DULCOMETER
Aegis-II® Cooling Tower and Boiler Controller

Use your Tablet or Smartphone. I’m WiFi ready!

Please carefully read these operating instructions before use! - Do not discard this manual! The operator shall be responsible for any damage caused by installation or operating errors! Technical changes reserved.
AEGIS II Browser

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1 Day-to-Day Browsing

The purpose of this manual is to show the user how to connect to the Aegis II controller using an Ethernet connection, or wirelessly via WiFi from a PC, tablet or smartphone. Secondly, to give examples of how to program the outputs, calibrate sensors and/or view the process. The Installation and Operation manual has detailed sensor information, keypad instruction and controller details and specification. The following sections detail connecting your smart device or PC to the controller. WiFi has the advantage of not requiring a physical cable. LAN setup follows this chapter, then the Home screen is explained as it is common to either connection method.

1.1 The WiFi Connection

A WiFi connection eliminates cables and the need to change your IP address. There are two steps needed to fully connect to the controller. **Step 1:** Connect your device to the wireless network that includes your controller. **Step 2,** Enter the IP address of the controller in a browser app. There could be multiple devices on this network.

Step 1 is provided in two parts, **1.1.1 Using a PC or Tablet** and **1.1.2 Using a Smartphone**

1.1.1 Using a PC or Tablet:

Click on the WiFi icon on your desktop.

Click on the AegisII_123 choice and press the Connect button.

The number 123 in this example will be different on each controller. These 3 digits are taken from the last 3 digits of the controller serial number. This allows you to differentiate between controllers if more than one is within WiFi range. Further differentiate your controller WiFi name. Edit the name in the System pages. See **10.3.1 LAN IP, Netmask, MAC, Gateway, WiFi IP**

You are now on the Aegis II WiFi network. Continue with section **1.1.3 Opening the Browser page**

**Sidebar:**

Once you are connected to a controller, you can edit the SSID (WiFi name) to make identification easier than trying to remember the three digits. See section **10.3 Communications** to make this change.
1.1.2 Using a Smartphone

Navigate to your Smartphone setting page. Select the WiFi page. Select the AegisII_123 choice.

NOTE: The number 123 will be different on each controller. These 3 digits will be the same as the last 3 digits of the controller serial number. This allows you to differentiate between controllers if more than one is within WiFi range.

Sidebar:
Once you are connected to a controller, you can edit the SSID (WiFi name) to make identification easier than trying to remember the three digits. See section 10.3 Communications to make this change.

Here are examples using Android and IPhone:

1.1.2.1 Setting up WiFi using an Android phone

From your home page, press the settings button then choose Wi-Fi.

There may be more than one controller nearby. Choose your controller by comparing the serial numbers last 3 digits with the options on the phone. Select your controller. The status should change for that choice. See example picture below; AegisII_060 is ‘Connected, no Internet’.

Continue with section 1.1.3 Opening the Browser page using WiFi
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1.1.2.2 Setting up WiFi using an IPhone

To connect your IPhone to an AegisII controller, make a WiFi connection; Select the Settings button from your desktop.

Select the WiFi button. Choose your controller. Note the connection status.

If you have more than one Aegis choice, the number on the screen represents the last 3 digits of the AegisII controller serial number.

1.1.3 Opening the Browser page using WiFi

Once a WiFi connection is established, continue here with step 2. To connect to the controller and see the screen, open a browser and enter the controller’s WiFi IP address. (Not the LAN IP). The default address is 192.168.1.1. If you do not see the connection status followed by the main page, it could be due to the WiFi address having been changed on the controller. Find the controller WiFi IP address using the controller keypad.

1) Press the Menu key
2) Press the up arrow (scroll up) until you see System. Press OK
3) You should be at the Communications menu. Press OK.
4) You will see the LAN IP address. Press the down arrow twice to see the WiFi IP Address. This is the address you need to use in the browser URL box. No need to add the WWW or Http. Just enter as shown here. 192.168.1.1 and press your return key.

Once connected, you can see values and status of many I/O point but you will not be able to edit or make programming changes without logging in. This is the HOME screen. See section 1.3 The Home Screen
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1.2 The LAN Connection

The most common connection is via a Local Area Network (LAN) connection. This requires an Ethernet cable and you will need to set up your Ethernet port to match the address of the controller.

The Ethernet cable no longer needs to be a ‘crossover’ type unless you are running a Windows version earlier than VISTA. WIN7 onward will determine which wires need to be transmit and receive and adjust to match the signals on the cable.

Attach the cable to the LAN port on your PC and to the LAN port inside the controller. (Lower left-hand corner). A green light should be seen on both ports. The amber light will blink with each packet that passes by in either direction.

1.2.1.1 Determine the LAN IP address of the controller

The default LAN IP address is 10.10.6.106. If you have not changed it and if the controller has not been placed on the customer's network, try this address. If it does not work, find the LAN address;

- Press the menu key on the controller
- Use the up arrow to System and press Enter
- Press Enter for Communication
- The LAN IP address is shown

Once you have determined the IP address of the controller, you need to set a static IP address on your PC that is compatible with the controller address.

1.2.1.2 Setup the Local Area Connection on your PC

Depending on which version of Windows you are using, these instructions will vary. The idea is to set a compatible static IP address on your PC for the Ethernet port you will use to physically connect to the controller.

Use the following instructions for VISTA, WIN7, WIN8 and WIN10.

Hold down the Windows key while you press the letter ‘r’.

Enter ‘ncpa.cpl’ in the Open box. Press OK.
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Double click on Local Area Connection and select Properties

2. Select Properties
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Select the ‘Use the following IP address’: circle (1)

Enter the first three numbers of the controller’s IP address (2)

Example: 010.010.006.____

Then enter a number between 000 and 255 that is different from the controller address

In this example, since the controller IP is 010.010.006.106, we used 010.010.006.101 (3)

Press the Tab key and enter the Subnet mask of 255.255.255.0

Select OK here and on the Local Area Connection window

Sidebar:
If you change the port number from the default address of 80, the WiFi port address will be changed automatically as well.
When the port number is 80, it is implied, therefore, you do not include it in the addressing.
However, if it is other than 80, you need to include it when you try to connect to the controller.
For example: if you change the address to 100, the default LAN IP address will now be entered as such:

10.10.6.106:100

The WiFi default address is now:

192.168.1.1:100
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1.3 The Home Screen

**View from Smartphone.** Scroll in any direction to access all I/O as shown in the PC/Tablet screen.

**View from PC or Tablet**

### Home Page System Icons
- See section 1.2.3

### Name the Home page
- See section 10.7 System Setup

### User Logon and Status
- See section 1.2.1

**DIGITAL IN:** 8 On/Off and pulse inputs from flow switches, watermeters and other dry contact signals. (No sinusoidal)

**ANALOG:** Sensor inputs including Potentiometric (mV from conductivity, temperature, pH and ORP), Amperometric (All 4-20mA inputs from Prominent PPM sensors and any other 4-20mA device)

**OUTPUTS:** ANALOG and DIGITAL - Analog 4-20mA output signals to pumps, PLCs, chart recorders, etc. Digital relays 1 to 5 Power outputs for pump, MOV and solenoid on/off control. Digital Relays 6 to 9 - Pulse or On/Off low voltage pump speed outputs
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1.4 Home Page Services

From the home page, you can see all the enabled inputs and outputs (I/O). Log-in to gain access to three levels of programing privileges. Operator has the least benefit, while Admin has full access.

1.4.1 Log-In

Once you are connected, log in by selecting a username and enter a password.

<table>
<thead>
<tr>
<th>Usernames with Default Passwords:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator1 = 1 Operator2 = 2 Operator3 = 3 Operator4 = 4.</td>
</tr>
<tr>
<td>Configure5 = 5 Configure6 = 6 Configure7 = 7 Administrator = AAAA</td>
</tr>
</tbody>
</table>

**Login Page:** Operators can view all controller pages. No access to most System pages. Configure users can edit the program. No access to most System pages.

**Modify Passwords:**
If the controller is accessible on the site LAN, you should modify all 8 passwords.

Two users cannot share the same password because only the password is used to identify keypad users. The controller displays **Password Fail** on a duplicate password.

See section **10.8 Passwords** to learn how to change passwords.

1.4.2 Home Page Detail

Now that you are logged in, you can edit the controller as well as monitor the action. The following pages break the Home page into sections to enhance identification.

1.4.2.1 Analog Input Display
1.4.2.2 Digital I/O Display

Max of 8 Digital inputs: Can be any combination of dry contact switches or digital watermeter signals from contact head or paddle wheel models.

Max of 5 Digital Output Relays to power pumps, solenoids and MOV valves

Digital output configuration covered in sections 2, 3 and 4.

Max of 4 Pulse frequency or On/Off relays
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1.4.3 Home Page System Icons

The home page has a variety of services unrelated to the program. These services are accessed via the icons in the upper left corner of the page.

The User Manuals icon gives you access to the two Aegis manuals; Operating and Browser (this manual). The Operating manual explains the keypad usage, wiring and specifications. The Browser manual shows you how to connect to and program an Aegis II controller.

The System Settings icon has the following menus: These menus are explained in sections 10 System Settings.

The change display icon allows users with dual systems to select how I/O points are displayed. See section 10.7 System Setup.

The report icon opens the report page. See section 1.2.4 Create a Report.

Finally, the alarm icon displays current alarms. Clear them from this menu page.

1.4.4 Create a Report

To create a report, select the report icon from the main screen. Follow the three steps as shown.

The Icons:

? Access the controller manuals

Exit from the report menu back to the Live view

Show/hide the report menu

Manage the report database

Show/hide the controller header

Show/acknowledge current alarms
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Note the trend zoom tools. Export as a picture

Manage the report database.
1.5 **View & Adjust Setpoints**

Select the 1 to 9 icon on the home page. This example adjusts the Relay 1 setpoint.

Select **Adjust Setpoint** from the pull-down.

Bleed controls turn ON at the higher setpoint & then OFF @ the lower setpoint as the conductivity is lowered by the low conductivity make-up water.

In this example, we **Submit** a new setpoint, logging the activity.

Sidebar:
Relays controlled by sensors power Pumps and Solenoids ON and OFF. (Relays are outputs 1 to 5 & outputs 6 to 9 set to ‘ON/OFF’)
Frequency controlled Pumps feed chemicals at varying rates. (Frequency controlled pumps are outputs 6 to 9 set to ‘Pulse’)

Tower Bleed solenoids use Setpoints 5uS to 20uS apart so that short bleeds are followed by short feeds. The resulting control has minimum variation in Inhibitor ppm and operates as close as possible to the target cycles of concentration.

ON-OFF Acid pumps use setpoints 0.05 pH apart so that the re-circulation delay between feeding acid and measuring its pH does not cause wide pH swings.

**WARNING:** Reversing setpoint order is blocked for ON/OFF controls but allowed for proportional Pulse controls. Reversing setpoints in this example would convert an Acid feed to a Caustic feed.
Setpoint values vary with the configuration of each control and the type of control output; ON/OFF or variable frequency (pulse).

Feeding on volume allows you to set the feedwater concentration. This example uses an ON/OFF pump. Using a frequency controlled pump simplifies setting a feed concentration.

In this example, a Pulse control has been configured to ON/OFF, ON 18.5% of every 5 minutes. In this example, a Pulse control feeds continuously. Typically the feed would be interlocked with a flowswitch or boiler run contact set from the site DCS.

Sidebar:
Controls may be configured to prevent one chemical feeding while another feeds (See ‘Blocking’) into a common injection header.

Inhibitor feeds may be delayed while the bleed solenoid is ON to prevent pumping inhibitor down the drain (See Section 3.)

Pumps or blowdown valve controls may be turned OFF when the tower or boiler is offline (See Interlocks)

Pay attention to the number 1 to 9 that precedes the pump, valve or solenoid name. It’s the physical location on the controller circuit board of the wiring that connects to the pump, valve or solenoid.

You may modify the name of the pump, valve or solenoid but you’ll need to know which output is controlling so you can check that enclosure cover indicating light is ON when the pump, valve or solenoid is ON. (Relays 1-5 on the LHS & Pulse 6-9 on the RHS)
1.6 Priming-Testing Pumps & Solenoids

Sidebar:
Priming may also be used to slug feed on system start-up in addition to testing pumps, valves or solenoids. Feed limit alarms may stop priming.
2.1 Conductivity Controlled Blowdown

Select the 1 to 9 icon on the home page. This example sets up the Relay 1 as a Bleed Control.

Select Setup from the pull-down.

Each control has 3 possible Control Types: Blowdown controls conductivity in Towers & Boilers.

There are 3 possible Blowdown modes. Select Sensor Control to use a Conductivity sensor to control the blowdown valve or bleed solenoid.

Select the sensor used to control the blowdown. This pulldown selects from installed conductivity & toroidal sensors, 4-20mA inputs & 'Phantoms' of 'Unassigned' type.

Select Configure from the pull-down.

Inherits the units from the controlling sensor. Rename if required-preferred. Max 3 characters.

Sets the number of digits after the decimal point used for setpoints. Inherits from controlling sensor. Unless a condensate control, fractional uS of little utility.

Towers & Boiler lower the conductivity when the bleed-blowdown opens & make-up-feedwater dilutes the circulating water. Note 1.

‘None’ for typical tower controls. See 2.2 for Boiler blowdown & 2.5 for Varying Cycles.

Sidebar:

Note 1: Closed loop conductivity controls usually use Control Action ON increases sensor.
Select Control by: More than one to bleed on the ratio of tower to make-up conductivities. See next page.
Conductivity Controlled Blowdown  continued

If you have a conductivity sensor installed in the tower make-up line, you can control on the ration of the tower conductivity to the make-up conductivity.

**CAUTION:** If your tower has a long holding time or large circulating volume or you are running the chemistry close to the scaling limit, look closely at control effects. Auto-Increasing cycles of concentration (make-up conductivity falls) when the bulk of the tower water has not changed, may scale heat exchangers.

If this is a new tower to you, take the time to watch a bleed cycle. The bleed opens but the conductivity continues to increase until the float opens. (If you have a meter on the make-up you’ll see it increment volume @ a higher rate) The conductivity then starts to fall & may continue to fall after the bleed has turned OFF, depending on the float dead band. You can’t control inside of the float dead band but you can see the parts of the blowdown control: sensor, solenoid, meter, float … all working.
2.2 Boiler Blowdown

Select the 1 to 9 icon on the home page. This example sets up the Relay 4 as a Boiler Blowdown

Select **Configure** from the pull-down

The timing of Captured Sample blowdown controls varies with boiler usage, piping size & length from boiler to sensor, pressure, needle valve setting & feedwater quality. Modify timing & Submit.

Blowdown lowers boiler conductivity

Lower pressure commercial boilers use Captured Sample on the surface blowdown line for TDS control. **Note 1.**

Blowdown valve opens long enough to clear the surface blowdown line to the sensor, delivering a representative hot, un-flashed sample & goes to **Measure. Note 2.**

Valve closed. Sample cools a fixed & repeatable amount. Conductivity is measured @ the end of the measure interval. **Note 3.**

If conductivity above the setpoint, valve opens & blows down for **Blowdown** period, then goes to **Measure**

If conductivity below the setpoint, waits for ReSample time & goes to **Sample. Note 4.**

Optional thermal switch @ sensor alarms if blowdown valve fails to open, piping valved OFF...

Sidebar:

**Note 1.** Higher pressure, utility-power generation boilers use a continuous blowdown & a sample cooler to measure conductivity.

**Note 2:** Sensor installed upstream of the blowdown valve-solenoid & throttling needle valve. Needle valve downstream of blowdown valve. Lower reliability, steam rated solenoids limited to very low pressure boilers.

**Note 3:** If you modify **Measure** time or needle valve setting. Recalibrate because you’ve changed the temperature at the measure point.

**Note 4:** Boilers which cycle up slowly can extend ReSample time to minimize **Sample** energy, water & chemical losses. Process boilers may need to **Sample** more frequently.
2.3 Metered Blowdown

Select the 1 to 9 icon on the home page. This example sets up the Relay 1 as Meter controlled Bleed.

Select Setup from the pull-down

Select Set Blowdown Mode = Water meter & select the controlling meter & Submit.

At sites where fouling or high silica prevents using contact conductivity sensors, two meter controls are usable if make-up water chemistry constant

Select Control By = More than one & edit to get a Makeup:Bleed sequential control. In the example ‘O’ is the make-up meter & ‘P’ the bleed.

Measure 300 Gallons or Make-up & then Bleeds 100 Gallons. Cycles of concentration = 3.

Measure 300 Gallons or Make-up & then Bleeds 100 Gallons. Cycles of concentration = 3.

Sidebar:
Toroidal (non-contact) conductivity sensors are also used in towers where fouling blocks contact type, conventional sensors.
2.4 Percentage Time Blowdown

Select the 1 to 9 icon on the home page. This example sets up the Relay 1 as a time controlled Bleed.

Select Setup from the pull-down

It would be unusual to control cycles using a Percent Time control; typically used as a temporary fix on loss of a conductivity sensor.

Select Set Blowdown Mode = Percent Time & Submit.

Setpoint is the % of every five minutes. In this example 25% = 75 seconds in every 5 minutes

Sidebar:
Blowdown controls like other controls can be interlocked with flowswitch(es) or run contact sets & are subject to run time limits - alarms & blocking by other controls.

For example, if you use a Percent Time control to blowdown while you replace a sensor or meter, the bleed will turn OFF while the inhibitor feeds if you have configure the bleed to be 'Blocked by' the inhibitor pump. However the bleed time owed in the current 5 minute cycle will be delivered when the inhibitor feed ends.
2.5 Variable Cycles

If your make-up changes seasonally or periodically and you have a 2\textsuperscript{nd} conductivity sensor installed in the tower make-up line you can control using Varying Cycles.

No not use Varying Cycles if:
1. The holding time or turnover time of the tower is ‘long’ then the bulk of the tower water has not changed when the make-up conductivity changes & you may scale if hardness limited. ‘Long’ is site specific and a function of temperature, water chemistry and treatment program.
2. The make-up conductivity does not track the component that limits the maximum cycles.
   For example, hardness may increase with conductivity but silica may not & you may be silica limited.

**Varying Cycles** is not a Special Control option until Control By: is set to the ratio of the Tower-to-Makeup conductivities, \( \frac{A}{F} \) in this example

Set Blowdown Mode = Sensor Control and Control by: to More than one. Then edit to the ratio of the [Tower]/[Make-up].
In this example the tower conductivity is measured @ input ‘A’ & the make @ input ‘F’
Mathematical expressions require capitol letters! (A/F)
2.6 Blowdown Limit Alarms

Select the 1 to 9 icon on the home page. This example uses the Alarms page for a blowdown control on Relay 1.

The number of minutes in any one bleed cycle:

No = Alarm Logs & Displays but does not turn OFF the bleed

Yes = Turns ON the alarm relay when Relay 1 alarms

Most recent alarm for Relay 1

Adjust for the number of minutes that would represent a failure to control cycles of concentration, 2 hours in this example.

The default sets OFF on Alarm = No, some blowdown is usually better than none.

If you are using another relay or DO with the Special Control = Alarm Output, then you can elect to have Relay 1 alarm trip that relay or DO.

Yes & Submit resets the alarm

Sidebar:

**Obvious Alarm Causes:**
Failed or blocked blowdown valve or solenoid, blowdown line inadvertently valved OFF after tower maintenance. If solenoid intermittent, check the static head required to operate.
Faulted or debris blocked blowdown meter for towers using sequential meter control.

**Less Obvious Causes:**
Undersized bleed as load increases &/or make-up chemistry changes.
Adding more gray water make-up @ higher than expected conductivity.
Failure to adjust bleed setpoints as seasonal changes in make-up chemistry occur.

**Self-Inflicted Causes:**
Recalibrating a low reading conductivity sensor rather than cleaning it or identifying the cause of the low reading. Sensor subsequently fails to track tower conductivity. This alarm may indicate higher levels of water & inhibitor usage.

**Note:**
No blowdown ON time may indicate a float stuck ON or partially ON.
2.7 Blowdown Interlocks-Flowswitches

Select the 1 to 9 icon on the home page. This example uses the Interlocked page for a boiler blowdown interlock on Relay 4.

An Interlock stops a control from turning ON when the interlock is OFF.

If the control is ON when the Interlock turns OFF, the control turns OFF.

Select Interlocked from the pull-down

All enabled contact set type inputs are shown on the Interlocked page. Select or deselect one or more Interlock & Submit

In this example, the contact set input @ T must be ON for the Boiler 1 blowdown control on Relay 4 to run.

Cooling tower feed systems use a common flowswitch to interlock the bleed & all the chemical feeds. Boiler blowdowns typically use a separate interlock for each boiler.

A cooling tower flowswitch typically comes from a CTFS sensor but can be from any digital input device that represents flow.

In this example pulse output 8 controls a sulfite pump typically feeding into the Deaerator sump.

If either Boiler 1 (T) or Boiler 2 (U) is online, we want the sulfite pump to be feeding so we select both to Interlock & ‘OR’ them.

A flowswitch is part of a CTFS serial conductivity sensor. The temperature and flowswitch signals from this sensor must be assigned to phantom inputs. See section 5.6 Sensor Attributes for Phantoms.

Selecting more than one Interlock requires you to select ‘OR’ed or ‘AND’ed

OR = Any selected Interlock ON turns ON the control
AND = All selected interlocks ON to turn ON the control

Sidebar:
Contact sets that are ON are usually CLOSED, but you may invert the ON state to be ON when the contact set is OPEN; Section 7.3
2.8 Blocking-Delaying a Blowdown

Select the 1 to 9 icon on the home page. This example uses the Blocked by page for a Tower bleed block on inhibitor feed.

Select Blocked By from the pull-down.

Blocking stops a control from turning ON when the blocking control is ON.

More than one block may be selected.

In this example, the Inhibitor Feed pump controlled by Relay 3 Blocks the bleed to prevent inhibitor from going direct to drain.

Select which controls you wish to Block the bleed & Submit.

If feeding an oxidant into a common header with other reactive chemicals, you may elect to block the other chemicals from feeding when feeding oxidant.

Sidebar:
Warning: A poorly conceived block may prevent a control from running or working correctly. In this example, if the tower is bleed limited or the inhibitor pump undersized & therefore ON for an extended period, bleed control may fault.

You could elect to have the Bleed Control block the Inhibitor Pump & if you set the Bleed Setpoint inside of the float conductivity change, you’ll have little effect on Inhibitor Levels.

Bleed then Feed Inhibitor feed controls block the Inhibitor Pump by feeding after the bleed ends.

Blocking inhibitor feed is seldom used on larger circulating volume towers where the feed point is usually remote in time & volume from the bleed point.
2.9 Blowdown Diagnostics

Select the 1 to 9 icon on the home page. This example uses the Diagnostic page for a Tower bleed block on Relay 1.

This example uses the Diagnostic page for a Tower bleed block on Relay 1.

Status: ON/OFF, blocked, interlocked, alarmed...

Current value of the control sensor or control equation.

ON time in the current bleed cycle. In this example the same as "ON today" time, may indicate a control problem.

Added special control information. In this example, that we are running in the lowest range of make-up conductivity.

This example is a Special Control = Captured Sample boiler blowdown control by the sensor connected to input 'F'.

Captured Sample controls only update the value of the controlling sensor @ the end of the Measure period.

Why is the conductivity value so low?
Did the sampling valve-solenoid fail to open?
Did it fail to close & are we flashing @ the sensor?
Are we valved OFF upstream?
Did we just start-up & is the boiler cycling up?
Diagnostics provide the information, you supply the context.

The blowdown has only been ON 30 seconds today, likely a single Sample-Measure sequence.

Currently in the ReSample delay period. In 11.3 mutes, we'll open the blowdown valve-solenoid, Sample, close the Valve for the Measure period & update the value of 'F' the controlling conductivity. Then we'll either Blowdown or start another ReSample period.
3.1 Water Meter Inhibitor Feed

Select the 1 to 9 icon on the home page. This example uses the Setup page for an Inhibitor feed controlled by Relay 3.

Feeding using a water meter on the make-up or bleed, is among the most ppm accurate, reliable & easiest to adjust methods for sites with relatively constant feedwater chemistry.

After Setup, go to Adjust Setpoint & set for your target chemical ppm, pump setting, meter location...

Measure does not have to be a multiple of the meter setting, the control does the math.

Feed is the pump ON time, estimated based on pump size, stroke & frequency setting or adjusted based on a ppm test result.

If using a pulse or frequency controlled pump, each stroke delivers a fixed amount (of Dispersant in this example) so the Feed setpoint is in ppm.

See Section 8.0 for ml/stroke defaults & adjustments.

Sidebar:
If using a water meter on the bleed & a pulse-controlled pump, the nominal inhibitor ppm in the tower is the Feed setpoint x% active/100; 100% if feeding neat. See following page for make-up meter example.
Water Meter Inhibitor Feed cont.

It’s common to feed inhibitor on the sum of potable-city & gray water make-ups. If inhibiting for corrosion control, then you may wish to feed more on gray water make-up; increase the grey water meter scaling accordingly.

(A 100G/contact gray meter set to 200G/contact will double the feed).

If inhibiting for scale, then you may wish to feed less inhibitor on gray make-up; decrease the gray water meter scaling proportionately.

(A 100G/contact gray meter set to 50G/contact will halve the feed).

Changing the meter setup will also affect the totalized watermeter reading!

Sidebar:

**Simplified example:** Yes, this begs for an app & likely you have access to one; if not:

An 8 GPD pump with the meter on the make-up & running 4 cycles of concentration feeding a 50% active product & requiring 20 ppm of inhibitor in the recirculating tower water:

- 100 gallons of make-up needs a 10 ppm (20ppm x 100%/50% / 4 cycles) feed.
- An 8 GPD pump feeds (8 G / (24hr. x 3600 sec/hr.) 92.6E⁻⁶ G/sec.
- Every 100 Gallons of make-up we’ll need to feed (100G x 10 ppm) 1E⁻³ gallons which @ 92.6E⁻⁶ G/sec feed rate will take (1E⁻³ / 92.6E⁻⁶) 10.8 seconds

There are error sources: How accurate is the % active?

Is 8GPD @ site temperature range & static head? How accurate is the cycle control?…..

This is a first guess; test ppm & adjust.

If this is a start-up, use pump Prime to get to an initial ppm.
3.2 Sensor Controlled Feeds

Select the 1 to 9 icon on the home page. This example uses the Setup page for an Oxidant feed controlled by Relay 2.

Setting up a sensor controlled feed has 3 steps: Setup, Configure & Adjust Setpoint.

Select Setup from the pull-down.

Select Control Type = Feed, Set Feed Mode = Sensor & then select the controlling sensor for Control by: from the pull-down & Submit.

Edit for your site, up to 16 characters.

Inherited from the controlling ORP sensor. Units may be edited, up to 3 characters.

Default is the correct Control Action for an oxidant where feeding increases the controlling ORP value. ON decreases sensor would be used for a bisulfite, de-chlor control.

Setpoints for an ORP control will vary with site water chemistry & target ppm. Biologicals drive the ORP down. When it's 300 mV the pump turns ON & stays ON until the ORP is 325 mV.
Outputs 6 to 9 may be Mode configured as either Pulse Output or ON/OFF Output. Use Pulse for frequency controlled pumps & ON/OFF for Run/Stop controlled pumps.

In this example, we’ve configured output 7 for a frequency controlled pump.

If Mode = Pulse Output, the Configure page will show the installed Pump Type its nominal ml/stroke setting. Default ml/stroke assumes 100% stroke. Refer to Section 8. for detail on pump selector & settings.

Pump speed varies linearly between setpoints with maximum strokes/minute set by Pump Type.

If Mode = ON/OFF Output, the Adjust Setpoint fields will be On: & Off.

Sidebar:
WARNING: Reversing setpoint order is blocked for ON/OFF controls but allowed for proportional Pulse controls. Reversing setpoints in this example would convert an Acid feed to a Caustic feed.
3.3 Proportional Feed
3.3.1 Bleed Based Feed

**Bleed & Feed** and **Bleed then Feed** are used to feed inhibitor proportional to the tower bleed ON time. Commonly used on smaller towers without a make-up or bleed meter installed.

**Bleed & Feed** is usually only used when the tower is 'bleed limited', with the bleed undersized and ON for more than 50% of the time.

---

**Sidebar:**

**Bleed then Feed** is used to feed cooling tower inhibitor when a make-up meter is not available and the bleed is ON typically for less than 50% of the time that the tower is on-line.

If the tower Bleeds for \( X \) Minutes, the Inhibitor is fed for a user set % of \( X \) minutes \textit{AFTER} the bleed ends. It’s a better way to feed inhibitor for small cooling towers than Bleed & Feed since less inhibitor is lost down the drain.

Inhibitor savings averaging more than 20% were measured on a mix of small towers in California simply by switching from **Bleed & Feed** to **Bleed then Feed**.

**Reliability:**

**Bleed then Feed & Bleed & Feed** controls are only as reliable as the tower bleed solenoid and conductivity sensor. So set bleed limit alarms to trap control faults.
Time Modulation allows an ON/OFF pump to operate like a frequency or 4-20mA controlled pump. ON-OFF pumps are typically set to maximum stroke and rate when Time Modulation is selected.

Select the 1 to 9 icon on the home page. This example uses the Configure page for an Oxidant feed controlled by Relay 2.

2: Oxidant_Control

Status: Reconfigured
Descriptor: Oxidant_Control
Display Units (UOM): mV
Decimal digits: 1
Enable/Disable: Yes
Control Action: ON increases sensor
Special Control: Time Modulate
Period: 120 seconds

Setup a sensor based control as shown in Section 3.2 Sensor Controlled Feeds then change Special Control from None.

The selection of Control Action alters the ON & OFF time calculation in each Period.

Select Special Control = Time Modulate and set the Modulation Period in seconds & Submit.

In this example the setpoints are 50mV apart & the Period = 120 seconds. If the current ORP = 320mV then the pump would be ON for 72 seconds (120 x (350-320)/(350-300)) and OFF for 48 seconds (120 - 72).

The pump would be ON for 120 seconds in every 120 seconds @ the On: ORP & OFF for 120 seconds in every 120 seconds @ the Off: ORP.

Sidebar:
Time Modulate Special Control is only selectable on Relays 1-5 and 6-9 only when they are set to Mode = ON/OFF Output.
Timed Cycling allows time for the controlling sensor to measure the effect of chemical before feeding more chemical. Timed Cycling is used where a chemical is fed occasionally into a system with a large volume. It may be several minutes before the chemical travels from the injection point through the piping and sump and then back to the controlling sensor location at the recirculating pump.

Based on the setpoint, the relay will be on for the ON time in each period and off for the remainder of the period. Once the setpoint is reached, the relay will not turn on again until the setpoint calls for chemical. It is either on for the ON Time each period, or off for the complete period.

Sidebar:
Often there is a long time delay between adding a chemical and measuring its effect at a sensor which causes setpoint overshoot and poor control.
3.3 Proportional Feed

3.3.4 PID Controls (Relays 6 through 9 only)

**Warning:** An incorrectly configured PID control can be unstable or unresponsive when loaded or not. Wide swings in the sensor value can be the result of a poor configuration. If long delays (>5 minutes) exist in your control loop, or you are not experienced in PID control with long delays, we advise that you use a different proportional Special Control. (See section 3.3.2 and 3.3.3)

Select the 6 to 9 icon on the home page. This example uses the Configure page for an Oxidant feed controlled by Relay 7 in pulse mode.

**Select Configure** from the pull-down

Setup a sensor based control as shown in Section 3.2 Sensor Controlled Feeds then change Special Control from None to PID.

Select Configure page for an Oxidant feed controlled by Relay 7 in pulse mode.
3.4 Base Feed

Base Feed is usually interlocked with a tower flowswitch or the boiler run contact set & feeds chemical continuously while the flowswitch is ON or boiler on-line.

Select the 1 to 9 icon on the home page. This example uses the Setup page for a Dispersant feed controlled by pulse output 9.

1. Select Control Type = Feed
2. Select Mode = Pulse Output
3. Select Set Feed Mode = Base Feed & Submit

Then Adjust Setpoint & Submit
The pump type & ml/stroke are viewed - selected on the Configure page.

Relay 1-5 controlled base feeds are the same as Pulse 6-9 outputs configured Mode = ON/OFF output with Set Feed Mode = Percent Time & Submit

Then Adjust Setpoint & Submit
For ON/OFF Percent Time controls, the Setpoint = ON time in every 5 minutes.
In this example 25% = 75 seconds ON in every 300 seconds
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3.5 Control During Events

Select the 1 to 9 icon on the home page. This example uses the Setup page for an Oxidant feed controlled by Relay 3.

Select Setup from the pull-down.

Events only exist on the pull-down if Control Type = Feed.
Set Feed Mode = Sensor Control & the control is an oxidant, Bromine in this example.

Feed Events are set as detailed in the following Section 4.0.

Application flexibility:
1. Event Control = No works like normal biofeed feed event, feeding @ the current pump setting for the event duration.
2. Typically, the event setpoint would be higher than the non-event setpoints. But the control also works with event setpoints less than non-event setpoints.

Adjust Setpoint controls the Relay 3 Oxidant Feed using these setpoints until an Event occurs.

During an Event, if Event Control = No the control is ON for the Event period with no setpoint controls.

During an Event, if Event Control = Yes these setpoints control.
### 3.6 Limiting Feed & Alarms

Feed Limits are used both to prevent sensor controlled overfeeds & to block the effect of errors in adjusting feed rates or setpoints. Configure both the alarm & response to the type of chemical & how you are controlling the feed.

- **Select the 1 to 9 icon on the home page.** This example uses the Alarms page for an Inhibitor feed controlled by relay output 3.
- **Select Alarms from the pull-down.**
- **You’re usually not concerned about extended feed periods with inhibitors, so Mins/Actuation typically set to never trip.**
- **At the expected usage for this size tower @ max. load, cumulative feed over 4 hours/day indicates either a control problem or setpoint error. When Minutes/Day is exceeded, feed stops.**
- **Inhibitor feeds usually set Midnight Reset = Yes, which auto resets alarms @ midnight allowing another 240.0 minutes of feed in the following day.**
- **If you are using another relay or DO with the Special Control = Alarm Output, then you can elect to have Relay 3 alarm trip that relay or DO.**
- **Select Reset Alarm = Yes & Submit to clear alarms (see Sidebar).**

**Sidebar:**

Unlike Blowdown controls, Feed controls stop feeding when alarmed. If alarmed on Mins/Actuation, the alarm ends the Actuation period, so Reset Alarm = Yes & Submit re-starts the feed.

If alarmed on Minutes/Day, Reset Alarm does not restart the feed because we’ve still exceeded the Minutes/Day limit. If you need to continue to feed, increase the Minutes/Day limit.

In either case. The alarms are either set too tight, operating conditions may have changed or there is a control-pump-feed-sensor problem.
Limiting Feed & Alarms cont.

Alarms on feeds for acid, caustic or oxidants that are not tripping because they are set too tight to the normal operating or seasonal variation, usually indicate a maintenance response is required.

Make-up water chemistry may have changed. Towers may have added a gray water make-up or boilers may have deaerator problems or contaminated condensate return. Sensors age, foul & drift. Meter wiring may be sharing conduit with power wiring...

Sidebar:
Feed controls stop feeding when alarmed. If alarmed on vol.@MAXspm, the alarm ends feed cycle, so Reset Alarm = Yes & Submit re-starts the feed.

If alarmed on Volume/Day, Reset Alarm does not restart the feed because we’ve still exceeded the Volume/Day limit. If you need to continue to feed, increase the Volume/Day limit.
3.7 No Feed on No Flow

Select the 1 to 9 icon on the home page. This example uses the **Interlocked** page for a Boiler treatment feed controlled by relay output 5.

In this example, when the contact set @ input 'U' Boiler 2 Online is ON then the relay 5 feed control runs.

Select **Interlock** from the pull-down.

Select **Interlock** @ the target input & Submit.

In this example relay output 3 controls an inhibitor pump. If both **Flowswitch** (S) and **Low_Level** (U) are ON, we want the inhibitor to be feeding so we select both to **Interlock** & ‘**AND**’ them. (Avoiding both a loss of prime & pumping dry.)

Selecting more than one Interlock requires you to select ‘**OR**’ed or ‘**AND**’ed

**OR** = Any selected Interlock ON turns ON the control

**AND** = All selected interlocks ON to turn ON the control.
3.8 Blocking-Delaying a Feed

Select the 1 to 9 icon on the home page. This example uses the Blocked by page for an Inhibitor feed controlled by relay output 3.

Select Blocked from the pull-down.

Blocking stops a feed control from turning ON when the blocking control is ON.

More than one block may be selected.

In this example, the Oxidant_Control pump controlled by Relay 2 Blocks the Inhibitor Feed on Relay 3 to prevent degrading the inhibitor in the common feed header.

Select which controls you wish to Block the Inhibitor Feed & Submit.

Sidebar:
Warning: A poorly conceived block may prevent a control from running or working correctly.

In this example, if the Oxidant_Control runs long because the chlorine demand is not met or the control setpoints are set too far apart, inhibitor levels in the recirculating water may fault.

Generally (dependent on tower size, injection point & siting), once you've met the initial chlorine demand, setting ORP setpoints 5-10mV apart should result in short oxidant feed periods.

If you have a large inhibitor pump &/or short inhibitor feeds, you could get the same result by blocking the Oxidant_Control with the inhibitor pump.
3.9 Feed Diagnostics

Select the 1 to 9 icon on the home page. This example uses the Diagnostic page for an Acid Pump controlled by pulse output 7.

Select either the I/O icon on the home page or Diagnostic from the pull-down menu. Diagnostic provides both configuration & state detail on one page.

In this example: We’ve measured volume but have not fed all the time required, so there is Time Owed.

Note that 1400G / 100G x 10sec = 2.33 minutes. But pump ON for 240.4 minutes today, so feed mode must have been changed.
Feed Diagnostics cont.

Control state: In this example, the Bleed then Feed Special Control is controlling Relay 3

The Bleed is now OFF & we owe 7475 seconds of pump run time. Is a 2 hour bleed cycle normal for this site or does it indicate a problem?

Control state: In this example, the Percent Time Special Control is controlling 9 configured as an ON/OFF output

We’re in the ON state for another 33 seconds of the 5 minute cycle. 25% of 5 minutes = 75 seconds

Control state: In this example, the Inhibitor feed on relay 3 is controlled by the meter @ input ‘O’ is OFF because the Flowswitch @ input ‘S’ is OFF (S Interlocks 3)

If ‘O’ measures volume while interlocked, the feed for the measured volume will occur when ‘S’ turns ON

Control state: In this example, the Oxidant Control by relay 2 is Blocked & OFF when Relay 3 turns ON
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4 Biocide Events & Other Controls: Feeding by Time & Date

4.1 Setting & Viewing Events

Select the 1 to 9 icon on the home page. This example uses Bioicide A controlled by relay 5.

Select Setup from the pull-down & after Submit, select Events.

Day# in the current 28 day cycle. Monday, Day 2 in this example. May be reset to the current Sunday, See Section 10.7

A new biocide control will have 0 Events set.

Events repeat Daily, Weekly or every 28 Days. Select the required Event Cycle.

In this example, the first event occurs on Monday, day 2 starting @ 7:00 AM & feeding for 20 minutes.

In this example, we’re also adding feed events on Wednesday, Friday & Sunday by selecting Alternate Days & Submit.

Sidebar:
Relay 1-5 and ON-OFF 6-9 controls have timed events = ON Time. Pulse-frequency controls 6-9 have volume feed events = Volume.
Setting & Viewing Events cont.

In the previous page’s example, 4 feed events on Monday, Wednesday, Friday & Sunday were added on Submit.

Select Activity to Edit an Event, Delete an Event, Delete All Events, or Add an Event (see previous page).

Pull down this selector to view all of the events for this control & to select an event for Editing or Deleting.

If Select Activity = Edit an Event or Add an Event, the values in these fields are set on Submit.

Sidebar:
Limit Alarms, Interlocking & Blocking also are used with Biocide Events. They are set identically to those for Chemical Feed Controls. Refer to Sections 3.5 to 3.7 for setup & state pages.

Biocide feeds are always interlocked with the tower flowswitch.

Timed & Volume events can also be used to wash sensors, flush sumps, block other controls for event times.
4.2 Prebleed – Lockout

Sidebar:
Prebleed-Lockout is used to prevent the tower from making up during & diluting the biocide concentration. Use is determined by biocide type & required concentration-residence time.

Prebleed is typically used for cycles limited towers with Lockout more common on towers inhibited for corrosion control. Few sites need to use both.

Prebleed costs both water & its inhibitor, but there may be no choice if hardness cycles limited. Lockout has a lower cost but not applicable for many sites.
4.3 Alarm Relay

Select the control# icon from the right side of the home page

Select Setup from the pulldown

Verify Control Type = Events-Other

Then select Configure from the pulldown

Set Special Control = Alarm Output & Submit

Sidebar:
If Special Control = Alarm Output is set for a pulse-frequency control (6 to 9), the control is converted to an ON/OFF control on Submit.
4.4 Sensor Wash

Sensor Wash is usable for systems-sites where all of the sensors are installed in a common header.

Sensor Wash locks all of the sensor values prior to starting the wash event, blocking alarms & unexpected sensor values on the HMIs. If concerned about other controls running during a wash, block (Section 3.7) the controls.

Sensor Wash events are set like all other feed events on either time (Relay controls 1 to 5 & ON/OFF Pulse controls) or pumped volume (Pulse controls 6-9).
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5 Sensors: Conductivity, pH, ORP, Corrosion, 4-20mA...

5.1 Sensor Calibration:
5.1.1 Single Point – Grab Sample

Select the A to N icon on the home page or the CAL icon below the A-N icons. This example calibrates conductivity sensor connected to input ‘A’.

If using the A to N icon, select Calibrate from the pulldown.

Enter value 1650 uS

Grab sample from the sensor header & enter measured conductivity & select Calibrate.

Factory Reset Yes ✔ No

Calibrating locks out the local keypad user so that both users are not calibrating at the same time. Cancel to remove the lock & exit calibration.

In this example we edited the current 1650 uS to measure 1700 uS.

Exit by selecting Cancel at the end of Calibration or you’ll lock out keypad calibration for this sensor for 15 minutes.

Single point, grab sample calibration is typically used for controlling sensors which need to be accurate at the single point used for control.

Each sensor type has calibration limits which usually indicate a sensor or installation problem, but not always.

If you get an error message you can ignore it by

Calib. Override = Yes & Submit

Factory Reset = Yes & Submit restores the sensor to its default values. Useful for pH, ORP & Conductivity sensors.

New sensor value may indicate fouling or end-of-life state or allow you to recover from a faulted calibration procedure.

Cancel leaves the sensor value unchanged, Removes the lock out on keypad calibration & exits.
Sidebar:
The DPD calibration applies to CLB, CTE & CLE3 Chlorine, CGE, CBR Bromine & PAA Peracetic sensors. All of these sensors connect to 4-20mA input driver cards. The G input does not have the necessary voltage to power a loop for the ProMinent amperometric sensors. ProMinent does not recommend ORP sensor calibration. If the sensor is not tracking, clean with a mild acid. The Offset may be adjusted +/- 40mV if necessary. Rather, consider changing the setpoint. There are many non-oxidants that affect ORP sensors falsely.
5.1 Sensor Calibration:

5.1.3 Boiler Conductivity

Select the A to N icon on the home page or the CAL icon below the A-N icons. This example calibrates the boiler conductivity sensor connected to input E.

The blowdown control is using Special Control = Captured Sample. Calibration includes services to verify the sensor installation.

Select Start once you have an un-flashed sample to initiate the Sample – Measure sequence.

Select Cancel to exit Calibration. Removes the calibration lockout for the keypad user & the calibration state from the blowdown valve control.

Use Refresh to see the conductivity increase during the Sample period. Low or varying conductivity indicates flashing. No change may indicate no-sample.

If you elect to edit the displayed conductivity & Calibrate before the end of Sample - Measure, the previous value conductivity will be used to calibrate.

If you edit the displayed conductivity & Calibrate after the end of Measure, the current, updated value conductivity will be used to calibrate.

Refresh during the Measure interval should show a stable & falling conductivity, verifying that the valve-solenoid has closed & that the sample is cooling a fixed & repeatable amount.

Successful Calibration. Select Cancel to exit & remove keypad calibration lock-out.

If an error message results, you can set Calib. Override = Yes & Submit or Start to re-calibrate.
5.1. Sensor Calibration:
5.1.4 pH Dual Buffer Calibration

Select the A to N icon on the home page or the CAL icon below the A-N icons. This example calibrates the pH sensor connected to input C.

If using the A to N icon, select Setup from the pulldown to verify 2 Point.

pH sensor calibration defaults to single point. To do a 2 buffer pH calibration, select Calibrate = 2 Point & Submit. Then select Calibrate from the pull down.

Caution: Sensor Removal
Always close the sensor piping upstream valve first. pH, ORP sensors & sensor with membranes may fail on the high transient pressure caused by quickly closing the downstream valve first.

Press Start. Remove the pH sensor & place in the 1st buffer. Calibration defaults to 7 & 10 buffers. If you are not using a 7 buffer, edit the buffer value before Start.

Start locks the pH value for control and alarms during the 2 buffer calibrate sequence.

The selected 1st buffer in this example is the default 7.00.

Refresh until the pH is stable & close to the buffer value. Then press Next.

Select Cancel to exit Calibration.

Select Cancel to exit Calibration.
5.1 Sensor Calibration: pH Dual Buffer Calibration 2 of 2

- If you are not using a 10 buffer, edit the buffer value before Next.
- Refresh until the pH is stable & close to the 2nd buffer value. Then press Calibrate.
- Select Cancel to exit Calibration.

Note: Two buffer pH calibration seldom results in better pH control than single point, grab sample calibration, but may be required by site practice.

Successful calibration. Press Cancel to exit Calibration.

On error message, select Calib. Override = Yes & Submit
Or Re-calibrate to do over
Or Cancel to exit leaving the current pH value unchanged.
5.1 Sensor Calibration:
5.1.5 4-20mA Input Loop Calibration 1 of 3

4-20mA inputs may be single or two point calibrated if they do not require a DPD test. Both options calibrate the sensor represented by the 4-20mA input & not the underlying 4-20mA current loop. For example: If calibrating a 4-20mA Temperature sensor, you are correcting the sensor to read the current measured Temperature test.

Select the A to N icon on the home page or the CAL icon below the A-N icons. This example calibrates the 4-20mA sensor connected to input G. If using the A to N icon, select Setup from the pulldown & check Calibrate = 1 Point.

Once a sensor has been selected for control by a relay, the Setup menu changes. ‘Sensor Type’ will not be seen. In its place is a Used by note depicting the relay being controlled. See section 3.2 Sensor Controlled Feeds. Choose a different sensor to release this sensor setup page. Remember to return the sensor selection when done.

In this example we’re going to single point Calibrate a Sensor Type = Other.

Edit the sensor value & Calibrate Status = Calibrated & displays new value.

Cancel To exit & to unlock keypad calibrate access.
On this page we are 2 point calibrating a 4-20mA Temperature sensor.
Verify the Setup page **Calibrate = 2 Point** & select **Calibrate** from the pull down.

In this example we’re going to 2 point Calibrate a Sensor Type = Other which requires (in this example) that you either put the temperature sensor into 2 solutions of differing temperatures OR use a 4-20mA current loop emulator.

Enter the first temperature & Start (In this example, spanned 0-100C, 8mA = 25C)

Move the sensor or modify the loop current, enter the 2nd temperature & **Calibrate** (In this example, spanned 0-100C, 12mA = 50C)

**Status** = **Calibrated** & displays most recent value

Sensor type = Other Always calibrates. Understandably, there are no calibration limits for ‘Other’ sensors

Cancel to exit & to unlock keypad calibrate access
5.1 Sensor Calibration: 4-20mA Input Loop Calibration 3 of 3

You'll rarely need to calibrate the underlying 4-20mA current loop. However, if Setup page Sensor type = Other and Calibrate = 2 Point you can calibrate the underlying 4mA & 20mA levels as follows:

You'll need either a current loop emulator Connected to input ‘G’ (in this example) or the means to switch the current loop to 4mA & then to 20mA

Set Calibrate 4-20mA = Yes & Submit

Set the current loop @ ‘G’ to 4mA & Start

Set the current loop @ ‘G’ to 20mA & Next

Select Calibrate to complete

The measured 4 & 20 levels are the actual currents at input ‘G’. If they are not nominally 4 & 20mA, then that may indicate why you are calibrating input ‘G’ or you may have an emulator problem

Status = Calibrated on success or error message

Cancel to exit & to unlock keypad calibrate access

Enter 1st value

40.07 C

4.00 mA measured

20.00 mA measured

Status

Calibrated

Enter Submittable

Yes

No

Start

Cancel

Submit

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5.1 Sensor Calibration:
5.1.6 Inventory

Phantom inputs do not physically exist; you can’t wire to them. They are of two types: Analog values in the ‘K’ to ‘N’ space & volumes-contact sets in the ‘W’ to ‘Z’ space. This example, uses ‘K’ as a tank level.

Phantom inputs do not physically exist; you can’t wire to them. They are of two types: Analog values in the ‘K’ to ‘N’ space & volumes-contact sets in the ‘W’ to ‘Z’ space. This example, uses ‘K’ as a tank level.

Input ‘K’ has Compensation set to Inventory

Inventory subtracts the volume pumped by pulse controls and/or the volume measured by displacement metering on the pump head from the user set volume.

In this example, the volume pumped by pulse control ‘6’ lowers the tank level.

Phantoms are logged, alarmed & can be used for controls. In this example, likely only a low tank level alarm is used.

When the tank is refilled, edit Enter Value & Calibrate to set the current tank level.

Cancel to exit & to unlock keypad calibrate access.
5.1 Sensor Calibration:

5.1.7 LSI & Manual Inputs

LSI (Langelier Saturation Index) Compensation was selected for phantom sensor input ‘L’

Calibrate prompts for those values not measured by the controller

In this example both the pH & conductivity are measured by controller sensors, so only 2 parameters are required to calculate the LSI. (Temperature always measured by the controller)

Measure Alkalinity, edit & Calibrate

Measure Hardness, edit & Calibrate

Calibration completes.
LSI recalculated.

Cancel to exit & to unlock keypad calibrate access

Sidebar:
Ryznar Stability Index or ‘Ryznar’ is a generalized measure of scaling-corrosivity & calculated concurrently from the same parameters & sensors as LSI.
The Ryznar value is displayed on the LSI Diagnostics page & Ryznar alarms are set on the LSI Alarms page

Manual LSI values are clamped to block measure-entry errors;
Alkalinity: 30 to 140 ppm        Hardness: 50 to 400 ppm
Conductivity: 100 to 10,000 uS    pH: 6 -10
If you enter a value outside of the range, the value is set to the closest range limit.
Phantoms are logged, alarmed & can be used for controls. In this example, the drop test results may be logged so that they can be aligned in time with feed rates & other sensor values.

Once Compensation has been set to Manual Entry, rename the Descriptor, Units & digits (after the decimal) to fit your usage.

Input ‘N’ has Compensation set to Manual Entry.

5.1.8 CTFS Flowswitch Calibration

A CTFS flowswitch can be adjusted by editing the “Flowswitches” value box in the conductivity -Configure menu. Lowering the value will cause the switch to turn on for a smaller amount of flow but may have difficulty turning off at no flow.
A corrosion rate sensor should never be calibrated. Open the Configuration menu and select the Alloy you are using. Press Submit.
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5.2 Sensor Alarms  1 of 2

Sidebar:

Every sensor, water meter, flowswitch & each control has alarms. Typically, alarms are used to trap changes in operating conditions (make-up water, temperature...) mechanical faults (stuck floats, valved off or faulted blowdown-valves), feed issues (loss of prime, low tank level, tubing faults) & sensor faults (failure to track, fouling...)

Setting alarms too tight so that they trip frequently under normal operating variances, may result in a critical alarm getting a slow or no response.

Understandably alarms are set to reflect site practice, chemistry & plumbing & time of year. Review each control loop, its sensor-meter, interlock, pump or actuator & setpoints. It’s typical that sensor & feed limit alarms in concert can trip on the most likely faults.
5.2 Sensor Alarms

LSI alarms differ from other sensor alarms which are limited to high & low alarms referenced to the current value of the sensor.

Sensor high & low alarms & LSI alarms latch. Meaning they persist until Clear Alarms. All unacknowledged alarms flash the red led at the top, right of the controller enclosure cover & appear on the home page on the browser HMI.

<table>
<thead>
<tr>
<th>Status</th>
<th>Alarmed</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSI Scaling</td>
<td>0.50</td>
</tr>
<tr>
<td>RYZ Corrode</td>
<td>8.50</td>
</tr>
<tr>
<td>RYZ Scaling</td>
<td>4.50</td>
</tr>
<tr>
<td>Alarm Relay</td>
<td>Yes</td>
</tr>
<tr>
<td>Delay on Alarm</td>
<td>5.0 minutes</td>
</tr>
<tr>
<td>Clear Alarms</td>
<td>Yes</td>
</tr>
<tr>
<td>Scale Alarm</td>
<td>10.28 2016-Aug-29</td>
</tr>
<tr>
<td>Disable Alarms</td>
<td>Yes</td>
</tr>
<tr>
<td>Slider Max.</td>
<td>10.00</td>
</tr>
<tr>
<td>Slider Min.</td>
<td>-10.00</td>
</tr>
</tbody>
</table>

Select the A to N icon on the home page. This example is LSI on phantom input ‘L’

Select Alarms from the pulldown

Practice varies, but typically any LSI > 0 indicates scaling

Again, opinions vary, but typically Ryznar > 8.0 indicates a corrosive stream

And typically a Ryznar < 6.0 indicates scaling

The LSI & Ryznar levels for alarms vary widely. In the absence of guidelines for your water chemistry, metallurgy, exchanger tube type & treatment program, it’s you & Wikipedia

Clear Alarms = Yes & Submit resets the alarm on ‘L’ only

If a sensor has previously alarmed, the most recent alarm type & when it occurred are here. LSI displays either Scale Alarm or Corrode Alarm

LSI & Ryznar duplicate a response on scaling. Not surprising since both indexes are derived from the same parameter set.
5.3 Sensor Setup 1 of 2

Select the A to N icon on the home page. This example is an ORP sensor connected to input ‘D’.

Select Setup from the pulldown.

Edit Descriptor to site name for browser & local HMIs. Maximum 16 characters.

Edit Units, defaults to typical for sensor type. Maximum 3 characters.

# of digits after decimal. Defaults to typical for sensor type. pH = 2, conductivity = 0.

1 Point or 2 Point calibration. Defaults to 1 Point, typical for controlling sensors.

Submit to modify.

Used by I/O blocks the Disable option & indicates where the sensor is used. Controls 7 & 8 in this example.

Select Configure from the pulldown to set the Sensor Alloy for corrosion rate sensors. Defaults to Carbon Steel.

Select Configure from the pulldown to set the Sensor Alloy for corrosion rate sensors. Defaults to Carbon Steel.

Sensor Alloy

Other

1.000

If the Sensor Alloy pull down does not have the electrode metallurgy you’re using, select Other & Submit. (Commonly used metals for cooling towers are in the pull down)

Alloy# is the ratio of Other electrodes to Carbon Steel (= 1.000) weight loss for LPR type sensors.

Sidebar:
Disabled sensors do not appear on either the local or browser HMIs or any option pull down. Sensors cannot be disabled while in use for control or compensation. Disabled sensors are re-enabled on the System / Enable I/O page.
5.3 Sensor Setup

Select Setup from the pulldown to set the type of conductivity sensor connected to a dual conductivity driver card.

Boiler Cond. are 2 wire, non-temperature compensated. Conductivity are 4 wire, non-metallic temperature compensated. Condensate are 4 wire, ¾” NPT, temperature compensated.

Sidebar:
Selecting a Sensor Type installs the correct 4-20 mA to sensor value conversion & sets calibration limits.
5.4 Sensor Compensation

Select Configure from the pulldown to select view Compensation. Not all sensor types have Compensation.

Tower conductivity is always thermally compensated. Select Compensation = Thermal Comp & Submit. Then select Thermal Sensor = target sensor & Submit.

This Compensation value works for cooling towers, your app may differ.

Serial conductivity sensors include a temperature sensor (assigned to ‘K’ in the example) & a thermal flowswitch with the option to Override the switch flow/no flow trip point.

Some amperometric oxidant sensors may be pH corrected. Seldom useful for cooling towers where cycle control fixes the pH. More useful for process apps where pH varies.

Select Compensation = pH Corrected & Submit. Then select pH Sensor = target sensor & Submit.

Sidebar:
Controllers are typically pre-configured for the target app. So cooling tower controllers will include a temperature compensated conductivity.

If you are re-purposing a controller or adding additional sensors & controls then you may be changing-modifying the default compensation.
### 5.5 Sensor Diagnostics  1 of 3

Select the A to N icon on the home page & the **Diagnostic** page will display

---

**A: Tower Conduct.**

<table>
<thead>
<tr>
<th>Sensor Type</th>
<th>Conductivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variance this hour</td>
<td>2542 to 2564 µS</td>
</tr>
<tr>
<td>Raw sensor</td>
<td>332</td>
</tr>
<tr>
<td>Gain Multiplier</td>
<td>8.5000</td>
</tr>
<tr>
<td>Offsets Adjust</td>
<td>0.0003uS</td>
</tr>
<tr>
<td>Alarmed High</td>
<td>14:52:34 2016-Aug-30</td>
</tr>
<tr>
<td>Sensor OK</td>
<td>Connected</td>
</tr>
<tr>
<td>78.1F Flow OFF</td>
<td>Flow 2514 ON @ 3600</td>
</tr>
</tbody>
</table>

---

Sensor inputs 'A' & 'B' are used for serial sensors.

Or select Diagnostic from the pulldown

If sensor used for control then **Variance** shows the range of values as the control operates. Reset on the hour.

The sensor value = Raw sensor $\times$ Gain $+$ Offset

Modified in this case by **Thermal Compensation**

After calibration, **Gain** or **Offset** or both will be adjusted

Most recent alarm type & time-date

Serial conductivity sensors include temperature (78.1F) & a thermal flowswitch.

**Flow 2514** is less than **ON @ 3600** so Flow OFF

---

Serial sensors auto-install on power ON.

If you switch types & the previous type was used for control, the control is disabled

Wiring-connection problems flagged here

Attributes which may be assigned to phantoms 'K' to 'N' (See Section 5.6) are displayed @ the source sensor I/O location.

The ‘Pitting’ or imbalance value in this example

Some fields are specific to the sensor type. In this case the corrosion rate sensor is using Carbon Steel electrodes

---

**Sidebar:**

Diagnostic is a summary of the sensor state. Contents vary widely with sensor type.
5.5 Sensor Diagnostics

Select the A to N icon on the home page & the Diagnostic page will display

Sensor inputs 'C-D', 'E-F' and 'I-J' are used for driver cards so the installed sensor will vary with the type of installed card: pH-ORP, conductivity, 4-20mA input, serial sensor or pH-Temperature

In this example, there is a pH-ORP card installed in the C-D slot & 'C' is a pH sensor

This pH sensor not used for control or the Variance would reflect the control loop delay dependant of feed point, sensor location & re-circ water volume

The sensor value = Raw sensor x Gain + Offset

Most recent alarm type & time-date

Parameters for the Dual pH or ORP card installed in the C-D slot

The sensor value = Raw sensor x Gain + Offset

Single point calibration modifies the Gain or Offset (varies with sensor type)
Two point calibration modifies both the Gain & Offset

Parameters for the Dual conductivity card installed in the E-F slot
AEGIS II Browser

5.5 Sensor Diagnostics  3 of 3

Select the A to N icon on the home page & the Diagnostic page will display

G:CLE3 Chlorine

Sensor inputs 'G' (4-20mA input) & 'H' (10mV/C thermal sensor input) are fixed in controller hardware unlike the sensor driver slots @ C-D, E-F & I-J

In this example, a 4-20mA CLE3 Chlorine sensor is connect to input 'G'

The user selected 0.00 to 10.00 ppm CLE3 sensor type converts the 4-20mA signal (10.99mA or 58.3% of span) from the sensor to a ppm value.

In this example 10.99mA x 0.833 -3.333 = 5.82ppm

(ppm = mA x Gain + Offset)

Phantom inputs configured to calculate LSI show Ryznar & the values of the LSI-Ryznar calculation parameters on the Diagnostic page.

L:LSI

Phantom inputs derived from sensor attributes may be independently calibrated modifying the Gain or Offset value applied to Raw Sensor

In this example the Temperature is derived from the sensor connected to input 'A', attribute 1 (this serial conductivity sensor has 3 attributes)

 Phantom inputs configured to calculate LSI show Ryznar & the values of the LSI-Ryznar calculation parameters on the Diagnostic page.
5.6 Using Sensor Attributes for Phantoms

Phantom sensors are input ‘K’ through ‘N’ and can be enabled from the System Enable I/O page. Once enabled they will automatically appear on the home page for the controller and can be assigned attributes from sensors or used for manual entries and inventory & LSI calculations.

Sidebar:
Phantom Sensors ‘K’ to ‘N’ and phantom meters-contact sets ‘W’ to ‘Z’ are logged, alarmed & can be used for compensation & controls. They are phantom in the sense that they do not have wiring locations.
5.7 Inventory: Using feed meters & pumped volumes

Select the K to N icon on the home page
To make a phantom input track tank volume

Select **Configure** from the pulldown

Select **Compensation = Inventory & Submit**

**Inventory** displays all of the volume measuring inputs & pulse controlled pumps.

If using a Tacmina or equivalent displacement meter on an ON/OFF pump, they are typically set to 1mL/pulse.
If U.S. units, meter scaling = 3785 pulses/G
If metric units scaling = 1000 pulses / L

Select all of the meters & pumps that use the target tank & **Submit**.
In this example only the Inhibitor Pump uses the target tank

Initial tank level & tank level on refill is set using **Calibrate**.
Measured & pumped volumes are subtracted from the **Calibrate** value.

<table>
<thead>
<tr>
<th>K:Inventory</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compensation</strong></td>
<td><strong>Inventory</strong></td>
</tr>
<tr>
<td><strong>Q: Tower Make-up</strong></td>
<td>unused</td>
</tr>
<tr>
<td><strong>P: Feedwater</strong></td>
<td>unused</td>
</tr>
<tr>
<td><strong>Q: Tower blowdown</strong></td>
<td>unused</td>
</tr>
<tr>
<td><strong>R: Grey Water add</strong></td>
<td>unused</td>
</tr>
<tr>
<td><strong>V: Water meter</strong></td>
<td>unused</td>
</tr>
<tr>
<td><strong>Z: Water meter</strong></td>
<td>unused</td>
</tr>
<tr>
<td><strong>6: Inhibitor Pump</strong></td>
<td><strong>Target Output</strong></td>
</tr>
<tr>
<td><strong>8: ORP pid</strong></td>
<td>unused</td>
</tr>
</tbody>
</table>

**Sidebar:**
Metric or U.S. units are set on the **System / System Setup** page.
The controller converts the pumped mL/stroke setting to either Liters or Gallons depending on the **System Setup metric units = Yes - No** setting.

Volume meters are assumed to measure either Gallons (U.S. units) or Liters (Metric) when calculating **Inventory** - tank levels or ppm concentrations.
Scale all of the volume meters according to the System units setting.
6.1 Configuring a New Meter

Select the O to V icon from the right side of the home page to configure—set up a new meter or modify an existing meter.

Select Setup from the pulldown menu and enable new meters @ the System, Enable I/O page. Enabled as a contact set and appears on right side of home page. See Section 7.1 to switch to meter.

Enable new meters @ the System, Enable I/O page. Enabled as a contact set and appears on right side of home page. See Section 7.1 to switch to meter.

Select the O to V icon from the right side of the home page to configure—set up a new meter or modify an existing meter.

Select Setup from the pulldown menu and enable new meters @ the System, Enable I/O page. Enabled as a contact set and appears on right side of home page. See Section 7.1 to switch to meter.

Select Edit Descriptor to set site name, 16 characters max, and Submit.

Select Edit Units (defaults to system units), 3 characters max, and Submit.

Select # digits after decimal and Submit.

Disable & Sensor Type options only display if meter not in use by another I/O.

Turbine Meters are scaled by "K" Factor (pulses/gallon)
Contact head, Water Meters are scaled in Vol/contact closure.

Select Sensor Type = Turbine Meter (3 wire meters)
or Water Meter (contact head, 2 wire)
& Submit to set meter type

In this example, the meter @ ‘O’ is used by the control relay ‘3’ so Disable & Sensor Type are not available.

Select Sensor Type = Turbine Meter
or Water Meter controls the type of debouncing used internally to measure pulse streams or contact closures.

Turbine Meters are scaled by ‘K’ Factor (pulses/gallon)
Contact head, Water Meters are scaled in Vol/contact closure.
6.2 Copying, Flow Rate Alarms & Rate-to-Volume

**Compensation = Copy Meter**

Use *Copy Meter* to sum make-up or blowdown volumes from multiple towers or boilers.

**Target Meter** = phantom Meter in the 'W' to 'Z' space & Submit

This example sums the meter volumes @ 'V' and 'Q' to the phantom meter at 'Z' using *Copy Meter*.

**FlowRate Alarm** is used to alarm on high or low flow rate. Disabled when offline on if *Flowswitch* not 'None'.

**Compensation = FlowRate Alarm & Submit**

Then set *High & Low* alarms & Submit. Set *Low Alarm* < 0 if you don’t want a low flow alarm or if flow is not continuous.

**Compensation = Rate to Vol & Submit**

Select a *Flowrate sensor* & Submit

Use *Rate to Vol* to convert a 4-20mA input on *Flowrate* to a volume on a meter input.

Alarms do not occur when *Flowswitch* = OFF

Optional: Select a *Flowswitch* & Submit

Select *Compensation = Rate to Vol.* Then select a *Flowrate sensor* & Submit

Use *Rate to Vol* to convert a 4-20mA input on *Flowrate* to a volume on a meter input.
6.3 Meter Diagnostics

Select the O to V icon from the right side of the home page to view the Diagnostic page.

Meters display the volume measured from midnight on the home page.

or select Diagnostic from the pulldown

Useful if the towers run 7 days/week otherwise discount for typical ON/OFF day ratio

Total since meter installed

Contact head meters calculate Rate using the interval since the last volume increase event. Therefore not representative on first count of a new cooling day or first count on a new bleed cycle.

Volume resolution (digits after the decimal) is set by Decimal Digits on the Setup page

Turbine type meters calculate Rate every second as meter pulse counts are measured. Therefore Rate is more representative than contact head meter rates because counting occurs more frequently.

DI (Digital Input) driver detail
Shared by all inputs ‘O’ thru ‘V’
6.4 Meter Alarms

Select the O to V icon from the right side of the home page to view the Diagnostic page or select Diagnostic from the pulldown.

**HiAlarm** is the volume measured from midnight. Edit & Submit

**LoAlarm** is set on the daily volume. It’s checked only once @ midnight. Edit & Submit

**Alarm Relay** = Yes & Submit will turn ON the alarm relay if one has been configured.

**Disable Alarms** = Yes stops new alarms on meter input ‘P’ in this example.

If alarmed, a Clear alarms option will be included on this page.

If you clear a HiAlarm & the day has not changed, it will re-alarm because today’s volume is more than HiAlarm.

In this example, we want an alarm on any **Grey Water** make-up. But don’t want an alarm if there is no **Grey Water** make-up (so LoAlarm is less than zero)

In this example, we’re also using one of the relays or pulse outputs as a dedicated alarm relay, perhaps to the site DCS.
7 Flowswitches, Interlocks & Contact Sets

7.1 Switching Meters & Contact Sets

Volume meters and contact set inputs are connected in the ‘O’ to ‘V’ namespace. They are also in the ‘W’ to ‘Z’ phantom space. If the meter or contact set input is not being used for control, it can be re-purposed, making a contact set a meter or the reverse.

When an input in the ‘O’ to ‘Z’ namespace is enabled, it’s initially configured as a contact set.

Contact sets are ON when the contact set is closed. The logical sense of the input may be inverted so that ON = contact set open (Refer to Section 7.3).

Select the O to V icon from the right side of the home page
Select Setup from the pulldown
Select Sensor Type from the pulldown
Water meter = 2 wire contact head meter
Turbine meter = 3 wire pulse meter
& Submit

Changing the DI (digital input) type using Sensor Type is not available if the DI is in use by a control, interlock, fail-to-feed...

In this example, Used by I/O indicates that S:Flowswitch is used by the control for relays 1 & 3. (likely as an interlock flowswitch)
7.2 Contact Set Alarms

Select the O to V icon from the right side of the home page
Select Alarms from the pulldown

In this example, if the flowswitch is ON for more than 10 hours it will alarm. Edit & Submit to modify

The No Flow Alarm is set to > 1440 (the number of minutes in a day) so it will never alarm.

Alarms use the time ON or OFF today which is reset to 0.0 @ midnight.

In this example, we’re using the alarm to alert us if the cooling tower is offline for more than an hour. Edit & Submit to modify

Sidebar:
Contact set alarms are frequently used to flag unusual operating conditions or outages.

If you are alarming on an event that bridges midnight, bear in mind that the ON or OFF time that trips the alarm is reset @ midnight.
7.3 Logically Inverting Contact Sets

Select the O to V icon from the right side of the home page
Select Configure from the pulldown

If you are interlocking using a contact set that is OPEN in the interlocked state, **Invert sense** & input ‘T’ will be ON when the contact set is open.

Set Invert sense = Yes & Submit

7.4 Fail-to-Feed

Fail-to-Feed alarms on the contact set input that monitors the pump head feed meter if measured feed events do not occur every **Delay on Alarm** period while the pump is ON.

In this example **U:Monitor Feed** would display a ‘Fail to Feed’ alarm if a feed contact closure did not occur every 30 seconds or less while Relay 3 is ON, unless ‘U’ alarms were disabled.

If you wire the feed verify meter in parallel to a volume meter input, you can measure the actual volume fed.

**Fail-to-feed** uses a meter on the output of the pump like those made by Tacmina, which measure volumes in the mL range. Depending on the pump size, there will be a delay between turning ON the pump & measuring the first & subsequent feed pulses.
7.5 Mirroring a Control ON/OFF

A phantom contact set may be configured to mirror a relay (1-5) or a pulse output (6-9) configured as an ON/OFF control. When the control is ON, the phantom contact set is ON.

This compensation is available to link controls when simply wiring them in parallel wouldn't work.

For example:
Site doesn't have a bleed meter installed but needs to feed into the bleed line whenever the bleed is ON (perhaps a de-chlor or a sequestrant for a component that’s concentrated when the tower cycles up).
Relay 1 controls the bleed on conductivity
Pulse 8 feeds the bleed line chemical, configured to base feed @ 5mL/minute
Phantom Contact Set ‘X’ mirrors Relay 1 & Interlocks Pulse 8

When done with Mirror output (instead of simply using conductivity to control Pulse 8) any blocking or Prebleed-Lockout that stops Relay 1, stops feeding into the bleed line.
# Frequency Controlled Pumps

## 8.1 Selecting a Pump, Adjust mL/stoke & SPM

Select the ‘6’ to ‘9’ icon from the right side of the home page

Select Configure from the pulldown

Select **Inhibitor Pump**

Set **Pump Type** = one of the built-in pumps & Submit

Set both the maximum SPM & typical 40 psi head feed rate

Use the default **ml/stroke** unless:
1. You require the accuracy you would get from calibrating with a graduated cylinder.
2. The pump is not at 100% stroke.

Be aware that the output of most pumps will vary when backpressure changes. Using a back pressure valve will hold that pressure steady.

**Edit ml/stroke & Rated SPM** for the installed pump & Submit

‘Other’ type pumps are limited to 25 ml/stroke. Listed pumps are limited to 2.0 ml/stroke. All have no minimum limit.

Exercise care not to exceed the Rated SPM for the pump, response to high pulse rates is indeterminate and maximum feed rates will be incorrect.

---

### Built-in Pump types

<table>
<thead>
<tr>
<th>Pump Type</th>
<th>ml/stroke</th>
<th>Liters/hr</th>
<th>Gallons/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1601</td>
<td>0.13</td>
<td>1.404</td>
<td>0.371</td>
</tr>
<tr>
<td>1602</td>
<td>0.24</td>
<td>2.592</td>
<td>0.685</td>
</tr>
<tr>
<td>1001</td>
<td>0.10</td>
<td>1.080</td>
<td>0.285</td>
</tr>
<tr>
<td>1002</td>
<td>0.24</td>
<td>2.592</td>
<td>0.685</td>
</tr>
<tr>
<td>0704</td>
<td>0.42</td>
<td>4.536</td>
<td>1.198</td>
</tr>
<tr>
<td>0705</td>
<td>0.50</td>
<td>5.400</td>
<td>1.427</td>
</tr>
</tbody>
</table>
9.1 Configure: Manual-Auto Switch

Select the letter icon from the bottom right side of the home page.
Select Configure from the pulldown.

A newly installed 4-20mA out card initializes to Manual mode & 0% (4mA) output current.

Select Control by: and the target control sensor from the pulldown & Submit.

Controls a Pump = Yes goes to 4mA when STOP key pressed.

In Auto mode, edit both 20mA Value & 4mA Value & Submit.

Controls a Pump

Sidebar: Manual Mode
Use Manual mode to verify the pump is 100% ON=20mA, completely OFF=4mA.
and to verify the loop span on the monitoring DCS that is using the current loop value to represent a controller conductivity, pH, ORP, corrosion rate sensor or ppm calculation.
AEGIS II Browser

9.2 Calibrate

Select the letter icon from the bottom right side of the home page.

Select Calibrate from the pulldown.

Select Start to start the two point calibration process.

Calibrate overrides the Manual setting or sensor control to set the output to 4mA & then 20mA.

Edit Output @ 4mA level & select Calibrate.

Use the mA current value displayed on the pump, measured by the DCS or meter.

Factory Reset = Yes & Submit

Returns the 4-20mA outputs to default.

Edit Output @ 20mA level & select Calibrate.

Calibration ends. Select Cancel to return the current loop to Manual or sensor control & exit calibration.
9.3 Diagnostic & Mirroring

Select the letter icon from the bottom right side of the home page to display Diagnostic page.

Or select Diagnostic from the pulldown.

Controlling sensor name

Gain & Offset are modified when a 4-20mA output is calibrated.
Factory Reset: Gain = 1.0 & Offset = 0.0

Mirroring a Pulse Controlled Pump
If you select a pump to control the 4-20mA output from the Control by: pull down
The 4-20mA output is automatically spanned
4mA = 0 SPM to 20mA = 100% SPM.

Mirroring provides a way to implement more complex controls on a 4-20mA output or to monitor pump speed on a DCS.

4-20mA in Manual mode
Shows both loop current & % of span (for loops controlling pumps)

4-20mA Output driver detail
Shared by inputs 'I' & 'J'

Driver detail shared by inputs 'I' & 'J'.
AEGIS II Browser

10 System Settings
10.1 Home & Diagnostic pages

S/N, Versions, Fuse & Fan state, Biofeed Week#

Select the controller icon at the top of the home page to get to the System pull down

Select Diagnostic from the pulldown

Does not affect manually entered text

Duplicates login state from top, right of home page

Logout here or on the home page. Logs out automatically if no activity for 30 minutes

Disables the 30 minute timer

The last three digits of the serial number. Used to ID E-mail, tags the log & activity files

Controller services & controls

Line power fuse for relays 1 & 2. May be used to power loads switched by relays 3-5.

Accumulates CPU crashes. Should read 0. Check incoming power.

Default = AAAA, otherwise known only to the Admin

Power for 3 wire turbine meters connected to inputs 'O' thru 'T'.

Power for 3 wire turbine meters connected to inputs 'U' thru 'V'. 'U' and 'V' have a separate power supply from 'O' – 'T'.

Cooling fan fault shuts down all sensor driver cards & controls. Displays only fault message on local HMI display

Events are entered as daily, weekly or monthly (28 days). In daily, every day is day = 1. In weekly, every Sunday is Sunday = 1. This page shows the 28 day cycle. This is day 9 of 28.
10.2 Activity Log:
10.2.1 User ID, time stamp

Select Activity Log from the System pulldown

Initially displays the current day’s activities in blocks of 10

View another day: Select Month & Day & Submit
(ast six months selectable)

List activities both by User ID & those that occur Automatically (System).

In these Activities, the System logs Alarmed activities & the admin user adjusts the Alarms on Input ‘S’

Next selection not shown @ end of day’s activities
In this example, we are viewing events 41-50 of 82 total activities

If you select a day when the controller was powered OFF or prior to it’s installation, you’ll get this response

<table>
<thead>
<tr>
<th>IC</th>
<th>Activity</th>
<th>User ID</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Alarms Alarmed High</td>
<td>System</td>
<td>12:38:01</td>
</tr>
<tr>
<td>C</td>
<td>Alarms Alarmed High</td>
<td>System</td>
<td>12:38:01</td>
</tr>
<tr>
<td>E</td>
<td>Alarms Alarmed Low</td>
<td>System</td>
<td>12:38:01</td>
</tr>
<tr>
<td>F</td>
<td>Alarms Alarmed Low</td>
<td>System</td>
<td>12:38:01</td>
</tr>
<tr>
<td>L</td>
<td>Alarms Scale Alarm</td>
<td>System</td>
<td>12:38:01</td>
</tr>
<tr>
<td>M</td>
<td>Alarms Alarmed High</td>
<td>System</td>
<td>12:38:01</td>
</tr>
<tr>
<td>S</td>
<td>Activity Adjusted Alarm</td>
<td>admin</td>
<td>12:38:52</td>
</tr>
<tr>
<td>U</td>
<td>Activity Changed</td>
<td>admin</td>
<td>13:40:30</td>
</tr>
<tr>
<td>U</td>
<td>Activity Changed</td>
<td>admin</td>
<td>13:40:41</td>
</tr>
<tr>
<td>U</td>
<td>Configure Compen. modify</td>
<td>admin</td>
<td>13:41:04</td>
</tr>
</tbody>
</table>

Next selection not shown @ end of day’s activities
In this example, we are viewing events 41-50 of 82 total activities

If you select a day when the controller was powered OFF or prior to it’s installation, you’ll get this response

<table>
<thead>
<tr>
<th>IC</th>
<th>Activity</th>
<th>User ID</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No activity file
AEGIS II Browser

10.3 Communications: 1 of 2
10.3.1 LAN IP, Netmask, MAC, Gateway, Wifi IP

You'll need to be logged in as the admin user to modify Communications. The top of the page will prompt you with the required login if you are not allowed to modify the current page.

The controller includes a DHCP client which means when you connect to the site LAN you can assign a static IP valid for the LAN or select DHCP and let the network assign a compatible IP address to the controller.

The controller includes a DHCP client which means when you connect to the site LAN you can assign a static IP valid for the LAN or select DHCP and let the network assign a compatible IP address to the controller.

Select Communications from the System pulldown

Current IP LAN address of the controller
If you edit & Submit to modify, you’ll lose the current browser connection. Re-connect using the new IP address

Select DHCP if you wish the system to choose the IP address. This ensures the controller is visible from and compliant with the customers network

Set LAN Netmask to desired netmask & Submit

If you are using the E-mail functionality (alarms & auto-reporting), then the LAN Gateway should match other devices on this LAN

Controller WiFi is limited to HTTP browser services for mobile devices & notebook WiFi & therefore uses a fixed IP address. With the SSID set on the System Setup page

The WiFi SSID defaults to _AegisII_XXX where XXX = last 3 numbers of the controller serial number. Edit to modify & Submit

The HTTP port is defaulted to 80, the standard browser port

Sidebar:
If you modify the IP or Netmask & can no longer connect, the current IP & Netmask can be viewed on the local HMI (keypad & display).

Key Menu / Up / System / OK / Communication / OK & Up - Down to scroll through the settings.

LAN (Local Area Network) refers to the Ethernet port connection. WiFi refers to the wireless connection. See section 1.1 for connection information.
Communications: 2 of 2

10.3.2 Com card setup

The communication card adds the option of communicating with a wide range of standard equipment protocol. This card includes a serial slave port for connection with a plant serial MODBUS, or a variety of Gateways for access to MODBUS TCP/IP, serial or IP BACnet or most any protocol with the proper Gateway.

The communication card includes two 4-20mA outputs while allowing a dual 4-20mA input card to be piggy-backed on the com card.

The Pyxis fluorometer is compatible with the MODBUS Master serial port while a serial Master can attach to the serial Slave port. The second slave port can be used to pass along the Master communication.

Consult the Addendum: Aegis II Communication Driver manual for complete instructions.

Note: The below picture is the lower part of the System: Communications menu from the previous page.
10.4 Time & Date:
10.4.1 Sync to Device

Select Time & Date from the System pulldown

Edit the Date, Time & Weekday fields & Submit
Follow the formatting for the Date (DD/MM/YY) and Time (HH:MM:SS) fields
or you'll get an error message
or use the Set fields... link

Adjusting the time & date affects biocide feed events, controls that use time, data logging, alarming.....

This is usually the easiest way to synch the controller to your device, click on the link & Submit.
10.5 E-Mail Setup – Test

Select E-mail Setup from the System pulldown

- **E-mail Enabled = Yes** sends a daily E-mail @ noon so you know the controller is up. Sensor values confirm control. E-mail services enable.

- **E-mail Service Reports** requires a paid subscription to H2Tronics.

- **E-mail Daily Data Log = Yes** sends a midnight E-mail. Includes sensor values, run times, volumes.... Targeted @ apps that parse E-mail body for content

- **E-mail on Alarm = Yes** sends an E-mail on alarm. Includes sensor values & volumes so you get operating context

- **E-mail Status = Yes** sends an E-mail on alarm. Includes sensor values & volumes so you get operating context. Choose noon, midnight, both or neither.

- **Mail To:** youraddress@yahoo.com

- **cc E-mail to**
  - Unassigned

- **cc E-mail to**
  - Unassigned

- **cc E-mail to**
  - Unassigned

- **cc E-mail to**
  - Unassigned

**Edit Mail To = your email & Submit**

**Edit to add up to four optional cc E-mail to**

*Edit zero length to remove & Submit*

Continued on next page
Continued from previous page

<table>
<thead>
<tr>
<th>SMTP IP Address</th>
<th>43.228.184.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMTP Port</td>
<td>2525</td>
</tr>
<tr>
<td>SMTP Username</td>
<td><a href="mailto:aegis@prominent.us">aegis@prominent.us</a></td>
</tr>
<tr>
<td>SMTP Password</td>
<td>****</td>
</tr>
<tr>
<td>SMTP reset</td>
<td>Yes ✔ No</td>
</tr>
<tr>
<td>Test E-mail</td>
<td>Yes ✔ No</td>
</tr>
<tr>
<td>Next mail</td>
<td>2:15 hrs</td>
</tr>
</tbody>
</table>

Shown are the default SMTP settings that point to the Prominent SMTP server. This is a free service. If you cannot use the service, enter your service information and press Submit.

Reset the SMTP setting to those shown on this page

Send a status report to all email addresses listed above

Next report is expected to send...
Sidebar:
All I/O points can be enabled and used in the program. Enabled points are displayed on the main screen. If a point is disabled, it is removed from the main screen and has no programmable function.
If you select two systems (System Setup menu), you will see the menu on the left. A single system user will see the menu in the lower right corner of this page.

Select Enable I/O from the System pulldown

To select a System# for Sensor or Control or Meter-Contact Set, select Configure to I/O type & Submit

If the System Setup page field # of Systems = Two
Enable I/O shows selectors for each I/O type.

System Setup page field # of Systems = One
Is limited to Enable IO

Select I/O you wish to enable or None & Submit
AEGIS II Browser

10.7 System Setup:
10.7.1 Naming, Sunday=Day1, Metric Units, Restart Options

You'll need to be logged in as the admin user to modify **System Setup**. The top of the page will prompt you with the required login if you are not allowed to modify the current page.

![System Setup diagram]

### System Setup

<table>
<thead>
<tr>
<th>Status</th>
<th>Reconfigured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site name</td>
<td>Pr minent</td>
</tr>
<tr>
<td>System-Name</td>
<td>Tower #1</td>
</tr>
<tr>
<td>2nd System-Name</td>
<td>Tower #2</td>
</tr>
<tr>
<td>Keypad Password</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Metric Units</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Sunday=Day 1</td>
<td>Yes/No</td>
</tr>
<tr>
<td># of Systems</td>
<td>Two</td>
</tr>
<tr>
<td>Alarm on STOPs</td>
<td>Yes/No</td>
</tr>
<tr>
<td>System restart</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Factory Reset</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Enable Alarm Chime</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>

- **Select System Setup from the System pulldown**
- **Site Name & System-Names** will tag your reports & E-mail alarms to differentiate controllers. Sixteen characters maximum. Edit & Submit
- **Select Keypad Password = Yes & Submit**
  Shares passwords & access level with browser users, see Section 10.7
- **Metric Units = Yes & Submit** displays temperatures in ‘C’ & measures volumes in Liters.
  **Metric Units = No & Submit** displays temperatures in ‘F’ & measures volumes in Gallons
- **Select Sunday=Day 1 = Yes & Submit**
  Resets 28 day biocide clock to the current week. For example if today is Wednesday, sets today to day #4
  **Note:** This option only displays if not already week #1.
- **Select # of Systems = One or Two & Submit**
  Two turns on selectors in Enable I/O page
- **Select Alarm on STOPs = Yes & Submit**
  To alarm when user presses STOP on local HMI keypad.
- **Select System restart = Yes & Submit**
  Same effect as cycling the power OFF-ON; restarts controls & actuation times
- **Select Factory Reset = Yes & Submit**
  Removes user settings, controls, naming, calibration...
  Load a default or previously saved configuration after **Factory Reset** to avoid reconfiguring each I/O.

- **Select Enable Alarm Chime = Yes & Submit**
  for audible tone on alarm
The System Passwords screen allows users to change their passwords. The Passwords screen seen by the Admin user is different from the other users. This page describes the Admin version. The next page explains the Users version.

Changes made on these pages are logged in the Activity Log.

**Default Passwords:**
Operator1 = 1  Operator2 = 2  Operator3 = 3  Operator4 = 4.
Configure5 = 5  Configure6 = 6  Configure7 = 7  Administrator = AAAA

**Login Page:** Operators can view all controller pages. No access to most System pages.
Configure users can edit the program. No access to most System pages.

**Modify Passwords:**
If the controller is accessible on the site LAN, you should modify all 8 passwords.

Two users cannot share the same password because only the password is used to identify keypad users. The controller displays **Password Fail** on a duplicate password.
AEGIS II Browser

Passwords: 2 of 2
10.8.2 View-Set Access Level - Users 1 - 7

System: Passwords

Select Passwords from the System pulldown

Show Access Level

The ‘Operate’ Access Level is used to prevent casual users from inadvertently modifying controls.

Displays User name. Edit and press Submit.

Use these boxes to change your current password. Enter the same word into both boxes and press Submit.

11 Appendices:

a. IO Namespace: Letters & Numbers

The controller uses the letters ‘A’ to ‘Z’ to refer to sensors, meters, contact sets & 4-20mA outputs and the numbers ‘1’ to ‘9’ to refer to controls.

Users can assign site specific names to all of the I/O, A-Z & 1-9. The I/O letters & numbers are a convenient, compact way to describe both the physical location of the I/O within the controller enclosure & the capabilities of each I/O.

Some letters are ‘phantom’, meaning they don’t have physical wiring location within the enclosure. ‘Phantoms’ are used to represent calculated & derived values that are logged, alarmed & may be used for control.

<table>
<thead>
<tr>
<th>I/O</th>
<th>Type</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-B</td>
<td>Serial sensors</td>
<td>3 wire Conductivity-Flowswitch-Temperature or Corrosion Rate or Differential pressure sensors</td>
</tr>
<tr>
<td>C-D E-F I-J</td>
<td>Dual sensor driver cards</td>
<td>pH-ORP: configurable as dual pH or dual ORP or pH-ORP 4-20mA input 4-20mA output Conductivity pH &amp; 4-20mA input Dual serial sensor</td>
</tr>
<tr>
<td>G</td>
<td>Built-in 4-20mA input</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Built-in 10mV/C temperature sensor input</td>
<td></td>
</tr>
<tr>
<td>K-N</td>
<td>Phantom sensors</td>
<td>Calculated (Inventory, Manual) or derived from other sensors &amp; meters</td>
</tr>
<tr>
<td>O-V</td>
<td>Volume meter &amp; contact set inputs</td>
<td>Each of 6 inputs configurable as Turbine, Contact Head meter or Contact Set</td>
</tr>
<tr>
<td>W-Z</td>
<td>Phantom volume meter &amp; contact set inputs</td>
<td>Calculated (Fail-to-Feed, Fail-to-Sample) or derived from other sensors &amp; meters</td>
</tr>
<tr>
<td>1-2</td>
<td>Line powered control relays</td>
<td>Form C, powers pumps, solenoids &amp; motorized valves</td>
</tr>
<tr>
<td>3-5</td>
<td>Dry or line powered control relays</td>
<td>Form C, may be used dry or powered.</td>
</tr>
<tr>
<td>6-9</td>
<td>Pulse or ON/OFF controls</td>
<td>Dry contact sets used to pulse or enable pumps, alarm… 24V 250mA max.</td>
</tr>
</tbody>
</table>
## b. Input Attributes & Phantoms

Many of the sensors connected to the controller have attributes other than the default value.

For example, the serial conductivity sensor measures conductivity, temperature & includes a flowswitch. The conductivity is the default value of the sensor connect to input ‘A’ (attribute A0) & the Temperature (attribute A1) & the flowswitch (attribute A2).

Notice that the A1 attribute is of the same type as the A0 attribute, both are sensor values but the A2 attribute is a contact set attribute (ON/OFF).

Attributes can be assigned to phantom inputs where they are logged, alarmed & used for control. A phantom input cannot be assigned to another phantom. (prevents circular references).

Phantoms in the **K-N** space are sensors. Those in the **W-Z** space are volumes & contact sets.

<table>
<thead>
<tr>
<th>I/O</th>
<th>Type</th>
<th>Attribute</th>
<th>Phantom</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-B</td>
<td>Serial Conductivity</td>
<td>x0 Conductivity</td>
<td>K-N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x1 Temperature</td>
<td>K-N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x2 Flowswitch</td>
<td>W-Z</td>
</tr>
<tr>
<td></td>
<td>Serial Corrosion Rate</td>
<td>x0 Corrosion Rate</td>
<td>K-N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x1 Pitting Rate (Imbalance)</td>
<td>K-N</td>
</tr>
<tr>
<td></td>
<td>Serial Differential Pressure</td>
<td>x0 Differential Pressure</td>
<td>K-N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x1 Inlet Pressure</td>
<td>K-N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x2 Outlet Pressure</td>
<td>K-N</td>
</tr>
<tr>
<td>C-D</td>
<td>pH-ORP driver card</td>
<td>x0 ORP or pH</td>
<td>K-N</td>
</tr>
<tr>
<td></td>
<td>Conductivity card</td>
<td>x1 Temperature if pH</td>
<td>K-N</td>
</tr>
<tr>
<td></td>
<td>pH- 4-20mA input card</td>
<td>x0 Conductivity</td>
<td>K-N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x1 Temperature if ‘Conductivity’ or ‘Condensate’</td>
<td>K-N</td>
</tr>
<tr>
<td></td>
<td>Serial Sensor card</td>
<td>x0 pH</td>
<td>K-N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x1 Temperature-pH side</td>
<td>K-N</td>
</tr>
<tr>
<td></td>
<td>Identical sensors &amp; attributes</td>
<td>To <strong>A-B</strong></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Temperature</td>
<td>x0 Temperature</td>
<td>K-N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x1 Rate</td>
<td>K-N</td>
</tr>
<tr>
<td>O-V</td>
<td>Volume meters</td>
<td>x0 Volume Today</td>
<td>W-Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x1 Rate</td>
<td>K-N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x2 Volume this Year</td>
<td>W-Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x3 Volume total</td>
<td>W-Z</td>
</tr>
</tbody>
</table>

Use the x0 attribute if you wish to have one sensor display two values.
For example, using a conductivity sensor to measure conductivity & salt concentration.
c. 4-20mA Input Selectable Types

Knowing the sensor type connected to a 4-20mA input allows the controller to:
A. Scale the input correctly for the selected sensor type
B. Provide calibration & calibration limits appropriate to selected type
C. Clamp the measured sensor values so that an open loop doesn’t measure a negative ppm or conductivity
Select **Sensor Type** = Other if A,B or C not applicable

<table>
<thead>
<tr>
<th>Sensor Type</th>
<th>Span Options &amp; units</th>
<th>mA Span</th>
<th>G=Gain, O=Offset Span not user modifiable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td>Generic 0-100</td>
<td>4-20</td>
<td>User modifiable span G= 6.25, O=-25</td>
</tr>
<tr>
<td>CBR Bromine</td>
<td>CBR 0-2ppm</td>
<td>4-16</td>
<td>G=0.167, O=-0.667</td>
</tr>
<tr>
<td>CBR 0-10ppm</td>
<td>4-16</td>
<td>G=0.833, O=-3.333</td>
<td></td>
</tr>
<tr>
<td>CGE Chlorine</td>
<td>CGE 0-2 ppm</td>
<td>4-16</td>
<td>G=0.167, O=-0.667</td>
</tr>
<tr>
<td>CGE 0-10ppm</td>
<td>4-16</td>
<td>G=0.833, O=-3.333</td>
<td></td>
</tr>
<tr>
<td>CLE3 Chlorine</td>
<td>CGE 0-2ppm</td>
<td>4-16</td>
<td>G=0.167, O=-0.667</td>
</tr>
<tr>
<td>CLE3 Chlorine</td>
<td>CGE 0-10ppm</td>
<td>4-16</td>
<td>G=0.833, O=-3.333</td>
</tr>
<tr>
<td>CLO Chlorine</td>
<td>CLO 0-2ppm</td>
<td>4-16</td>
<td>G=0.167, O=-0.667</td>
</tr>
<tr>
<td>CLO 0-10ppm</td>
<td>4-16</td>
<td>G=0.833, O=-3.333</td>
<td></td>
</tr>
<tr>
<td>CTE Chlorine</td>
<td>CTE 0-2ppm</td>
<td>4-16</td>
<td>G=0.167, O=-0.667</td>
</tr>
<tr>
<td>CTE 0-10ppm</td>
<td>4-16</td>
<td>G=0.833, O=-3.333</td>
<td></td>
</tr>
<tr>
<td>Diff. Pressure</td>
<td>DeltaP 0-100psi</td>
<td>4-20</td>
<td>G= 6.25, O=-25</td>
</tr>
<tr>
<td>Fluorescent</td>
<td>Fluor 0-200ppm</td>
<td>4-20</td>
<td>G= 12.5, O=-50</td>
</tr>
<tr>
<td>PAA 0-200ppm</td>
<td>PAA 0-200ppm</td>
<td>4-16</td>
<td>G=16.67, O=-66.67</td>
</tr>
<tr>
<td>PAA 0-2000ppm</td>
<td>4-16</td>
<td>G=166.67, O=-666.67</td>
<td></td>
</tr>
<tr>
<td>pH-transducer</td>
<td>pH 0 to 14</td>
<td>4-20</td>
<td>4mA=-1.45pH 20mA=15.45pH pH outside of 0-14 blocked G=1.056, O=-5.674 5.373mA=0pH, 18.6mA=14pH</td>
</tr>
<tr>
<td>ORP-transducer</td>
<td>ORP 0-1000mV</td>
<td>4-20</td>
<td>G= 62.5, O=-250</td>
</tr>
<tr>
<td>Temperature</td>
<td>Temp. 0-100C</td>
<td>4-20</td>
<td>G= 62.5, O=-25</td>
</tr>
<tr>
<td>Toroidal</td>
<td>Tor. 0-10000uS</td>
<td>4-20</td>
<td>G= 625, O=-2500</td>
</tr>
<tr>
<td>Toroidal</td>
<td>Tor. 0-100000uS</td>
<td>4-20</td>
<td>G= 6250, O=-2500</td>
</tr>
</tbody>
</table>

Notes:
1. Gain & Offset return to the table values @ Calibrate = Factory Reset
2. The preceding table applies to the ChemFeed version of the Aegis II
d. Enabling-Disabling I/O & Adding-Removing Driver Cards

Inputs A-Z cannot be disabled if in use.
The disable option in both the HTTP & local HMIs is replaced with a message telling you where the target sensor is used, so you can remove the dependency.
Note that the sensor can be used for control, compensation of other sensors & in the case of sensors with more than one attribute; as a source for phantom sensors.

When you disable a sensor, the compensation is removed so that if for example:
You disable a thermally compensated conductivity sensor and the thermal sensor is subsequently removed or disabled, there is no conflict when the conductivity sensor is re-enabled, but it’s no longer thermally compensated.

When a C-D, E-F or I-J driver card is removed, all of the dependencies are removed on the next power ON. Outputs that use the removed driver sensor(s) for control have the control equation removed. Other sensors which use the removed driver sensors are modified.

When you install a new driver, the sensor inputs default. For example, adding a pH-ORP driver, configures for one pH & one ORP sensor on power ON.

Auto-Removing Phantoms:
Phantoms are auto-removed if they are derived from inputs >= ‘C’
If the Phantom is in use as an interlock a latching alarm is set.
Example: User removes a serial sensor card with a CTFS sensor OR connects a corrosion rate sensor to a CTFS sensor input on a serial sensor card.

Phantoms derived from inputs ‘A’ & ‘B’ are not auto-removed unless the sensor type is changed.
This is done to prevent wholesale auto-reconfiguration & safety related interlock removals on ‘A’ & ‘B’ CTFS conductivity sensors.