parameters change in real-time;
- Output a high resolution 4-20mA current loop to an external data processor such as a Programmable Logic Controller (PLC) and/or Analog Input (AI) card for data retention and process control (PLC and AI card are not included with the *WaterFeature8™* System Builder Kit).

The *WaterFeature8™* is designed specifically for water and wastewater treatment monitoring and control solutions, although ITS™ encourages the use of custom-built integrated systems to address a wide range of different water quality challenges.

U.S Customary units are typically used for each sensor when available except in specific situations. The following units are compatible with the *WaterFeature8™* and cannot be changed in the current firmware version.

- Dissolved Oxygen (DO): milligrams per liter (mg/L)
- Oxidation-Reduction Potential (ORP): millivolts (mV)
- pH: unitless (sometimes called “standard units” or SU)
- Temperature: Fahrenheit (°F)
- Flow: gallons per minute (gpm)
- Conductivity: milliSiemens per centimeter (mS/cm)

## 2 *WaterFeature8*<sup>™</sup> BOARD COMPONENTS

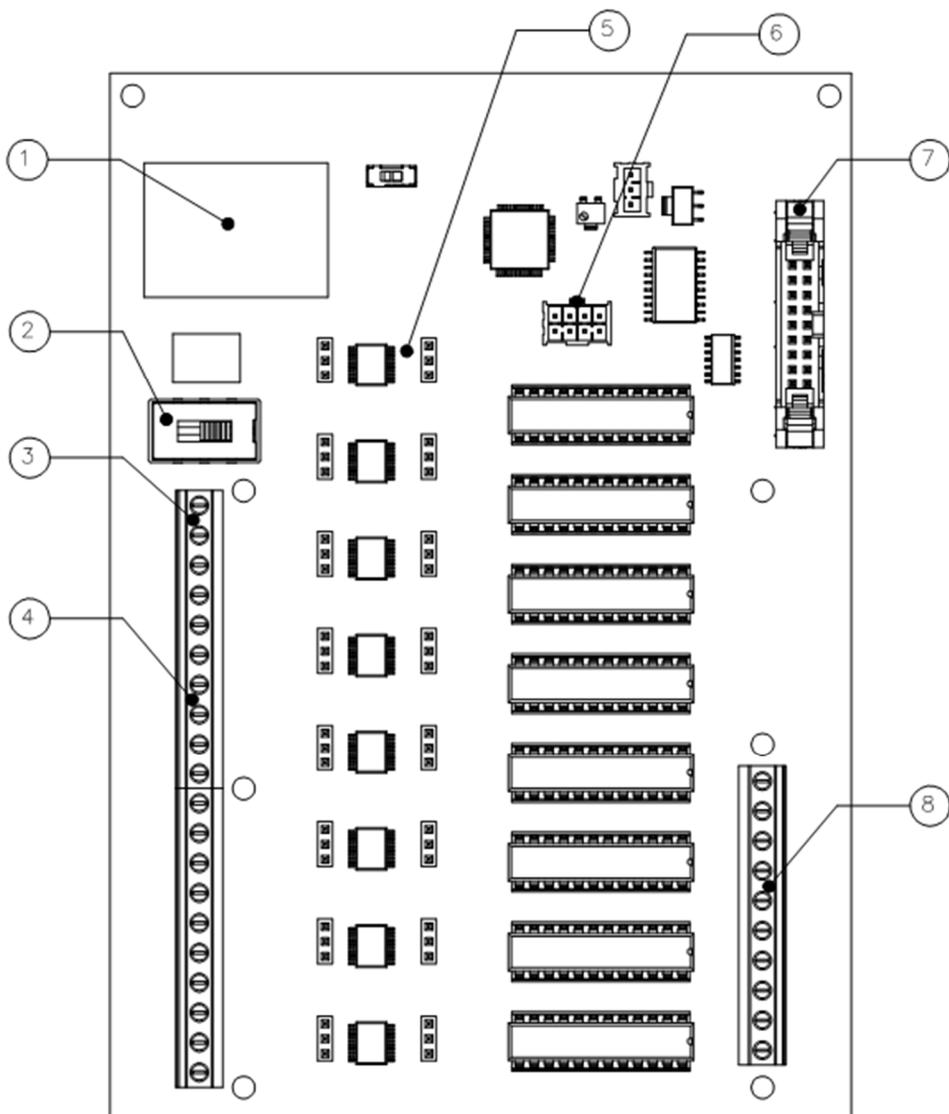
The *WaterFeature8*<sup>™</sup> is designed specifically to work with Atlas Scientific, LLC<sup>™</sup> EZO<sup>™</sup> water monitoring circuits.

THE *WaterFeature8*<sup>™</sup> IS NOT DESIGNED TO WORK WITH NON-ATLAS SCIENTIFIC, LLC<sup>™</sup> WATER QUALITY MONITORING CIRCUITS. DO NOT ATTEMPT TO INSERT ANY OTHER CIRCUITS INTO THE ONBOARD MOUNTS AS THIS WILL VOID ALL WARRANTIES ASSOCIATED WITH THE *WaterFeature8*<sup>™</sup> PRODUCT.

Certain components are intended to be removable such as the Atlas Scientific, LLC<sup>™</sup> Serial Expander and EZO<sup>™</sup> module and the digital to analog conversion modules. Exercise caution when inserting and removing these devices from the board sockets. Integrated Treatment Systems, LLC<sup>™</sup> does not warrant these devices nor the *WaterFeature8*<sup>™</sup> board against failure due to excessive insertion or removal stress.

### **WARNING:**

*Exercise caution when handling sensitive electronics. Electrostatic Discharge (ESD) may damage EZO<sup>™</sup> circuits and/or the *WaterFeature8*<sup>™</sup> board. Take suitable ESD protective measures whenever working with these devices. This may include using ESD mats, grounded wrist straps, and other industry standard ESD precautions. Damage caused by ESD failure will void the *WaterFeature8*<sup>™</sup> warranty.*



1. Atlas Scientific, LLC™ 8:1 Serial Expander P/N COM-102
2. Power On/Off Switch
3. 24V Input Power and Ground Terminals
4. Sensor Input Terminals
5. Atlas Scientific, LLC™ EZO™ Module Sockets
6. HMI Button Wire Harness Header
7. LCD HMI Header
8. 4-20 mA Analog Output Terminals

**1. Atlas Scientific, LLC™ 8:1 Serial Expander P/N COM-102**

The *WaterFeature8™* microcontroller uses the Atlas Scientific, LLC Serial Expander to automatically identify and manage sequencing and polling of all inserted EZO™ circuits. The *WaterFeature8™* is shipped with this circuit pre-installed.

**2. Power On/Off Switch**

Use this switch to manually power the board on and off before/after connecting/disconnecting power, sensor, or current loop wiring.

**3. Input Power and Ground Terminals**

Power the board with a +12VDC to +24VDC nominal power source. Maximum power consumption is less than 5 W when each EZO™ socket is populated with Electroconductivity EZO™ circuits (this is a maximum potential power consumption scenario). Note that the analog output circuits may not have enough power to transmit over long wire runs if the system is powered with +12VDC, so it is advised to power the system with a standard +24VDC power source.

**4. Input Sensor Terminals**

Connect sensor signal wire at these terminals. Alternatively, connect sensor wiring to external terminal strip and wire to the *WaterFeature8™* accordingly. Note: powered sensors such as flow meters may require a separate power supply.

**5. Atlas Scientific, LLC™ EZO™ Chip Sockets**

Insert Atlas Scientific, LLC™ EZO™ circuits in these locations. Take care to correctly orient the parts by lining up the pin labels on the EZO™ with the silkscreen socket labels printed on the board. The standalone *WaterFeature8™* *DOES NOT include any EZO™ circuits*; they must be purchased separately.

**6. HMI Button Pins**

The *WaterFeature8™* A-Series is shipped with four buttons wired to a common connector with approximately 24" of wire. The connector is polarized to fit one way with the onboard pushbutton header. If you need to make your own button wiring harness use Samtec P/N IPD1-04-D-L connector and Samtec CC79R-2024-01-L crimp pins.

**7. LCD HMI Socket**

The *WaterFeature8™* A-Series is shipped with an LCD screen and approximately 24" ribbon cable. The ribbon cable plug is designed to fit one way into the board header and LCD module. Make your own LCD

ribbon cable using 18 conductor 3M HF365/18SF ribbon cable with Amphenol 71600-018LF (18-pin) IDC connector and strain relief on one end and Amphenol 71600-020LF (20-pin) IDC connector and strain relief on the opposite end.

## **8. Analog Output Terminals**

Connect analog output wires here. The *WaterFeature8™* board is considered a sourcing analog device; for PLC compatibility use a sinking or dual sourcing/sinking analog input card.



Sensor Circuit Type	Display Values (4 Digits)			Analog Output Values (16-bit Signal Resolution is 0.000153 mA)		
	Display Resolution	Unit Display	Calibration Points	Low (4 mA)	High (20 mA)	Output Resolution
DO	0.01	mg/L	1 or 2	0 mg/L	10 mg/L	0.00015 mg/L
ORP	1	mV	1	-1,020 mV	1,020 mV	0.0311 mV
pH	0.01 to 0.1	S.U.	1, 2, or 3	0	14	0.0021
RTD	0.1 to 1	degF	1	25 °F	252 °F	0.0043 °F
Flow	0.1	gpm	N/A	0 gpm	525.12 gpm	0.01 gpm
EC	0.001 to 1.	mS/c	1 or 2	0 mS/cm	200 mS/cm	0.003 mS/cm

The following table describes the numerical ranges and resolutions of both the LCD HMI and the analog output current loops.

The *WaterFeature8™* system may operate between +12VDC and +24VDC input power, however, it is recommended to supply +24VDC to the circuit board:

Minimum @24VDC nominal = 0.5W [0.02A]

Maximum Power Consumption @ 24VDC nominal = 4.7W [0.2A]

Actual power consumption will vary based on which EZO™ modules are populated on the board and the analog output current ranges while in use.

Environmental temperature ranges are:

Minimum Temperature = -20 °C [-4 °F]

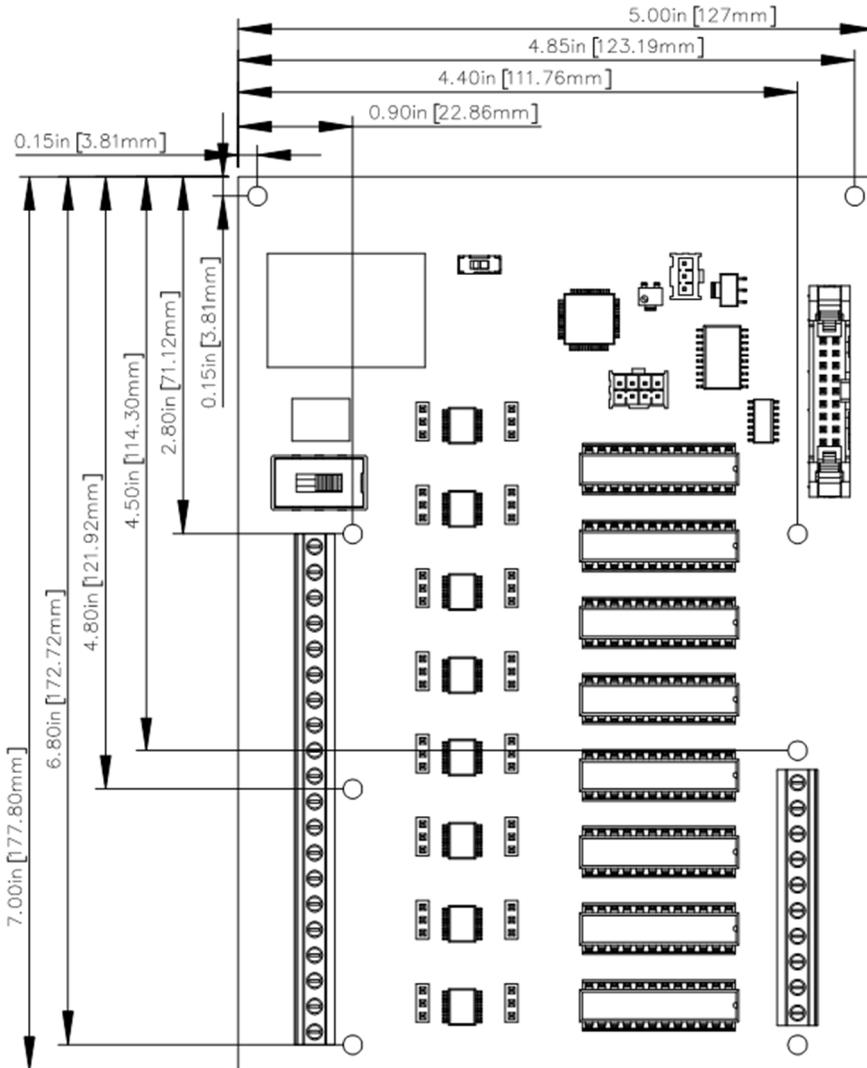
Maximum Temperature = 60 °C [140 °F]

*Note that the LCD module will appear sluggish at low temperatures and may interfere with normal display operations, however, this does not interfere with analog output performance.*

## 4 INSTALLATION

### Mounting Dimensions

The following image shows each of the eight (8) 0.15 inch [3.8 mm] diameter mounting holes for the *WaterFeature8™* board.



Use the provided spacers and screws when installing the *WaterFeature8™*. If other mounting methods are preferred, consider that the board is 1/8" (3 mm) thick when selecting mounting devices.

Although the *WaterFeature8™* is designed to perform in demanding industrial environments, we strongly recommend allowing for ambient air flow across the surface of the circuit board. The *WaterFeature8™* board does not generate a large amount of heat but may get warm with certain sensors continuously online.

## Installation Procedure

The following installation method is recommended for new installations of the *WaterFeature8™* system.

1. \*\*\* Confirm the Power Switch is in the OFF position. \*\*\*
2. Carefully mount the *WaterFeature8™* board onto subpanel or enclosure frame.

Complete steps 3 through 9 in any order:

3. Install up to eight (8) EZO™ circuits. Carefully inspect socket labels and properly orient the EZO™ circuit so that the correct terminals are aligned. Set the EZO™ circuit firmly in the socket.
4. Wire sensor signal and ground/shield wires to the corresponding screw terminals on the input side of the board. Land signal wires on the PRB# terminal and ground/shield wires on the PGND# terminal. Exercise caution to segregate main signal and ground/shield wiring to minimize interference that may result in jumpy or jittery readings.
5. If 4-20 mA analog output functionality of the *WaterFeature8™* is desired, wire to the corresponding screw terminals A1 through A8 on the output side of the board. These connections are NOT REQUIRED to enable the local display, the *WaterFeature8™* will continue to display sensor values on the LCD screen without analog connections. Two GND terminals are provided to complete the current loops.
6. Connect the button wiring harness into the HMI button wiring harness header, noting the polarity direction of the socket. Mount the buttons nearby. The LCD screen shows button commands 1 through 4 vertically down the right side of the display, with button 1 at the top down and

button 4 at the bottom. The corresponding header pins are marked [SW1] through [SW4] on the *WaterFeature8™* board.

7. Connect the LCD ribbon cable into the LCD HMI header on the board and on the LCD panel, noting the polarity direction of the sockets. Mount the LCD screen nearby. If needed, adjust the brightness of the LCD screen by turning the adjustment screw on the potentiometer located above the “LCD CONTRAST” text on the *WaterFeature8™* board. The brightness is set at the factory to a visible level. Exercise care when adjusting the potentiometer; it requires a very small flat head screwdriver and is very easy to damage.
8. Connect incoming 12-24VDC power and ground wiring to the input power terminals. Maximum power consumption could be as high as 2W, although it is typically much lower.
9. Confirm the PGM/RUN switch is in the RUN position. It is shipped in the RUN position and should always remain in this position.

Once steps 3 through 9 are complete, start the *WaterFeature8* system:

10. Slide the Power Switch to the ON position to initialize the firmware operating system. There is a three second delay when powering on the board to allow EZO™ circuits time to perform their internal startup routines before the *WaterFeature8™* firmware starts.

During each power-on cycle the *WaterFeature8™* system will query each channel and automatically confirm EZO™ circuit installations. It will then continually poll each EZO™ circuit in ascending numerical order at a rate of approximately two circuits per second but varies based on the specific types of circuits that are mounted.

The order and sequencing of EZO™ circuits does not matter. The LCD screen will display the channel number of each EZO™ based on its insertion location on the *WaterFeature8™* board.

## Disclaimer

The *WaterFeature8™* system is a tool to be used for observing water quality parameters. It may also perform as part of a PID control loop when connected

to a third-party PLC system. It is good engineering practice to consider how critical each piece of hardware is to the control loop scheme, and to plan for and design appropriate fail-safe hardware and/or procedures accordingly. Integrated Treatment Systems, LLC is not responsible for process disruption due to hardware or firmware failure.

## 5 EZO™ CIRCUIT SETUP

There are two ways to set up Atlas Scientific, LLC™ EZO™ circuits to function with the *WaterFeature8™* circuit board:

1. Using the AutoConfig function available on firmware v1.02 and later, and
2. Manually using a terminal emulator and serial converter.

This section of the user manual describes both methods of EZO™ programming. Programming an EZO™ circuit will NOT overwrite existing calibration that has been previously programmed into the EZO™ memory. As such, using the AutoConfig or manually configuring an EZO™ will not reset calibration settings as long as a “Factory Reset” has not been performed. Refer to EZO™ circuit documentation for more information regarding the “factory” command.

### Automatic Configuration

The firmware version shipped with this Serial Number includes the AutoConfig EZO™ circuit programming function. AutoConfig works with all compatible EZO™ circuits to provide a hassle-free method of programming factory default installed EZO™ circuits without a terminal emulator or serial communications device.

Under normal circumstances, startup is performed normally and the AutoConfig function is not performed. The *WaterFeature8™* boot program checks to see if the AutoConfig function is called on every startup.

To call the AutoConfig feature, the user holds [SW2] (Switch 2 is the second button down on the right-hand side of the LCD screen) while turning the board power ON. As the program initiates it will confirm that [SW2] is being actuated and then bypasses normal startup operation and begins the AutoConfig process. Release [SW2] once the AutoConfig menu appears.

When AutoConfig is called, the normal boot process is interrupted, and the system displays the following AutoConfig menu:

```
WaterFeature8 EZO AutoConfiguration
Function Initiated
Press CONFIRM to Continue   Confirm-->
Press CANCEL to Abort       Cancel-->
```

Pressing **Cancel**--> [SW4] immediately restarts the normal boot operation without performing Automatic Configuration.

Pressing **Confirm**--> [SW3] begins the AutoConfigure procedure and the program begins sending commands to all EZO™ circuit sockets whether populated or not. While running, the following display is shown:

```
WaterFeature8 EZO AutoConfiguration
      PROCESSING
```

The AutoConfig function happens very quickly and typically requires less than one second to perform. Once complete, the following screen displays for 3 seconds:

```
WaterFeature8 EZO AutoConfiguration
      COMPLETE
```

At this point the AutoConfig function has finished and the WF8™ system immediately reboots. After rebooting WF8™ Home screen should correctly display the proper EZO™ circuits in the correctly installed channels. If the EZO™ circuits do not appear something has failed during AutoConfig. The user may attempt to run AutoConfig again to see if this corrects the issue, otherwise Manual Configuration may be required.

### Manual Configuration

If the AutoConfig function fails to properly set up an EZO™ circuit, or the user prefers to program their EZO™ circuits manually, the following procedure describes the required EZO™ parameters to be compatible with the *WaterFeature8™* system.

Refer to the EZO™ datasheets downloadable from [www.Atlas-Scientific.com](http://www.Atlas-Scientific.com) for additional instructions on programming EZO™ circuits. A brief programming guide can be downloaded from [www.intreatsys.com/wf8](http://www.intreatsys.com/wf8) if additional programming instruction is desired.

The following EZO™ items will need to be programmed prior to installation:

1. Each EZO™ circuit will need to be set for UART communication mode. Although UART is the default mode from the factory, we recommend checking this when programming any EZO™.
2. The Protocol Lock command should be sent to lock the EZO™ into UART so it cannot accidentally be changed to I2C mode.
3. Flow and Conductivity EZO™ circuits require K-value inputs prior to installation on the *WaterFeature8™* board.
4. Unused outputs will need to be disabled such as continuous readings, OK response, and other values not used by the *WaterFeature8™* firmware.
5. If reusing or repurposing previously deployed EZO™ circuits, issuing a Factory Reset command to the EZO™ may be recommended prior to configuration for use with the *WaterFeature8™*. Consult the Atlas Scientific, LLC™ datasheets when performing a Factory Reset.

We recommend using an Atlas Scientific, LLC™ electrically isolated USB EZO™ Carrier Board (P/N USB-ISO) to connect the EZO™ circuit to a computer. A terminal emulator such as Tera Term is needed to send commands to the connected EZO™ circuit. Other methods of connection and software terminals may also be used to program the EZO™ circuits.

The following descriptions include the settings that must be configured on each EZO™ prior to installation. Parameters shown in *italics* are factory default settings; they do not need to be programmed unless they have been manually changed.

#### Dissolved Oxygen (DO)

- *Set UART baud rate to 9,600:* Baud, 9600
- *Enable mg/L output:* O, mg, 1
- *Disable saturation outputs:* O, %, 0
- Disable continuous readings: C, 0
- Disable 'OK' response function: \*OK, 0

#### Oxidation Reduction Potential (ORP)

- *Set UART baud rate to 9,600:* Baud, 9600

- Disable continuous readings: C, 0
- Disable 'OK' response function: \*OK, 0

## pH

- Set UART baud rate to 9,600: Baud, 9600
- Disable continuous readings: C, 0
- Disable 'OK' response function: \*OK, 0

## Temperature (RTD)

- Set UART baud rate to 9,600: Baud, 9600
- Set temperature scale to Fahrenheit: S, f
- Disable continuous readings: C, 0
- Disable 'OK' response function: \*OK, 0

## Flow

- Set UART baud rate to 9,600: Baud, 9600
- Set time value to minutes: Frp, m
- Enable Total Volume Output: O, TV, 1
- Enable Instantaneous Flow Rate Output: O, FR, 1
- Disable continuous readings: C, 0
- Disable response code: \*OK, 0

The *WaterFeature8™* board is designed to work in gallons per minute (gpm) units. Atlas Scientific, LLC meter K-values are in metric units. The K-value volume terms must be manually translated into gpm by multiplying by the appropriate volume ratio. For example, for a K-value in liters per minute of K,1.5,2 is either 1.5 liters per two pulses or 1.5 lpm at 2 Hz. Multiplying the middle term by 0.264 yields a new K-value of K,0.396,2. Also, when calculating the conversion term be sure to account for differences in time value (e.g. volume/second versus volume/minute).

This programming must be done by manually connecting the EZO to a computer and using a terminal emulator and entering each K-value as needed using one of the following commands depending on how many K-values there are:

If there is only 1 K-value: K, [vol. per pulse], [number of pulses]

If there are multiple K-values: K, [vol. at freq.], [freq. in Hz]

Instructions for performing this programming can be found on the ITS website at <https://www.intreatsys.com/downloads>.

Refer to the Flow EZO™ datasheet for additional programming reference.

Note that the *WaterFeature8™* does not include flow totalizer functionality, even though the Total Volume string is enabled in the EZO™ output.

### Conductivity (EC)

- *Set UART baud rate to 9,600:* Baud, 9600
- *Set probe type:* K, 1
- *Enable conductivity:* O, EC, 1
- *Disable total dissolved solids output:* O, TDS, 0
- *Disable salinity output:* O, S, 0
- *Disable specific gravity output:* O, SG, 0
- *Disable continuous readings:* C, 0
- *Disable 'OK' response function:* \*OK, 0

The *WaterFeature8™* board is designed to output Conductivity in units of milliSiemens per centimeter (mS/cm). Conductivity EZO™ circuits have a default output of microSiemens per centimeter (µS/cm), and the *WaterFeature8™* automatically converts these values to allow a broad range of values over a four character numerical limitation.

The *WaterFeature8™* is designed to operate in the optimal range of a 1.0 K-value conductivity sensor, although other K-value sensors may work in the range of 0.003 to 200 mS/cm. Analog outputs above 200 mS/cm are not achievable.

## 6 STARTING THE *WaterFeature8™*

Start the *WaterFeature8™* by applying 12 to 24 VDC and Ground to the input terminal block and turning the [POWER] switch to the ON position.

Every time the *WaterFeature8™* is started a brief boot screen is shown similar to the following:

```
WaterFeature8(TM)                               V#.##  
A-series  
  
Copyright 2018-2019  
Integrated Treatment Systems, LLC
```

After the boot screen is shown the *WaterFeature8™* firmware checks the installed positions of EZO™ circuits and compares them to the previously installed position. Depending on previous ON status and EZO™ circuit configuration, different screens may be shown.

If this is the first time booting the *WF8™* system it will likely display the following screen:

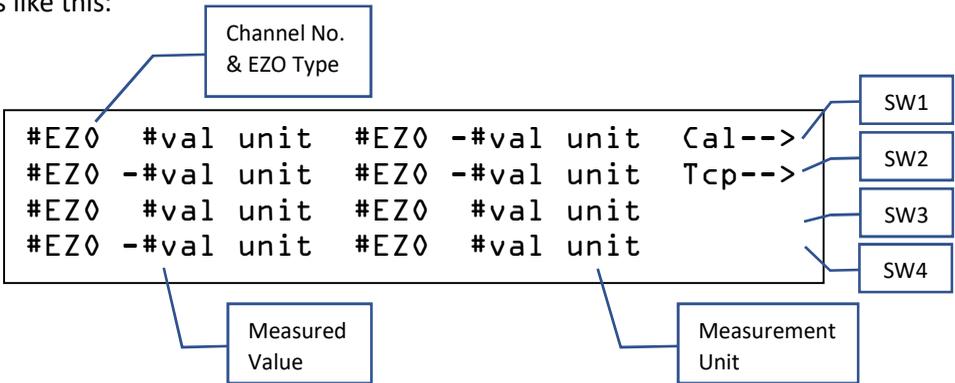
```
NOTICE  
EZO Reconfiguration Detected  
All Temperature Compensation  
Assignments RESET
```

This notice occurs when the detected EZO™ circuit population is different from the previously installed population. On first boot this is due to the random configuration of EZO™ circuits installed when installing firmware and performing QA/QC at the ITS shop, and it is not likely that the user's specific EZO™ installation locations match. The EZO™ detection scheme is used to retain Temperature Compensation values if they have been previously assigned. However, for future power cycles, if the EZO™ circuit locations have not been changed the *WaterFeature8™* will display the following screen:

The display shown below confirms that previously assigned Temperature Compensation assignments are retained because the EZO™ population matches the previous population before the power OFF/ON cycle.

EZO Configuration Confirmed  
 All Temperature Compensation  
 Assignments RESTORED

Once the system completes the boot cycle it will immediately enter the Home screen, which is also referred to as the Main Menu screen. The Home screen displays all populated EZO™ circuits as well as their active measurements. On the right-hand side of the home screen there will be one or more submenu selection buttons depending on the current firmware version. The Home screen looks like this:



The Home screen will only display EZO™ circuits that have been properly configured to work with the *WaterFeature8™* system. While in operation the Home screen continually shows the measured reading of the populated EZO™ circuit and will output an appropriately scaled 4-20mA current if connected to an external Programmable Logic Controller, Analog Input device, or other system compatible with 4-20mA current loops. Refer to the Device Specifications chapter of this manual for information related to 4-20 mA analog output scaling.

## 7 CALIBRATION INSTRUCTIONS

Each sensor type (except for Flow) can be calibrated using the on-board Calibration submenu (**Cal-->**) to reset the sensor known points to fixed values programmed in the *WaterFeature8™*. Sensor recalibration may also be warranted if measured values appear to be significantly outside anticipated performance parameters, but this is a judgement call to be made by the system operator.

The calibration procedures are intended to be intuitive, but each particular EZO™ circuit has different requirements to be considered properly calibrated.

### General Calibration Procedures

Calibration Mode is entered by pressing **Cal-->** [SW1] on the LCD HMI. The most recently accessed calibration submenu screen will appear:

```
#EZO  #val unit                               Next-->
                                              Prev-->
                                              CALIBRATE-->
                                              Main Menu-->
```

*While in Calibration Mode the firmware will freeze all 4-20 mA signals and continue to output them at their current value. These output signals will begin sending correct values as soon as calibration is complete and the system is returned to the Main Menu/Home screen.*

Once a sensor is calibrated the new calibration values will be stored in the non-volatile memory of that sensor's EZO™ circuit. Sensor calibrations DO NOT need to be performed after a power loss as they are permanently stored in the sensor circuit until the next calibration event.

The general calibration procedure is as follows:

1. When the Calibration submenu appears, the current channel is displayed in the top left corner of the LCD screen. Press **Next-->** [SW1] or **Prev-->** [SW2] to cycle between the various installed sensor channels. *Note, when in Calibration Mode the sensor values shown on the LCD screen may not be correct even after completing calibration due to internal calculation scaling. If this occurs proceed with the calibration procedure anyway. The correct values will be calculated and displayed on the Main Menu/Home screen. Do not be alarmed if the characters*

“\*ERO” appear momentarily when cycling through channels. This is a result of the communication timing between the firmware and the EZO™ and does not indicate equipment failure.

2. Once the desired sensor channel is shown in the upper-left portion of the screen, press **CALIBRATE**--> [SW1] to proceed with the EZO™ specific calibration procedure.
3. Press **Main Menu**--> [SW4] to return to the Main Menu/Home screen.

### EZO™ Specific Calibration Procedures

Each sensor has unique calibration values. Standard calibration fluids can be purchased from Atlas Scientific™ at [www.atlas-scientific.com](http://www.atlas-scientific.com) or from other vendors. However, the calibration fluid target values programmed into the *WaterFeature8*™ cannot be changed.

Refer to the EZO™ datasheets from Atlas Scientific, LLC for additional descriptions of calibration methods and theories.

1. Prepare the desired sensor and place in ambient air or calibration solution as required by the sensor. If placed in calibration fluid, ensure air bubbles are not trapped at the face of the sensor which may skew calibration values.
2. Watch sensor readings on the LCD until they stabilize. This can take between 10 and 90 seconds. Allow for more time if a reading quickly reaches a calibration high or low limit such as 0.00 mg/L dissolved oxygen.
3. This part of the procedure varies for different EZO sensors:

- a. For single point calibration sensors RTD and ORP:

Follow the on-screen sensor placement instructions and press **CALIBRATE**--> [SW1] to proceed to step 7.

- b. For multiple point calibration sensors DO, pH, and EC:

Press the appropriate calibration initiation button once to enter the point-specific submenu. This might be [CAL LOW-->] or [CAL HIGH-->] or something similar depending on the sensor being calibrated. The point-specific submenu will display sensor placement instructions. Follow the instructions, then press **CALIBRATE-->** [SW1] to proceed to step 7.

4. The word “CONFIRM-->” will begin to flash. Momentarily press the flashing **CONFIRM-->** [SW1] button to store the calibration in the sensor’s EZO™ circuit. The word “CONFIRMED” will illuminate solid.
5. Depending on if the EZO requires a specific calibration order, the calibration software will either display “CALIBRATION COMPLETE” and return to the top Calibration Menu or it will proceed to the next calibration point.
6. Continue calibrating devices (return to Step 2, above) or press **Main Menu-->** [SW4] to exit Calibration Mode and display all installed sensor channels.

## Dissolved Oxygen

Dissolved oxygen may be calibrated at one or two different points:

- Single point calibration (ambient air)
- Dual point calibration (this is an optional calibration for sensors needing to read accurately below 1.0 mg/L).

The first calibration point is between 9.09 and 9.1X mg/L which is the ambient air calibration value. The second calibration point is 0.00 mg/L and requires Zero DO calibration solution.

Single point calibration may be performed without Dual point calibration. If this is desired press **CANCEL-->** [SW4] on the DO calibration screen after performing the [CAL HIGH] calibration step. This will return to the Calibration Menu. However, when performing Dual point calibration the air calibration value [Cal High] *must* be set before the 0.0 mg/L [CAL LOW] second point.

## Oxidation-Reduction Potential

Oxidation-Reduction Potential is calibratable to a single point, +225 mV.

After pressing **Cal** --> [SW1] on the LCD HMI, follow the on-screen prompts to complete calibration.

## pH

pH may be calibrated at the following points:

- Single point
- Dual point
- Three point

The three available calibration points are at pH of 4.0, 7.0, and 10.0, using fluids manufactured to the appropriate pH. Calibrating pH = 7.0 will reset HIGH and LOW calibration points. Therefore, when performing single point calibration use pH = 7.0. If performing dual or three point calibration, calibrate the center point (pH = 7.0) first, then proceed calibrating the next one or two points in either order.

## Temperature

Temperature is calibratable to a single point, 50 °F.

A small bath of 50 °F water can be made up with tap water and a few ice cubes in a small cup. Use a known calibrated thermometer to establish the 50 °F control temperature.

## Flow

Flow meters are not calibrated the way submersible sensors are and attempting to calibrate a flow meter via the Calibration Menu will display a “No CALIBRATION REQUIRED” message. However, K-values for any given flow meter may be manually adjusted after performing a bucket test or by comparison versus a known good meter and reprogramming the K-values in the Flow EZO. Adjusting EZO K-values cannot be done while the Flow EZO™ is connected to the *WaterFeature8*™. Bucket testing also requires translating observed flow per unit time information from the bucket test into pulse volume and pulse frequency data for K-value input.

The firmware polling cycle routine is hard-programmed to take at least 1 second to ensure that Flow meter pulses down to 1 Hz will be readable by the firmware. Flow meter pulses slower than 1 Hz will be read as 0.00 gpm.

## Conductivity

Conductivity is calibratable to one or two points.

*The conductivity values shown during calibration are raw values and they are both truncated and unscaled. Given screen character constraints the firmware currently shows only the raw data from the EZO™ during calibration. This means that the values may not visibly stabilize in the calibration fluid due to rounding error. Be sure to allow ample stabilization time prior to confirming calibration points.*

For any EC sensor the initial calibration point is Cal Dry (0.00  $\mu\text{S}/\text{cm}$ ). This tunes the EZO to the specific sensor and only needs to be done once whenever A) a new sensor is installed, B) an existing sensor is disconnected and reconnected, or C) a different EC EZO™ circuit is installed in the channel.

Single point calibration is done to the [Cal Mid] value of 12,880  $\mu\text{S}/\text{cm}$ , while dual point calibration is done to [Cal Mid] (12,880  $\mu\text{S}/\text{cm}$ ) first and [Cal High] (80,000  $\mu\text{S}/\text{cm}$ ) second. Once calibration is complete, and while still viewing the Calibration Menu, the EC submenu should display 1288 for [Cal Mid] and 8000 for [Cal High]. These values will properly update to display in  $\text{mS}/\text{cm}$  on the Main Menu.

*Note, the Conductivity calibration submenu allows for the calibration procedures to be completed in any order, however, the instruction provided above should be followed carefully.*

## Calibration Tips

Calibrating sensors can be tricky, requiring a little bit of skill, knowledge, patience, and in some cases repeated calibrations. The following tips may help establish finicky sensor calibrations.

- When pressing the button during the flashing **CONFIRM-->** prompt there is a slight delay in the firmware while communication with the EZO is executed. This requires a momentary press and hold action to affirmatively complete the calibration.
- Some sensors seem to operate better after performing the two point calibration procedure twice in a row.

- If a sensor does not appear to calibrate or otherwise does not settle onto a stable value during immersion in calibration fluid, attempt to recondition the sensor with reconditioning fluids or rebuild the sensor with a rebuild kit. Additional information can be found at [www.atlas-scientific.com](http://www.atlas-scientific.com) or from the sensor supplier.
- After calibration, confirm proper device measurement by observing the sensor value while submerged in the calibration fluid. It should be the same value as the calibration fluid, or reasonably close within some allowable error. If the value continues to change while resting in calibration fluid wait a little longer until the values stabilize and recalibrate the sensor.
- Revising the K-value of a DC-pulse type flow meter requires knowledge of machine programming, specialized wiring for access to the circuit, and meter manufacturer pulse size data. *Note, turbine style dc-pulse meters are not known to be highly accurate. Do not use these meters for legal permit required flow monitoring and reporting.*
- If sensor values appear unreasonably “jittery” during operation or calibration, confirm that the proper type of field wiring is installed and firmly connected.
- Follow the long-term storage requirements of each sensor when possible. This includes using sensor caps and storage fluids when required by the sensor manufacturer.
- Some sensors must stay wet and are not allowed to dry out. Take this into consideration if installed in a reactor that is regularly emptied or has a regularly changing water level.

## 8 Temperature Compensation

The Temperature Compensation (TComp or **TCp-->**) feature is designed to improve the accuracy of pH, DO, and EC EZO™ circuits by supplying liquid temperature data from an RTD EZO™ with temperature probe. The temperature data is used by the pH, DO, or EC circuit to adjust, or compensate, the output value to a more accurate number. The science of temperature compensation is beyond the scope of this manual, however, Atlas Scientific, LLC™ provides additional documentation and justification in their EZO™ datasheets.

Only pH, Dissolved Oxygen, and Electroconductivity EZO™ circuits are eligible for temperature compensation.

*The WaterFeature8™ does not currently support pressure or salinity compensation for any EZO™ circuits. Temperature compensation support was added in firmware v1.10. Also, temperature compensation is limited to 1 °C maximum resolution.*

The TComp feature is accessed by pressing **TCp-->** [SW2] while on the Main Menu/Home screen.

### TComp Initiation

When the **TCp-->** [SW2] is actuated the Temperature Compensation submenu routine begins and the *WF8™* firmware will freeze analog output values at their current readings.

The firmware will immediately confirm if any RTD EZO™ circuits are installed and if none are installed will display “NO RTD FOUND // Temperature Compensation Not Available”. The “NO RTD FOUND” text will alternately flash ON/OFF for 3 seconds (0.5 sec on, 0.5 sec off, repeating x3) while the “Temperature Compensation Not Available” text remains solidly illuminated. After 3 seconds the program will automatically return to the Main Menu/Home screen.

NO RTD FOUND  
Temperature Compensation Not Available

## Channel Target Assignments

If RTD EZO™ circuits are installed and discovered during system startup, the TComp submenu starts similarly to the Cal submenu with the most recently observed channel displayed in the upper left-hand corner of the display. Similar to the Calibration submenu, the **Prev->** [SW1] and **Next->** [SW2] buttons will cycle forwards or backwards through the available populated channels, and the channel displayed in the upper left corner of the screen will be considered “active.”

If an active channel is not eligible for temperature compensation (i.e. is populated with an ORP, RTD, or Flow EZO™ circuit), the active channel will display “Not eligible for Temperature // Compensation”. When the active channel is ineligible for temperature compensation the **Cycle TCp->** button [SW3] will do nothing.

```
#EZO                               Prev->
  Not Eligible For Temperature     Next->
    Compensation                   Cycle TCp->
                                   Main Menu->
```

If the active channel is eligible for temperature compensation (i.e. is populated with a pH, DO, or EC EZO™ circuit), the active channel will display “Temperature Compensation // from CH# RTD”.

```
#EZO                               Prev->
  Temperature Compensation         Next->
    From CH# RTD                  Cycle TCp->
                                   Main Menu->
```

If no temperature compensation channel is currently assigned for the active channel (this is the default condition until a temperature compensation RTD channel is assigned), the octothorpe (# sign) is displayed. If a temperature compensation channel is identified for the active channel, then the appropriate channel is identified in lieu of the octothorpe. *This channel number matches the RTD EZO™ channel from which the active channel will receive temperature values.*

When the user presses **Cycle TCp->** [SW3] the temperature compensation channel will cycle to the next higher observed RTD channel. When the available RTD channels are exhausted the octothorpe will again be displayed to indicate

that the active channel is not being temperature compensated. Pressing **Cycle TCp**-> [SW3] will continue to assign compensation channels from the various populated RTD channels.

Note, there is no explicit “save temperature compensation function” in the TCp submenu. The firmware assumes that if a temperature compensation channel is tagged then this is what the user has selected to compensate the active channel. If no channel is identified (i.e. the # sign is displayed) then the active channel is not temperature compensated.

At any time during navigation of the TCp submenu the user may press **Main Menu**-> [SW4] to return to the Main Menu/Home screen. Channel compensation targets will be automatically saved to system memory and will be retained if system power is lost.

The Temperature Compensation function allows for any pH, DO, or EC EZO™ channel to receive temperature values from any populated RTD EZO™ channel. Accordingly, one RTD EZO™ channel could provide temperature readings to up to seven other channels as well. Any combination of assignments is theoretically possible, although any specific pH DO, or EC EZO™ may only receive temperature readings from ONE assigned RTD EZO™ circuit.

## 9 BILL OF MATERIALS

The following items are included with the *WaterFeature8™* System Builder Kit:

#	Description	Qty	Source	Part Number
1	<i>WaterFeature8™</i> A-Series Circuit Board	1	Integrated Treatment Systems	PCBA-1.2
2	4x40 LCD Display	1	Newhaven Display International	NHD-0440AZ-FL- YBW
3	Display Ribbon Cable <sup>1</sup>	1	3M	HF365/18SF
4	Ribbon Cable IDC Connector <sup>1</sup>	1 1	Amphenol	71600-018LF 71600-020LF
5	SPST-NO Button <sup>2</sup>	4	E-Switch	S1024ABLK
6	Push Button Wiring <sup>2</sup>	1	Varies	20ga or 22ga UL1007/1569 Hookup Wire
7	Push Button Connector <sup>2</sup>	1	Samtec	IPL1-04-D-K
8	5/8" 4-40 Hex Female Standoff, Aluminum	9	McMaster Carr	91780A165
9	1" 4-40 Hex Female Standoff, Aluminum	5	McMaster Carr	91780A167
10	5/16" 4-40 Narrow Fillister Phillips Screw, SS	13	McMaster Carr	91737A076
11	1/2" 4-40 Pan Head Combination Phillips/Slotted Screw, SS	13	McMaster Carr	90604A554

1: Display ribbon cable and connectors (parts 3 and 4) are shipped pre-assembled.

2: The push button wiring harness (parts 5, 6, and 7) is shipped pre-assembled.

# 10 GUARANTEE

## Warranty Statement

Integrated Treatment Systems, LLC™ warrants the *WaterFeature8™* A-Series circuit board to be free of defects during the debugging phase of system integration, or 30 days after receiving the *WaterFeature8™* device, whichever comes first.

The debugging phase is defined by Integrated Treatment Systems, LLC™ as the time between when the device is initially unpacked to when it is installed into or onto another device. Debugging activities may include but are not limited to:

- Inserting EZO™ circuits into their respective sockets;
- Connecting Pushbuttons and HMI cables;
- Mounting into an enclosure;
- Connecting power, input signal, and output signal wiring;
- Powering on the device;
- Confirming firmware/HMI functionality;
- Pre-deployment or bench-top sensor calibration.

The following activities will explicitly void this limited warranty:

- Soldering or de-soldering any component on the circuit board;
- Switching the PGM/RUN switch from RUN to PGM without express authorization and instruction from Integrated Treatment Systems, LLC™;
- Deploying the circuit in a control panel or other integrated in-service monitoring and control system;
- Placing the circuit in environments known to be hostile to circuit boards such as temperatures above 125 °F, extreme thermal shock, high

humidity or otherwise moist environments, and vibrating or moving conditions.

## Design Philosophy

The folks at Integrated Treatment Systems, LLC™ are always looking for a better way of doing something. Our mission is to make water quality monitoring more robust and simpler at the same time. For this product we had a need to collect a large amount of process data in an inexpensive package and this was our solution.

When we discovered the Atlas Scientific, LLC™ line of EZO™ water monitoring circuits we knew this was a serious product we could integrate into our own treatment systems.

We also believe in simplicity. Our products have been tested in the field to be as basic and reliable as possible. We seek process monitoring accuracy high enough to perform water treatment process adjustments such as change a blower speed, ramp a pump up or down, drive a VFD, open/close/modulate a valve, run a dosing pump, and other simple analog PID tasks.

The *WaterFeature8*™ platform remains in regular development so please stay tuned, we have plans to release future firmware updates for free on our website, which you will be able to download and install on this A-Series *WaterFeature8*™ board in the field.

We are excited to continue developing cost effective solutions to solving water quality challenges and are looking forward to your suggestions to improve our products.

Feel free to contact us in any of the following ways:

Phone: 812.648.4800

Email: [custsomerservice@intreatsys.com](mailto:custsomerservice@intreatsys.com)

Web: <http://www.intreatsys.com/contact-its>

## 11 VERSION HISTORY & EZO™ COMPATIBILITY

The following version data provides a snapshot of hardware and firmware development to date.

### Hardware

PCB Ver.	Date	Description
1.2	Oct. 2018	Initial release

### Firmware

FW Ver.	Date	Description
1.01	Oct. 2018	Initial public release
1.02	Apr. 2019	Added AutoConfig feature
1.10	May 2019	Added Temperature Compensation submenu, EZO™ population checks, and other minor HMI tweaks
1.11	May 2019	Minor updates, bug fixes
1.12	May 2019	Added 'OK' prompt to Reconfiguration Detected boot screen
1.13	May 2019	Minor spelling/grammar changes
1.14	May 2019	Updated Flow EZO v2.0 compatibility, revised AutoConfig function
1.20	Jun. 2019	Revised Flow EZO v2.01 output string defaults, updated AutoConfig, added polling cycle timing, revised FLO and RTD output ranges

### Compatibility

The following table describes known and tested compatibility of the *WaterFeature8™* firmware versus EZO™ circuit firmware (not to be confused with EZO™ *datasheet* versions). Testing is not performed on every new EZO™ released by Atlas Scientific, LLC™ unless major command changes are made between EZO™ versions. Most newly purchased EZO™ circuits should work with the *WaterFeature8™*, and we coordinate with Atlas Scientific, LLC™ when discussing EZO™ and WF8™ compatibility. Exemptions from this list do not mean

an EZO™ is incompatible (unless otherwise noted), it simply means we have not physically tested it in our shop.

WF8™	DO	pH	ORP	EC	RTD	FLO
1.01	2.12	2.11	2.10	2.12	2.10	Pre-2.0
1.02	2.13	2.12	2.10	2.13	2.10	2.00
1.10	2.13	2.12	2.10	2.13	2.10	2.00
1.11	2.13	2.12	2.10	2.13	2.10	2.00
1.12	2.13	2.12	2.10	2.13	2.10	2.00
1.13	2.13	2.12	2.10	2.13	2.10	2.00
1.14	2.13	2.12	2.10	2.13	2.10	2.00
1.20	2.13	2.12	2.10	2.13	2.10	2.01*

\* *WaterFeature8™* firmware versions 1.20 and later are not compatible with FLO EZO™ firmware versions earlier than 2.01.

**END**

*Integrated Treatment Systems, LLC™*  
[www.intreatsys.com](http://www.intreatsys.com) :: 812.648.4800  
customerservice@intreatsys.com



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