PULSE INSTRUMENTS

AP100
Wall Mount Industrial Controller

Pulse Instruments
www.pulseinstruments.net

3233 Mission Oaks Blvd., Unit P, Camarillo, CA 93012 Phone:(800) 462-1926 Fax: (800) 878-9172

TABLE OF CONTENTS

1.0 INTRODUCTION

The AP100 controllers offer a high level of flexibility in controlling water treatment applications.

One sensor input is available that are compatible with a variety of sensors:

- Contacting conductivity with cell constant 0.01, 0.1, 1.0 or 10.0
- Electrodeless conductivity
- pH
- ORP

Three relay outputs may be set to a variety of control modes:

- On/Off set point control
- Time Proportional control
- Activate with a contact closure
- Timed activation triggered by a Water Contactor or Paddlewheel flow meter's accumulated total flow
- Activate with another output
- Daily, Weekly, 2-week or 4-week timers
- Dual Set Point control (In-Range and Out-of-Range)
- Diagnostic Alarm triggered by:
  - High or Low sensor reading
  - No Flow
  - Relay output timeout
  - Sensor error

Models with pulse outputs may also be used for pulse proportional control of electronic metering pumps.

An optional isolated analog output may be included to retransmit sensor input signals to a chart recorder, data logger, PLC or other device.

Our unique USB feature provides the ability to upgrade the software in the controller to the latest version.

2.0 SPECIFICATIONS

2.1 Measurement Performance

0.01 Cell Contacting Conductivity
Range 0-300 µS/cm
Resolution 0.01 µS/cm, 0.0001 mS/cm, 0.001 mS/m, 0.0001 S/m, 0.01 ppm
Accuracy ± 1% of reading

0.1 Cell Contacting Conductivity
Range 0-3,000 µS/cm
Resolution 0.1 µS/cm, 0.0001 mS/cm, 0.01 mS/m, 0.0001 S/m, 0.1 ppm
Accuracy ± 1% of reading

1.0 Cell Contacting Conductivity
Range 0-30,000 µS/cm
Resolution 1 µS/cm, 0.001 mS/cm, 0.1 mS/m, 0.0001 S/m, 1 ppm
Accuracy ± 1% of reading

10.0 Cell Contacting Conductivity
Range 0-300,000 µS/cm
Resolution 10 µS/cm, 0.01 mS/cm, 1 mS/m, 0.001 S/m, 10 ppm
Accuracy ± 1% of reading

pH
Range -2 to 16 pH units
Resolution 0.01 pH units
Accuracy ± 0.01% of reading

ORP
Range -1500 to 1500 mV
Resolution 0.1 mV
Accuracy ± 1 mV

Disinfection Sensors
Range (mV) -2000 to 1500 mV
Resolution (mV) 0.1 mV
Accuracy (mV) ± 1 mV

Range (ppm) 0-2 ppm to 0-20,000 ppm
Resolution (ppm) Varies with range and slope
Accuracy (ppm) Varies with range and slope

Temperature
Range 23 to 500°F (-5 to 260°C)
Resolution 0.1°F (0.1°C)
Accuracy ± 1% of reading

Electrodeless Conductivity

Ranges	Resolution	Accuracy
500-12,000 µS/cm	1 µS/cm, 0.01 mS/cm, 0.1 mS/m, 0.001 S/m, 1 ppm	± 1% of reading
3,000-40,000 µS/cm	1 µS/cm, 0.01 mS/cm, 0.1 mS/m, 0.001 S/m, 1 ppm	± 1% of reading
10,000-150,000 µS/cm	10 µS/cm, 0.1 mS/cm, 1 mS/m, 0.01 S/m, 10 ppm	± 1% of reading
50,000-500,000 µS/cm	10 µS/cm, 0.1 mS/cm, 1 mS/m, 0.01 S/m, 10 ppm	± 1% of reading
200,000-2,000,000 µS/cm	100 µS/cm, 0.1 mS/cm, 1 mS/m, 0.1 S/m, 100 ppm	± 1% of reading

Temperature °C	Range Multiplier
0	**181.3**
10	**139.9**
15	**124.2**
20	**111.1**
25	**100.0**
30	**90.6**
35	**82.5**
40	**75.5**
50	**64.3**
60	**55.6**
70	**48.9**

Temperature °C	Range Multiplier
80	**43.5**
90	**39.2**
100	**35.7**
110	**32.8**
120	**30.4**
130	**28.5**
140	**26.9**
150	**25.5**
160	**24.4**
170	**23.6**
180	**22.9**

Note: Conductivity ranges above apply at 25°C. At higher temperatures, the range is reduced per the range multiplier chart.

2.2 Electrical: Input/Output

Input Power	100 to 240 VAC, 50 or 60 Hz, 7 A maximum Fuse: 6.3 A
Input Signals	
Contacting Conductivity:	0.01, 0.1, 1.0, or 10.0 cell constant
Temperature	100 or 1000 ohm RTD, 10K or 100K Thermistor
State-Type Digital Inputs	Electrical: Optically isolated and providing an electrically isolated 9VDC power with a nominal 2.3mA current when the digital input switch is closed Typical response time: < 2 seconds Devices supported: Any isolated dry contact (i.e. relay, reed switch) Types: Interlock
Low Speed Counter-Type Digial Inputs	Electrical: Optically isolated and providing an electrically isolated 9VDC power with a nominal 2.3mA current when the digital input switch is closed 0-10 Hz, 50 msec minimum width Devices supported: Any device with isolated open drain, open collector, transistor or reed switch Types: Contacting Flowmeter
High Speed Counter-Type Digial Inputs	Electrical: Optically isolated and providing an electrically isolated 9VDC power with a nominal 2.3mA current when the digital input switch is closed, 0-250 Hz, 1.25 msec minimum width Devices supported: Any device with isolated open drain, open collector, transistor or reed switch Types: Paddlewheel Flowmeter
Outputs	
Powered mechanical relays	Pre-powered on circuit board switching line voltage 6 A (resistive), 1/8 HP (93 W) All three relays are fused together as one group, total current for this group must not exceed 6A
Pulse Outputs	Opto-isolated, Solid State Relay 200mA, 40 VDC Max. VLOWMAX = 0.05V @ 18 mA
Dry contact mechanical relays	6 A (resistive), 1/8 HP (93 W) Dry contact relays are not fuse protected
4 - 20 mA (optional)	Internally powered Fully isolated 600 Ohm max resistive load Resolution 0.0015% of span Accuracy ± 0.5% of reading
Agency Approvals	
Safety	ANSI/UL 61010-1:2012 3rd Ed. C22.2 No. 61010-1:2012 3rd Ed. IEC 61010-1:2010 3rd Ed. EN 61010-1:2010 3rd Ed.
EMC	IEC 61326-1:2005 EN 61326-1:2006

Note: For EN61000-4-6, EN61000-4-3 the controller met performance criteria B.
*Class A equipment: Equipment suitable for use in establishments other than domestic, and those directly connected to a low voltage (100-240 VAC) power supply network which supplies buildings used for domestic purposes.

2.3 Mechanical

Enclosure Material	Polycarbonate
Enclosure Rating	NEMA 4X (IP65)
Dimensions	8” x 8” x 3” (203 mm x 203 mm x 76 mm)
Display	128 x 64 graphic backlit display
Operating Ambient Temp	-4 to 131 °F (-20 to 55 °C)
Storage Temperature	-4 – 176°F (-20 – 80°C)

2.4 Variables and their Limits

	Low Limit	High Limit
Sensor input settings		
Alarm limits	Low end of sensor range	High end of sensor range
Alarm dead band	Low end of sensor range	High end of sensor range
Cell constant (conductivity only)	0.01	10
Installation Factor (Electrodeless conductivity only)	0.5	1.5
Cable length	0.1	3,000
PPM conversion factor (conductivity only if units = PPM)	0.001	10.000
Default temperature	-5	302
Flow meter input settings		
Totalizer alarm	0	100,000,000
Volume/contact	0	100,000
K Factor	0	1,000
Relay output settings		
Output Limit Time	1 second	86,400 seconds (0 = unlimited)
Hand Time Limit	1 second	86,400 seconds (0 = unlimited)
Set Point	Low end of sensor range	High end of sensor range
Dead Band	Low end of sensor range	High end of sensor range
Feed duration (Feed on Watermeter mode)	0 seconds	86,400 seconds
Accumulated volume (Feed on Watermeter mode)	0	1,000,000
Feed Percentage (Bleed then Feed mode)	0%	100%
Feed Lockout (Bleed & Feed, Bleed then Feed modes)	0 seconds	86,400 seconds
Prebleed Conductivity (Biocide mode)	1 (0 = no prebleed)	30,000
Prebleed Time (Biocide mode)	0 seconds	86,400 seconds
Bleed Lockout(Biocide mode)	0 seconds	86,400 seconds
Event duration (Biocide mode)	0 seconds	86,400 seconds
Proportional band	0	30,000
Sample period (Time Proportional mode)	10 seconds	3600 seconds
Sample Time (Intermittent Sampling mode)	0 seconds	3600 seconds
Hold Time (Intermittent Sampling mode)	0 seconds	3600 seconds
Maximum Blowdown (Intermittent Sampling mode)	0 seconds	3600 seconds
Wait Time (Intermittent Sampling mode)	0 seconds	86,400 seconds
Max Rate (Pulse Proportional mode)	10 pulses/minute	480 pulses/minute
Minimum Output (Pulse Proportional mode)	0%	100%
Maximum Output (Pulse Proportional mode)	0%	100%
Analog (4-20 mA) output settings		
4 mA Value	Low end of sensor range	High end of sensor range
20 mA Value	Low end of sensor range	High end of sensor range
Hand Output	0%	100%
Set Point	Low end of sensor range	High end of sensor range
Proportional Band	Low end of sensor range	High end of sensor range
Minimum Output	0%	100%
Maximum Output	0%	100%
Off Mode Output	0%	100%
Error Output	0%	100%
Access code	0000	9999

3.0 UNPACKING & INSTALLATION

3.1 Unpacking the unit

Inspect the contents of the carton. Please notify the carrier immediately if there are any signs of damage to the controller or its parts. Contact your distributor if any of the parts are missing. The carton should contain a AP100 series controller and an instruction manual. Any options or accessories will be incorporated as ordered.

3.2 Mounting the electronic enclosure

The controller is supplied with mounting holes on the enclosure. It should be wall mounted with the display at eye level, on a vibration-free surface, utilizing all four mounting holes for maximum stability. Use M6 (1/4" diameter) fasteners that are appropriate for the substrate material of the wall. The enclosure is NEMA 4X (IP65) rated. The maximum operating ambient temperature is 131°F (55°C); this should be considered if installation is in a high temperature location. The enclosure requires the following clearances:

Top:	2" (50 mm)
Left:	8" (203 mm) (not applicable for prewired models)
Right:	4" (102 mm)
Bottom:	7" (178 mm)

3.3 Sensor Installation

Refer to the specific instructions supplied with the sensor being used, for detailed installation instructions.

General Guidelines

Locate the sensors where an active sample of water is available and where the sensors can easily be removed for cleaning. Position the sensor such that air bubbles will not be trapped within the sensing area. Position the sensor where sediment or oil will not accumulate within the sensing area.

In-Line Sensor Mounting

In-line mounted sensors must be situated so that the tee is always full and the sensors are never subjected to a drop in water level resulting in dryness. Refer to Figures 2 through 4 for typical installation.

Tap off the discharge side of the recirculation pump to provide a minimum flow of 1 gallon per minute through the flow switch manifold. The sample must flow into the bottom of the manifold in order to close the flow switch, and return to a point of lower pressure in order to ensure flow. Install an isolation valve on both sides of the manifold to stop flow for sensor maintenance.

IMPORTANT: To avoid cracking the female pipe threads on the supplied plumbing parts, use no more than 3 wraps of Teflon tape and thread in the pipe FINGER tight plus 1/2 turn! ***Do not use pipe dope to seal the threads of the flow switch because the clear plastic will crack!***

Submersion Sensor Mounting
If the sensors are to be submersed in the process, mount them firmly to the tank, and protect the cable with plastic pipe, sealed at the top with a cable gland, to prevent premature failure. Place the sensors in an area of good solution movement.

Sensors should be located such that they respond rapidly to a well-mixed sample of the process water and the treatment chemicals. If they are too close to the chemical injection point, they will see spikes in concentration and cycle on and off too frequently. If they are too far away from the chemical injection point, they will respond too slowly to the concentration changes, and you will overshoot the set point.

The **contacting conductivity sensor** should be placed as close to the controller as possible, to a maximum distance of 250 ft. (76 m). Less than 25 ft. (8 m) is recommended. The cable must be shielded from background electrical noise. Always route low voltage (sensor) signals with at least a 6" (15 cm) separation from AC voltage wiring.

The **electrodeless conductivity sensor** should be placed as close to the controller as possible, to a maximum distance of 20 ft. (6 m). The cable must be shielded from background electrical noise. Always route low voltage (sensor) signals with at least a 6" (15 cm) separation from AC voltage wiring. These sensors are affected by the geometry and conductivity of their surroundings, so either maintain 6 inches (15 cm) of sample around the sensor or ensure that any nearby conductive or non-conductive items are consistently positioned. Do not install the sensor in the path of any electrical current that may be flowing in the solution, as this will shift the conductivity reading.

The **pH/ORP electrode** should be placed as close to the controller as possible, to a maximum distance of 1000 feet (300 m) from the controller. A junction box and shielded cable are available to extend the standard 20 foot (6 m) length. pH and ORP electrodes must be installed such that the measuring surfaces will always remain wet. A U-trap provided in the manifold design should achieve this, even if the sample flow stops. These electrodes also must be installed with the measuring surfaces pointing down; that is 5 degrees above the horizontal, at a minimum.

The **disinfection sensor** should be placed as close to the controller as possible, to a maximum distance of 1000 feet (300 m) from the controller. A junction box and shielded cable are available to extend the standard 20 foot (6 m) length. The sensor should be mounted such that the measuring surfaces will always stay wet. If the membrane dries out, it will respond slowly to changing disinfectant values for 24 hours, and if dried out repeatedly, will fail prematurely. The flow cell should be placed on the discharge side of a circulation pump or downhill from a gravity feed. Flow into the cell must come from the bottom side that has the ¾" x ¼" NPT reducing bushing installed. **The reducing bushing provides the flow velocity required for accurate readings and must not be removed!** A "U" trap should be installed so that if the flow stops, the sensor is still immersed in the water. The outlet of the flow cell must be plumbed to open atmosphere unless the system pressure is at or below 1 atmosphere. If the flow through the line cannot be stopped to allow for cleaning and calibration of the sensor, then it should be placed in a by-pass line with isolation valves to allow for sensor removal. Install the sensor vertically, with the measuring surface pointing down, at least 5 degrees above horizontal. Flow rate regulation must be done

upstream from the sensor, because any flow restriction downstream can increase the pressure above atmospheric and damage the membrane cap!

3.4 Icon Definitions

Symbol	Publication	Description
	IEC 417, No.5019	Protective Conductor Terminal
|	IEC 417, No. 5007	On (Supply)
O	IEC 417, No. 5008	Off (Supply)
	ISO 3864, No. B.3.6	Caution, risk of electric shock
	ISO 3864, No. B.3.1	Caution

3.5 Electrical installation

The various standard wiring options are shown in figure 1, below. Your controller will arrive from the factory prewired or ready for hardwiring. Depending on your configuration of controller options, you may be required to hardwire some or all of the input/output devices. Refer to figures 5through 15 for circuit board layout and wiring.

Note: when wiring the optional 4-20 mA output or a remote flow switch, it is advisable to use stranded, twisted, shielded pair wire between 22-26 AWG. Shield should be terminated at the controller (see figure 12).

 **CAUTION** 

1. There are live circuits inside the controller even when the power switch on the front panel is in the OFF position! The front panel must never be opened before power to the controller is REMOVED!
   If your controller is prewired, it is supplied with a 8 foot, 18 AWG power cord with USA style plug. A tool (#1 Phillips driver) is required to open the front panel.
2. When mounting the controller, make sure there is clear access to the disconnecting device!
3. The electrical installation of the controller must be done by trained personnel only and conform to all applicable National, State and Local codes!
4. Proper grounding of this product is required. Any attempt to bypass the grounding will compromise the safety of persons and property.
5. Operating this product in a manner not specified by Pulse may impair the protection provided by the equipment.

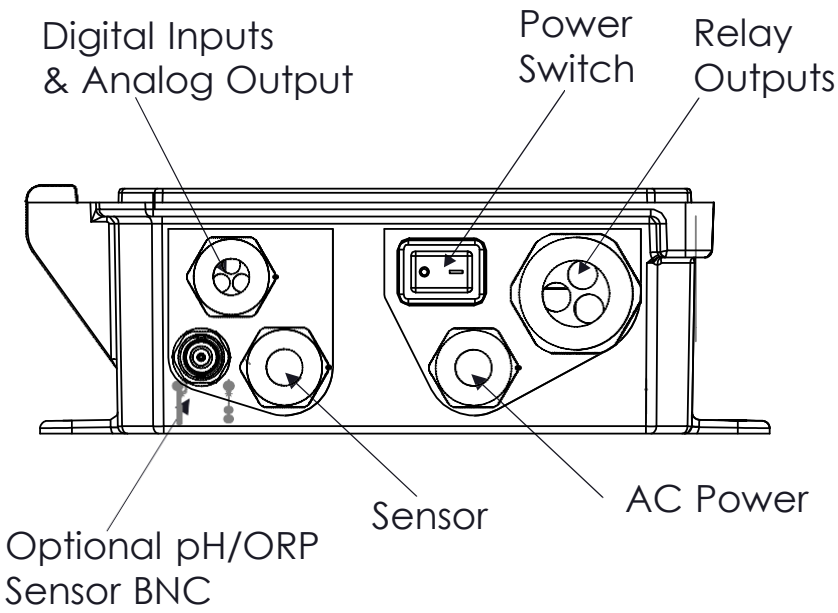


Figure 1 Conduit Wiring

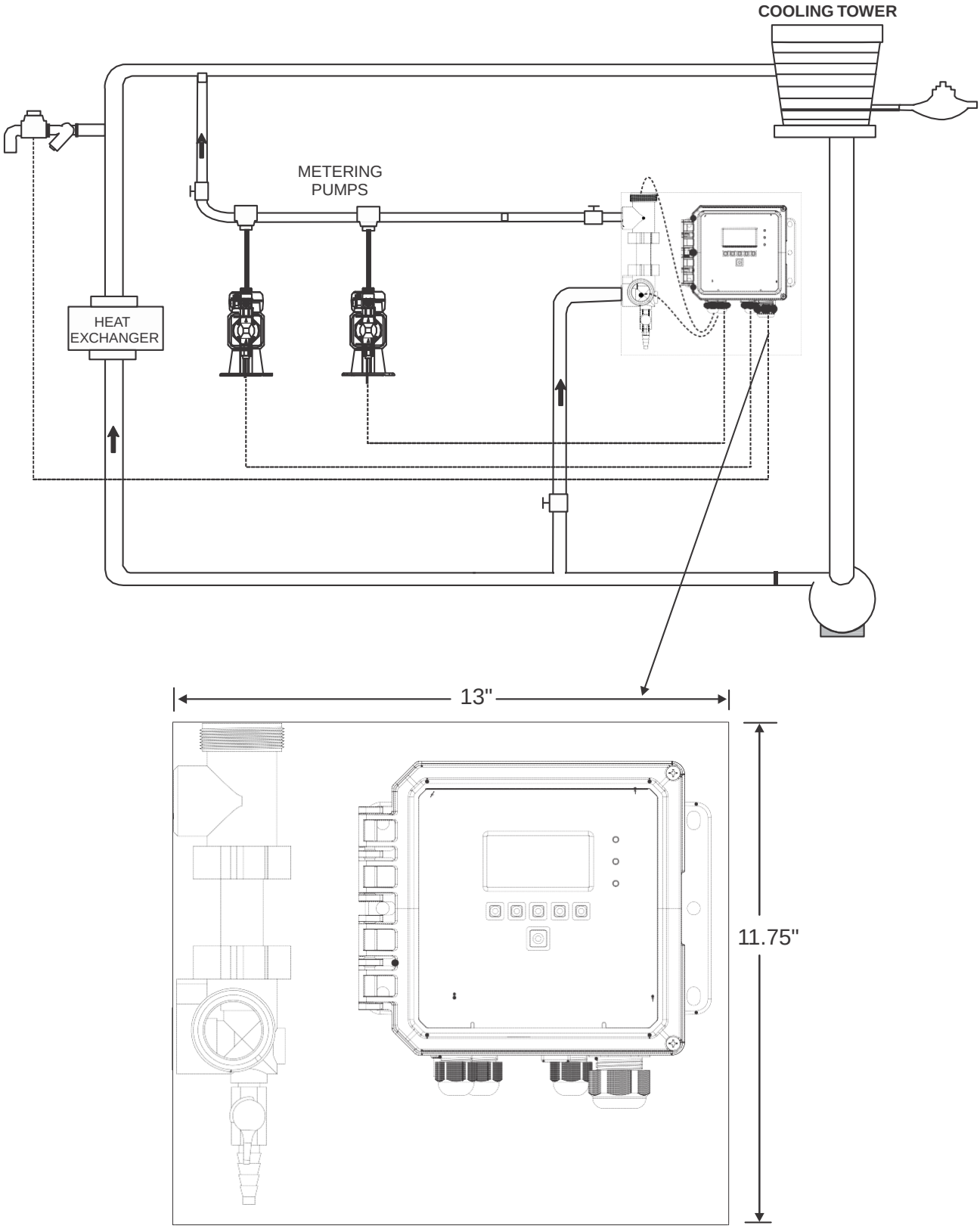


Figure 2 Typical Inline Sensor Installation

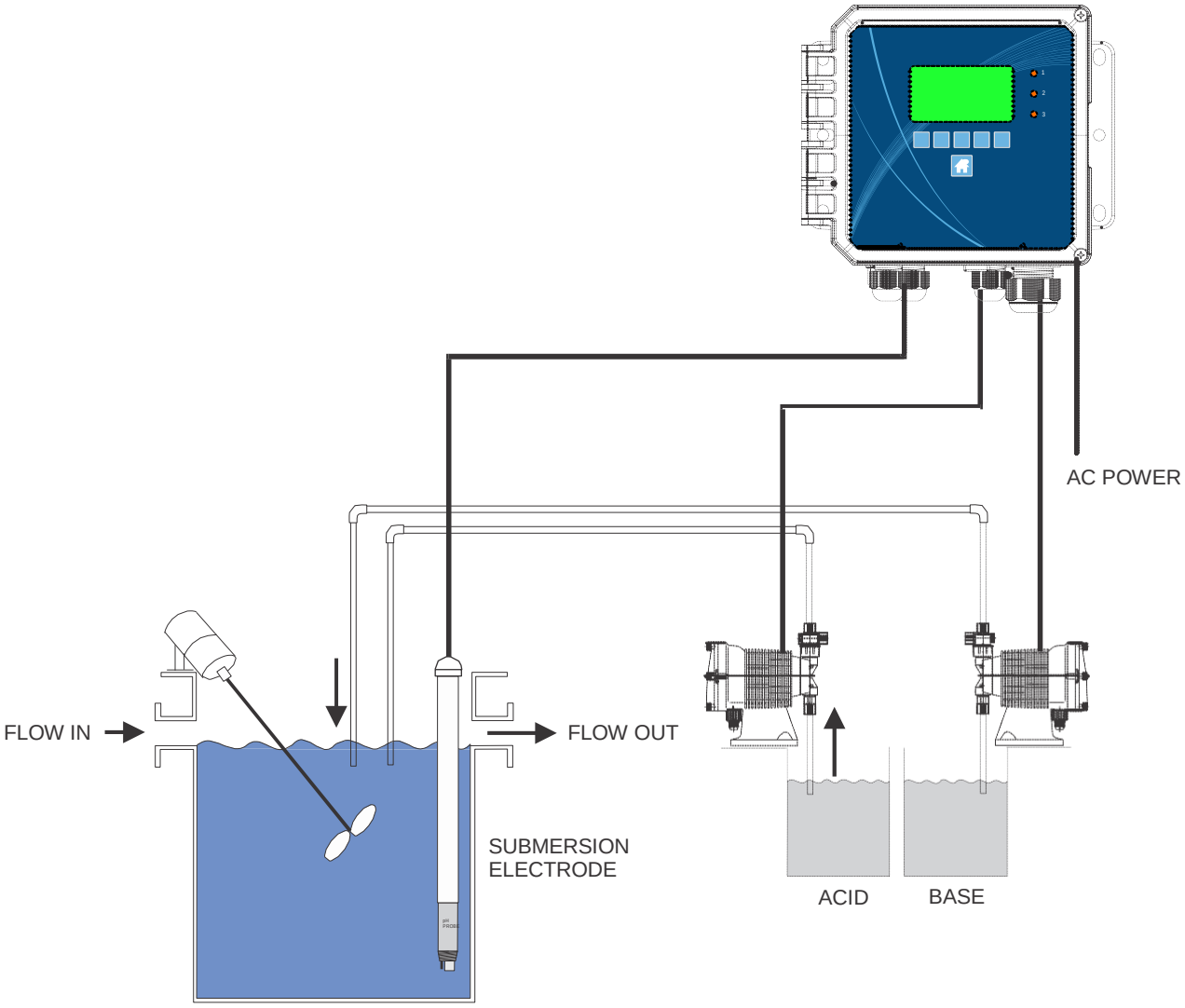


Figure 3 Typical Submersion Sensor Installation

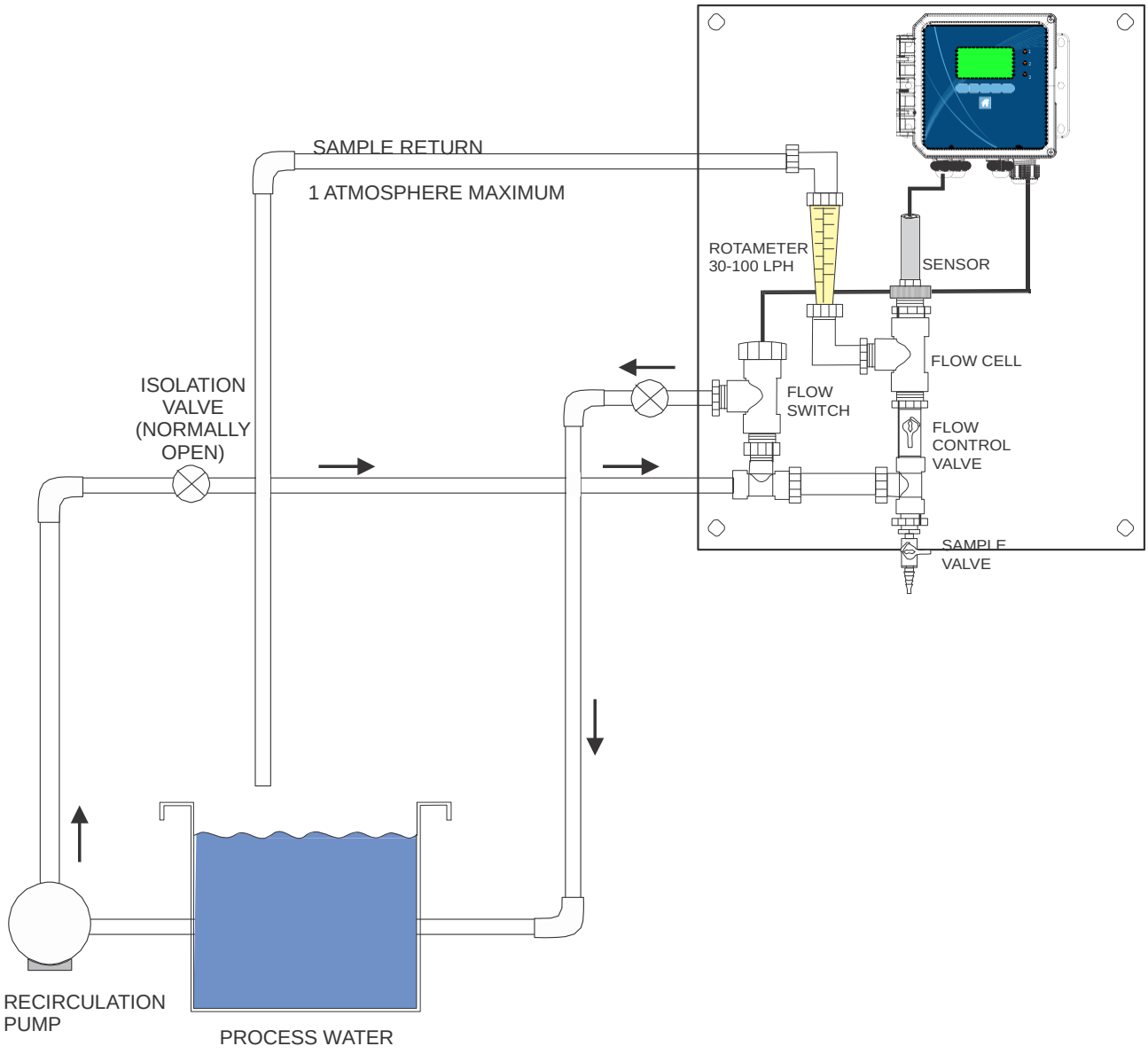


Figure 4 Typical Disinfection Sensor Installation

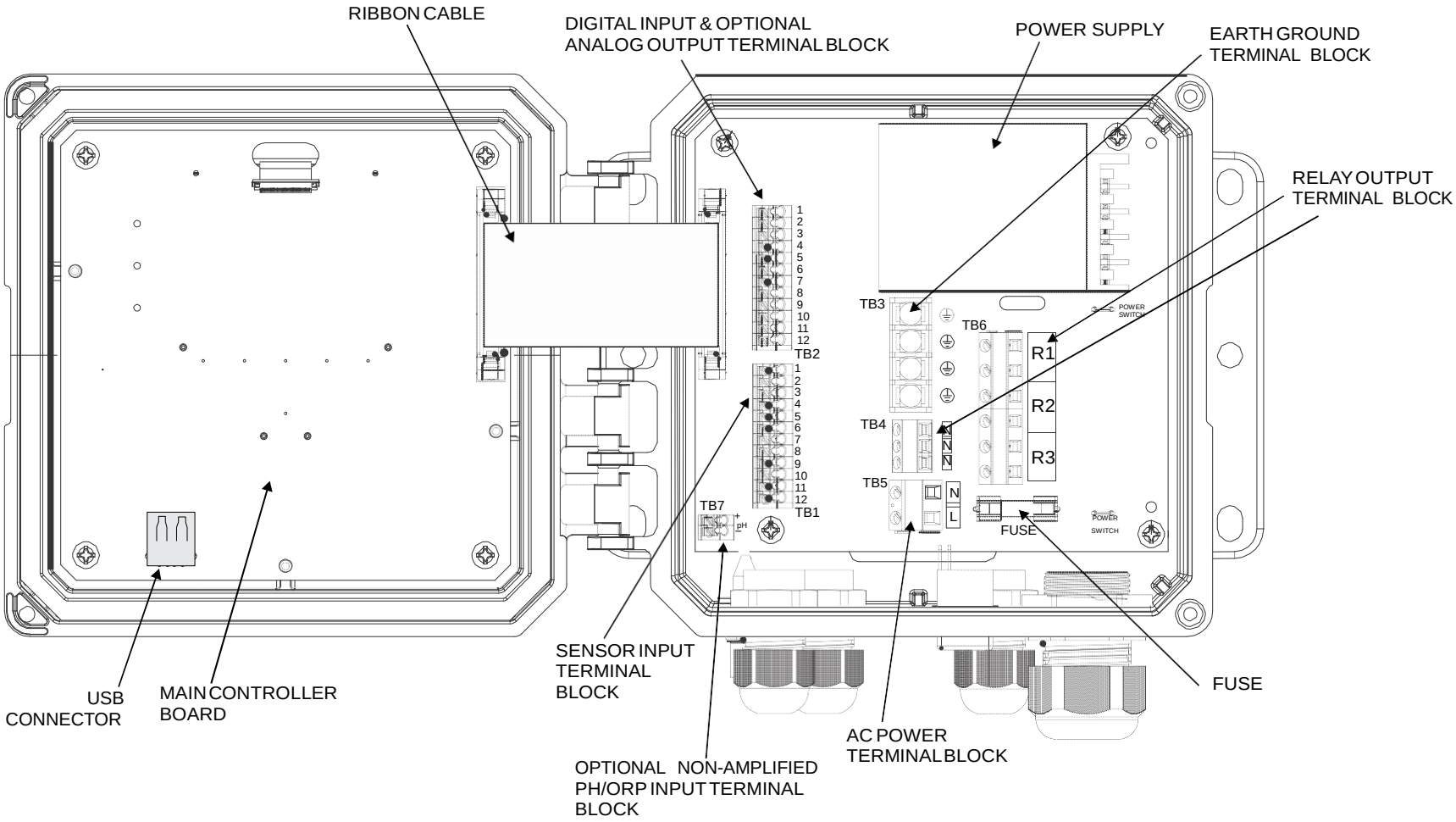
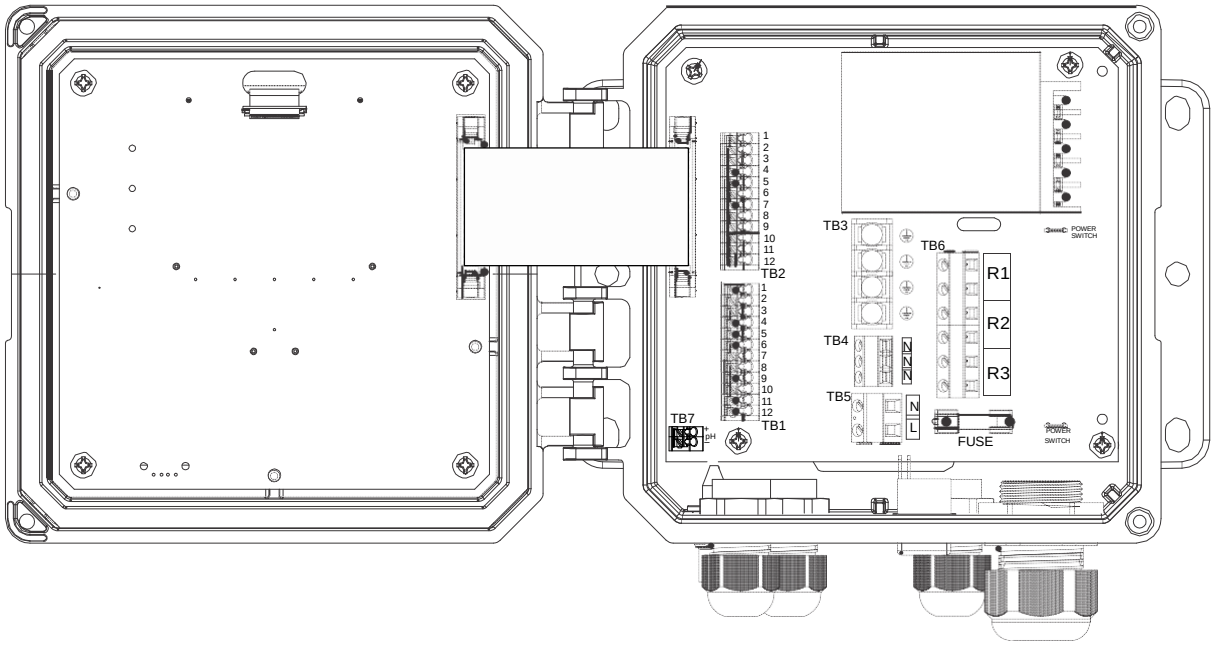


Figure 5 Identification of Parts



TB1	ECOND	CCOND	pH/ORP w/BNC	pH/ORP DIS	TB2	FUNCTION
1	XMT+	XMT			1	4-20 OUT–
2	XMT–				2	4-20 OUT+
3	X-SHLD	SHIELD	SHIELD	SHIELD	3	SHIELD
4			USE BNC FOR INPUT SIGNAL	+5V	4	DIG IN 2–
5	RCV–				5	DIG IN 2+
6	RCV+				6	+9 VDC
7		RCV		IN+	7	SHIELD
8				–5V	8	DIG IN 1–
9	TEMP–	TEMP–	TEMP–	TEMP–	9	DIG IN 1+
10	TEMP+	TEMP+	TEMP+	TEMP+	10	+9 VDC
11	R-SHLD			IN–	11	SHIELD
12					12	

SAFETY COVER LABEL

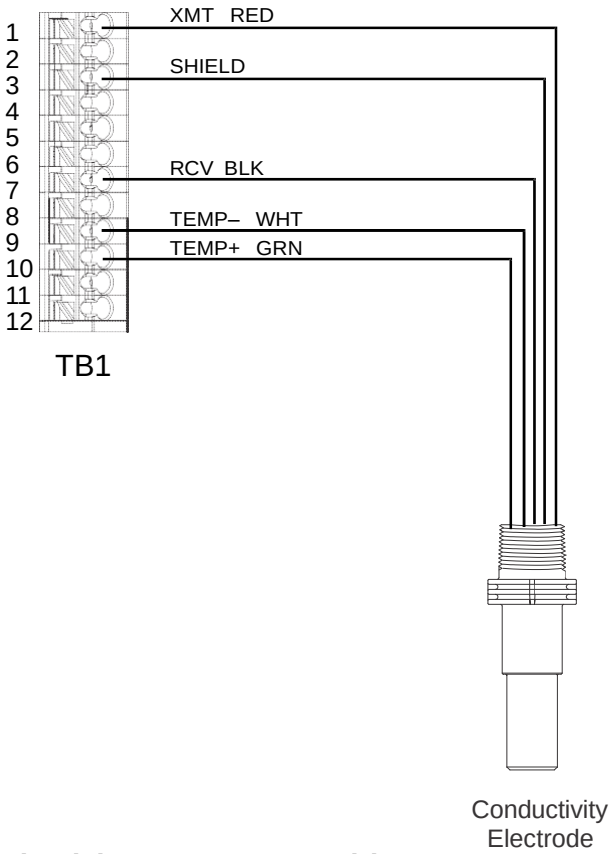
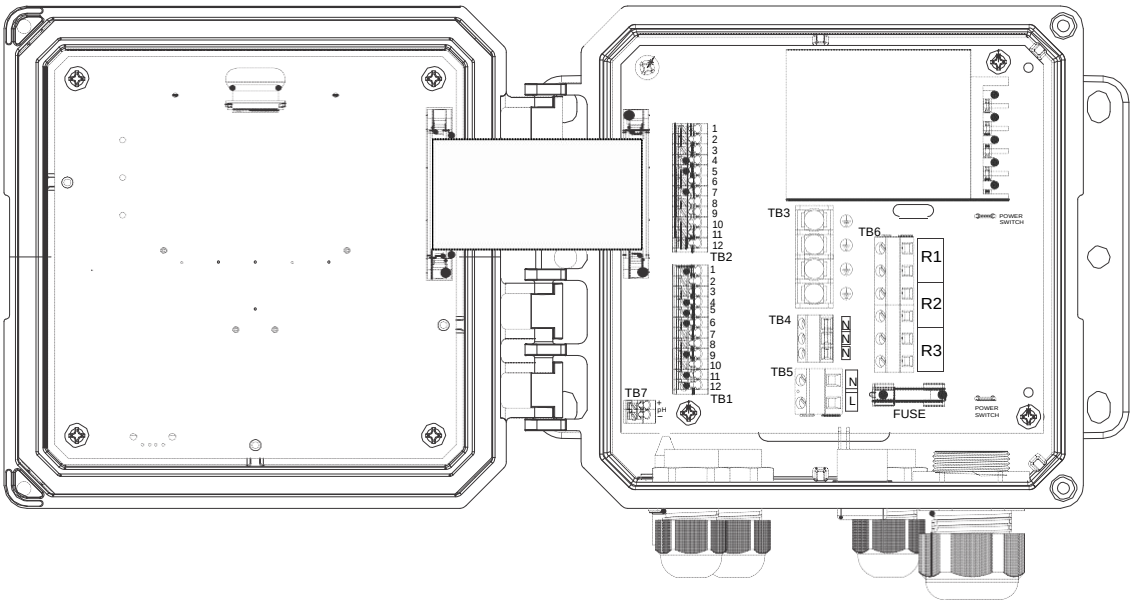
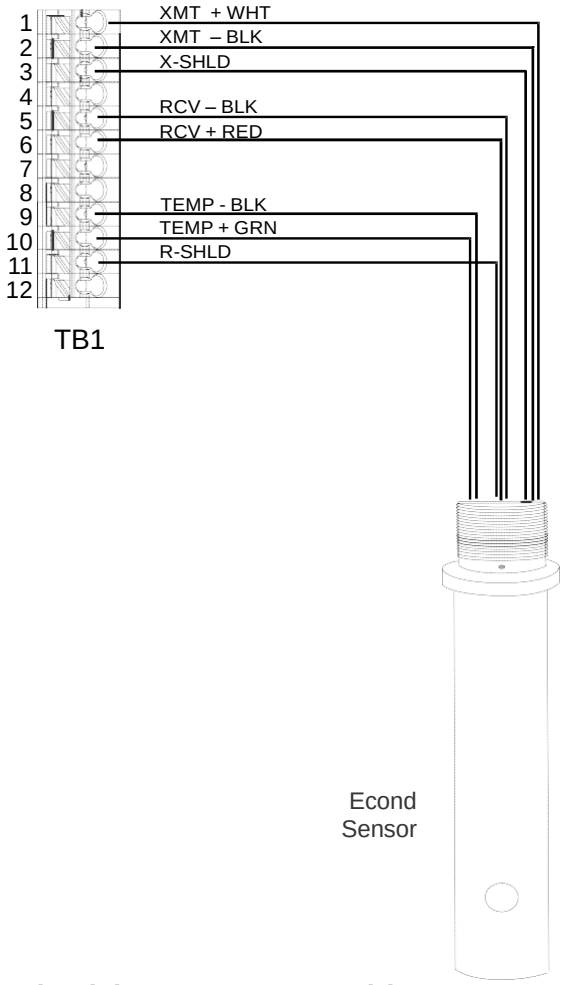


Figure 6 Contacting Conductivity Sensor Input Wiring



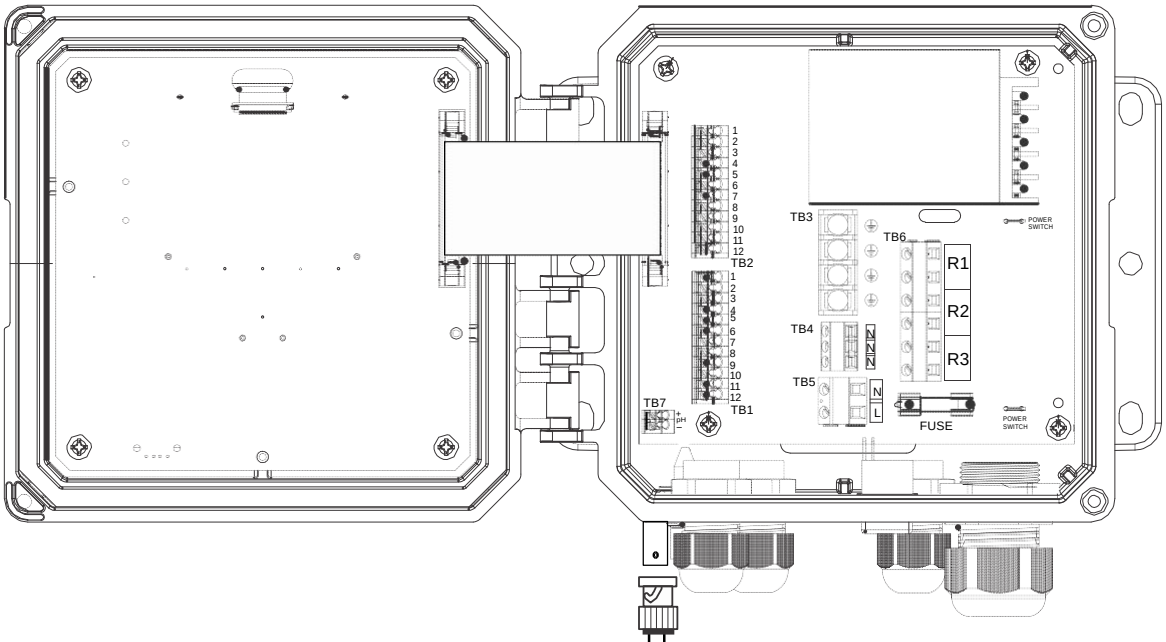
TB1	ECOND	CCOND	pH/ORP w/BNC	pH/ORP DIS	TB2	FUNCTION
1	XMT+	XMT			1	4-20 OUT–
2	XMT–				2	4-20 OUT+
3	X-SHLD	SHIELD	SHIELD	SHIELD	3	SHIELD
4			USE BNC FOR INPUT SIGNAL	+5V	4	DIG IN 2–
5	RCV–				5	DIG IN 2+
6	RCV+				6	+9 VDC
7		RCV		IN+	7	SHIELD
8				–5V	8	DIG IN 1–
9	TEMP–	TEMP–	TEMP–	TEMP–	9	DIG IN 1+
10	TEMP+	TEMP+	TEMP+	TEMP+	10	+9 VDC
11	R-SHLD			IN–	11	SHIELD
12					12	

SAFETY COVER LABEL



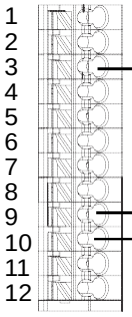
TB1

Figure 7 Electrodeless Conductivity Sensor Input Wiring



TB1	ECOND	CCOND	pH/ORP w/BNC	pH/ORP DIS	TB2	FUNCTION
1	XMT+	XMT			1	4-20 OUT–
2	XMT–				2	4-20 OUT+
3	X-SHLD	SHIELD	SHIELD	SHIELD	3	SHIELD
4			USE BNC FOR INPUT SIGNAL	+5V	4	DIG IN 2–
5	RCV–				5	DIG IN 2+
6	RCV+				6	+9 VDC
7		RCV		IN+	7	SHIELD
8				–5V	8	DIG IN 1–
9	TEMP–	TEMP–	TEMP–	TEMP–	9	DIG IN 1+
10	TEMP+	TEMP+	TEMP+	TEMP+	10	+9 VDC
11	R-SHLD			IN–	11	SHIELD
12					12	

SAFETY COVER LABEL



TB1

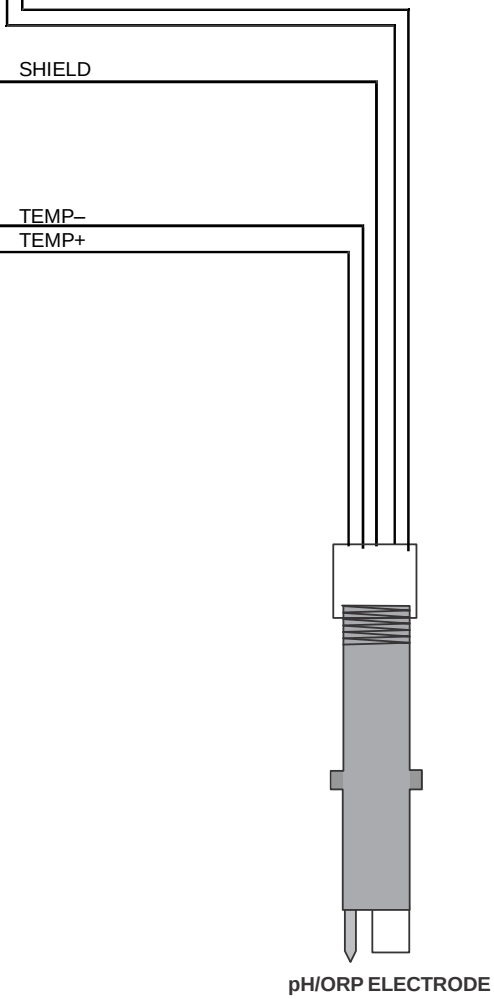
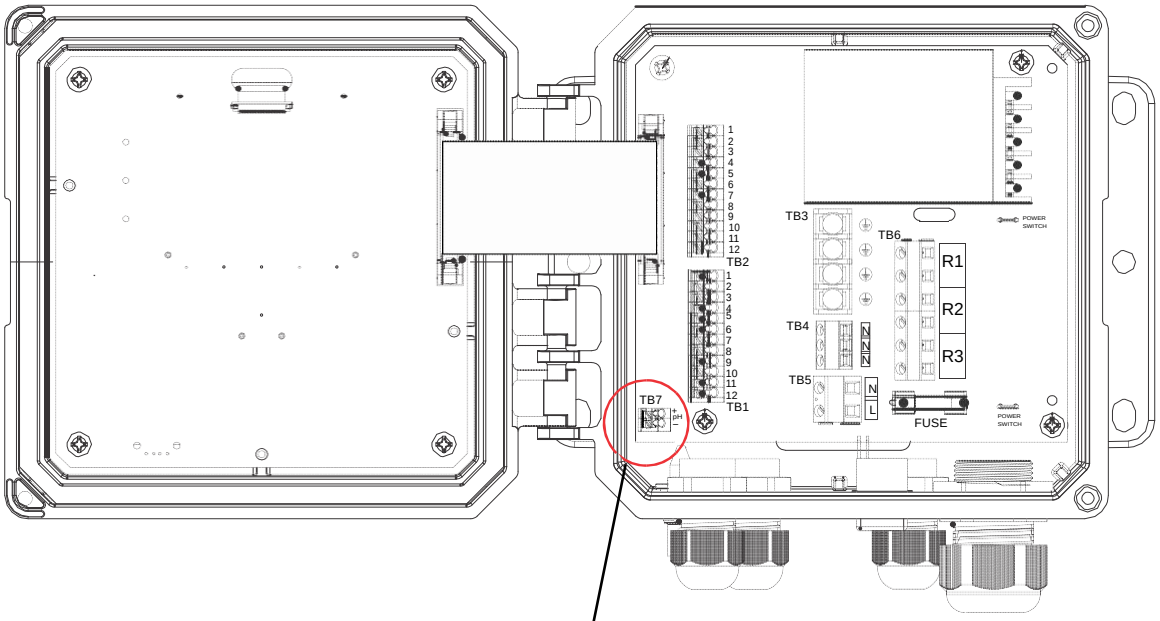


Figure 8 Non-Amplified pH/ORP Sensor Input Wiring with BNC



TB1	ECOND	CCOND	pH/ORP w/BNC	pH/ORP DIS	TB2	FUNCTION
1	XMT+	XMT			1	4-20 OUT–
2	XMT–				2	4-20 OUT+
3	X-SHLD	SHIELD	SHIELD	SHIELD	3	SHIELD
4			USE BNC FOR INPUT SIGNAL	+5V	4	DIG IN 2–
5	RCV–				5	DIG IN 2+
6	RCV+				6	+9 VDC
7		RCV		IN+	7	SHIELD
8				–5V	8	DIG IN 1–
9	TEMP–	TEMP–	TEMP–	TEMP–	9	DIG IN 1+
10	TEMP+	TEMP+	TEMP+	TEMP+	10	+9 VDC
11	R-SHLD			IN–	11	SHIELD
12					12	

SAFETY COVER LABEL

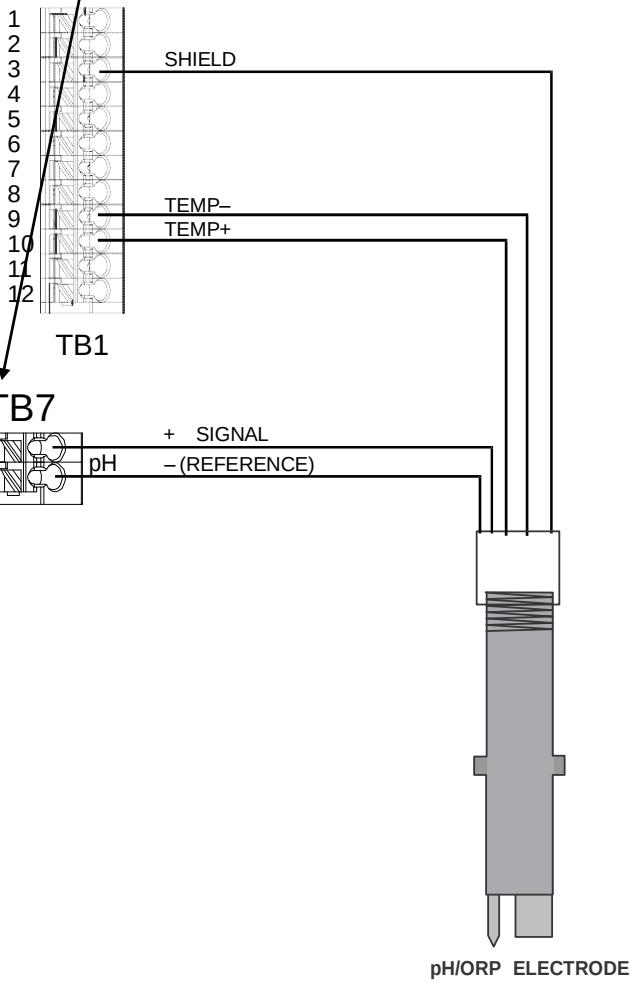
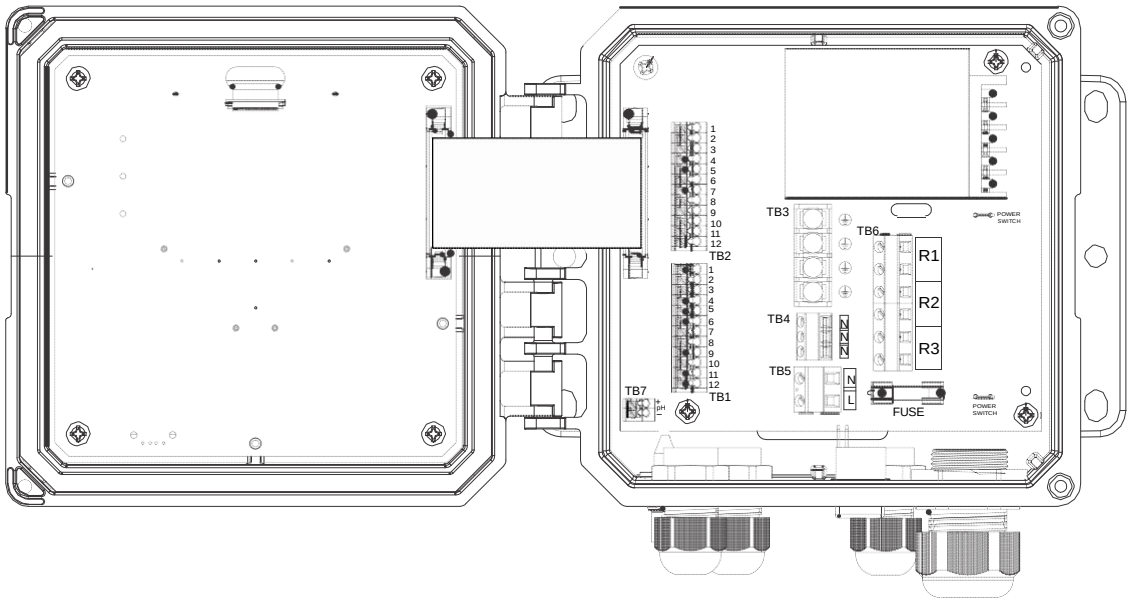
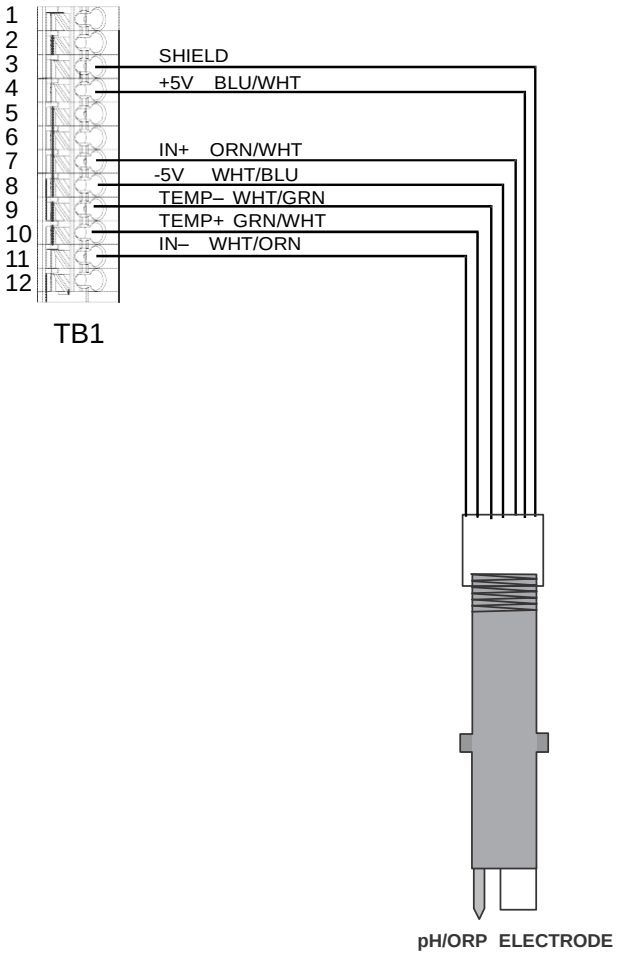


Figure 9 Non-Amplified pH/ORP Sensor Input Wiring



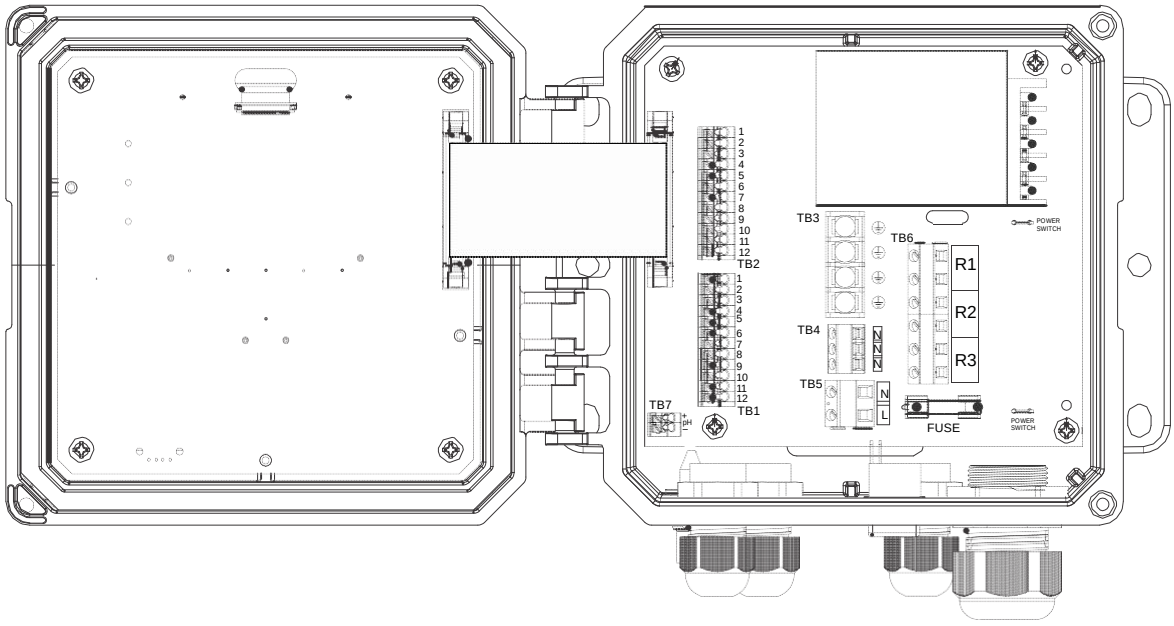
TB1	ECOND	CCOND	pH/ORP w/BNC	pH/ORP DIS	TB2	FUNCTION
1	XMT+	XMT			1	4-20 OUT–
2	XMT–				2	4-20 OUT+
3	X-SHLD	SHIELD	SHIELD	SHIELD	3	SHIELD
4			USE BNC FOR INPUT SIGNAL	+5V	4	DIG IN 2–
5	RCV–				5	DIG IN 2+
6	RCV+				6	+9 VDC
7		RCV		IN+	7	SHIELD
8				–5V	8	DIG IN 1–
9	TEMP–	TEMP–	TEMP–	TEMP–	9	DIG IN 1+
10	TEMP+	TEMP+	TEMP+	TEMP+	10	+9 VDC
11	R-SHLD			IN–	11	SHIELD
12					12	

SAFETY COVER LABEL



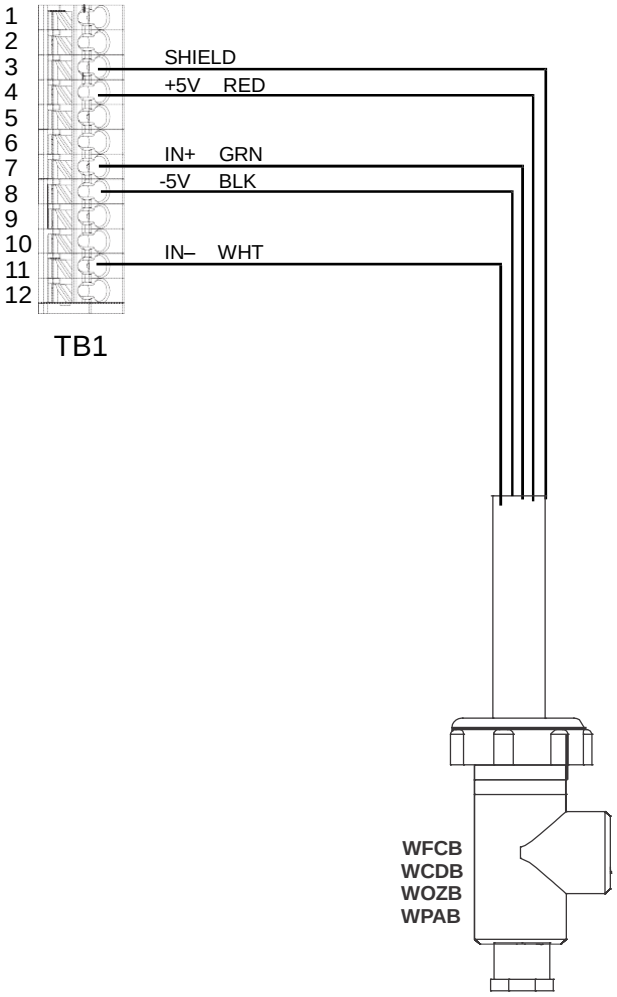
TB1

Figure 10 Amplified pH/ORP Sensor Input Wiring



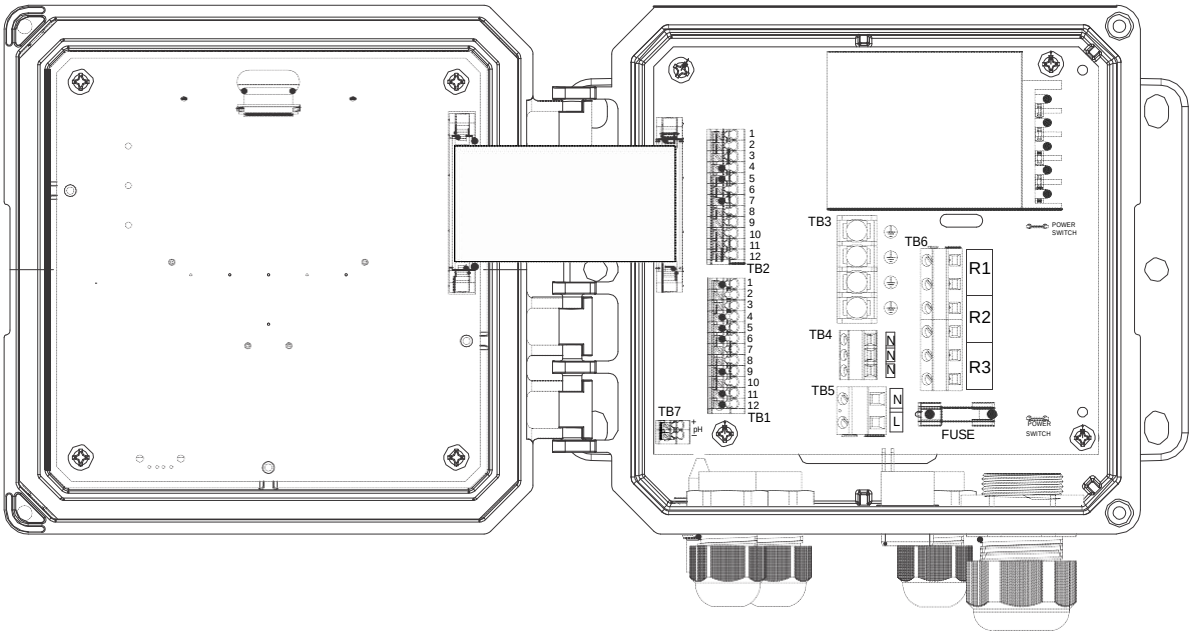
TB1	ECOND	CCOND	pH/ORP w/BNC	pH/ORP DIS	TB2	FUNCTION
1	XMT+	XMT			1	4-20 OUT–
2	XMT–				2	4-20 OUT+
3	X-SHLD	SHIELD	SHIELD	SHIELD	3	SHIELD
4			USE BNC FOR INPUT SIGNAL	+5V	4	DIG IN 2–
5	RCV–				5	DIG IN 2+
6	RCV+				6	+9 VDC
7		RCV		IN+	7	SHIELD
8				–5V	8	DIG IN 1–
9	TEMP–	TEMP–	TEMP–	TEMP–	9	DIG IN 1+
10	TEMP+	TEMP+	TEMP+	TEMP+	10	+9 VDC
11	R-SHLD			IN–	11	SHIELD
12					12	

SAFETY COVER LABEL



TB1

Figure 11 Disinfection Sensor Input Wiring



TB1	ECOND	CCOND	pH/ORP w/BNC	pH/ORP DIS	TB2	FUNCTION
1	XMT+	XMT			1	4-20 OUT–
2	XMT–				2	4-20 OUT+
3	X-SHLD	SHIELD	SHIELD	SHIELD	3	SHIELD
4			USE BNC FOR INPUT SIGNAL	+5V	4	DIG IN 2–
5	RCV–				5	DIG IN 2+
6	RCV+				6	+9VDC
7		RCV		IN+	7	SHIELD
8				–5V	8	DIG IN 1–
9	TEMP–	TEMP–	TEMP–	TEMP–	9	DIG IN 1+
10	TEMP+	TEMP+	TEMP+	TEMP+	10	+9VDC
11	R-SHLD			IN–	11	SHIELD
12					12	

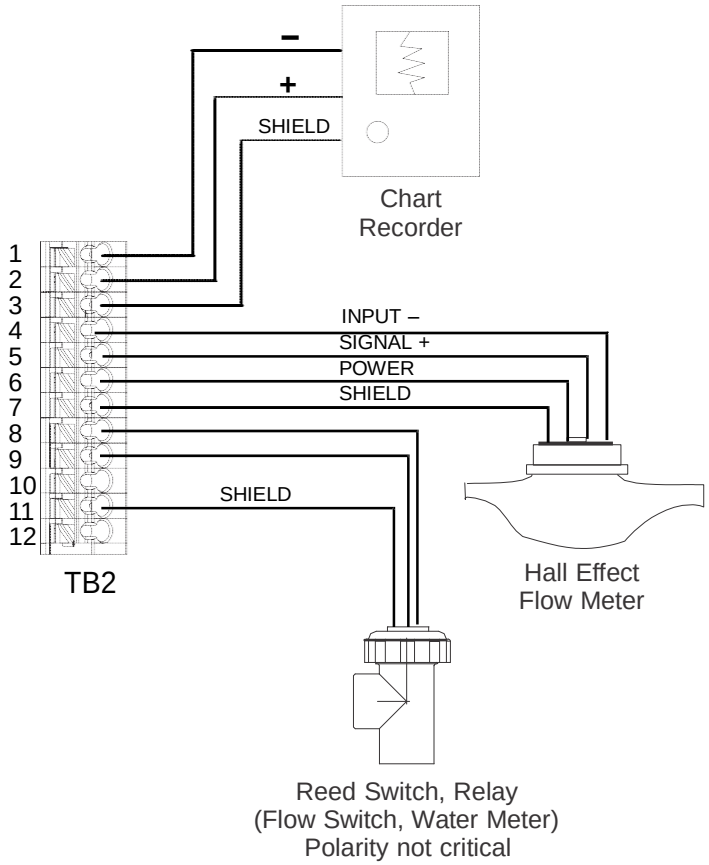


Figure 12 Digital Input /Analog Output Wiring

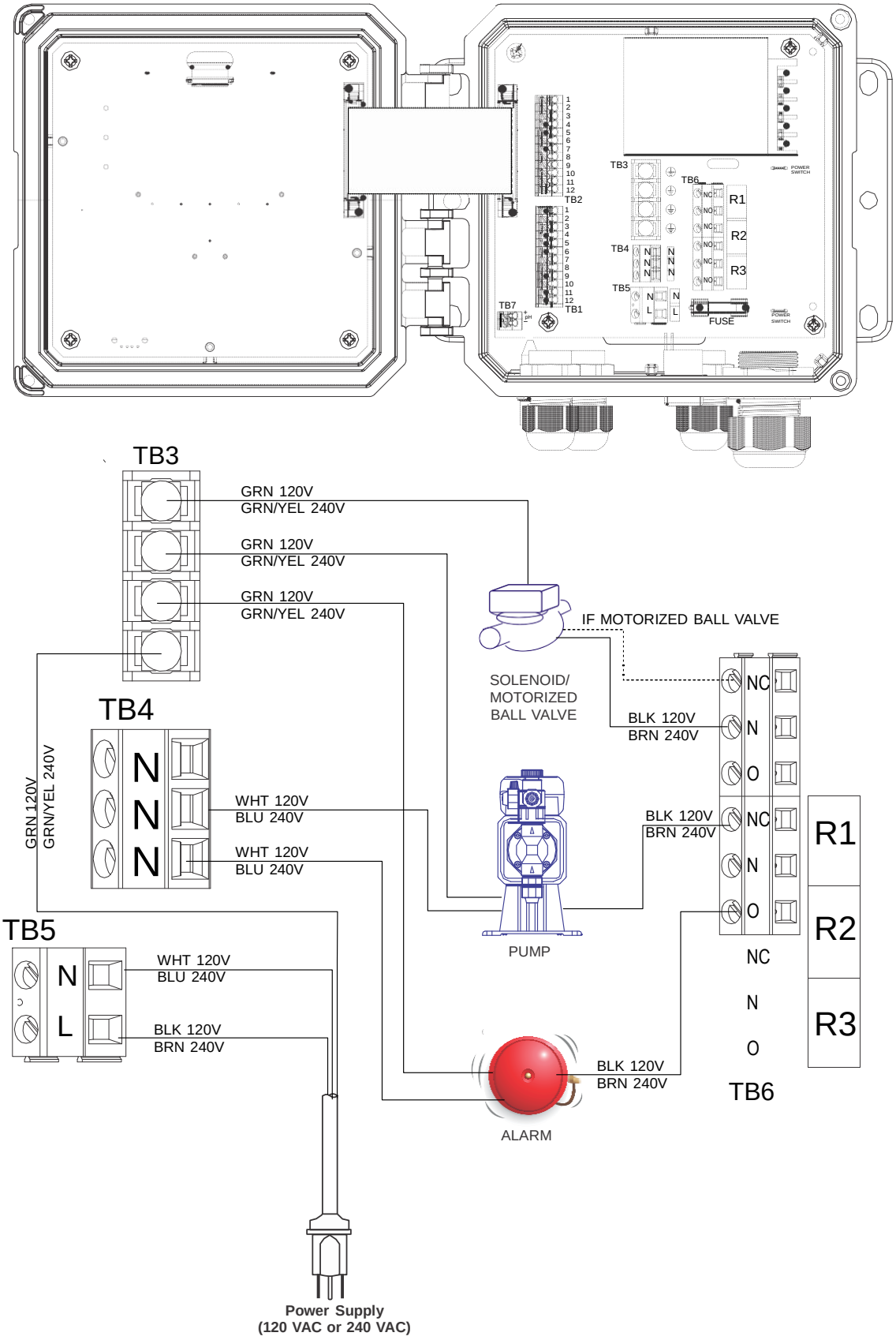
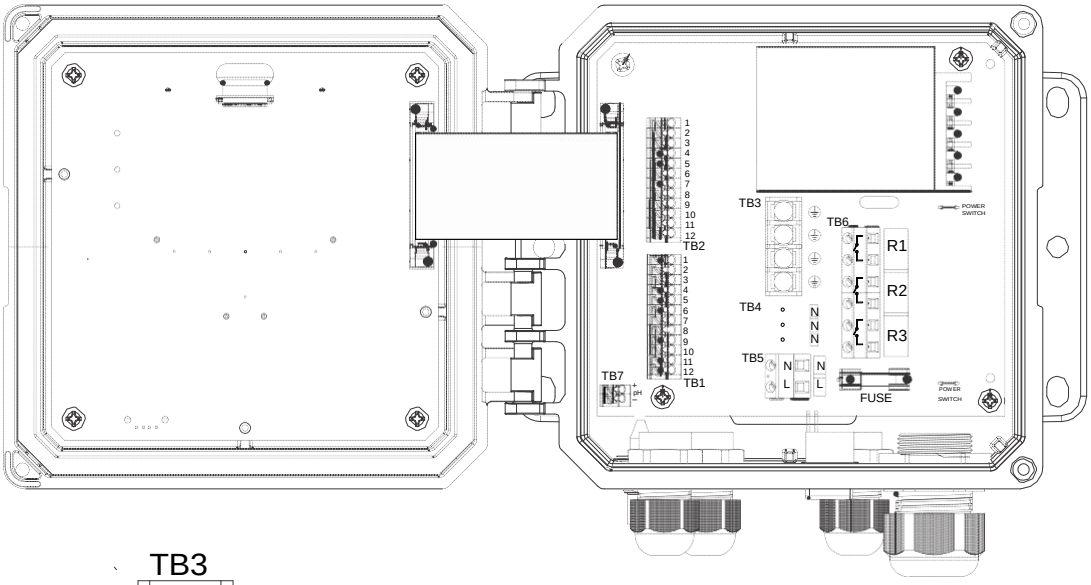


Figure 13 E AC Power & Relay Output Wiring



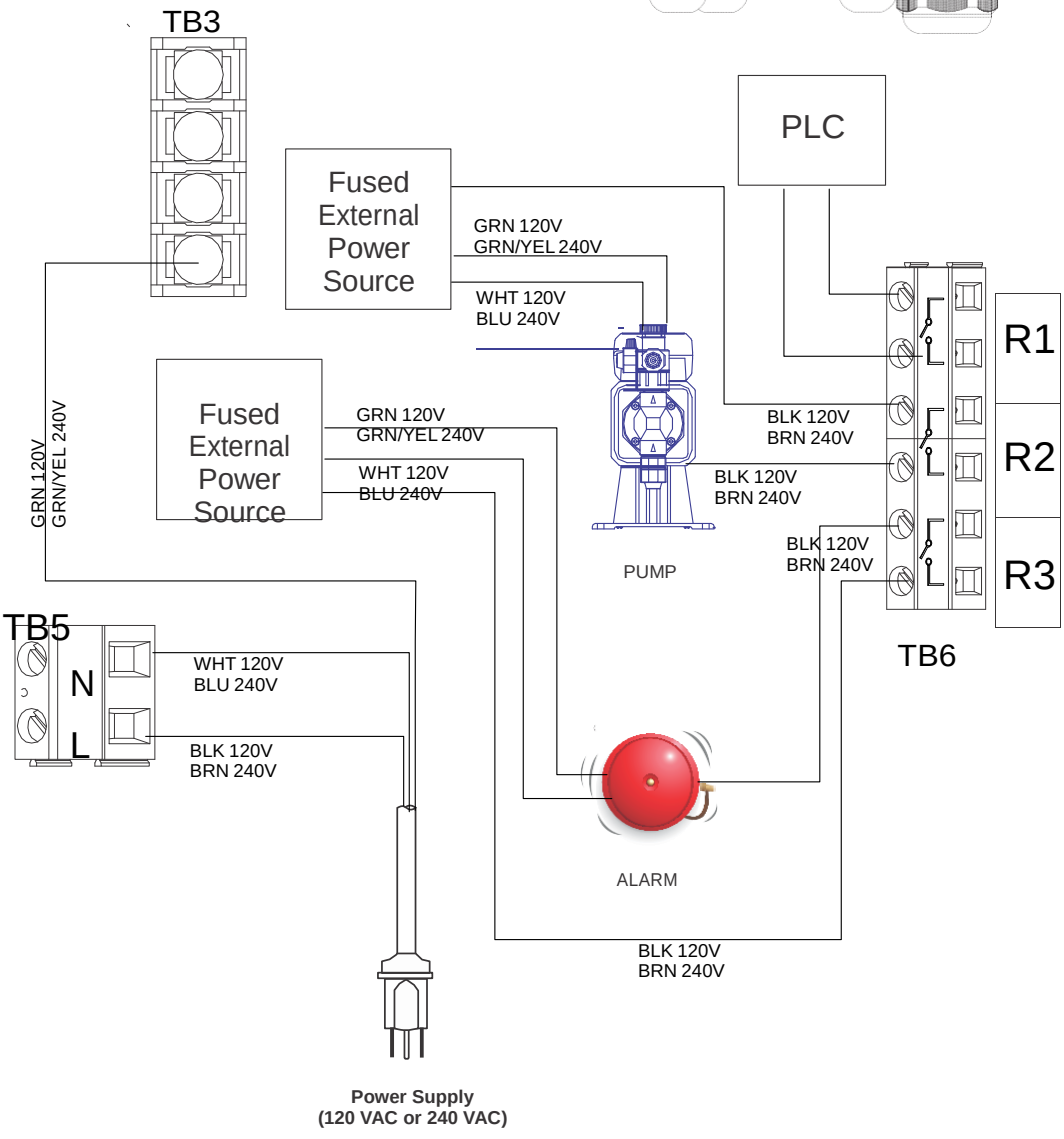


Figure 14 W110 AC Power & Relay Output Wiring

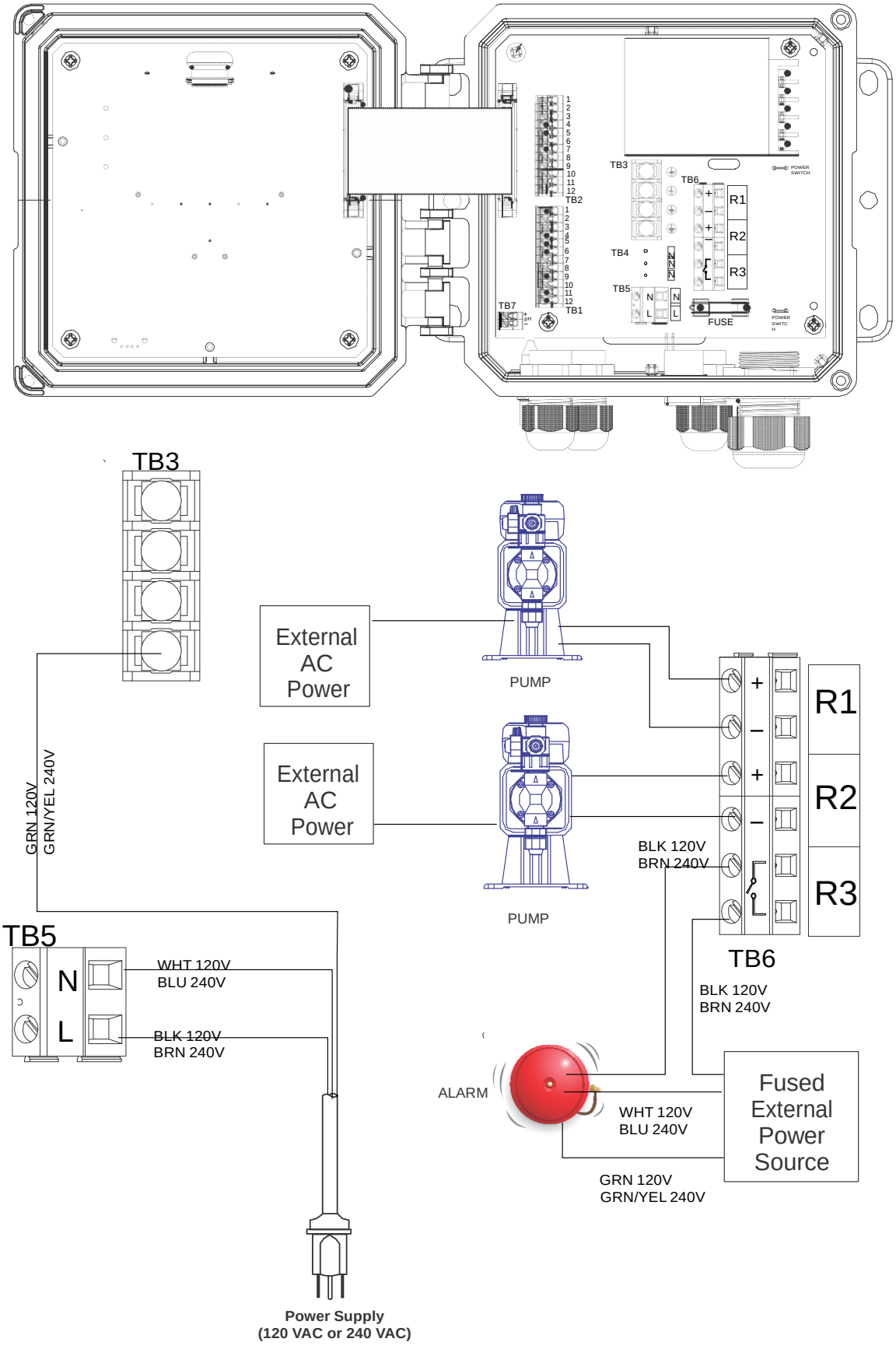


Figure 15 W120 AC Power & Relay Output Wiring

4.0 FUNCTION OVERVIEW

4.1 Front Panel

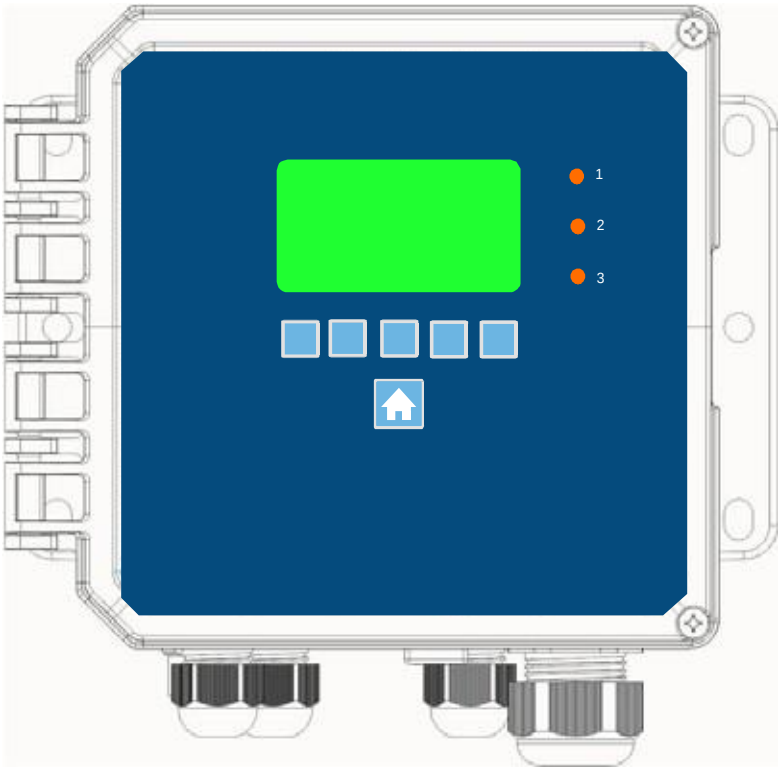


Figure 16 Front Panel

4.2 Display

A Home screen is displayed while the controller is on. This display shows the sensor readings, active alarms and a row of icons that are used to navigate to other screens.

4.3 Keypad

The keypad consists of 5 ATM type keys and a Home key used to return to the Home screen. The icon above the ATM keys will define its purpose on the current screen being displayed.

4.4 Icons

The following icons appear on the Home screen. Press the key below the icon to get to the main menu selections.


Alarm Menu


Inputs Menu


Outputs Menu


Settings Menu

Other icons may appear in the menu screens.


Calibration key appears in sensor input menus and brings up the calibration menu


Cancel key aborts a calibration

The Page Down icon scrolls down to a new page in a list of options.


The Page Up icon scrolls up to a new page in a list of options.


The Confirm icon accepts a choice and advances to the next calibration step


The Back/Return icon returns the display to the previous screen


The Make Character Higher key is used when making an alphanumeric entry


The Make Character Lower key is used when making an alphanumeric entry


The Move Cursor key is used to scroll left to right within an alphanumeric entry


The ENTER key is used to finish entering data or enter a highlighted menu choice

Overview of the use of keys

Changing Numeric Values
To change a number, use the Move Cursor key to the digit to be changed. If the new number will be negative, start with the sign using the Make Character Higher key. Move the cursor to each digit and change the value using either the Make Character Higher or Lower keys. Once the value of the number is correct use the Enter key to store the new value into memory, or use the Cancel key to leave the number at its previous value and go back.

Changing Names
To change the name used to identify an input or output, use the Move Cursor key to the character to be changed and change it using either the Make Character Higher or Lower keys. Upper case and lower case letter, numbers, a blank space, period, plus and minus symbols are available. Move the

cursor to the right and modify each character. Once the word is correct, use the Enter key to store the new value into memory, or use the Cancel key to leave the word at its previous value and go back.

Choosing from a List
Selecting the type of sensor, the units of measure of an input, or the control mode used for an output, the selection is picked from a list of available options. Use the Page Up or Down keys to highlight the desired option, and then use the Enter key to store the new option into memory, or use the Return key to leave the option at its previous value and go back.

Hand-Off-Auto Relay Mode
Use the Left or Right Move Cursor keys to highlight the desired relay mode. In Hand mode the relay is forced on for a specified amount of time and when that time is up the relay returns to its previous mode, in Off mode the relay is always off until taken out of Off mode, and in Auto mode the relay is responding to control set points. Use the Confirm key to accept the option, or the Return key to leave the option at its previous value and go back.

Interlock and Force On Menus
To select which outputs to force on, or which outputs to be interlocked, use the Move Cursor key to highlight the output to be selected, then use the Make Character Higher or Lower keys to check or uncheck that output. When finished, press the Confirm key to accept the changes or the Cancel key to leave the selections at the previous settings and go back.

4.5 Startup

Initial Startup

After having mounted the enclosure and wired the unit, the controller is ready to be started.

Plug in the controller and turn on the power switch to supply power to the unit. The display will briefly show the model number and then revert to the normal summary display. Scroll through the menus and calibrate the conductivity reading, temperature, and set the control parameters detailed in Section 5, Operation.

To return to the Home display, press the Home key.

Normal Startup

Startup is a simple process once your set points are in memory. Simply check your supply of chemicals, turn on the controller, and calibrate the sensor if necessary and it will start controlling.

4.6 Shut Down

To shut the controller down, simply turn off the power. Programming remains in memory.

5.0 OPERATION

These units control continuously while power is applied. Programming is accomplished via the local keypad and display.

To see the top level menu keys, press the Home key if not already there. The menu structure is grouped by Alarms, Inputs, Outputs, and configuration Settings. Each input has its own menu for calibration and unit selection as needed. Each output has its own setup menu including set points, timer values and operating modes as needed. Under Settings will be general settings such as the clock, the language, etc.

Keep in mind that even while moving through menus, the unit is still controlling.

5.1 Alarms Menu 

Press the key below the Alarms icon to view a list of active alarms. If there are more than two active alarms, the Page Down icon will be shown, and this key press will bring up the next page of inputs.

Press the Back/Return button to go back to the previous screen.

5.2 Inputs Menu 

Press the key below the Inputs icon to view a list of all sensor and digital inputs. The Page Down icon scrolls down the list of inputs, the Page Up icon scrolls up the list of inputs, the Return icon brings back the previous screen.

Press the Enter key with an input highlighted to access that input's details, calibration (if applicable) and settings.

Sensor Input Details
The details for any type of sensor input include the current value read, alarms, the raw (uncalibrated) signal, the sensor type, and the calibration gain and offset. If the sensor has automatic temperature compensation, then the sensor's temperature value and alarms, the temperature resistance value read, and the type of temperature element required are also displayed.

Calibration 
Press the Calibration key to calibrate the sensor. Select the calibration to perform: One Point Process, One Point Buffer or Two Point Buffer Calibration. Not all calibration options are available for all types of sensor.

One Point Process Calibration

New Value
Enter the actual value of the process as determined by another meter or laboratory analysis and press Confirm.

Cal Successful or Failed
If successful, press Confirm to put the new calibration in memory.
If failed, you may retry the calibration or cancel. Refer to Section 7 to troubleshoot a calibration failure.

One Point Buffer Calibration, Disinfection Sensor Zero Cal, Electrodeless Conductivity Air Cal

Cal Disables Control

Press Confirm to continue or Cancel to abort

Buffer Temperature (only appears if no temperature sensor is detected for sensor types that use automatic temperature compensation)

Enter the temperature of the buffer and press Confirm.

Buffer Value (only appears for One Point Calibration)

Enter the value of the buffer being used

Rinse Sensor

Remove the sensor from the process, rinse it off, and place it in the buffer solution (or oxidizer-free water for Zero Cal, or air for the electrodeless conductivity open air cal). Press Confirm when ready.

Stabilization

When the temperature (if applicable) and signal from the sensor is stable, the controller will automatically move to the next step. If they don't stabilize you may manually go to the next step by pressing Confirm.

Cal Successful or Failed

If successful, press Confirm to put the new calibration in memory.

If failed, you may retry the calibration or cancel. Refer to Section 7 to troubleshoot a calibration failure.

Resume Control

Replace the sensor in the process and press Confirm when ready to resume control.

Two Point Buffer Calibration

Cal Disables Control

Press Confirm to continue or Cancel to abort

Buffer Temperature (only appears if no temperature sensor is detected for sensor types that use automatic temperature compensation)

Enter the temperature of the buffer and press Confirm.

Buffer Value

Enter the value of the buffer being used

Rinse Sensor

Remove the sensor from the process, rinse it off, and place it in the buffer solution. Press Confirm when ready.

Stabilization

When the temperature (if applicable) and signal from the sensor is stable, the controller will automatically move to the next step. If they don't stabilize you may manually go to the next step by pressing Confirm.

Second Buffer Value

Enter the value of the buffer being used

Rinse Electrode

Remove the sensor from the process, rinse it off, and place it in the buffer solution. Press Confirm when ready.

Stabilization

When the temperature (if applicable) and signal from the sensor is stable, the controller will automatically move to the next step. If they don't stabilize you may manually go to the next step by pressing Confirm.

Cal Successful or Failed

If successful, press Confirm to put the new calibration in memory. The calibration adjusts the offset and the gain (slope) and displays the new values. If failed, you may retry the calibration or cancel. Refer to Section 7 to troubleshoot a calibration failure.

Resume Control

Replace the sensor in the process and press Confirm when ready to resume control.

5.2.1 Contacting Conductivity (Only available in some models)

Settings 

Press the Settings key view or change the settings related to the sensor.

Alarms	Low-Low, Low, High and High-High Alarms limits may be set.
Deadband	This is the Alarm Deadband. For example, if the High Alarm is 3000, and the deadband is 10, the alarm will activate at 3001 and deactivate at 2990.
Default Temp	If the temperature signal is lost at any time, then the controller will use the Default Temp setting for temperature compensation.
Cable Length	The controller automatically compensates for errors in the reading caused by varying the length of the cable.
Gauge	The cable length compensation depends upon the gauge of wire used to extend the cable
Cell Constant	Do not change unless instructed by the factory.
Units	Select the units of measure for the conductivity.
Name	The name used to identify the sensor may be changed.
Type	Select the type of sensor to be connected.

5.2.2 pH

Settings 

Press the Settings key view or change the settings related to the sensor.

Alarms	Low-Low, Low, High and High-High Alarms limits may be set.
Deadband	This is the Alarm Deadband. For example, if the High Alarm is 9.50, and the deadband is 0.05, the alarm will activate at 9.51 and deactivate at 9.45.
Default Temp	If the temperature signal is lost at any time, then the controller will use the Default Temp setting for temperature compensation.
Cable Length	The controller automatically compensates for errors in the reading caused by varying the length of the cable.
Gauge	The cable length compensation depends upon the gauge of wire used to extend the cable
Name	The name used to identify the sensor may be changed.
Type	Select the type of sensor to be connected.

5.2.3 ORP

Settings 
Press the Settings key view or change the settings related to the sensor.

Alarms	Low-Low, Low, High and High-High Alarms limits may be set.
Deadband	This is the Alarm Deadband. For example, if the High Alarm is 800, and the deadband is 10, the alarm will activate at 801 and deactivate at 790.
Cable Length	The controller automatically compensates for errors in the reading caused by varying the length of the cable.
Gauge	The cable length compensation depends upon the gauge of wire used to extend the cable
Name	The name used to identify the sensor may be changed.
Type	Select the type of sensor to be connected.

5.2.4 Disinfection (Only available in some models)

Settings 
Press the Settings key view or change the settings related to the sensor.

Alarms	Low-Low, Low, High and High-High Alarms limits may be set.
Deadband	This is the Alarm Deadband. For example, if the High Alarm is 7.00, and the deadband is 0.1, the alarm will activate at 7.01 and deactivate at 6.90.
Cable Length	The controller automatically compensates for errors in the reading caused by varying the length of the cable.
Gauge	The cable length compensation depends upon the gauge of wire used to extend the cable
Name	The name used to identify the sensor may be changed.
Sensor	Select the specific type and range of disinfection sensor to be connected.
Type	Select the type of sensor to be connected.

5.2.5 Electrodeless Conductivity (Only available in some models)

Settings 

Press the Settings key view or change the settings related to the sensor.

Alarms	Low-Low, Low, High and High-High Alarms limits may be set.
Deadband	This is the Alarm Deadband. For example, if the High Alarm is 3000, and the deadband is 10, the alarm will activate at 3000 and deactivate at 2990.
Default Temp	If the temperature signal is lost at any time, then the controller will use the Default Temp setting for temperature compensation.
Installation Factor	Do not change unless instructed by the factory.
Cable Length	The controller automatically compensates for errors in the reading caused by varying the length of the cable.
Gauge	The cable length compensation depends upon the gauge of wire used to extend the cable
Cell Constant	Do not change unless instructed by the factory.
Range	Select the range of conductivity that best matches the conditions the sensor will see.
Units	Select the units of measure for the conductivity.
Name	The name used to identify the sensor may be changed.
Type	Select the type of sensor to be connected.

5.2.6 Temperature

Settings 

Press the Settings key view or change the settings related to the sensor.

Alarms	Low-Low, Low, High and High-High Alarms limits may be set.
Deadband	This is the Alarm Deadband. For example, if the High Alarm is 100, and the deadband is 1, the alarm will activate at 100 and deactivate at 99.
Name	The name used to identify the sensor may be changed.
Element	Select the specific type of temperature sensor to be connected.

5.2.7 DI State

Input Details
The details for this type of input include the current state with a custom message for open versus closed, alarms, and the status of the interlock.

Settings 
Press the Settings key view or change the settings related to the sensor.

Open Message	The words used to describe the switch state may be customized.
Closed Message	The words used to describe the switch state may be customized.
Interlock	Choose whether the input should be in the interlocked state when the switch is either open or closed.
Alarm	Choose if an alarm should be generated when the switch is open, or closed, or if no alarm should ever be generated.
Name	The name used to identify the switch may be changed.
Type	Select the type of sensor to be connected to the digital input channel.

5.2.8 Flow Meter, Contactor Type

Input Details
The details for this type of input include the total volume accumulated through the flow meter and alarms.

Settings 
Press the Settings key view or change the settings related to the sensor.

Totalizer Alarm	A high limit on the total volume of water accumulated may be set.
Reset Flow Total	Enter this menu to reset the accumulated flow total to 0. Press Confirm to accept, Cancel to leave the total at the previous value and go back.
Volume/Contact	Enter the volume of water that needs to go through the flow meter in order to generate a contact closure.
Flow Units	Select the units of measure for the water volume.
Name	The name used to identify the sensor may be changed.
Type	Select the type of sensor to be connected to the digital input channel.

5.2.9 Flow Meter, Paddlewheel Type

Input Details
The details for this type of input include the current flow rate, total volume accumulated through the flow meter and alarms.

Settings 
Press the Settings key view or change the settings related to the sensor.

Totalizer Alarm	A high limit on the total volume of water accumulated may be set.
Reset Flow Total	Enter this menu to reset the accumulated flow total to 0. Press Confirm to accept, Cancel to leave the total at the previous value and go back.
K Factor	Enter the pulses generated by the paddlewheel per unit volume of water.
Flow Units	Select the units of measure for the water volume.
Rate Units	Select the units of measure for the flow rate time base.
Name	The name used to identify the sensor may be changed.
Type	Select the type of sensor to be connected to the digital input channel.

5.3 Outputs Menu 

Press the key below the Outputs icon to view a list of all relay and analog outputs. The Page Down icon scrolls down the list of outputs, the Page Up icon scrolls up the list of outputs, the Return icon brings back the previous screen.

Press the Enter key with an output highlighted to access that output's details and settings.

NOTE: When the output control mode or the input assigned to that output is changed, the output reverts to OFF mode. Once you have changed all settings to match the new mode or sensor, you must put the output into AUTO mode to start control.

5.3.1 Relay, Any Control Mode

Output Details
The details for this type of output include the relay on/off state, HOA mode or Interlock status, accumulated on-time and alarms.

Settings 
Press the Settings key view or change the settings related to the relay. Settings that are available for any control mode include:

HOA Setting	Select Hand, Off or Auto mode (see section 4.4).
Output Time Limit	Enter the maximum amount of time that the relay can be continuously activated. Once the time limit is reached, the relay will deactivate until the Reset Output Timeout menu is entered.
Reset Output Timeout	Enter this menu to clear an Output Timeout alarm and allow the relay to control the process again.
Interlock Channels	Select the relays and digital inputs that will interlock this relay.
Activate With Channels	Select the relays and digital inputs that will activate this relay.
Hand Time Limit	Enter the amount of time that the relay will activate for when it is in Hand mode.
Name	The name used to identify the relay may be changed.
Mode	Select the desired control mode for the output.

5.3.2 Relay, On/Off Control Mode

Output Details

The details for this type of output include the relay on/off state, HOA mode or Interlock status, accumulated on-time and alarms.

Settings 

Press the Settings key view or change the settings related to the relay.

Set point	Enter the sensor process value at which the relay will activate.
Deadband	Enter the sensor process value away from the set point at which the relay will deactivate.
Input	Select the sensor to be used by this relay.
Direction	Select the control direction.

5.3.3 Relay, Alarm Mode

Output Details

The details for this type of output include the relay on/off state, HOA mode or Interlock status, accumulated on-time and alarms.

Settings 

An alarm relay will activate if any alarm is active. There are no additional programmable parameters.

5.3.4 Relay, Time Proportional Control Mode

Output Details

The details for this type of output include the relay on/off state, HOA mode or Interlock status, accumulated on-time and alarms.

Settings 

Press the Settings key view or change the settings related to the relay.

Set point	Enter the sensor process value at which the relay will be off for the entire Sample Period.
Proportional Band	Enter the distance that the sensor process value is away from the set point at which the relay will be on for the entire Sample Period.
Sample Period	Enter the duration of the sample period.
Input	Select the sensor to be used by this relay.
Direction	Select the control direction.

5.3.5 Relay, Pulse Proportional Control Mode

Output Details

The details for this type of output include the relay pulse rate, HOA mode or Interlock status, accumulated on-time and alarms.

Settings 

Press the Settings key view or change the settings related to the relay.

Set point	Enter the sensor process value at which the output will pulse at the Minimum Output % set below.
Proportional Band	Enter the distance that the sensor process value is away from the set point beyond which the output will be pulsing at the Maximum Output % set below.
Minimum Output	Enter the lowest possible pulse rate as a percentage of the Maximum Stroke Rate set below (normally 0%).
Maximum Output	Enter the highest possible pulse rate as a percentage of the Maximum Stroke Rate set below.
Maximum Rate	Enter the maximum pulse rate that the metering pump is designed to accept (10 - 360 pulse/minute range).
Input	Select the sensor to be used by this relay.
Direction	Set the control direction.

5.3.6 Relay, Dual Set Point Mode

Output Details
The details for this type of output include the relay on/off state, HOA mode or Interlock status, accumulated on-time and alarms.

Settings 
Press the Settings key view or change the settings related to the relay.

Set point	Enter the first sensor process value at which the relay will activate.
Set point 2	Enter the second sensor process value at which the relay will activate.
Deadband	Enter the sensor process value away from the set point at which the relay will deactivate.
Input	Select the sensor to be used by this relay.
Direction	Select the control direction. In Range will activate the relay when the input reading is between the two set points. Out of Range will activate the relay when the input reading is outside the two set points.

5.3.7 Relay or Analog Output, Manual Mode

Output Details
The details for this type of output include the relay on/off state or analog output %, HOA mode or Interlock status, accumulated on-time and alarms.

Settings 
A Manual relay will activate if the HOA mode is Hand, or if it is Activated With another channel. There are no additional programmable parameters.

5.3.8 Relay, Flow Timer Control Mode

Output Details
The details for this type of output include the relay on/off state, HOA mode or Interlock status, accumulated on-time and alarms.

Settings 
Press the Settings key view or change the settings related to the relay.

Feed Duration	Enter the amount of time for the relay to activate for once the accumulated volume through the water meter has been reached.
Accumulated Volume	Enter the volume of water to pass through the water meter required to trigger the chemical feed.
Input	Select the input to be used to control this output.

5.3.9 Relay, Percent Timer Control Mode

Output Details

The details for this type of output include the relay on/off state, HOA mode or Interlock status, cycle time, accumulated on-time and alarms.

Settings 

Press the Settings key view or change the settings related to the relay.

Sample Period	Enter the duration of the sample period.
Feed Percentage	Enter the % of the sample period time to use for the feed relay activation time

5.3.10 Relay, Timer Control Mode

Output Details

The details for this type of output include the relay on/off state, HOA mode or Interlock status, accumulated on-time and alarms. The current week number is displayed (even if there is no multi-week repetition event programmed). Cycle Time shows the time counting down of the currently active part of the biocide cycle (pre-bleed, biocide feed, or post biocide feed lockout of the bleed).

Settings 

Press the Settings key view or change the settings related to the relay.

Event 1 Repetition	Select the time cycle to repeat the biocide feed event: Daily, 1 Week, 2 Week, 4 Week, or None. An event means that the output is turned on at the same time of day, for the same amount of time, and except for the Daily cycle, on the same day of the week.
Event 1 Week	If the Event Repetition is Daily or 1 Week, select N/A. For longer cycles, select the week during which the event will occur.
Event 1 Day	If the Event Repetition is Daily, select N/A. For longer cycles, select the day of the week during which the event will occur.
Event 1 Start Time	Enter the time of day to start the biocide feed event. The event begins with the Prebleed if applicable, then the chemical feed, and then the Bleed Lockout.
Event 1 Duration	Enter the amount of time that the biocide chemical feed pump will be on.

Repeat for up to 10 events…

5.3.11 Analog Output, Retransmit Mode

Output Details

The details for this type of output include the output %, HOA mode or Interlock status, accumulated on-time and alarms.

Settings

Press the Settings key view or change the settings related to the analog output.

4 mA Value	Enter the process value to correspond to a 4 mA output signal.
20 mA Value	Enter the process value to correspond to a 20 mA output signal.
Hand Output	Enter the output % desired when the output is in Hand mode.
Input	Select the sensor input to retransmit.

5.3.12 Analog Output, Proportional Control Mode

Output Details

The details for this type of output include the output %, HOA mode or Interlock status, accumulated on-time and alarms.

Settings

Press the Settings key view or change the settings related to the analog output.

Set point	Enter the sensor process value at which the output % will be the programmed minimum %.
Proportional Band	Enter the sensor process value away from the set point at which the output % will be the programmed maximum %.
Minimum Output	Enter the lowest output %. If the output should be off at the set point, this will be 0%.
Maximum Output	Enter the highest output %.
Hand Output	Enter the output % desired when the output is in Hand mode.
Input	Select the sensor input to use for proportional control.
Direction	Select the control direction.
Off Mode Output	Enter the output mA value desired when the output is in Off mode, or being Interlocked, or during a calibration of the sensor being used as an input. The acceptable range is 0 to 21 mA.
Error Output	Enter the output mA desired when the sensor is not giving the controller a valid signal. The acceptable range is 0 to 21 mA.

5.4 Settings Menu

The configuration Settings Menu is used for settings and activities that are not tied to Inputs or Outputs.

5.4.1 Global Settings

Date	Enter the current year, month and day.
Time	Enter the current hour (military time), minute, and second.
Global Units	Select the units to be used for cable length and wire gauge settings, metric or Imperial.
Temperature Units	Select between Fahrenheit and Celsius.
Controller Log Out	Logging Out when Security is Enabled, and after the password has been entered, requires immediate use of a password to calibrate or change settings. If not manually logged out, the controller will automatically log out after 10 minutes of inactivity.
Security	Select Enable to require a password in order to calibrate or change settings, or Disable to allow calibration and set point changes without a password.
Password	Enter the desired security password. The default is 5555.
Language	Select the language the software will use

5.4.2 Display Settings

Home 1	Select the input or output to display on the 1st line of the display Home screen.
Home 2	Select the input or output to display on the 2nd line of the display Home screen.
Key Beep	Select enable to hear a beep when a key is pressed, or disable for silence

5.4.3 File Utilities

File Transfer Status	Displays the status of the last attempt to export a file
Export Event Log	Save the Event Log file to a USB stick. This records set point changes, user calibrations, alarms, relay state changes, file exports, etc.
Export System Log	Save the System Log file to a USB stick. This records hardware changes, software upgrades, automatic calibrations, power loss, system-level issues, etc.
Software Upgrade	Remove power from the controller and insert an USB stick that has the upgrade file stored in the root directory into USB connector (see figure 5). Press the Enter key, and then press the Confirm key to start the upgrade.

NOTE: Remove power before inserting or removing the USB adapter!

5.4.4 Controller Details

Controller	Displays the name for the group of default settings used as built
Product Name	Displays the model of the controller as built
Control Board	Displays the revision number of the front panel circuit board
Software Version	Displays the software version on the control board
Sensor Board	Displays the revision number of the sensor board
Software Version	Displays the software version on the sensor board
Power Board	Displays the revision number of the power/relay board
Display Board	Displays the revision number of the display board
AO Board	Displays the revision number of the analog output board
Battery Power	Displays the VDC output of the battery that is used to hold the date and time. The acceptable range is 2.4-3.2 VDC.
Internal Temp 1	Displays the temperature of the main processor. The acceptable range is -10 to 65 C.
Internal Temp 2	Displays the temperature of the sensor input processor. The acceptable range is -10 to 65 C.

6.0 MAINTENANCE

The controller itself requires very little maintenance. Wipe with a damp cloth. Do not spray down the controller unless the enclosure door is closed and latched.

6.1 Replacing the Fuse

CAUTION: Disconnect power to the controller before opening front panel!

Models that include powered relays have a fuse to protect the controller from devices connected to the relays that draw excessive current. Locate the fuse on the circuit board at the back of the controller enclosure, underneath the clear cover. (See figure 5.) Gently remove the old fuse from its retaining clip and discard. Press the new fuse into the clip, replace the clear cover, secure the front panel of the controller and return power to the unit.

Warning: Use of non-approved fuses can affect product safety approvals. Specifications are shown below. To insure product safety certifications are maintained, it is recommended that a Pulse fuse be used.

F1 Fuse	Pulse P/N
5 x 20 mm, 6.3A, 250V	102834

7.0 TROUBLESHOOTING

CAUTION: Disconnect power to the controller before opening front panel!

Troubleshooting and repair of a malfunctioning controller should only be attempted by qualified personnel using caution to ensure safety and limit unnecessary further damage. Contact the factory.

7.1 Calibration Failure

Calibrations will fail if the adjustments to the reading are outside of the normal range for a properly functioning system. Refer to the instruction manual for the specific sensor being used for further information.

7.1.1 Contacting Conductivity Sensors

The calibration will fail if the adjustment to the gain is outside of 0.5 to 1.5.

Possible Cause	**Corrective Action**
Dirty electrode	Clean electrode
Improper wiring of sensor to controller	Correct wiring
Wrong cell constant entered	Program the controller cell constant setting at the value that matches the electrode being used
Incorrect temperature reading or setting	Ensure that the temperature is accurate
Incorrect cable length or wire gauge setting	Set to the correct values
Faulty electrode	Replace electrode

7.1.2 Electrodeless Conductivity Sensors

The calibration will fail if the adjustment to the gain is outside of 0.5 to 1.5.

Possible Cause	**Corrective Action**
Dirty sensor	Clean sensor
Improper wiring of sensor to controller	Correct wiring
Sensor placed too close to container walls	Relocate sensor
Sensor placed in the direct path of electrical current flow	Relocate sensor
Incorrect temperature reading or setting	Ensure that the temperature is accurate
Incorrect cable length or wire gauge setting	Set to the correct values
Faulty sensor	Replace sensor

7.1.3 pH Sensors

The calibration will fail if the adjustment to the gain is outside of 0.2 to 1.2, or if the calculated offset is outside of -60 to 60.

Possible Cause	Corrective Action
Dirty electrode	Clean electrode
Improper wiring of sensor to controller	Correct wiring
Incorrect temperature reading or setting	Ensure that the temperature is accurate
Incorrect cable length or wire gauge setting	Set to the correct values
Faulty electrode	Replace electrode
Faulty preamplifier	Replace preamplifier

7.1.4 ORP Sensors

The calibration will fail if the adjustment to the gain is outside of 0.5 to 1.5, or if the calculated offset is outside of -300 to 300.

Possible Cause	Corrective Action
Dirty electrode	Clean electrode
Improper wiring of sensor to controller	Correct wiring
Faulty electrode	Replace electrode
Faulty preamplifier	Replace preamplifier

7.1.5 Disinfection Sensors

The calibration will fail if the adjustment to the gain is outside of 0.2 to 10.0, or if the calculated offset is outside of -40 to 40.

Possible Cause	Corrective Action
Insufficient conditioning	Wait for the appropriate amount of time before attempting a calibration.
Insufficient sample flow	Increase flow rate to between 30 and 100 liter per hour.
Air bubbles on membrane	Dislodge bubbles. Adjust flow rate higher if necessary.
Air bubbles in electrolyte	Refill membrane cap with electrolyte.
Dirty membrane	Clean membrane
Loose membrane cap	Tighten membrane cap.
Faulty membrane	Replace membrane cap.
High Pressure	Reduce pressure to below 1 atmosphere and refill cap with electrolyte
No electrolyte fill solution in membrane cap	Fill membrane cap with electrolyte. Replace membrane cap if it will not hold solution.
Improper wiring of sensor to controller	Correct wiring
Faulty sensor	Replace sensor
Faulty analysis equipment or reagents	Consult test equipment instructions
Sample contaminated with interfering molecule (refer to Sensitivity specification in sensor instructions)	Remove source of contamination

7.2 Alarm Messages

Alarm messages will include the Name of the input or output as defined in the Settings menu, the hardware identifying type and number (S for sensor input, D for digital input, R for relay output, A for analog output), and the type of alarm.

HIGH or HIGH-HIGH ALARM

Occurs if the sensor reading rises above the high alarm set points. If your unit is programmed for an alarm relay output, the alarm relay will activate. The controller will continue to check the sensor reading, and any outputs using the sensor will remain active.

Possible Cause	Corrective Action
The process went further out of control than normal.	May have to increase chemical flow rate.
The chemical supply has run out.	Replenish the chemical supply.
The pump or valve or supply line is faulty.	Repair or replace the control device.
Wrong chemical is being controlled.	Replace with correct chemical.
The sensor is not responding to changes.	Repair or replace sensor. Evaluate mixing or recirculation.
The pump is siphoning, valve leaking.	Repair or replace the control device or re-route tubing.
Control output has been left in "HAND" mode.	Switch back to "AUTO".
It may be a normal part of the process.	None required.

LOW or LOW-LOW ALARM

Occurs if the sensor reading drops below the low alarm set points. If your unit is programmed for an alarm relay output, the alarm relay will activate. The controller will continue to check the sensor reading, and any outputs using the sensor will remain active.

Possible Cause	Corrective Action
The process went further out of control than normal.	May have to increase chemical flow rate.
The chemical supply has run out.	Replenish the chemical supply.
The pump or valve or supply line is faulty.	Repair or replace the control device.
Wrong chemical is being controlled.	Replace with correct chemical.
The sensor is not responding to changes.	Repair or replace sensor. Evaluate mixing or recirculation.
The pump is siphoning, valve leaking.	Repair or replace the control device or re-route tubing.
Control output has been left in "HAND" mode.	Switch back to "AUTO".
It may be a normal part of the process.	None required.

DI STATE CUSTOM MESSAGE

A digital input that is a DI State type can be set such that either the open or closed state generates an alarm. The alarm message may be customized. The most common use for this will be a Flow Switch.

Possible Cause	Corrective Action
No flow	Check piping for closed valves, blockage, etc. Check recirculation pump.
Faulty flow switch/cable	Check with ohmmeter.
Faulty controller	Check by shorting digital input in controller.

TOTAL ALARM
Occurs if the flow meter totalizer alarm limit is exceeded.

Normal operation	Reset the total to clear alarm
AC coupled onto flow meter cable	Route cable at least 6 inches (150 mm) away from any AC voltage
Noise coupled onto flow meter cable	Shield cable

OUTPUT TIMEOUT
This error condition will stop control. It is caused by the output (either relay or analog) being activated for longer than the programmed Time Limit.

Possible Cause	**Corrective Action**
The process went further out of control than normal.	Increase time limit or reset timer.
The chemical supply has run out.	Replenish the chemical supply.
The pump or valve or supply line is faulty.	Repair or replace the control device.
Wrong chemical is being controlled.	Replace with correct chemical.
The sensor is not responding to changes.	Replace sensor. Evaluate mixing or recirculation.

RANGE ALARM
It indicates that the signal from the sensor is out of the normal range. This error condition will stop control of any output using the sensor. This prevents controlling based upon a false sensor reading. If the temperature sensor goes into range alarm, then the controller will go into manual temperature compensation using the Default Temperature setting.

Possible Cause	**Corrective Action**
Sensor wires shorted	Disconnect short
Faulty sensor	Replace sensor
Faulty controller	Replace or repair controller

SENSOR FAULT
This error indicates that the signal from the sensor is no longer valid at all. This error condition will stop control of any output using the sensor.

Possible Cause	**Correction Action**
Sensor wires shorted	Disconnect short
Faulty sensor	Replace sensor
Faulty controller	Replace or repair controller

INPUT FAILURE
This alarm indicates that the sensor input circuit is no longer working. This error condition will stop control of any output using the sensor.

Possible Cause	**Correction Action**
Faulty controller	Replace or repair controller

BATTERY POWER LOW
This alarm indicates that the battery which holds the date and time in memory is below 2.4 VDC.

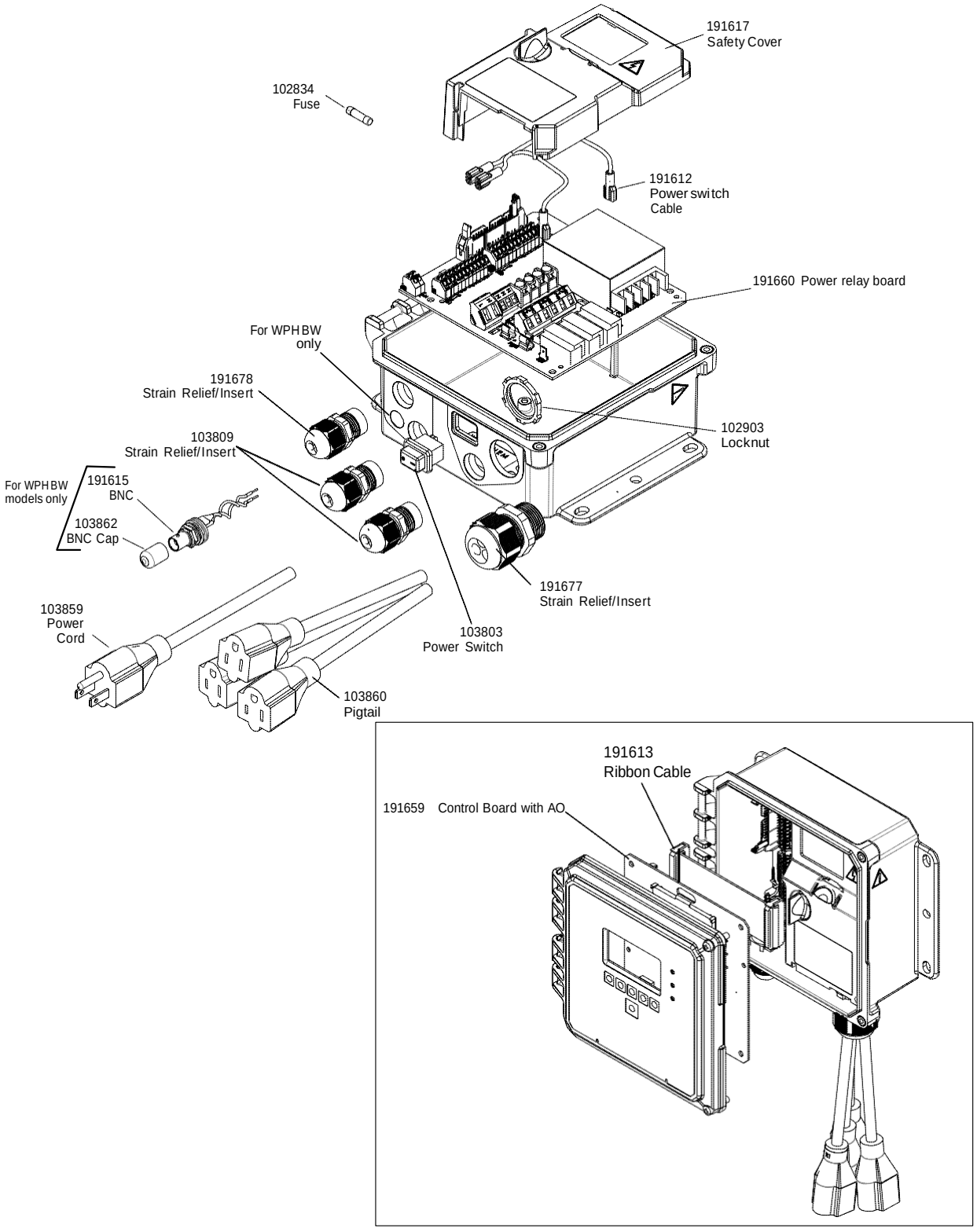
Possible Cause	**Correction Action**
Faulty battery	Replace battery

SYSTEM TEMP LOW This alarm indicates that the temperature inside the controller is below -10 °C.	
Possible Cause	**Correction Action**
Low ambient temperatures	Provide heat for the controller

SYSTEM TEMP HIGH This alarm indicates that the temperature inside the controller is above 65 °C.	
Possible Cause	**Correction Action**
High ambient temperatures	Provide cooling for the controller

DISPLAY ERROR This alarm occurs if the user interface gets lost	
Possible Cause	**Correction Action**
Pressing keys very quickly	Exit out of the screen and continue programming

8.0 SPARE PARTS IDENTIFICATION



Controller Parts

9.0 SERVICE POLICY

The AP100 series controller has a 2-year warranty on electronic components and a 1-year warranty on mechanical parts (terminal strip and relays).

We stock circuit boards for immediate exchange after we have isolated the cause of the problem.

Factory authorized repairs that are received by next-day-air will be returned within 24 hours. Normal priority for returns is two weeks.

Out of warranty repairs or circuit board exchanges are done on a flat fee basis after the warranty is expired