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SHIPCO® PUMPS
www.shipcopumps.com

AQUEOUS™

Automated Water Controls

Program Manual

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FORM USER GUIDE AQUEOUS-MANUAL

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Contents

SYMBOLS USED IN THIS MANUAL	
	 Only 4-inch *Aqueous*™ HMI Touchscreen model
	 Only 7- and 15-inch *Aqueous*™ HMI Touchscreen models

Features

Basic Package

Typically used for (but not limited to) Condensate, Boiler Feed and Vacuum Producers

- Control circuit disconnect
- Audible alarm bell
- Auto/Off/Continuous or Auto/Off/Hand switch per pump
- **4-inch Color Touchscreen HMI**, NEMA 4
- **Pump control for up to 4 pumps** with status indication for idle/run/fault as well as totalized and cycle based run timers
- Pumps can be configured with **2 unique staging sequences** (e.g., vacuum, boiler feed, condensate, recirculation, etc.)
- **Up to 3 Relay outputs** configured per application. Typically used for on/off operations based on sensor inputs (e.g., makeup, drain, steam injection, electric heaters, recirculation solenoids, blowdown timers, etc.)
- Analog input for Tank Level, Tank Temperature, Tank Pressure, Pump Discharge Pressure(s), System Pressure(s) used for pump staging, **1 configurable spare sensor**. *Sensors priced separately unless otherwise noted.*
- **Up to 4 Analog outputs** configured per application. (e.g., modulated makeup, modulated steam regulators, VFD speed, etc.)
- See **Standard Package** for adders.

Standard Package

Typically used for (but not limited to) Vacuum Condensate, Vacuum Boiler Feed and Deaerators

- Control circuit disconnect
- Audible alarm bell
- Auto/Off/Continuous or Auto/Off/Hand switch per pump
- **7-inch Color Touchscreen HMI**, NEMA 4
- **Pump control for up to 8 pumps** with status indication for idle/run/fault as well as totalized and cycle based run timers
- Pumps can be configured with **3 unique staging sequences** (e.g., vacuum, boiler feed, condensate, recirculation, etc.)
- **Up to 7 Relay outputs** configured per application. Typically used for on/off operations based on sensor inputs (e.g., makeup, drain, steam injection, electric heaters, recirculation solenoids, blowdown timers, etc.)
- Analog input for Tank Level, Tank Temperature, Tank Pressure, Pump Discharge Pressure(s), System Pressure(s) used for pump staging, **2 flowmeters with temperature, 3 configurable spare sensors**. *Sensors priced separately unless otherwise noted.*
- **Up to 8 Analog outputs** configured per application. (e.g., modulated makeup, modulated steam regulators, VFD speed, etc.)

Standard Package Adders:

- 15-inch Color Touchscreen HMI, NEMA 4
- HMI cover for NEMA 4X and outdoor UV protection
- Modulated vent sequence for Deaerators

System Architecture

Root Menu

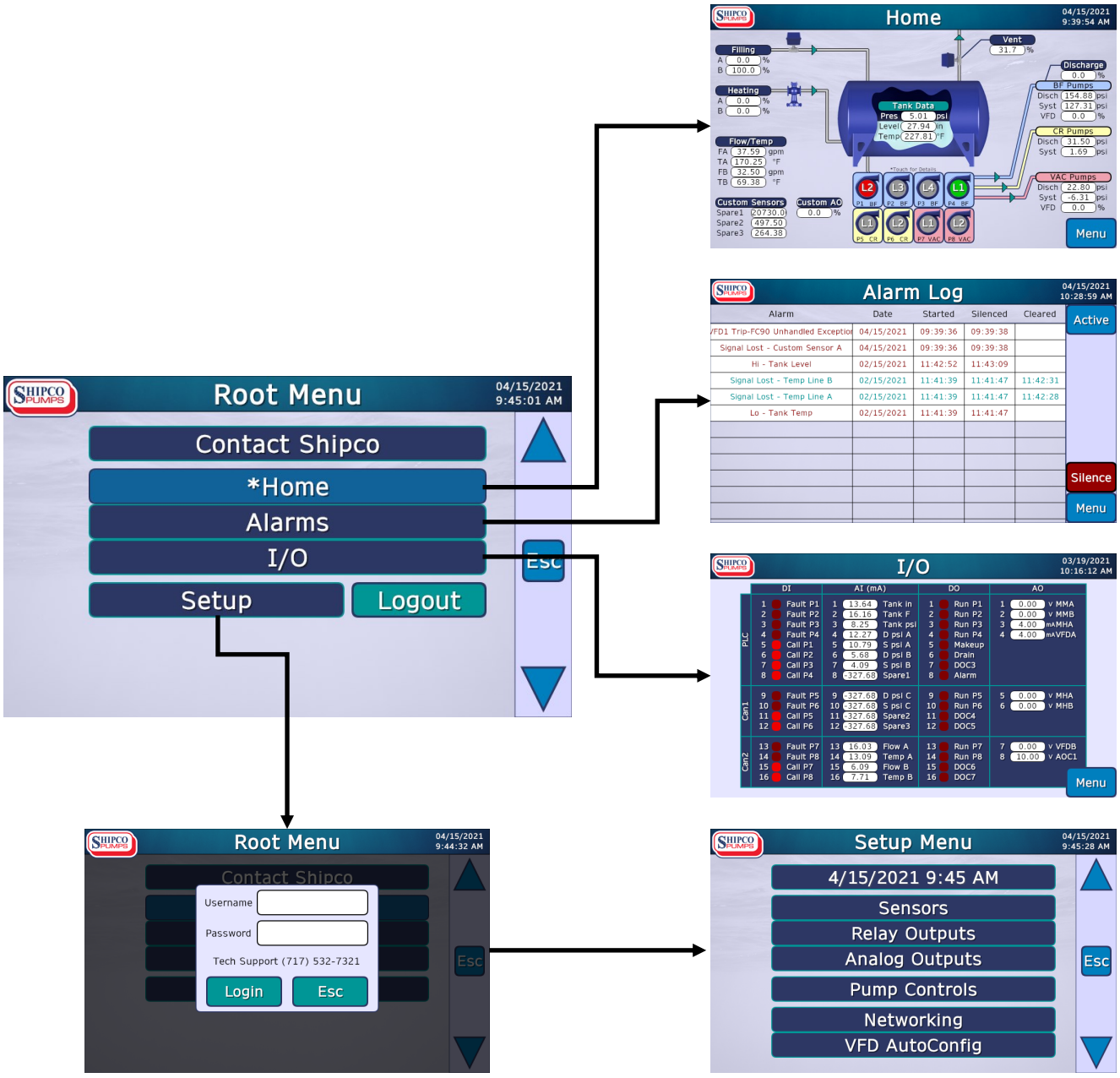
Contact Shipco
Displays Shipco® contact information. This is also the initial start-up screen.

Home (p. 9)
Unit and/or pump status screen for a condensate, boiler feed, deaerator or vacuum unit.

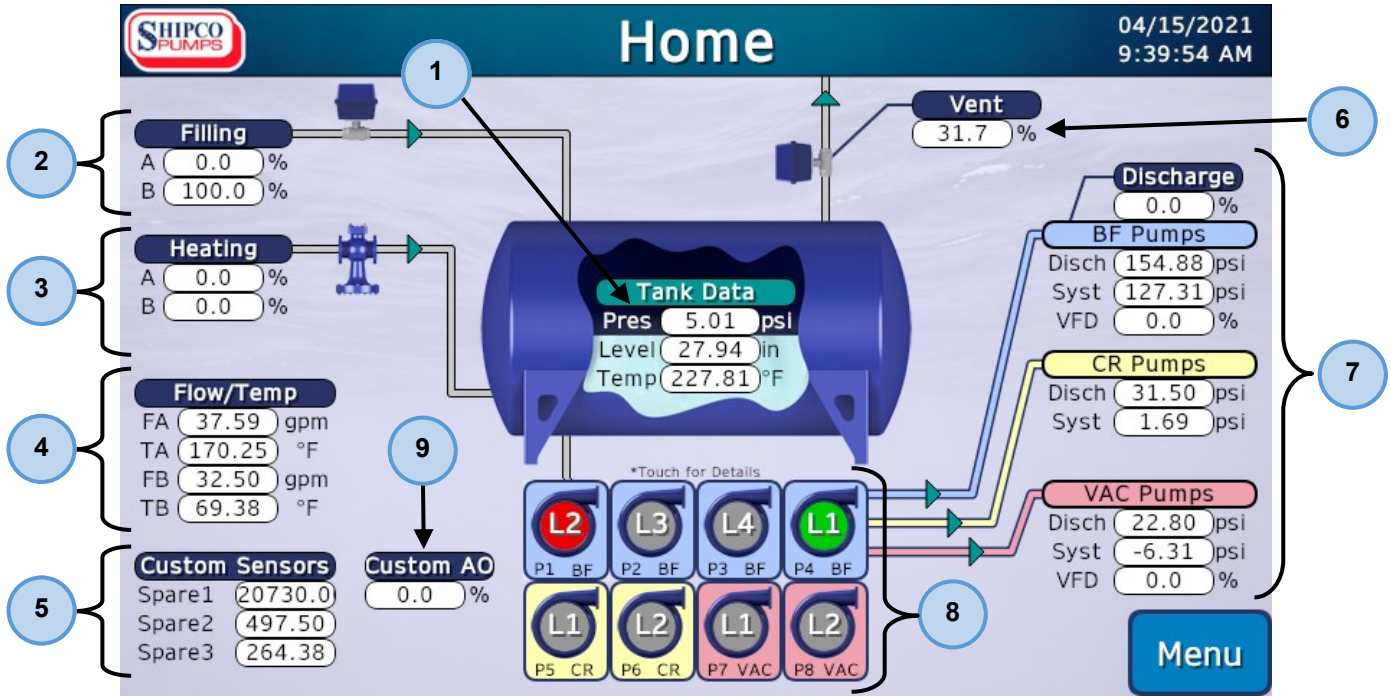
Alarms (p. 13)
View active alarms and alarm history log.

I/O (p. 15)
Displays sensor information for digital/analog inputs and outputs for the controller and any expansion I/O.

Setup (p. 17)
Change settings for sensors and adjust unit configuration.


Home
04/15/2021
9:39:54 AM
Filling
Heating
Flow/Temp
Custom Sensors
Custom AO
Tank Data
Vent
Discharge
BF Pumps
CR Pumps
VAC Pumps
Menu
Alarm Log
04/15/2021
10:28:59 AM
Alarm
Date
Started
Silenced
Cleared
Active
Silence
Menu
Hi - Tank Level
Signal Lost - Temp Line B
Signal Lost - Temp Line A
Lo - Tank Temp
Root Menu
04/15/2021
9:45:01 AM
Contact Shipco
*Home
Alarms
I/O
Setup
Logout
Esc
I/O
03/19/2021
10:16:12 AM
DI
AI (mA)
DO
AO
PLC
Can1
Can2
Menu
Root Menu
04/15/2021
9:44:32 AM
Username
Password
Tech Support (717) 532-7321
Login
Esc
Setup Menu
04/15/2021
9:45:28 AM
4/15/2021 9:45 AM
Sensors
Relay Outputs
Analog Outputs
Pump Controls
Networking
VFD AutoConfig
Esc

Home



Example Home screen on 7- and 15-inch models.

The Home screen displays useful information, current status of a unit and the status of any pumps, as well as other features that are included on the unit. Depending on the type of unit, only certain items on this screen may be visible.

1. Tank Data

The current water level, temperature and pressure (if applicable) inside the tank.

7/15 2. Filling

Percentage amount which a modulating make-up valve is open (up to 2 valves).

7/15 3. Heating

Percentage amount which a steam regulator is open (up to 3 regulators).

7/15 4. Flow/Temperature

Status indication for an additional 2 flow rate sensors (FA & FB expressed in gallons per minute) and/or 2 temperature sensors (TA & TB expressed in °F) placed on the unit.

7/15 5. Other Sensors

Additional user-defined sensors (added separately) which can be custom labeled and configured under *Custom Sensors* setup menu (page 25).

7/15 6. Vent

Percentage amount which an external varying vent valve is open. 100% indicates the vent is fully open.

7. Pump Groups

Pumps can be divided up into 3 groups on 7- and 15-inch models or 2 groups on 4-inch models. Each pump group is assigned a tag (or label) and color starting with blue, yellow and then red. Under *Pump Control* settings (page 38), a

pump group can be assigned a specific alternation control type, pump staging sequence, timings, run permissions, etc. that differs from another pump group.

If applicable sensors or variable frequency drives (VFD) are used, pump discharge pressure, system pressure and percentage of VFD speed are presented under each pump group.

8. Pumps

Each pump is represented as an individual “card” icon on the home screen. Pumps are sequentially numbered by pump number (P#) beginning with P1, P2, etc. Tap on a pump’s card for additional details such as run cycle timers and push-to-test functionality.

Count Maximum 8 pumps 

Maximum 4 pumps 

Group Within the card, a pump is also shown with its corresponding group tag and matching color as the card background.

Status The pump icon changes according to the current pump status.

Green = Active / Running

Red * = Fault / Problem

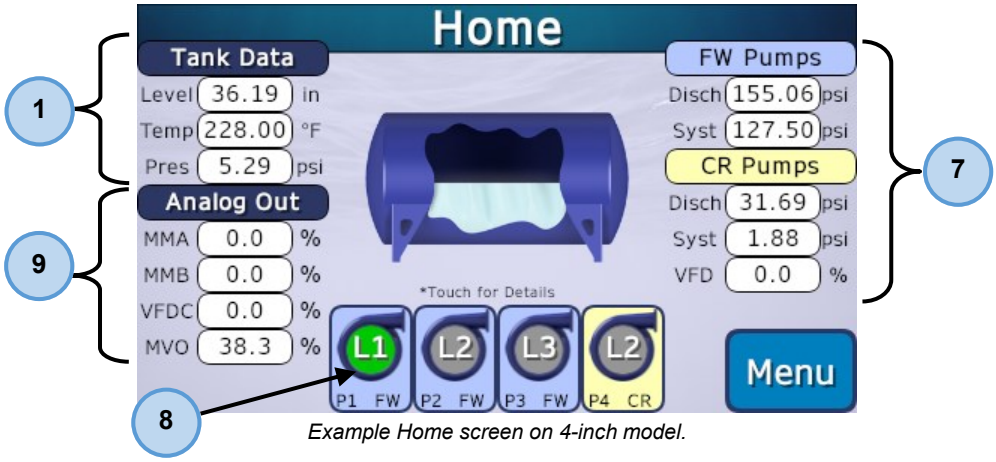
Grey = Inactive / Off

*** Any condition interrupting control will register as a fault (e.g., over-amperage or taking a pump out of “Auto” via the Auto/Off/Continuous selector switch on the unit control panel).**

Position Inside the pump icon, a pump is labeled with its sequencing lead-lag position (L#) within its designated pump group. For example, in the image, pump P4 is the lead pump (L1) within the BF pump group; followed by pumps P1 (L2 or lag 2), P2 (L3 or lag 3), and P3 (L4 or lag 4). Pump P5 is the lead pump (L1) within the CR pump group, etc.

9. Analog Out

Percentage amount for various custom analog outputs indicating, for example, how much a valve is open or closed or the speed at which a VFD is running, etc.

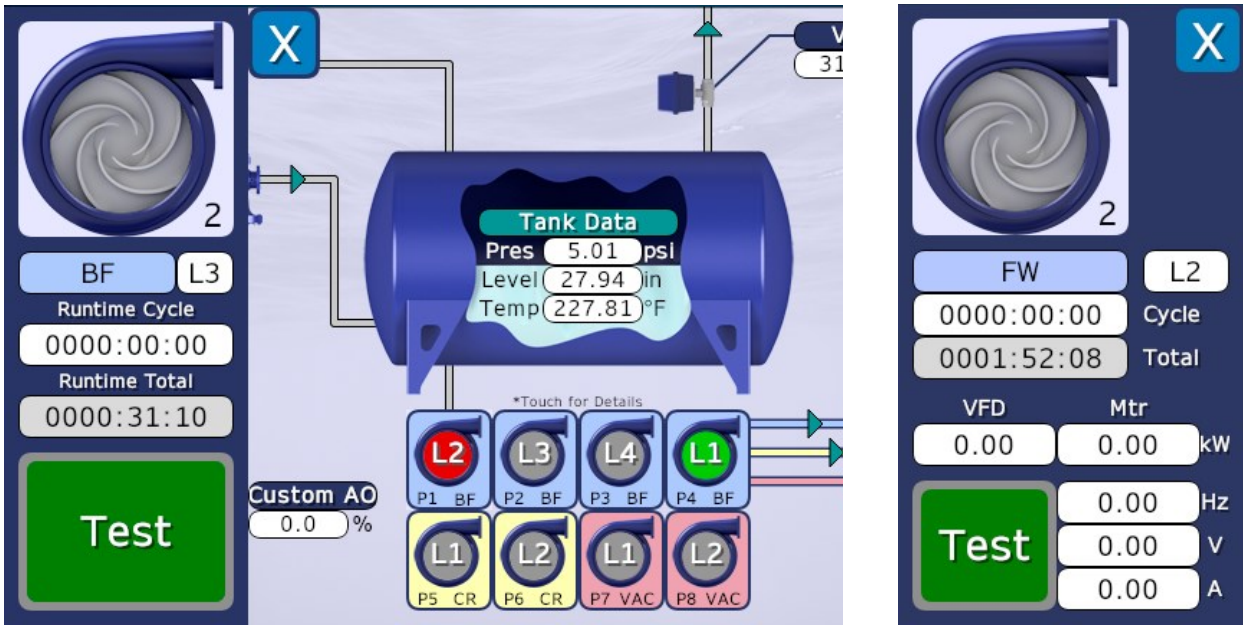


Example Home screen on 4-inch model.

Pump Details Panel

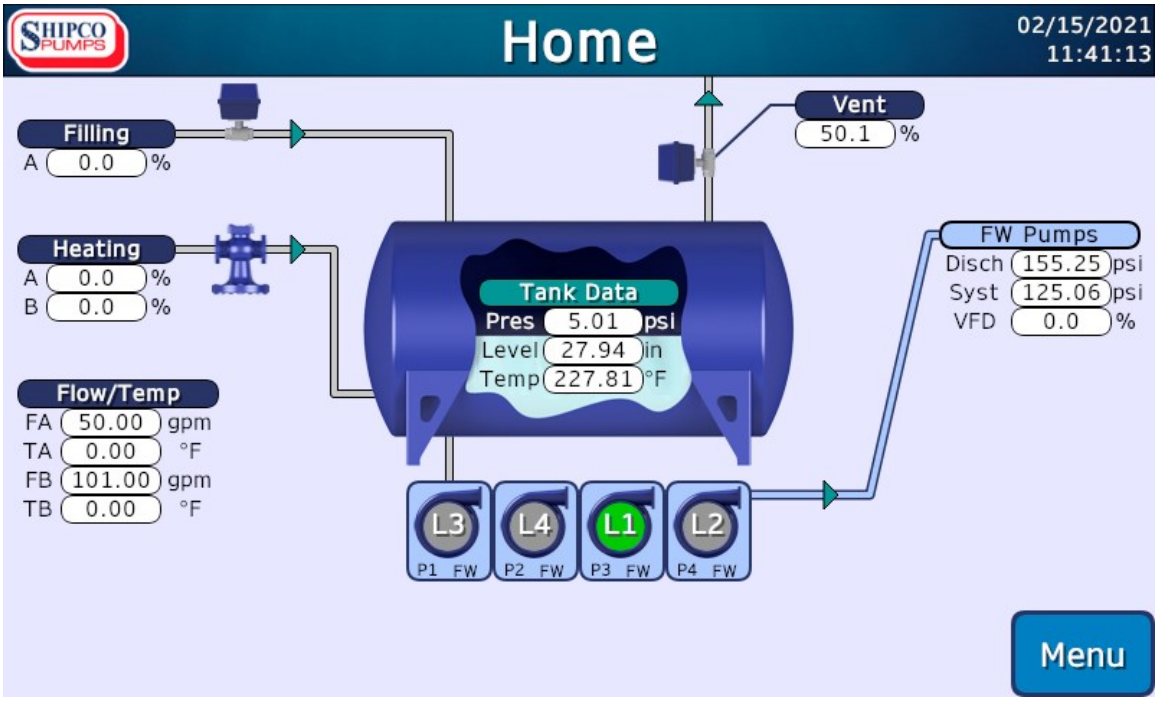
Tap any pump card to display pump runtime cycle, pump runtime total and a push-to-test button. Press the “X“ button to dismiss the panel.

Special VFD details: If the pump is equipped with an Altivar™ ATV212 series variable frequency drive (VFD), more information may be present showing the power consumption in kilowatts (kW) of both the motor and the VFD as well its frequency (Hz), voltage (V) and amperage draw (A).

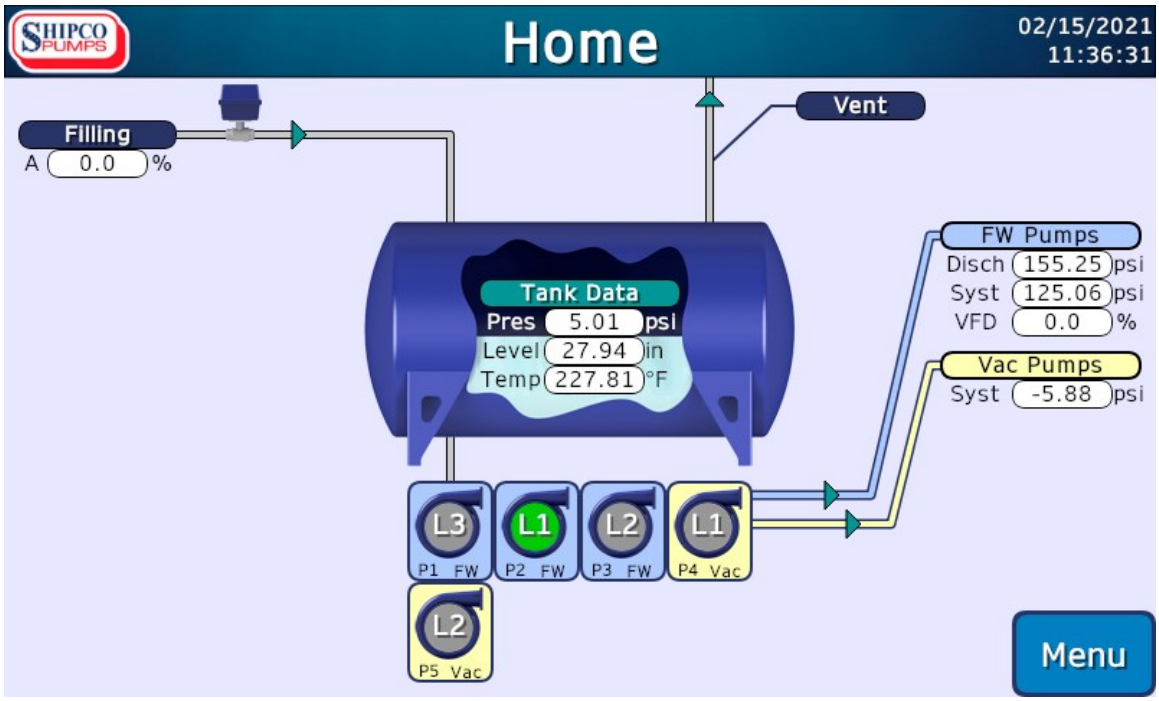


Pump details panel (left) and pump details panel with VFD (right) on 7- and 15-inch models.

Pump details panel (top) and pump details panel with VFD (bottom) on 4-inch model.



Example home screen of a deaerator unit.



Example home screen of a vacuum boiler feed unit.

Active Alarms

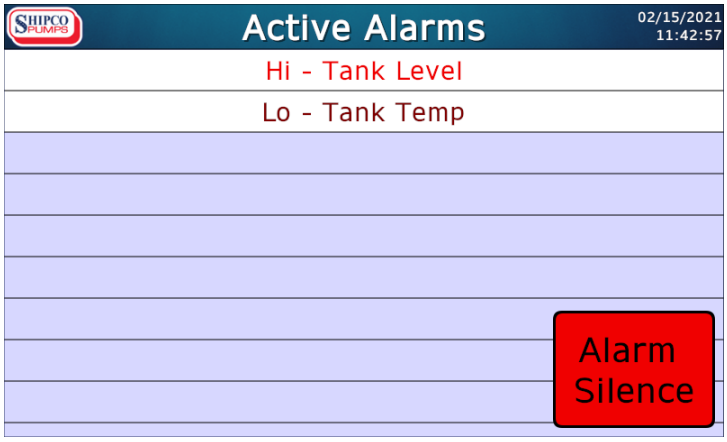
Alarms

Active Alarms on 7- and 15-inch models.

The *Active Alarms* screen shows a list of active alarms that are occurring in real-time. Alarm items in **bright red** are actively occurring and items in **dark red** have been silenced yet still active. Press **[Log]** to view the *Alarm Log*, a record of recent previous alarms (see page 14).

Active Alarm Pop-up

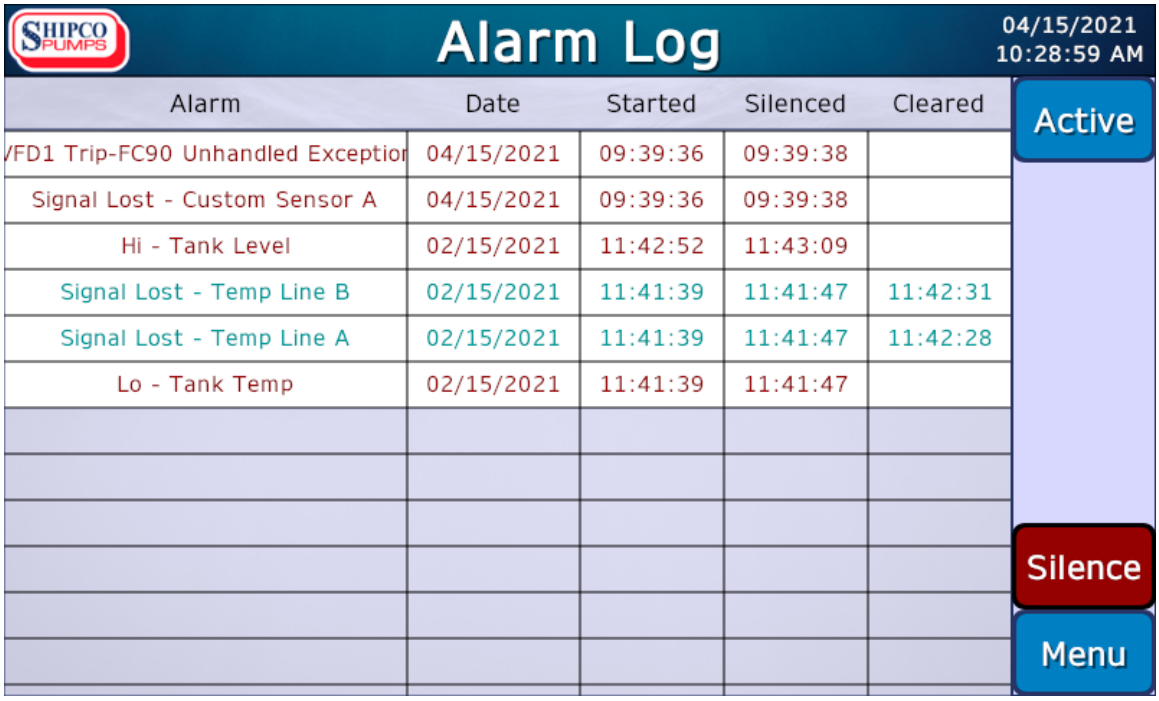
When an alarm is triggered the following alarm list pop-up screen appears. Pressing **[Alarm Silence]** dismisses the pop-up and returns to the previous screen and silences the audible alarm.



Active Alarms Popup with Alarm Silence button on 7- and 15-inch models.

Alarm Log

Alarms

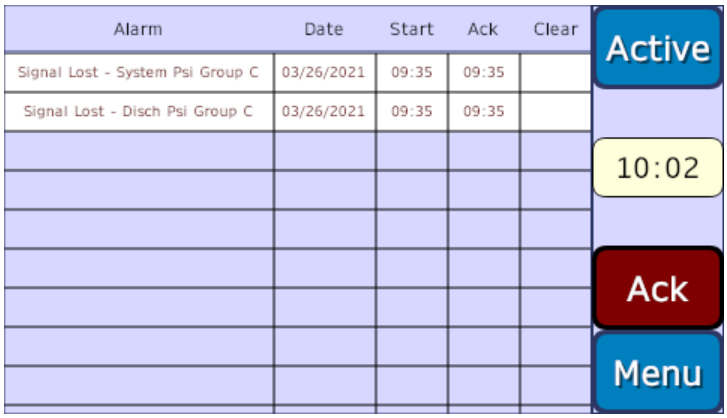


Alarms Log on 7- and 15-inch models.

The Alarm Log screen shows a table of alarms that have previously occurred. Alarm items are shown with alarm description, date and time when the alarm first triggered, as well as the time it was silenced and/or cleared. Alarm items in **bright red** indicate the alarm is still actively occurring, items in **dark red** have been acknowledged and items in **light blue** have cleared.

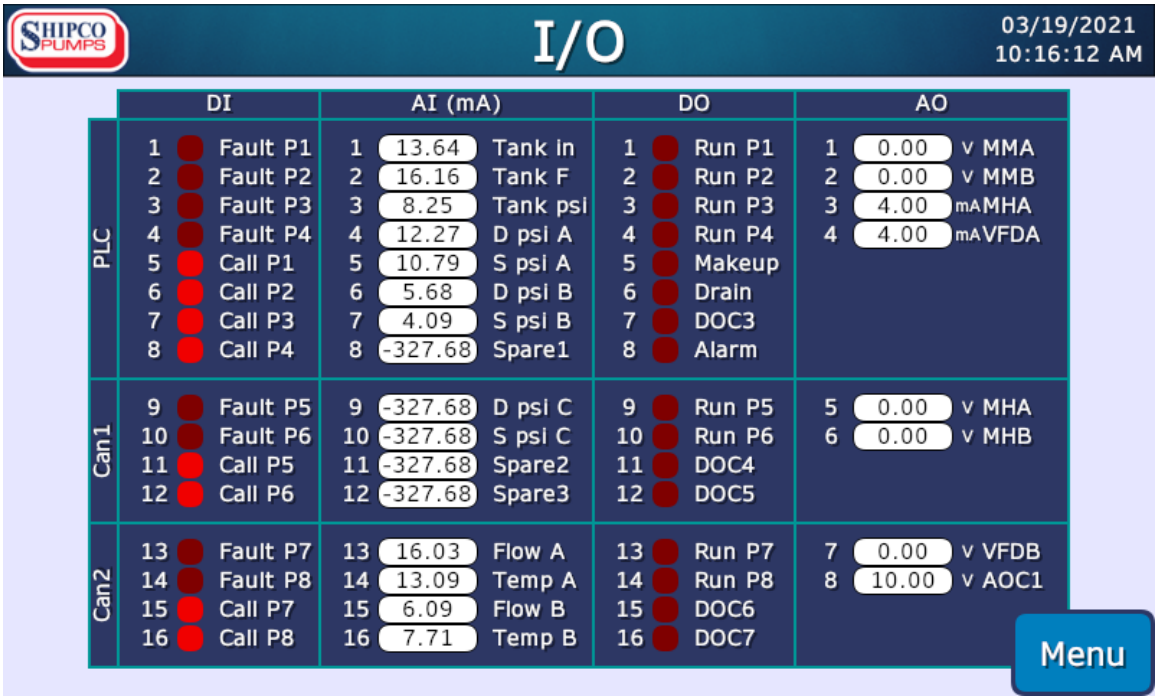
Press **[Active]** to return to the Active Alarms list.

Note: Maximum record of alarms is 255 after which the oldest alarms will be dropped from the local storage.



Alarms Log on 4-inch model.

I/O (Input / Output)



I/O on 7- and 15-inch models.

The I/O (input/output) screen displays all possible digital inputs (DI), analog inputs (AI), digital outputs (DO) and analog outputs (AO) across the local controller and, if present, any expansion I/O. Digital inputs and outputs are simply ON/OFF while analog inputs and outputs display the analogous sensor reading value.

Local (PLC)

The local Aqueous controller features the following built-in I/O.

- 8 digital inputs
- 8 analog inputs
- 8 digital outputs
- 4 analog outputs

I/O on 4-inch model.

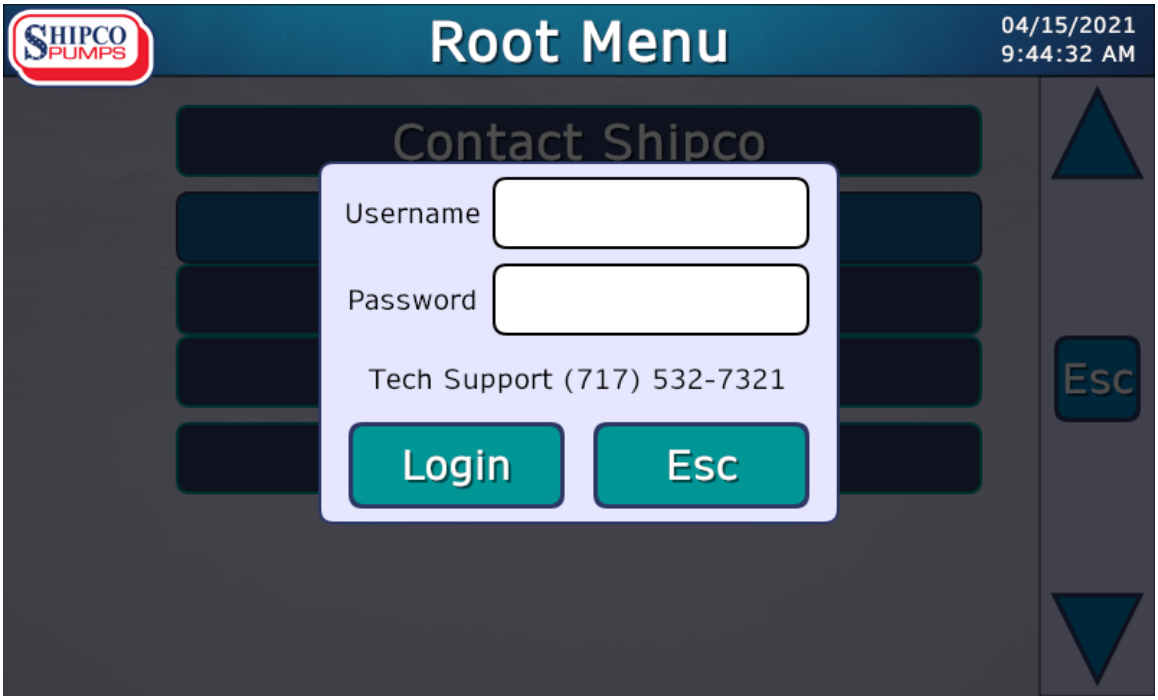
7/15 Expansion (CAN1 / CAN2)

An expansion module can be added via CAN bus with the following additional I/O.

- 4 digital inputs
- 4 analog inputs
- 4 digital outputs
- 2 analog outputs

Up to 2 expansion modules can be added.

Setup Menu (Login)



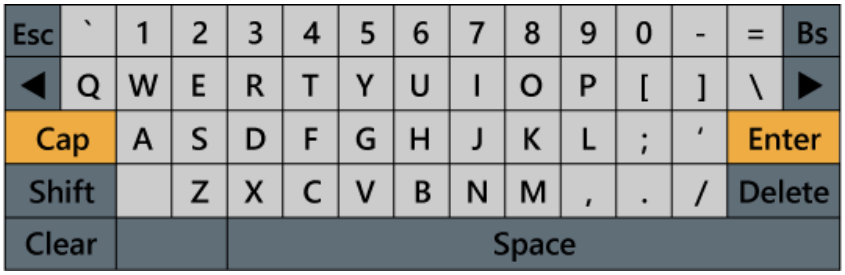
Setup is protected by a basic user name and password to prevent unintentional tampering with sensors and unit configuration. Default login credentials are:

Username: **SETUP** (*all caps*)

Password: **1234**

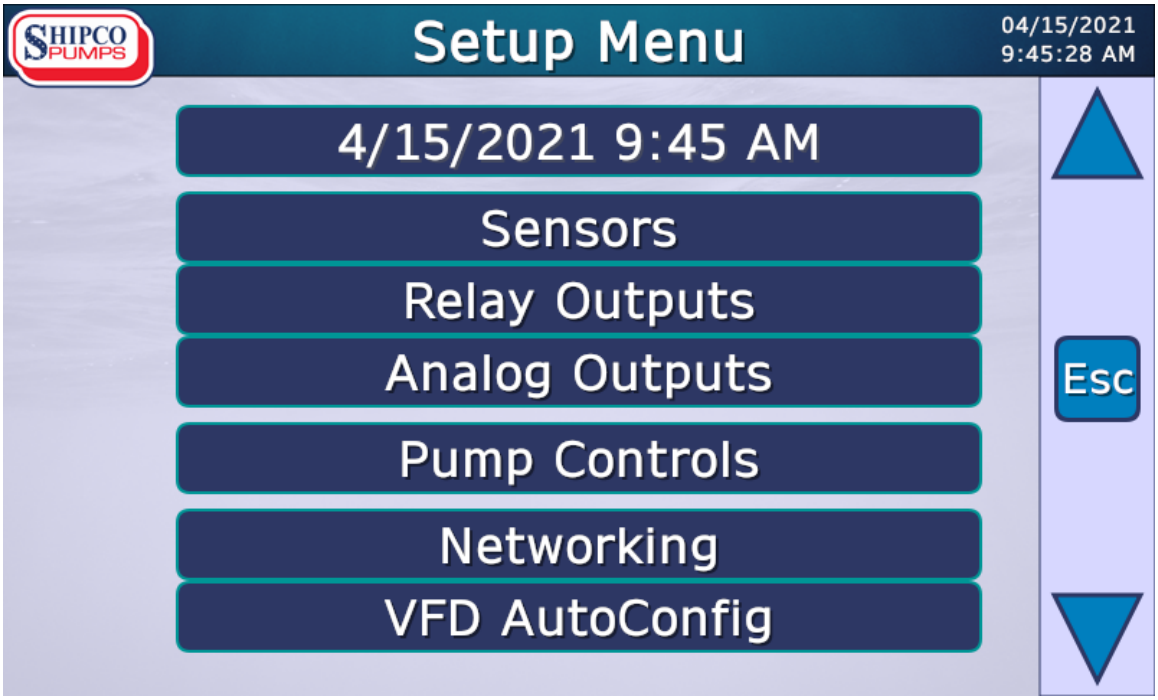
Otherwise login credentials are obtained by consulting the factory or your local service representative.

Tap inside the **[Username]** or **[Password]** fields to display the virtual keyboard. Pressing Caps Lock (***Cap***) toggles between uppercase and lowercase letters. Input the value for each field and press **[Login]** when finished or **[Esc]** to cancel. If the Username and Password are valid then the controller redirects to the Setup Menu.



Setup Menu

WARNING: Be cautious adjusting parameters in Setup! Certain parameters are factory set to design specifications and incorrectly adjusting these parameters could result in unit malfunction and/or serious equipment damage. Consult the factory before making adjustments which could affect unit operation.



Date & Time
Adjust the controller's date and time.

Sensors (p. 19)
Configure various sensors and alarm set points.

Relays (p. 26)
Configure relay outputs (DO or digital output) contacts.

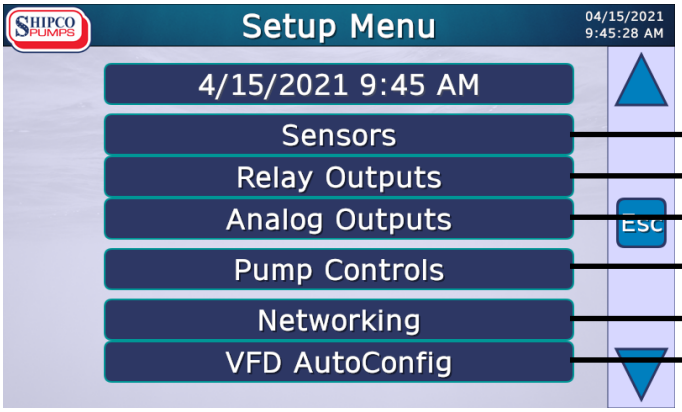
Analog Outputs (p. 28)
Configure analog outputs (AO) such as makeup, heaters, vent, etc.

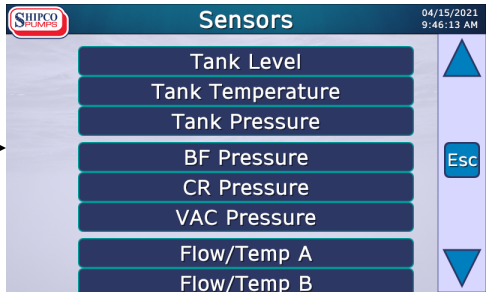
Pump Controls (p. 38)
Adjust pump controls, sequencing for pumps.

4 *Separate "Pump Group A" and "Pump Group B" buttons are shown instead of "Pump Controls".*

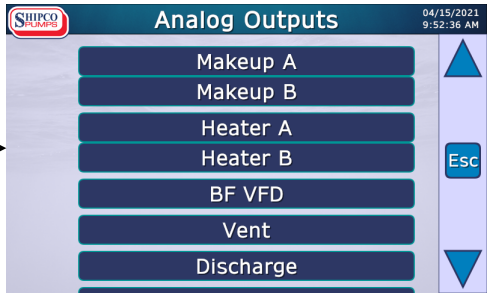
Networking (p. 41)
Network communications and remote overrides.

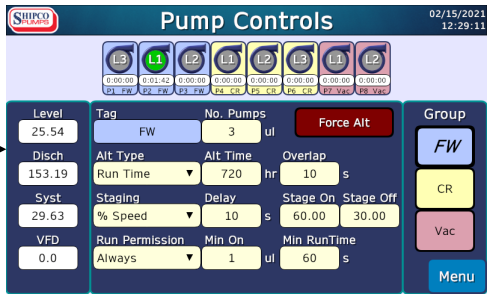
VFD AutoConfig (p. 43)
Auto configuration and tuning for applicable ATV212 VFDs.

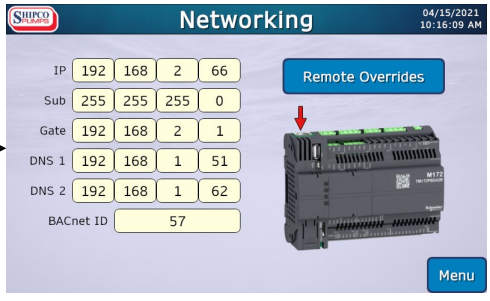

Setup Menu
04/15/2021
9:45:28 AM
4/15/2021 9:45 AM
Sensors
Relay Outputs
Analog Outputs
Pump Controls
Networking
VFD AutoConfig
Esc

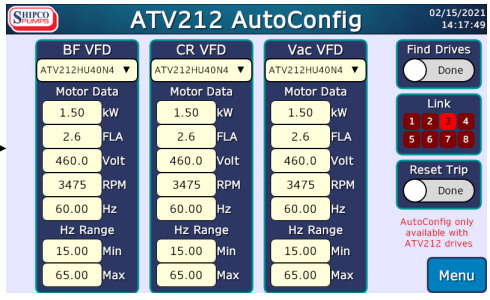

Sensors
04/15/2021
9:46:13 AM
Tank Level
Tank Temperature
Tank Pressure
BF Pressure
CR Pressure
VAC Pressure
Flow/Temp A
Flow/Temp B
Esc


Relay Outputs
03/19/2021
10:17:44 AM
Timer:
On seconds
Off Hours
Bypass and
Chem Pump:
On/Off not
used.
Otherwise:
On/Off same
units as Type
If On > Off
Make on Rise
If Off > On
Make on Fall
1 Tag Makeup On 30.00
Type Tank Level Off 36.00
2 Tag Drain On 55.00
Type Tank Level Off 50.00
3 Tag DOC3 On 0.00
Type PGA Chem Pump Off 0.00
4 Tag DOC4 On 0.00
Type Disabled Off 0.00
Esc

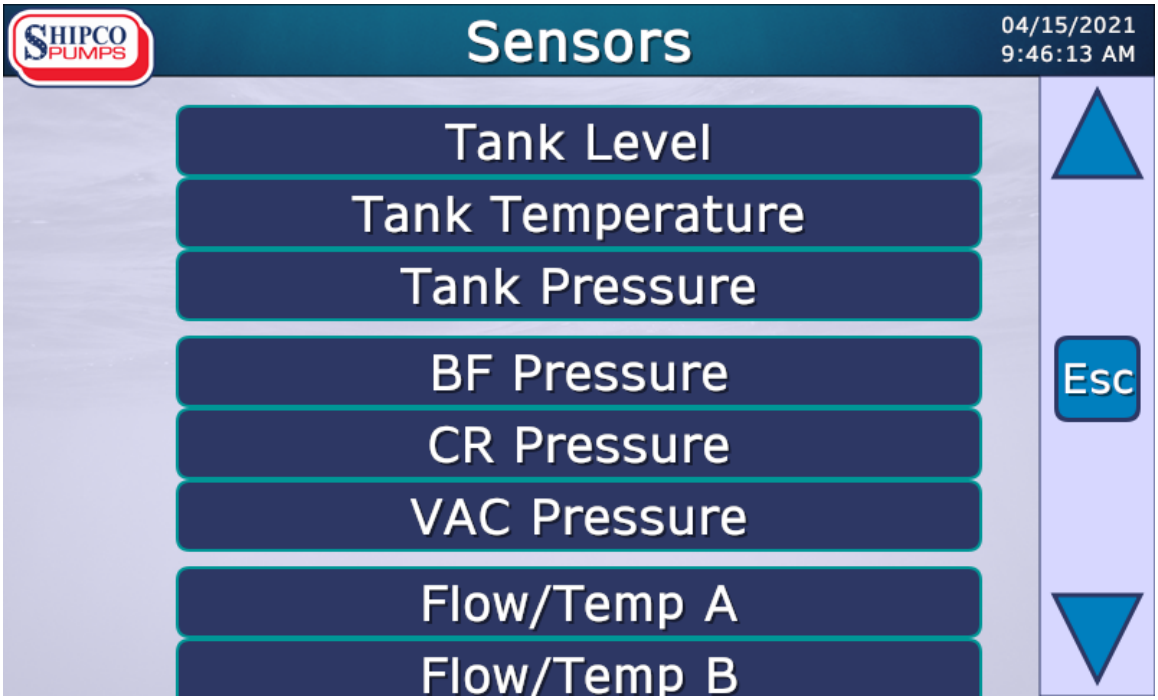

Analog Outputs
04/15/2021
9:52:36 AM
Makeup A
Makeup B
Heater A
Heater B
BF VFD
Vent
Discharge
Esc


Pump Controls
02/15/2021
12:29:11
Level 25.54
Disch 153.19
Syst 29.63
VFD 0.0
Tag FW
No. Pumps 3
Force Alt
Alt Type Run Time
Alt Time 720 hr
Overlap 10 s
Staging % Speed
Delay 10 s
Stage On 60.00
Stage Off 30.00
Run Permission Always
Min On 1
Min RunTime 60 s
Group
FW
CR
Vac
Menu


Networking
04/15/2021
10:16:09 AM
IP 192 168 2 66
Sub 255 255 255 0
Gate 192 168 2 1
DNS 1 192 168 1 51
DNS 2 192 168 1 62
BACnet ID 57
Remote Overrides
Menu


ATV212 AutoConfig
02/15/2021
14:17:49
BF VFD
CR VFD
Vac VFD
ATV212HU40N4
Motor Data
1.50 kW
2.6 FLA
460.0 Volt
3475 RPM
60.00 Hz
Hz Range
15.00 Min
65.00 Max
Find Drives
Done
Link
Reset Trip
Done
AutoConfig only
available with
ATV212 drives
Menu

Sensors



Tank Level (p. 20)
Configuration for tank level sensor and alarm setpoints.

Tank Temperature (p. 21)
Configuration for tank temperature sensor and alarm setpoints.

Tank Pressure (p. 22)
Configuration for tank pressure sensor and alarm setpoints.

“Pump Group” Pressure (p. 23)
Configuration for pressure sensors applicable to each pump group. Menu items are labeled with corresponding pump group tag.

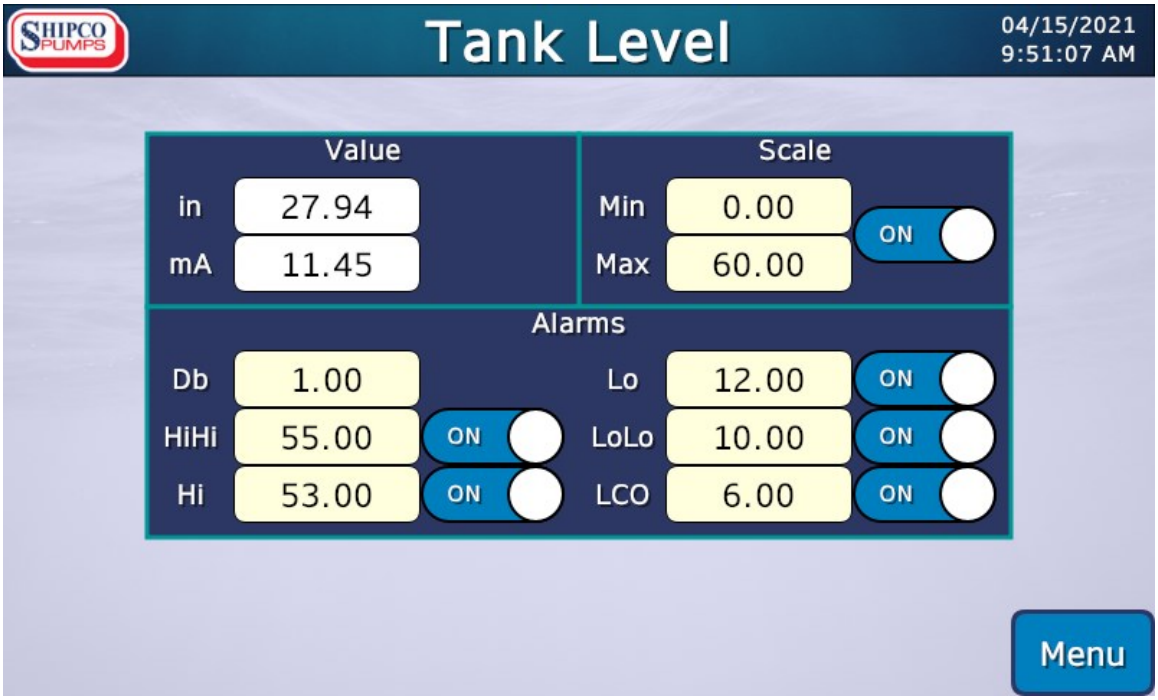
Pump groups shown: 7/15 1, 2 or 3 4 1 or 2

7/15 Flow/Temp (p. 24)
Configuration for additional flow and/or temperature sensors on the unit.

Custom (p. 25)
Configuration for extra or custom user-defined sensors. By default labels are “Spare1”, “Spare2”, etc.

Tank Level

Sensors



Sensor

Level (in) Current water level in the tank expressed in inches (read-only).

Signal (mA) Current 4-20 mA signal for water level sensor (read-only).

Min / Max (in) Minimum and maximum water level sensor range amount. Minimum is typically 0 inch and maximum is typically the diameter or height of the tank expressed in inches. This sensor and all alarms can be toggled **[ON]** / **[OFF]**.

Alarms

Alarm setpoints can be individually toggled **[ON]** / **[OFF]**.

Db (in) Tank water level deadband. The amount of level change that must occur before the controller releases an alarm status. Typically 1 inch.

HiHi (in) Tank water level must rise to this value before an extra-high water level (second) alarm status is triggered.

Hi (in) Tank water level must rise to this value before a high water level (first) alarm status is triggered.

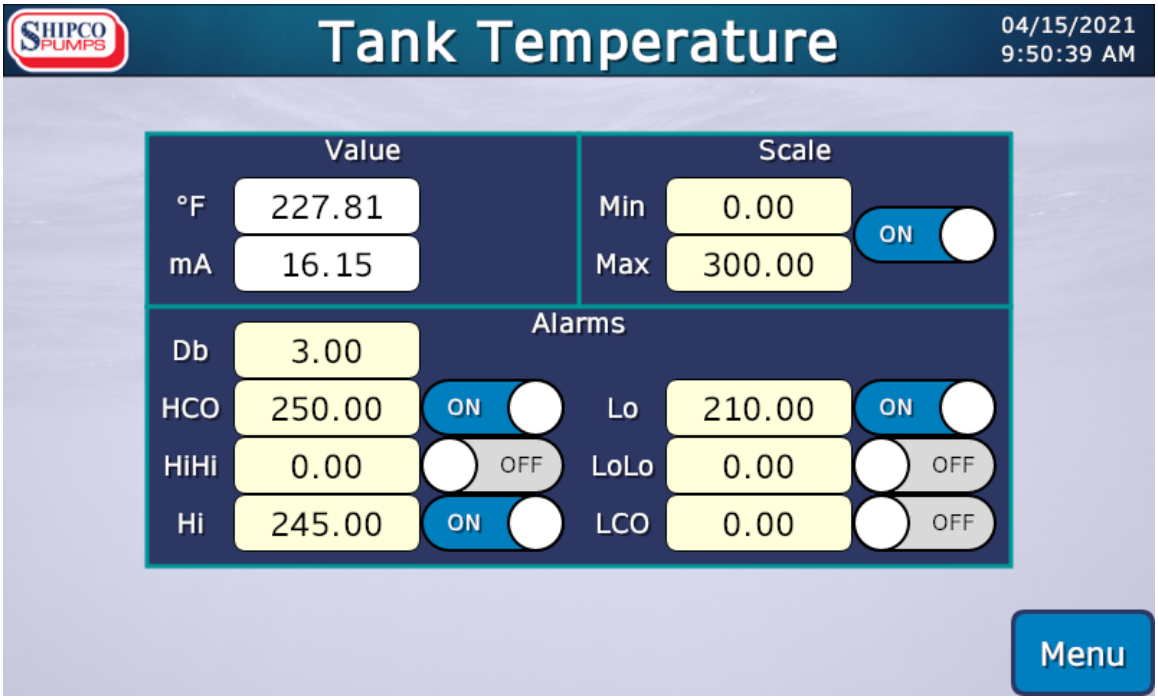
Lo (in) Tank water level must fall to this value before a low water level alarm (first) status is triggered.

LoLo (in) Tank water level must fall to this value before an extra-low water level (second) alarm status is triggered.

LCO (in) Tank water level must fall to this value before a low water level cut-off operation occurs where all pumps are shut off and alarm status is triggered.

Tank Temperature

Sensors



Sensor

Temperature (°F) Current water temperature in the tank expressed in °F (read-only).

Signal (mA) Current 4-20 mA signal for water temperature sensor (read-only).

Min / Max (°F) Minimum and maximum water temperature sensor range amount. Minimum is typically 0°F and maximum is typically 300°F. This sensor and all alarms can be toggled **[ON]** / **[OFF]**.

Alarms

Alarm setpoints can be individually toggled **[ON]** / **[OFF]**.

Db (°F) Tank water temperature deadband. The amount of temperature change that must occur before the controller releases an alarm status.

HCO (°F) Tank water temperature must rise to this value before a high water temperature cut-off operation occurs where all pumps are shut off to prevent seal damage and alarm status is triggered.

HiHi (°F) Tank water temperature must rise to this value before an extra-high water temperature (second) alarm status is triggered.

Hi (°F) Tank water temperature must rise to this value before a high water temperature (first) alarm status is triggered.

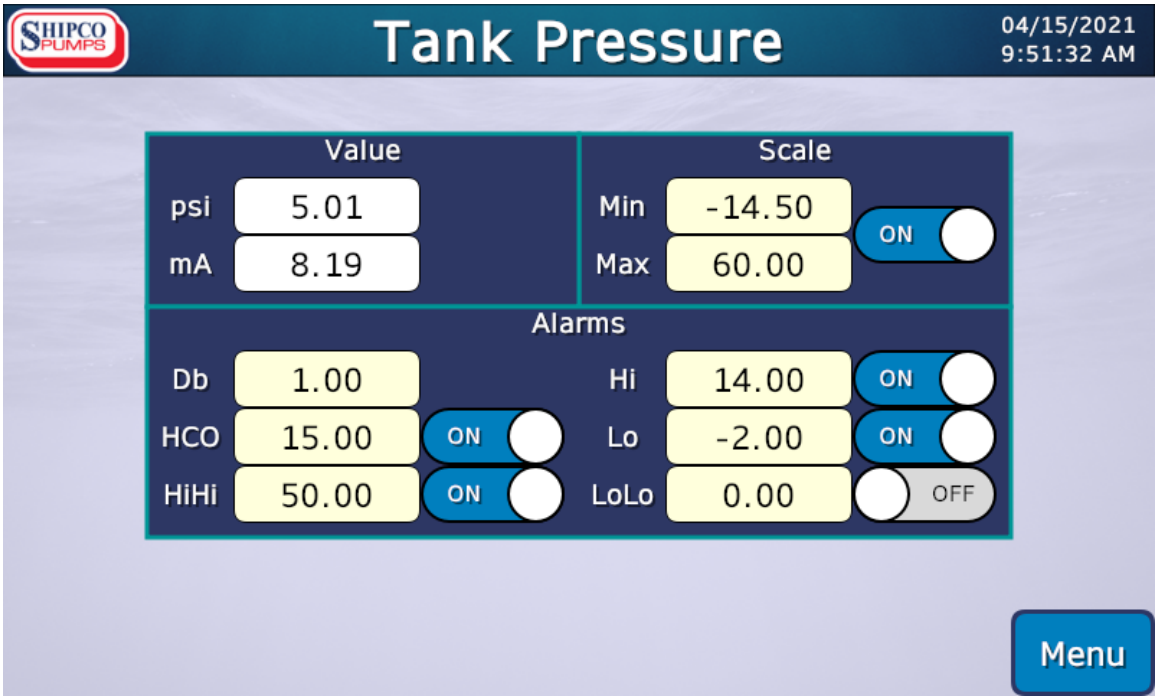
Lo (°F) Tank water temperature must fall to this value before a low water temperature alarm (first) status is triggered.

LoLo (°F) Tank water temperature must fall to this value before an extra-low water temperature (second) alarm status is triggered.

LCO (°F) Tank water temperature must fall to this value before a low water temperature cut-off operation occurs where all pumps are shut off and alarm status is triggered.

Tank Pressure

Sensors



Sensor

Pressure (psi) Current pressure in the tank expressed in psi (read-only).

Signal (mA) Current 4-20 mA signal for pressure sensor (read-only).

Min / Max (psi) Minimum and maximum tank pressure sensor range amount in the tank. Minimum is typically -14.5 psi and maximum is typically 60 psi. This sensor and all alarms can be toggled **[ON]** / **[OFF]**.

Alarms

Alarm setpoints can be individually toggled **[ON]** / **[OFF]**.

Db (psi) Tank pressure deadband. The amount of pressure change that must occur before the controller releases an alarm status. This is typically 1 psi.

HCO (psi) Tank pressure must rise to this value before a relief valve pressure alarm status is triggered.

HiHi (psi) Tank pressure must rise to this value before an extra-high tank pressure (second) alarm status is triggered.

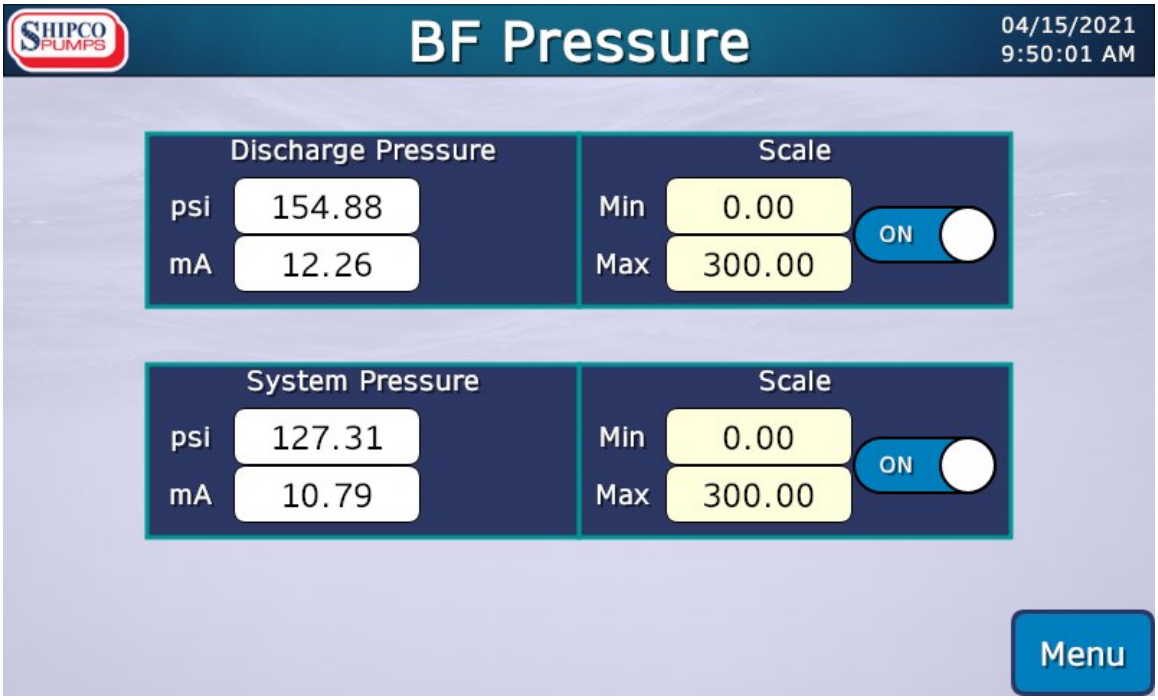
Hi (psi) Tank pressure must rise to this value before a high tank pressure (first) alarm status is triggered.

Lo (psi) Tank pressure must fall to this value before a low tank pressure alarm (first) status is triggered.

LoLo (psi) Tank pressure must fall to this value before an extra-low pressure (second) alarm status is triggered.

“Pump Group” Pressure

Sensors



Defines scaling for discharge pressure and/or system pressure sensors for a specific pump group. The defined tag label for each pump group is displayed. Refer to *Pump Controls* (p. 38) to set or rename the pump group.

Discharge Pressure

Pressure (psi) Current discharge pressure for pump group expressed in psi (read-only).

Signal (mA) Current 4-20 mA signal for discharge pressure sensor (read-only).

Min / Max (psi) Minimum and maximum discharge pressure range amount for pump group. This sensor can be toggled **[ON]** / **[OFF]**.

System Pressure

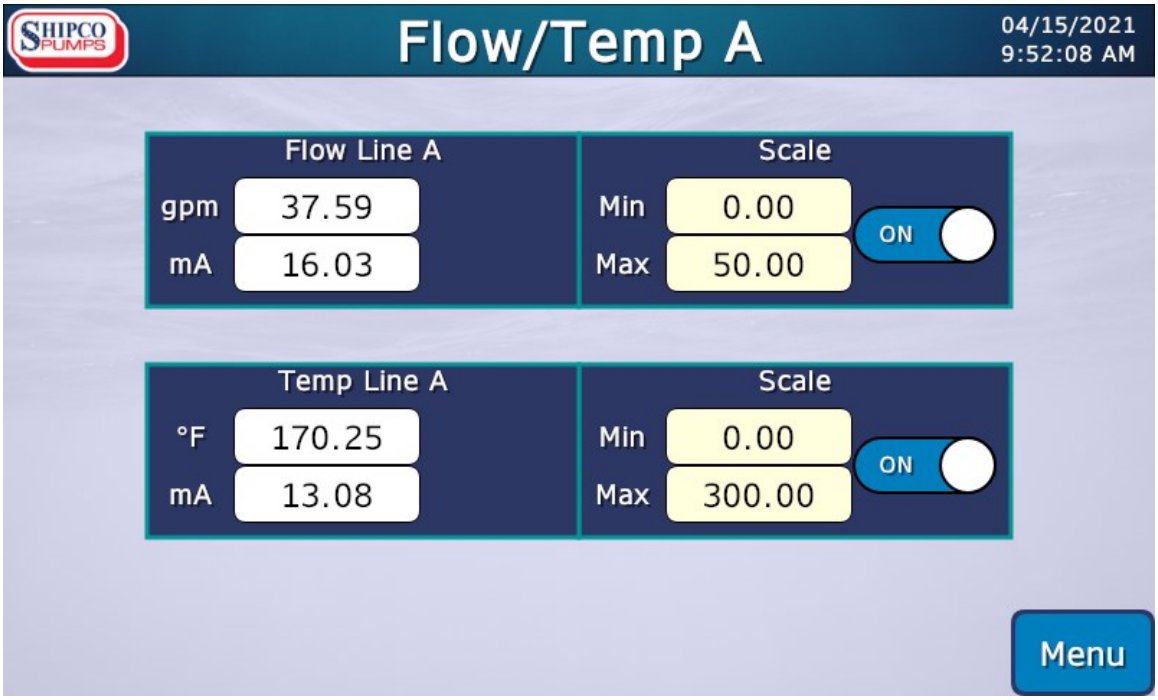
Pressure (psi) Current system pressure for pump group expressed in psi (read-only).

Signal (mA) Current 4-20 mA signal for system pressure sensor (read-only).

Min / Max (psi) Minimum and maximum system pressure range amount for pump group. This sensor be toggled **[ON]** / **[OFF]**.

Flow & Temperature 7/15

Sensors



Defines scaling for additional flow rate and temperature sensors (Flow/Temp A and Flow/Temp B, respectively known as "Line A" and "Line B", are defined on separate screens). Both Lines A and B are required when using a modulating orifice vent valve on a deaerator (see *Vent,* p. 34).

Flow Sensor

Flow (gpm) Current flow rate expressed in gallons per minute (gpm) (read-only).

Signal (mA) Current 4-20 mA signal for flow rate sensor (read-only).

Min / Max (gpm) Minimum and maximum flow rate sensor range amount. This sensor can be toggled **[ON]** / **[OFF]**.

Temperature Sensor

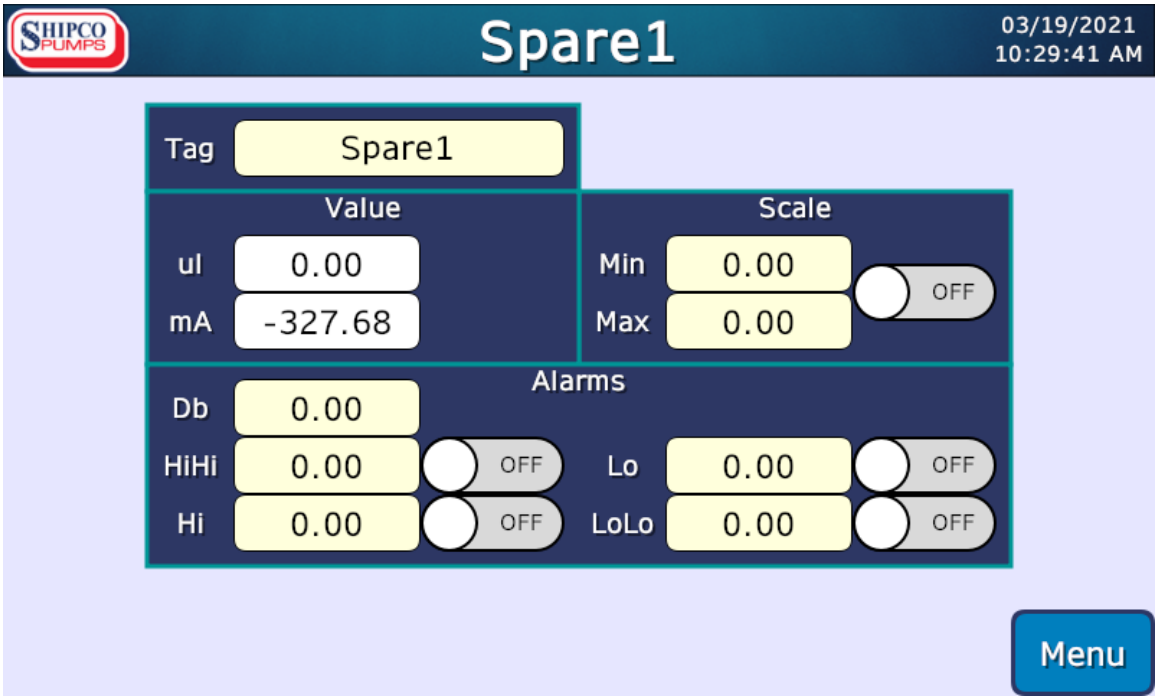
Temperature (°F) Current temperature expressed in °F (read-only).

Signal (mA) Current 4-20 mA signal for temperature sensor (read-only).

Min / Max (°F) Minimum and maximum temperature sensor range amount. This sensor can be toggled **[ON]** / **[OFF]**.

Custom

Sensors



Defines scaling and alarm set points for a custom sensor (if available). Custom sensors: 7/15 1, 2 or 3 4 only 1

Sensor

Tag A label given to identify the custom sensor. The tag name is displayed in dropdown lists.

Value (ul) Current custom sensor value (read-only). The amount is unitless.

Signal (mA) Current 4-20 mA signal for sensor (read-only).

Min / Max (ul) Minimum and maximum custom sensor range amount. This sensor and all alarms can be toggled **[ON]** / **[OFF]**.

Alarms

Alarm setpoints can be individually toggled **[ON]** / **[OFF]**.

Db (ul) Custom sensor deadband. The amount of change that must occur before the controller releases an alarm status.

HiHi (ul) Custom sensor reading must rise to this value before an extra-high (second) alarm status is triggered.

Hi (ul) Custom sensor reading must rise to this value before a high (first) alarm status is triggered.

Lo (ul) Custom sensor reading must fall to this value before a low (first) status is triggered.

LoLo (ul) Custom sensor reading must fall to this value before an extra-low (second) alarm status is triggered.

Relay Outputs

IMPORTANT: Relays are 300V 3A rated and acceptable for use in 120VAC or 24VDC/VAC control circuits.

Relay Outputs on 7- and 15-inch models.

Several relay outputs (also known as digital outputs or contacts) are already reserved for specific use in the controller. This screen is used to bind additional, unreserved relays to open/close by sensor input, timer or other circumstances.

Additional relay outputs: 7/15 up to 7 4 up to 3

Tag

A label to easily identify the purpose of the relay. By default labels are “DOC1”, “DOC2”, etc.

Type

Choose a sensor, timer or special case from the **[Type]** dropdown list to bind a relay to. More information on the different contact categories is explained on the following page.

Disabled	Relay is disabled or not applicable.
Tank Level	*(Sensor).* Relay contact engaged on tank level. **[On]** and **[Off]** expressed in inches.
Tank Temp	*(Sensor).* Relay contact engaged on tank temperature. **[On]** and **[Off]** expressed in °F.
Tank Pres	*(Sensor).* Relay contact engaged on tank pressure. **[On]** and **[Off]** expressed in psi.
“Spare” (Custom)	*(Sensor).* Custom sensor label is shown here. Relay contact engaged on custom sensor where **[On]** and **[Off]** expressed as the unit of measure for the sensor. Refer to *Custom Sensors* setup, page 25.
Timer	*(Timer).* Relay contact closes for **[On]** seconds every **[Off]** hours. Typically used for blowdown solenoids.
PG(A|B|C) Bypass	*(Bypass).* Relay contacts used for bypass recirculation pumps per pump group.
PG(A|B|C) Chem	*(Chemical Feed Pump).* Relay contacts used when chemical feed pumps are present per pump group.

Sensor

The *Sensor* types engage relay contacts within a specified range based on the input from the chosen sensor. For *Sensor* types, the units of **[On]** and **[Off]** inherit the units of measure for the chosen sensor. Configuration is as follows:

If the [On] value > [Off] value, then *make on rise*.

If the [Off] value > [On] value, then *make on fall*.

For a "*make on rise*" example, a relay contact controlling an overflow drain solenoid valve is closed when the level of water rises to the **[On]** value of 55 inches, opening the drain valve and discharging water from the tank. When the level falls to the **[Off]** value of 50 inches, the relay contact is opened and the drain valve closes.

For a "*make on fall*" example, a relay contact controlling a makeup solenoid valve is closed when the level of water falls to the **[On]** value of 30 inches, opening the solenoid and allowing water into the tank. When the level rises to the **[Off]** value of 36 inches, the relay contact is open and the solenoid closes.

Timer

[On] is expressed in *seconds*.

[Off] is expressed in *hours*.

The *Timer* type is used to close relay contacts on a recurring interval. **[On]** is the amount of time in seconds that the relay contact remains closed. **[Off]** is the amount of time in hours that the relay contact spends open (waiting) before it is closed again.

For example, a relay contact controlling a valve for blowdown operation is opened every 6 hours and remains open for exactly 30 seconds then closes again and the cycle repeats. The **[Off]** value is 6; the number of hours to wait. The **[On]** value is 30; the number of seconds the relay contact stays closed with the valve open.

Bypass

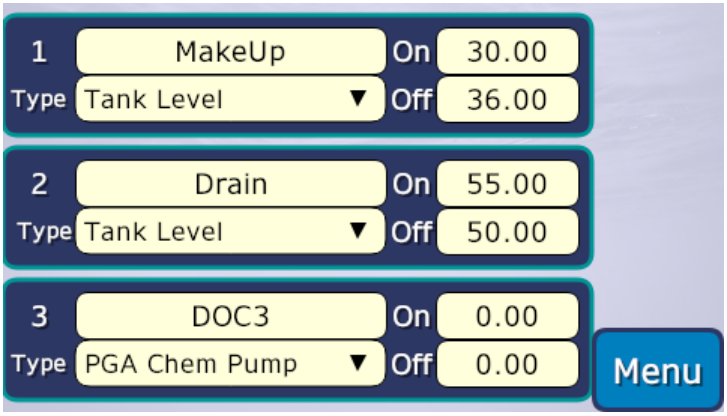
The corresponding [On] and [Off] values are not used.

A *Bypass* type relay closes when the number of pumps on equals the minimum number of pumps within the pump group (see the **[Min On]** setting within the applicable pump group under *Pump Controls*, page 38). This is typically a minimum flow recirculation solenoid, piped off the discharge header and back to the receiver. If the number of pumps on is greater than **[Min On]**, then the system demand is greater than the minimum flow rate for continuous run pumps and the relay opens; closing the recirculation solenoid.

Chemical Feed Pump

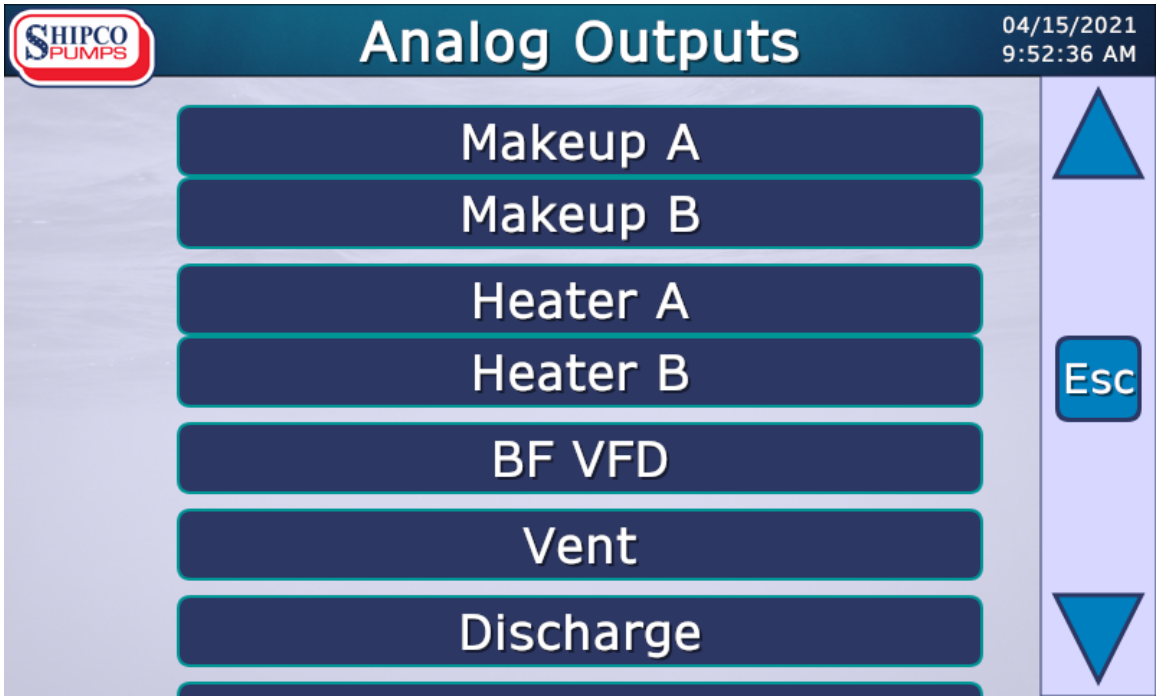
The corresponding [On] and [Off] values are not used.

A *Chemical Feed Pump* type is powered when any number of pumps are running within the pump group. This is an end switch to notify the chemical system that water is actively moving through the pumping system.



Relay Outputs on 4-inch model.

Analog Outputs



Analog outputs are used to adjust actuating valves, equipment and/or drives and how they react to sensor input changes. Examples include modulating makeup valves, regulators that release steam (heaters), variable frequency drives (VFDs) controlling pump motors, etc.

The options displayed on this screen vary depending on the installed equipment on the unit.

Note: Some 2-10V actuators will register 20% output (2V) as 0 and 0% output as a loss of signal.

Makeup (p. 30)
Configuration for 1 or 2 modulating makeup valves. A makeup feed valve will modulate to increase or decrease the flow of makeup water into the tank.

Heater (p. 31)
Configuration for up to 3 steam regulator valves. A steam regulator will modulate to increase or decrease the flow of steam into the tank.

“Pump Group” VFD (p. 32)
Configuration for variable frequency drives (VFDs) applicable to a pump group. Menu items are prefixed with corresponding pump group tag followed by “VFD”. VFDs variably speed up or slow down the motor .

7/15 Vent (p. 34)
Configuration of a variable vent valve which throttles deaerator vent capacity to the live deaerator load.

7/15 Discharge (p. 35)
Configuration of pump discharge valves used with high temperature condensate return (HT units) to prevent water hammer from ON/OFF operations.

Custom Analog Outputs (p. 36)

For any additional equipment not explicitly defined or commonly used on a unit and which utilizes an analog output on the controller. Up to 2 custom analog outputs can be assigned a control type. May be initially shown as “AOC1” or “AOC2”.

Linear Control Information

Linear control maintains a ratio within a provided minimum and maximum range.

CV = Control Variable (what changes)

PV = Process Variable (or actual, what is monitored)

Min = Minimum user defined value

Max = Maximum user defined value

$$CV = \frac{PV - Min}{Max - Min}$$

$$\text{if } PV > Max,\ CV = 100\%$$
$$\text{if } PV < Min,\ CV = 0\%$$

PID Control Information

PID control maintains a set point. PID stands for Proportional–Integral–Derivative and is a control loop feedback mechanism for applications requiring continuous modulating control.

CV = Control Variable (what changes)

PV = Process Variable (or actual, what is monitored)

SP = Set Point (or target value, what the PV should be)

e = “error” (how far off the PV is from the target)

P, I and **D** = coefficients for the proportional, integral, and derivative

$$CV = P\left(e + \int_0^I e dI + \frac{e de}{dD}\right)$$

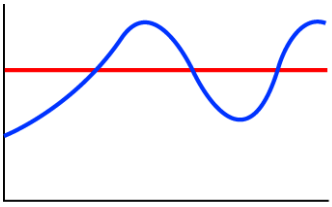
$$e = (SP - PV)$$

PID Tuning Example

1. Set **P**, **I** and **D** coefficients = 0. **D** typically remains 0.

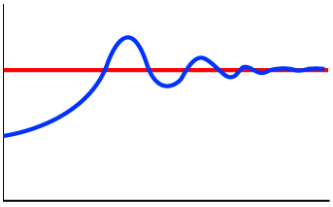
CV will not change

2. Increase **P** value for a small overshoot.



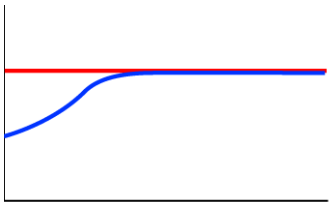
P↑ I = 0

3. Increase **I** value to reduce bounce or hunting.



P↑ I↓

Fast response

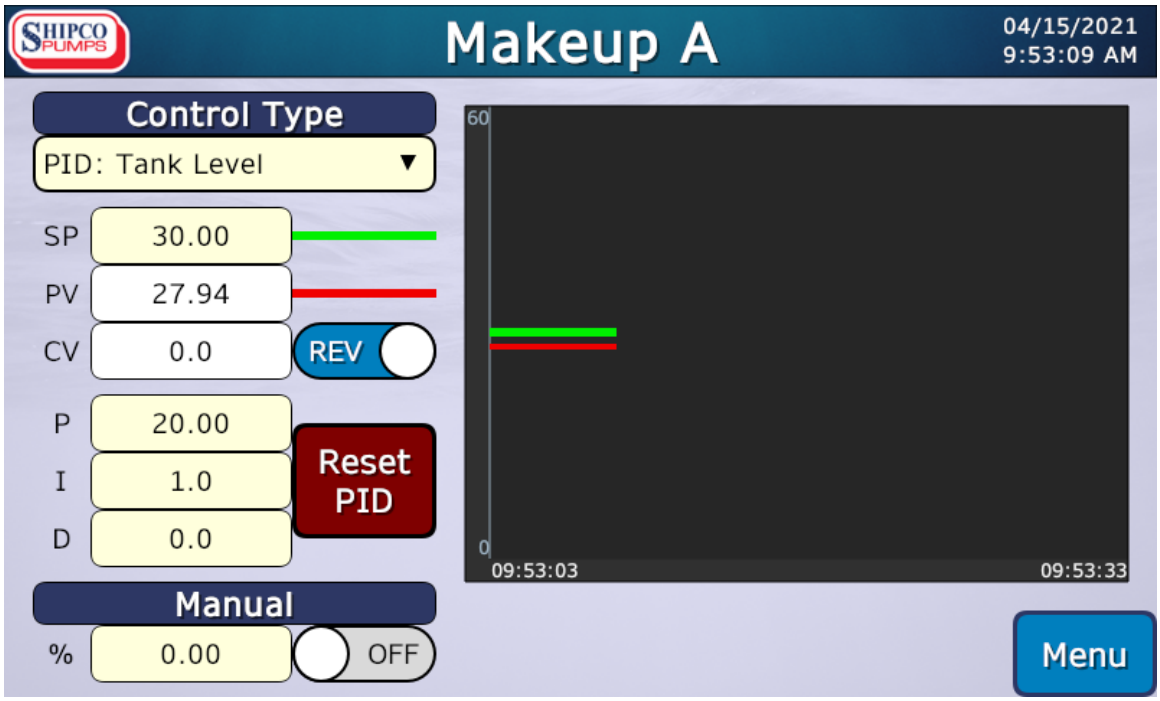


P↓ I↑

No overshoot

Makeup

Analog Outputs



Control Type

For modulating makeup valves A & B, if present, choose a control method from the **[Control Type]** dropdown list.

Disabled Makeup valve control is disabled or not applicable.

PID: Tank Level Makeup valve modulates to maintain a tank level set point **[SP]** (inch).

Additionally shown are the read-only variables ***PV*** process (actual, what is monitored) and ***CV*** control (what changes). Toggle the **[FWD]** / **[REV]** switch if the control type is reverse-acting (e.g., normally open instead of normally closed).

The values for PID control — proportional (%), integral (repetitions per second), derivative (seconds) — can be adjusted via respective **[P]**, **[I]** and **[D]** fields (advanced users only). Press **[Reset PID]** to reset these values to factory defaults.

Graph

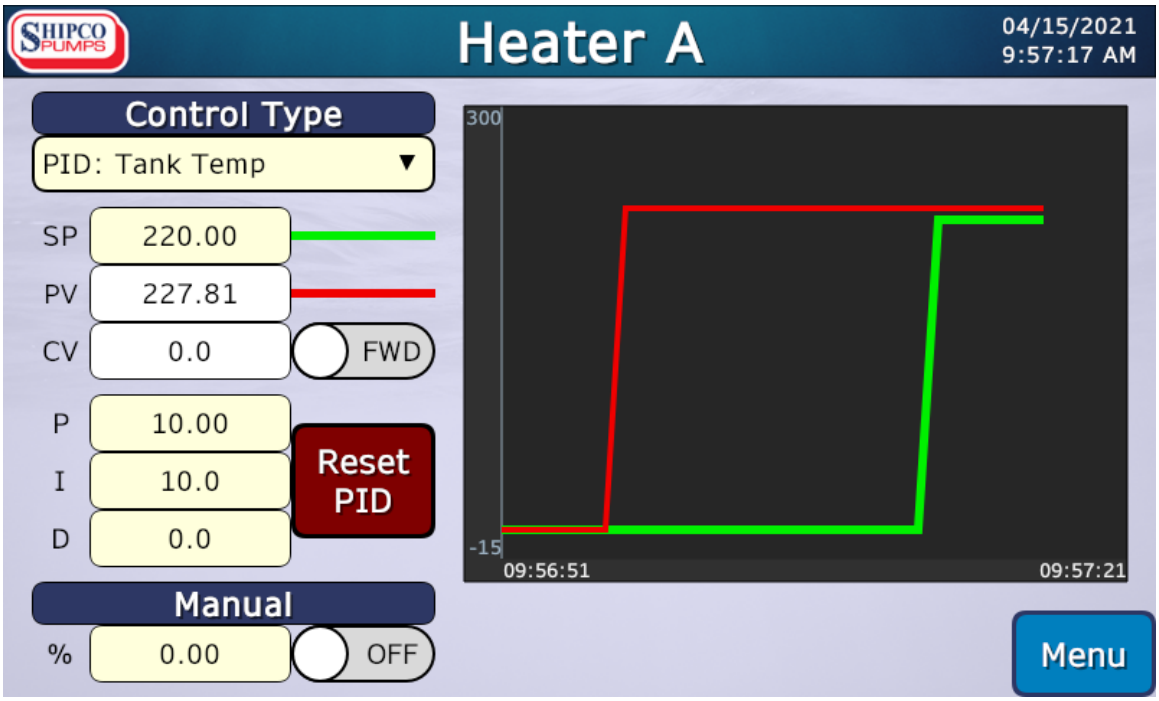
The graph displays the target **[SP]** versus actual (***PV***) changes over a brief period of time. Ideally the actual would closely match the target.

Manual

Manual is shown when a control type (except Disabled) is chosen. Manual % allows the user to take manual control of the modulating makeup valve. Enter a percentage **[%]** which the valve is to open between 0 (full closed) and 100 (full open), then toggle the **[OFF] / [ON]** switch to disable or enable manual control.

Heaters

Analog Outputs



Control Type

For steam regulator valves A, B & C, if present, choose a control method from the **[Control Type]** dropdown list.

Disabled	Steam regulator control is disabled or not applicable.
PID: Tank Temp	Steam regulator modulates to maintain a tank temperature set point **[SP]** (°F). Typically used on atmospheric applications.
PID: Tank Pres	Steam regulator modulates to maintain a tank pressure set point **[SP]** (psi). Typically used on pressurized applications.

Additionally shown are the read-only variables ***PV*** process (actual, what is monitored) and ***CV*** control (what changes). Toggle the **[FWD]** / **[REV]** switch if the valve is reverse-acting (e.g., normally open instead of normally closed).

The values for PID control — proportional (%), integral (repetitions per second), derivative (seconds) — can be adjusted via respective **[P]**, **[I]** and **[D]** fields (advanced users only). Press **[Reset PID]** to reset these values to factory defaults.

Graph

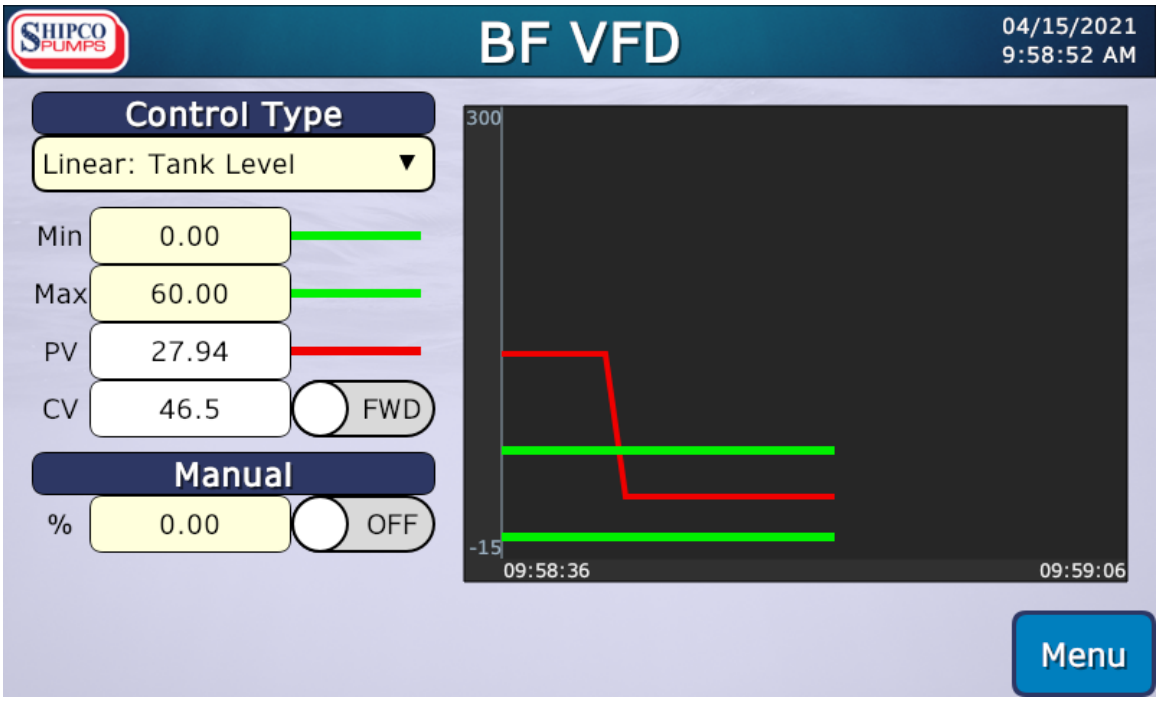
The graph displays the target **[SP]** versus actual (***PV***) changes over a brief period of time. Ideally the actual would closely match the target.

Manual

Manual is shown when a control type (except Disabled) is chosen. Manual % allows the user to take manual control of the steam regulator valve. Enter a percentage **[%]** which the valve is to open between 0 (full closed) and 100 (full open), then toggle the **[OFF]** / **[ON]** switch to disable or enable manual control.

"Pump Group" VFDs

Analog Outputs



Example of a linear control type.

Control Type

For variable frequency drives (VFDs) on a specific pump group, if present, choose a control method from the **[Control Type]** dropdown list.

Disabled VFDs are disabled or not applicable.

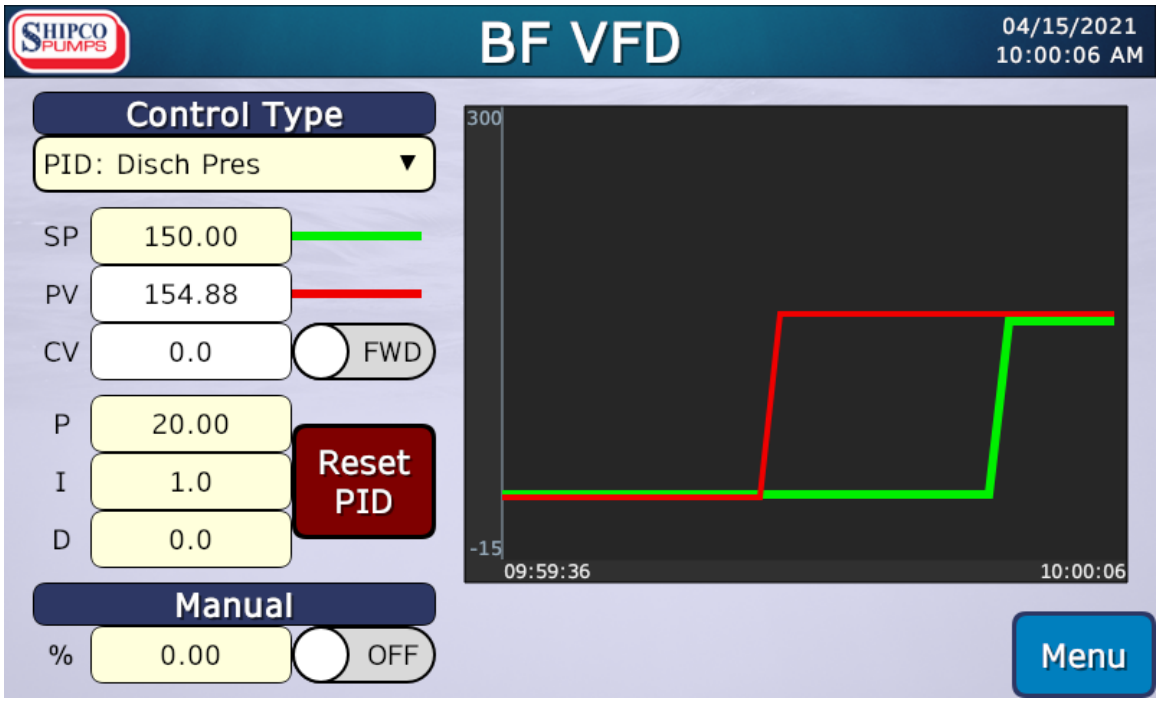
Linear: Tank Level VFDs modulate to maintain a ratio between minimum **[Min]** (inch) and maximum **[Max]** (inch) level range. This control type is typically used on condensate units to dampen water hammer.

Linear: Syst Pres VFDs modulate to maintain a ratio between minimum **[Min]** (psi) and maximum **[Max]** (psi) pressure range. This control type is typically used on boiler feed units without a modulated feed valve where system pressure is measured in the steam header to limit discharge pressure based on downstream boiler pressure.

PID: Tank Level VFDs modulate to maintain a tank level set point **[SP]** (inch). This control type is typically used on high-temperature, pressurized condensate units to maintain a water seal and limit flashing.

PID: Disch Pres VFDs modulate to maintain a discharge pressure set point **[SP]** (psi). This control type is typically used on transfer pumps to limit pump flow rate (gallons per minute) based on a variable demand (modulated valve).

PID: Syst Pres VFDs modulate to maintain a system pressure set point **[SP]** (psi). This control type is typically used on vacuum units where the system pressure is measured in the condensate return line to maintain a consistent vacuum by changing the volumetric flow (cubic feet per minute or CFM) of the vacuum pumps.



Example of a PID control type.

PID: Diff. Pres VFDs modulate to maintain a differential pressure set point **[SP]** (psi). This control type is typically used on boiler feed units with a modulated feed valve where system pressure is measured in the steam header. This control type has the highest possible turndown based on the boiler water consumption and operating pressure to overcome.

Additionally shown are the read-only variables ***PV*** process (actual, what is monitored) and ***CV*** control (what changes). Toggle the **[FWD] / [REV]** switch if the VFD is reverse-acting.

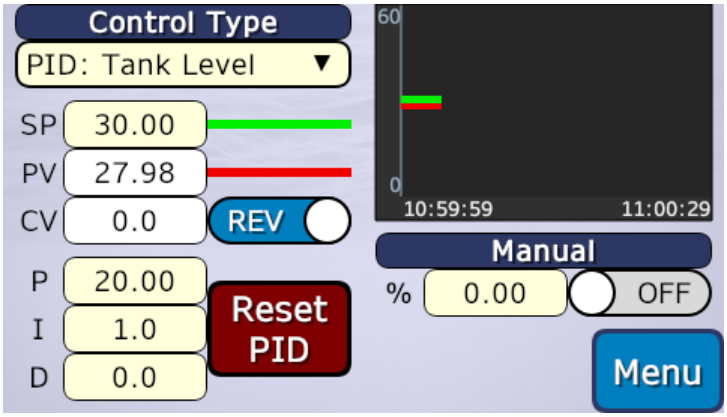
The values for PID control — proportional (%), integral (repetitions per second), derivative (seconds) — can be adjusted via respective **[P]**, **[I]** and **[D]** fields (advanced users only). Press **[Reset PID]** to reset these values to factory defaults.

Graph

When the control type is a Linear selection, the graph shows the actual (***PV***) with the minimum **[Min]** and maximum **[Max]**. The actual will fluctuate between the minimum and maximum. When the control type is a PID selection, the graph displays the target **[SP]** versus actual (***PV***) changes over a brief period of time. Ideally the actual would closely match the target.

Manual

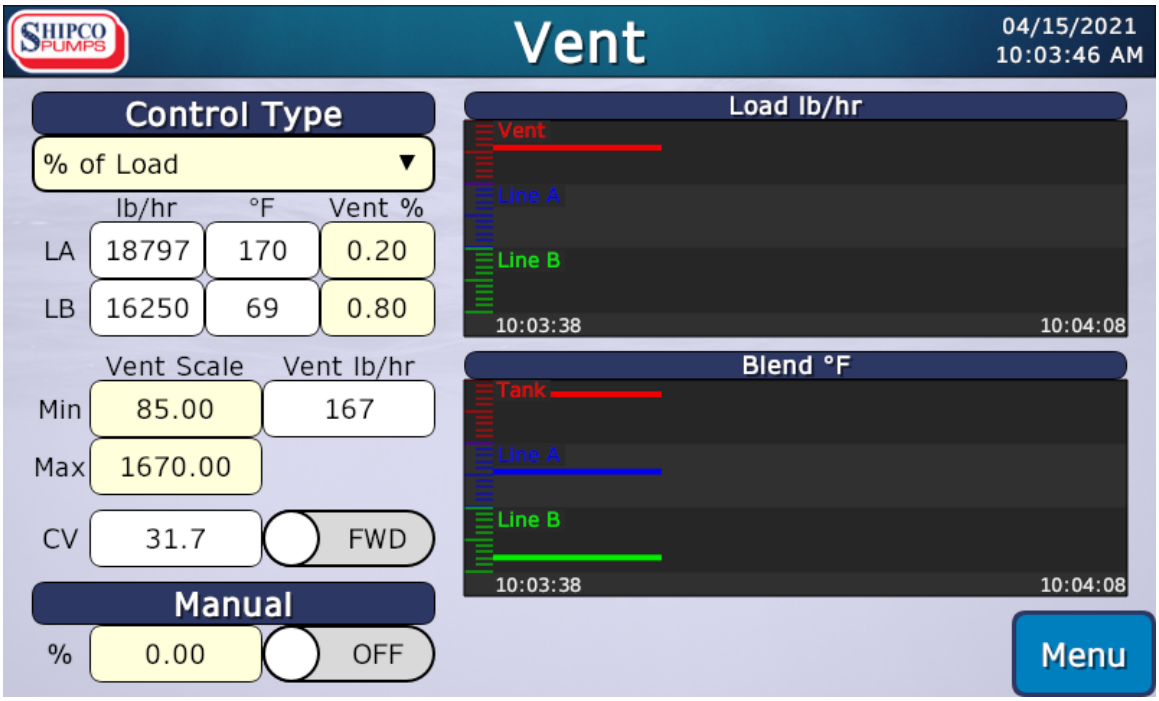
Manual is shown when a control type (except Disabled) is chosen. Manual % allows the user to take manual control of the VFD speed. Enter a percentage **[%]** which the VFD is to run between 0 (no speed) and 100 (full speed), then toggle the **[OFF] / [ON]** switch to disable or enable manual control.



Analog Outputs on 4-inch model.

Vent 7/15

Analog Outputs



Used to configure a calibrated modulating vent valve for use with deaerator applications to limit steam loss based on live load. Requires additional flow rate and temperature sensors to be installed (see *Flow & Temperature*, p. 24).

Control Type

For vent, if present, choose a control method from the **[Control Type]** dropdown list.

Disabled Vent control is disabled or not applicable.

% of Load Sets the vent to react to changes in load.

Both Line A (LA) and Line B (LB) have their corresponding flow load expressed in pounds-per-hour (***lb/hr***) and temperature (***°F***) displayed for each line. Industry standard fixed vent orifices are sized between 0.1–0.5% of nominal deaerator capacity. This sequence modulates a linear control valve to throttle venting for live loads. **[Vent %]** can be adjusted for 2 independent flow measurements in order to account for higher oxygen contents in cold makeup versus hot condensate returns.

Vent Scale **[Min]** and **[Max]** are dependent on vent valve capacity and preset by the factory. These values **should not** be changed without first consulting the factory! The load amount being vented is shown as ***Vent lb/hr***.

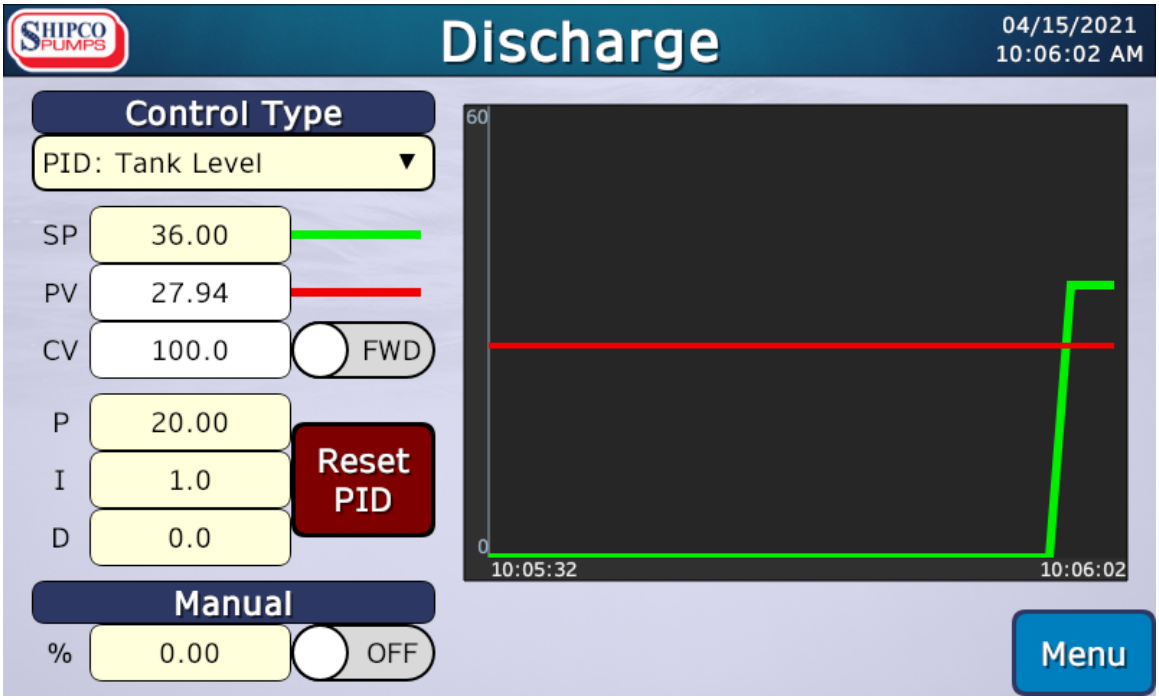
Additionally shown are the read-only ***CV*** control variable (what changes). Toggle the **[FWD] / [REV]** switch if the vent is reverse-acting (e.g., normally open instead of normally closed).

Manual

Manual is shown when a control type (except Disabled) is chosen. Manual % allows the user to take manual control of the vent. Enter a percentage **[%]** which the vent is to open between 0 (full closed) and 100 (full open), then toggle the **[OFF] / [ON]** switch to disable or enable manual control. **IMPORTANT:** In case of emergency pressure vessels can be quickly vented by toggling manual and setting to 100%.

Discharge 7/15

Analog Outputs



Control Type

For discharge valves, if present, choose a control method from the **[Control Type]** dropdown list.

Disabled	Discharge valves are disabled or not applicable.
Linear: Tank Level	Discharge modulate to maintain a ratio between minimum **[Min]** (inch) and maximum **[Max]** (inch) level range.
PID: Tank Level	Discharge valves modulate to maintain a tank level set point **[SP]** (inch).

Additionally shown are the read-only variables ***PV*** process (actual, what is monitored) and ***CV*** control (what changes). Toggle the **[FWD] / [REV]** switch if the discharge pressure valve is reverse-acting.

The values for PID control — proportional (%), integral (repetitions per second), derivative (seconds) — can be adjusted via respective **[P]**, **[I]** and **[D]** fields (advanced users only). Press **[Reset PID]** to reset these values to factory defaults.

Graph

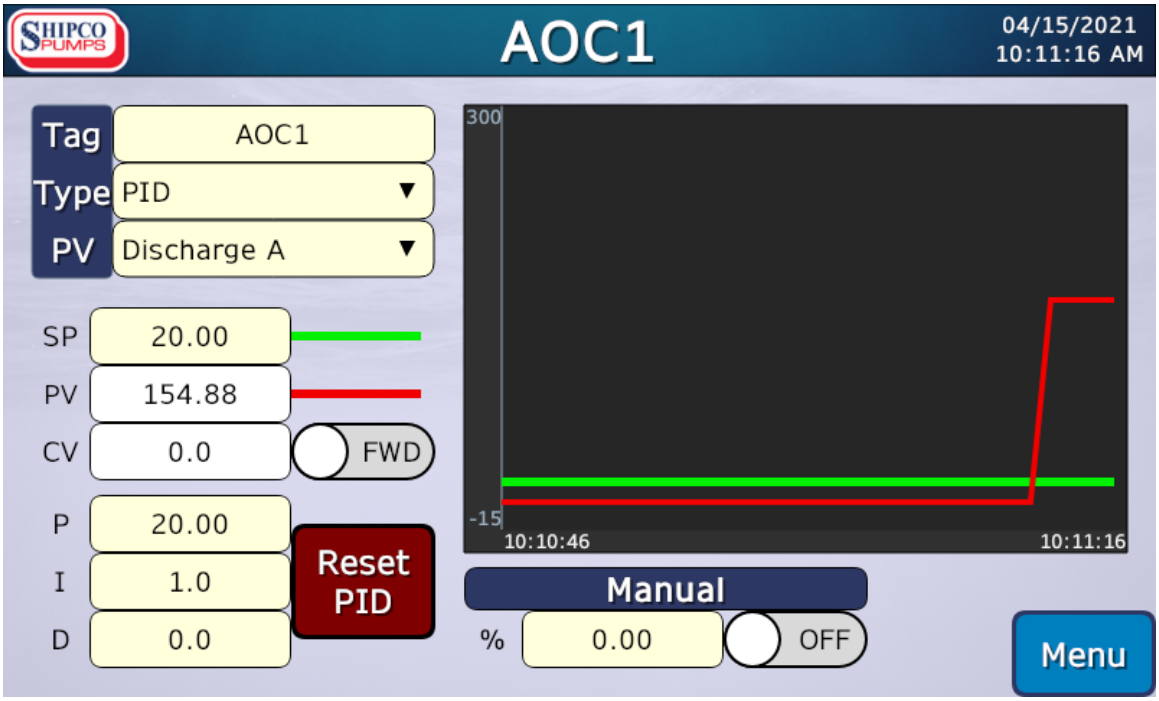
When the control type is a Linear selection, the graph shows the actual (***PV***) with the minimum **[Min]** and maximum **[Max]**. The actual will fluctuate between the minimum and maximum. When the control type is a PID selection, the graph displays the target **[SP]** versus actual (***PV***) changes over a brief period of time. Ideally the actual would closely match the target.

Manual

Manual is shown when a control type (except Disabled) is chosen. Manual % allows the user to take manual control of the discharge pressure valve. Enter a percentage **[%]** which the vent is to open between 0 (full closed) and 100 (full open), then toggle the **[OFF] / [ON]** switch to disable or enable manual control.

Custom

Analog Outputs



The Aqueous controller supports assigning custom analog outputs to react to changes based on a chosen sensor input and also how the analog should react to that sensor input. This allows for possibilities of specialized equipment or adding custom equipment later without re-programming the controller.

Tag

A label to easily identify the purpose of the custom analog output. By default labels are “AOC1”, “AOC2”, etc.

Type

Choose a control method for the custom analog output from the **[Type]** dropdown list.

Disabled	Custom analog output is disabled or not applicable.
Linear	Custom analog output reacts to changes based on an inclusive minimum **[Min]** and maximum **[Max]** range.
PID	Custom analog output modulates to maintain a set point **[SP]** .

PV

Select the process value sensor to complete the feedback loop.

Tank Level	Reacts to changes in tank level.
Tank Temp	Reacts to changes in tank temperature.
Tank Pres	Reacts to changes in tank pressure.
“Spare” (Custom)	Custom sensor label is shown here. Reacts to changes in custom defined sensor input. Refer to *Custom Sensors* setup, page 25.

Discharge (A|B|C)	Custom analog output reacts to changes in pump group discharge pressure.
System (A|B|C)	Custom analog output reacts to changes in pump group system pressure.
Differential (A|B|C)	Custom analog output reacts to changes in pump group differential pressure.

Additionally shown are the read-only variables ***PV*** process (what is monitored) and ***CV*** control (what changes). Toggle the **[FWD] / [REV]** switch if the equipment is reverse-acting.

The values for PID control — proportional (%), integral (repetitions per second), derivative (seconds) — can be adjusted via respective **[P]**, **[I]** and **[D]** fields (advanced users only). Press **[Reset PID]** to reset these values to factory defaults.

Graph

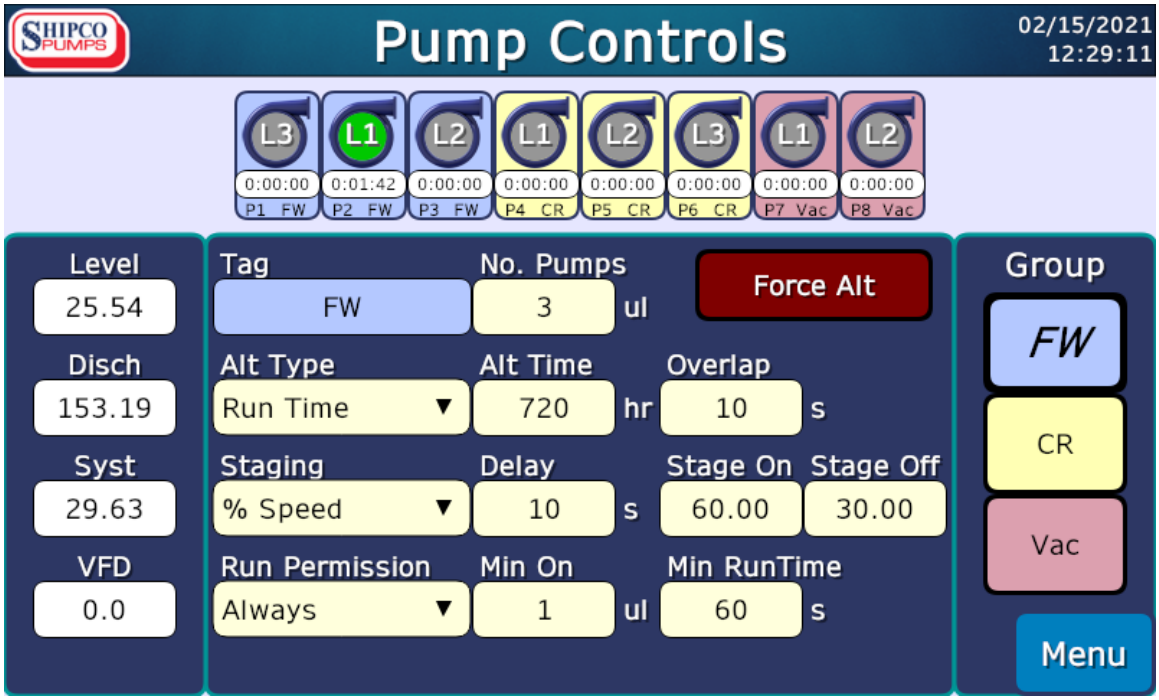
When the control type is a Linear selection, the graph shows the current (***PV***) with the minimum **[Min]** and maximum **[Max]**. The current will fluctuate between the minimum and maximum. When the control type is a PID selection, the graph displays the target **[SP]** versus current (***PV***) changes over a brief period of time. Ideally the current would closely match the target.

Manual

Manual is shown when a control type (except Disabled) is chosen. Manual % allows the user to take manual control of the equipment. Enter a percentage **[%]** which the equipment is to module to between 0 and 100, then toggle the **[OFF] / [ON]** switch to disable or enable manual control.

Pump Controls

or (Pump Group A/B)



Pump Controls screen on 7- and 15-inch models.

Groups

Pumps that are grouped will alternate and stage together as a set. There are three available groups of pump settings so that multiple pumps can operate under different control paradigms. The total number of pumps **[No. Pumps]** between all groups cannot exceed 8 pumps. Discharge pressure (**Disch**), System pressure (**Syst**) and variable frequency drive speed % (**VFD**) are specific to each group.

7/15 ***Note:*** *You will need to choose a Group first to display and interact with the following group options.*

Tag

Assigns a label to the pump group (maximum 4 characters).

4 *Tag is labeled as Pump Group A and Pump Group B respectively.*

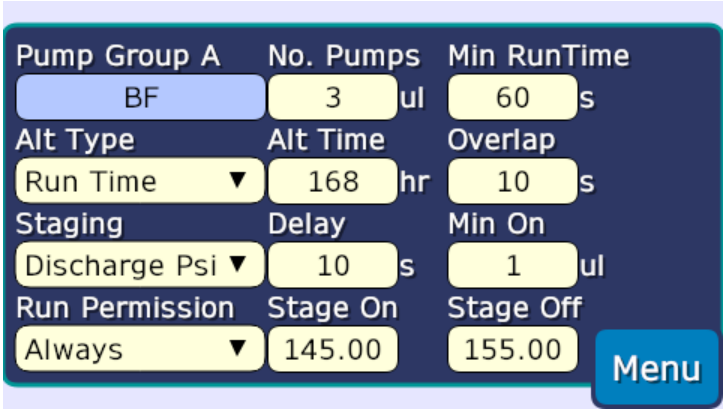
Force Alt *(Force Alternate)*

Press **[Force Alt]** to manually alternate the pumps in the specific group. The current lead pump in the group will be held on for **[Overlap]** seconds after an alternation.

Alt Type *(Alternation Type)*

If or when pumps should alternate.

Disabled	Pumps will not alternate. Lead/lag positions will default to 1-n counted left to right within the group. **[Alt Time]** and **[Overlap]** are not used for this sequence.
Run Time	Typical for continuous run applications. Pumps will alternate after the lead pump has accumulated **[Alt Time]** run hours. The current lead pump will be kept on for **[Overlap]** seconds after an alternation.
Cycle	Typical for ON/OFF applications. Pumps will alternate once all energized pumps are turned off. **[Alt Time]** and **[Overlap]** are not used for this sequence.



Pump Controls screen on 4-inch model.

Staging

The determining factor for how pumps energize on and off. This is strictly based on the type of unit and may be limited to features available on the unit.

Relay Logic This control sequence allows for innumerable configurations where pumps are controlled by relays and timers outside the Shipco® Aqueous controller.

Pumps energize when the controller sees a closed relay (or digital input). Pumps de-energize when the controller sees an open relay and the specified **[Min RunTime]** has been satisfied.

[Delay], **[Stage On]**, **[Stage Off]**, **[Run Permission]**, and **[Min On]** are not used for this sequence.

Tank Level Staging based on tank level. This control sequence is typical for condensate return applications.

If the tank ***level*** is above **[Stage On]**, the next pump will energize every **[Delay]** seconds until all pumps in the group are energized. If the tank ***level*** drops below **[Stage Off]**, all pumps de-energize immediately.

The **[Min On]** specified number of pumps will stay energized. However, **[Min On]** is typically 0 for this sequence. **[Min RunTime]** must also be satisfied before pumps will de-energize. However, **[Min RunTime]** is typically 0 for this sequence.

Disch Pres Staging based on discharge pressure (***Disch***) which is typical for transfer and boiler feed pumps on a common header.

If discharge pressure (***Disch***) is below **[Stage On]**, the next pump will energize every **[Delay]** seconds until all pumps in the group are energized. If discharge pressure (***Disch***) is above **[Stage Off]**, the last pump will de-energize every **[Delay]** seconds until the **[Min On]** number of pumps is achieved. **[Min RunTime]** must also be satisfied before pumps will de-energize.

Syst Pres Staging based on system pressure, which is typical for vacuum pumps. System pressure (***Syst***) is the vacuum sensor located on the condensate return line.

If system pressure (***Syst***) is above **[Stage On]**, the next pump will energize every **[Delay]** seconds until all pumps in the group are energized. If system pressure (***Syst***) is below **[Stage Off]**, the last pump will de-energize every **[Delay]** seconds until the **[Min On]** number of pumps is achieved. **[Min RunTime]** must also be satisfied before pumps will de-energize.

Diff. Pres Staging based on differential pressure which is typical for boiler feed pumps with variable frequency drives (VFDs); this sequence operates few pumps at high speed.

System pressure (***Syst***) is the steam pressure sensor located on the steam main near the boilers.

If discharge pressure (***Disch***) is below system pressure (***Syst***) + **[Stage On]**, the next pump will energize every **[Delay]** seconds until all pumps in the group are energized. If discharge pressure (***Disch***) is above system pressure (***Syst***) + **[Stage Off]**, the last pump will de-energize every **[Delay]** seconds until the **[Min On]** number of pumps is achieved. **[Min RunTime]** must also be satisfied before pumps will de-energize.

*Note: In reference to pump affinity laws and the notion that "many hands make light work," Shipco® prefers the **"% Speed"** sequence over **"Diff. Pres"** to reduce amperage draw and extend pump life.*

% Speed Staging based on the speed percentage of drives. Typical for boiler feed pumps with variable frequency drives (VFDs); this sequence operates many pumps at low speed.

System pressure (***Syst***) is the steam pressure sensor located on the steam main near the boiler(s).

If **VFD** speed % is above **[Stage On]**, the next pump will energize every **[Delay]** seconds until all pumps in the group are energized. If **VFD** speed % is below **[Stage Off]**, the last pump will de-energize every **[Delay]** seconds until the **[Min On]** number of pumps is achieved. **[Min RunTime]** must also be satisfied before pumps will de-energize.

Run Permission

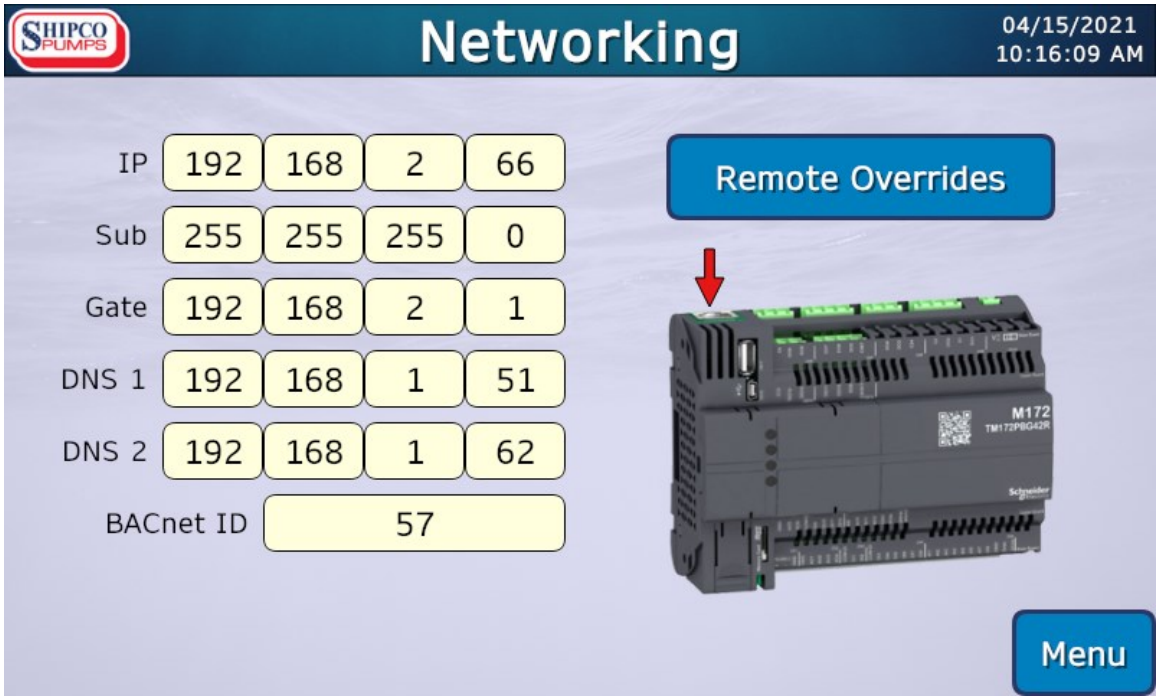
If pumps should run on a contact close or always.

Contact This is an end switch to disable all pumps within a group. If the controller's digital input is closed, staging will proceed normally. Once open, all pumps will de-energize immediately and the staging sequence will reset the required number of pumps. The run permission contact is the same as the run command input for the lead pump in the group.

Typically used with a boiler level call to energize the primary pump and discharge pressure staging in order to energize standby pump on pressure sag with time delay.

Always Staging will proceed normally.

Networking



Ethernet Configuration

Modbus TCP and/or BACnet IP requires physical connection to the 10/100 Mbps Ethernet (LAN) port on the controller. **DO NOT connect Ethernet to the HMI touchscreen display!**

The controller must be manually assigned an individual IP **[IP]**, Subnet **[Sub]** and Gateway **[Gate]** address expressed in IPv4 dot-decimal notation. Primary and secondary DNS server (**[DNS 1]** and **[DNS 2]**) fields are also provided if necessary. Consulting with local information technology (IT) or computer network personnel may be necessary to obtain this information.

Modbus

The port used for Modbus TCP is port 502.

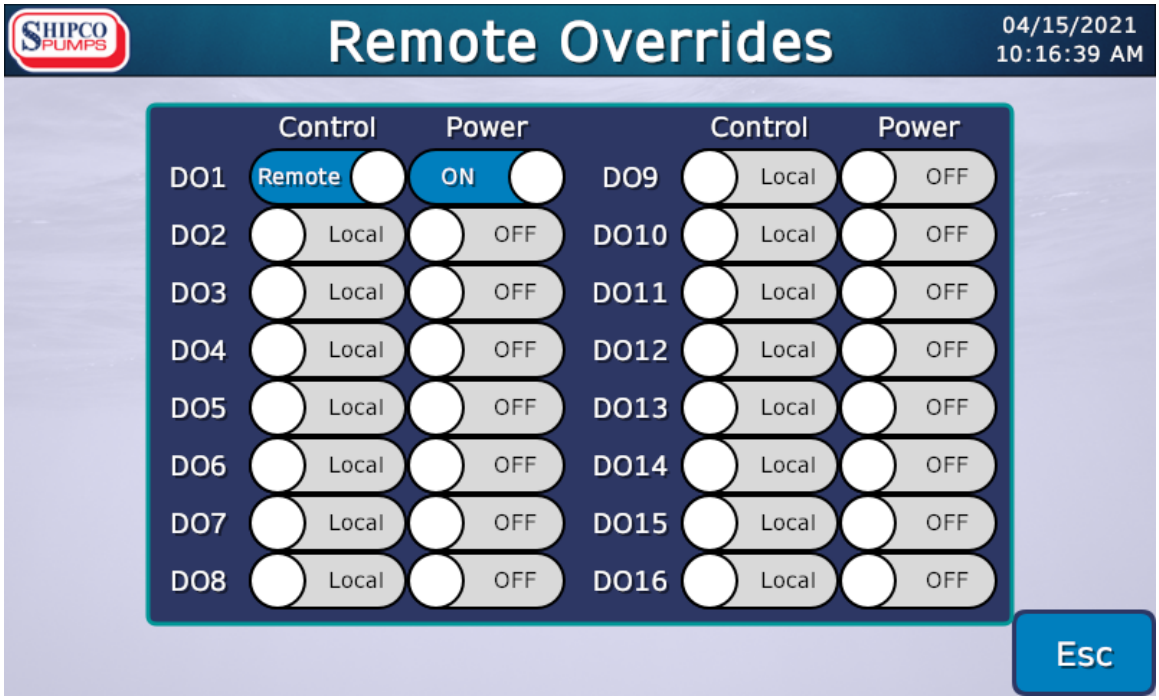
BACnet

The **[BACnet ID]** or Device ID is a network-wide unique number from 0 to 4194302. ***Note:*** Changing **[BACnet ID]** requires a controller restart to take effect.

The port used for BACnet IP is port 47808 (0xBAC0).

Remote Overrides

Networking



Remote Overrides

Allows the specified relay (or digital output) output feature to be overridden allowing a building management system (BMS) to remotely control the output. For a specific digital output, the corresponding Control location must be set to REMOTE, then toggling an output's Power switch to ON will override the controller and energize the specific output. Setting Control location to LOCAL allows the PLC to regain control and the Power switch setting is ignored.

Control

LOCAL (0) = Controller manages the output.

REMOTE (1) = Building management system (BMS) manages the output.

Power

OFF (0) = Output is not energized.

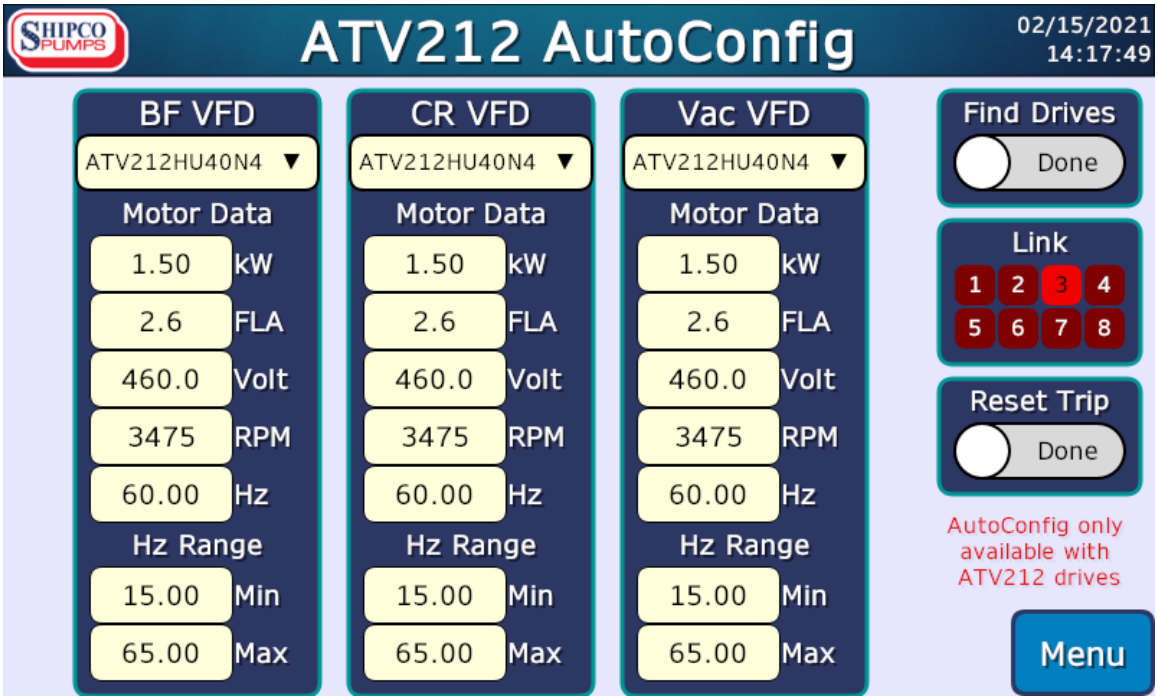
ON (1) = Output is energized.

If the controller is connected to a BACnet or Modbus network, the commands listed on this screen allow the specified output to be ON or OFF for manual remote override by changing the appropriate communication register (refer to Appendix "Communication Points"). This screen allows maintenance personnel at the controller to remove BMS overrides.

For example, if a pump is connected to energize via DO1, a user must first toggle the DO1 Control switch to "REMOTE" thereby relinquishing control from the controller. To manually turn on said pump remotely, a user must toggle the DO1 Power switch to "ON" on this screen (or "1" via register) and the motor turns on.

VFD Auto Configuration

Fields on this screen are for Modbus communications with Altivar™ ATV212 Series variable frequency drives (VFDs). Other drives can be used with the Aqueous controller but must be individually configured.



VFD Auto Configuration screen on 7- and 15-inch models.

Allows automatic configuration of Altivar™ ATV212 Series VFDs within the Aqueous controller.

Pump Groups

A column representing each of the 3 available pump groups is displayed. Select a specific ATV212 model from the dropdown list which matches the installed VFDs.

IMPORTANT: The same ATV212 model VFD drives must be used on all pumps within the pump group. DO NOT mix different model drives for a pump group.

Motor Data & Hz Range

Enter motor nameplate data in the fields for the corresponding pump group. Hertz (Hz) range will be dictated by pump model but is typically 15 to 65 Hz.

VFD Auto Configuration screen on 4-inch model.

Find Drives & Link

When ***Find Drives*** is toggled, a 30-second search is initiated to query any installed ATV212 VFD drives. When installed properly, powered and connected, ATV212 VFDs will respond with their pump number position as shown under ***Link***.

Reset Trip

Toggling this attempts to reset tripped or faulted ATV212 VFDs.

Appendix

Communications Points

No.	Name	Type	Description	Unit	BACnet Name	BACnet	Modbus
1	TL_Value	REAL	Tank Level in	in	AI_TL_Value	AI 0	8960
2	TT_Value	REAL	Tank Temp F	°F	AI_TT_Value	AI 1	8962
3	TP_Value	REAL	Tank Pressure psi	psi	AI_TP_Value	AI 2	8964
4	DPA_Value	REAL	Discharge Psi Group A	psi	AI_DPA_Value	AI 3	8966
5	SPA_Value	REAL	System Psi A	psi	AI_SPA_Value	AI 4	8968
6	DPB_Value	REAL	Discharge Psi Group B	psi	AI_DPB_Value	AI 5	8970
7	SPB_Value	REAL	System Psi B	psi	AI_SPB_Value	AI 6	8972
8	DPC_Value	REAL	Discharge Psi Group C	psi	AI_DPC_Value	AI 7	8974
9	SPC_Value	REAL	System Psi C	psi	AI_SPC_Value	AI 8	8976
10	AIC1_Value	REAL	Custom Sensor 1 ul	ul	AI_AIC1_Value	AI 9	8978
11	AIC2_Value	REAL	Custom Sensor 2 ul	ul	AI_AIC2_Value	AI 10	8980
12	AIC3_Value	REAL	Custom Sensor 3 ul	ul	AI_AIC3_Value	AI 11	8982
13	FLA_Value	REAL	Flow Line A gpm	gpm	AI_FLA_Value	AI 12	8984
14	TLA_Value	REAL	Temp Line A F	°F	AI_TLA_Value	AI 13	8988
15	FLB_Value	REAL	Flow Line B gpm	gpm	AI_FLB_Value	AI 14	8990
16	TLB_Value	REAL	Temp Line B F	°F	AI_TLB_Value	AI 15	8994
17	MMA_CV	INT	Mod Makeup A 1000 = %100.0 Open	%	AI_MMA_CV	AI 16	8998
18	MMB_CV	INT	Mod Makeup B 1000 = %100.0 Open	%	AI_MMB_CV	AI 17	8999
19	MHA_CV	INT	Mod Heater A 1000 = %100.0 Open	%	AI_MHA_CV	AI 18	9000
20	MHB_CV	INT	Mod Heater B 1000 = %100.0 Open	%	AI_MHB_CV	AI 19	9001
21	MHC_CV	INT	Mod Heater C 1000 = %100.0 Open	%	AI_MHC_CV	AI 20	9002
22	VFDA_CV	INT	VFD A 1000 = %100.0 Full Speed	%	AI_VFDA_CV	AI 21	9003
23	VFDB_CV	INT	VFD B 1000 = %100.0 Full Speed	%	AI_VFDB_CV	AI 22	9004
24	VFDC_CV	INT	VFD C 1000 = %100.0 Full Speed	%	AI_VFDC_CV	AI 23	9005
25	MVO_CV	INT	Mod Vent 1000 = %100.0 Open	%	AI_MVO_CV	AI 24	9006
26	MDV_CV	INT	Mod Discharge 1000 = %100.0 Open	%	AI_MDV_CV	AI 25	9007
27	AOC1_CV	INT	Custom 1 1000 = %100.0 Open	%	AI_AOC1_CV	AI 26	9008
28	AOC2_CV	INT	Custom 2 1000 = %100.0 Open	%	AI_AOC2_CV	AI 27	9009
29	HMI_Enrgz_P1	BOOL	Output Energize Pump 1	1/0	BI_Enrgz_P1	BV 0	9094
30	HMI_Enrgz_P2	BOOL	Output Energize Pump 2	1/0	BI_Enrgz_P2	BV 1	9095
31	HMI_Enrgz_P3	BOOL	Output Energize Pump 3	1/0	BI_Enrgz_P3	BV 2	9096
32	HMI_Enrgz_P4	BOOL	Output Energize Pump 4	1/0	BI_Enrgz_P4	BV 3	9097
33	HMI_Enrgz_P5	BOOL	Output Energize Pump 5	1/0	BI_Enrgz_P5	BV 4	9098
34	HMI_Enrgz_P6	BOOL	Output Energize Pump 6	1/0	BI_Enrgz_P6	BV 5	9099
35	HMI_Enrgz_P7	BOOL	Output Energize Pump 7	1/0	BI_Enrgz_P7	BV 6	9100
36	HMI_Enrgz_P8	BOOL	Output Energize Pump 8	1/0	BI_Enrgz_P8	BV 7	9101
37	HMI_Enrgz_Alm	BOOL	Output Energize Alarm	1/0	BI_Enrgz_Alm	BV 8	9102

Communications Points

No.	Name	Type	Description	Unit	BACnet Name	BACnet	Modbus
38	HMI_Enrgz_DOC1	BOOL	Output Configurable Relay 1	1/0	BI_Enrgz_DOC1	BV 9	9103
39	HMI_Enrgz_DOC2	BOOL	Output Configurable Relay 2	1/0	BI_Enrgz_DOC2	BV 10	9104
40	HMI_Enrgz_DOC3	BOOL	Output Configurable Relay 3	1/0	BI_Enrgz_DOC3	BV 11	9105
41	HMI_Enrgz_DOC4	BOOL	Output Configurable Relay 4	1/0	BI_Enrgz_DOC4	BV 12	9106
42	HMI_Enrgz_DOC5	BOOL	Output Configurable Relay 5	1/0	BI_Enrgz_DOC5	BV 13	9107
43	HMI_Enrgz_DOC6	BOOL	Output Configurable Relay 6	1/0	BI_Enrgz_DOC6	BV 14	9108
44	HMI_Enrgz_DOC7	BOOL	Output Configurable Relay 7	1/0	BI_Enrgz_DOC7	BV 15	9109
45	REM_Ctrl_DO1	BOOL	Remote Control Of Digital Out 1	1/0	BV_Ctrl_DO1	BV 16	9389
46	REM_Pwr_DO1	BOOL	Remote On/Off Digital Out 1	1/0	BV_Pwr_DO1	BV 17	9390
47	REM_Ctrl_DO2	BOOL	Remote Control Of Digital Out 2	1/0	BV_Ctrl_DO2	BV 18	9391
48	REM_Pwr_DO2	BOOL	Remote On/Off Digital Out 2	1/0	BV_Pwr_DO2	BV 19	9392
49	REM_Ctrl_DO3	BOOL	Remote Control Of Digital Out 3	1/0	BV_Ctrl_DO3	BV 20	9393
50	REM_Pwr_DO3	BOOL	Remote On/Off Digital Out 3	1/0	BV_Pwr_DO3	BV 21	9394
51	REM_Ctrl_DO4	BOOL	Remote Control Of Digital Out 4	1/0	BV_Ctrl_DO4	BV 22	9395
52	REM_Pwr_DO4	BOOL	Remote On/Off Digital Out 4	1/0	BV_Pwr_DO4	BV 23	9396
53	REM_Ctrl_DO5	BOOL	Remote Control Of Digital Out 5	1/0	BV_Ctrl_DO5	BV 24	9397
54	REM_Pwr_DO5	BOOL	Remote On/Off Digital Out 5	1/0	BV_Pwr_DO5	BV 25	9398
55	REM_Ctrl_DO6	BOOL	Remote Control Of Digital Out 6	1/0	BV_Ctrl_DO6	BV 26	9399
56	REM_Pwr_DO6	BOOL	Remote On/Off Digital Out 6	1/0	BV_Pwr_DO6	BV 27	9400
57	REM_Ctrl_DO7	BOOL	Remote Control Of Digital Out 7	1/0	BV_Ctrl_DO7	BV 28	9401
58	REM_Pwr_DO7	BOOL	Remote On/Off Digital Out 7	1/0	BV_Pwr_DO7	BV 29	9402
59	REM_Ctrl_DO8	BOOL	Remote Control Of Digital Out 8	1/0	BV_Ctrl_DO8	BV 30	9403
60	REM_Pwr_DO8	BOOL	Remote On/Off Digital Out 8	1/0	BV_Pwr_DO8	BV 31	9404
61	REM_Ctrl_DO9	BOOL	Remote Control Of Digital Out 9	1/0	BV_Ctrl_DO9	BV 44	9405
62	REM_Pwr_DO9	BOOL	Remote On/Off Digital Out 9	1/0	BV_Pwr_DO9	BV 45	9406
63	REM_Ctrl_DO10	BOOL	Remote Control Of Digital Out 10	1/0	BV_Ctrl_DO10	BV 46	9407
64	REM_Pwr_DO10	BOOL	Remote On/Off Digital Out 10	1/0	BV_Pwr_DO10	BV 47	9408
65	REM_Ctrl_DO11	BOOL	Remote Control Of Digital Out 11	1/0	BV_Ctrl_DO11	BV 48	9409
66	REM_Pwr_DO11	BOOL	Remote On/Off Digital Out 11	1/0	BV_Pwr_DO11	BV 49	9410
67	REM_Ctrl_DO12	BOOL	Remote Control Of Digital Out 12	1/0	BV_Ctrl_DO12	BV 50	9411
68	REM_Pwr_DO12	BOOL	Remote On/Off Digital Out 12	1/0	BV_Pwr_DO12	BV 51	9412
69	REM_Ctrl_DO13	BOOL	Remote Control Of Digital Out 13	1/0	BV_Ctrl_DO13	BV 52	9413
70	REM_Pwr_DO13	BOOL	Remote On/Off Digital Out 13	1/0	BV_Pwr_DO13	BV 53	9414
71	REM_Ctrl_DO14	BOOL	Remote Control Of Digital Out 14	1/0	BV_Ctrl_DO14	BV 54	9415
72	REM_Pwr_DO14	BOOL	Remote On/Off Digital Out 14	1/0	BV_Pwr_DO14	BV 55	9416
73	REM_Ctrl_DO15	BOOL	Remote Control Of Digital Out 15	1/0	BV_Ctrl_DO15	BV 56	9417
74	REM_Pwr_DO15	BOOL	Remote On/Off Digital Out 15	1/0	BV_Pwr_DO15	BV 57	9418
75	REM_Ctrl_DO16	BOOL	Remote Control Of Digital Out 16	1/0	BV_Ctrl_DO16	BV 58	9419
76	REM_Pwr_DO16	BOOL	Remote On/Off Digital Out 16	1/0	BV_Pwr_DO16	BV 59	9420

Communications Points

No.	Name	Type	Description	Unit	BACnet Name	BACnet	Modbus
77	REM_MMA_Man	BOOL	HMI Mod Makeup A Manual Control	1/0	BV_Ctrl_MMA	BV 32	9421
78	REM_MMA_Perc	REAL	HMI Mod Makeup A 1000=%100.0	%	AVr_MMA_Perc	AV 0	9422
79	REM_MMB_Man	BOOL	HMI Mod Makeup B Manual Control	1/0	BV_Ctrl_MMB	BV 33	9424
80	REM_MMB_Perc	REAL	HMI Mod Makeup B 1000=%100.0	%	AVr_MMB_Perc	AV 1	9425
81	REM_MHA_Man	BOOL	HMI Mod Heater A Manual Control	1/0	BV_Ctrl_MHA	BV 34	9427
82	REM_MHA_Perc	REAL	HMI Mod Heater A 1000=%100.0	%	AVr_MHA_Perc	AV 2	9428
83	REM_MHB_Man	BOOL	HMI Mod Heater B Manual Control	1/0	BV_Ctrl_MHB	BV 35	9430
84	REM_MHB_Perc	REAL	HMI Mod Heater B 1000=%100.0	%	AVr_MHB_Perc	AV 3	9431
85	REM_MHC_Man	BOOL	HMI Mod Heater C Manual Control	1/0	BV_Ctrl_MHC	BV 36	9433
86	REM_MHC_Perc	REAL	HMI Mod Heater C 1000=%100.0	%	AVr_MHC_Perc	AV 4	9434
87	REM_MDV_Man	BOOL	HMI Mod Discharge Manual Control	1/0	BV_Ctrl_MDV	BV 41	9436
88	REM_MDV_Perc	REAL	HMI Mod Discharge 1000=%100.0	%	AVr_MDV_Perc	AV 9	9437
89	REM_MVO_Man	BOOL	HMI Vent Orifice Manual Control	1/0	BV_Ctrl_MVO	BV 40	9439
90	REM_MVO_Perc	REAL	HMI Vent Orifice 1000=%100.0	%	AVr_MVO_Perc	AV 8	9440
91	REM_VFDA_Man	BOOL	HMI VFD A Manual Control	1/0	BV_Ctrl_VFDA	BV 37	9442
92	REM_VFDA_Perc	REAL	HMI VFD A 1000=%100.0	%	AVr_VFDA_Perc	AV 5	9443
93	REM_VFDB_Man	BOOL	HMI VFD B Manual Control	1/0	BV_Ctrl_VFDB	BV 38	9445
94	REM_VFDB_Perc	REAL	HMI VFD B 1000=%100.0	%	AVr_VFDB_Perc	AV 6	9446
95	REM_VFDC_Man	BOOL	HMI VFD C Manual Control	1/0	BV_Ctrl_VFDC	BV 39	9448
96	REM_VFDC_Perc	REAL	HMI VFD C 1000=%100.0	%	AVr_VFDC_Perc	AV 7	9449
97	REM_AOC1_Man	BOOL	HMI AO Config A Manual Control	1/0	BV_Ctrl_AOC1	BV 42	9451
98	REM_AOC1_Perc	REAL	HMI AO Config A 1000=%100.0	%	AVr_AOC1_Perc	AV 10	9452
99	REM_AOC2_Man	BOOL	HMI AO Config B Manual Control	1/0	BV_Ctrl_AOC2	BV 43	9454
100	REM_AOC2_Perc	REAL	HMI AO Config B 1000=%100.0	%	AVr_AOC2_Perc	AV 11	9455

BACnet objects provided with corresponding instance number.

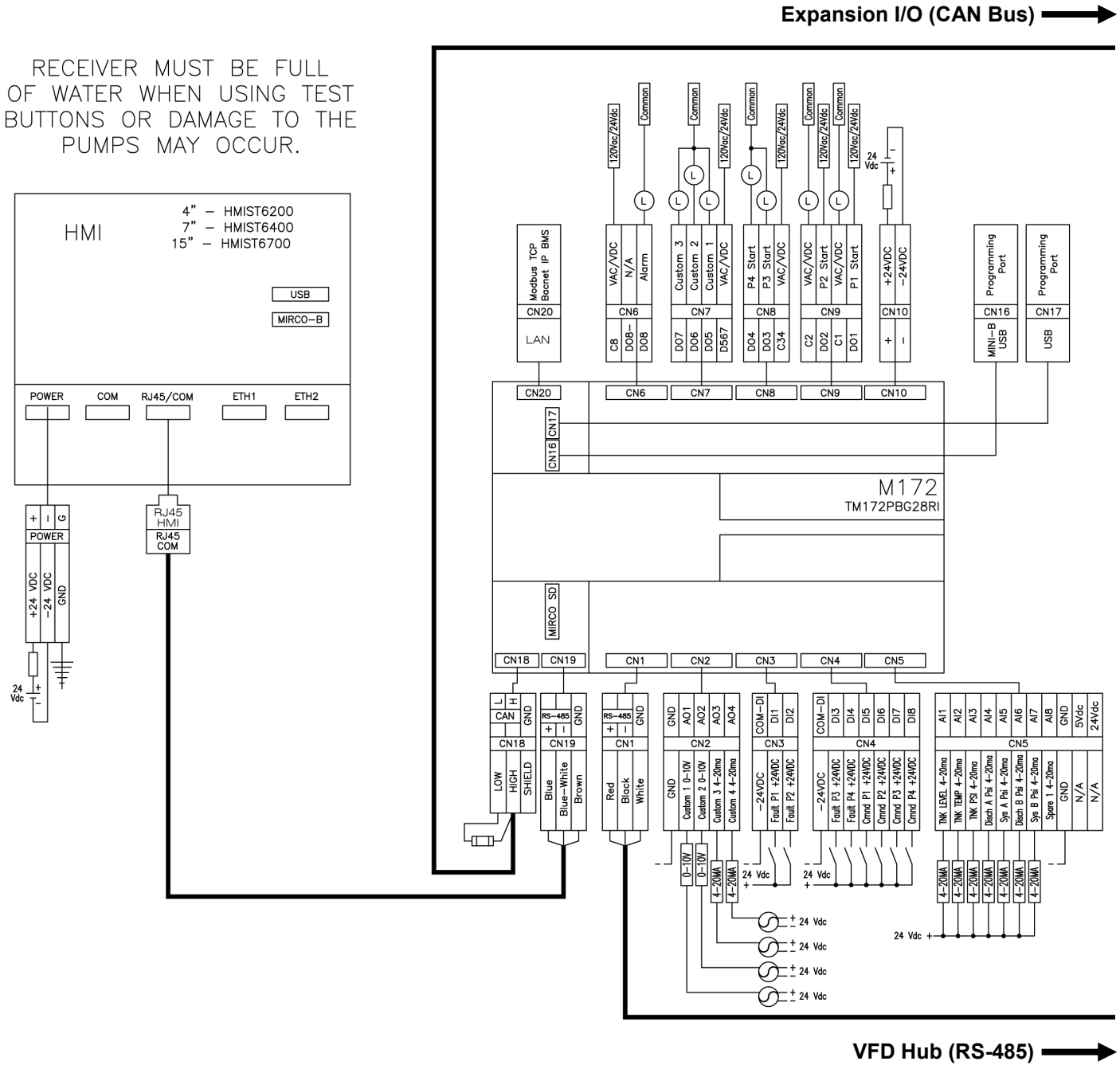
AI = Analog Input

AV = Analog Value

BI = Binary Input

BV = Binary Value

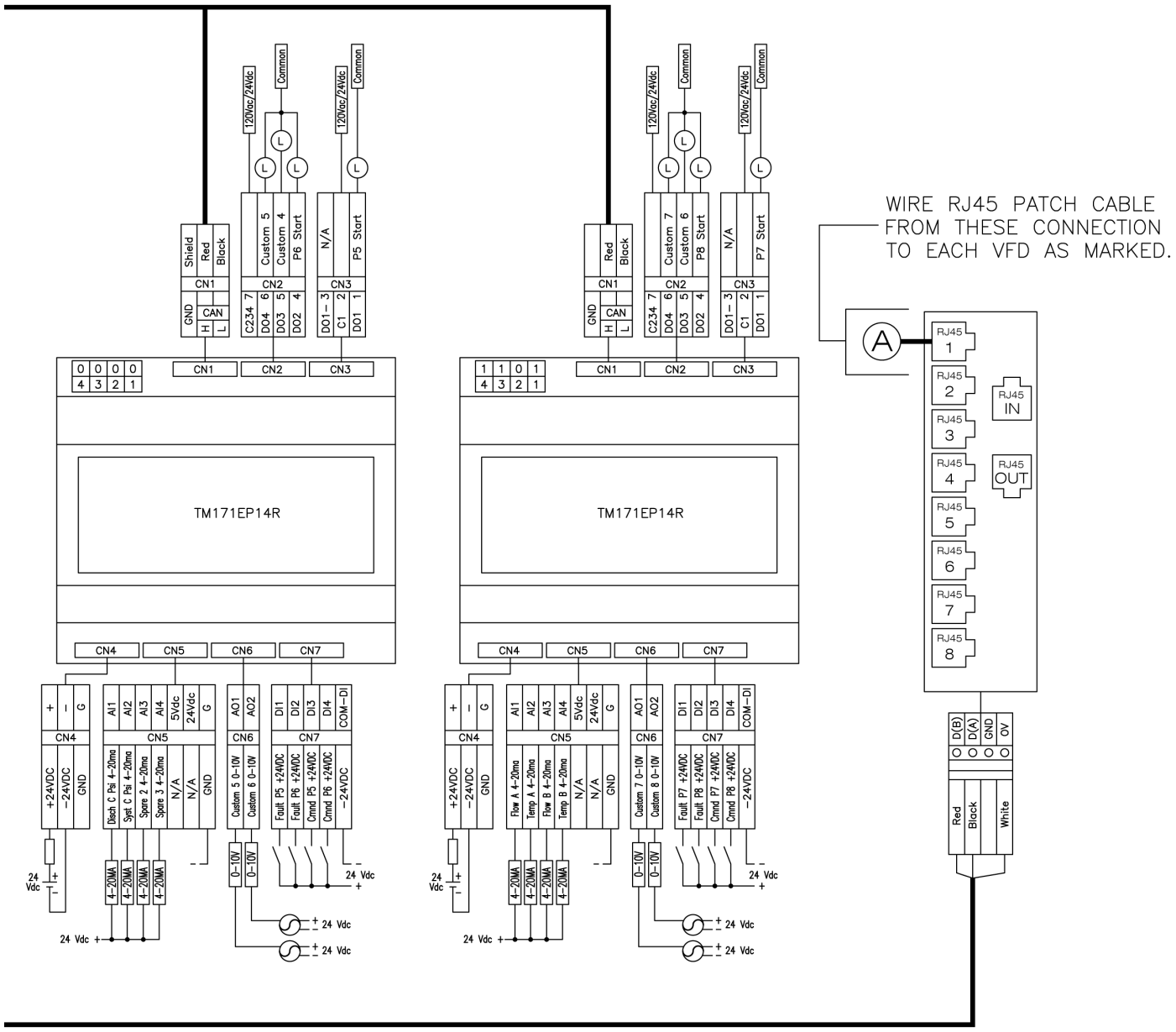
Wiring Diagram



Wiring Diagram

(continued)

Expansion I/O (CAN Bus)



VFD Hub (RS-485)

Technical Data

This information is excerpted from ***Schneider Electric®*** literature with provided ***Schneider Electric®*** Product Data Sheet reference.

Controller — Product Data Sheet TM172PBG28RI

Product Name:	Modicon M171/M172
Total inputs/outputs:	28 (8 digital input, 8 analog input, 4 analog output, 8 digital output)
Discrete input voltage:	24 V AC/DC
Sensor power supply:	5 V DC 50 mA supplied by the controller
	24 V DC 150 mA supplied by the controller
[Us] rated supply voltage:	24 V +/- 10 % AC
	20...38 V DC
Power consumption in W:	12 W 24 V AC/DC
Realtime clock:	Built-in <= 30 s/month -4…149 °F (-20…65 °C)
Ambient air temperature for operation:	-4…149 °F (-20…65 °C) UL 60730-1
	-4…140 °F (-20…60 °C) horizontal UL 60730-1
Ambient air temperature for storage:	-22…158 °F (-30…70 °C)
Relative humidity:	5…95 % non-condensing
IP degree of protection:	IP20

Expansion I/O — Product Data Sheet TM171EP14R

Total inputs/outputs:	14 (4 digital input, 4 analog input, 2 analog output, 4 digital output)
Discrete input voltage:	24 V AC/DC
Sensor power supply:	12 V DC 85 mA
[Us] rated supply voltage:	24 V

4” HMI Touchscreen — Product Data Sheet HMIST6200

Product Name:	Harmony ST6
Display:	4-inch Color TFT LCD, 16 million colors, 480 x 272 pixels
[Us] rated supply voltage:	24 V DC +/- 20 %
Power consumption in W:	6.9 W
Inrush Current:	30 A
Realtime Clock	Built-in 0…50°C ; Built-in 10…90 % RH
Ambient air temperature for operation	32…122 °F (0…50 °C)
Ambient air temperature for storage	-4…140 °F (-20…60 °C)
Relative humidity	10…90 % non-condensing
Operating altitude	6561.68 ft (2000 m)
IP degree of protection	IP20 IEC 61131-2 (rear panel) ; IP65 IEC 61131-2 (front panel)
NEMA degree of protection	NEMA 4 front panel (indoor use) ; NEMA 13 front panel (in enclosure)

7” HMI Touchscreen — Product Data Sheet HMIST6400

Product Name:	Harmony ST6
Display:	7-inch Color TFT LCD, 16 million colors, 800 x 480 pixels
[Us] rated supply voltage:	24 V DC +/- 20 %
Power consumption in W:	9 W
Inrush Current:	30 A
Realtime Clock	Built-in 0…50°C ; Built-in 10…90 % RH
Ambient air temperature for operation	32…122 °F (0…50 °C)
Ambient air temperature for storage	-4…140 °F (-20…60 °C)
Relative humidity	10…90 % non-condensing
Operating altitude	6561.68 ft (2000 m)
IP degree of protection	IP20 IEC 61131-2 (rear panel) ; IP65 IEC 61131-2 (front panel)
NEMA degree of protection	NEMA 4 front panel (indoor use) ; NEMA 13 front panel (in enclosure)

15” HMI Touchscreen — Product Data Sheet HMIST6700

Product Name:	Harmony ST6
Display:	15-inch Color TFT LCD, 16 million colors, 1366 x 768 pixels
[Us] rated supply voltage:	24 V DC +/- 20 %
Power consumption in W:	18.5 W
Inrush Current:	30 A
Realtime Clock	Built-in 0…50°C ; Built-in 10…90 % RH
Ambient air temperature for operation	32…122 °F (0…50 °C)
Ambient air temperature for storage	-4…140 °F (-20…60 °C)
Relative humidity	10…90 % non-condensing
Operating altitude	6561.68 ft (2000 m)
IP degree of protection	IP20 IEC 61131-2 (rear panel) ; IP65 IEC 61131-2 (front panel)
NEMA degree of protection	NEMA 4 front panel (indoor use) ; NEMA 13 front panel (in enclosure)

AQUEOUS™

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