
W A L C H E M

IWAKI America Inc.

W600 Series Metal Finishing Controller

Instruction Manual

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Notice

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1.0 INTRODUCTION

The Walchem W600 Series controllers offer a high level of flexibility in controlling metal finishing applications.

Two sensor input slots are available to accommodate a variety of cards:

- Single Copper or Nickel plus Single pH

- Dual Analog (4-20 mA) Input

- Single Analog Input + Single Sensor (Contacting Conductivity, pH, ORP, Disinfection or Generic linear voltage between -2 and 2 VDC)

- Sensor Input (Electrodeless Conductivity, Contacting Conductivity, pH, ORP, Disinfection or Generic linear voltage between -2 and 2 VDC)

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

- Plating Control

- Plating Follow

- Flow Timer

- On/Off set point control

- Time Proportional control

- Pulse Proportional control (when purchased with Pulse solid state opto outputs)

- PID control (when purchased with Pulse solid state opto outputs)

- Lead/Lag control of up to 6 relays

- Dual set point

- Timer

- Feed as a percent of elapsed time

- Always on unless interlocked

- Probe Wash timer

- Spike to alternate set point on timed basis

- Diagnostic Alarm triggered by:

 - High or Low sensor reading

 - No Flow

 - Relay output timeout

 - Sensor error

An option card with two isolated analog outputs may be installed to retransmit sensor input signals to a chart recorder, datalogger, PLC or other device. They may also be connected to valves, actuators or metering pumps for linear proportional control or PID control.

An Ethernet option provides remote access to the controller's programming via a PC connected directly, via a local area network, or via Walchem's VTouch account management server. It also allows emailing of datalog files (in CSV format, compatible with spreadsheets like Excel) and alarms, to up to eight email addresses.

Our USB features provide the ability to upgrade the software in the controller to the latest version. The Config file feature allows you to save all the set points from a controller onto a USB flash disk, and then import them into another controller, making the programming of multiple controllers fast and easy. The data logging feature allows you to save the sensor readings and relay activation events to a USB flash disk.

2.0 SPECIFICATIONS

2.1 Measurement Performance

Sensor Specs			
Copper			
Range		0.10 to 99 g/l (varies with the sensor type and the chemical being measured)	
		0.10 to 5.50 g/l typical for electroless copper	
Resolution		0.01 g/l	
Accuracy		± 0.01 g/l	
Nickel			
Range		0.10 to 99 g/l (varies with the sensor type and the chemical being measured)	
		0.10 to 5.50 g/l typical for electroless copper	
Resolution		0.01 g/l	
Accuracy		± 0.01 g/l	
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		ORP	
Range	-2 to 16 pH units	Range	-1500 to 1500 mV
Resolution	0.01 pH units	Resolution	0.1 mV
Accuracy	± 0.01% of reading	Accuracy	± 1 mV
Disinfection Sensors			
Range (mV)	-2000 to 1500 mV	Range (ppm)	0-2 ppm to 0-20,000 ppm
Resolution (mV)	0.1 mV	Resolution (ppm)	Varies with range and slope

Accuracy (mV)	± 1 mV	Accuracy (ppm)	Varies with range and slope
Temperature		Analog (4-20 mA)	
Range	23 to 500°F (-5 to 260°C)	Range	0 to 22 mA
Resolution	0.1°F (0.1°C)	Resolution	0.01 mA
Accuracy	± 1% of reading	Accuracy	± 0.5% of reading
Electrodeless Conductivity			
Range	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 on page 2 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
Inputs	
<i>Copper/Nickel Sensor Signals (0, 1 or 2 depending on model code):</i>	
Copper	Walchem 190787 immersible OR 190785, 190893, 191596 flow through sensors
Nickel	Walchem 190784 flow through sensor
<i>Sensor Input Signals (0, 1 or 2 depending on model code):</i>	
Contacting Conductivity	0.01, 0.1, 1.0, or 10.0 cell constant OR
Electrodeless Conductivity	(not available on the combination sensor/analog input card) OR
Disinfection	OR
Amplified pH or ORP	Requires a preamplified signal. Walchem WEL or WDS series recommended. ±5VDC power available for external preamps.
Each sensor input card contains a temperature input	

Temperature	100 or 1000 ohm RTD, 10K or 100K Thermistor (For Cu/Ni card, only 1000 ohm RTD)
Analog (4-20 mA) Sensor Input (0, 1, 2 or 4 depending on model code):	<p>2-wire loop powered or self-powered transmitters supported</p> <p>3 or 4 –wire transmitters supported</p> <p>Each dual sensor input board has two channels</p> <p>Channel 1, 130 ohm input resistance</p> <p>Channel 2, 280 ohm input resistance</p> <p>The combination input board has one channel, 280 ohm input resistance</p> <p>Available Power:</p> <p>One independent isolated 24 VDC \pm 15% supply per channel</p> <p>1.5 W maximum for each channel</p> <p>2W (83 mA at 24 VDC) total power consumption for all channels (four total channels possible if two dual boards are installed; 2W is equivalent to 2 Little Dipper sensors)</p>
Digital Input Signals (6):	
State-Type Digital Inputs	<p>Electrical: Optically isolated and providing an electrically isolated 9V power with a nominal 2.3mA current when the digital input switch is closed</p> <p>Typical response time: < 2 seconds</p> <p>Devices supported: Any isolated dry contact (i.e. relay, reed switch)</p> <p>Types: Interlock</p>
Low Speed Counter-Type Digital Inputs	<p>Electrical: Optically isolated and providing an electrically isolated 9V power with a nominal 2.3mA current when the digital input switch is closed 0-10 Hz, 50 msec minimum width</p> <p>Devices supported: Any device with isolated open drain, open collector, transistor or reed switch</p> <p>Types: Contacting Flowmeter</p>
High Speed Counter-Type Digital Inputs	<p>Electrical: Optically isolated and providing an electrically isolated 9V power with a nominal 2.3mA current when the digital input switch is closed, 0-500 Hz, 1.00 msec minimum width</p> <p>Devices supported: Any device with isolated open drain, open collector, transistor or reed switch</p> <p>Types: Paddlewheel Flowmeter</p>
Outputs	
Powered mechanical relays (0 or 6 depending on model code):	<p>Pre-powered on circuit board switching line voltage</p> <p>6 A (resistive), 1/8 HP (93 W)</p> <p>All six relays are fused together as one group, total current for this group must not exceed 6A</p>
Dry contact mechanical relays (0, 2 or 4 depending on model code):	<p>6 A (resistive), 1/8 HP (93 W)</p> <p>Dry contact relays are not fuse protected</p>
Pulse Outputs (0, 2 or 4 depending on model code):	<p>Opto-isolated, Solid State Relay</p> <p>200mA, 40 VDC Max.</p> <p>VLOWMAX = 0.05V @ 18 mA</p>
4 - 20 mA (0 or 2)	<p>Internally powered</p> <p>Fully isolated</p> <p>600 Ohm max resistive load</p> <p>Resolution 0.0015% of span</p> <p>Accuracy \pm 0.5% of reading</p>
Ethernet	<p>10/100 802.3-2005</p> <p>Auto MDIX support</p> <p>Auto Negotiation</p>

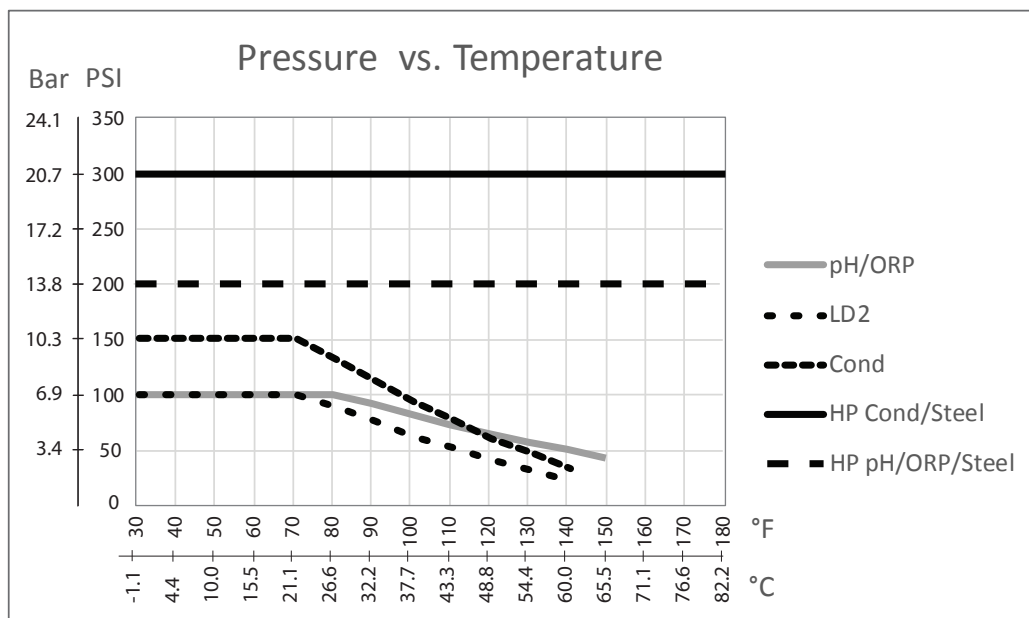
Agency Approvals:	
Safety	UL 61010-1:2012 3rd Ed. CSA C22.2 No. 61010-1:2012 3rd Ed. IEC 61010-1:2010 3rd Ed. EN 61010-1:2010 3rd Ed.
EMC	IEC 61326-1:2012 EN 61326-1:2013
<p>Note: For EN61000-4-6, EN61000-4-3 the controller met performance criteria B.</p> <p>*Class A equipment: Equipment suitable for 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.</p>	

2.3 Mechanical

Enclosure Material	Polycarbonate
Enclosure Rating	NEMA 4X (IP65)
Dimensions	9.5" x 8" x 4" (241 mm x 203 mm x 102 mm)
Display	320 x 240 pixel monochrome backlit display with touchscreen
Operating Ambient Temp	-4 to 131 °F (-20 to 55 °C)
Storage Temperature	-4 – 176°F (-20 – 80°C)

Mechanical (Sensors) (*see graph)

Sensor	Pressure	Temperature	Materials	Process Connections
Immersible Copper	Not applicable	32-200 F (0-93 C)	Polypropylene, glass	Not Applicable
Flow through Copper or Nickel	0-14.7 psi (0-1 bar)	32-200 F (0-93 C)	Polyethylene, glass, FKM	3/8" OD tubing compression fittings
Electrodeless conductivity	0-150 psi (0-10 bar)*	CPVC: 32-158°F (0 to 70°C)* PEEK: 32-190°F (0 to 88°C)	CPVC, FKM in-line o-ring PEEK, 316 SS in-line adapter	1" NPTM submersion 2" NPTM in-line adapter
pH	0-100 psi (0-7 bar)*	50-158°F (10-70°C)*	CPVC, Glass, FKM o-rings, HDPE, Titanium rod, glass-filled PP tee	1" NPTM submersion 3/4" NPTF in-line tee
ORP	0-100 psi (0-7bar)*	32-158°F (0-70°C)*		
Contacting conductivity (Condensate)	0-200 psi (0-14 bar)	32-248°F (0-120°C)	316SS, PEEK	3/4" NPTM
pH (High Pressure)	0-300 psi (0-21 bar)*	32-275°F (0-135°C)*	Glass, Polymer, PTFE, 316SS, FKM	1/2" NPTM gland
ORP (High Pressure)	0-300 psi (0-21 bar)*	32-275°F (0-135°C)*	Platinum, Polymer, PTFE, 316SS, FKM	1/2" NPTM gland
Free Chlorine/Bromine	0-14.7 psi (0-1 bar)	32-113°F (0-45°C)	PVC, Polycarbonate, silicone rubber, SS, PEEK, FKM, Isoplast	1/4" NPTF Inlet 3/4" NPTF Outlet
Extended pH Range Free Chlorine/Bromine	0-14.7 psi (0-1 bar)	32-113°F (0-45°C)		
Total Chlorine	0-14.7 psi (0-1 bar)	32-113°F (0-45°C)		
Chlorine Dioxide	0-14.7 psi (0-1 bar)	32-131°F (0-55°C)		
Ozone	0-14.7 psi (0-1 bar)	32-131°F (0-55°C)		
Peracetic Acid	0-14.7 psi (0-1 bar)	32-131°F (0-55°C)		
Hydrogen Peroxide	0-14.7 psi (0-1 bar)	32-113°F (0-45°C)		
Flow switch manifold	0-150 psi (0-10 bar) up to 100°F (38°C)* 0-50 psi (0-3 bar) at 140°F (60°C)	32-140°F (0-60°C)	GFRPP, PVC, FKM, Isoplast	3/4" NPTF
Flow switch manifold (High Pressure)	0-300 psi (0-21 bar)*	32-158°F (0-70°C)*	Carbon steel, Brass, 316SS, FKM	3/4" NPTF



2.4 Variables and their Limits

Sensor Input Settings	Low Limit	High Limit
Calibration Offset (Copper or Nickel only)	-10 g/l or oz/gal	10 g/l or oz/gal
Stabilization Time (Copper or Nickel only)	0:00 minutes	59:59 minutes
Alarm limits	Low end of sensor range	High end of sensor range
Input alarm dead band	Low end of sensor range	High end of sensor range
Cell constant (conductivity only)	0.01	10
Smoothing Factor	0%	90%
Temp Comp Factor (conductivity linear ATC only)	0%	20.000%
Installation Factor (Electrodeless conductivity only)	0.5	1.5
Cable length	0.1	3,000
PPM conversion factor (only if units = PPM)	0.001	10.000
Default temperature	-5	500
Deadband	Low end of sensor range	High end of sensor range
Calibration Required Alarm	0 days	365 days
Sensor Slope (Generic sensor only)	-1,000,000	1,000,000
Sensor Offset (Generic sensor only)	-1,000,000	1,000,000
Low Range (Generic sensor only)	-1,000,000	1,000,000
High Range (Generic sensor only)	-1,000,000	1,000,000
4 mA value (Transmitter, AI Monitor analog input only)	0	100
20 mA value (Transmitter, AI Monitor analog input only)	0	100
Flow meter input settings	Low Limit	High Limit
Totalizer alarm	0	100,000,000
Volume/contact for units of Gallons or Liters	1	100,000
Volume/contact for units of m ³	0.001	1,000
K Factor for units of Gallons or Liters	0.01	100,000
K Factor for units of m ³	1	1,000,000
Smoothing Factor	0%	90%
Set Flow Total	0	1,000,000,000
Feed Monitor Input Settings	Low Limit	High Limit

Totalizer Alarm	0 vol. units	1,000,000 vol. units
Set Flow Total	0 vol. units	1,000,000,000 vol. units
Flow Alarm Delay	00:10 Minutes	59:59 Minutes
Flow Alarm Clear	1 Contact	100,000 Contacts
Dead Band	0%	90%
Reprime Time	00:00 Minutes	59:59 Minutes
Volume/Contact	0.001 ml	1,000.000 ml
Smoothing Factor	0%	90%
Relay output settings	Low Limit	High Limit
Output Limit Time	1 second	86,400 seconds (0 = unlimited)
Hand Time Limit	1 second	86,400 seconds (0 = unlimited)
Min Relay Cycle	0 seconds	300 seconds
Set Point	Low end of sensor range	High end of sensor range
Spike Set Point (Spike mode)	Low end of sensor range	High end of sensor range
Onset Time (Spike Mode)	0 seconds	23:59:59 HH:MM:SS
Duty Cycle Period (On/Off, Spike, Dual Setpoint modes)	0:00 minutes	59:59 minutes
Duty Cycle (On/Off, Spike, Dual Setpoint modes)	0%	100%
On Delay Time (Manual, On/Off, Dual Setpoint modes)	0 seconds	23:59:59 HH:MM:SS
Off Delay Time (Manual, On/Off, Dual Setpoint modes)	0 seconds	23:59:59 HH:MM:SS
Dead Band	Low end of sensor range	High end of sensor range
Turnover Volume (Plating Control, Plating Follow modes)	0	10,000
Turnover Limit (Plating Control, Plating Follow modes)	0	100
Pump Capacity (Plating Control, Plating Follow modes)	0	1,000
Pump Setting (Plating Control, Plating Follow modes)	0%	100%
Feed duration (Flow Timer mode)	0 seconds	86,400 seconds
Accumulator volume (Flow Timer mode)	0	1,000,000
Event duration (Timer modes)	0	30,000
Proportional band (Time/Pulse Proportional mode)	Low end of sensor range	High end of sensor range
Sample period (Time Proportional mode)	0 seconds	3600 seconds
Hold Time (Probe Wash modes)	0 seconds	3600 seconds
Max Rate (Pulse Proportional, Pulse PID modes)	0%	100%
Minimum Output (Pulse Proportional, Pulse PID modes)	0%	100%
Maximum Output (Pulse Proportional, Pulse PID modes)	0%	100%
Gain (Pulse PID Standard mode)	0.001	1000.000
Integral Time (Pulse PID Standard mode)	0.001 seconds	1000.000 seconds
Derivative Time (Pulse PID Standard mode)us	0 seconds	1000.000 seconds
Proportional Gain (Pulse PID Parallel mode)	0.001	1000.000
Integral Gain (Pulse PID Parallel mode)	0.001 /second	1000.000 /second
Derivative Gain (Pulse PID Parallel mode)	0 seconds	1000.000 seconds
Input Minimum (Pulse PID modes)	Low end of sensor range	High end of sensor range
Input Maximum (Pulse PID modes)	Low end of sensor range	High end of sensor range
Wear Cycle Time (Lag mode)	10 seconds	23:59:59 HH:MM:SS
Delay Time (Lag mode)	0 seconds	23:59:59 HH:MM:SS
Analog (4-20 mA) Output Settings	Low Limit	High Limit
4 mA Value (Retransmit mode)	Low end of sensor range	High end of sensor range
20 mA Value (Retransmit mode)	Low end of sensor range	High end of sensor range
Hand Output	0%	100%
Set Point (Proportional, PID modes)	Low end of sensor range	High end of sensor range

Proportional Band (Proportional mode)	Low end of sensor range	High end of sensor range
Minimum Output (Proportional, PID modes)	0%	100%
Maximum Output (Proportional, PID modes)	0%	100%
Off Mode Output (Proportional, PID modes, Flow Prop modes)	0 mA	21 mA
Error Output (not in Manual mode)	0 mA	21 mA
Hand Time Limit (not in Retransmit mode)	1 second	86,400 seconds (0 = unlimited)
Output Time Limit (Proportional, PID modes)	1 second	86,400 seconds (0 = unlimited)
Gain (PID, Standard mode)	0.001	1000.000
Integral Time (PID Standard mode)	0.001 seconds	1000.000 seconds
Derivative Time (PID Standard mode)	0 seconds	1000.000 seconds
Proportional Gain (PID Parallel mode)	0.001	1000.000
Integral Gain (PID Parallel mode)	0.001 /second	1000.000 /second
Derivative Gain (PID Parallel mode)	0 seconds	1000.000 seconds
Input Minimum (PID modes)	Low end of sensor range	High end of sensor range
Input Maximum (PID modes)	Low end of sensor range	High end of sensor range
Target (Flow Prop mode)	0 ppm	1,000,000 ppm
Pump Capacity (Flow Prop mode)	0 gal/hour or l/hour	10,000 gal/hour or l/hour
Pump Setting (Flow Prop mode)	0%	100%
Specific Gravity (Flow Prop mode)	0 g/ml	9.999 g/ml
Low Cycles Limit (Flow Prop mode)	0 cycles	100 cycles
Configuration settings	Low Limit	High Limit
Local Password	0000	9999
VTouch update period	1 minute	1440 minutes
VTouch reply timeout	10 seconds	60 seconds
Alarm Delay	0:00 minutes	59:59 minutes
SMTP Port	0	65535
Auto Dim Time	0 seconds	23:59:59 HH:MM:SS
Graph settings	Low Limit	High Limit
Low axis limit	Low end of sensor range	High end of sensor range
High axis limit	Low end of sensor range	High end of sensor range

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 W600 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 Immersible Copper Sensor Installation

The immersible copper sensor is designed for direct in-tank monitoring of electroless copper and microetch solutions. By monitoring the copper content directly in the solution, control lag and hydraulic problems are eliminated.

The sensor is constructed such that a constant path length exists between the fiber optic light guides. The solution between the light guides absorbs light at specific wavelengths in proportion to the copper concentration. The lamp and electronics are located under the cover of the sensor. In order to avoid a shift in calibration due to condensation, the sensor's cover should NEVER be opened.

The immersible sensor is provided with a mounting plate and 20 feet of cable. Extension cable is available if the sensor cannot be mounted within 20 feet of the controller. The maximum cable length is 80 feet.

While the positioning of the sensor is not particularly sensitive to the tank layout, the following suggestions are given to aid installation:

- Do not place the sensor beside heaters; if solution flow stops, the polypropylene guard may melt.
- Do not immerse the entire sensor, or the cable.
- Place the sensor where the loads of parts will not strike it.
- Place the sensor in an area of good solution movement, but not directly in the path of any air agitation.
- Mount the sensor securely to the rim of the tank using the holes provided. If the tank is rimless, use a block to provide the support for the mounting plate.
- Attach the cable's connector to the WCU controller. The connector is keyed, do not force! The sensor you receive with the controller has already been calibrated.

3.4 Flow Through Copper Sensor/Sample Loop Installation

The copper flow through sensor is designed for out-of-tank monitoring of electroless copper and microetch solutions.

The sensor is designed with a glass tube that contains the copper solution that forms a fixed path length between the lamp and receptor module. The solution absorbs light at specific wavelengths in proportion to the copper concentration. In order to avoid a shift in calibration caused by condensation, the sensor cover should NEVER be removed!

The flow through sensor is provided with a mounting plate and 20 feet of cable. Extension cable is available if the sensor cannot be placed within 20 feet of the controller. The maximum cable length is 80 feet.

The sample loop consists of a shut off valve, a cooling coil or plate, a sensor and a pump or any combination thereof. The shut off valve is to quickly isolate the system if necessary. A cooling coil or plate is necessary to cool the copper solution down to a temperature acceptable to a sample pump. Cooling the solution is also recommended to help reduce the amount of plate out which may form in the sample loop. The pump may be either a stand alone sample pump (which typically have temperature restriction) or a high temperature pump (which is usually just a branch off the recirculation pump).

3.5 Flow Through Nickel Sensor/Sample Loop Installation

The nickel flow through sensor is designed for out-of-tank monitoring of electroless nickel solutions.

The sensor is designed with a glass tube that contains the nickel solution that forms a fixed path length between the lamp and receptor module. The solution absorbs light at specific wavelengths in proportion to the nickel concentration. In order to avoid a shift in calibration caused by condensation, the sensor cover should NEVER be removed!

The flow through sensor is provided with a mounting plate and 20 feet of cable. Extension cable is available if the sensor cannot be placed within 20 feet of the controller. The maximum cable length is 80 feet. Always route AC

voltage wiring in conduit that is separated a minimum of 6 inches from low voltage DC signal lines (such as the sensor signal).

The sample loop consists of a shut off valve, a cooling coil or plate, a sensor, an optional pH adapter assembly, a pump, or any combination thereof. The shut off valve is to quickly isolate the system if necessary. A cooling coil or plate is necessary to cool the nickel solution down to a temperature acceptable to a sample pump and/or pH electrode (if applicable). Cooling the solution is also recommended to help reduce the amount of plate-out that may form in the sample loop. The pH adapter assembly is used to mount an in-line pH electrode. It should be mounted such that the electrode is always immersed in the 'U' trap. The pump may be either a stand-alone sample pump (which will typically have high temperature restrictions), or a high temperature pump (which is usually a branch off of the recirculation pump).

The flow through sensor/sample loop must be installed according to the following guidelines:

- Mount the sensor on a vibration-free, vertical surface so that the sensor tubing inlet connection is at the bottom and the outlet is at the top. The vertical orientation will prevent air bubbles from being trapped in the sensor.
- Install a shut-off valve at the beginning of the sample loop so that the system may be shut off quickly if necessary.
- If a sample pump is to be used, it must be installed last, after the cooling coil or cooling plate, the flow through sensor, and the pH adapter assembly, if applicable.
- If a high temperature recirculation pump is to supply flow, adjust flow rate through the sample loop between 400 - 500 mL/min (approx. 0.11 - 0.13 gal/min). This flow rate will help ensure adequate cooling of the solution while maintaining a reasonable lagtime in longer runs of tubing. If this is not possible or is undesirable, see Application Notes below.

Other installation guidelines that may be helpful in the overall system:

- Mount the sensor as close to solution as possible. Keep tubing distances to the sensor inlet as short as possible to avoid hydraulic lag time. Maximum recommended length of tubing from solution to sensor is 25 feet. If this is not possible, see Application Notes below.
- The solution inlet should draw sample from an area of good solution movement in order to respond quickly to chemical additions. However, the solution inlet should not draw too near to where the chemistry is added to avoid artificial 'spikes' in concentration.
- The solution discharge should be open to atmospheric pressure in order to ensure proper flow.
- The cable connector to the controller is keyed, do not force!

Application Notes

If the distance from the solution to the sensor is further than the recommended length of 25 feet, the maximum lagtime must be calculated from the desired control band to determine a pump flow rate based on a given distance of standard, uniform tubing. The maximum lagtime is the maximum allowable time for the solution to continuously get to the sensor in order to achieve the desired control band.

To calculate maximum lagtime:

$$\text{Max. Lagtime} = \frac{\text{Desired Control Band}^*}{4 \times \text{Depletion Rate}}$$

where Control band = Maximum deviation of concentration
 Depletion rate = Rate at which the bath will deplete per unit of time

The deadband should be adjusted so that it is 1/4 the desired control band.

For Example: The set point is 4.00 g/L.

If the desired control band is 0.20 g/L (± 0.10 g/L or 2.5%) and the bath is depleting at a rate of 1.25 g/L every 15 minutes (0.08333 g/L every minute),

$$\text{then Max. Lagtime} = \frac{0.20 \text{ g/L}}{4 \times (0.08333 \text{ g/L /min})} = 0.60 \text{ minutes}$$

So, 0.60 minutes is the maximum time it should take for the solution to reach the sensor.

To calculate pump flow rate:

$$\text{Minimum Pump Flow Rate} = \frac{\text{Volume of System}^*}{\text{Maximum Lagtime}}$$

$$\text{where Volume of system} = \pi \left(\frac{\text{Tubing I.D.}}{2} \right)^2 \times \text{Length of tubing}$$

$$\text{Maximum lagtime} = \text{Previously calculated time to get solution to sensor.}$$

* Volume is based on length from solution to sensor, not the return.

For Example: If the system parameters are: Tubing is 3/8" O.D. ' 1/4" I.D.
Length is 30 feet (360 inches)

$$\begin{aligned} \text{then the volume of the system} &= \pi \left(\frac{0.25 \text{ in}}{2} \right)^2 \times (360 \text{ in}) \\ &= 17.7 \text{ in}^3 \end{aligned}$$

Note: 1 U.S. Gallon = 231 U.S cubic inches		1 Liter = 61.03 U.S. cubic inches
Note: Volume of Cooling Coil:	0.018 Gallons 0.068 Liters	Volume of Cooling Plate: 0.023 Gallons 0.088 Liters
Volume of 3/8" O.D. x 1/4" I.D. (0.59 in ³ /ft): 0.00255 Gallons/linear ft 0.00965 Liters/linear ft		

$$\text{Volume of the system} = \frac{17.7 \text{ in}^3}{231 \text{ in}^3 / \text{gallon}} = 0.0765 \text{ gallons}$$

$$\text{Maximum lagtime} = 0.60 \text{ minutes (previously calculated)}$$

$$\text{So, the minimum pump flow rate} = \frac{0.0765 \text{ gallons}}{0.60 \text{ minutes}} = 0.127 \text{ gal/min (483 mL/min)}$$

Caution: The calculated pump flow rate is the minimum required to obtain the desired control band, however, if the flow rate increases over the recommended rate of 500 mL/min (approx. 0.13 gal/min) the rate of cooling will decrease. This may be compensated for by re-evaluating the system criteria: length / desired control band or to double up on the cooling plate/coil.

Consult factory with any further installation questions.

3.6 Other 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 Figure 3 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 120 ft. (37 m). Less than 20 ft. (6 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. 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 (305 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 100 feet (30 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 3/4" x 1/4" 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!

3.7 Icon Definitions

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

3.8 Electrical installation

The various standard wiring options are shown in figure 1, below. Your controller will arrive from the factory pre-wired or ready for hardwiring. Depending on your configuration of controller options, you may be required to hard-wire some or all of the input/output devices. Refer to figures 6 through 17 for circuit board layout and wiring.

Note: when wiring the optional flow meter contactor input, the 4-20 mA outputs 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 at the most convenient shield terminal.



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 an 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 Walchem may impair the protection provided by the equipment.

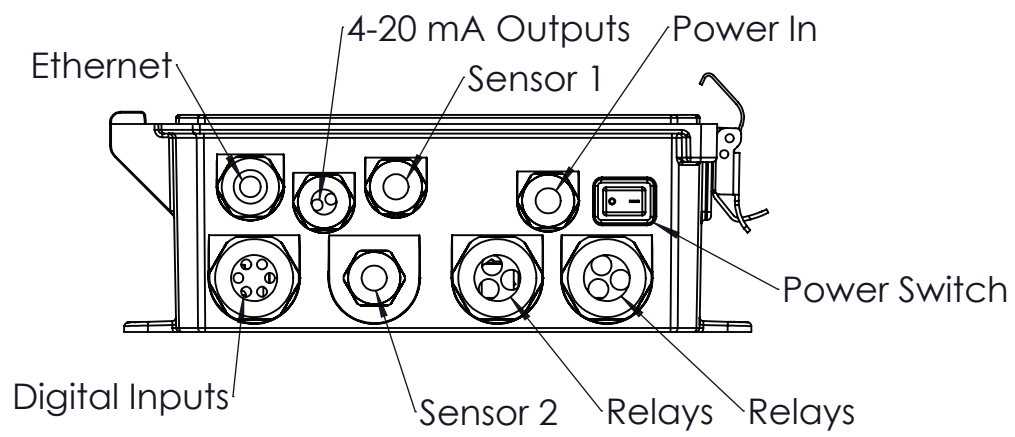
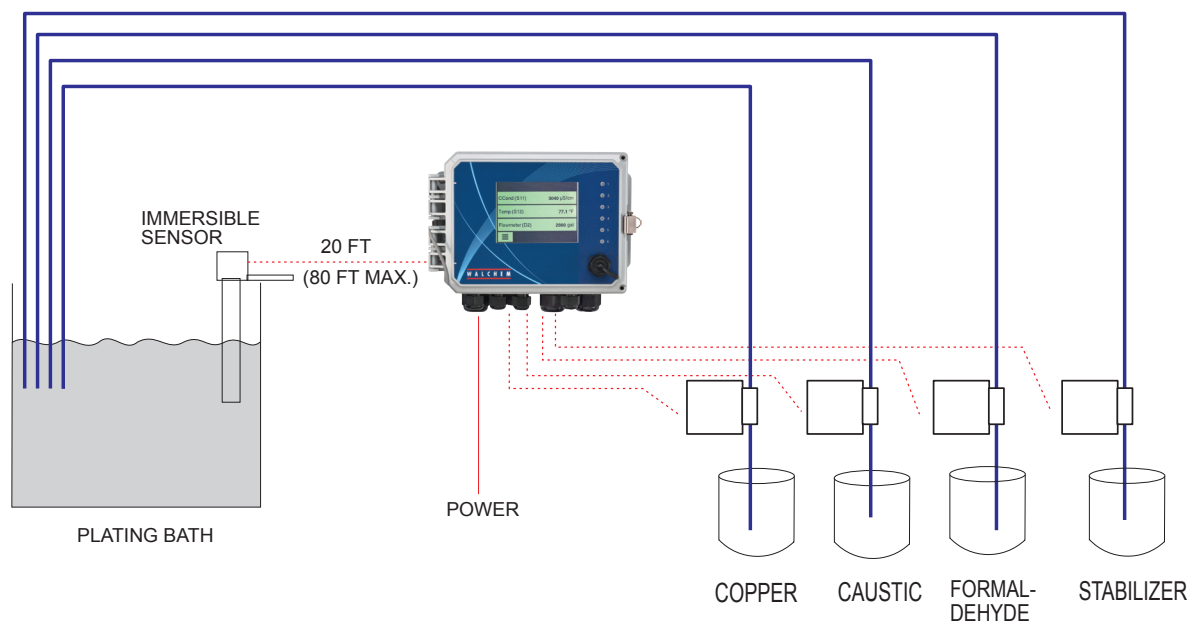
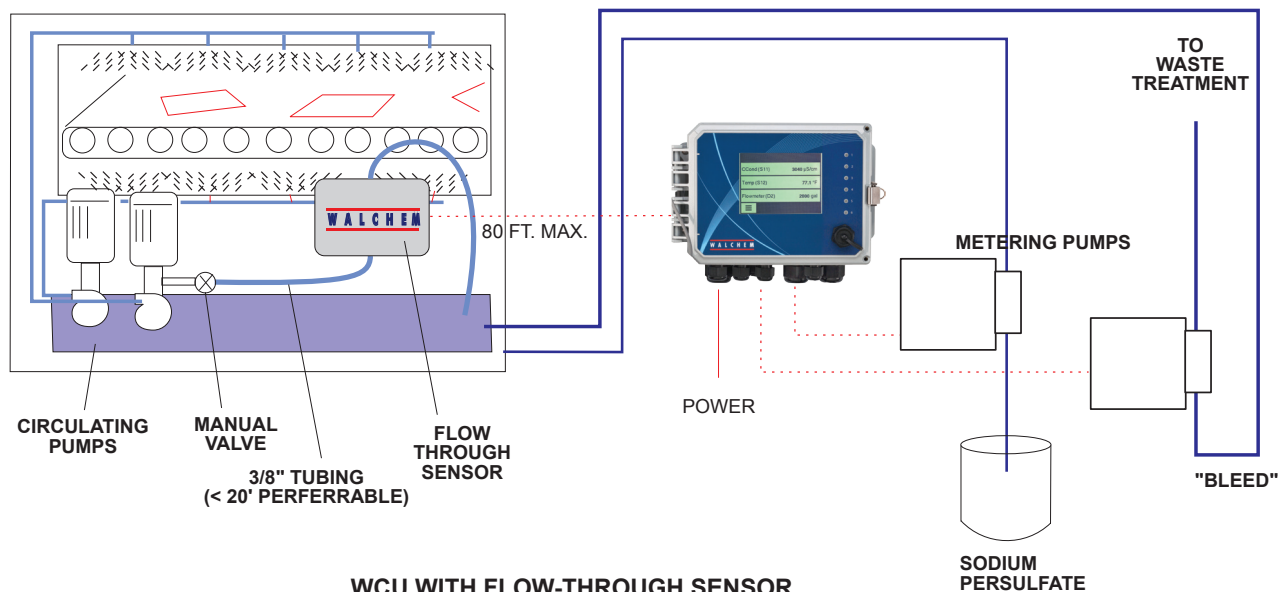


Figure 1 Conduit Wiring



**WCU WITH IMMERSIBLE SENSOR
(TYPICAL ELECTROLESS COPPER APPLICATION)**

CONVEYORIZED SPRAY EQUIPMENT



**WCU WITH FLOW-THROUGH SENSOR
(TYPICAL MICROETCH APPLICATION)**

Figure 2

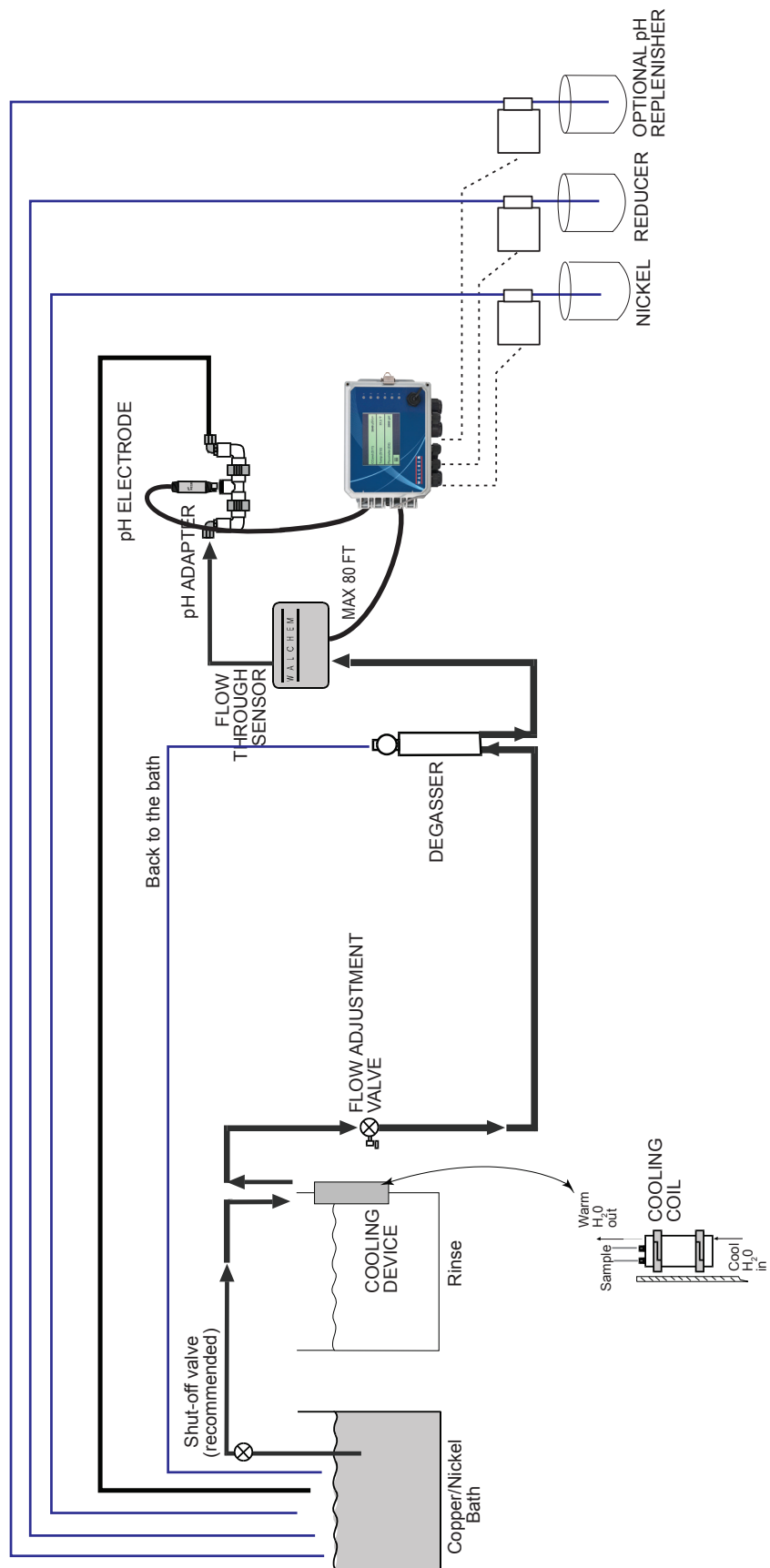


Figure 3
WNI with Flow through Sensor and Degasser
(Typical Electroless Nickel Application)

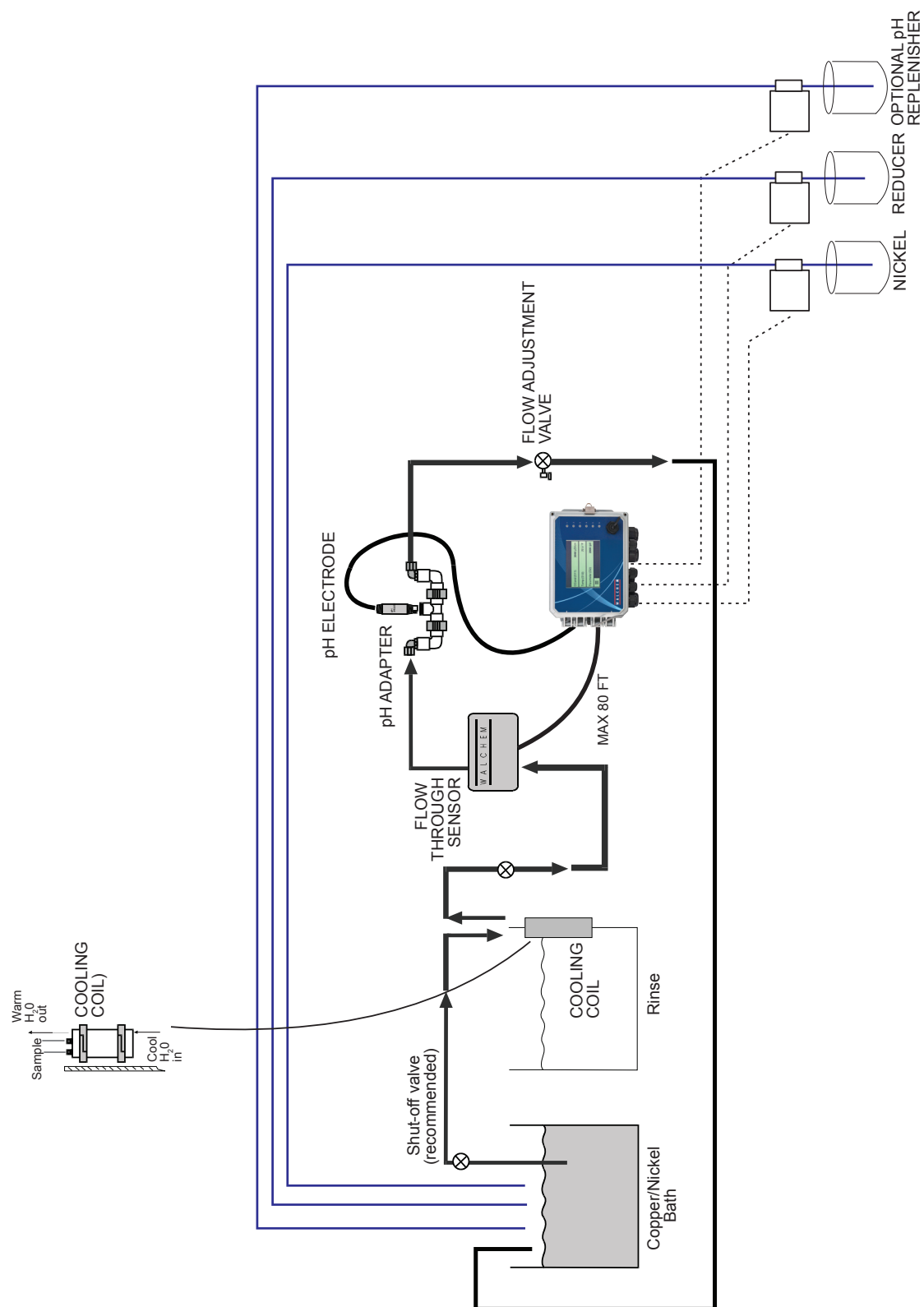


Figure 4
WNI with Flow Through Sensor, without Degasser
(Typical Electroless Nickel Application)

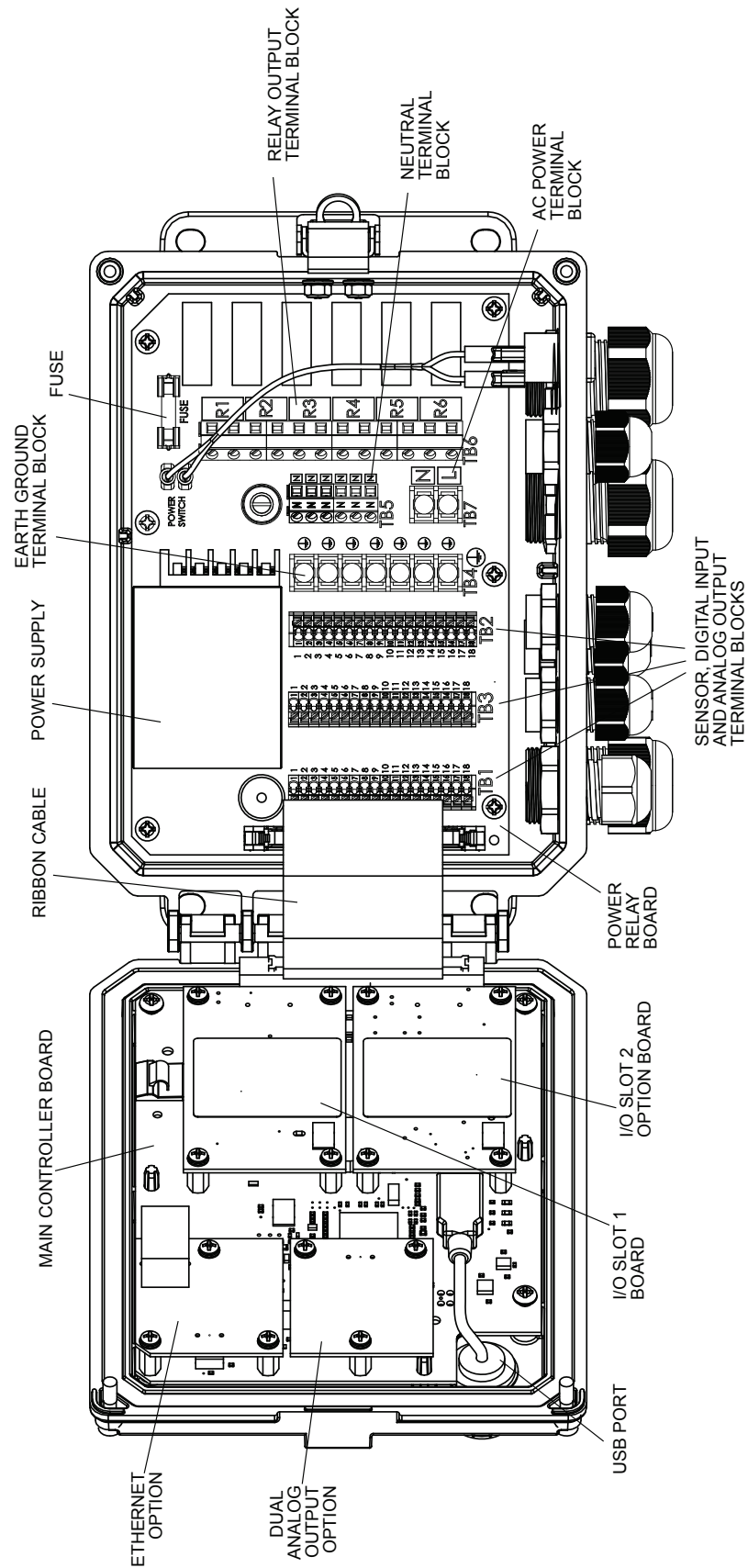


Figure 5 Parts Identification

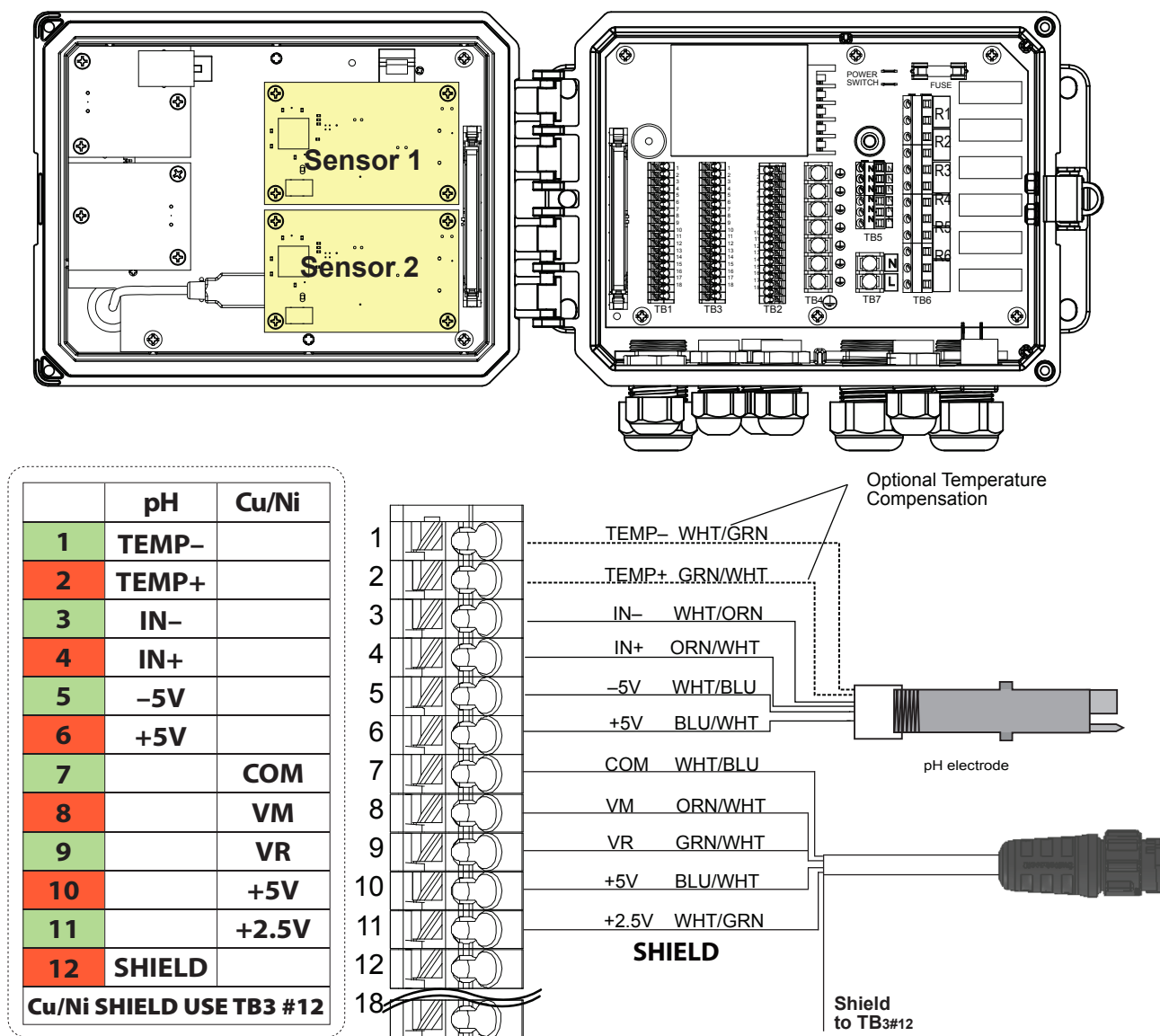
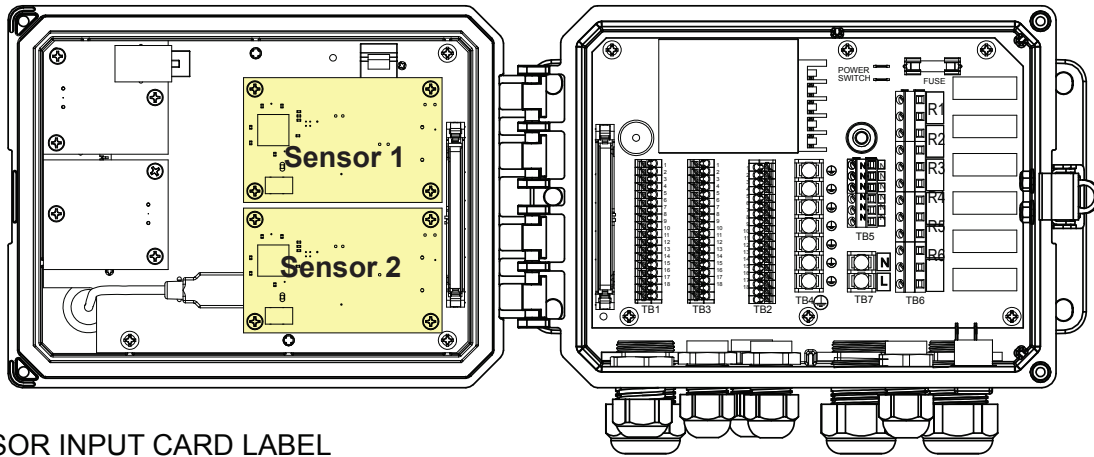
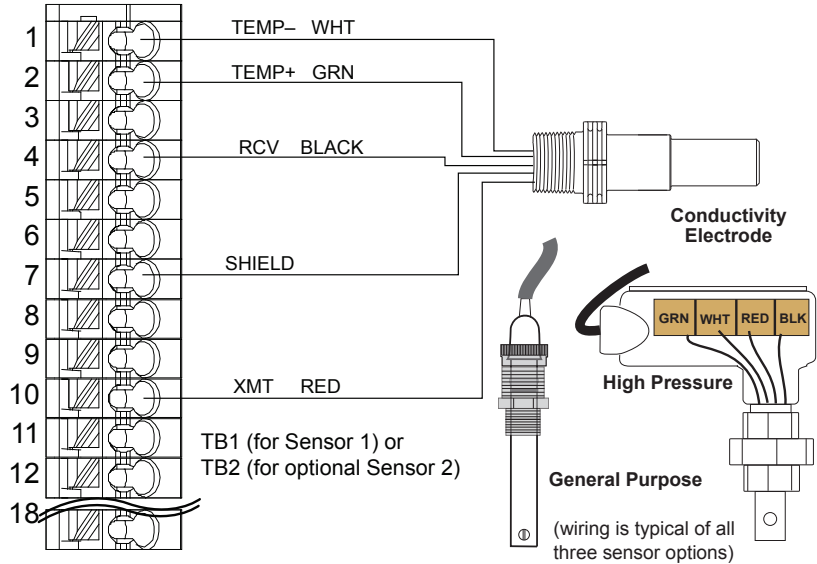


Figure 6 - Copper/Nickel + pH Board Sensor Input Wiring

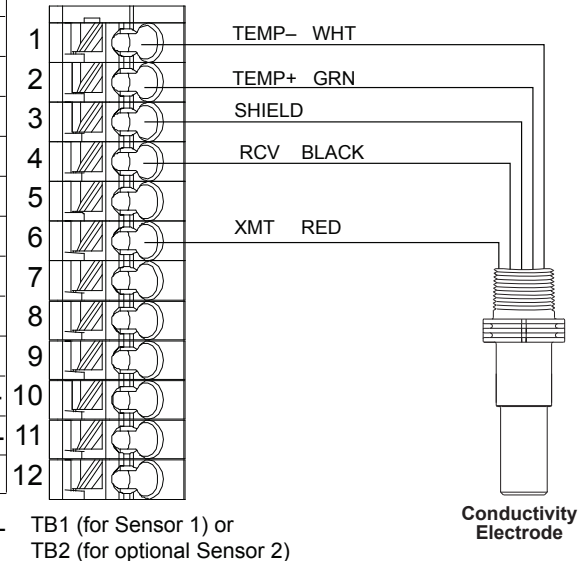


SENSOR INPUT CARD LABEL

	ECOND	CCOND	pH/ORP DIS
1	TEMP-	TEMP-	TEMP-
2	TEMP+	TEMP+	TEMP+
3	R-SHLD		IN-
4		RCV	IN+
5	RCV-		
6	RCV+		
7	X-SHLD	SHIELD	SHIELD
8			+5V
9			-5V
10	XMT+	XMT	
11	XMT-		
12			

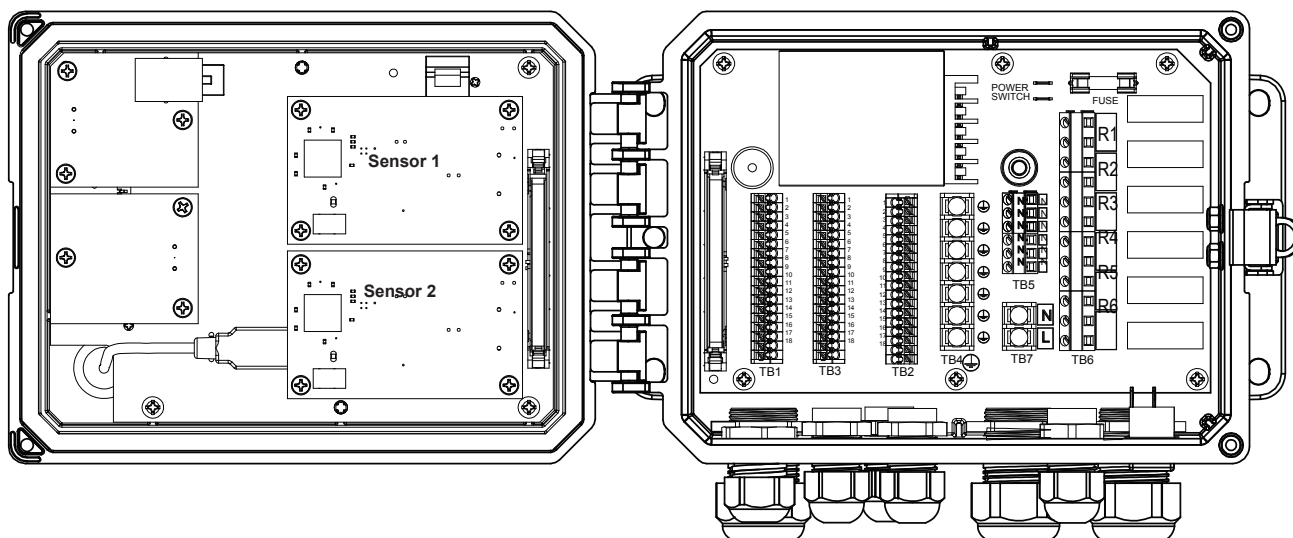


	CCOND	pH/ORP DIS	2 Wire Loop	2 Wire Pwrd	3 Wire	4 Wire
1	TEMP-	TEMP-				
2	TEMP+	TEMP+				
3	SHIELD	IN-				
4	RCV	IN+				
5		-5V				
6	XMT					
7		+5V				
8					COM(-) 24V(-)	
9			+24V		+24V	+24V
10				XMTR-		XMTR-
11			XMTR-	XMTR+	XMTR+	XMTR+
12			SHIELD or use DI SHIELD (TB3 7-12)			



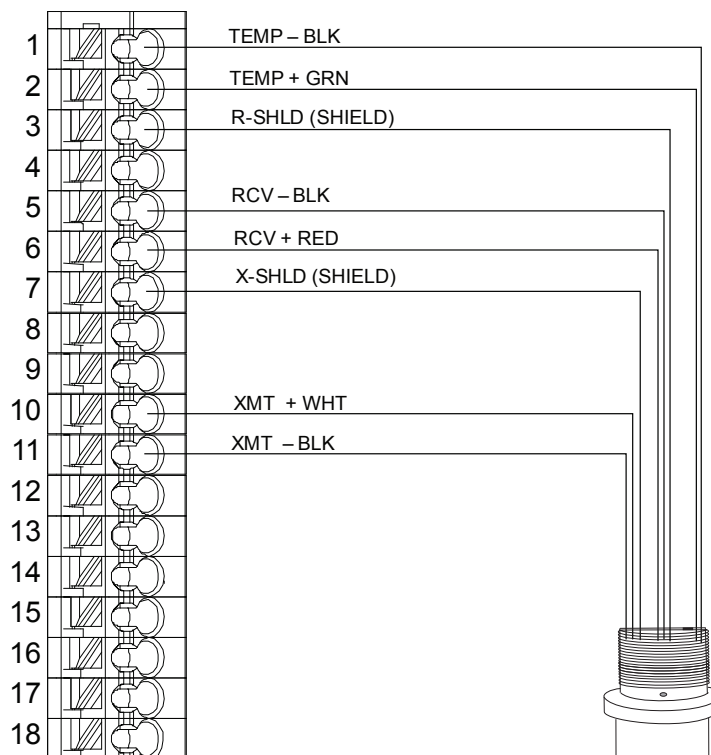
COMBINATION SENSOR/ANALOG CARD LABEL

Figure 7 Contacting Conductivity Sensor Input Wiring



	ECOND	CCOND	pH/ORP DIS
1	TEMP-	TEMP-	TEMP-
2	TEMP+	TEMP+	TEMP+
3	R-SHLD		IN-
4		RCV	IN+
5	RCV-		
6	RCV+		
7	X-SHLD	SHIELD	SHIELD
8			+5V
9			-5V
10	XMT+	XMT	
11	XMT-		
12			

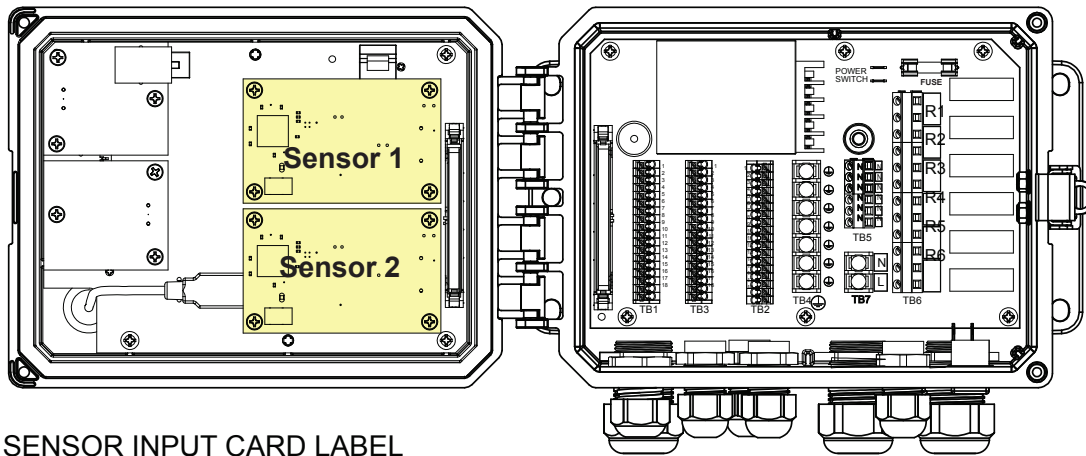
SENSOR LABEL



TB1 (for Sensor 1) or
TB2 (for optional Sensor 2)

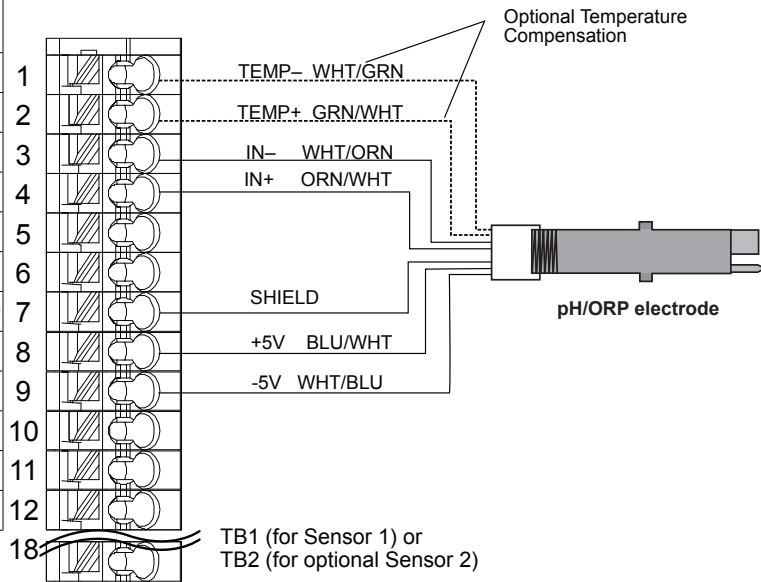
ELECTRODELESS
CONDUCTIVITY
SENSOR

Figure 8 Electrodeless Conductivity Sensor Input Wiring



SENSOR INPUT CARD LABEL

	ECOND	CCOND	pH/ORP DIS
1	TEMP-	TEMP-	TEMP-
2	TEMP+	TEMP+	TEMP+
3	R-SHLD		IN-
4		RCV	IN+
5	RCV-		
6	RCV+		
7	X-SHLD	SHIELD	SHIELD
8			+5V
9			-5V
10	XMT+	XMT	
11	XMT-		
12			



	CCOND	pH/ORP DIS	2 Wire Loop	2 Wire Pwr	3 Wire	4 Wire
1	TEMP-	TEMP-				
2	TEMP+	TEMP+				
3	SHIELD	IN-				
4	RCV	IN+				
5		-5V				
6	XMT	+5V				
7						
8					COM(-)	24V(-)
9			+24V		+24V	+24V
10				XMTR-		XMTR-
11			XMTR-	XMTR+	XMTR+	XMTR+
12						

COMBINATION SENSOR/ANALOG CARD LABEL

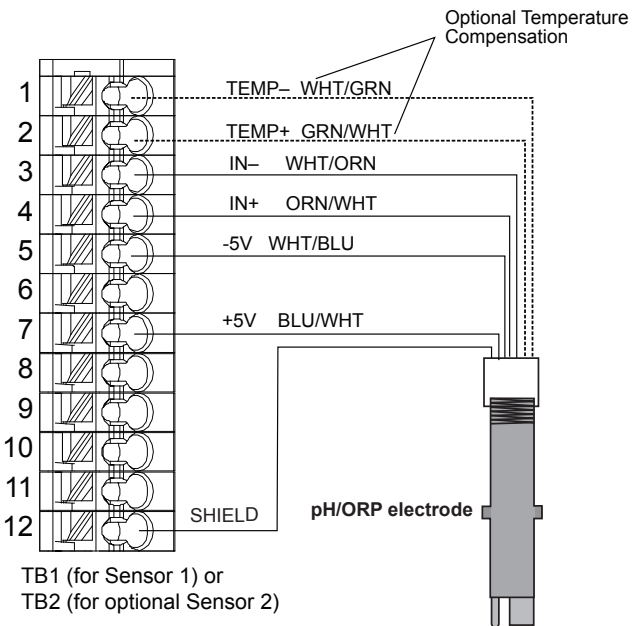
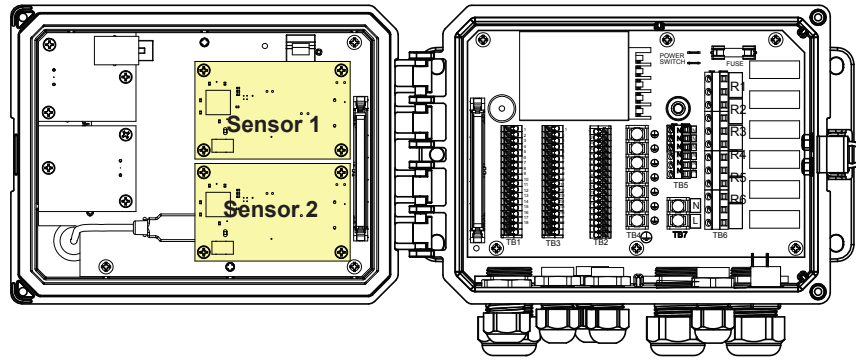


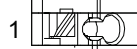
Figure 9 pH/ORP Sensor Input Wiring



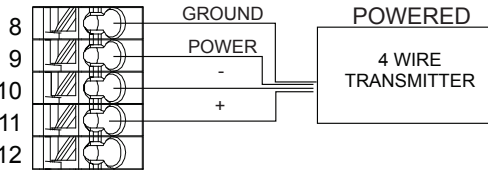
SENSOR LABEL

	CCOND	pH/ORP DIS	2 Wire Loop	2 Wire Pwr	3 Wire	4 Wire
1	TEMP-	TEMP-				

TB1 (for Sensor 1) or
TB2 (for optional Sensor 2)



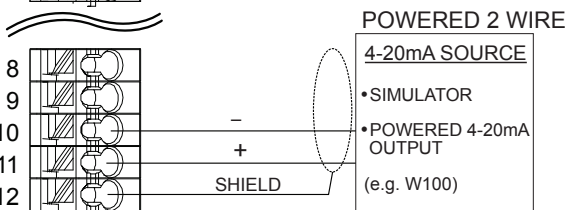
8					COM(-)	24V(-)
9			+24V		+24V	+24V
10				XMTR-		XMTR-
11				XMTR-	XMTR+	XMTR+
12			SHIELD or use DI SHIELD (TB3 7-12)			



	CCOND	pH/ORP DIS	2 Wire Loop	2 Wire Pwr	3 Wire	4 Wire
1	TEMP-	TEMP-				



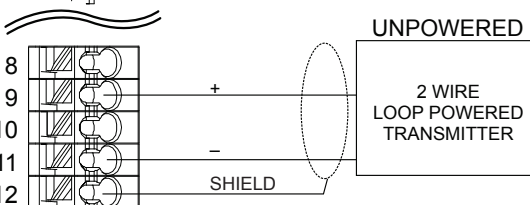
8					COM(-)	24V(-)
9			+24V		+24V	+24V
10				XMTR-		XMTR-
11				XMTR-	XMTR+	XMTR+
12			SHIELD or use DI SHIELD (TB3 7-12)			



	CCOND	pH/ORP DIS	2 Wire Loop	2 Wire Pwr	3 Wire	4 Wire
1	TEMP-	TEMP-				



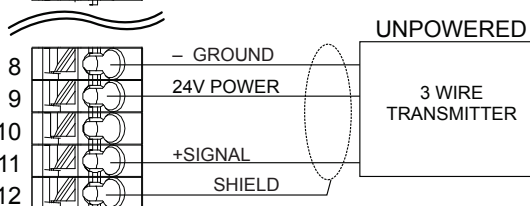
8					COM(-)	24V(-)
9			+24V		+24V	+24V
10				XMTR-		XMTR-
11				XMTR-	XMTR+	XMTR+
12			SHIELD or use DI SHIELD (TB3 7-12)			



	CCOND	pH/ORP DIS	2 Wire Loop	2 Wire Pwr	3 Wire	4 Wire
1	TEMP-	TEMP-				

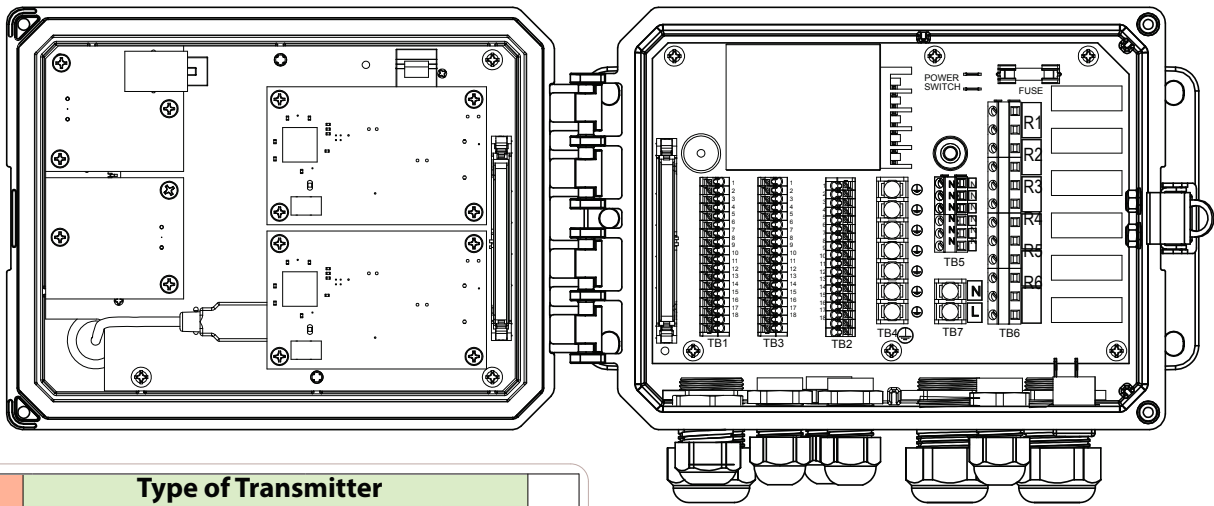


8					COM(-)	24V(-)
9			+24V		+24V	+24V
10				XMTR-		XMTR-
11				XMTR-	XMTR+	XMTR+
12			SHIELD or use DI SHIELD (TB3 7-12)			

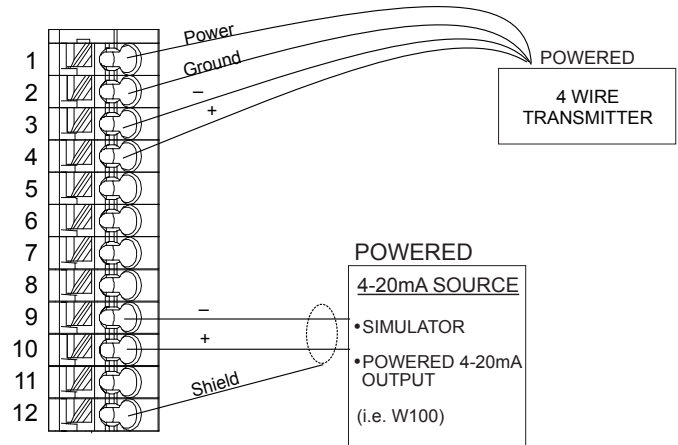


NOTE: To program the combination card analog input, you must go to Inputs menu, then enter the analog input (S13 or S23), scroll down to Transmitter, and select the type of transmitter from the list.

Figure 10 Combination Card 4-20mA Dual Sensor Input Wiring

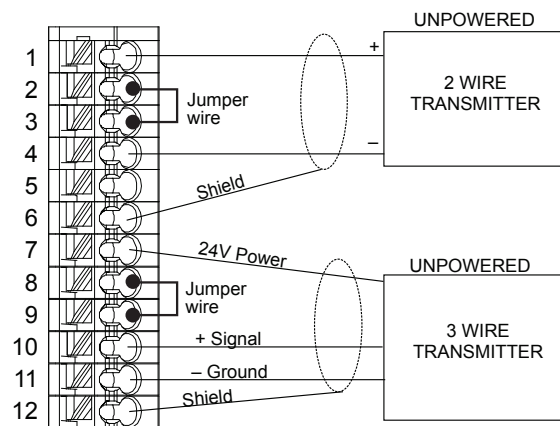


TB Pin#	Type of Transmitter				AI#
	2 Wire Loop	2 Wire Powered	3 Wire	4 Wire	
1	+24V		+24V	+24V	1
2				24V(-)	
3					
4	XMTR-	XMTR+	XMTR+	XMTR+	
5			COM(-)		
6	SHIELD	SHIELD	SHIELD	SHIELD	2
7	+24V		+24V	+24V	
8				24V(-)	
9					
10	XMTR-	XMTR+	XMTR+	XMTR+	
11			COM(-)		
12	SHIELD	SHIELD	SHIELD	SHIELD	



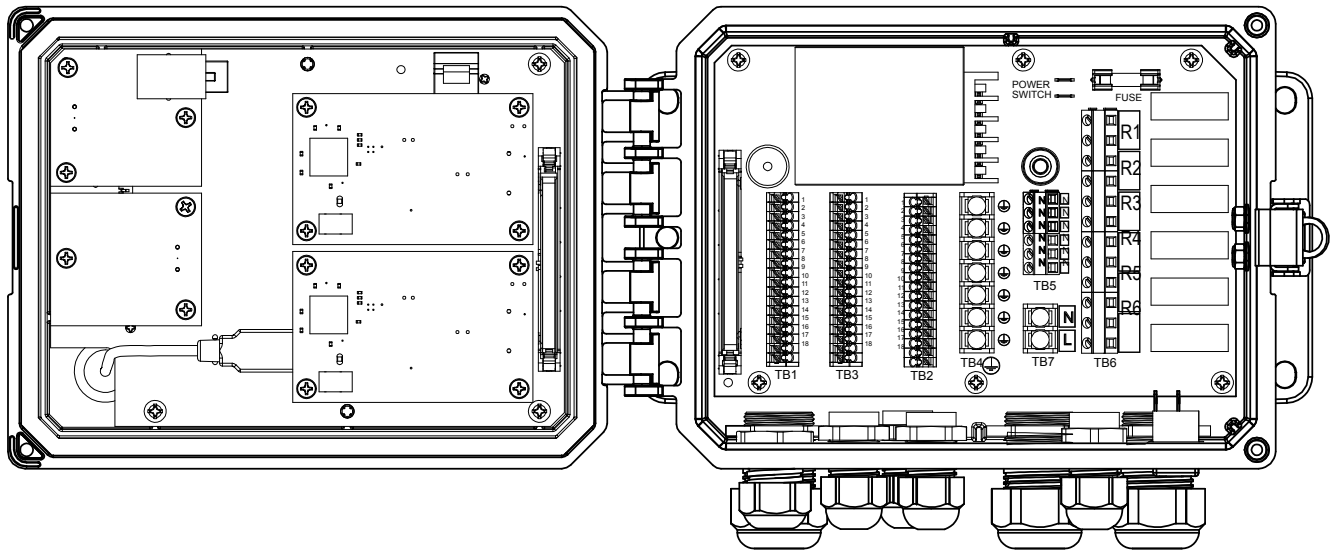
TB1 (for Sensor 1) or
TB2 (for optional Sensor 2)

TB Pin#	Type of Transmitter				AI#
	2 Wire Loop	2 Wire Powered	3 Wire	4 Wire	
1	+24V		+24V	+24V	1
2				24V(-)	
3					
4	XMTR-	XMTR+	XMTR+	XMTR+	
5			COM(-)		
6	SHIELD	SHIELD	SHIELD	SHIELD	2
7	+24V		+24V	+24V	
8				24V(-)	
9					
10	XMTR-	XMTR+	XMTR+	XMTR+	
11			COM(-)		
12	SHIELD	SHIELD	SHIELD	SHIELD	



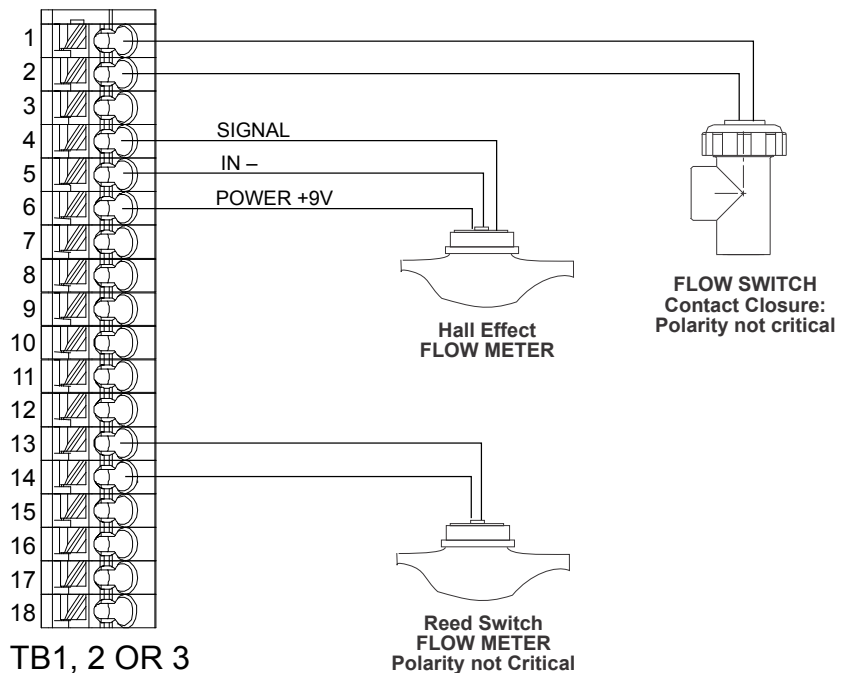
TB1 (for Sensor 1) or
TB2 (for optional Sensor 2)

Figure 11 Dual 4-20mA Sensor Input Wiring



1		1 DIG IN 3+	1	
2		2 DIG IN 3-	2	
3		3 +9 VDC	3	
4		4 DIG IN 4+	4	
5		5 DIG IN 4-	5	
6	SEE SENSOR 1 LABEL	6 +9 VDC	6	SEE SENSOR 2 LABEL
7		7	7	
8		8	8	
9		9 DI SHIELD	9	
10		10	10	
11		11	11	
12		12	12	
13 DIG IN 1+		13 DIG IN 5+	13 DIG IN 2+	
14 DIG IN 1-		14 DIG IN 5-	14 DIG IN 2-	
15 +9 VDC		15 +9 VDC	15 +9 VDC	
16 4-20 OUT1+		16 DIG IN 6+	16 4-20 OUT2+	
17 4-20 OUT1-		17 DIG IN 6-	17 4-20 OUT2-	
18 SHIELD		18 +9 VDC	18 SHIELD	
TB1		TB3	TB2	

SAFETY COVER LABEL



TB1, 2 OR 3
(TB 3 SHOWN)

Figure 12 Digital Inputs

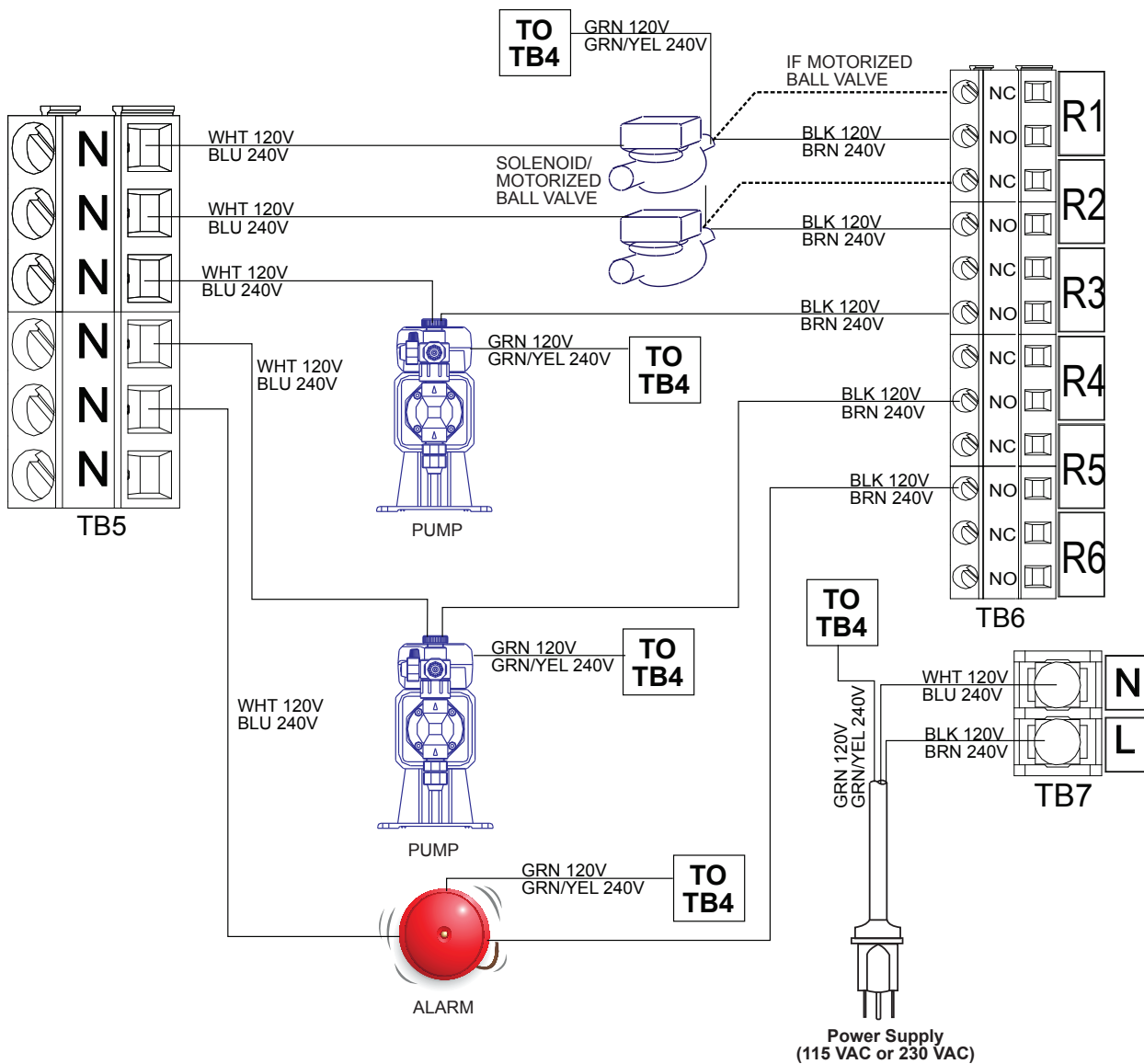
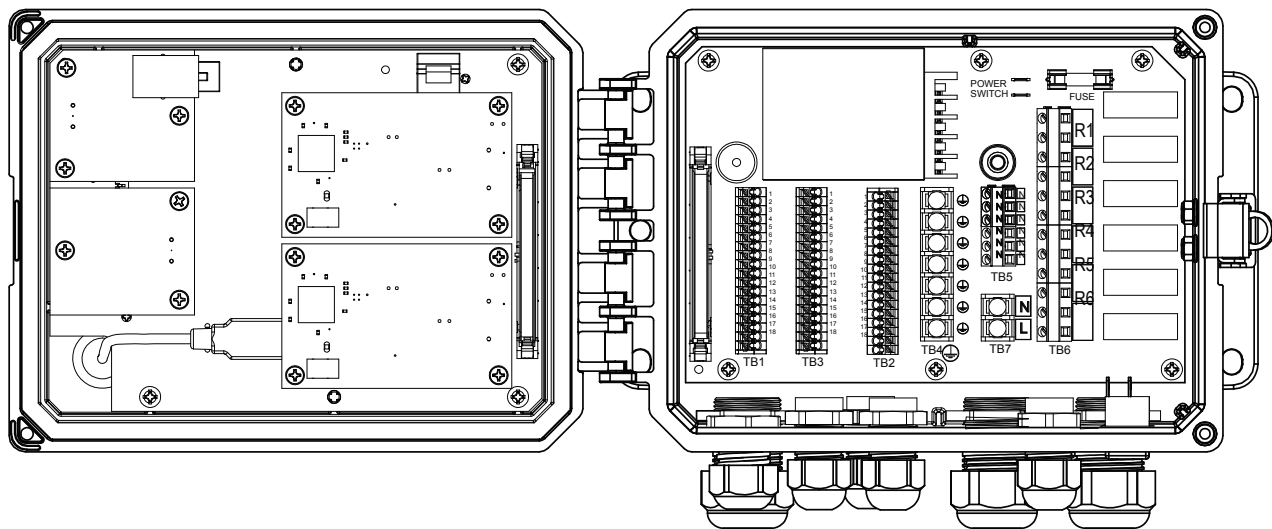


Figure 13 W600 AC Power + Relay Output Wiring

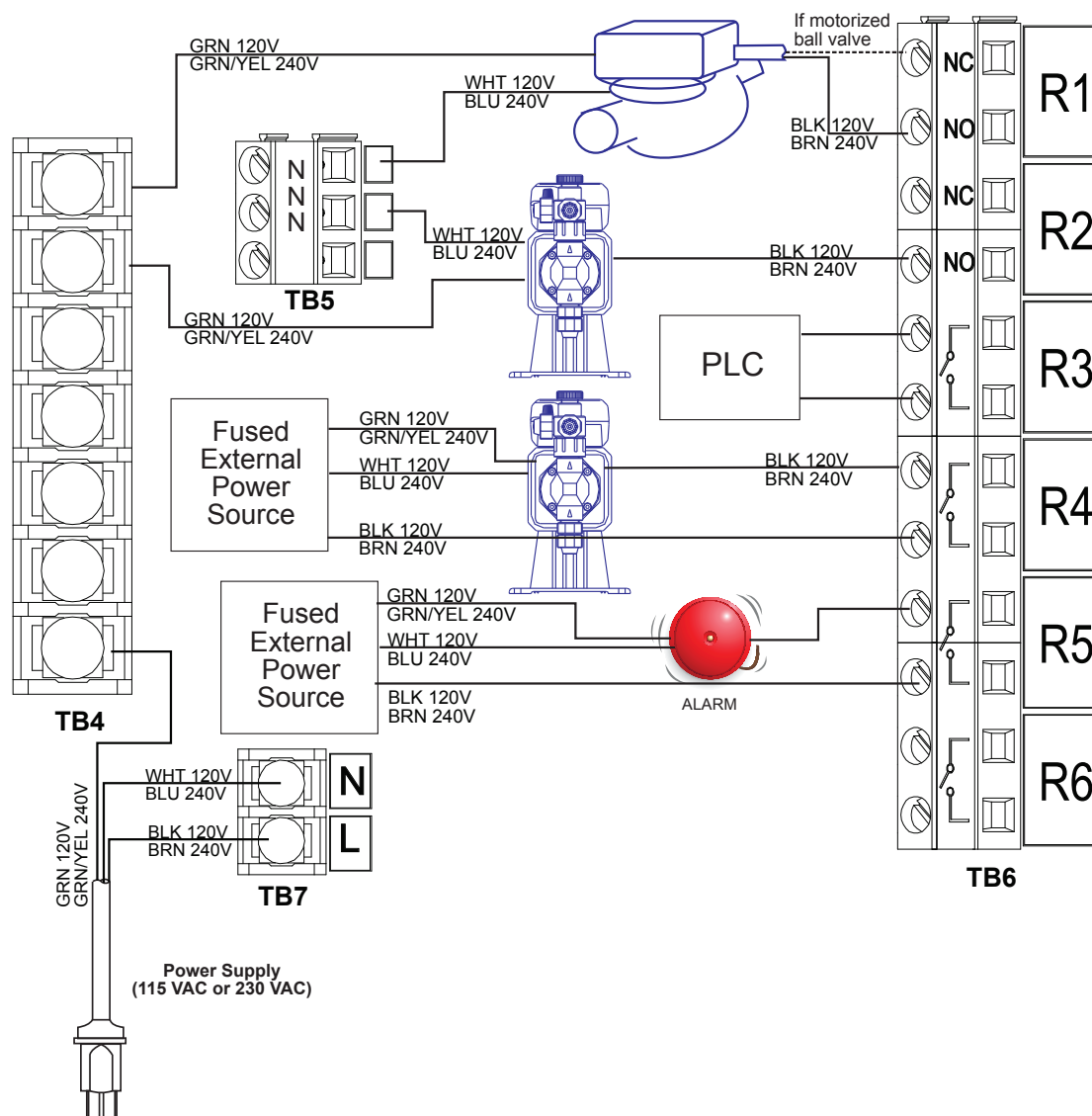
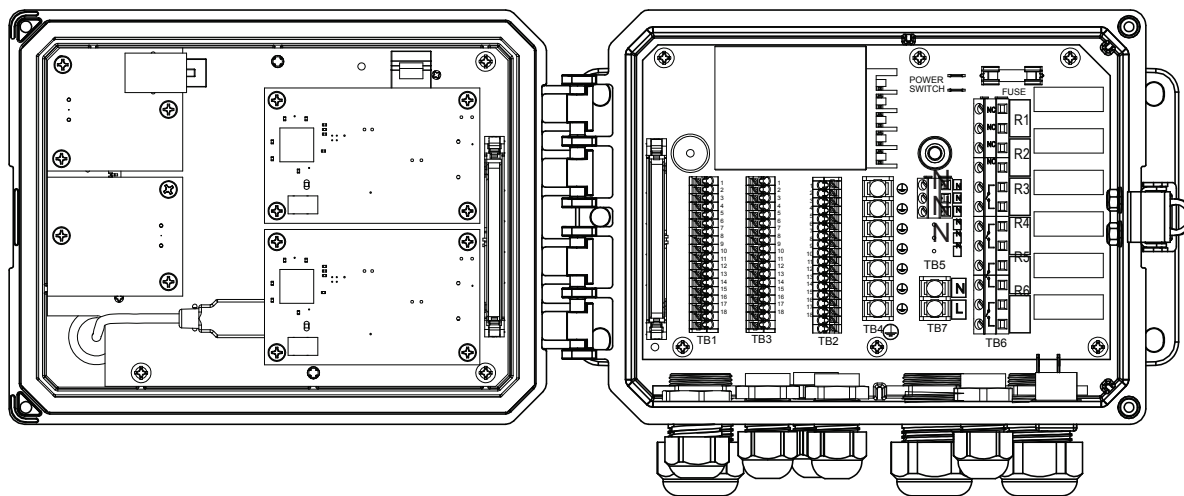


Figure 14 W610 AC Power and Relay Wiring

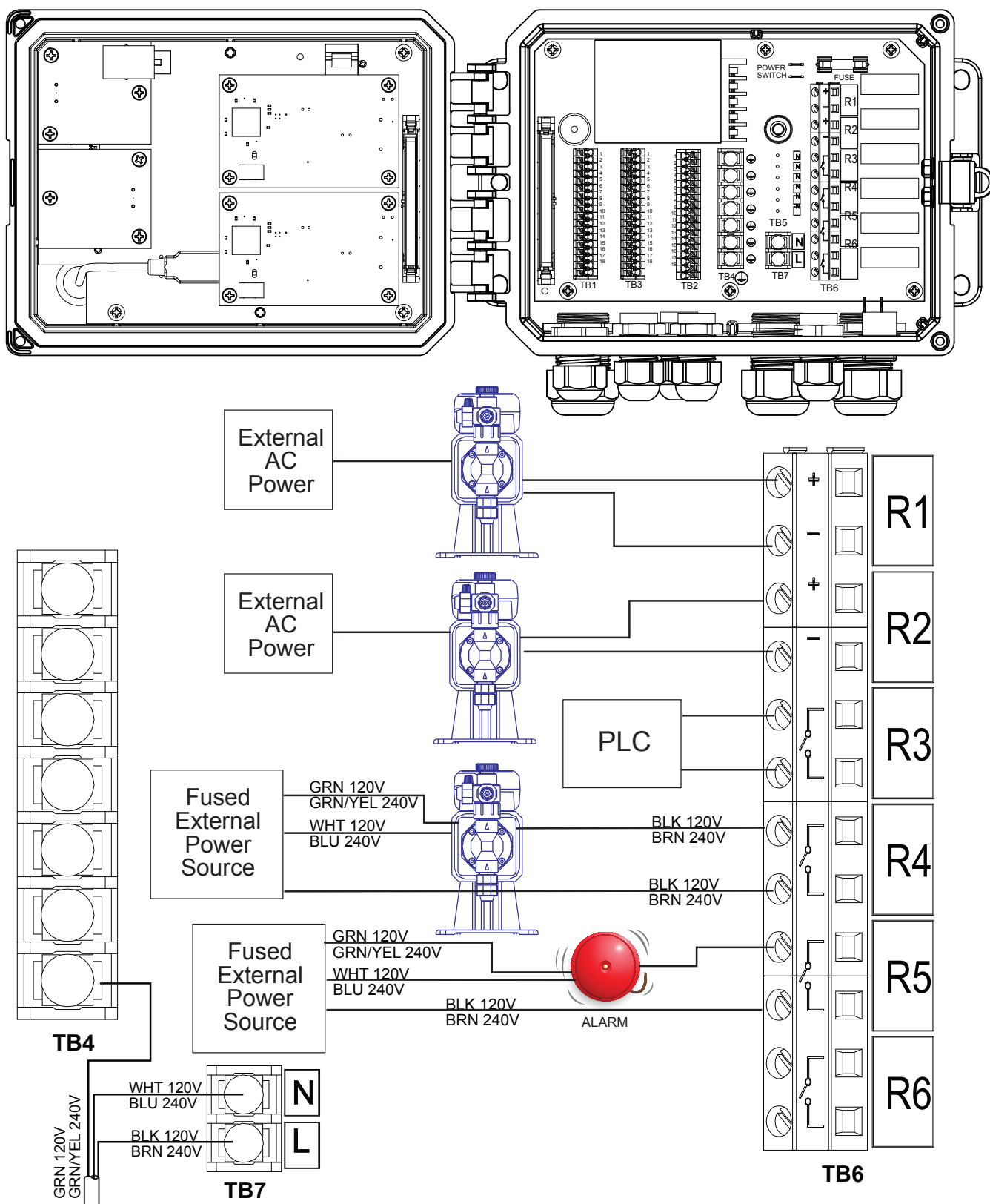


Figure 15 W620 AC Power & Relay Output Wiring

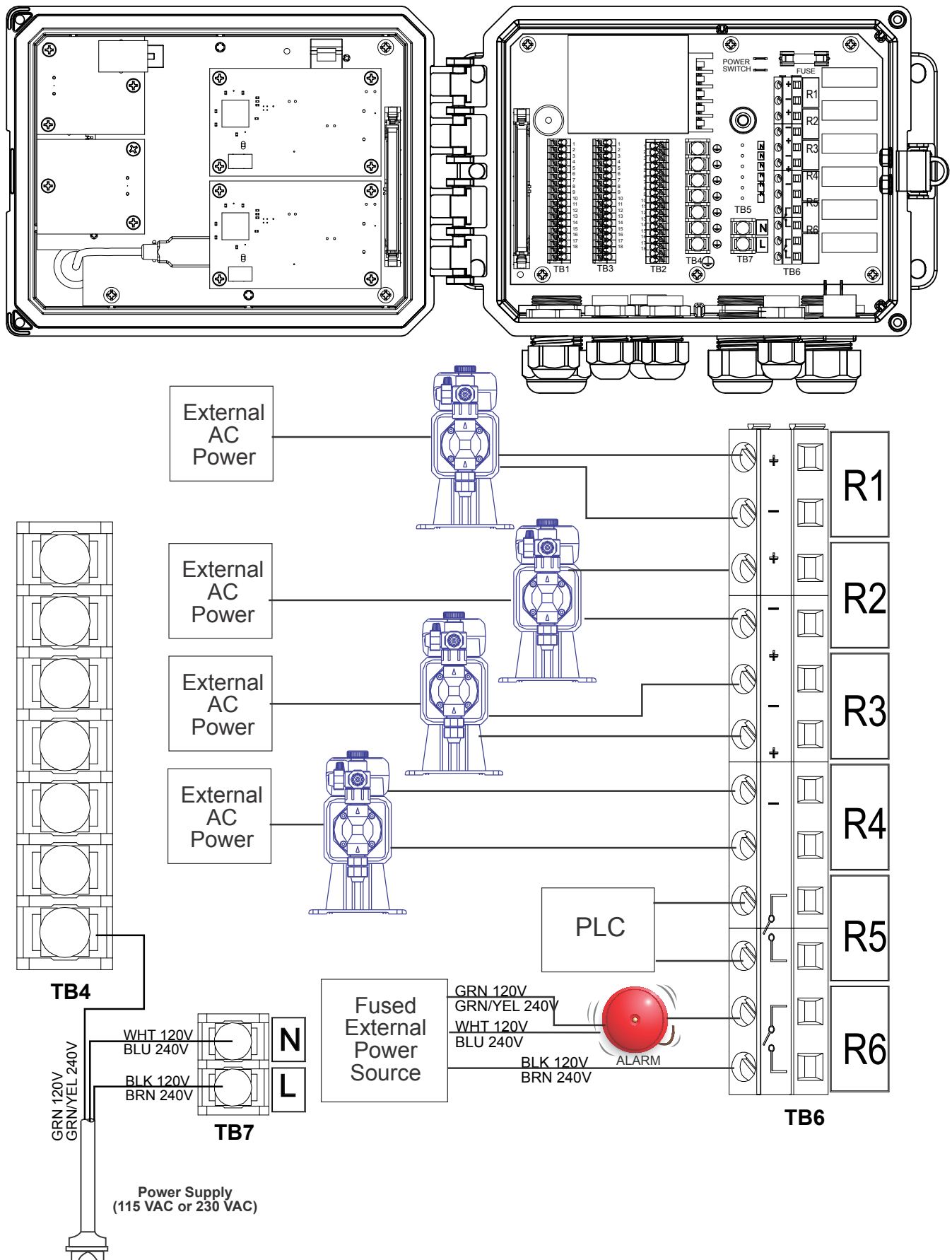


Figure 16 W640 AC Power & Relay Output Wiring

4.0 FUNCTION OVERVIEW

4.1 Front Panel



Figure 18 Front Panel

4.2 Touchscreen

A Home screen is displayed while the controller is on. This display shows a user-defined list of input readings or status of outputs. Touching any of the items on the Home Screen will bring up the item’s Details Screen, where you can access calibration and setting menus. If more than four items have been selected to be displayed on the Home screen, the display will toggle between the first group of up to four and the next group. A “pause button” icon, when touched, stops the automatic toggling. Touching the down arrow icon allows for manual toggling. Touching the “play button” icon enables automatic toggling again. Touching the Menu icon brings up the Main Menu screen.

4.3 Icons

The following icons appear on the Home screen.



The Main Menu icon brings you to the list of menu options listed below.






The following icons appear on the Main Menu screen. Touch the icon to get to the menu selections.

















Alarm Menu



Inputs Menu

	Outputs Menu
	Configuration Menu
	HOA Menu
	Graph Menu
	Home Page

Other icons may appear in the menu screens.

	Calibration icon appears in sensor input menus and brings up the calibration menu
	Cancel icon aborts a calibration or setting change
	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 Back/Return icon returns the display to the previous screen
	The Make Character Higher icon is used when making an alphanumeric entry
	The Make Character Lower icon is used when making an alphanumeric entry
	The Move Cursor icon is used to scroll left to right within an alphanumeric entry
	The Confirm icon accepts a choice, finishes entering data, or advances to the next calibration step
	Settings Menu
	The Character Delete icon deletes part of an alphanumeric entry
	The Shift icon switches between upper and lower case alpha entry screens
	The Next Screen icon moves to the next step in a calibration sequence. In a Graph it shifts the graph forward in time.
	The Previous Screen icon moves back a step in a calibration sequence. In a Graph it shifts the graph backwards in time.

Overview of the use of icons

Changing Numeric Values

To change a number, use the Character Delete icon to the digit to be changed. If the new number will be negative, start with touching the minus sign, then use the numeric touchpad and decimal point to type the number (some entries must be integers and the decimal will be ignored and the setting rounded to the nearest integer). Once the value of the number is correct touch the Confirm icon to store the new value into memory, or touch the Cancel icon 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 icon to the character to be changed and change it using either the Make Character Higher or Lower icons. 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 icon to store the new value into memory, or use the Cancel icon 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. Touch the Page Up or Down icons if necessary to find the desired option, and then touch the option to highlight it. Touch the Confirm icon to store the new option into memory, or touch the Cancel icon to leave the selection at its previous value and go back.

Hand-Off-Auto Relay Mode

Touch 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. Touch the Return icon to go back to the relay settings.

Interlock and Activate with Channels Menus

To select which digital inputs or relays will interlock this relay (Interlock Channels), or which digital inputs or relays will force this relay on (Activate with Channels), touch the input or relay number(s). The background of the selected item will turn dark. When finished selecting as many as needed, touch the Confirm icon to accept the changes or the Cancel icon to leave the selections at the previous settings and go back.

4.4 Startup

Inputs (see section 5.2)

Program the settings for each input

The S11 sensor input will be displayed. Touch it to get to the Details screen. Touch the Settings icon. If the name of the sensor does not describe the type of sensor connected, touch the Scroll Down icon until Type is displayed. **This should be the copper/nickel sensor input.** Touch the Type field. Touch the Scroll Down icon until the correct type of sensor is displayed, then touch it to highlight it. Touch the Confirm icon to accept the change. This will bring you back to the Settings screen. Finish the rest of the S11 settings. **For copper/nickel sensors select the units of measure.**

The S12 input is the optional pH input for electroless nickel, if a pH sensor will be used, change the Type from No Sensor to pH. This will bring you back to the Settings screen. Finish the rest of the S12 settings.

The S13 temperature input Element should be set to RTD 1000Ω if the S12 pH sensor includes a temperature element. If so, set the alarm set points and alarm deadband. To calibrate the temperature, return to the S13 Details screen, touch the Calibrate icon, and touch the Enter icon to perform a calibration.

If the other input card is a Dual Analog Input card (4-20mA signal), then select the type of sensor that will be connected. Select AI Monitor if the device can be calibrated on its own and the W600 calibration will only be in units of mA. Select Transmitter if the device connected cannot be calibrated on its own and the W600 will need to be used to calibrate in engineering units of measure.

If a flow switch or liquid level switch is connected, D1 through D6 (whichever one has the device connected to it) should be set to DI State type (if no switch is connected, select No Sensor). Set the state that will possibly interlock control outputs (refer to the Outputs settings to program which outputs, if any, will be interlocked by the switch). Set the state, if any, that will result in an alarm.

If a contacting head or paddlewheel flow meter is connected, D1 through D6 (whichever one has the device connected to it) should be set to that type (if no flow meter is connected, select No Sensor). Set the units of measure, volume/contact or K factor, etc.

Calibrate the copper/nickel and optional pH sensor

To calibrate the sensor, return to the list of inputs, touch the sensor to calibrate, touch the Calibrate icon, and select one of the calibration routines. **For copper/nickel sensors, start with a Water/Sample Calibration. After that, a calibration offset setting can be applied, to match the reading to a titration, from the Settings menu.** Refer to section 5.2.

Touch the Main Menu icon. Touch the Outputs icon.

MAIN MENU/HOME SCREEN OVERVIEW

Inputs	
Nickel (S11)	7.00 g/l
ph (S12)	4.50
Temp (S13)	77.1 F
Generic AI (S21)	30.5%
<div> <div></div> <div></div> </div>	

List of possible Inputs:
 Plating Control
 Plating Follow
 Contacting Conductivity
 Electrodeless Conductivity
 Temperature
 pH
 ORP
 Disinfection
 Generic
 Transmitter/AI Monitor
 DI State
 Flow Meter, Contactor type
 Flow Meter, Paddlewheel type
 Feed Monitor
 Virtual Input

Outputs	
On/Off (R1)	Off
Flow Timer (R2)	Off
Flow Timer (R3)	Off
Manual (R4)	Off
<div> <div></div> <div></div> </div>	

List of possible Outputs:
 Plating Control
 Plating Follow
 On/Off control mode
 Flow Timer control mode
 Percent Timer control mode
 Alarm Output mode
 Time Proportional control mode
 Manual control mode
 Pulse Proportional control mode
 PID control mode
 Dual Setpoint mode
 Timer control mode
 Probe Wash control mode
 Spike control mode
 Lag Output control mode
 Analog Output, Retransmit mode
 Analog Output, Proportional control mode
 Analog Output, PID control mode
 Analog Output, Manual mode
 Analog Output, Flow Proportional mode

Alarms	
List of all Active Alarms	
<div> <div></div> <div></div> </div>	

HOME SCREEN (example)

<div> <div></div> <div>Flowswitch (D1) No Flow</div> </div>	
Nickel (S11)	7.00 g/l
ph	4.50.°F
Temp (S13)	77.0°F
<div> <div></div> <div></div> </div>	

MAIN MENU

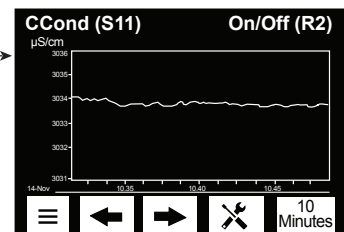
Main Menu 09:19:01 14-Mar-2017			
	Inputs		Config
	Outputs		HOA
	Alarm		Graph
<div> <div></div> <div></div> </div>			

To HOME SCREEN

Config	
Global Settings	
Security Settings	
Network Settings	
Network Details	
<div> <div></div> <div></div> </div>	

Additional Config Settings:
 Remote Communications (Modbus)
 Email Report Settings
 Display Settings
 File Utilities
 Controller Details

> HOA			
R1	R2	R3	
R4	R5	R6	
Hand	Off	Auto	<div> <div></div> <div></div> </div>

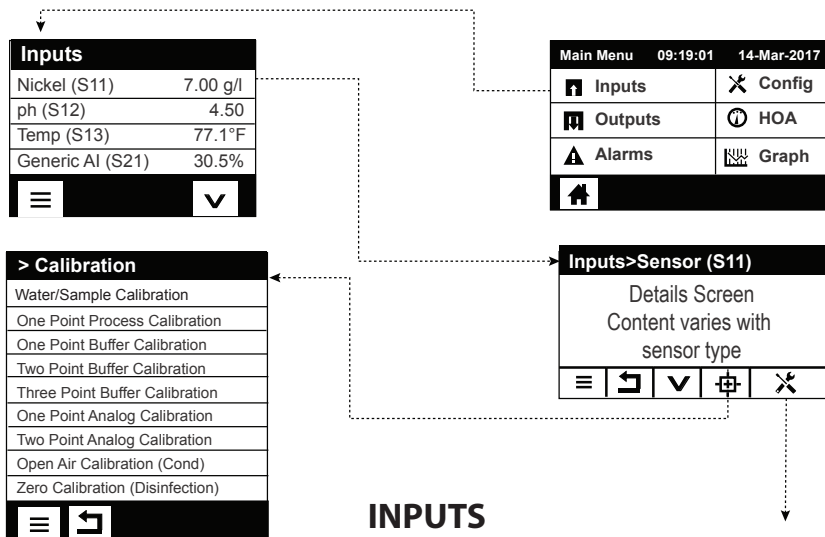


Graph Settings	
Sensor	
DI Relay	
Low Axis Limit	
High Axis Limit	
<div> <div></div> <div></div> </div>	

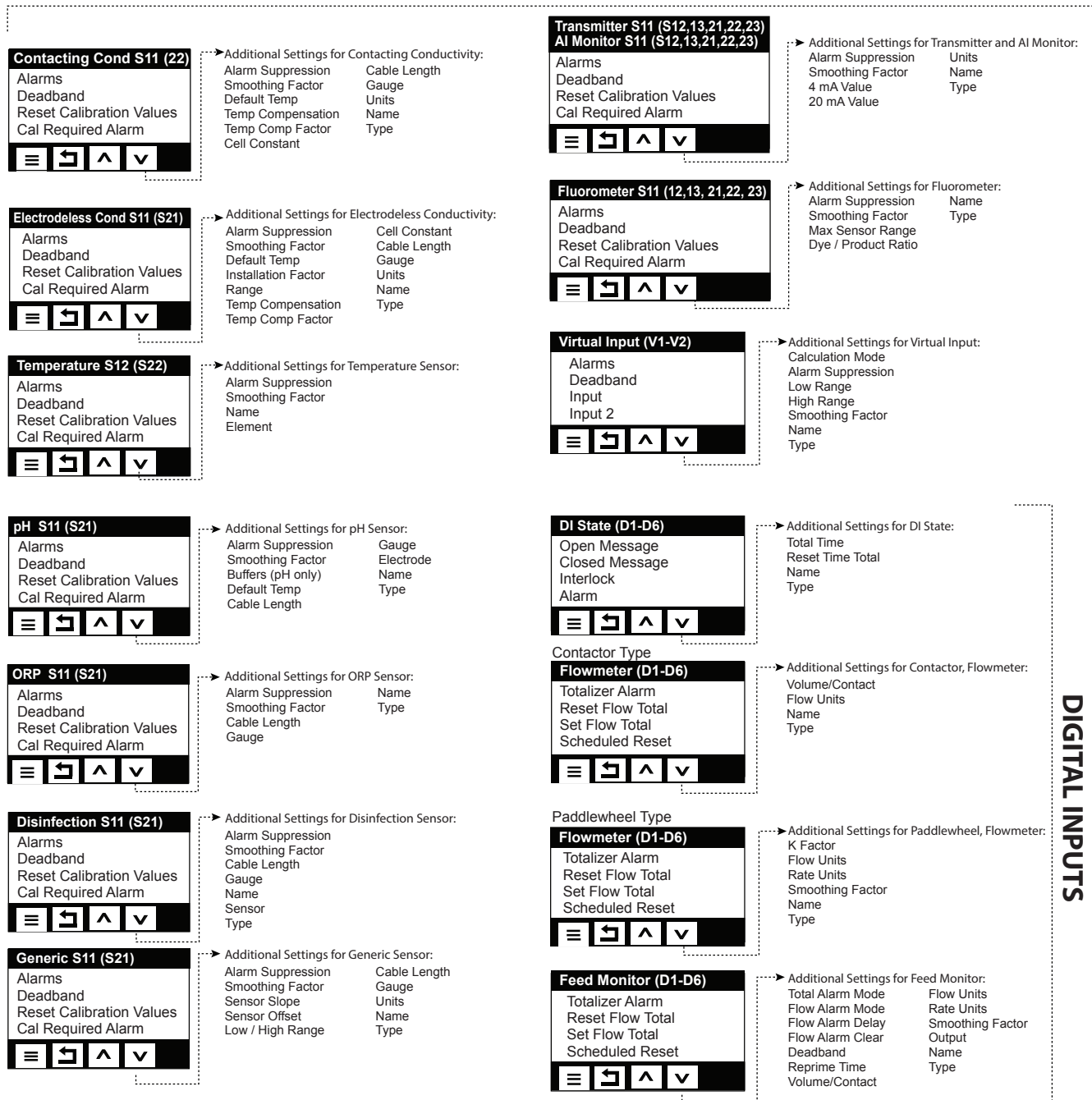
Additional Graph Settings:
 Time Range

Time Range	
10 Minutes	
30 Minutes	
1 Hour	
2½ Hours	
<div> <div></div> <div></div> </div>	

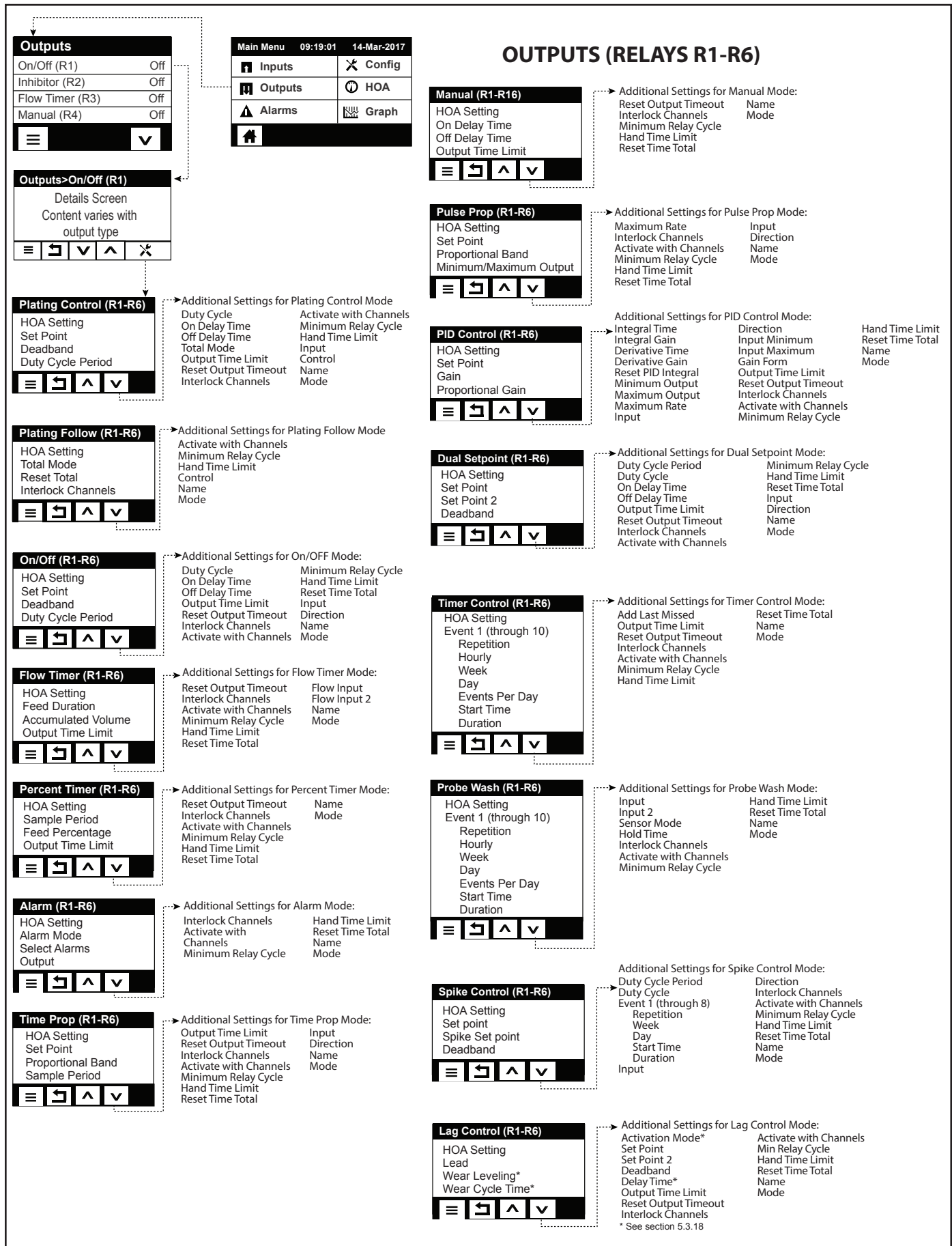
More possible settings:
 8 Hours
 12 Hours
 1 Day
 ½ Week
 1 Week
 2 Weeks
 4 Weeks



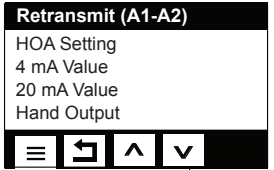
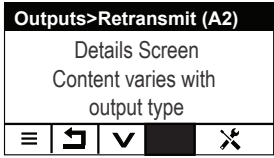
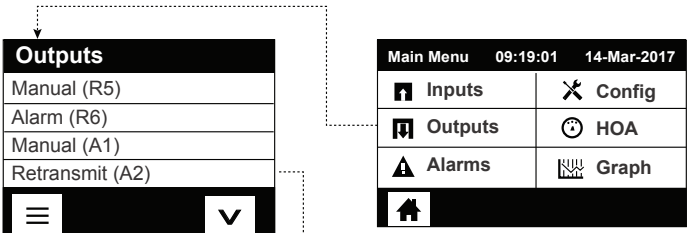
INPUTS



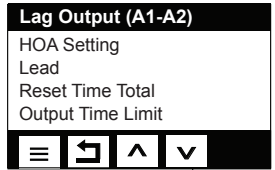
DIGITAL INPUTS



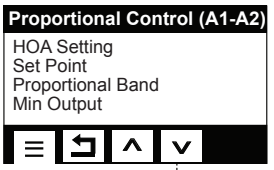
OUTPUTS (ANALOG A1-A2)



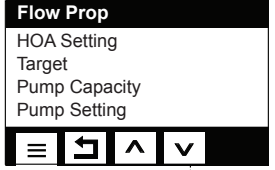
Additional settings for Retransmit Mode:
Error Output
Reset Time Total
Input
Name
Mode



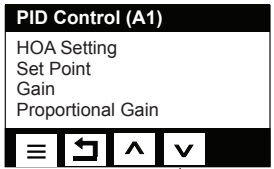
Additional settings for Lag Output Mode:
Reset Output Timeout
Wear Leveling
Wear Cycle Time
Name
Mode



Additional Settings for Proportional Control Mode:
Max Output
Output Time Limit
Reset Output Timeout
Interlock Channels
Activate with Channels
Hand Output
Hand Time Limit
Reset Time Total
Off Mode Output
Error Output
Input
Direction
Name
Mode

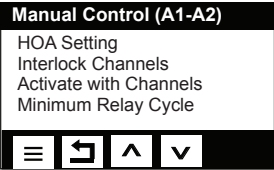


Additional settings for Flow Prop Control Mode:
Specific Gravity
Output Time Limit
Reset Output Timeout
Interlock Channels
Activate with Channels
Hand Output
Hand Time Limit
Off Mode Output
Error Output
Reset Time Total
Flow Input
Cycles Input
Low Cycles Limit
Name
Mode

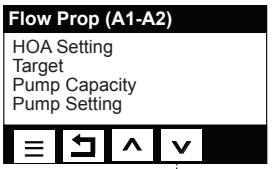


Additional Settings for PID Control Mode:
Integral Time
Integral Gain
Derivative Time
Derivative Gain
Reset PID Integral
Min Output
Max Output
Max Rate
Output Time Limit
Reset Output Timeout
Interlock Channels
Activate with Channels
Hand Output
Hand Time Limit
Off Mode Output
Error Output
Reset Time Total
Input
Direction
Input Minimum
Input Maximum
Gain Form
Name
Mode

Only if HVAC mode is disabled



Additional Settings for Manual Control Mode:
Hand Time Limit
Reset Time Total
Name
Mode



Additional Settings for Flow Prop Control Mode:
Specific Gravity
Output Time Limit
Reset Output Timeout
Interlock Channels
Activate with Channels
Hand Output
Hand Time Limit
Off Mode Output
Error Output
Reset Time Total
Flow Input
Name
Mode

CONFIG MENU

HOME SCREEN (example)

▲ Flowswitch (D1) No Flow	
CCond (S11)	3041 µS/cm
Temp (S12)	77.0°F
Flowswitch (D1)	No Flow

Main Menu 09:19:01 14-Mar-2017	
Inputs	Config
Outputs	HOA
Alarms	Graph

Config	
Global Settings	
Security Settings	
Network Settings	
Network Details	

Additional Config Settings:
 Remote Communications (Modbus)
 Email Report Settings
 Display Settings
 File Utilities
 Controller Details

Global Settings	
Date	
Time	
Name	
Location	

Additional Global Settings:
 Global Units
 Temperature Units
 Pump Units
 Alarm Delay
 Language
 Live Connect Status

Security Settings	
Controller Log Out	
Security	
Local Password	

Network Settings	
DHCP Setting	
Controller IP Address	
Network Netmask	
Network Gateway	

Additional Network Settings:
 DNS Server 1
 VTouch Status
 LiveConnect Status
 Update Period
 Reply Timeout

Network Details	
Alarms	
DHCP Status	
Controller IP Address	
Network Netmask	

Additional Network Details:
 Network Gateway
 DNS Server
 MAC Address
 Last VTouch Data
 Last VTouch Config

Remote Communications	
Comm Status	
Data Format	
Data Port	
Verbose Logging	

Email Report Settings	
Report #1 through #4	
Email Addresses	
Email Server	
SMTP Server	

Additional Email Report Settings:
 SMTP Port
 From Address
 ASMTTP Username
 ASMTTP Password

Report #1-4 Settings:
 Report Type
 Email Recipients
 Repetition (Datalog/Summary Reports)
 Reports Per Day (Datalog/Summary Reports)
 Day (Datalog/Summary Reports)
 Day of Month (Datalog/Summary Reports)
 Report Time (Datalog/Summary Reports)
 Log Frequency (Datalog Report)
 Alarm Mode (Alarms Report)
 Select Alarms (Alarms Report)
 Alarm Delay (Alarms Report)

Display Settings	
Home 1	
Home 2	
Home 3	
Home 4	

Additional Display Settings:
 Adjust Display
 Auto Dim Time
 Key Beep
 Home 5
 Home 6
 Home 7
 Home 8

File Utilities	
File Transfer Status	
Data Log Range	
Log Frequency	
Export Data Log File	

Additional File Utilities:
 Export Event Log
 Export System Log
 Export User Config File
 Import User Config File
 Restore Default Config
 Software Upgrade

Controller Details	
Controller	
Product Name	
Serial Number	
Controller Board	

Additional Controller Details:
 Software Version
 Power Board
 Sensor Board #1
 Software Version
 Sensor Board #2
 Software Version
 Network Board
 Software Version
 AO Board
 Last Data Log
 Battery Power
 Processor Temp
 I/O Card 1 Temp
 I/O Card 2 Temp
 Network Temp
 +5 Volt Supply
 +3.3 Volt Supply
 LCD Bias Voltage
 LCD Supply

Outputs (see section 5.3)

Program the settings for each output

The R1 relay output will be displayed. Touch the relay field to get to the Details screen. Touch the Settings icon. If the name of the relay does not describe the control mode desired, touch the Scroll Down icon until Mode field is displayed. Touch the Mode field. Touch the Scroll Down icon until the correct control mode is displayed, then touch the Confirm icon to accept the change. This will bring you back to the Settings screen. Finish the rest of the R1 settings.

If you want the output to be interlocked by a flow switch or by another output being active, enter the Interlock Channels menu and select the input or output channel that will interlock this output. The default is for the output to be in Off mode, where the output does not react to the settings. Once all settings for that output are complete, enter the HOA Setting menu and change it to Auto.

Repeat for each output.

The default setting is for R1 to be used for the copper or nickel replenishment, using the Plating Control mode. This mode allows for totalizing the amount of metal fed by logging the time, or converting time to volume using the replenishment pump output, or by metal turnovers. Select this using the Total Mode menu. If using a copper sensor, select the Control direction as Electroless (force higher) or Microetch (force lower).

Select Plating Control for the pH control relay in an electroless nickel application to get the same Total Mode choices. If totalizing by volume is not a priority, choose On/Off or Time Proportional.

R2-R4 default to Plating Follow mode. These relays will activate at the same time as the relay feeding metal (R1 is the default, select the proper relay for your installation). The intention is to feed pH adjustment, reducing agent, and/or stabilizer in proportion to the metal.

Normal Startup

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

4.5 Shut Down


To shut the controller down, simply turn off the power. Programming remains in memory. It is important that the pH/ORP electrode remains wet. If the shutdown is expected for any longer than a day, and it is possible for the electrode to dry out, remove the electrode from the tee and store it in pH 4 buffer or cooling tower water. Take care to avoid freezing temperatures when storing the pH/ORP electrodes to avoid breakage of the glass.

5.0 OPERATION using the touchscreen

These units control continuously while power is applied. Programming is accomplished either via the touchscreen or the optional Ethernet connection. See section 6.0 for Ethernet instructions.

To view the readings of each sensor, or whatever user-defined list of parameters that has been set, touch the Home icon if not already there. The menus for each of these parameters may be accessed directly by touching the parameter.

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

Touch the Main Menu icon  from the home page to access all settings. The menu structure is grouped by alarms, inputs and outputs. Under the Configuration menu will be general settings such as the clock, the language, etc. that do not have an input or output associated with it. 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.

5.1 Alarms Menu



Touch the Alarms icon to view a list of active alarms. If there are more than six active alarms, the Page Down icon will be shown; touch this icon to bring up the next page of alarms.

Touch the Main Menu icon to go back to the previous screen.

5.2 Inputs Menu



Touch the Inputs icon to view a list of all sensor and digital inputs. The Page Down icon pages down the list of inputs, the Page Up icon pages up the list of inputs, the Main Menu icon brings back the previous screen.

Touch the input 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 under a separate sensor input menu.

Calibration

Touch the Calibration icon to calibrate the sensor. Select the calibration to perform: **Water/Sample Calibration**, One Point Process, One Point Buffer, Two Point Buffer, **Three Point Buffer**, **One Point Analog**, or **Two Point Analog** Calibration. Not all calibration options are available for all types of sensor.

Water/Sample Calibration

Begin Calibration

OK to disable control?

Touch Confirm to continue or Cancel to abort.

Remove Sensor

Please provide water sample to sensor

Place the immersible sensor in clean tap or DI water, or circulate through the flow through sensor. Touch Confirm to continue or Cancel to abort.

Stabilization

When the signal from the sensor is stable, the controller will automatically move to the next step. If it doesn't stabilize you may manually go to the next step by touching Confirm.

Process Sample

Enter the value of the process solution to be used to calibrate and touch Confirm.

Process Sample

Please provide process sample to sensor

Place the immersible sensor in the process sample, or circulate through the flow through sensor. Touch Confirm to continue or Cancel to abort.

Stabilization

When the signal from the sensor is stable, the controller will automatically move to the next step. If it doesn't stabilize you may manually go to the next step by touching Confirm.

Calibration Successful or Failed

If successful, touch Confirm to put the new calibration in memory. The calibration **adjusts the water offset and slope and displays the new slope and the mV in water at both measurement and reference wavelengths.** If failed, you may retry the calibration or cancel. Refer to Section 8 to troubleshoot a calibration failure.

Resume Control

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

One Point Process Calibration

New Value

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

Cal Successful or Failed

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

If failed, you may retry the calibration or cancel. Refer to Section 8 to troubleshoot a calibration failure.

One Point Buffer Calibration, Disinfection/Generic Sensor Zero Cal, Conductivity Air Cal

Cal Disables Control

Touch 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 touch Confirm.

Buffer Value (only appears for One Point Calibration except when automatic buffer recognition is used))

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 conductivity open air cal). Touch 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, touch Confirm to put the new calibration in memory.

If failed, you may retry the calibration or cancel. Refer to Section 8 to troubleshoot a calibration failure.

Resume Control

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

Two Point Buffer Calibration

Cal Disables Control

Touch 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 touch Confirm.

First Buffer Value (does not appear if automatic buffer recognition is used)

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. Touch 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 touching Confirm.

Second 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.

Second Buffer Value (does not appear if automatic buffer recognition is used)

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. Touch 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 touching Confirm.

Cal Successful or Failed

If successful, touch 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 8 to troubleshoot a calibration failure.

Resume Control

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

Three Point Buffer Calibration (pH sensors only)

Cal Disables Control

Touch Confirm to continue or Cancel to abort

Buffer Temperature (only appears if no temperature sensor is detected)

Enter the temperature of the buffer and touch Confirm.

First Buffer Value (does not appear if automatic buffer recognition is used)

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. Touch 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 touching Confirm.

Second Buffer Temperature (only appears if no temperature sensor is detected)

Enter the temperature of the buffer and touch Confirm.

Second Buffer Value (does not appear if automatic buffer recognition is used)

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. Touch 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 touching Confirm.

Third Buffer Temperature (only appears if no temperature sensor is detected)

Enter the temperature of the buffer and touch Confirm.

Third Buffer Value (does not appear if automatic buffer recognition is used)

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. Touch 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.

Cal Successful or Failed

If successful, touch Confirm to put the new calibration in memory. The calibration adjusts the offset, gain (slope) and calibration midpoint 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 touch Confirm when ready to resume control.

One Point Analog Calibration

OK to disable control? Touch Confirm to continue or Cancel to abort.

Input Value

Enter the mA value that the transmitter will be sending. Touch Confirm to continue or Cancel to abort.

Please set input signal to specified value

Make sure that the transmitter is sending the desired mA signal. Touch Confirm to continue or Cancel to abort.

Automatic circuit calibration in progress

Cal Successful or Failed

If successful, touch Confirm to save calibration results. The calculated offset will be displayed.

If failed, you may retry the calibration or cancel. You may also restore calibration to the factory defaults. The calibration will fail if the measured mA is more than 2 mA away from the Input Value entered.

Please restore input signal to process value

Put the transmitter back into normal measurement mode if necessary and touch Confirm when ready to resume control.

Two Point Analog Calibration

OK to disable control? Touch Confirm to continue or Cancel to abort.

Input Value

Enter the mA value that the transmitter will be sending. Touch Confirm to continue or Cancel to abort.

Please set input signal to specified value

Make sure that the transmitter is sending the desired mA signal. Touch Confirm to continue or Cancel to abort.

Automatic circuit calibration in progress

Second Input Value

Enter the mA value that the transmitter will be sending. Touch Confirm to continue or Cancel to abort.

Please set input signal to specified value

Make sure that the transmitter is sending the desired mA signal. Touch Confirm to continue or Cancel to abort.

Automatic circuit calibration in progress

Cal Successful or Failed

If successful, touch Confirm to save calibration results. The calculated offset and gain will be displayed. If failed, you may retry the calibration or cancel. You may also restore calibration to the factory defaults. The calibration will fail if the offset is more than 2 mA or the gain is not between 0.5 and 2.0.

Please restore input signal to process value

Put the transmitter back into normal measurement mode if necessary and touch Confirm when ready to resume control.

5.2.1 Copper/Nickel

Settings

Touch the Settings icon to 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 3 g/l, and the deadband is 0.10, the alarm will activate at 3.01 g/l and deactivate at 2.90 g/l.
Calibration Offset	<p>This menu is used to change the sensor reading without performing a water/sample calibration. This calibration is best performed at normal operating temperature.</p> <p>Keep the immersible sensor in place or have solution flowing through the flow-through sensor. Take a sample of the solution and note the concentration displayed by the controller. Carefully perform the normal laboratory analysis of the metal concentration. Calculate the offset by subtracting the displayed value from the lab results. If the lab analysis is significantly different, adjust the offset using the arrow keys to change the value and the +/- sign. If the controller's display is higher than the lab analysis, the offset should be negative.</p> <p>The maximum offset for calibration offset is 10 g/l or oz/gal from the last water/sample calibration value. If you have an offset larger than this, then perform a new water/sample calibration (see section 5.2).</p>
Reset Calibration Values	Enter this menu to reset the sensor calibration back to factory defaults.
Cal Required Alarm	To get an alarm message as a reminder to calibrate the sensor on a regular schedule, enter the number of days between calibrations. Set it to 0 if no reminders are necessary.
Alarm Suppression	If any of the relays or digital inputs are selected, any alarms related to this input will be suppressed if the selected relay or digital input is active. Typically this is used to prevent alarms if there is no sample flow past the flow switch digital input.
Smoothing Factor	Increase the smoothing factor percentage to dampen the response to changes. For example, with a 10% smoothing factor, the next reading shown will consist of an average of 10% of the previous value and 90% of the current value.
Stabilization Time	The sensor needs some time to warm up on power-up. Enter the time delay on start-up before the sensor signal is valid.
Units	Select the units of measure for the copper/nickel (g/l or oz./gal).
Name	The name used to identify the sensor may be changed.
Type	Select the type of sensor to be connected.

5.2.2 Contacting Conductivity

Settings

Touch the Settings icon to 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.
Reset Calibration Values	Enter this menu to reset the sensor calibration back to factory defaults.
Cal Required Alarm	To get an alarm message as a reminder to calibrate the sensor on a regular schedule, enter the number of days between calibrations. Set it to 0 if no reminders are necessary.
Alarm Suppression	If any of the relays or digital inputs are selected, any alarms related to this input will be suppressed if the selected relay or digital input is active. Typically this is used to prevent alarms if there is no sample flow past the flow switch digital input.
Smoothing Factor	Increase the smoothing factor percentage to dampen the response to changes. For example, with a 10% smoothing factor, the next reading shown will consist of an average of 10% of the previous value and 90% of the current value.
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.
Temp Compensation	Select between the standard NaCl temperature compensation method or a linear %/degree C method.
Temp Comp Factor	This menu only appears if Linear Temp Comp is selected. Change the %/degree C to match the chemistry being measured. Standard water is 2%.
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.

5.2.3 Electrodeless Conductivity

Settings

Touch the Settings icon to 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.
Reset Calibration Values	Enter this menu to reset the sensor calibration back to factory defaults.
Cal Required Alarm	To get an alarm message as a reminder to calibrate the sensor on a regular schedule, enter the number of days between calibrations. Set it to 0 if no reminders are necessary.
Alarm Suppression	If any of the relays or digital inputs are selected, any alarms related to this input will be suppressed if the selected relay or digital input is active. Typically this is used to prevent alarms if there is no sample flow past the flow switch digital input.
Smoothing Factor	Increase the smoothing factor percentage to dampen the response to changes. For example, with a 10% smoothing factor, the next reading shown will consist of an average of 10% of the previous value and 90% of the current value.
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.
Temp Compensation	Select between the standard NaCl temperature compensation method or a linear %/degree C method.
Temp Comp Factor	This menu only appears if Linear Temp Comp is selected. Change the %/degree C to match the chemistry being measured. Standard water is 2%.
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.

5.2.4 Temperature

Settings

Touch the Settings icon to 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 dead-band is 1, the alarm will activate at 100 and deactivate at 99.
Reset Calibration Values	Enter this menu to reset the sensor calibration back to factory defaults.
Cal Required Alarm	To get an alarm message as a reminder to calibrate the sensor on a regular schedule, enter the number of days between calibrations. Set it to 0 if no reminders are necessary.
Alarm Suppression	If any of the relays or digital inputs are selected, any alarms related to this input will be suppressed if the selected relay or digital input is active. Typically this is used to prevent alarms if there is no sample flow past the flow switch digital input.
Smoothing Factor	Increase the smoothing factor percentage to dampen the response to changes. For example, with a 10% smoothing factor, the next reading shown will consist of an average of 10% of the previous value and 90% of the current value.
Name	The name used to identify the sensor may be changed.
Element	Select the specific type of temperature sensor to be connected.

5.2.5 pH

Settings

Touch the Settings icon to 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 dead-band is 0.05, the alarm will activate at 9.51 and deactivate at 9.45.
Alarm Suppression	If any of the relays or digital inputs are selected, any alarms related to this input will be suppressed if the selected relay or digital input is active. Typically this is used to prevent alarms if there is no sample flow past the flow switch digital input.
Smoothing Factor	Increase the smoothing factor percentage to dampen the response to changes. For example, with a 10% smoothing factor, the next reading shown will consist of an average of 10% of the previous value and 90% of the current value.
Reset Calibration Values	Enter this menu to reset the sensor calibration back to factory defaults.
Cal Required Alarm	To get an alarm message as a reminder to calibrate the sensor on a regular schedule, enter the number of days between calibrations. Set it to 0 if no reminders are necessary.

Buffers	Select if calibration buffers will be manually entered, or if they will be automatically detected, and if so, which set of buffers will be used. The choices are Manual Entry, JIS/NIST Standard, DIN Technical, or Traceable 4/7/10.
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
Electrode	Select Glass for a standard pH electrode, or Antimony. Antimony pH electrodes have a default slope of 49 mV/pH and an offset of -320 mV at pH 7.
Name	The name used to identify the sensor may be changed.
Type	Select the type of sensor to be connected.

5.2.6 ORP

Settings

Touch the Settings icon to 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.
Reset Calibration Values	Enter this menu to reset the sensor calibration back to factory defaults.
Cal Required Alarm	To get an alarm message as a reminder to calibrate the sensor on a regular schedule, enter the number of days between calibrations. Set it to 0 if no reminders are necessary.
Alarm Suppression	If any of the relays or digital inputs are selected, any alarms related to this input will be suppressed if the selected relay or digital input is active. Typically this is used to prevent alarms if there is no sample flow past the flow switch digital input.
Smoothing Factor	Increase the smoothing factor percentage to dampen the response to changes. For example, with a 10% smoothing factor, the next reading shown will consist of an average of 10% of the previous value and 90% of the current value.
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.

5.2.7 Disinfection

Settings

Touch the Settings icon to 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.
Reset Calibration Values	Enter this menu to reset the sensor calibration back to factory defaults.
Cal Required Alarm	To get an alarm message as a reminder to calibrate the sensor on a regular schedule, enter the number of days between calibrations. Set it to 0 if no reminders are necessary.
Alarm Suppression	If any of the relays or digital inputs are selected, any alarms related to this input will be suppressed if the selected relay or digital input is active. Typically this is used to prevent alarms if there is no sample flow past the flow switch digital input.

Smoothing Factor	Increase the smoothing factor percentage to dampen the response to changes. For example, with a 10% smoothing factor, the next reading shown will consist of an average of 10% of the previous value and 90% of the current value.
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.

5.2.8 Generic Sensor

Settings

Touch the Settings icon to 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.
Reset Calibration Values	Enter this menu to reset the sensor calibration back to factory defaults.
Cal Required Alarm	To get an alarm message as a reminder to calibrate the sensor on a regular schedule, enter the number of days between calibrations. Set it to 0 if no reminders are necessary.
Alarm Suppression	If any of the relays or digital inputs are selected, any alarms related to this input will be suppressed if the selected relay or digital input is active. Typically this is used to prevent alarms if there is no sample flow past the flow switch digital input.
Sensor Slope	Enter the slope of sensor in mV/Units
Sensor Offset	Enter the offset of the sensor in mV if 0 mV is not equal to 0 units.
Low Range	Enter the low end of the range of the sensor
High Range	Enter the high end of the range of the sensor
Smoothing Factor	Increase the smoothing factor percentage to dampen the response to changes. For example, with a 10% smoothing factor, the next reading shown will consist of an average of 10% of the previous value and 90% of the current value.
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
Units	Type in the units of measure for the input, for example, ppm.
Name	The name used to identify the sensor may be changed.
Type	Select the type of sensor to be connected.

5.2.9 Transmitter Input and AI Monitor Input

Select AI monitor if the device connected can be calibrated on its own and the W600 calibration will only be in units of mA. Select Transmitter if the device connected cannot be calibrated on its own and the W600 will be used to calibrate in engineering units of measure.

Settings

Touch the Settings icon to 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.
Reset Calibration Values	Enter this menu to reset the sensor calibration back to factory defaults.

Cal Required Alarm	To get an alarm message as a reminder to calibrate the sensor on a regular schedule, enter the number of days between calibrations. Set it to 0 if no reminders are necessary.
Alarm Suppression	If any of the relays or digital inputs are selected, any alarms related to this input will be suppressed if the selected relay or digital input is active. Typically this is used to prevent alarms if there is no sample flow past the flow switch digital input.
Smoothing Factor	Increase the smoothing factor percentage to dampen the response to changes. For example, with a 10% smoothing factor, the next reading shown will consist of an average of 10% of the previous value and 90% of the current value.
4 mA Value	Enter the value that corresponds to a 4 mA output signal from the transmitter.
20 mA Value	Enter the value that corresponds to a 20 mA output signal from the transmitter.
Units	Select the units of measure for the transmitter.
Transmitter	Only appears if the input is on a Combination Sensor/Analog Input Card. Select the type of transmitter that is wired to this input; as a 2-wire loop powered type, 2-wire externally powered type, 3-wire or 4-wire.
Name	The name used to identify the transmitter may be changed.
Type	Select the type of sensor to be connected. The choice of AI Monitor and Transmitter is only available if a 4-20mA type sensor card is installed.

5.2.10 DI State

Input Details

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

Settings

Touch the Settings icon to 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.
Total Time	Choose to totalize the amount of time that the switch has been open or closed. This will be displayed on the input details screen.
Reset Total Time	Enter this menu to reset the accumulated time to zero. Touch Confirm to accept, Cancel to leave the total at the previous value and go back.
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.

5.2.11 Flow Meter, Contactor Type

Input Details

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

Settings

Touch the Settings icon to view or change the settings related to the sensor.

Totalizer Alarm	A high limit on the total volume of water accumulated may be set.
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Reset Flow Total	Enter this menu to reset the accumulated flow total to 0. Touch Confirm to accept, Cancel to leave the total at the previous value and go back.
Set Flow Total	This menu is used to set the total volume stored in the controller to match the register on the flow meter. Enter the desired value.
Scheduled Reset	Choose to automatically reset the flow total, and if so, Daily, Monthly or Annually.
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.

5.2.12 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, alarms, and the current type of input setting.

Settings

Touch the Settings icon to 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. Touch Confirm to accept, Cancel to leave the total at the previous value and go back.
Set Flow Total	This menu is used to set the total volume stored in the controller to match the register on the flow meter. Enter the desired value.
Scheduled Reset	Choose to automatically reset the flow total, and if so, Daily, Monthly or Annually.
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.
Smoothing Factor	Increase the smoothing factor percentage to dampen the response to changes. For example, with a 10% smoothing factor, the next reading shown will consist of an average of 10% of the previous value and 90% of the current value.
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.

5.2.13 Feed Monitor

The Feed Monitor Digital Input type performs the following functions:

- Monitors a pulse signal from a pump (Iwaki PosiFlow, Tacmina Flow Checker, LMI Digital Pulse, etc)
- Totalizes the chemical feed and calculates the current flow rate
- Activates a Total Alarm if the feed exceeds a specified limit
- Activates a Flow verify alarm if the control output is ON and the feed monitor does not record any pulses within a specified period of time.

Each Feed Monitor input can be linked to any type of output channel (powered relay, dry contact relay, solid state relay, or analog 4-20 mA) to validate chemical feed from any type of pump.

Total Alarm

The W600 monitors the total feed and activates a Total Alarm if the value exceeds the Totalizer Alarm set point. When used in conjunction with Scheduled Reset selections (Daily, Monthly, or Annually), this alarm can be used to alert users to situations where excess chemical product is used and/or to discontinue chemical feed if the amount exceeds the set point during the specified time period.

While a Total Alarm is active, the linked pump will be controlled based on the Total Alarm Mode setting:

Interlock	The output will be OFF while the alarm is active.
Maintain	The alarm condition has no effect on output control.

Flow Verify Alarm

The W600 monitors the status or current percent output of the channel linked to the feed monitor to determine if a Flow Verify alarm should be activated.

The *Flow Alarm Delay* setting (MM:SS) contains the time to trigger the alarm if the output is activated and no pulses are registered. To avoid nuisance alarms at very low flow rates, if the linked output is a solid state relay (set with a pulse proportional or PID control mode) or an analog 4-20 mA output, the alarm will only be activated if no input pulses are monitored while the output is set to greater than a specified Dead Band (%).

The *Flow Alarm Clear* setting is the number of pulses that must be registered to verify that pump operation is restored and clear the Flow Verify alarm. During Flow Verify alarm conditions, the count of pulses registered will be reset to zero if no single pulses occur during the Flow Alarm Delay time period. In this manner, random single pulses spread over a long time period will not accumulate and result in a Flow Verify alarm being cleared before product feed is actually restored.

If desired, a user can configure the feed monitor to attempt to reprime the pump when a Flow Verify alarm first is activated.

The *Reprime Time* (MM:SS) specifies the amount of time that the output should be energized after the initiation of a Flow Verify alarm. If the linked output is a solid state relay (set to a pulse proportional or PID control mode) or an analog 4-20 mA output, the output will be set to the Max Output percent during the reprime event. If the Flow Verify alarm is cleared during the reprime event (because the specified number of pulses was registered), the reprime event will be immediately ended and normal control of the output channel will be restored.

While a Flow Verify alarm is active, the linked pump will be controlled based on the Flow Alarm Mode setting:

Disabled	<i>Flow Verify</i> alarms are not monitored, no change in output control.
Interlock	The output will be forced OFF while the alarm is active.(except during the reprime event)
Maintain	The alarm condition has no effect on output control. (except during the reprime event)

If a *Flow Verify* alarm is active and *Interlock* is selected, the output to the pump will be turned off after the specified Reprime Time and only operator actions can restore normal control operations. In most cases, action will be taken to manually reprime the pump, refill the chemical tank, etc. and the output will be put into Hand mode to confirm proper operation of the pump. When the Feed Monitor registers sufficient pulses, the Flow Verify alarm will clear and the pump output can be put back into Auto Mode.

If both *Total Alarm* and *Flow Verify* alarms are active simultaneously, an Interlock selection for either mode setting will take precedence for pump control. Automatic output control will continue despite the alarm conditions only if Maintain is selected for both mode settings.

Interlocking or Activating any Control Output with a Feed Monitor Input

Digital Input channels are available for selection as Interlock Channels or Activate With Channels by any output. If a Feed Monitor is selected in this manner, the Digital Input will trigger that action if any alarm (Flow Verify, Total Alarm, or Range Alarm) is currently active.

Input Details

The details for this type of input include the current flow rate of chemical feed, the total volume fed since the last reset, alarms, the status of the output linked to the input, the date and time of the last total reset, and the current type of input setting.

Settings

Touch the Settings icon to view or change the settings related to the sensor.

Totalizer Alarm	A high limit on the total accumulated volume of chemical fed may be set, to trigger a Total Alarm.
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Reset Flow Total	Enter this menu to reset the accumulated flow total to 0. Touch Confirm to accept, Cancel to leave the total at the previous value and go back.
Set Flow Total	This menu is used to set the total accumulated volume stored in the controller to match a specified volume.
Scheduled Reset	Choose to automatically reset the flow total, and if so, Daily, Monthly or Annually
Total Alarm Mode	Choose to Interlock or Maintain the control of the linked pump while the Total Alarm is active.
Flow Alarm Mode	Choose to Interlock or Maintain the control of the linked pump while a Flow Verify alarm is active. Choose Disable to monitor flow rate and accumulate total without any flow alarms.
Flow Alarm Delay	Time (MM:SS) that will trigger a Flow Verify alarm if the output is activated and no pulses are registered.
Flow Alarm Clear	Enter the number of contacts that must be registered to clear a Flow Verify alarm.
Dead band	Enter the percent output above which the pump is considered On for monitoring of Flow Verify alarms. This setting is only available if the linked Output is a solid state (pulsing) relay or analog (4-20 mA) output.
Reprime Time	Time (MM:SS) that the output should be energized for the reprime event.
Volume/Contact	Enter the volume, in ml, of chemical delivered for each pulse of the feed monitoring device.
Flow Units	Select the units of measure for the accumulated feed total.
Rate Units	Select the units of measure for the feed flow rate time base.
Smoothing Factor	Increase the smoothing factor percentage to dampen the response to changes in the flowrate. For example, with a 10% smoothing factor, the next reading shown will consist of an average of 10% of the previous value and 90% of the current value.
Output	Select the relay or analog (4-20 mA) output channel controlling the pump which will be monitored by this feed monitor input.
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

5.2.14 Virtual Input

A Virtual Input is not a physical sensor; it is a value that is calculated from two physical sensor inputs. The analog values that can be used for each type of calculation are selected from a List of all defined sensor inputs, analog inputs, flowmeter rates, the other virtual input, solid state relay %, and analog output %.

Calculation modes are:

- **Difference** (Input - Input 2)
- **Ratio** (Input / Input 2)
 - This selection could be used to calculate Cycles of Concentration in HVAC applications, for example
- **Total** (Input + Input 2)
- **% Difference** [(Input - Input 2) / Input]
 - This selection could be used to calculate % Rejection in RO applications, for example

Virtual Input Details

The details for any type of virtual input include the current value calculated, alarms, the status, and the input type.

Settings

Touch the Settings icon to view or change the settings related to the virtual input.

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.

Input	Select the physical input whose value will be used in the calculation shown above as the Input in the formula.
Input 2	Select the physical input whose value will be used in the calculation shown above as the Input 2 in the formula.
Calculation Mode	Select a calculation mode from the list.
Alarm Supression	If any of the relays or digital inputs are selected, any alarms related to this input will be suppressed if the selected relay or digital input is active. Typically, this is used to prevent alarms if there is no sample flow past the flow switch digital input.
Low Range	Set the low end of the normal range for the calculated value. A value below this will trigger a Range Alarm and deactivate any control output using the virtual input.
High Range	Set the high end of the normal range for the calculated value. A value above this will trigger a Range Alarm and deactivate any control output using the virtual input.
Smoothing Factor	Increase the smoothing factor percentage to dampen the response to changes. For example, with a 10% smoothing factor, the next reading shown will consist of an average of 10% of the previous value and 90% of the current value.
Name	The name used to identify the input may be changed.
Type	Select the type of input; either Calculation or Not Used.



5.3 Outputs Menu

Touch the Outputs icon from the Main Menu to view a list of all relay and analog outputs. The Page Down icon pages down the list of outputs, the Page Up icon pages up the list of outputs, the Main Menu icon brings back the previous screen.

Touch an output 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

Settings

Touch the Settings icon to 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 by touching the desired mode.
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, when those other relays are activated in Auto mode. Using Hand or Off to activate relays bypasses the Interlock logic.
Activate With Channels	Select the relays and digital inputs that will activate this relay, when those other relays are activated in Auto mode. Using Hand or Off to activate relays bypasses the Activate With logic.
Minimum Relay Cycle	Enter the number of seconds that will be minimum amount of time that the relay will be in the active or inactive state. Normally this will be set to 0, but if using a motorized ball valve that takes time to open and close, set this high enough that the valve has time to complete its movement.
Hand Time Limit	Enter the amount of time that the relay will activate for when it is in Hand mode.

Reset Time Total	Press the Confirm icon to reset the total accumulated on-time stored for the output back to 0.
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, alarms related to this output, current cycle on time, relay type and the current control mode setting.

Settings

Touch the Settings icon to 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.
Duty Cycle Period	Using a duty cycle helps to prevent overshooting the set point in applications where the response of the sensor to chemical additions is slow. Specify the amount of time for the cycle, and the percentage of that cycle time that the relay will be active. The relay will be off for the rest of the cycle, even if the set point has not been satisfied. Enter the length of the duty cycle in minutes:seconds in this menu. Set the time to 00:00 if use of a duty cycle is not required.
Duty Cycle	Enter the percentage of the cycle period that the relay will be active. Set the percentage to 100 if use of a duty cycle is not required.
On Delay Time	Enter the delay time for relay activation in hours:minutes:seconds. Set the time to 00:00:00 to immediately activate the relay.
Off Delay Time	Enter the delay time for relay deactivation in hours:minutes:seconds. Set the time to 00:00:00 to immediately deactivate the relay.
Input	Select the sensor to be used by this relay.
Direction	Select the control direction.

5.3.3 Plating Control

Plating Control works like On/Off Control described above, with the exception that it is possible to calculate the volume of chemical fed, or to calculate the number of metal turnovers. For copper control, the control direction is selected as Electroless (force higher, low set point) or Microetch (force lower, high set point).

Output Details

The details for this type of output include the relay on/off state, HOA mode or Interlock status, accumulated on-time, **total feed volume or turns (if enabled)**, alarms related to this output, current value of the assigned input sensor, current cycle on time, relay type and the current control mode setting.

Settings

Touch the Settings icon to 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.
Duty Cycle Period	Using a duty cycle helps to prevent overshooting the set point in applications where the response of the sensor to chemical additions is slow. Specify the amount of time for the cycle, and the percentage of that cycle time that the relay will be active. The relay will be off for the rest of the cycle, even if the set point has not been satisfied. Enter the length of the duty cycle in minutes:seconds in this menu. Set the time to 00:00 if use of a duty cycle is not required.
Duty Cycle	Enter the percentage of the cycle period that the relay will be active. Set the percentage to 100 if use of a duty cycle is not required.

On Delay Time	Enter the delay time for relay activation in hours:minutes:seconds. Set the time to 00:00:00 to immediately activate the relay.
Off Delay Time	Enter the delay time for relay deactivation in hours:minutes:seconds. Set the time to 00:00:00 to immediately deactivate the relay.
Total Mode	Enter this menu to select the method and program feed totalization
Pump Capacity	Only appears for As Volume or As Turns. Enter the maximum feed rate of the pump connected to this relay.
Pump Setting	Only appears for As Volume or As Turns. Enter the stroke length setting for the metering pump, in percent
Turnover Volume	Only appears for As Turns. Enter the volume of chemical replenishment that equals one metal turnover.
Turnover Limit	Only appears for As Turns. Enter the maximum number of turnovers. The controller can activate an alarm when this number has been exceeded.
Reset Total	Enter this menu to reset the accumulated time, volume, or metal turnovers , to zero. Touch Confirm to accept, Cancel to leave the total at the previous value and go back.
Input	Select the sensor to be used by this relay.
Control	Select the control direction.

5.3.4 Plating Follow

Plating Follow is commonly used to feed pH adjustment, reducing agent and/or stabilizer in proportion to electroless copper or nickel replenishment. The Plating Follow relay will activate at the same time as the assigned Control relay, for the same amount of time.

Output Details

The details for this type of output include the relay on/off state, HOA mode or Interlock status, accumulated on-time, **total feed volume (if enabled)**, alarms related to this output, relay type and the current control mode setting.

Settings

Touch the Settings icon to view or change the settings related to the relay.

Total Mode	Enter this menu to select the method and program feed totalization
Pump Capacity	Only appears for As Volume. Enter the maximum feed rate of the pump connected to this relay.
Pump Setting	Only appears for As Volume. Enter the stroke length setting for the metering pump, in percent
Reset Total	Enter this menu to reset the accumulated time, or volume , to zero. Touch Confirm to accept, Cancel to leave the total at the previous value and go back.
Control	Select the relay to be used to activate this relay.

5.3.5 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, alarms related to this output, current cycle on time, relay type and the current control mode setting.

Settings

Touch the Settings icon to 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

5.3.6 Relay, Alarm Output Mode

Output Details

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

Settings

Touch the Settings icon to view or change the settings related to the relay.

Alarm Mode	Select the alarm conditions that will put the relay into the alarm state: All Alarms Selected Alarms
Select Alarms	Scroll through the list of all inputs and outputs, as well as System Alarms and Network (Ethernet) alarms. Touch the parameter to select alarms related to that parameter, then scroll through the list of alarms. Touch each alarm to check the box indicating the alarm is selected. Touch the Confirm icon when finished with that parameter to save the changes. Repeat for each input and output.
Output	Select if the relay will be active when in the alarm state (Normally Open) or if the relay will be active when not in the alarm state (Normally Closed).

5.3.7 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, the current % on time calculated for the cycle, the current point in the cycle time, accumulated on-time, alarms related to this output, current cycle on time, relay type and the current control mode setting.

Settings

Touch the Settings icon to 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.

5.3.8 Relay, Manual Mode

Output Details

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

Settings

A Manual relay will activate if the HOA mode is Hand, or if it is Activated With another channel.

On Delay Time	Enter the delay time for relay activation in hours:minutes:seconds. Set the time to 00:00:00 to immediately activate the relay.
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Off Delay Time	Enter the delay time for relay deactivation in hours:minutes:seconds. Set the time to 00:00:00 to immediately deactivate the relay.
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5.3.9 Relay, Pulse Proportional Control Mode

ONLY AVAILABLE IF CONTROLLER INCLUDES PULSE OUTPUT HARDWARE

Output Details

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

Settings

Touch the Settings icon to 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.

5.3.10 Relay, PID Control Mode

ONLY AVAILABLE IF CONTROLLER INCLUDES PULSE OUTPUT HARDWARE

The PID algorithm controls a solid state relay using standard Proportional-Integral-Derivative control logic. The algorithm provides feedback control based on an error value continuously calculated as the difference between a measured process variable and a desired set point. Tuning settings specify the response for proportional (the size of the error), integral (the time that the error has been present), and derivative (the rate of change for the error) parameters. With proper tuning, the PID control algorithm can hold the process value close the set point while minimizing overshoot and undershoot.

Normalized Error

The error value versus set point that is calculated by the controller is normalized and represented as percent of full scale. As a result, tuning parameters entered by the user are not dependent upon the scale of the process variable and the PID response with similar settings will be more consistent even when using different types of sensor inputs.

The scale used to normalize the error is dependent upon the type of sensor selected. By default, the full nominal range of the sensor is used. This range is editable by the user if tighter control is desired.

PID Equation Formats

The controller supports two different forms of the PID equation as specified by the Gain Form setting. The two forms require different units for entry of the PID tuning parameters.

Standard

The standard form is more commonly used in industry because its time-based settings for the integral and derivative coefficients are more meaningful. This form is selected by default.

Parameter	Description	Units
K_p	Gain	unitless
T_i	Integral Time	seconds or seconds/repeat
T_d	Derivative Time	seconds

$$Output (\%) = K_p \left[e(t) + \frac{1}{T_i} \int e(t) dt + T_d \frac{de(t)}{dt} \right]$$

Parameter	Description	Units
e(t)	Current Error	% of full scale
dt	Delta Time Between Readings	seconds
de(t)	Difference Between Current Error & Previous Error	% of full scale

Parallel

The parallel form allows the user to enter all parameters as Gains. In all cases, larger gain values result in faster output response.

Parameter	Description	Units
K _p	Proportional Gain	unitless
K _i	Integral Gain	1/seconds
K _d	Derivative Gain	seconds

$$Output (\%) = K_p e(t) + K_i \int e(t) dt + K_d \frac{de(t)}{dt}$$

Integral Value Management

To determine the integral component of the PID calculation, the controller software must maintain a running total of the accumulated area under the error curve (Current Integral). The sign of the value added to the accumulated Current Integral during each cycle may be positive or negative based on the current Direction setting as well as the relative values of the current process reading and the set point.

Override Control

The Current Integral accumulates when the output is set to Auto mode. If the controller is switched to Off mode, the value no longer accumulates, but it is not cleared. Therefore, PID control will resume where it left off if the controller is switched from Off back to Auto. Similarly, accumulation of the Control Integral will be suspended if the output is interlocked and resume after the lock-out is removed.

Bumpless Transfer

When the output is switched from Hand to Auto mode, the controller calculates a value for the Current Integral using the current error to generate the same output percent as the Hand Output setting. This calculation does not use the Derivative tuning setting to minimize errors from momentary fluctuations in the input signal. This feature ensures a smooth transition from manual to automatic control with minimal overshoot or undershoot as long as the user sets the Hand Output percentage close to the value that the process is expected to require for optimal control in Auto mode.

Wind-up Suppression

The Current Integral value that is accumulating while the output is set to Auto can become very large or very small if the process value remains on the same side of the set point for a prolonged period of time. However, the controller may not be able to continue to respond if its output is already set to the minimum or maximum limits (0-100% by default). This condition is referred to as Control Wind-Up and can result severe overshoot or undershoot after a prolonged upset has ended.

For example, if the process value remains far below the set point despite a control output being pinned at 100%, the Current Integral will continue to accumulate errors (wind-up). When the process value finally rises to above the set point, negative errors will begin to decrease the Current Integral value. However, the value may remain large enough to keep the output at 100% long after the set point is satisfied. The controller will overshoot the set point and the process value will continue to rise.

To optimize system recovery after wind-up situations, the controller suppresses updates to the Current Integral that would drive the output beyond its minimum or maximum limit. Ideally, the PID parameters will be tuned

and the control elements (pump, valves, etc.) will be sized properly so that the output never reaches its minimum or maximum limit during normal control operations. But with this wind-up suppression feature, overshoot will be minimized should that situation occur.

Output Details

The details for this type of output include the pulse rate in %, HOA mode or Interlock status, input value, current integral, current and accumulated on-times, alarms related to this output, relay type, and the current control mode setting.

Set Point	Numeric entry of a process value used as a target for PID control. The default value, units and display format (number of decimal places) used during data entry are defined based on the Input channel setting selected.
Gain	When the Gain Form setting is Standard, this unitless value is multiplied by the total of the proportional, integral, and derivative terms to determine the calculated output percent.
Proportional Gain	When the Gain Form setting is Parallel, this unitless value is multiplied by the normalized error (current process value versus set point) to determine the proportional component of the calculated output percent.
Integral Time	When the Gain Form setting is Standard, this value is divided into the integral of the normalized error (area under the error curve), then multiplied by the Gain to determine the integral component of the calculated output percent.
Integral Gain	When the Gain Form setting is Parallel, this value is multiplied by the integral of the normalized error (area under the error curve) to determine the integral component of the calculated output percent.
Derivative Time	When the Gain Form setting is Standard, this value is multiplied by the change in error between the current reading and the previous reading, then multiplied by the Gain to determine the derivative component of the calculated output percent.
Derivative Gain	When the Gain Form setting is Parallel, this value is multiplied by the change in error between the current reading and the previous reading to determine the derivative component of the calculated output percent.
Reset PID Integral	The PID Integral Value is a running total of the accumulated area under the error curve (Current Integral). When this menu option is selected, this total is set to zero and the PID algorithm is reset to its initial state.
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 – 480 pulse/minute range).
Input	Select the sensor to be used by this relay
Direction	Set the control direction. This setting is used to determine the sign of the calculated error (current process value versus set point) and allows flexible control with only positive values for all PID tuning parameters.
Input Minimum	The low end of the sensor input range, used to normalize errors into percent of full scale units. These values are set to the nominal range of the selected input sensor by default.
Input Maximum	The high end of the sensor input range, used to normalize errors into percent of full scale units. These values are set to the nominal range of the selected input sensor by default.
Gain Form	Select the PID Equation Format used to enter tuning parameters.

5.3.11 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, alarms related to this output, current cycle on time, relay type and the current control mode setting.

Settings

Touch the Settings icon to 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.
Duty Cycle Period	Using a duty cycle helps to prevent overshooting the set point in applications where the response of the sensor to chemical additions is slow. Specify the amount of time for the cycle, and the percentage of that cycle time that the relay will be active. The relay will be off for the rest of the cycle, even if the set point has not been satisfied. Enter the length of the duty cycle in minutes:seconds in this menu. Set the time to 00:00 if use of a duty cycle is not required.
Duty Cycle	Enter the percentage of the cycle period that the relay will be active. Set the percentage to 100 if use of a duty cycle is not required.
On Delay Time	Enter the delay time for relay activation in hours:minutes:seconds. Set the time to 00:00:00 to immediately activate the relay.
Off Delay Time	Enter the delay time for relay deactivation in hours:minutes:seconds. Set the time to 00:00:00 to immediately deactivate the relay.
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.

5.3.12 Relay, Timer Control Mode

Basic Timer Operation

When a timer event triggers the algorithm will activate the relay for the programmed time.

Special Condition Handling

Overlapping timer events

If a second timer event occurs while the first one is still active, the second event will be ignored. An Event Skipped alarm will be set.

Interlock Conditions

Interlocks override the relay control, but do not change the operation of the timer control.

A digital input or output interlock condition does not delay the relay activation. The relay activation duration timer will continue even if the relay is deactivated due to an interlock condition. This will prevent delayed events which can potentially cause problems in they do not occur at the correct time.

“Activate With” Conditions

“Activate with channels” settings override the relay control, but do not change the operation of the timer control. The relay activation duration timer continues counting when the timer relay is forced on, and ends at the expected time (event start time plus duration). If the “activate with” condition continues after the end of the event time, the relay remains activated.

Alarms

An Event Skipped alarm is set when a second timer event occurs while one event is still running.

An Event Skipped alarm is also set when the timer relay never turns on during an event because of an interlock condition.

The alarm is cleared when the relay is next activated for any reason (the next timer event or HAND mode or “activate with” force on condition).

Output Details

The details for this type of output include the relay on/off state, HOA mode or Interlock status, accumulated on-time, alarms related to this output, current cycle on time, relay type and the current control mode setting. The current week number and day of the week 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 timer cycle.

Settings

Touch the Settings icon to view or change the settings related to the relay.

Event 1 (through 10)	Enter these menus to program timer events via the menus below:
Repetition	Select the time cycle to repeat the event: Hourly, 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.
Week	Only appears if Repetition is longer than 1 Week. Select the week during which the event will occur.
Day	Only appears if Repetition is longer than Daily. Select the day of the week during which the event will occur.
Events Per Day	Only appears if Repetition is Hourly. Select the number of events per day. The events occur on the Start Time and then evenly spaced throughout the day.
Start Time	Enter the time of day to start the event.
Duration	Enter the amount of time that the relay will be on.
Add Last Missed	Select Enabled if the controller should delay start the most recent timer cycle until immediately after an Interlock clears, or Disabled if all events should be skipped if there is an Interlock condition at the time the add was due to start.

5.3.13 Relay, Probe Wash Control Mode

Basic Timer Operation

When a Probe Wash event triggers, the algorithm will activate the relay for the programmed time. The relay will activate a pump or valve to supply a cleaning solution to the sensor or sensors. The output of the selected sensors will either be held or disabled during the cleaning cycle, and for a programmable hold time after the cleaning cycle.

Special Condition Handling

Overlapping timer events

If a second timer event occurs while the first one is still active, the second event will be ignored. An Event Skipped alarm will be set.

Interlock Conditions

Interlocks override the relay control, but do not change the operation of the timer control.

A digital input or output interlock condition does not delay the relay activation. The relay activation duration timer will continue even if the relay is deactivated due to an interlock condition. This will prevent delayed events which can potentially cause problems in they do not occur at the correct time.

“Activate With” Conditions

“Activate with channels” settings override the relay control, but do not change the operation of the timer control. The relay activation duration timer continues counting when the timer relay is forced on, and ends at the expected time (event start time plus duration). If the “activate with” condition continues after the end of the event time, the relay remains activated.

Alarms

An Event Skipped alarm is set when a second timer event occurs while one event is still running.

An Event Skipped alarm is also set when the timer relay never turns on during an event because of an interlock condition.

The alarm is cleared when the relay is next activated for any reason (the next timer event or HAND mode or “activate with” force on condition).

Output Details

The details for this type of output include the relay on/off state, HOA mode or Interlock status, accumulated on-time, alarms related to this output, current cycle on time, relay type and the current control mode setting. The current week number and day of the week 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 timer cycle.

Settings

Touch the Settings icon to view or change the settings related to the relay.

Event 1 (through 10)	Enter these menus to program timer events via the menus below:
Repetition	Select the time cycle to repeat the event: Hourly, 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.
Week	Only appears if Repetition is longer than 1 Week. Select the week during which the event will occur.
Day	Only appears if Repetition is longer than Daily. Select the day of the week during which the event will occur.
Events Per Day	Only appears if Repetition is Hourly. Select the number of events per day. The events occur on the Start Time and then evenly spaced throughout the day.
Start Time	Enter the time of day to start the event.
Duration	Enter the amount of time that the relay will be on.
Input	Select the sensor that will be washed.
Input 2	Select the second sensor, if applicable, that will be washed.
Sensor Mode	Select the effect that the probe wash event will have on any control outputs that use the sensor(s) being washed. The options are to either Disable the sensor readings (turn the control output off) or Hold the sensor reading at the last valid sensor reading prior to the start of the probe wash event.
Hold Time	Enter the amount of time needed to hold the sensor reading after the event has finished, in order for the wash solution to be replaced by process solution.

5.3.14 Relay, Spike Control Mode

Basic Timer Operation

This algorithm is typically used to provide a baseline amount of chlorine for disinfection, and periodically shocking the system with a larger dose. During normal operation, the relay will be reacting to sensor to maintain a set point within a programmable Deadband, as described in On/Off Control Mode above. When a Spike event triggers, the algorithm will change from the normal set point to the Spike Set Point, and once it reaches that set point, maintains it for the programmed time. Once the time expires, control to the normal set point resumes.

Special Condition Handling

Overlapping timer events

If a second timer event occurs while the first one is still active, the second event will be ignored. An Event Skipped alarm will be set.

Interlock Conditions

Interlocks override the relay control, but do not change the operation of the timer control.

A digital input or output interlock condition does not delay the relay activation. The relay activation duration timer will continue even if the relay is deactivated due to an interlock condition. This will prevent delayed events which can potentially cause problems if they do not occur at the correct time.

“Activate With” Conditions

“Activate with channels” settings override the relay control, but do not change the operation of the timer control. The relay activation duration timer continues counting when the timer relay is forced on, and ends at the expected time (event start time plus duration). If the “activate with” condition continues after the end of the event time, the relay remains activated.

Alarms

An Event Skipped alarm is set when a second timer event occurs while one event is still running.

An Event Skipped alarm is also set when the timer relay never turns on during an event because of an interlock condition.

The alarm is cleared when the relay is next activated for any reason (the next timer event or HAND mode or “activate with” force on condition).

Output Details

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

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.
Spike Set point	Enter the sensor process value at which the relay will activate during the Spike Event time.
Deadband	Enter the sensor process value away from the set point at which the relay will deactivate. The same Deadband is used for the normal Set Point and the Spike Set Point.
Onset Time	The onset time determines when the duration timer starts. If set to zero, the duration time starts immediately. If set higher than that, the controller will not start the duration timer until the spike set point is achieved, or until the onset time is over, whichever comes first.
Duty Cycle Period	Using a duty cycle helps to prevent overshooting the set point in applications where the response of the sensor to chemical additions is slow. Specify the amount of time for the cycle, and the percentage of that cycle time that the relay will be active. The relay will be off for the rest of the cycle, even if the set point has not been satisfied. Enter the length of the Duty Cycle Period in minutes:seconds in this menu. Set the time to 00:00 if use of a duty cycle is not required.
Duty Cycle	Enter the percentage of the cycle period that the relay will be active. Set the percentage to 100 if use of a duty cycle is not required.
Event 1 (through 8)	Enter these menus to program spike events via the menus below:
Repetition	Select the time cycle to repeat the 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.

Week	Only appears if Repetition is longer than 1 Week. Select the week during which the event will occur.
Day	Only appears if Repetition is longer than Daily. Select the day of the week during which the event will occur.
Start Time	Enter the time of day to start the event.
Duration	Enter the amount of time that the relay will be on.
Input	Select the sensor to be used by this relay.
Direction	Select the control direction.

5.3.15 Relay, or Analog Output, Lag Control Mode

Overview

The Lead Lag control mode allows a group of outputs to be controlled by a single control algorithm using a variety of configurations. The control mode support backup pumps operation, alternate pump with wear leveling, and the activation of additional outputs after a time delay, or based on alternate set points, or based on digital state changes.

A Lead Lag group consists of a single Lead output and one or more Lag outputs. The Lead output can be set to any control mode. The new Lag control mode can be selected for any number of additional outputs (limited only by the number of outputs available within the controller). A setting for each Lag output allows selection of a Lead output that is used to create an ordered group of Lead Lag relays.

Example: R1 is an On/Off relay, R2 is set for Lag mode with a Lead output of R1. R3 is set as an additional Lag mode relay with a Lead output of R2, thus creating an ordered chain of three relays in the Lead Lag group (R1←R2←R3). After the group is defined, the Lead output (R1) operates with the standard On/Off Control functionality. The last Lag mode relay in the chain (R3) offers various settings that are used to define the desired control operations for the entire Lead Lag group. Selectable Lead Lag control options include backup, wear leveling, and/or activating additional outputs based on various criteria.

Backup Pump Control

By default, Lead Lag groups always provide backup operation if the Lead control mode determines that its output should be energized but it is disabled due to a Flow Verify alarm and/or because the Lead output HOA setting is Off or Hand (not in Auto mode).

Wear Leveling Modes

The order of Lead and Lag output activation can be changed based on configurable wear leveling modes. This option is intended to allow users to manage the usage of primary and secondary pumps within a system. One wear leveling mode selects a different output each time the group is activated. Additional modes vary the activation of the pumps within the group based on the time-on for each output, with the intent to either balance the usage of each pump or to energize the primary output most often and periodically exercise auxiliary pumps to insure proper operation when they are needed.

Output Activation Modes

Depending on the control mode selected for the Lead output, Lag output(s) can be configured for activation of additional outputs based on one or more of the following criteria:

On-time (for example, energize a second relay 10 minutes after the primary relay is turned on)

Control set points (for example, energize a second relay if the pH continues to rise)

Switch change (for example, energize a second pump to maintain a tank level when the low-low level switch opens)

Control Operation

Backup Pump Control

The default control operation for the Lead Lag group is that if a condition exists that prevents one relay from being activated, it is skipped and the next output in the group is turned on instead. This situation may occur if the output is experiencing an active Flow Verify alarm or the output is not in Auto mode. Backup control using a Lag output does not require any additional settings and could be used to create an output for a backup pump to be activated only if the main pump loses prime and/or is taken out of service for maintenance.

Example: A Lead Lag group consisting of R1, R2 & R3 is configured (R1←R2←R3). All three pumps have PosiFlow monitors wired to inputs D1, D2 & D3, respectively. R1 uses On/Off mode to control caustic feed to maintain a pH set point above 7.0. R1 and R3 pumps are in Auto mode, R2 pump has been taken out of service for maintenance and is currently in HOA Off mode. The process pH falls below 7.0 and R1 is energized. Before the pH rises to satisfy the dead band, the D1 PosiFlow input monitors an error condition and activates a Flow Verify alarm for the R1 pump. The Lead Lag system de-energizes R1 and checks the status of R2. Because R2 is not in service, R3 is energized to maintain caustic feed.

Each digital input channel set up as a Feed Monitor type has a Flow Alarm Mode setting used to specify how the pump output is handled when Flow Verify alarms are identified. Based on this setting, the Lead Lag group responds as follows:

Disabled	The Flow Verify alarm is never activated and the Lead Lag group is not affected by the status of the PosiFlow input.
Interlock	When a Flow Verify alarm is activated, the related output is immediately turned off; if available, other outputs in the Lead Lag group are activated instead.
Maintain	When a Flow Verify alarm is activated, other outputs in the Lead Lag group are activated instead if they are available; if no other outputs are available, or if additional outputs are required due to Output Activation Mode settings, output(s) reporting a Flow Verify alarm may still be activated as a last resort.

Wear Leveling Modes

After the Lead Lag group is defined, additional parameters can be configured within the settings list of the last output in the group. These options optimize the behavior of the Lead Lag functionality. Several different wear leveling options can be selected to control the order in which outputs are activated.

Disabled

The order in which the Lead and Lag outputs turn on does not change automatically. They are always energized in the same order.

Duty Based

The order in which outputs are activated changes every time the Lead output is activated. How long each individual pump has been running is not considered.

Example: When the Lead output, set for On/Off control, drops below the setpoint, R1 is activated. R1 turns off after its deadband is satisfied. The next time the measurement goes below the setpoint, R2 is activated and R1 remains off. After all outputs in the group have been exercised for one feed cycle, the process begins again with the first output (R1).

Time Balanced

Time balanced mode alternates outputs in a manner that equalizes the runtime of all connected pumps. This mode takes into account how long each output in the Lead Lag group has been running (since a manual reset) and selects the output that has the lowest on-time during each cycle. If the output remains energized longer than the specified cycle time, the time-on for each output is recalculated and a different output may be activated to balance the usage of each.

Example: In a two-pump Lead Lag group, time balanced wear leveling is selected with a cycle time of 2 hours. When the Lead control mode (R1) determines the output should be activated, R2 turns on because it has the lowest accumulated on-time. After 2 hours, if the output remains activated, the on-times are re-evaluated and R2 turns off and R1 turns on because it now has the least accumulated total on time. The cycle continues until the Lead control mode determines the feed is complete.

Time Unbalanced

This wear leveling mode improves fault-tolerance of the group by varying the wear on each pump by activating each pump for a different percentage of time. In this mode, a primary output is activated most of the time and secondary (auxiliary) output(s) are activated for a smaller percentage of the total output on-time. This strategy can be useful to ensure that a backup pump is exercised sufficiently so that it will be functional when needed, but does not wear at the same rate as the primary pump to minimize the chances of both pumps failing at the same time. When one Lag pump is defined within the Lead Lag group, the Lead pump runs 60% of the time and the Lag pump runs 40%. If more than two (2) pumps are defined for the group, fixed ratios are used to insure all pumps are exercised periodically and wear at different rates, as shown in the chart.

Percent On	Number of Relays				
Relay	2	3	4	5	6
1	60.0%	47.4%	41.5%	38.4%	36.5%
2	40.0%	31.6%	27.7%	25.6%	24.4%
3		21.1%	18.5%	17.1%	16.2%
4			12.3%	11.4%	10.8%
5				7.6%	7.2%
6					4.8%

Output Activation Modes

Depending on the current control mode selection for the Lead output, additional settings may be available within the settings list of the last output in the group to provide additional option(s) to optimize the behavior of the Lead Lag functionality. Several different activation modes can be selected to control the status of additional output(s) based on either elapsed time, alternate setpoints, and/or alternate switch inputs.

Disabled

No action is taken to activate more than one output within the Lead Lag group of outputs. This mode is used when a group of Lead Lag outputs exists only to provide backup in case of a **Flow Verify** failure on one of the pumps, or if a pump is taken out of service, and/or if only wear leveling is desired.

Time Based

Lag outputs are activated following the Lead output after a user-settable delay. The same delay value is used for all outputs. This menu selection is available only when the Lead output is using On/Off, Dual Setpoint, Spike or Manual control modes.

Example: If the Lead output is set to Manual, this control option could be used to force on the output based on a digital input signal (e.g., level switch). If the level switch remains open for more than the specified delay time, the second output in the Lead Lag group is energized. If another delay time elapses, a third output (if available) is also turned on.

In On/Off, Dual Setpoint, or Spike control modes, additional pump(s) are energized if the process value remains outside the setpoint range for more than the specified delay time.

Example: In a two-output Lead Lag group (R1←R2), the Lead (R1) output, set for Dual Setpoint control, is programmed to energize its output when the D.O. reading is outside the 4.0-4.5 ppb control range with a deadband of 0.1 ppb. Time based output activation is selected with a delay time of 15 minutes. When the D.O. value falls below 4.0 ppb, R1 is activated. After 15 minutes, if the D.O. has not risen to 4.1 ppb or higher, R2 will also be activated. When the process value reaches 4.1 ppb, both outputs are turned off.

Setpoint Based

Each Lag output has its own setpoint(s) and deadband when this option is selected. The setpoints for each output in the Lead Lag group are evaluated individually and outputs are added as needed based on the current process value. Setpoint based activation mode also incorporates time based activation and can also be configured to trigger an additional pump (if available) after a specified delay time. This menu selection is available only when the Lead output is using On/Off or Dual Setpoint control modes.

Example 1: The Lead output (R1) is set for On/Off control of pH with a setpoint of 8.50, a deadband of 0.20 and a “force lower” control direction. The first Lag output (R2) has a setpoint of 9.00 and a deadband of 0.20. The second Lag output (R3) has a setpoint of 9.50 and a deadband of 0.20. The delay time is disabled (set for 0:00 minutes). Wear leveling is disabled. When the pH goes above 8.50, R1 energizes. If the pH proceeds to exceed 9.00, R2 energizes. And if the pH rises above 9.50, R3 energizes. When the pH decreases to below 9.30, R3 goes off. When the pH falls to below 8.80, R2 goes off. And finally, when the pH decreases to below 8.30, R1 is turned off.

Example 2: The same three-pump configuration (R1←R2←R3) as in Example 1 except the delay time is set for 30 minutes. When the pH goes above 8.50, R1 energizes. If 30 minutes passes before the pH exceeds 9.00 or drops below 8.30, R1 remains on and R2 is energized. If the pH then rises above 9.00, the next output in the group, R3, is energized. If the pH continues to rise and exceeds 9.50, no additional action is possible. When the pH decreases to below 8.80, R3 goes off. When the pH falls to below 8.30, both R1 and R2 are turned off.

This control is very similar to the operation if three (3) separate On/Off control outputs are configured all with the pH as Input and using the setpoints listed above. However, the Lead Lag option improves on this control by incorporating backup pump controls and optional time based activation. If the pH rises above 8.50 when pump R1 has an active **Flow Verify** alarm or is in HOA Off mode, pump R2 immediately energizes. R3 energizes when the pH goes above 9.00. Although no third pump is available to activate if the pH continues to rise above 9.50, this control system is more fault tolerant than the currently available options.

Switch Based

When using switch based activation mode, each Lag output has an Activate With Channels setting that is used to specify one or more digital input or relay output channels that activates an additional output. Switch based activation mode incorporates time based activation and can also be configured to trigger an additional output (if available) after a specified delay time. This menu selection is available only when the Lead output is using Manual control mode.

Example 1: A lift station includes a tank with a high level switch (D1) and a high-high level switch (D2). Three pumps are configured as a Lead Lag group (R1←R2←R3). The Lead output (R1) is set for Manual control mode with an Activate With Channels selection of D1 (high level switch), R1 will be energized if D1 closes. The first Lag output (R2) has an Activate With Channels selection of D2 (high-high level switch). The last Lag output (R3) has no Activate With Channels selected. All pumps are in HOA Auto mode. The delay time is disabled (set for 0:00 minutes). Wear leveling is disabled. When the high level switch closes, the R1 pump is activated. If the high-high level switch closes, the R2 pump is also activated. When D2 opens, R2 is turned off. When D1 opens, R1 is turned off. In this configuration, the R3 pump serves only as a backup in case one of the pumps is down for maintenance (in HOA Off mode).

Example 2: The same lift station, two-level switches, three-pump configuration (R1←R2←R3) as in Example 1 except the delay time is set for 1 hour. When the high level switch closes, the R1 pump is activated. If the high-high level switch closes, the R2 pump is also activated. If the tank level remains above the high-high level switch for another 1 hour, the R3 pump is activated. When D2 opens, R3 is turned off. When D1 opens, both R2 and R1 are turned off. In this configuration, the R3 pump serves not only as a backup in case one of the pumps is down for maintenance, but also provides additional capacity should it be needed.

Advanced Functionality

The examples listed above detail the control behavior if wear leveling or output activation modes are enabled. The features are implemented independently. Wear Leveling modes are used to determine which output(s) are activated. Output Activation modes determine how many output(s) are activated at one time. More advanced output control strategies can be implemented when these features are used in combination.

Example: In a two-pump scenario, the Lead output (R1) is set for On/Off control of pH with a setpoint of 8.50, deadband of 0.20 and a “force lower” control direction. The Lag output (R2) has a setpoint of 9.00 and a deadband of 0.20. Time unbalanced (80/20) wear leveling is selected with a cycle time of 15 minutes. When the pH

goes above 8.50, the on-times for each pump are evaluated. If R1 has been on less than 80% of the total time for the two pumps, it is energized. Otherwise, R2 has been on for less than 20% of the total time, so it is energized. If the pH remains above the deadband and does not exceed the second setpoint ($8.30 < \text{pH} < 9.00$), the pump selection is re-evaluated every 15 minutes and, if warranted, the pump in operation is switched. If the pH proceeds to exceed 9.00, both pumps are energized and wear leveling is no longer a consideration. When the pH fails to below 8.80, the pump on-times are again evaluated and the appropriate pump is turned off.

Note that while this control is quite powerful, it might cause confusion with users because the setpoints entered for a specific pump within the Lead Lag group may not coincide with the setpoints used to activate that particular pump during operation. The information shown on the Details pages for each pump should be sufficient to minimize this ambiguity.

Control Mode Conflicts

Some control modes are incompatible with Lag output functionality because of an interactive relationship between the output and one or more linked inputs:

- Intermittent Sampling – This control mode places a linked sensor into a Hold state during most of its operational cycle
- Probe Wash – This control mode places one or two linked sensors into a Hold state when a wash cycle is in progress and for a specified Hold period afterward

The link between the output and the sensor input(s) cannot be easily transferred to other outputs, so these types of control modes cannot be designated as Lead output for a Lead Lag group. Outputs configured with these types of control modes are not included on the selection list presented for Lead output. Also, the control mode of an output that is the Lead output for a Lead Lag group cannot be changed to one of these types. If selected, the controller will be unable to save the change and an error message will be added to system log.

Output Details

The details for this type of output include the relay on/off state, relay status (HOA mode, Interlock from sensor calibration, probe wash, or other condition), the current cycle and the total on-times, alarms related to this output, the output defined as the Lead of the group, the output that is the Last Lag output of the group, the number of outputs currently energized within the group, the elapsed time since the last change in the number of outputs energized, the elapsed time since the last wear leveling evaluation, the type of output, and the current control mode setting.

Settings

Touch the Settings icon to view or change the settings related to the relay.

The Lag control mode output defined as the Last Lag within the Lead Lag group offers settings to define the parameters controlling operation of the entire group.

All Lag mode outputs that are not the Last Lag output in the Lead Lag group (those that are selected as a Lead output from another Lag mode output) offer a more limited list of settings.

Lag Settings (Menus with * are shown only in the Last Lag output settings)

HOA Setting	Select Hand, Off or Auto mode by touching the desired mode
Lead	Select the output that will be the lead output for this relay
Wear Leveling*	Select the wear leveling scheme to use. Refer to the detailed description above.
Wear Cycle Time*	This setting only appears if Time Balanced or Time Unbalanced Wear Leveling has been selected above. Enter the amount of elapsed time before time on totals for each output are reevaluated for wear leveling.
Activation Mode*	This entry is only appears if the control mode of the Lead output is On/Off, Dual Setpoint, Spike or Manual. Select one of the options that will determine if and when an additional output will be activated if the primary output is unable to reach the setpoint.

Set point	This setting only appears if the control mode of the Lead output is On/Off or Dual Setpoint and the Activation Mode above is Setpoint Based. Enter the process value for the input assigned to the Lead output that will trigger an additional output to activate.
Set point 2	This setting only appears if the control mode of the Lead output is Dual Setpoint and the Activation Mode above is Setpoint Based. Enter the process value for the input assigned to the Lead output that will trigger an additional output to activate.
Deadband	This setting only appears if the control mode of the Lead output is On/Off or Dual Setpoint and the Activation Mode above is Setpoint Based. Enter the sensor process value away from the set point(s) at which the relay will deactivate.
Delay Time*	This setting only appears if the control mode of the Lead output is On/Off, Dual Setpoint, Spike or Manual. Enter the amount of time, if any, to delay the activation of the output.
Activate With Channels	This setting only appears if the control mode of the Lead output is Manual and the activation mode is Switch Based. Select one or more digital input and/or relay output channels that, if activated, will also activate the Lag output
Reset Time Total	Enter this menu to clear the accumulated time that the output has been activated . This value is used for Time Balanced or Time Unbalanced wear leveling.
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.
Name	The name used to identify the relay may be changed.
Mode	Select the desired control mode for the output.

Several standard settings that are available for most control modes are not available for Lag outputs. These features affect the entire Lead Lag group and can be specified only within the Lead output's settings. The settings for these fields are propagated down through the entire Lead Lag group when changed for the Lead output. Although the settings for these fields are identical for all outputs in the Lead Lag group, the handling by each Lag output may be independent or group-managed.

Below are the settings that are in the Lead Relay settings that will affect the Lead Lag group:

Interlock Channels	Select the relays and digital inputs that will interlock this relay and all others in the group.
Min Relay Cycle	Enter the number of seconds that will be minimum amount of time that each relay in the group will be in the active or inactive state. Normally this will be set to 0, but if using a motorized ball valve that takes time to open and close, set this high enough that the valve has time to complete its movement.
Hand Time Limit	Enter the amount of time that each relay in the group will activate for when it is in Hand mode.
Hand Output	This menu only appears for pulse relay or analog output Lead outputs. Enter the output % desired for each output in the group when the output is in Hand mode.

Off Mode Output	This menu only appears for analog output Lead outputs. Enter the output mA value desired for each output in the group 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	This menu only appears for analog output Lead outputs. Enter the output mA desired for each output in the group when the sensor is not giving the controller a valid signal. The acceptable range is 0 to 21 mA.

The **Activate With Channels** setting, normally available for all outputs, is **not** propagated through the Lead Lag group. This field can be entered independently for each Lag Output when the control mode of the Lead output is Manual and the activation mode is Switch Based.

Most other settings for the various types of Lead control modes are managed independently from other outputs within a Lead Lag group. In most cases, no **Activation Mode** settings are available, so the Lead output determines the status for the entire group based on its settings and the current controller parameters. However, when an Activation Mode is enabled, the handling of some settings may require some additional explanation. For example,

- **Duty Cycle** - If a Lead output with a control mode of On/Off or Dual Setpoint has a Duty Cycle setting of less than 100%, this cycle will be managed for the Lead output only. The Duty Cycle will drive other Lag outputs for Backup or Wear Leveling purposes. However, if additional Lag Output(s) are energized due to Setpoint-Based or Time-Based Activation Mode settings, the additional outputs will operate independently of the Duty Cycle setting. The Lead output will continue to cycle On and Off, however, the additional outputs will remain activated with 100% duty cycle until the setpoint deadband is satisfied.
- **On Delay / Off Delay** - If the Lead output with a control mode of On/Off, Dual Setpoint, or Manual has either an On or Off Delay Time setting specified, the delay will be managed for the Lead output only. If one or more Lag outputs provide Backup or Wear Leveling support, the Delay Times would also effect these outputs. However, if additional Lag Output(s) are energized due to Activation Mode settings, the additional outputs will operate independently of the On or Off Delay Time setting(s) and will energize and de-energize without delay when needed.

5.3.16 Relay or Analog Output, Lag Control Mode

Output Details

The details for this type of output include the output %, HOA mode or Interlock status, accumulated on-time, alarms related to this output, current cycle on time, relay type and the current control mode setting.

Settings

Touch the Settings icon to view or change the settings related to the relay.

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.
Error Output	Enter the output % desired when the input signal is invalid (Error mode).
Input	Select the sensor input to retransmit.

5.3.17 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, alarms related to this output, current cycle on time, relay type and the current control mode setting.

Settings

Touch the Settings icon to view or change the settings related to the relay.

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.
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.
Input	Select the sensor input to use for proportional control.
Direction	Select the control direction.

5.3.18 Analog Output, PID Control Mode

The PID algorithm controls an analog (4-20 mA) output using standard Proportional-Integral-Derivative control logic. The algorithm provides feedback control based on an error value continuously calculated as the difference between a measured process variable and a desired set point. Tuning settings specify the response for proportional (the size of the error), integral (the time that the error has been present), and derivative (the rate of change for the error) parameters. With proper tuning, the PID control algorithm can hold the process value close the set point while minimizing overshoot and undershoot.

Normalized Error

The error value versus set point that is calculated by the controller is normalized and represented as percent of full scale. As a result, tuning parameters entered by the user are not dependent upon the scale of the process variable and the PID response with similar settings will be more consistent even when using different types of sensor inputs.

The scale used to normalize the error is dependent upon the type of sensor selected. By default, the full nominal range of the sensor is used. This range is editable by the user if tighter control is desired.

PID Equation Formats

The controller supports two different forms of the PID equation as specified by the Gain Form setting. The two forms require different units for entry of the PID tuning parameters.

Standard

The standard form is more commonly used in industry because its time-based settings for the integral and derivative coefficients are more meaningful. This form is selected by default.

Parameter	Description	Units
K_p	Gain	unitless
T_i	Integral Time	seconds or seconds/repeat
T_d	Derivative Gain	seconds

$$Output (\%) = K_p \left[e(t) + \frac{I}{T_i} \int e(t) dt + T_d \frac{de(t)}{dt} \right]$$

Parameter	Description	Units
$e(t)$	Current Error	% of full scale

dt	Delta Time Between Readings	seconds
de(t)	Difference Between Current Error & Previous Error	% of full scale

Parallel

The parallel form allows the user to enter all parameters as Gains. In all cases, larger gain values result in faster output response. This form is used in the WebMaster controller and is used internally by the Control Module.

Parameter	Description	Units
K_p	Proportional Gain	unitless
K_i	Integral Gain	1/ seconds
K_d	Derivative Gain	seconds

$$Output (\%) = K_p e(t) + K_i \int e(t)dt + K_d \frac{de(t)}{dt}$$

Integral Value Management

To determine the integral component of the PID calculation, the controller software must maintain a running total of the accumulated area under the error curve (Current Integral). The sign of the value added to the accumulated Current Integral during each cycle may be positive or negative based on the current Direction setting as well as the relative values of the current process reading and the set point.

Override Control

The Current Integral accumulates when the output is set to Auto mode. If the controller is switched to Off mode, the value no longer accumulates, but it is not cleared. Therefore, PID control will resume where it left off if the controller is switched from Off back to Auto. Similarly, accumulation of the Control Integral will be suspended if the output is interlocked and resume after the lock-out is removed.

Bumpless Transfer

When the output is switched from Hand to Auto mode, the controller calculates a value for the Current Integral using the current error to generate the same output percent as the Hand Output setting. This calculation does not use the Derivative tuning setting to minimize errors from momentary fluctuations in the input signal. This feature ensures a smooth transition from manual to automatic control with minimal overshoot or undershoot as long as the user sets the Hand Output percentage close to the value that the process is expected to require for optimal control in Auto mode.

Wind-up Suppression

The Current Integral value that is accumulating while the output is set to Auto can become very large or very small if the process value remains on the same side of the set point for a prolonged period of time. However, the controller may not be able to continue to respond if its output is already set to the minimum or maximum limits (0-100% by default). This condition is referred to as Control Wind-Up and can result severe overshoot or undershoot after a prolonged upset has ended.

For example, if the process value remains far below the set point despite a control output being pinned at 100%, the Current Integral will continue to accumulate errors (wind-up). When the process value finally rises to above the set point, negative errors will begin to decrease the Current Integral value. However, the value may remain large enough to keep the output at 100% long after the set point is satisfied. The controller will overshoot the set point and the process value will continue to rise.

To optimize system recovery after wind-up situations, the controller suppresses updates to the Current Integral that would drive the output beyond its minimum or maximum limit. Ideally, the PID parameters will be tuned and the control elements (pump, valves, etc.) will be sized properly so that the output never reaches its minimum or maximum limit during normal control operations. But with this wind-up suppression feature, overshoot will be minimized should that situation occur.

Output Details

The details for this type of output include the analog output value in %, HOA mode or Interlock status, input value, current integral, current and accumulated on-times, alarms related to this output, and the current control mode setting.

Set Point	Numeric entry of a process value used as a target for PID control. The default value, units and display format (number of decimal places) used during data entry are defined based on the Input channel setting selected.
Gain	When the Gain Form setting is Standard, this unitless value is multiplied by the total of the proportional, integral, and derivative terms to determine the calculated output percent.
Proportional Gain	When the Gain Form setting is Parallel, this unitless value is multiplied by the normalized error (current process value versus set point) to determine the proportional component of the calculated output percent.
Integral Time	When the Gain Form setting is Standard, this value is divided into the integral of the normalized error (area under the error curve), then multiplied by the Gain to determine the integral component of the calculated output percent.
Integral Gain	When the Gain Form setting is Parallel, this value is multiplied by the integral of the normalized error (area under the error curve) to determine the integral component of the calculated output percent.
Derivative Time	When the Gain Form setting is Standard, this value is multiplied by the change in error between the current reading and the previous reading, then multiplied by the Gain to determine the derivative component of the calculated output percent.
Derivative Gain	When the Gain Form setting is Parallel, this value is multiplied by the change in error between the current reading and the previous reading to determine the derivative component of the calculated output percent.
Reset PID Integral	The PID Integral Value is a running total of the accumulated area under the error curve (Current Integral). When this menu option is selected, this total is set to zero and the PID algorithm is reset to its initial state.
Minimum Output	Enter the lowest possible output value (normally 0%).
Maximum Output	Enter the highest possible output value as a percentage.
Off Mode Output	Enter the output mA value desired when the output is in Off mode, or being Interlocked, or if the Output Time Limit has expired, or during a calibration of the sensor being used as an input. Also if there is a Probe Wash programmed for the sensor, and the Sensor Mode option is set to Disable the output during the Wash cycle (if the Sensor Mode option is set to Hold the output holds its last setting and the Integral is not updated during the Wash). 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.
Input	Select the sensor to be used by this output.
Direction	Set the control direction. This setting is used to determine the sign of the calculated error (current process value versus set point) and allows flexible control with only positive values for all PID tuning parameters.
Input Minimum	The low end of the sensor input range, used to normalize errors into percent of full scale units. These values are set to the nominal range of the selected input sensor by default.
Input Maximum	The high end of the sensor input range, used to normalize errors into percent of full scale units. These values are set to the nominal range of the selected input sensor by default.
Gain Form	Select the PID Equation Format used to enter tuning parameters.

5.3.19 Analog Output, Manual Mode

Output Details

The details for this type of output include the analog output %, HOA mode or Interlock status, accumulated on-time, alarms related to this output, current cycle on time, and the current control mode setting.

Settings

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

5.3.20 Analog Output, Flow Proportional Mode

Overview

In Flow Proportional control mode, the controller monitors the rate of flow through an analog or digital flow meter, and continuously adjusts the analog (4-20 mA) output proportional band to achieve a target PPM level.

The user enters the target PPM and the data necessary to calculate the proportional band (the water flow rate at which the maximum pulse rate will occur) required to maintain the target PPM with that flow rate of water.

$$\% \text{ output} = \frac{\text{Target PPM} \times \text{Water Flow Rate (liter or gal)}}{\text{Cycles} \times \text{Pump Capacity (liter or gal/hr)} \times \text{Pump Setting (\%)} \times \text{Specific Gravity} \times 166.67}$$

$$\% \text{ output} = \frac{\text{Target PPM} \times \text{Water Flow Rate (m}^3\text{)}}{\text{Cycles} \times \text{Pump Capacity (liter/hr)} \times \text{Pump Setting (\%)} \times \text{Specific Gravity} \times 0.16667}$$

Control Operation

If the output is continuously on for longer than the Output Time Limit, then output will deactivate.

Output Details

The details for this type of output include the output %, HOA mode or Interlock status, alarms related to this output, current cycle on time, total accumulated on-time, mA output, and the current control mode setting.

Settings

Touch the Settings icon to view or change the settings related to the relay.

Target	Enter the desired PPM set point for the product.
Pump Capacity	Enter the maximum flow rate for the metering pump.
Pump Setting	Enter the stroke length setting for the metering pump, in percent.
Specific Gravity	Enter the specific gravity of the product to be added.
Hand Output	Enter the output % desired when the output is in Hand mode.
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.
Flow Input	Select the flow meter to be used as an input for this control relay.
Cycles Input	Select the virtual input that is programmed as a Ratio calculation of the system conductivity/makeup conductivity, or select None.
Low Cycles Limit	Enter the lower limit for cycles of concentration, if used. The calculated on-time is limited to a maximum value if the cycles of concentration gets too low.

5.4 Configuration 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.
Name	Enter the name to help identify the controller when it connects to VTouch.
Location	Enter the location to help identify the controller when it connects to VTouch.
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.
Pump Units	Select between liters/hour, gallons/hour, or ml/minute.
Alarm Delay	Enter how much time to wait after powering up the controller before alarm conditions are considered valid.
Language	Select the language the software will use.

5.4.2 Security Settings

Controller Log Out	When Security is Enabled, and after the password has been entered, the controller requires immediate use of a password to calibrate or change settings. Once finished making changes, log out to prevent unauthorized changes by someone else. 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. In order to enable security, the default password must be entered first, then touch Enabled, then touch the Confirm icon.
Local Password	Used to change the touchscreen password needed for full configuration capability if security has been enabled. The default local password is 5555. This can and should be changed using this menu if Security is enabled.

5.4.3 Network Settings

DHCP Setting	Select Enabled to get an IP address from the LAN or Disabled to use a fixed IP address.
Controller IP Address	Enter the default IP address to use if a network is not available or if DHCP is disabled.
Network Netmask	Enter the default netmask to use if a network is not available or if DHCP is disabled.
Network Gateway	Enter the default gateway address to use if a network is not available or if DHCP is disabled.
DNS Server	Enter the default DNS server IP address to use if DHCP is disabled.
VTouch Status	Select Enabled to activate a connection to VTouch, or Disabled to stop sending data and alarms to VTouch.
LiveConnect Status	Select Enabled to allow the ability to access the controller programming and log files remotely using VTouch, or Disabled to prevent remote connection to the controller using VTouch. The controller can still send data and alarms to VTouch, but the Live-Connect icon will not appear on the VTouch webpages.
Update Period	Enter the time between data updates being sent to VTouch.
Reply Timeout	Enter the maximum time allowed for VTouch to respond.

5.4.4 Network Details

The Network Details are for information only and display the network settings currently in use, and the recent history of the VTouch connection.

Alarms	Displays any active Network-related alarms
DHCP Status	Displays if the connection to the LAN using DHCP was successful or not.
Controller IP Address	Displays the IP address that the controller is currently using.

Network Netmask	Displays the netmask address that the controller is currently using.
Network Gateway	Displays the gateway address that the controller is currently using.
DNS Server	Displays the DNS server address that the controller is currently using.
MAC Address	Displays the MAC address of the Ethernet card.
Last VTouch Config	Displays the date and time of the last attempt to send configuration data to the VTouch server.
Last VTouch Data	Displays the date and time of the last attempt to send a data to the VTouch server.
LiveConnect Status	Displays the status of the controller's connection to the VTouch server that allows the ability to access the controller programming and log files remotely using VTouch.

5.4.5 Remote Communications (Modbus)

This menu will appear only if one of the optional Remote Communications activation keys has been imported into the controller, either by the factory at the time of ordering, or later using a field activation file.

To add the Modbus feature in the field, purchase the activation key file and save it to an USB drive, as the only file stored on the root directory of the stick. Insert the stick into the USB port of the controller. Go to the Configuration Menu, then File Utilities, then Import User Config File. Press the Confirm icon to start the activation process.

The display will report whether the import was successful or not. The activation key file is only valid for the serial number of the controller for which it was purchased.

For a complete description of the Modbus feature and register map, refer to the separate Modbus instruction manual.

Comm Status	Select Modbus to enable the feature, or Disabled.
Data Format	Select to receive Modbus data in Standard (Float) format or Float Inverse format.
Data Port	The standard port for Modbus data is port 502. Enter the port used if it is non-standard.
Verbose Logging	If logging is Enabled, all Modbus requests will be logged in the Event Log (any errors, the function called, starting register, number of registers, value of the first register). This is useful when first setting up the HMI, but it will quickly fill the Event Log if it is not Disabled during normal operation. The Verbose Logging function will be automatically disabled after power to the controller is cycled.

5.4.6 Email Report Settings

These menus are used to set up email reports. Once set up, the report may be tested by setting the time for the report to be run to just after the current time, or in the case of alarm reports, by triggering an alarm condition. If the report is not received, you can access the SMTP log by typing /networklog after the IP address in the browser using the web interface (for example, <http://10.0.100.101/networklog>).

Report #1 (through 4)	Enter this menu to activate and set up a report to email, via the menus below:
Report Type	Select the type of report to email: None, Alarm, Datalog, or Summary. (the Home webpage showing a Summary of current conditions)
Email Recipients	Select up to 8 email addresses that reports may be sent to by touching the check box. The addresses are entered in the Email Addresses menu described above.
Repetition	Only appears if Report Type is Datalog/Summary. Select how frequently to repeat sending the report: None, Hourly, Daily, Weekly or Monthly.
Reports Per Day	Only appears if Report Type is Datalog/Summary. Only appears if the repetition is set to Hourly. Select the number of reports per day: 2, 3, 4, 6, 8, 12 or 24. The report is sent on the Report Time and then evenly spaced throughout the day.

Day	Only appears if Report Type is Datalog/Summary. Only appears if the repetition is set to Weekly. Choose the day of the week on which the report will be sent.
Day of Month	Only appears if Report Type is Datalog/Summary. Only appears if the repetition is set to Monthly. Choose the day of the month on which the report will be sent. If the current month has less days than the number entered, the report will be sent on the last day of the month.
Report Time	Only appears if Report Type is Datalog/Summary. Only appears if the repetition is set to Daily, Weekly or Monthly. Enter the time of day for the report to be sent.
Log Frequency	Only appears if the Report Type is Datalog. Select the amount of time between data points. The amount of time allowed varies with the repetition of the report.
Alarm Mode	Only appears if Report Type is Alarm. Choose to send emails on All Alarms or only Selected Alarms.
Select Alarms	Only appears if Report Type is Alarm. Only appears if the Alarm Mode is set to Selected Alarms. Select an Input or Output channel, System Alarm or Network Alarm, then touch the check box for individual alarms that will trigger an email to the list of recipients. Repeat for as many as desired.
Alarm Delay	Only appears if Report Type is Alarm. Enter how much time to wait after the alarm has been triggered before alarm conditions are considered valid and the email is sent.
Email Addresses	Enter up to 8 email addresses that reports may be sent to.
Email Server	Select the type of email server to be used: SMTP, or ASMTMP.
SMTP Server	Enter the SMTP server address, either numeric or its name. Only appears if the email server type is SMTP or ASMTMP.
SMTP Port	Enter the port to be used by SMTP server. Only appears if the email server type is SMTP or ASMTMP. The default is port 25 for SMTP and port 587 for ASMTMP.
From Address	Enter the controller's email address. Only appears if the email server type is SMTP or ASMTMP.
ASMTMP Username	Enter the username required for authentication. Only appears if the email server type is ASMTMP.
ASMTMP Password	Enter the password required for authentication. Only appears if the email server type is ASMTMP.

5.4.7 Display Settings

Home 1	Select the input or output to display on the 1 st line of the display Home screen.
Home 2	Select the input or output to display on the 2 nd line of the display Home screen.
Home 3	Select the input or output to display on the 3 rd line of the display Home screen.
Home 4	Select the input or output to display on the 4 th line of the display Home screen.
Home 5	Select the input or output to display on the 5 th line of the display Home screen.
Home 6	Select the input or output to display on the 6 th line of the display Home screen.
Home 7	Select the input or output to display on the 7 th line of the display Home screen.
Home 8	Select the input or output to display on the 8 th line of the display Home screen.
Adjust Display	Change the contrast and the brightness by touching the arrow keys. If the display becomes unreadable, it is possible to reset the defaults by powering down and pressing the bottom right corner of the touchscreen while powering back on.

Auto Dim Time	If this is set to a non-zero time, the display backlight will dim if the touchscreen is not touched for that amount of time. Touching the screen will turn the back to normal brightness.
Key Beep	Select enable to hear a beep when an icon is pressed, or disable for silence

5.4.8 File Utilities

File Transfer Status	Displays the status of the last attempt to export a file
Data Log Range	Select how far back in time for data to be downloaded: Since Previous download, past 6 hours, all the way up to the past 3 months.
Log Frequency	Select the amount of time between data points. The amount of time allowed varies with the Data Log Range. If the Data Log Range is selected as Since Previous download, the choices for frequency of data points will be limited by how far back in time the last download occurred.
Export Data Log File	Save the Data Log file, as defined by the Data Log Range and Log Frequency settings above, to a USB stick.
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.
Export User Config File	The User Configuration file contains all settings for the controller. Enter this menu to save the controller's settings to an USB stick for using later to restore settings to this controller, or to program additional controllers with the same settings as this one. It takes several minutes to create the file and transfer it to the stick.
Import User Config File	The User Configuration file contains all settings for the controller. Insert an USB stick containing the desired Configuration file. Enter this menu to import the file from the stick onto the controller.
Restore Default Config	Enter this menu to restore all of the settings to the factory default values. Any changes to settings that were previously made will be lost!
Software Upgrade	Insert a USB stick that has the upgrade file stored in the root directory into the USB connector under the watertight cap on the outside of the front panel (see figure 18). Touch the Confirm icon, and then touch the Confirm icon to start the upgrade.

NOTE: To maintain the IP65 rating, always remove the stick and replace the cap securely over the USB connector when not in use.

5.4.9 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
Serial Number	Displays the serial number of the controller
Controller Board	Displays the revision number of the front panel circuit board
Software Version	Displays the software version on the controller board
Power Board	Displays the revision number of the power/relay board
Sensor Board #1	Displays the revision number of the sensor board in the Sensor 1 slot
Software Version	Displays the software version on the sensor board in the Sensor 1 slot
Sensor Board #2	Displays the revision number of the sensor board in the Sensor 2 slot
Software Version	Displays the software version on the sensor board in the Sensor 2 slot
Network Board	Displays the revision number of the network board
Software Version	Displays the software version on the network board

Display Board	Displays the revision number of the display board
AO Board	Displays the revision number of the analog output board
Last Data Log	Displays the date and time of the last data log download
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.
Processor Temp	Displays the temperature of the main processor. The acceptable range is -10 to 65 C.
I/O Card 1 Temp	Displays the temperature of the sensor input processor installed in I/O slot 1. The acceptable range is -10 to 65 C.
I/O Card 2 Temp	Displays the temperature of the sensor input processor installed in I/O slot 2. The acceptable range is -10 to 65 C.
Network Temp	Displays the temperature of the network card processor. The acceptable range is -10 to 65 C.
+5 Volt Supply	The normal range is 4.75 to 5.25 VDC. The 5 V supply is used for powering all the I/O.
+3.3 Volt Supply	The normal range is 3.135 to 3.465 VDC. The 3V supply is used to run the system.
LCD Bias Voltage	The normal range is -25 to -20 VDC. This is the touchscreen voltage after contrast adjustment.
LCD Supply	The normal range is -25 to -20 VDC. This is the touchscreen voltage before contrast adjustment.

5.5 HOA Menu



The HOA (Hand-Off-Automatic) Menu is used to quickly and easily test all relay outputs, and to stop or enable automatic control.

Touch the relay number in order to change the HOA state of that relay. The relay number will be shaded dark, and its current HOA state will be shaded dark. Then touch the desired state. The change happens immediately unless that relay has a Minimum Relay Cycle programmed that is above 0 seconds.



5.6 Graph Menu



The Graph Menu is used to display a graph containing one sensor or analog input value plus one digital input or relay state. Touch the Graph icon and the controller will display “Generating Graph Please Stand By” for a few seconds then show the graph. The default is to show the value of sensor input S11 and the state of relay output R1 over the past 10 minutes.

Touching any point on either line on the graphs displays a vertical line plus the details for that data point: date and time, value of the sensor, and an arrow showing if the state or the digital input/relay was high or low at that time.



Touching the  or the  icons will redraw the graph forward or backwards in time, in increments of one time range. It can only go back in time to the point where the data log file used to generate the graph starts. Changing the time frame while in the graph view, after moving back in time, shows data from that past time. Exiting the graph menu and returning to the graph menu moves back to the current time.

Settings

Sensor	Enter this menu to select the sensor, analog input, flowmeter type digital input (total flow and/or flow rate if applicable), or analog output value to show on the graph
DI/Relay	Enter this menu to select digital input, or analog output value to show on the graph
Low Axis Limit	The graph auto-scales based on the sensor value if both Low and High Axis Limit are set to 0. To manually adjust the Y axis scale, enter the low limit here.
High Axis Limit	The graph auto-scales based on the sensor value if both Low and High Axis Limit are set to 0. To manually adjust the Y axis scale, enter the high limit here.

Time Range	Select the time range for the X axis of the graph. The time range may also be accessed from the graph view by touching the time range icon in the lower right corner.
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The resolution of the screen only allows for 84 data points per graph, so not all data points in each time range can be shown. For finer resolution, download the data log CSV file from the Config – File Utilities menu and graph the data in Excel or equivalent spreadsheet application.

Time Range	Time between data points	Datalog file used
10 minutes	10 seconds	Daily
30 minutes	30 seconds	Daily
1 hour	1 minute	Daily
2½ hours	2 minutes	Weekly
8 hours	6 minutes	Weekly
½ day	10 minutes	Weekly
1 day	20 minutes	Weekly
½ week	1 hour	Monthly
1 week	2 hours	Monthly
2 weeks	4 hours	Monthly
4 week	8 hours	Monthly

6.0 OPERATION using Ethernet

All of the same settings that are available using the touchscreen are also available using a browser that is connected to the controller's Ethernet IP address. The controller may be connected to a Local Area Network (LAN), directly to the Ethernet port of a computer, or to the VTouch account management system server.

6.1 Connecting to a LAN

Connect the controller's network card to the LAN using a CAT5 cable with RJ45 connector.

6.1.1 Using DHCP

Using the touchscreen, from the Main menu, touch Config, then touch Network Settings, then touch DHCP Setting. Touch Enabled, then the Confirm icon.

After a power cycle of the controller, return to Config, then Network Details to view the Controller IP Address that has been assigned to the controller by the network.

6.1.2 Using a fixed IP Address

Using the touchscreen, from the Main menu, touch Config, then touch Network Settings, then touch DHCP Setting. Touch Disabled, then the Confirm icon. Cycle power to the controller. If DHCP is already Disabled then you can skip this step.

Using the touchscreen, from the Main menu, touch Config, then touch Network Settings, then touch Controller IP Address. Enter the IP address provided by the administrator of the LAN then touch the Confirm icon. Repeat for the Network Netmask and Network Gateway settings. Cycle power to the controller.

6.2 Connecting Directly to a Computer

Connect the controller's network card to the computer using a CAT5 cable with RJ45 connector.

Follow the instructions above to give the controller a fixed IP address that is compatible with the network settings of the computer.

Open a browser and type the numeric Controller IP address in the web page address field. The login screen should quickly appear. The default user name is admin and the default password is 5555. The default View-Only user name is user and default password is 1111. These can and should be changed in the Config menu, under Security Settings.

6.3 Navigating the web pages

From any computer that is directly connected to the controller, or is on the same network as the controller, open a browser and type the numeric Controller IP address in the web page address field. The login screen should quickly appear. The default user name is admin and the default password is 5555. The default View-Only user name is user and default password is 1111. These can and should be changed in the Config menu, under Security Settings.

The Home page will appear. This will display the date and time, any active alarms, and the current readings or status of all of the Inputs and Outputs. On the left side of the page you will see links to the Main Menu selections: Alarms, Inputs, Outputs and Config. Hover the mouse pointer over each menu to see the submenus, and click on the submenu to access all of the details and settings associated with it. The security settings for the web interface are not the same as the Local Password that is set using the touchscreen.”

7.0 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.

7.1 Copper or Nickel Sensor Cleaning

NOTE: The controller must be recalibrated after cleaning the sensor.

Frequency

The sensor should be cleaned periodically. The frequency required will vary by installation. In a new installation, it is recommended that the sensor be cleaned only if a 1-Point Calibration cannot be successfully performed.

Cleaning Procedure

The most important maintenance item for the sensor is to keep the optical paths clean of plate-out or other coatings. In electroless applications, the sensor should be etched when the tank is etched, or when ever plate-out is evident. If plate-out does occur in the sample line or sensor, etch the system as you would the tank.

Avoid any mechanical cleaning of the optical surfaces to avoid scratching them. Chemical cleaning is preferred over mechanical cleaning methods. Plate-out should be removed using nitric acid or a persulfate or peroxide/sulfuric etch.

7.2 pH Electrode Maintenance

The pH electrode requires periodic cleaning and calibration. These electrodes are like batteries and their voltage outputs will change with time even if they are not being used. After installation, the rate of change increases, and factors such as temperature, extremes of pH, abrasion and chemical attack will increase the required frequency of calibration. If the process solution contains oils, scale or other solids, the electrode surfaces will tend to coat, its response time will slow down and cleaning will be required.

The frequency of cleaning and calibrating will vary greatly depending upon the application, the factors list

ed above, as well as the accuracy of control you require. The best way to determine the optimum number of days between calibrations is to remove the electrode from the process periodically (weekly in clean water applications, daily in dirty or hot applications) and check its accuracy in a buffer solution. If using manual temperature compensation, remember to change the temperature from that of the process to that of the buffer. If the accuracy of the reading is within your required tolerances, and the speed of response is good, replace the electrode in the process. If not, clean the electrode and perform a two point calibration.

The method of cleaning the electrode will depend upon the coating, as well as the materials of construction of the electrode. Do not use a solvent that will attack the electrode! Care must be taken to avoid scratching the pH electrode's glass, as this will shorten its life.

Oily coatings should be removed with a mild detergent or isopropyl alcohol. Hard scales such as calcium carbonate can usually be removed with a dilute hydrochloric acid solution. Soft coatings can be removed using a soft cloth or soft toothbrush.

A two point calibration should always be performed after cleaning the electrode. Because the electrode signal is so sensitive, the condition of the cable and connectors between the electrode, preamplifier and controller is critical. Make sure that all electrical connections stay clean and dry. Never splice the cable prior to preamplification. Replace the cable if there is any sign of damage.

7.3 Replacing the Fuse Protecting Powered Relays



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

Locate the fuse on the circuit board at the back of the controller enclosure under the plastic safety cover. Gently remove the old fuse from its retaining clip and discard. Press the new fuse into the clip, 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 Walchem fuse be used.

Fuse 5 x 20 mm, 6A, 250V	Walchem P/N 102834
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8.0 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.

8.1 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.

8.1.1 Copper or Nickel Sensors

The calibration offset will fail if the adjustment is outside of -10 to +10.

Possible Cause	Corrective Action
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Dirty sensor	Clean or etch sensor
Water/Sample Calibration has not been performed, or performed incorrectly	Perform a Water/Sample Calibration
Condensation inside sensor	Allow sensor to dry out. Replace desiccant.
Faulty sensor cable or photodetector	Repair or replace sensor
Faulty sensor receptacle on controller	Replace

8.1.2 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 -140 to 140.

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

8.1.3 Contacting Conductivity Sensors

The calibration will fail if the adjustment to the gain is outside of 0.5 to 2.0.

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

8.1.4 Electrodeless Conductivity Sensors

The calibration will fail if the adjustment to the gain is outside of 0.2 to 10, or the offset is outside of -10,000 to 10,000.

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

8.1.5 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

8.1.6 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

8.1.7 Analog Inputs

The calibration will fail if the adjustment to the gain is outside of 0.5 to 2.0, or if the calculated offset is outside of -2 to 2 mA.

Possible Cause	Corrective Action
Improper wiring of sensor to controller	Correct wiring
Faulty sensor	Replace sensor

8.1.8 Temperature Sensors

The calibration will fail if the calculated offset is outside of -10 to 10.

Possible Cause	Corrective Action
Improper wiring of sensor to controller	Correct wiring
Temperature input is set to the incorrect element	Reprogram to match the connected temperature element
Faulty sensor	Replace sensor

8.2 Alarm Messages

NO SAMPLE

No Sample will be displayed if the measurement signals indicate excess air in the sample. In the Input Details menu, both the Sample Measurement and Sample Reference mV will be between 0.4 and 0.7 times what the readings were in water during the last Water/Sample Calibration (Water Measurement and Water Reference mV).

Liquid level too low for immersible sensor	Raise level or lower sensor
Sample pump failure	Repair or replace sample pump
Leak in or blockage of the sample line	Repair sample line
Excess air in sample tubing	Purge sample line of air. Check for leaks. Check orientation of sensor. Make sure sample line inlet is not placed where there is air or gas in the tank.
Contamination of the bath	A chemical in the bath may be absorbing at the reference wavelength. Test the sensor in a sample of uncontaminated copper solution.
Faulty sensor	Repair or replace sensor
Controller is faulty	Repair or replace controller

LAMP OUT

Lamp Out will be displayed if the measurement signals indicate almost no light getting through. In the Input Details menu, both the Sample Measurement and Sample Reference mV will be less than 0.01 times what the readings were in water during the last Water/Sample Calibration (Water Measurement and Water Reference mV).

Possible Cause	Corrective Action
Sensor wire(s) disconnected	Reconnect.
Lamp failure	Replace lamp
Dirty sensor	Clean or etch sensor
Faulty sensor	Repair or replace sensor.
Controller is faulty	Repair or replace controller

PLATE OUT

Plate Out will be displayed if the measurement signals indicate very light getting through. In the Input Details menu, both the Sample Measurement and Sample Reference mV will be less than 0.4 times what the readings were in water during the last Water/Sample Calibration (Water Measurement and Water Reference mV).

Water/Sample Calibration has not been performed, or performed incorrectly	Perform a Water/Sample Calibration
Dirty sensor	Clean or etch sensor
Faulty sensor receptacle on controller	Replace
Faulty sensor	Repair or replace sensor
Controller is faulty	Repair or replace controller

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 or feed monitor totalizer alarm limit is exceeded.

Possible Cause	Corrective Action
Normal operation	Reset the total to clear alarm, or wait for the automatic total reset to occur.
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

RANGE ALARM (for flow meter or feed monitor type digital inputs)

Occurs if the flow meter or feed monitor accumulated total is too large. The maximum total is 1 trillion times the increment of the device. For example, if the increment is one gallon per pulse the maximum total is 1 trillion gallons.

Possible Cause	Corrective Action
Normal operation	Reset the total to clear alarm, or wait for the automatic total reset to occur.

FLOW VERIFY

Occurs if the feed monitor digital input does not register any contacts while the control output for that pump has been active for longer than the Flow Alarm Delay time.

Possible Cause	Corrective Action
Metering pump has lost prime	Re-prime metering pump
Faulty metering pump	Repair or replace metering pump
Incorrect feed monitoring device wiring	Correct wiring. Make sure that digital input that the feed monitoring device is connected to has been assigned to the correct relay
Faulty feed monitoring sensor	Replace feed monitoring sensor
Blown fuse	Verify the pump is getting power. Replace fuse
Faulty output relay	Replace relay board
Faulty digital input	Verify that feed monitoring device is making contact closures using an ohmmeter. If OK, and connected properly, replace the controller circuit board.

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 (for sensor inputs)	
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
EVENT SKIPPED ALARM	
An event skipped alarm is set when a second timer event occurs while one event is still running. An event skipped alarm is also set when the timer relay never turns on during an event because of an interlock condition. The alarm is cleared when the relay is next activated for any reason (the next timer event or HAND mode or “activate with” force on condition).	
Possible Cause	Corrective Action
Incorrect programming	Reprogram to eliminate overlapping events
Long duration interlock condition	Normal operation
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, or that one of the inputs used to calculate a virtual input is in a Sensor Fault condition. This error condition will stop control of any output using the input.	
Possible Cause	Correction Action
Faulty controller	Replace or repair controller
If using virtual inputs, sensor fault of one of the inputs	See Sensor Fault troubleshooting above
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 of the controller or sensor processor IC is above 75 °C, or that the temperature of the Ethernet card processor IC is above 85 °C.	
Possible Cause	Correction Action
High ambient temperatures	Provide cooling for the controller
High power draw	Do not use the controller's 24VDC to power more than 1.5W total
DISPLAY ERROR	
This alarm occurs if the user interface gets lost	
Possible Cause	Correction Action
Pressing icons very quickly	Exit out of the screen and continue programming
NETWORK CARD FAILURE	
This alarm occurs if the Ethernet circuit board fails	
Possible Cause	Correction Action
Ethernet card locked up	Try a power cycle to reset it

Ethernet card not seated correctly	Unplug the network card and plug it back in
Faulty Ethernet card	Replace Ethernet card
WEB SERVER FAILURE	
This alarm occurs if the web server on the Ethernet circuit board fails	
Possible Cause	Correction Action
Web server locked up	Try a power cycle to reset it
Faulty Ethernet card	Replace Ethernet card
VTouch DATA COMM ERROR	
This alarm occurs if the controller attempts to send data to VTouch and VTouch fails to acknowledge receipt of the data	
Possible Cause	Correction Action
No connection to LAN	Connect Ethernet cable to LAN
Wrong IP, subnet and/or gateway address	Program valid settings for LAN in the controller or use DHCP if supported by the LAN
LAN is blocking outside access	Program LAN's router to open access
Network card failure	See above
SENSOR CAL REQUIRED	
This alarm occurs if the sensor's Cal Reminder Alarm has been set to more than 0 days and if the sensor has not been calibrated within that number of days	
Possible Cause	Correction Action
Time to calibrate	Calibrate the sensor
Reminder set in error	Set the Cal Reminder Alarm to 0
CALCULATION ERROR	
This alarm occurs if a virtual input calculation cannot be completed, for example if it has to divide by zero.	
Possible Cause	Correction Action
Zero value for the input used as the denominator	Calibrate or evaluate that input
DI FLOW VERIFY	
This alarm occurs if the control output is on but the associate flow verification device is not registering flow	
Possible Cause	Correction Action
Metering pump has lost prime	Re-prime metering pump
Faulty metering pump	Repair or replace pump
Faulty verification device wiring	Correct wiring
Wrong digital input assigned to the output	Correct programming error
Faulty verification device	Repair or replace device
Faulty wiring of output to pump	Correct wiring
Faulty output board	Repair or replace board
Faulty digital input	Replace board
CONTROLLER, POWER, DISPLAY, OR SENSOR BOARD ERROR	
This alarm occurs if the board listed is not recognized	
Possible Cause	Correction Action
Poor ribbon cable connection	Remove and reseal ribbon cable, cycle power
Poor option card connection	Remove and reseal the board, cycle power
Faulty board	Return the controller for repair
CONTROLLER, POWER, SENSOR, DISPLAY, NETWORK OR ANALOG OUTPUT BOARD VARIANT	
This alarm occurs if the type of board that is detected is not a valid type	
Possible Cause	Correction Action
Poor ribbon cable connection	Reseat ribbon cable
Faulty ribbon cable	Replace ribbon cable
Faulty Board	Replace the board listed in the error message

SENSOR SOFTWARE VERSION	
This alarm occurs if a sensor input card with software v2.11 or lower is installed onto a controller board running software v2.13 or higher	
Possible Cause	Correction Action
Software is not compatible between boards	Perform a Software Upgrade
NETWORK SOFTWARE VERSION	
This alarm occurs if an Ethernet card is installed onto a controller board running a higher software version than the Ethernet card	
Possible Cause	Correction Action
Software is not compatible between boards	Perform a Software Upgrade
INVALID SENSOR TYPE	
This alarm occurs if the programmed sensor type is not possible for the installed sensor board	
Possible Cause	Correction Action
The sensor board has been removed and replaced with a different type	Reinstall the correct board or reprogram the input to a valid type for the board installed
INVALID CONTROL MODE	
This alarm occurs if the programmed control mode is not possible for the installed power relay board	
Possible Cause	Correction Action
The power relay board has been removed and replaced with an incorrect model	Reinstall the correct board or reprogram the output to a valid type for the board installed
VTouch LIVE CONNECT ERROR	
This alarm occurs if the controller is unable to establish an encrypted connection to the VTouch server. If there is also a VTouch Data Comm Error, fix that first.	
Possible Cause	Correction Action
No UDP support on Port 9012 or TCP support on Port 44965	Open ports/protocols on router
DISABLED (SENSOR, DIGITAL OR VIRTUAL INPUT; RELAY OR ANALOG OUTPUT)	
This alarm occurs if software for that input or output did not start correctly	
Possible Cause	Correction Action
The software is not functioning	If the error message clears on its own, no action is required. If the error message persists, cycle power. If the error message still persists, return the controller for repair.
RELAY OR ANALOG OUTPUT CONTROL FAILURE	
This alarm occurs if software for that output did not run correctly	
Possible Cause	Correction Action
The software is not functioning	If the error message clears on its own, no action is required. If the error message persists, cycle power. If the error message still persists, return the controller for repair.
FRAM FILE SYSTEM ERROR	
This alarm occurs if the FRAM is not detected at power up	
Possible Cause	Correction Action
The FRAM was or is not functioning	If the error message clears on its own, no action is required. If the error message persists, cycle power. If the error message still persists, replace the controller board.

8.3 Procedure for Evaluation of Conductivity Electrode

Try cleaning the electrode first. To check the electrode, check the electrode connections to the terminal strip (refer to Figure 7). Make sure that the correct colors go to the correct terminals, and that the connections are tight. Restore power and see if the conductivity is back to normal. If not, replace the electrode.

8.4 Procedure for evaluation of the pH/ORP electrode

The most common cause of a calibration failure is an electrode problem. First try cleaning the electrode, then retry the calibration. If this fails again, replace the electrode and retry the calibration.

The next most common problem is wet or poor connections. Check the connection of the electrode to the cable for moisture. Check the connections between the cable and the terminal strip. Make sure that they are tight, that

the terminal is not clamped to the plastic jacket, and that the wires are routed to the correct terminal. If there is a junction box installed between the electrode and the controller, check the wiring there as well.

You should be able to measure the +5VDC $\pm 5\%$ and -5VDC $\pm 5\%$ vs IN- at the terminal strip. If not, the controller is faulty. You should be able to measure the IN+ vs IN- (DC scale) and get the appropriate values for the buffer solutions used. If not, the preamplifier or its wiring is faulty.

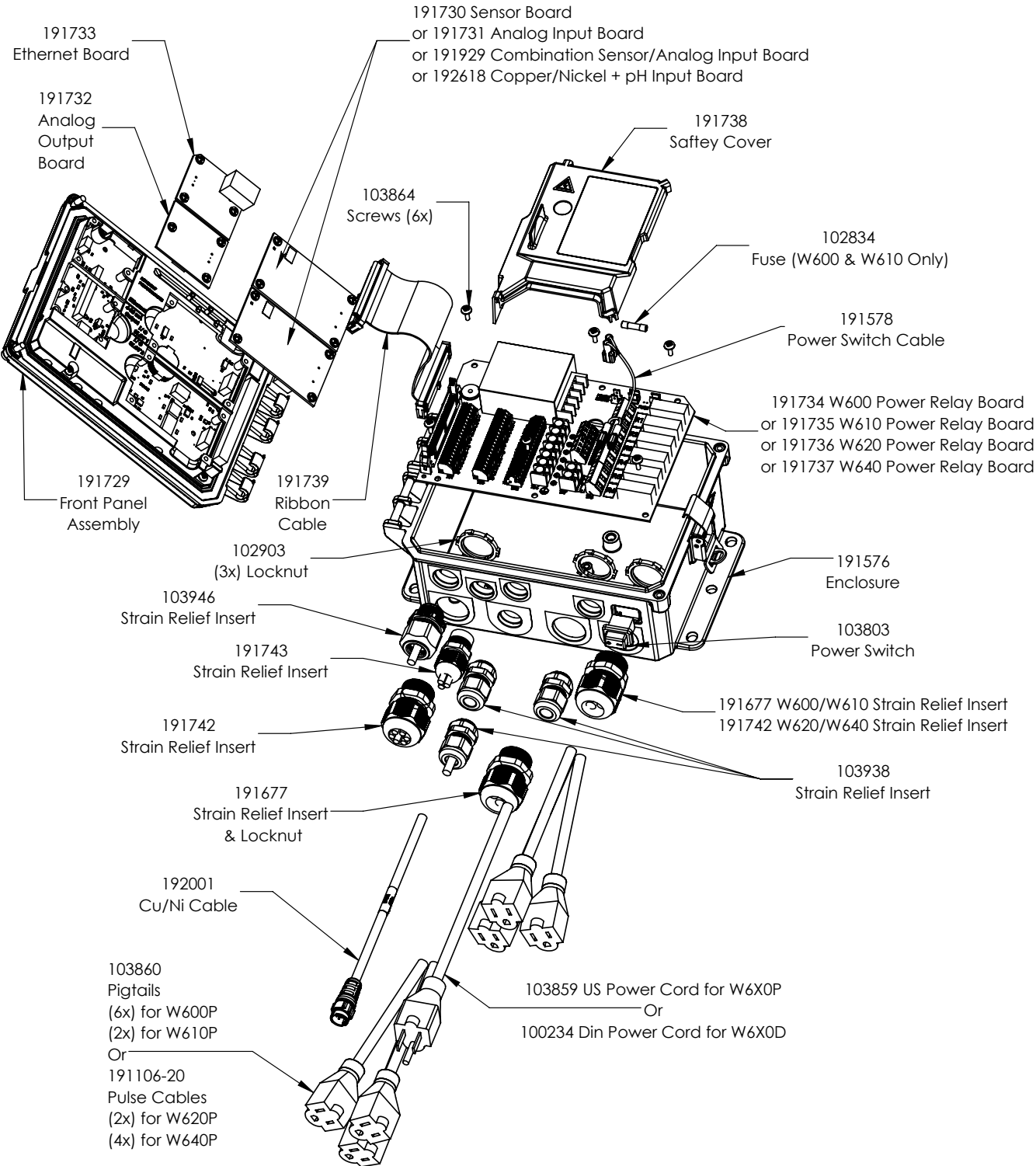
The last possibility is to try replacing the preamplifier.

8.5 Diagnostic Lights

Some of the circuit boards inside the controller have diagnostic lights.

POWER/RELAY BOARD AMBER NEON (ONLY FOR MODELS WITH POWERED RELAYS) Indicates status of the fuse protecting the relays. Normal operation is ON. If not on:	
Possible Cause	Correction Action
Fuse has blown or is missing	Replace fuse
Controller model has only dry contact or pulse proportional relays	Normal
CONTROLLER BOARD D7 LED Indicates status of the software application. Normal operation is that 5 seconds after power-up, it does one long blink on, two short blinks, on long blink off. If it is not doing this:	
Possible Cause	Correction Action
Controller software is not running	Try a power cycle to reset it
Faulty controller board	Replace controller board
CONTROLLER BOARD D8 LED Indicates the status of the 5 VDC power supply. Normal operation is ON. If not on:	
Possible Cause	Correction Action
Faulty ribbon cable	Replace ribbon cable
Faulty power supply	Replace power/relay board
CONTROLLER BOARD D9 LED Indicates the status of the 3.3 VDC power supply. Normal operation is ON. If not on:	
Possible Cause	Correction Action
Faulty ribbon cable	Replace ribbon cable
Faulty power supply	Replace power/relay board
SENSOR BOARD LED Indicates the status of the sensor board. Blinks slowly for several seconds during power-up. Normal operation is OFF. If not behaving this way:	
Possible Cause	Correction Action
Sensor card locked up	Try a power cycle to reset it
Sensor card not seated correctly	Unplug the card and plug it back in
Faulty sensor card	Replace sensor card

9.0 Spare Parts Identification



10.0 Service Policy

Walchem controllers have a 2-year warranty on electronic components and a 1-year warranty on mechanical parts and electrodes. See Statement of Limited Warranty in front of manual for details.

Walchem controllers are supported by a worldwide network of authorized master distributors. Contact your authorized Walchem distributor for troubleshooting support, replacement parts, and service. If a controller is not functioning properly, circuit boards may be available for exchange after the problem has been isolated. Authorized distributors will provide a Return Material Authorization (RMA) number for any products being returned to the factory for repair. Repairs are generally completed in less than one week. Repairs that are returned to the factory by next-day-air freight will receive priority service. Out-of-warranty repairs are charged on a time and material basis.