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👉 PLEASE LEAVE THIS MANUAL FOR OWNER'S USE 👈

SHIPCO[®] LOGIC CONTROL

TYPE SLC-FWS



SHIPCO[®] Logic Controller Program Manual for Feed Water Systems

Technical Support: (717) 532-7321

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Features



- The controller is equipped with a touchscreen.
- Simply tap menu items or use the **Up** Δ and **Down** ∇ arrow keys to highlight menu options.
- Pressing the **Esc** key will return to a previous screen, previous menu or to cancel an action.
- Pressing the **Enter** [\downarrow] key will confirm and execute the action of the highlighted menu item (e.g., an action is to input or select a value, enter a submenu or go to another screen).

Operates a Feed Water System such as a Boiler Feed, Deaerator or combined Deaerator/Surge (duo system). Configurations depend on end user requirements.

- Live graphical and numeric indication for water level and temperature via Shipco® Transmitter or differential pressure level transmitter and RTD temperature transmitter.
- Operates up to 8 boiler feed pumps and 4 transfer pumps with alternating and manual control; pump graphics to indicate status; operate from boiler level signals, maintain feed pressure or with VFDs.
- Support for modulating feed valves and steam regulators.
- Failure indication and protection with various high & low water alarms; high & low temperature alarm. Shutoff for high temperature and low water. Alarms for routine maintenance and standby pumps and loss of sensor signal indicators.
- VFD Max Efficiency Sequence optimizes efficiency by maintaining multiple feed pumps at low speed.
- Support for additional modulating and solenoid feed valves; transfer pumps; flow meters on makeup, transfer and feed water headers.

Modulating Level Control

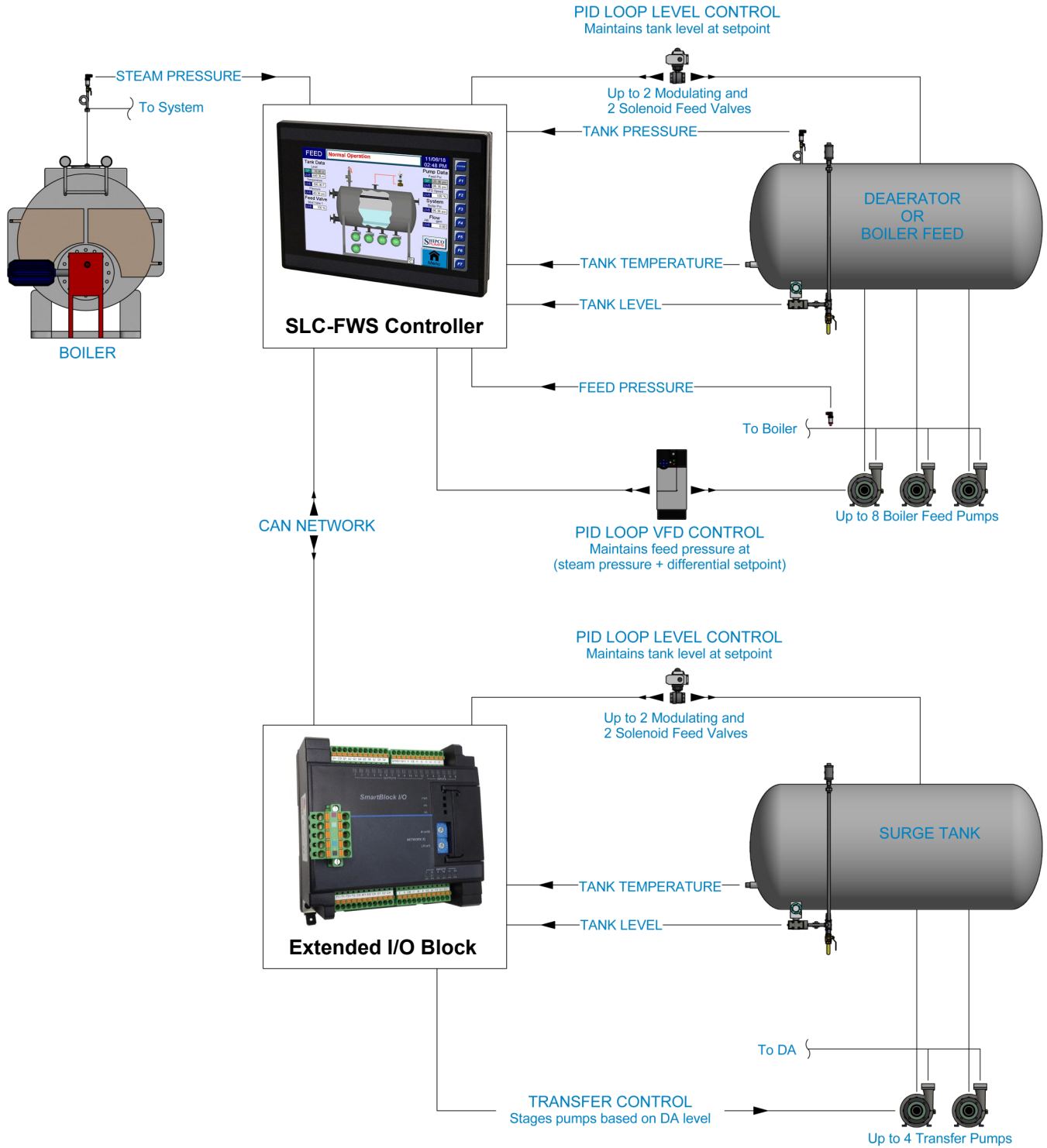
- 6-, 10- or 15-inch touchscreen control.
- Modulating Feed Valve Control.
- Differential pressure level transmitter or guided float level.
- RTD temperature transmitter.
- Alarms for level, temperature, pressure, etc.
- Up to 2 solenoid feed valves.
- Up to 2 modulating feed valves.

Deaerator, Surge Tank or Duo System

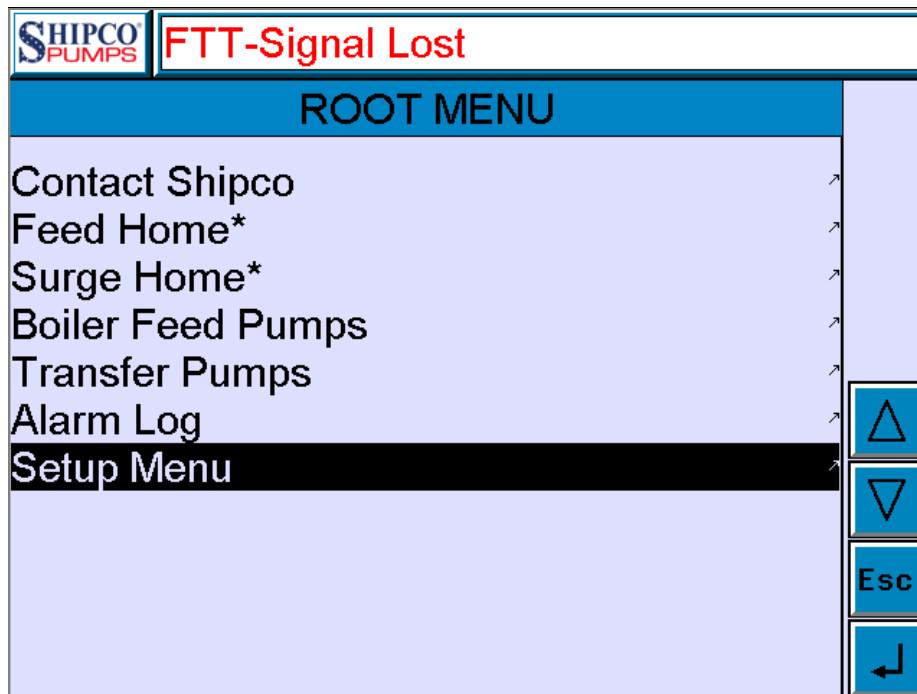
- 6-, 10- or 15-inch touchscreen control.
- Adds Pump Control.
- Up to 8 boiler feed pumps and up to 4 transfer pumps.
- Up to 2 solenoid feed valves (per tank).
- Up to 2 modulating feed valves (per tank).
- Up to 2 steam regulators.
- Alarms for level, temperature, pressure, pump fault, routine maintenance, etc.
- Alternation and manual sequencing.
- On/Off operation from boiler level signals or to maintain feed pressure.
- Continuous for automatic standby.
- VFD Max Efficiency Sequence.
- Total and service interval run timers.

Features

Feed Tank & Surge Tank Application



Root Menu



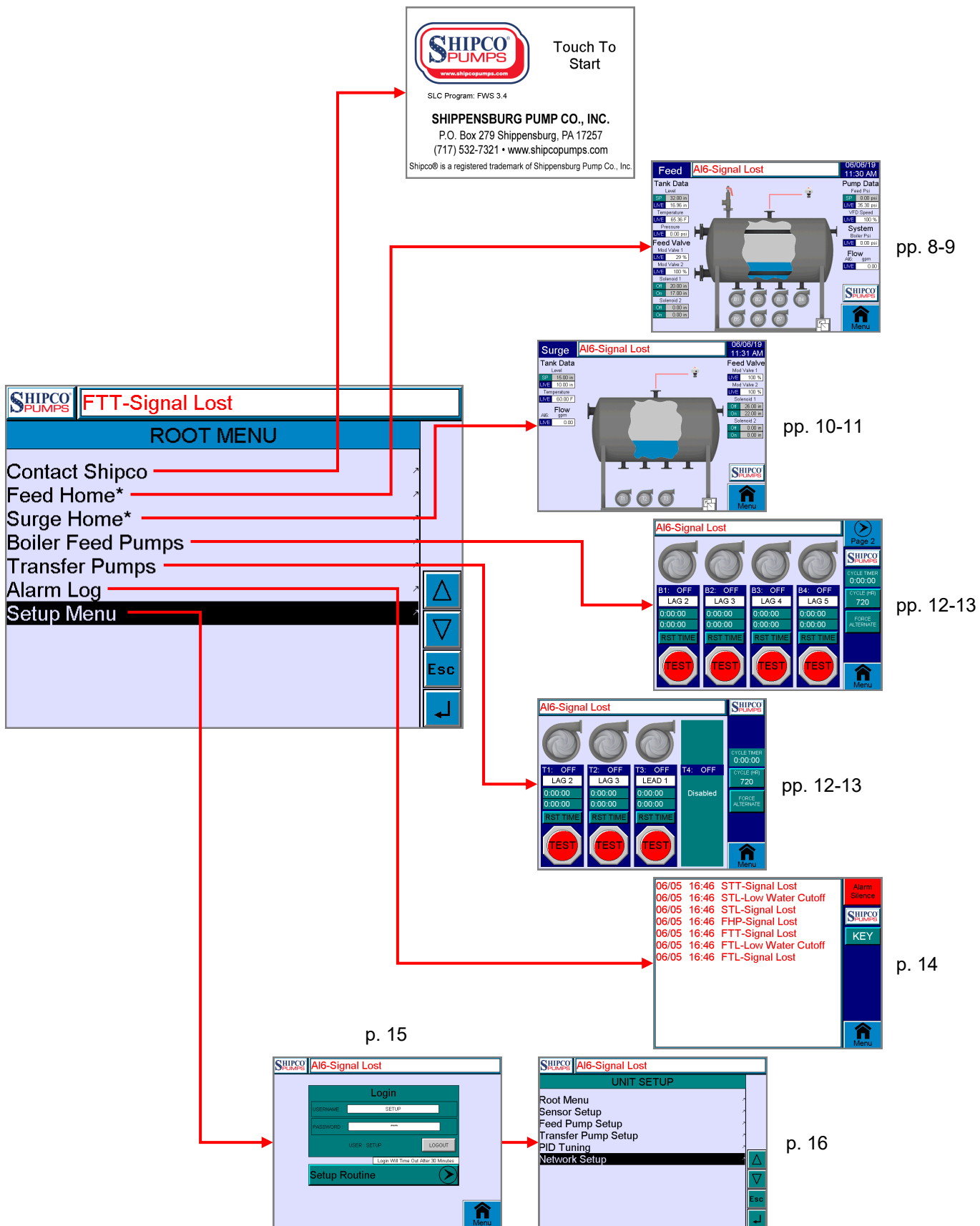
Root Menu

Note: This manual only covers menu items present on a standard controller configuration. For certain configurations some menu items may not be displayed. On custom configurations there may be additional menu items and options which are used to configure special equipment specific to the unit. These additional items are not covered in this manual; please consult factory for details.

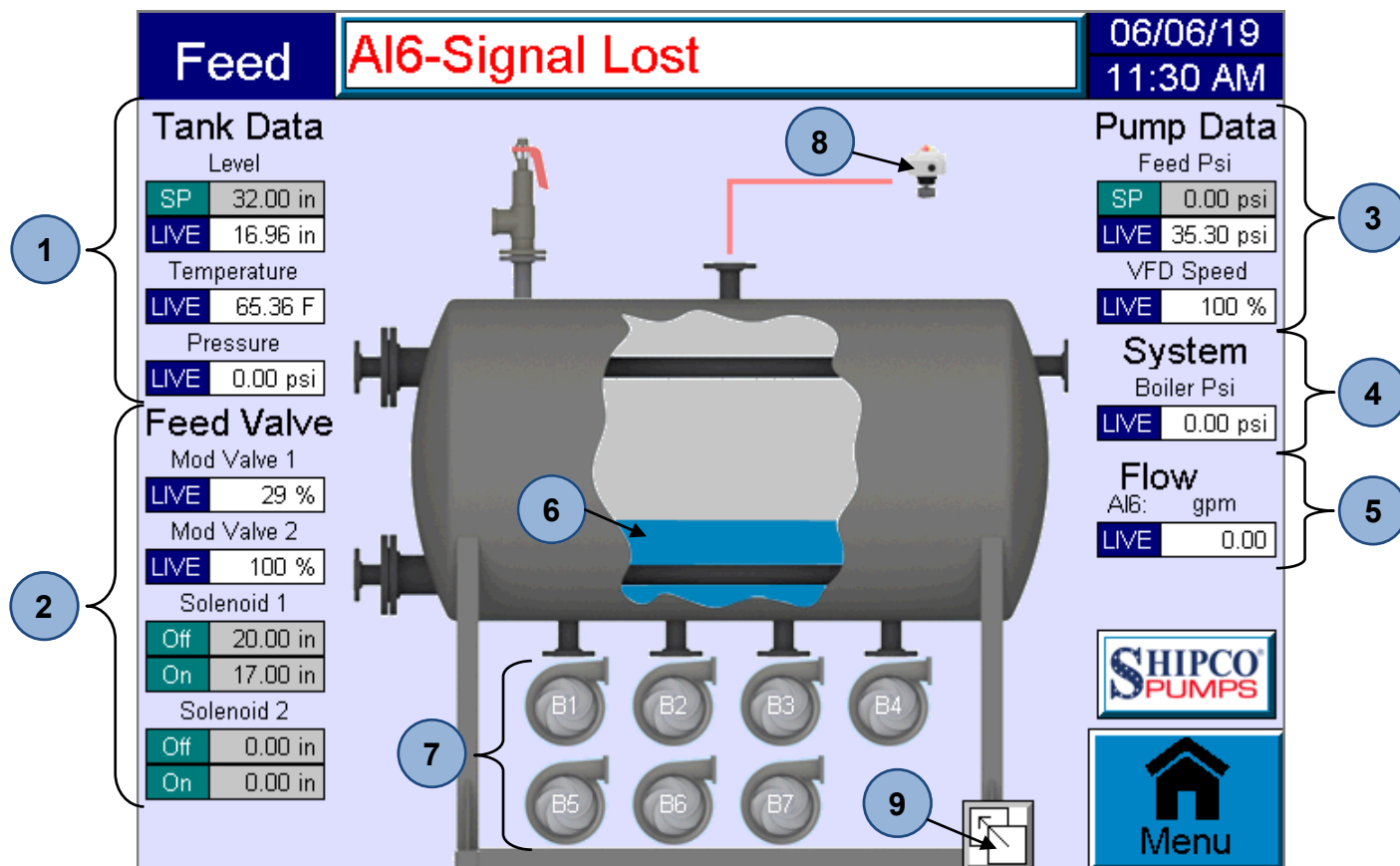
- Contact Shipco** Displays Shipco® contact information.
- Feed Home** Unit status screen for the boiler feed or deaerator unit.
- Surge Home** Unit status screen for a separate surge unit.
- Boiler Feed Pumps** Boiler feed pump controls screen for the boiler feed or deaerator.
- Transfer Pumps** Transfer pumps controls screen for surge unit.
- Alarm Log** View and/or clear alarm events history.
- Setup Menu** Change settings for sensors and adjust unit configuration.

Root Menu

Navigation



Feed Home



The Feed Home screen provides current visual details for operations occurring on the boiler feed or deaerator unit. This screen changes and/or rearranges depending on the unit style and configuration. The numerical details shown on the sides are enabled from the various sensors.

1. Tank Data

Level

SP (*unit: in.*) Set point for the level of water to be maintained inside the tank.

LIVE (*unit: in.*) Current water level inside the feed tank.

Temperature

LIVE (*unit: °F*) Current temperature inside the feed tank.

Pressure

LIVE (*unit: psi*) Current pressure inside the feed tank.

2. Feed Valve

Mod Valve 1 & Mod Valve 2

LIVE (*unit: %*) Percentage amount to which the modulating valve is open. 100% indicates the valve is full open.

Solenoid 1 & Solenoid 2

Off (*unit: in.*) Set point which the water level in the tank must rise to close the solenoid.

On (*unit: in.*) Set point which the water level in the tank must lower to open the solenoid.

Feed Home

(continued)

3. Pump Data

Feed Psi (Pressure)

SP (*unit: psi*) Set point for the discharge pressure of the boiler feed pumps.

LIVE (*unit: psi*) Current discharge pressure of the boiler feed pumps.

VFD Speed

LIVE (*unit: %*) Percentage amount to which VFDs are running the boiler feed pumps. 100% indicates VFD(s) are running full speed.

4. System

Boiler Psi (Pressure)

LIVE (*unit: psi*) Current pressure being transmitted from the steam main or steam header.

5. Additional Analog Input

AI6: (Custom unit)

LIVE (*unit: any*) Used for a custom additional 4-20mA analog input. Label, unit type and min/max scaling can be entered in unit setup for the AI6 sensor.

6. Live Level Graphic

Rises and falls according to the water level in the tank.

7. Boiler Feed Pumps

Up to 8 boiler feed pumps can be displayed with status indication.

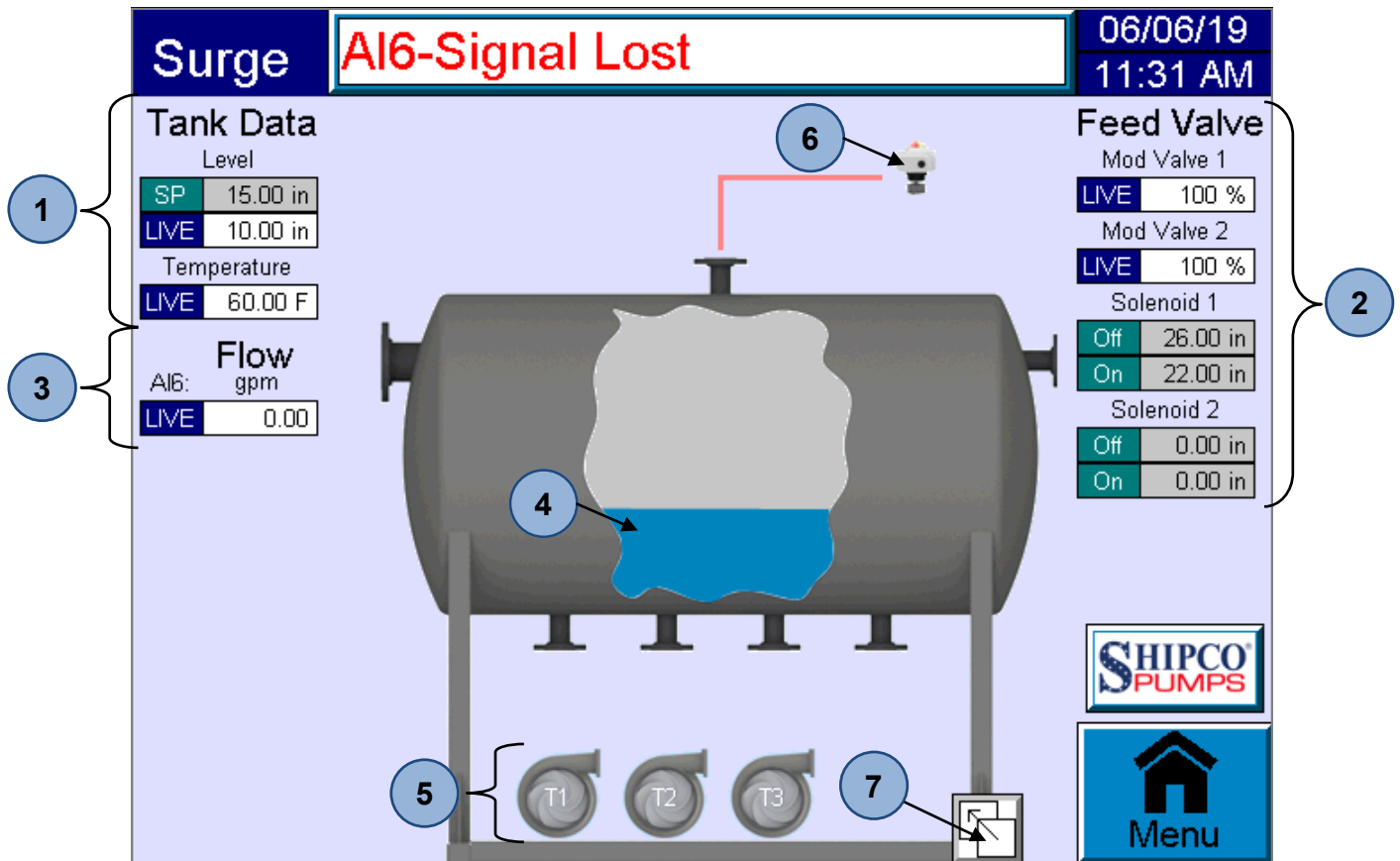
8. Feed Valve

Displays icon for a ball, gate, solenoid or modulating feed valve(s) if present.

9. Unit Style Selection

The style of the displayed unit can be changed by pressing the button and cycling through the various options. These changes are purely cosmetic and do not affect unit operation. (Appendix, p. 66)

Surge Home



The Surge Home screen provides current visual details for operations occurring on the surge tank unit (if available). This screen changes and/or rearranges depending on the unit style and configuration. The numerical details shown on the sides are enabled from the various sensors.

1. Tank Data

Level

SP (*unit: in.*) Set point for the level of water to be maintained inside the tank.

LIVE (*unit: in.*) Current water level inside the tank.

Temperature

LIVE (*unit: °F*) Current temperature inside the tank.

2. Feed Valve

Mod Valve 1 & Mod Valve 2

LIVE (*unit: %*) Percentage amount to which the modulating valve is open. "100%" indicates the valve is full open.

Solenoid 1 & Solenoid 2

Off (*unit: in.*) Set point which the water level in the tank must rise to close the solenoid.

On (*unit: in.*) Set point which the water level in the tank must lower to open the solenoid.

Surge Home

(continued)

3. Additional Analog Input

AI6: (Custom unit)

LIVE (*unit: any*) Used for a custom additional 4-20mA analog input. Label, unit type and min/max scaling can be entered in unit setup for the AI6 sensor.

4. Live Level Graphic

Rises and falls according to the water level in the tank.

5. Transfer Pumps

Up to 4 transfer pumps can be displayed with status indication.

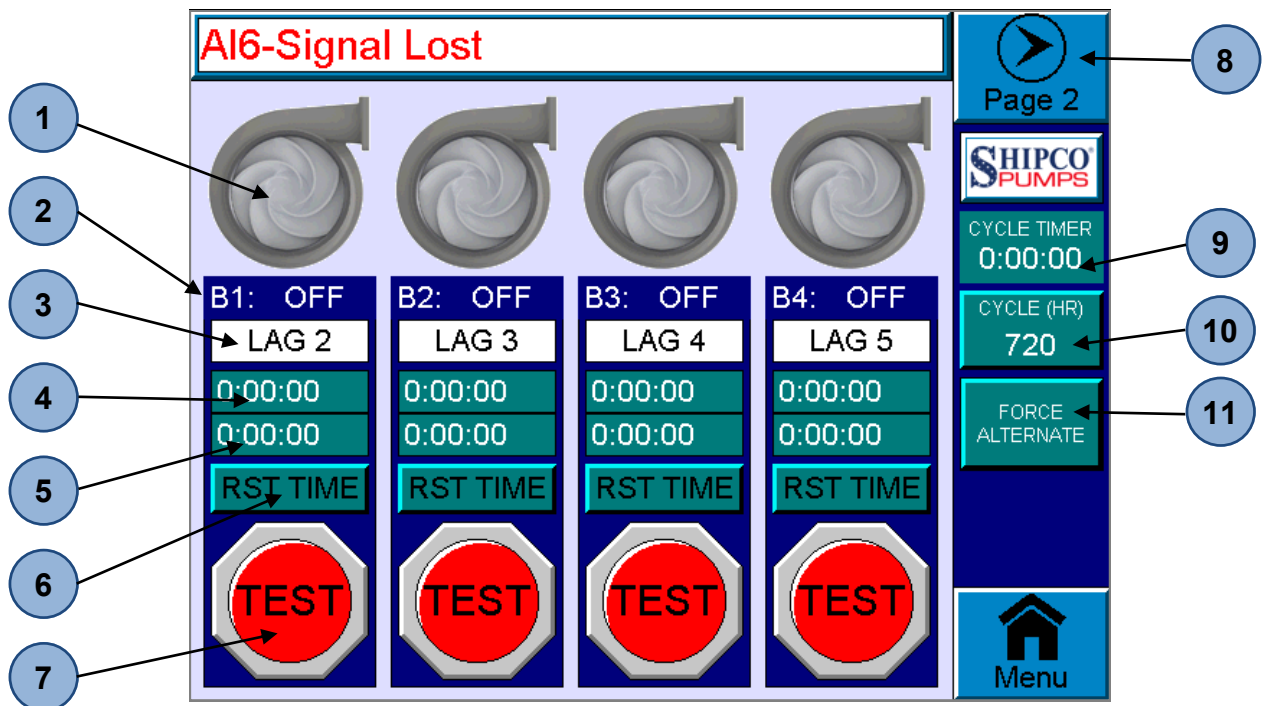
6. Feed Valve

Displays icon for a ball, gate, solenoid or modulating feed valve(s) if present.

7. Unit Style Selection

The style of the displayed unit can be changed by pressing the button and cycling through the various options. These changes are purely cosmetic and do not affect unit operation. (Appendix, p. 66)

Boiler Feed Pumps & Transfer Pumps



Control Type

Alternation Control

Alternation control allows the controller to automatically alternate pumps via LEAD-LAG sequence operation over a set cycle period. Pumps will alternate based on their position in the sequence beginning with the pump labeled LEAD1, LAG2, LAG3, etc.

Manual Control

Manual control allows the user to define the pump sequence without alternation via LEAD-LAG operation or a discrete digital input.

1. Pump Graphic

Color changes to reflect pump status.

GREY = OFF (Inactive)

GREEN = ON (Active / Running)

RED = FAULT *



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

2. Pump Label

Indicates physical pump number (B1-B8 for boiler feed pumps, T1-T4 for transfer pumps) followed by indicator text for pump status: ON, OFF and FAULT.

3. Pump Sequence Position

Displays the pump LEAD-LAG sequence position. The sequence order can be changed in the *Sequencing* menu (Feed Pump Setup, p. 43; Transfer Pump Setup, p. 49).

Boiler Feed Pumps & Transfer Pumps

(continued)

Note for Boiler Feed Pumps: When *Control Type* is set to “Digital Signal” (Feed Pump Setup, p. 39) the controller relinquishes its pump control and “run command” (RC) control is issued via discrete digital input. In this mode each of the feed pumps is labeled “RC#” where # indicates which pump is energized from the digital input signal (*Figure 1*).

4. Total Lifetime Run Counter

The total run time (HH:MM:SS) for the pump in the specified position. This counter continues to increment when the pump is energized and cannot be reset.

5. Periodic & Maintenance Run Counter

A periodic or maintenance run time (HH:MM:SS) for the pump in the specified position. This counter continues to increment when the pump is energized.

6. Reset Time

Resets the periodic & maintenance counter for the pump. Does not reset the total lifetime run counter.

7. Test

Push and hold to energize the pump for testing purposes. **Note:** The pump must be in “Auto” via the Auto/Off/Continuous selector switch on the unit control panel.

8. Page (Boiler Feed Pumps only)

Only 4 pumps are shown on a single screen. Press to toggle viewing boiler feed pumps 1-4 or 5-8.

9. Cycle Timer (Alternation Control only)

The elapsed time of the current cycle. When the current cycle time reaches the set cycle period, pump alternation occurs and the cycle time resets to zero.

10. Set Cycle Period (Alternation Control only)

The amount of elapsed time before pumps are signaled to alternate. Press to adjust the alternation cycle period expressed in hours. Default is 720 hours (30 days).

11. Force Alternate (Alternation Control only)

Press to forcibly alternate the pump sequence and resetting the cycle timer. This causes the last available LAG pump to shift into the LEAD1 position and all other pumps increment their LAG position (former LEAD1 pump becomes new LAG2, former LAG2 pump becomes new LAG3, etc.)

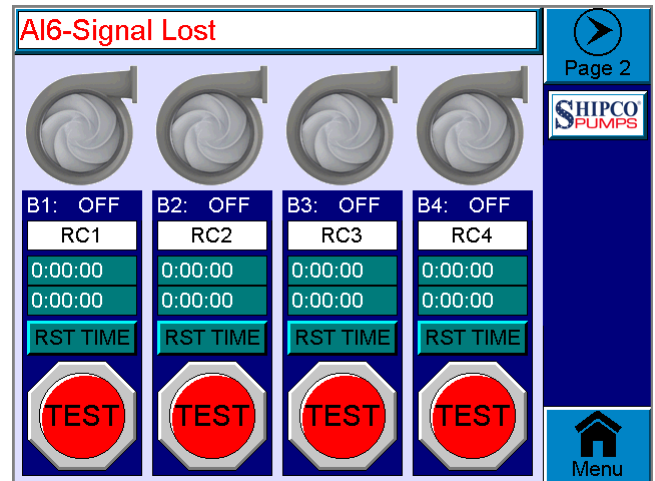
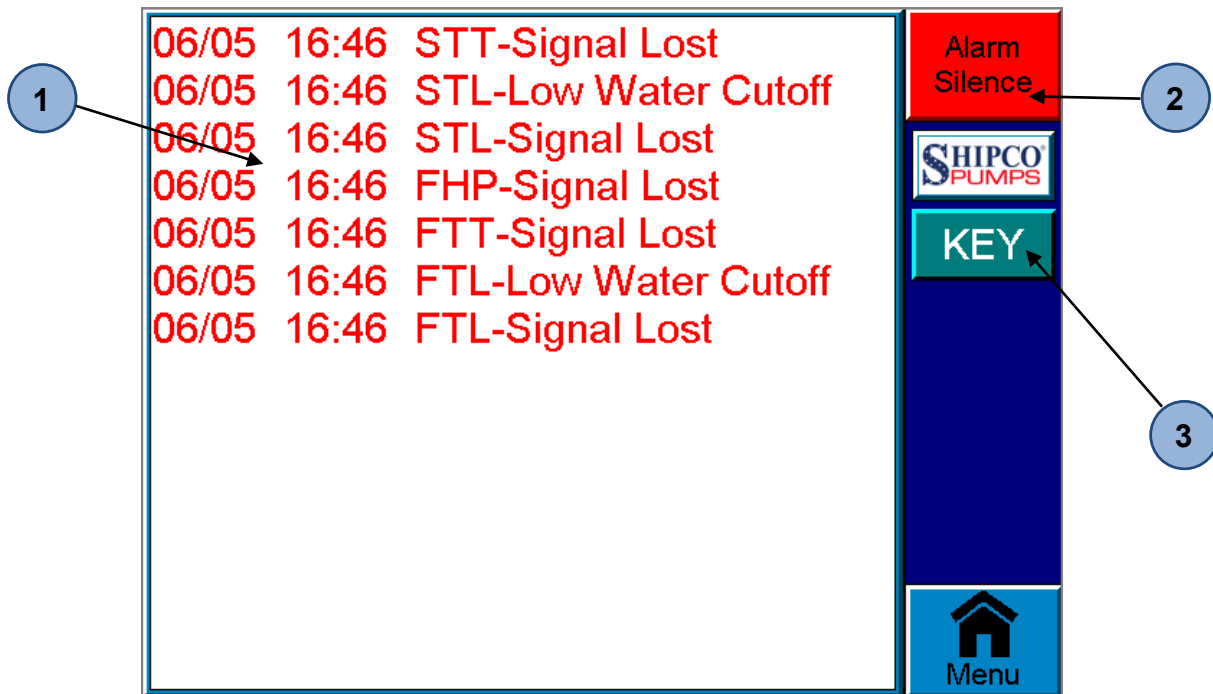


Figure 1. Run command control for boiler feed pumps.

Alarm Log



1. Alarm Log

The alarm log displays all unit status alarms and loss of signal indication for various sensors. This screen appears immediately if an alarm status is triggered. Touch the alarm log list to clear individual alarms or the entire log (Figure 1).

2. Alarm Silence

Silences any audible alarm and dismisses the alarm log screen should it appear.

3. Key

Shows alarm key (Figure 2). Each alarm item has a prefix to designate which sensor was triggered followed by a brief description of its purpose. (e.g., “FTL-Low Water Cutoff” indicates a low water cutoff alarm was reported by the Feed Tank Level sensor.)

Managing Alarms

Alarms can be enabled/disabled for each sensor as well as conditions which trigger an alarm state. (Sensor Setup, page 18).

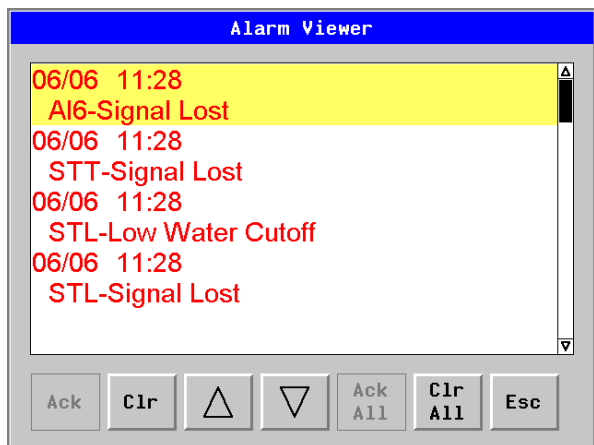


Figure 1. Clearing alarms screen

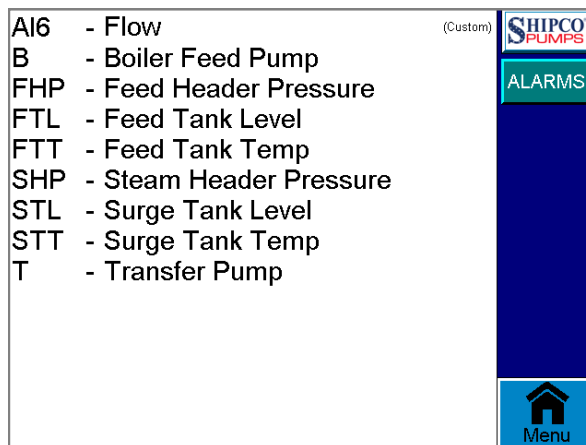


Figure 2. Alarm Key screen

Login (to Unit Setup)

Unit 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) and Password: **1234** otherwise login credentials are obtained by consulting the factory or your local service representative.

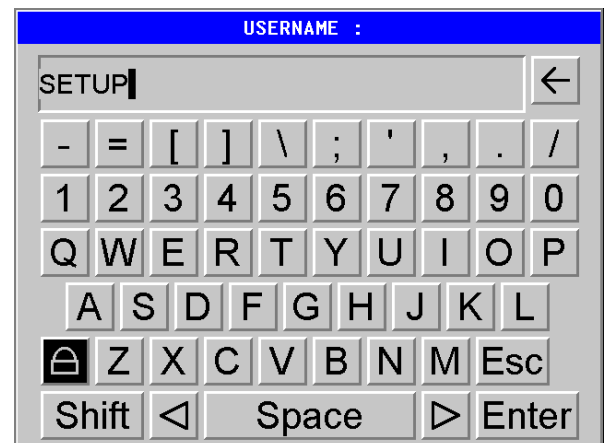
Login

Tap inside the Username or Password fields to bring up the virtual keyboard. Pressing the Caps Lock (padlock) symbol toggles between uppercase and lowercase letters. Input the value for each field and press **[Enter]** when finished or **[Esc]** to cancel.

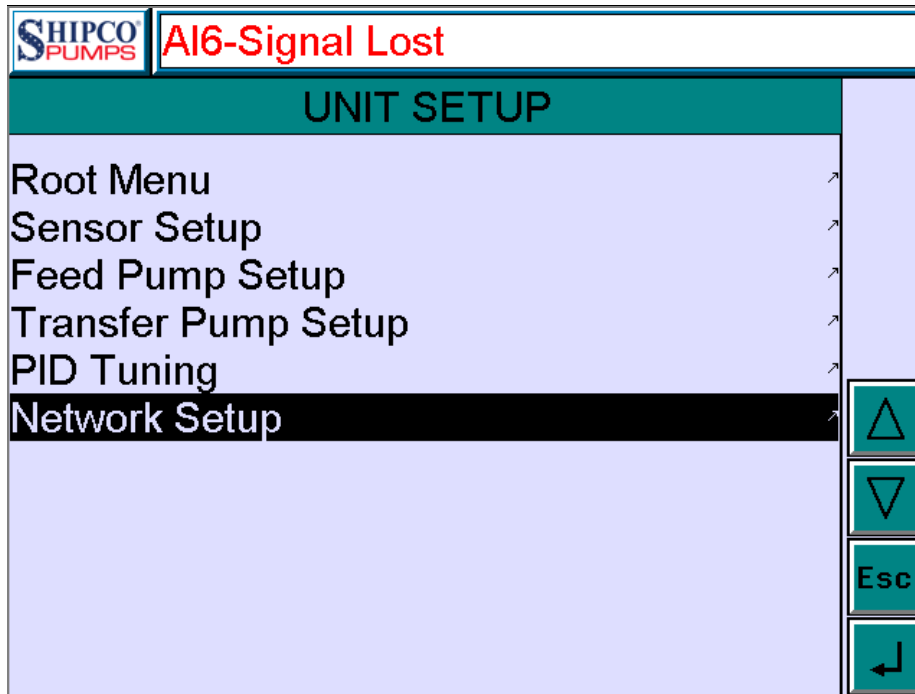
Press the **[Login]** button. If the Username and Password are valid, User will change to show who is currently logged in. The Login button will also change to display **[Logout]**.

A logged in User will stay logged in for 30 minutes or until **[Logout]** is pressed.

Press **[Setup Routine]** to enter the Unit Setup menu.



Unit Setup



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

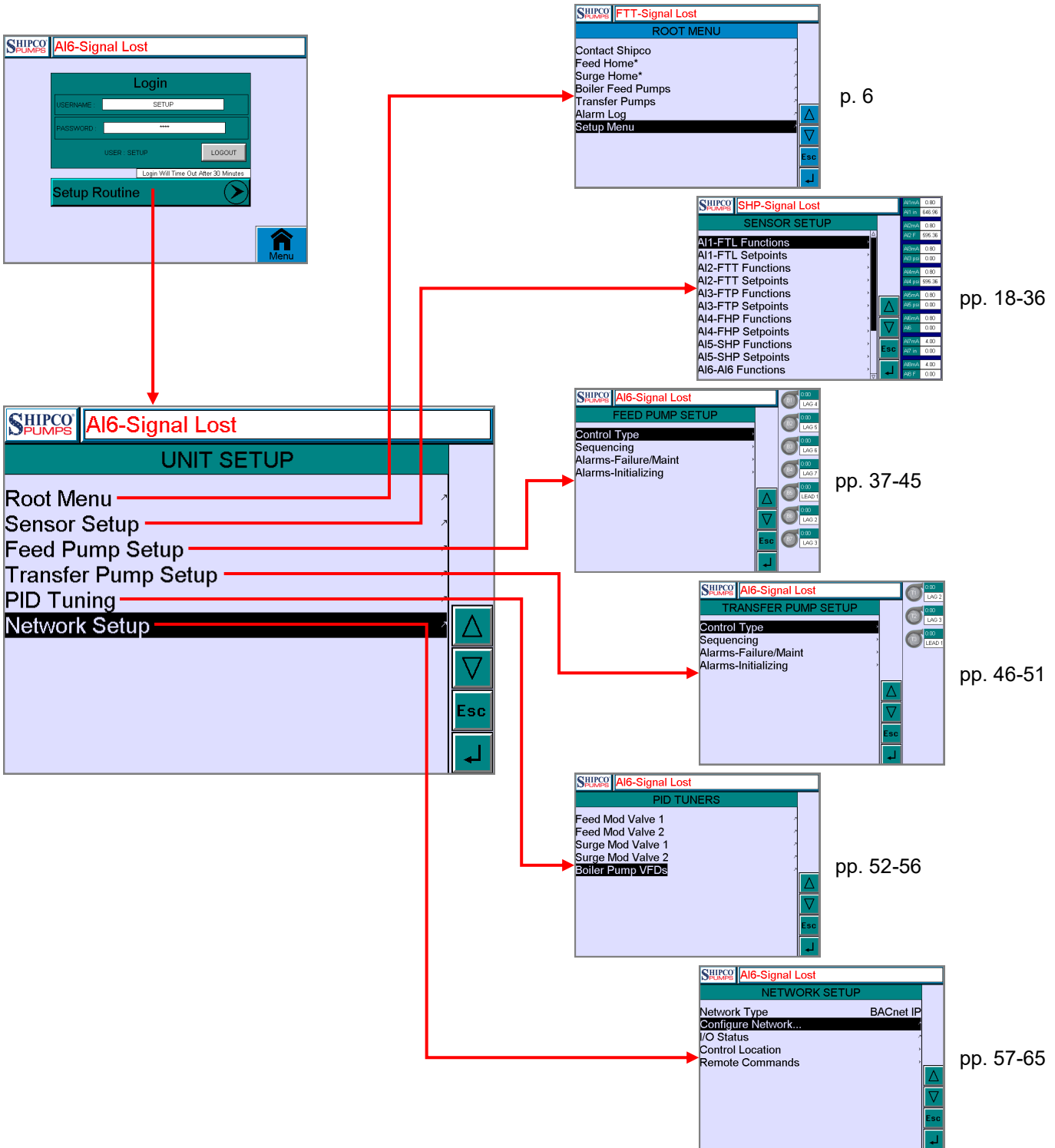
Unit Setup Menu

Note: This manual only covers menu items present on a standard controller configuration. For certain configurations some menu items may not be displayed. On custom configurations there may be additional menu items and options which are used to configure special equipment specific to the unit. These additional items are not covered in this manual; please consult factory for details.

Root Menu	Goes back to the Root Menu screen.
Sensor Setup	Adjust various sensors, set points and unit configuration operations.
Feed Pump Setup	Change controls, sequencing and alarms for feed pumps (feed tank).
Transfer Pump Setup	Change controls, sequencing and alarms for transfer pumps (surge tank).
PID Tuning	Adjust tuning for modulating feed valves and boiler feed VFDs.
Network Setup	Network communications and I/O status.

Unit Setup

Navigation



Sensor Setup

SHIPCO PUMPS SHP-Signal Lost	
AI1 mA	0.80
AI1 in	646.96
AI2 mA	0.80
AI2 F	595.36
AI3 mA	0.80
AI3 psi	0.00
AI4 mA	0.80
AI4 psi	595.36
AI5 mA	0.80
AI5 psi	0.00
AI6 mA	0.80
AI6	0.00
AI7 mA	4.00
AI7 in	0.00
AI8 mA	4.00
AI8 F	0.00

The list of analog input sensors configurable from this screen. Every sensor has a specific configuration and its menu items are described in detail in the following pages, but essentially each is divided into its “Functions” and its “Setpoints”.

Sensors (pp. 21-36)

- AI1-FTL** Analog Input 1—Feed Tank Level
- AI2-FTT** Analog Input 2—Feed Tank Temperature
- AI3-FTP** Analog Input 3—Feed Tank Pressure
- AI4-FHP** Analog Input 4—Feed Header Pressure
- AI5-SHP** Analog Input 5—Steam Header Pressure
- AI6-AI6** Analog Input 6—Custom Analog Input (mA)
- AI7-STL** Analog Input 7—Surge Tank Level
- AI8-STT** Analog Input 8—Surge Tank Temperature

Functions

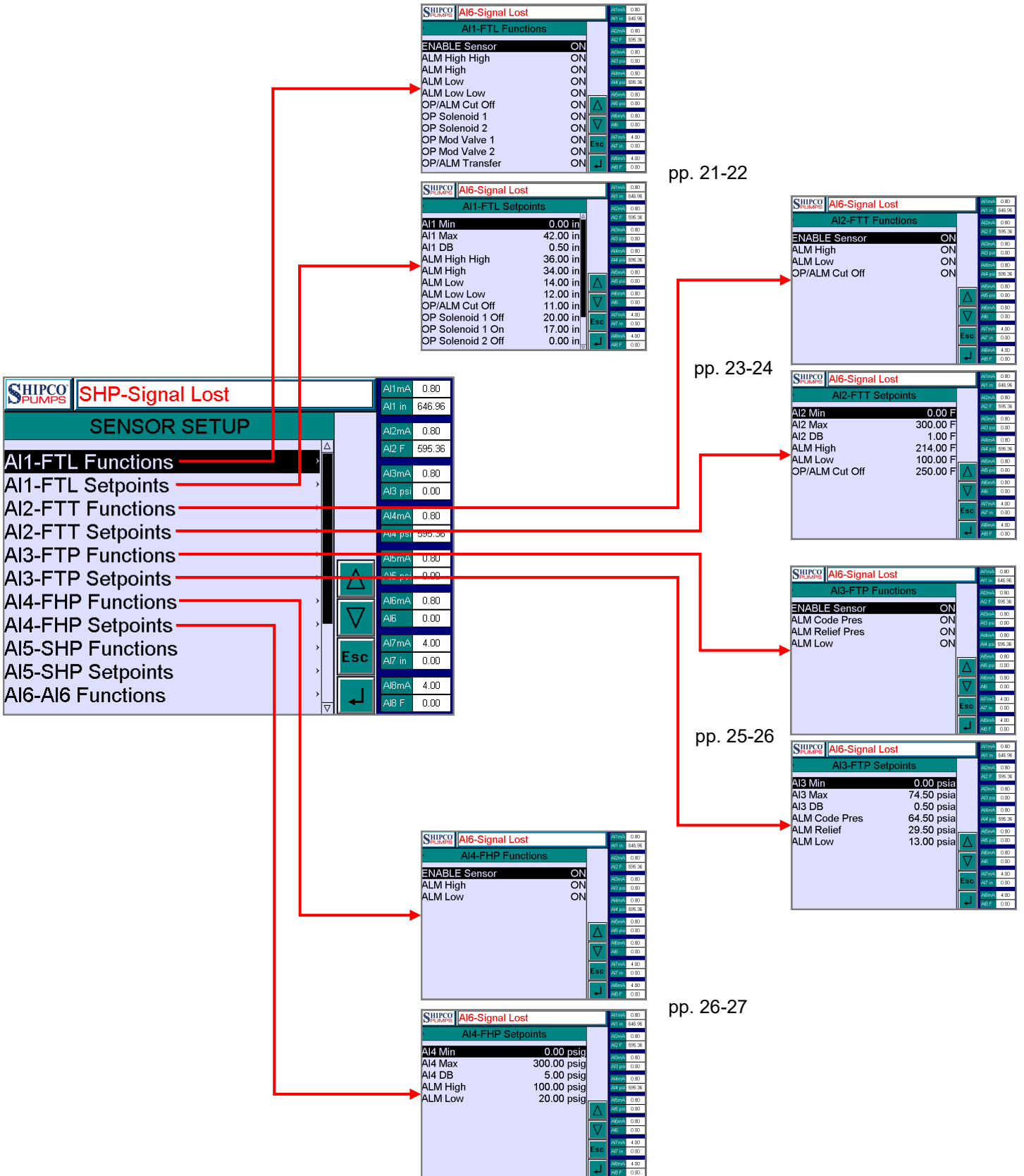
Functions for each sensor are used to enable/disable a sensor, as well as enable/disable alarms and unit configuration operations that are affected by that sensor (e.g., whether or not a unit has a modulating valve).

Setpoints

Setpoints for each sensor are used to adjust conditional parameters and scaling, such as when alarms should trigger and various unit configuration operations should occur (e.g., when a modulating valve should open or close).

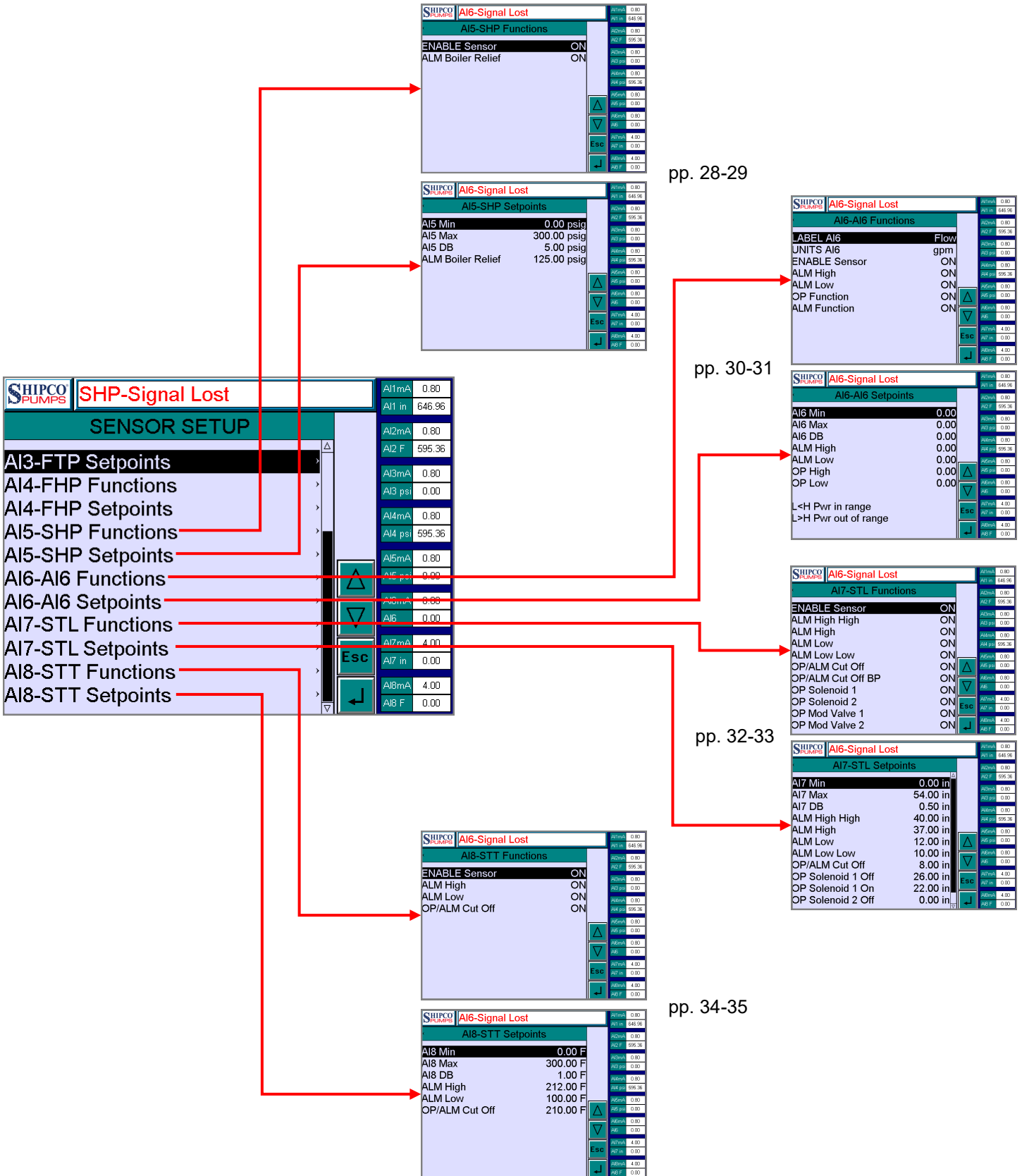
Sensor Setup

Navigation



Sensor Setup

Navigation (continued)



Sensor Setup

AI1-FTL: Feed Tank Level

About AI1-FTL

Name	Analog Input 1—Feed Tank Level
Location	On Controller
Signal	4-20 mA
Description	Used to monitor water level inside the feed tank (e.g., boiler feed or deaerator unit).

SHIPCO PUMPS		AI6-Signal Lost		AI1mA	0.80
				AI1 in	646.96
				AI2mA	0.80
				AI2 F	595.36
				AI3mA	0.80
				AI3 psi	0.00
				AI4mA	0.80
				AI4 psi	595.36
				AI5mA	0.80
				AI5 psi	0.00
				AI6mA	0.80
				AI6	0.00
				AI7mA	4.00
				AI7 in	0.00
				AI8mA	4.00
				AI8 F	0.00

SHIPCO PUMPS		AI6-Signal Lost	
AI1-FTL Functions			
ENABLE Sensor	ON	△	
ALM High High	ON		
ALM High	ON		
ALM Low	ON		
ALM Low Low	ON		
OP/ALM Cut Off	ON	▽	
OP Solenoid 1	ON		
OP Solenoid 2	ON		
OP Mod Valve 1	ON	Esc	
OP Mod Valve 2	ON		
OP/ALM Transfer	ON	↵	

SHIPCO PUMPS		AI6-Signal Lost		AI1mA	0.80
				AI1 in	646.96
				AI2mA	0.80
				AI2 F	595.36
				AI3mA	0.80
				AI3 psi	0.00
				AI4mA	0.80
				AI4 psi	595.36
				AI5mA	0.80
				AI5 psi	0.00
				AI6mA	0.80
				AI6	0.00
				AI7mA	4.00
				AI7 in	0.00
				AI8mA	4.00
				AI8 F	0.00

SHIPCO PUMPS		AI6-Signal Lost	
AI1-FTL Setpoints			
AI1 Min	0.00 in	△	
AI1 Max	42.00 in		
AI1 DB	0.50 in		
ALM High High	36.00 in		
ALM High	34.00 in		
ALM Low	14.00 in	▽	
ALM Low Low	12.00 in		
OP/ALM Cut Off	11.00 in		
OP Solenoid 1 Off	20.00 in	Esc	
OP Solenoid 1 On	17.00 in		
OP Solenoid 2 Off	0.00 in	↵	

Sensor Setup

AI1-FTL: Feed Tank Level (continued)

AI1-FTL Functions

- ENABLE Sensor** Toggles the AI1 (Analog Input 1) sensor.
- ALM High High** Toggles Extra High Water Level Alarm
- ALM High** Toggles High Water Level Alarm
- ALM Low** Toggles Low Water Level Alarm
- ALM Low Low** Toggles Extra Low Water Level Alarm
- OP/ALM Cut Off** Toggles Low Water Level Feed Pump Cut Off Operation and Alarm
- OP Solenoid 1** Toggles First Solenoid Valve Operation
- OP Solenoid 2** Toggles Second Solenoid Valve Operation
- OP Mod Valve 1** Toggles First Modulating Valve Operation
- OP Mod Valve 2** Toggles Second Modulating Valve Operation
- OP/ALM Transfer** Toggles Remote Transfer Pump Power Operation and Alarm (Note: This is for a 5th transfer pump which cannot be monitored. Only used on two-tank systems where the feed tank has a controller but the surge tank does not.)

AI1-FTL Setpoints

- AI1 Min** Minimum water level range amount in the feed tank. Typically 0 inch.
- AI1 Max** Maximum water level range amount in the feed tank. Typically the diameter or height of the feed tank expressed in inches.
- AI1 DB** Water level deadband for feed tank. The amount of level change that must occur before the controller raises an alarm status. Typically 0.5 inch.
- ALM High High** Water level in the feed tank must rise to this value before an extra-high water level (second) alarm status is triggered.
- ALM High** Water level in the feed tank must rise to this value before a high water level (first) alarm status is triggered.
- ALM Low** Water level in the feed tank must fall to this value before a low water level alarm (first) status is triggered.
- ALM Low Low** Water level in the feed tank must fall to this value before an extra-low water level (second) alarm status is triggered.
- OP/ALM Cut Off** Water level in the feed tank must fall to this value before a low water level cut-off operation occurs where all feed pumps are shut off and alarm status is triggered.
- OP Solenoid 1 Off** Water level in the feed tank must rise to this value before first solenoid valve is signaled to close stopping makeup water into feed tank.
- OP Solenoid 1 On** Water level in the feed tank must fall to this value before first solenoid valve is signaled to open allowing makeup water into feed tank.
- OP Solenoid 2 Off** Water level in the feed tank must rise to this value before second solenoid valve is signaled to close stopping makeup water into feed tank.
- OP Solenoid 2 On** Water level in the feed tank must fall to this value before second solenoid valve is signaled to open allowing makeup water into feed tank.
- OP/ALM Transfer Off** Water level in the feed tank must rise to this value to signal remote transfer pumps (surge tank) to stop operation and trigger alarm status.
- OP/ALM Transfer On** Water level in the feed tank must fall to this value to signal remote transfer pumps (surge tank) to start operation and trigger alarm status.

Sensor Setup

AI2-FTT: Feed Tank Temperature

About AI2-FTT

- Name** Analog Input 2—Feed Tank Temperature
Location On Controller
Signal 4-20 mA
Description Used to monitor water temperature inside the feed tank (e.g., boiler feed or deaerator unit).

SHIPCO PUMPS AI6-Signal Lost		AI1mA	0.80
AI2-FTT Functions		AI1 in	646.96
ENABLE Sensor	ON	AI2mA	0.80
ALM High	ON	AI2 F	595.36
ALM Low	ON	AI3mA	0.80
OP/ALM Cut Off	ON	AI3 psi	0.00
		AI4mA	0.80
		AI4 psi	595.36
		AI5mA	0.80
		AI5 psi	0.00
		AI6mA	0.80
		AI6	0.00
		AI7 mA	4.00
		AI7 in	0.00
		AI8mA	4.00
		AI8 F	0.00

SHIPCO PUMPS AI6-Signal Lost		AI1mA	0.80
AI2-FTT Setpoints		AI1 in	646.96
AI2 Min	0.00 F	AI2mA	0.80
AI2 Max	300.00 F	AI2 F	595.36
AI2 DB	1.00 F	AI3mA	0.80
ALM High	214.00 F	AI3 psi	0.00
ALM Low	100.00 F	AI4mA	0.80
OP/ALM Cut Off	250.00 F	AI4 psi	595.36
		AI5mA	0.80
		AI5 psi	0.00
		AI6mA	0.80
		AI6	0.00
		AI7 mA	4.00
		AI7 in	0.00
		AI8mA	4.00
		AI8 F	0.00

Sensor Setup

AI2-FTT: Feed Tank Temperature (continued)

AI2-FTT Functions

- ENABLE Sensor** Toggles the AI2 (Analog Input 2) sensor.
- ALM High** Toggles High Water Temperature Alarm
- ALM Low** Toggles Low Water Temperature Alarm
- OP/ALM Cut Off** Toggles Operation and Alarm for High Water Temperature Cut Off

AI2-FTT Setpoints

- AI2 Min** Minimum water temperature range amount in the feed tank. Typically 0°F.
- AI2 Max** Maximum water temperature range amount in the feed tank. Typically 300°F.
- AI2 DB** Water temperature deadband for feed tank. The amount of temperature change that must occur before the controller raises an alarm status. Typically 1°F.
- ALM High** Water temperature in the feed tank must rise to this value before a high water temperature alarm status is triggered.
- ALM Low** Water temperature in the feed tank must fall to this value before a low water temperature alarm status is triggered.
- OP/ALM Cut Off** Water temperature in the feed tank must rise to this value before a high water temperature cut-off operation occurs and alarm status is triggered. Typically 250°F where mechanical seal damage begins to occur.

Sensor Setup

AI3-FTP: Feed Tank Pressure

About AI3-FTP

Name	Analog Input 3—Feed Tank Pressure
Location	On Controller
Signal	4-20 mA
Description	Used to monitor pressure inside the feed tank (such as a boiler feed or deaerator unit).

SHIPCO PUMPS		AI6-Signal Lost		AI1mA	0.80
				AI1 in	646.96
				AI2mA	0.80
				AI2 F	595.36
				AI3mA	0.80
				AI3 psi	0.00
				AI4mA	0.80
				AI4 psi	595.36
				AI5mA	0.80
				AI5 psi	0.00
				AI6mA	0.80
				AI6	0.00
				AI7 mA	4.00
				AI7 in	0.00
				AI8mA	4.00
				AI8 F	0.00

SHIPCO PUMPS		AI6-Signal Lost		AI1mA	0.80
				AI1 in	646.96
				AI2mA	0.80
				AI2 F	595.36
				AI3mA	0.80
				AI3 psi	0.00
				AI4mA	0.80
				AI4 psi	595.36
				AI5mA	0.80
				AI5 psi	0.00
				AI6mA	0.80
				AI6	0.00
				AI7 mA	4.00
				AI7 in	0.00
				AI8mA	4.00
				AI8 F	0.00

SHIPCO PUMPS		AI6-Signal Lost		AI1mA	0.80
				AI1 in	646.96
				AI2mA	0.80
				AI2 F	595.36
				AI3mA	0.80
				AI3 psi	0.00
				AI4mA	0.80
				AI4 psi	595.36
				AI5mA	0.80
				AI5 psi	0.00
				AI6mA	0.80
				AI6	0.00
				AI7 mA	4.00
				AI7 in	0.00
				AI8mA	4.00
				AI8 F	0.00

SHIPCO PUMPS		AI6-Signal Lost		AI1mA	0.80
				AI1 in	646.96
				AI2mA	0.80
				AI2 F	595.36
				AI3mA	0.80
				AI3 psi	0.00
				AI4mA	0.80
				AI4 psi	595.36
				AI5mA	0.80
				AI5 psi	0.00
				AI6mA	0.80
				AI6	0.00
				AI7 mA	4.00
				AI7 in	0.00
				AI8mA	4.00
				AI8 F	0.00

Sensor Setup

AI3-FTP: Feed Tank Pressure (continued)

AI3-FTP Functions

- ENABLE Sensor** Toggles the AI3 (Analog Input 3) sensor.
- ALM Code Pres** Toggles ASME Code Pressure Alarm.
- ALM Relief Pres** Toggles Relief Pressure Alarm.
- ALM Low** Toggles Low Pressure Alarm.

AI3-FTP Setpoints

- AI3 Min** Minimum tank pressure range amount in the feed tank. Typically -14.5 psig (or 0 psia).
- AI3 Max** Maximum tank pressure range amount in the feed tank. Typically 60 psig (or 74.5 psia) greater than the ASME code rating.
- AI3 DB** Tank pressure deadband. The amount of pressure change that must occur before the controller raises an alarm status. This is typically 0.5 psig/psia.
- ALM Code Pres** Tank pressure must rise to this value before an ASME code pressure alarm status is triggered. This is typically the ASME U1 Stamp rating.
- ALM Relief** Tank pressure must rise to this value before a relief valve pressure alarm status is triggered.
- ALM Low** Tank pressure must fall to this value before a low tank pressure alarm status is triggered.

Note: Pressure units on the AI3-FTP Setpoints screen may vary depending on the type of pressure sensor used on the unit! Some controllers may have a sensor where pressure is calibrated in absolute pressure (psia) rather than gauge pressure (psig).

Gauge Pressure (psig) = Absolute Pressure (psia) - 14.5

Absolute Pressure (psia) = Gauge Pressure (psig) + 14.5

Parameter	Value	Unit
AI3 Min	0.00	psia
AI3 Max	74.50	psia
AI3 DB	0.50	psia
ALM Code Pres	64.50	psia
ALM Relief	29.50	psia
ALM Low	13.00	psia

AI1mA	0.80
AI1 in	646.96
AI2mA	0.80
AI2 F	595.36
AI3mA	0.80
AI3 psi	0.00
AI4mA	0.80
AI4 psi	595.36
AI5mA	0.80
AI5 psi	0.00
AI6mA	0.80
AI6	0.00
AI7 mA	4.00
AI7 in	0.00
AI8mA	4.00
AI8 F	0.00

Sensor Setup

AI4-FHP: Feed Header Pressure

About AI4-FHP

Name	Analog Input 4—Feed Header Pressure
Location	On Controller
Signal	4-20 mA
Description	Used to monitor pressure in the feed header for a feed tank (such as a boiler feed or deaerator unit).

SHIPCO PUMPS		AI6-Signal Lost		AI1mA	0.80
SHIPCO PUMPS		AI4-FHP Functions		AI1 in	646.96
ENABLE Sensor		ON		AI2mA	0.80
ALM High		ON		AI2 F	595.36
ALM Low		ON		AI3mA	0.80
				AI3 psi	0.00
				AI4mA	0.80
				AI4 psi	595.36
				AI5mA	0.80
				AI5 psi	0.00
				AI6mA	0.80
				AI6	0.00
				AI7 mA	4.00
				AI7 in	0.00
				AI8mA	4.00
				AI8 F	0.00

SHIPCO PUMPS		AI6-Signal Lost		AI1mA	0.80
SHIPCO PUMPS		AI4-FHP Setpoints		AI1 in	646.96
AI4 Min		0.00 psig		AI2mA	0.80
AI4 Max		300.00 psig		AI2 F	595.36
AI4 DB		5.00 psig		AI3mA	0.80
ALM High		100.00 psig		AI3 psi	0.00
ALM Low		20.00 psig		AI4mA	0.80
				AI4 psi	595.36
				AI5mA	0.80
				AI5 psi	0.00
				AI6mA	0.80
				AI6	0.00
				AI7 mA	4.00
				AI7 in	0.00
				AI8mA	4.00
				AI8 F	0.00

Sensor Setup

AI4-FHP: Feed Header Pressure (continued)

AI4-FHP Functions

- ENABLE Sensor** Toggles the AI4 (Analog Input 4) sensor.
- ALM High** Toggles High Pressure Alarm in Feed Header.
- ALM Low** Toggles Low Pressure Alarm in Feed Header.

AI4-FHP Setpoints


- AI4 Min** Minimum pressure range amount in the feed header. Typically 0 psig.
- AI4 Max** Maximum pressure range amount in the feed header. Typically 300 psig.
- AI4 DB** Feed header pressure deadband. The amount of pressure change that must occur before the controller raises an alarm status. Typically 5 psig.
- ALM High** Feed header pressure must rise to this value before a high feed header pressure alarm status is triggered.
- ALM Low** Feed header pressure must fall to this value before a low feed header pressure alarm status is triggered.


Sensor Setup

AI5-SHP: Steam Header Pressure

About AI5-SHP

Name	Analog Input 5—Steam Header Pressure
Location	On Controller
Signal	4-20 mA
Description	Used to monitor pressure in the steam header for a feed tank (such as a boiler feed or deaerator unit).

		AI6-Signal Lost		AI1mA	0.80
				AI1 in	646.96
AI5-SHP Functions				AI2mA	0.80
ENABLE Sensor		ON		AI2 F	595.36
ALM Boiler Relief		ON		AI3mA	0.80
				AI3 psi	0.00
				AI4mA	0.80
				AI4 psi	595.36
				AI5mA	0.80
				AI5 psi	0.00
				AI6mA	0.80
				AI6	0.00
				AI7 mA	4.00
				AI7 in	0.00
				AI8mA	4.00
				AI8 F	0.00

		AI6-Signal Lost		AI1mA	0.80
				AI1 in	646.96
AI5-SHP Setpoints				AI2mA	0.80
AI5 Min		0.00 psig		AI2 F	595.36
AI5 Max		300.00 psig		AI3mA	0.80
AI5 DB		5.00 psig		AI3 psi	0.00
ALM Boiler Relief		125.00 psig		AI4mA	0.80
				AI4 psi	595.36
				AI5mA	0.80
				AI5 psi	0.00
				AI6mA	0.80
				AI6	0.00
				AI7 mA	4.00
				AI7 in	0.00
				AI8mA	4.00
				AI8 F	0.00

Sensor Setup

AI5-SHP: Steam Header Pressure (continued)

AI5-SHP Functions

ENABLE Sensor Toggles the AI5 (Analog Input 5) sensor.

ALM Boiler Relief Toggles High Pressure Alarm For Runaway Boiler Pressure

AI5-SHP Setpoints

AI5 Min Minimum pressure range amount in the steam header. Typically 0 psig.

AI5 Max Maximum pressure range amount in the steam header. Typically 300 psig.

AI5 DB Steam header pressure deadband. The amount of pressure change that must occur before the controller raises and alarm status. Typically 5 psig.

ALM Boiler Relief Steam header pressure must rise to this value before a high steam header pressure alarm status is triggered.

Sensor Setup

AI6-AI6: Custom Analog Input

About AI6-AI6

Name	Analog Input 6—Custom Analog Input
Location	On Controller
Signal	4-20 mA
Description	A custom analog input which can be configured independently for custom operation and alarms. Supports custom label and unit of measure.

SHIPCO PUMPS		AI6-Signal Lost		AI1mA	0.80
AI6-AI6 Functions				AI1 in	646.96
LABEL AI6	Flow	AI2mA	0.80	AI2 F	595.36
UNITS AI6	gpm	AI3mA	0.80	AI3 psi	0.00
ENABLE Sensor	ON	AI4mA	0.80	AI4 psi	595.36
ALM High	ON	AI5mA	0.80	AI5 psi	0.00
ALM Low	ON	AI6mA	0.80	AI6	0.00
OP Function	ON	AI7 mA	4.00	AI7 in	0.00
ALM Function	ON	AI8mA	4.00	AI8 F	0.00

SHIPCO PUMPS		AI6-Signal Lost		AI1mA	0.80
AI6-AI6 Setpoints				AI1 in	646.96
AI6 Min	0.00	AI2mA	0.80	AI2 F	595.36
AI6 Max	0.00	AI3mA	0.80	AI3 psi	0.00
AI6 DB	0.00	AI4mA	0.80	AI4 psi	595.36
ALM High	0.00	AI5mA	0.80	AI5 psi	0.00
ALM Low	0.00	AI6mA	0.80	AI6	0.00
OP High	0.00	AI7 mA	4.00	AI7 in	0.00
OP Low	0.00	AI8mA	4.00	AI8 F	0.00
L<H Pwr in range					
L>H Pwr out of range					

Sensor Setup

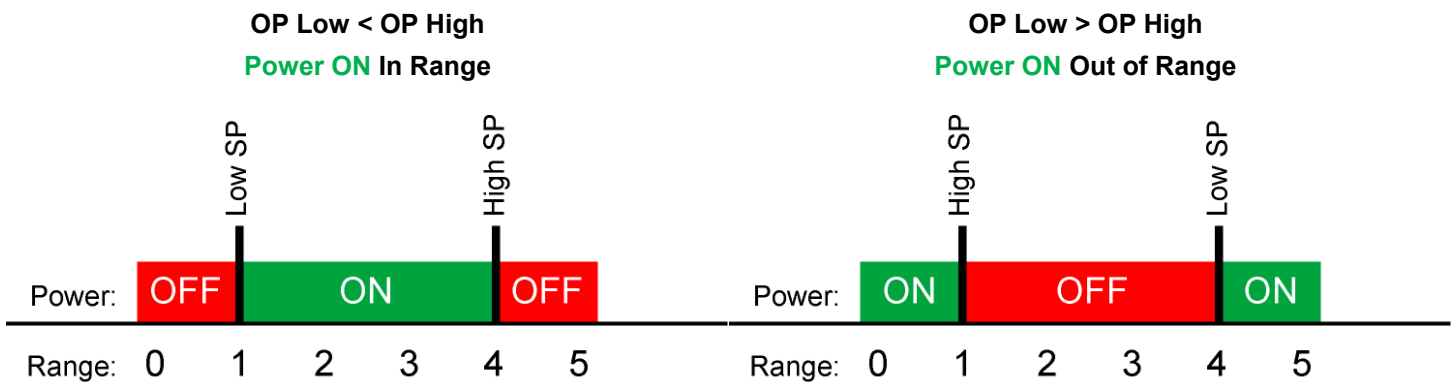
AI6-AI6: Custom Analog Input (continued)

AI6-AI6 Functions

- LABEL AI6** A custom label to describe AI6 measurement. This label displays on home screens for feed or surge tank (e.g., “Flow”).
- UNITS AI6** A custom unit of measure for AI6 measurement. The unit of measure is displayed with the AI6 value (e.g., “gpm”). Limit 5 characters.
- ENABLE Sensor** Toggles the AI6 (Analog Input 6) sensor.
- ALM High** Toggles High Alarm.
- ALM Low** Toggles Low Alarm.
- OP Function** Toggles Range Function to Power Digital Output Operation
- ALM Function** Toggles Range Function to Trigger Alarm

AI6-AI6 Setpoints

- AI6 Min** Custom minimum range amount.
- AI6 Max** Custom maximum range amount.
- AI6 DB** Custom deadband. The amount of change that must occur before the controller raises an alarm status.
- ALM High** Custom reading must rise to this value before high alarm status is triggered.
- ALM Low** Custom reading must fall to this value before low alarm status is triggered.
- OP High** Custom operation high power range amount (see usage below).
- OP Low** Custom operation low power range amount (see usage below).



Sensor Setup

AI7-STL: Surge Tank Level

About AI7-STL

Name	Analog Input 7—Surge Tank Level
Location	Extended I/O Block
Signal	4-20 mA
Description	Used to monitor water level inside a surge tank (feeds a boiler feed or deaerator unit).

SHIPCO PUMPS		AI6-Signal Lost		AI1mA	0.80
				AI1 in	646.96
				AI2mA	0.80
				AI2 F	595.36
				AI3mA	0.80
				AI3 psi	0.00
				AI4mA	0.80
				AI4 psi	595.36
				AI5mA	0.80
				AI5 psi	0.00
				AI6mA	0.80
				AI6	0.00
				AI7 mA	4.00
				AI7 in	0.00
				AI8mA	4.00
				AI8 F	0.00

SHIPCO PUMPS		AI6-Signal Lost	
AI7-STL Functions			
ENABLE Sensor	ON		
ALM High High	ON		
ALM High	ON		
ALM Low	ON		
ALM Low Low	ON		
OP/ALM Cut Off	ON	▲	
OP/ALM Cut Off BP	ON	▼	
OP Solenoid 1	ON		
OP Solenoid 2	ON	Esc	
OP Mod Valve 1	ON		
OP Mod Valve 2	ON	⏏	

SHIPCO PUMPS		AI6-Signal Lost		AI1mA	0.80
				AI1 in	646.96
				AI2mA	0.80
				AI2 F	595.36
				AI3mA	0.80
				AI3 psi	0.00
				AI4mA	0.80
				AI4 psi	595.36
				AI5mA	0.80
				AI5 psi	0.00
				AI6mA	0.80
				AI6	0.00
				AI7 mA	4.00
				AI7 in	0.00
				AI8mA	4.00
				AI8 F	0.00

SHIPCO PUMPS		AI6-Signal Lost	
AI7-STL Setpoints			
AI7 Min	0.00 in	▲	
AI7 Max	54.00 in		
AI7 DB	0.50 in		
ALM High High	40.00 in		
ALM High	37.00 in		
ALM Low	12.00 in	▲	
ALM Low Low	10.00 in	▼	
OP/ALM Cut Off	8.00 in		
OP Solenoid 1 Off	26.00 in	Esc	
OP Solenoid 1 On	22.00 in		
OP Solenoid 2 Off	0.00 in	⏏	

Sensor Setup

AI7-STL: Surge Tank Level (continued)

AI7-STL Functions

ENABLE Sensor	Toggles the AI7 (Analog Input 7) sensor.
ALM High High	Toggles Extra High Water Level Alarm
ALM High	Toggles High Water Level Alarm
ALM Low	Toggles Low Water Level Alarm
ALM Low Low	Toggles Extra Low Water Level Alarm
OP/ALM Cut Off	Toggles Low Water Surge Tank Pump Cut Off Operation and Alarm
OP/ALM Cut Off BP	Toggles Low Water Feed Tank Pump Cut Off Operation and Alarm
OP Solenoid 1	Toggles First Solenoid Valve Operation
OP Solenoid 2	Toggles Second Solenoid Valve Operation
OP Mod Valve 1	Toggles First Modulating Valve Operation
OP Mod Valve 2	Toggles Second Modulating Valve Operation

AI7-STL Setpoints

AI7 Min	Minimum water level range amount in the surge tank. This is typically 0 inches (empty tank).
AI7 Max	Maximum water level range amount in the surge tank. This is typically the diameter or height of the surge tank expressed in inches.
AI7 DB	Water level deadband for surge tank. The amount of level change that must occur before the controller raises an alarm status. This is typically 0.5 inches.
ALM High High	Water level in the surge tank must rise to this value before an extra-high water level (second) alarm status is triggered.
ALM High	Water level in the surge tank must rise to this value before a high water level (first) alarm status is triggered.
ALM Low	Water level in the surge tank must fall to this value before a low water level (first) alarm status is triggered.
ALM Low Low	Water level in the surge tank must fall to this value before an extra-low water level (second) alarm status is triggered.
OP/ALM Cut Off	Water level in the surge tank must fall to this value before a low water level cut-off operation occurs where all transfer pumps are shut off and alarm status is triggered.
OP Solenoid 1 Off	Water level in the surge tank must rise to this value before first solenoid valve is signaled to close stopping makeup water into surge tank.
OP Solenoid 1 On	Water level in the surge tank must fall to this value before first solenoid valve is signaled to open allowing makeup water into surge tank.
OP Solenoid 2 Off	Water level in the surge tank must rise to this value before second solenoid valve is signaled to close stopping makeup water into surge tank.
OP Solenoid 2 On	Water level in the surge tank must fall to this value before second solenoid valve is signaled to open allowing makeup water into surge tank.

Sensor Setup

AI8-STT: Surge Tank Temperature

About AI8-STT

Name	Analog Input 8—Surge Tank Temperature
Location	Extended I/O Block
Signal	4-20 mA
Description	Used to monitor water temperature inside a surge tank (feeds a boiler feed or deaerator unit).

SHIPCO PUMPS		AI6-Signal Lost		AI1mA	0.80
AI8-STT Functions		AI1 in	646.96	AI2mA	0.80
ENABLE Sensor	ON	AI2 F	595.36	AI3mA	0.80
ALM High	ON	AI3 psi	0.00	AI4mA	0.80
ALM Low	ON	AI4 psi	595.36	AI5mA	0.80
OP/ALM Cut Off	ON	AI5 psi	0.00	AI6mA	0.80
		AI6	0.00	AI7 mA	4.00
		AI7 in	0.00	AI8mA	4.00
		AI8 F	0.00		

SHIPCO PUMPS		AI6-Signal Lost		AI1mA	0.80
AI8-STT Setpoints		AI1 in	646.96	AI2mA	0.80
AI8 Min	0.00 F	AI2 F	595.36	AI3mA	0.80
AI8 Max	300.00 F	AI3 psi	0.00	AI4mA	0.80
AI8 DB	1.00 F	AI4 psi	595.36	AI5mA	0.80
ALM High	212.00 F	AI5 psi	0.00	AI6mA	0.80
ALM Low	100.00 F	AI6	0.00	AI7 mA	4.00
OP/ALM Cut Off	210.00 F	AI7 in	0.00	AI8mA	4.00
		AI8 F	0.00		

Sensor Setup

AI8-STT: Surge Tank Temperature (continued)

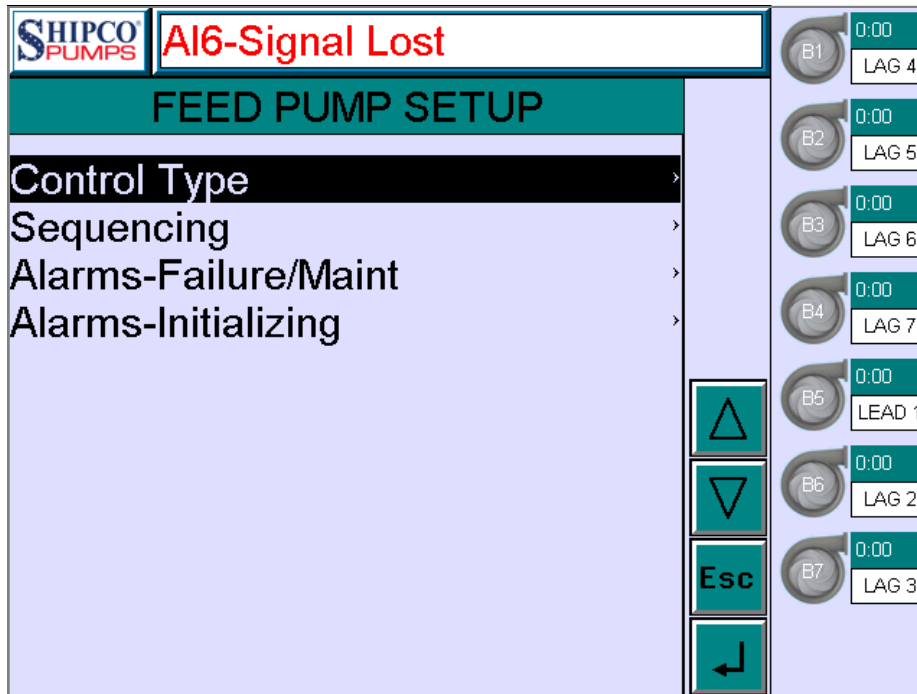
AI8-STT Functions

- ENABLE Sensor** Toggles the AI8 (Analog Input 8) sensor.
- ALM High** Toggles High Water Temperature Alarm
- ALM Low** Toggles Low Water Temperature Alarm
- OP/ALM Cut Off** Toggles Operation and Alarm for High Water Temperature Cut Off

AI8-STT Setpoints

- AI8 Min** Minimum water temperature range amount in the surge tank. This is typically 0°F.
- AI8 Max** Maximum water temperature range amount in the surge tank. This is typically 300°F.
- AI8 DB** Water temperature deadband for surge tank. The amount of temperature change that must occur before the controller raises an alarm status. This is typically 1°F.
- ALM High** Water temperature in the surge tank must rise to this value before a high water temperature alarm status is triggered.
- ALM Low** Water temperature in the surge tank must fall to this value before a low water temperature alarm status is triggered.
- OP/ALM Cut Off** Water temperature in the surge tank must rise to this value before a high water temperature cut-off operation occurs and alarm status is triggered. Typically 210°F where NPSH concerns increase as temperature approaches saturation (212°F).

Feed Pump Setup



Control Type (pp. 39-42)

The Control Type menu has a “Control Type” setting which consists of the following options: *Digital Signal*, *Pressure Drop*, *VFD Minimum Wear* and *VFD Max Efficiency*. Each setting changes how feed pumps are staged on and off based on several factors adjusted after the selected Control Type. All control sequences include an on delay and off delay timer which can be set by the user to prevent nuisance starts or short cycling. Common menu items below appear under each control type selection:

Number of Pumps Sets the number of feed pumps from 0 up to 8 pumps.

Lead Pump Continuous Toggles ON/OFF whether the pump in the LEAD1 position should be continuous running.

Pump Off Delay Amount of time the controller waits before it stages off a feed pump. Default is 20 seconds.

Standby (On) Delay Amount of time the controller waits before it will stage on a feed pump. Default is 10 seconds. Note: Not available for Control Type: *Digital Signal* setting.

Sequencing (p. 43)

Boiler feed pump sequencing and alternation adjustment.

Alarms-Failure/Maintenance (p. 44)

Adjust alarms for boiler feed pump failures and maintenance.

Alarms-Initializing (p. 45)

Adjust alarms for energizing boiler feed pumps and run command.

Feed Pump Setup

Navigation

SHIPCO PUMPS A16-Signal Lost

FEED PUMP SETUP

Control Type
Sequencing
Alarms-Failure/Maint
Alarms-Initializing

B1 0.00 LAG 4
B2 0.00 LAG 5
B3 0.00 LAG 6
B4 0.00 LAG 7
B5 0.00 LEAD 1
B6 0.00 LAG 2
B7 0.00 LAG 3

Esc

SHIPCO PUMPS A16-Signal Lost

Control Type

Control Type Digital Signal
Number Of Pumps 7 Ea
Lead Pump Continuous ON
Pump Off Delay 20 Sec

RC1
RC2
RC3
RC4
RC5
RC6
RC7

p. 39

SHIPCO PUMPS A16-Signal Lost

Control Type

Control Type Pressure Drop
Number Of Pumps 7 Ea
Lead Pump Continuous ON
Pump Off Delay 20 Sec
Standby Delay 10 Sec
Standby Off Pressure 78.00 psi
Standby On Pressure 70.00 psi

LAG 4
LAG 5
LAG 6
LAG 7
LEAD 1
LAG 2
LAG 3

p. 40

SHIPCO PUMPS A16-Signal Lost

Control Type

Control Type VFD Min Wear
Number Of Pumps 7 Ea
Lead Pump Continuous ON
Pump Off Delay 20 Sec
Standby Delay 10 Sec
Standby Off % Diff 95 %
Standby On % Diff 85 %

LAG 4
LAG 5
LAG 6
LAG 7
LEAD 1
LAG 2
LAG 3

p. 41

SHIPCO PUMPS A16-Signal Lost

Control Type

Control Type VFD Max Eff.
Number Of Pumps 7 Ea
Lead Pump Continuous ON
Pump Off Delay 20 Sec
Standby Delay 10 Sec
Speed Min 30 hz
Speed Max 60 hz
Standby Off Speed 40 hz
Standby On Speed 50 hz

LAG 4
LAG 5
LAG 6
LAG 7
LEAD 1
LAG 2
LAG 3

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SHIPCO PUMPS A16-Signal Lost

Sequencing

Sequencing Alternate
Alternation Period 720 Hr
B1 Initial 1
B2 Initial 2
B3 Initial 3
B4 Initial 4
B5 Initial 5
B6 Initial 6
B7 Initial 7
B8 Initial 8

LAG 4
LAG 5
LAG 6
LAG 7
LEAD 1
LAG 2
LAG 3

p. 43

SHIPCO PUMPS A16-Signal Lost

Alarms-Failure/Maint

Fault B1 ON
Fault B2 ON
Fault B3 ON
Fault B4 ON
Fault B5 ON
Fault B6 ON
Fault B7 ON
Fault B8 ON
Maintenance Interval 8760 Hr
Maintenance B1 ON
Maintenance B2 ON

LAG 4
LAG 5
LAG 6
LAG 7
LEAD 1
LAG 2
LAG 3

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SHIPCO PUMPS A16-Signal Lost

Alarms-Initializing

Energized B1 OFF
Energized B2 OFF
Energized B3 OFF
Energized B4 OFF
Energized B5 OFF
Energized B6 OFF
Energized B7 OFF
Energized B8 OFF
Run Command 1 OFF
Run Command 2 OFF
Run Command 3 OFF

LAG 4
LAG 5
LAG 6
LAG 7
LEAD 1
LAG 2
LAG 3

p. 45

Feed Pump Setup

Control Type: Digital Signal

SHIPCO PUMPS		A16-Signal Lost	
Control Type			
Control Type	Digital Signal		
Number Of Pumps	7 Ea		
Lead Pump Continuous	ON		
Pump Off Delay	20 Sec		
		△	
		▽	
		Esc	
		↵	
	B1	0:00	RC1
	B2	0:00	RC2
	B3	0:00	RC3
	B4	0:00	RC4
	B5	0:00	RC5
	B6	0:00	RC6
	B7	0:00	RC7

Control Type: Digital Signal

Typically used for boilers with dedicated pumps or multi-pressure systems. Standby pumps must operate from pressure switches for this sequence. The controller is only providing ON/OFF delays and monitoring pump status. No alternation or pressure sensors are available. Each pump is tied to a discrete digital input on the controller. Inputs can be daisy-chained or have parallel control switches. When a switch closes, the controller powers a pump. When that switch opens, controller waits "off delay" seconds then pump shuts off.

Feed Pump Setup

Control Type: Pressure Drop

SHIPCO PUMPS		A16-Signal Lost	
Control Type			
Control Type	Pressure Drop		
Number Of Pumps	7 Ea		
Lead Pump Continuous	ON		
Pump Off Delay	20 Sec		
Standby Delay	10 Sec		
Standby Off Pressure	78.00 psi		
Standby On Pressure	70.00 psi		
		△	
		▽	
		Esc	
		↵	
			B1 0:00 LAG 4
			B2 0:00 LAG 5
			B3 0:00 LAG 6
			B4 0:00 LAG 7
			B5 0:00 LEAD 1
			B6 0:00 LAG 2
			B7 0:00 LAG 3

Control Type: Pressure Drop

Typically used when manifolded boiler feed pumps are feeding a single pressure system with starters. Controller stages pumps to maintain feed pressure. The lead pump is typically continuous but can be ON/OFF.

Standby Off Pressure

If the pressure is above the maximum setpoint the controller waits “off delay” seconds then stages off a pump. Should the pressure remain above the maximum setpoint the controller waits “off delay” seconds then stages off another pump. This process continues until 1 lead pump is running.

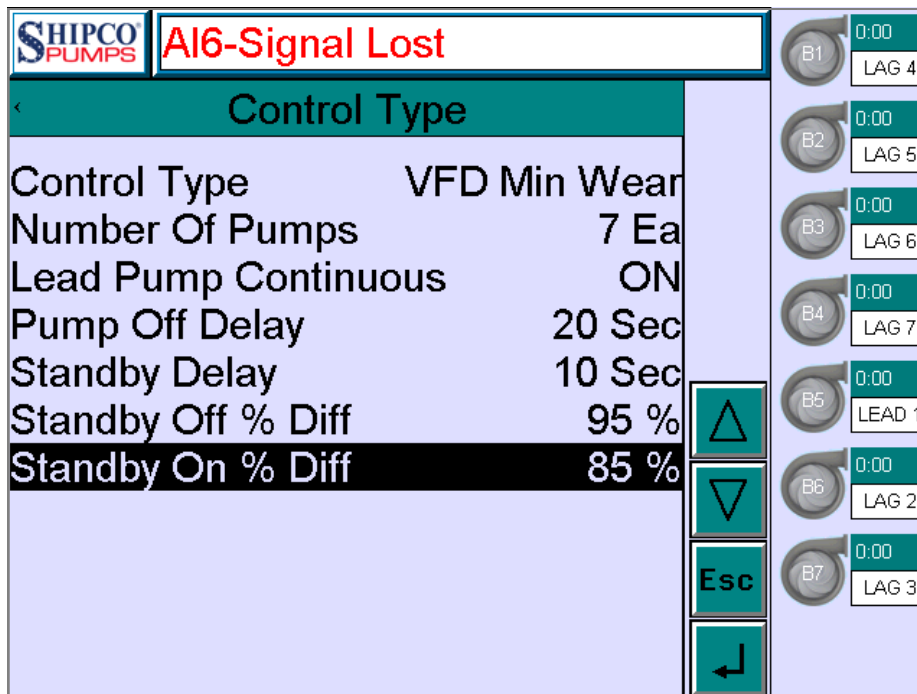
If the *Lead Pump Continuous* is toggled “ON” then the lead pump stays on, otherwise lead pump will stage off.

Standby On Pressure

If the pressure is below the minimum setpoint the controller waits “on delay” seconds then stages on a pump. Should the pressure remain below the minimum setpoint the controller waits “on delay” seconds then stages on another pump. This process continues until all pumps are running.

Feed Pump Setup

Control Type: VFD Min Wear



Control Type: VFD Minimum Wear

Typical used when manifolded boiler feed pumps are feeding a single pressure system with VFDs. The controller stages pumps to maintain feed pressure. The lead pump is typically continuous but can be ON/OFF. VFD speed is controlled by a PID loop within the controller. Since the target discharge pressure moves with boiler operating pressure, staging is based on a percentage of target pressure. Percentages are field adjustable but typical as follows:

Standby Off % Diff

If the pressure is above 95% setpoint the controller waits “off delay” seconds then stages off a pump. Should the pressure remain above 95% setpoint the controller waits “off delay” seconds then stages off another pump. This process continues until 1 lead pump is running.

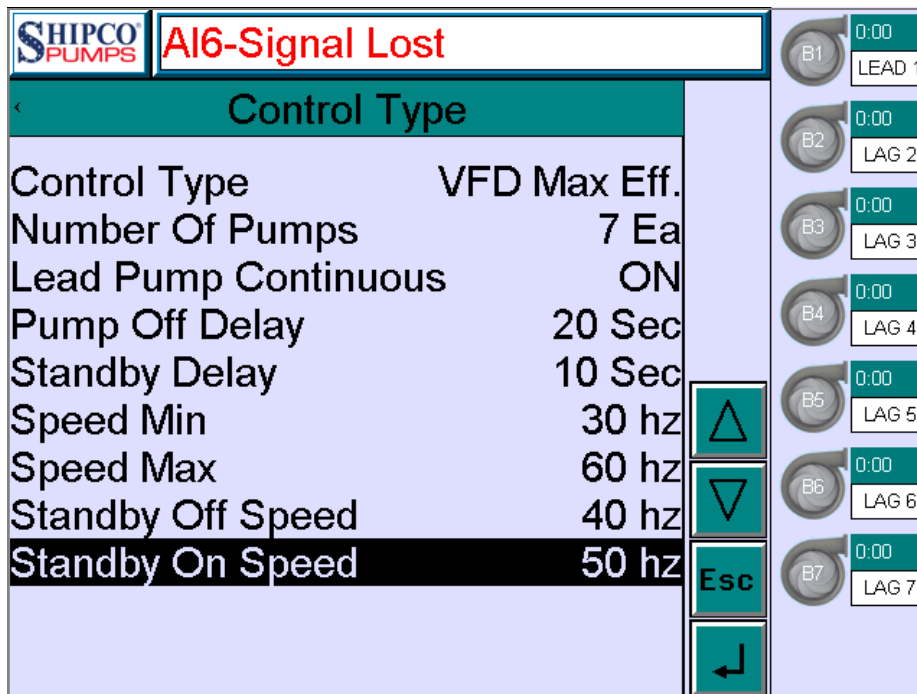
If the *Lead Pump Continuous* is toggled “ON” then the lead pump stays on, otherwise lead pump will stage off.

Standby On % Diff

If the pressure is below 85% setpoint the controller waits “on delay” seconds then stages on a pump. Should the pressure remain below 85% setpoint the controller waits “on delay” seconds then stages on another pump. This process continues until all pumps are running.

Feed Pump Setup

Control Type: VFD Max Efficiency



Control Type: VFD Maximum Efficiency

Typically used when manifolded boiler feed pumps are feeding a single pressure system with VFDs. The controller stages pumps to maintain speed (Hz-RPM). The lead pump is typically continuous but can be ON/OFF. VFD speed is controlled by a PID loop within the controller. According to pump affinity laws, multiple pumps at lower flow require less total amperage draw than fewer pumps at higher flow. This sequence tries to keep as many pumps on as possible and stages them off when they are close to minimum speed. Speeds are field adjustable.

Speed Min/Max

Minimum and maximum range for VFD speed. Default minimum is 30 Hz; maximum is 60 Hz.

Standby Off Speed

If speed is below 40 Hz (default) the controller waits “off delay” seconds then stages off a pump. Should the speed remain below 40 Hz the controller waits “off delay” seconds then stages off another pump. This process continues until 1 lead pump is running.

If the *Lead Pump Continuous* is toggled “ON” then the lead pump stays on, otherwise lead pump will stage off.

Standby On Speed

If speed is above 50 Hz (default) the controller waits “on delay” seconds then stages on a pump. Should the speed remain above 50 Hz the controller waits “on delay” seconds then stages on another pump. This process continues until all pumps are running.

Feed Pump Setup

Sequencing

SHIPCO PUMPS		A16-Signal Lost	
Sequencing			
Sequencing	Alternate		
Alternation Period	720 Hr		
B1 Initial	1	B1	0:00 LAG 4
B2 Initial	2	B2	0:00 LAG 5
B3 Initial	3	B3	0:00 LAG 6
B4 Initial	4	B4	0:00 LAG 7
B5 Initial	5	B5	0:00 LEAD 1
B6 Initial	6	B6	0:00 LAG 2
B7 Initial	7	B7	0:00 LAG 3
B8 Initial	8		

Sequencing

Sets feed pumps to “Alternate” or “Manual”. Alternation allows the controller to automatically alternate pumps via LEAD-LAG sequence operation over a set cycle period. Manual allows the user to define pump sequence without alternation.

Note: For FWS versions 3.0-3.10 when *Control Type* is set to “Digital Signal” then *Sequencing* is locked to “Manual”.

This limitation was removed in FWS 3.11 to allow Alternation sequencing for the Digital Signal control type.

Alternation Period

When *Sequencing* is set to “Alternate” this is amount of time to elapse before pumps are signaled to alternate. Default is 720 hours (30 days). This is the same as adjusting *Cycle (Hr)* on the Boiler Feed Pumps screen.

B1-B8 Initial (Feed Pump Sequence Position)

Adjusts the initial energizing sequence for feed pumps where items B1-B8 refer to the physical feed pump. When *Sequencing* is set to “Manual” then adjusting the sequence number for a feed pump changes its LEAD-LAG position in the sequence.

Note: When *Control Type* is set to “Digital Signal”, these sequence numbers correspond to which physical feed pump is energized based on its run command input signal. (Appendix, p. 66)

Feed Pump Setup

Alarms-Failure/Maintenance

Item	Status	Value	Label
Fault B1	ON		
Fault B2	ON		
Fault B3	ON		
Fault B4	ON		
Fault B5	ON		
Fault B6	ON		
Fault B7	ON		
Fault B8	ON		
Maintenance Interval		8760 Hr	
Maintenance B1	ON		
Maintenance B2	ON		
B1		0:00	LAG 4
B2		0:00	LAG 5
B3		0:00	LAG 6
B4		0:00	LAG 7
B5		0:00	LEAD 1
B6		0:00	LAG 2
B7		0:00	LAG 3

Fault B1-B8 (Feed Pump Fault Alarm)

Toggle ON/OFF fault alarms for feed pumps where items B1-B8 refer to the physical feed pump.

Maintenance Interval

Sets the amount of time to elapse before a recommended pump maintenance notice appears. This notice is based on each pump's maintenance run counter (p. 13) and is accompanied by an icon next to the pump on the Boiler Feed Pumps screen. Default is 8760 hours (1 year).

Maintenance B1-B8 (Feed Pump Fault Alarm)

Toggle ON/OFF maintenance alarm and icon for feed pumps where items B1-B8 refer to the physical feed pump.

Feed Pump Setup

Alarms-Initializing

The screenshot displays the 'Alarms-Initializing' configuration screen for SHIPCO PUMPS. The main area contains a table of parameters and their current status:

Parameter	Status
Energized B1	OFF
Energized B2	OFF
Energized B3	OFF
Energized B4	OFF
Energized B5	OFF
Energized B6	OFF
Energized B7	OFF
Energized B8	OFF
Run Command 1	OFF
Run Command 2	OFF
Run Command 3	OFF

On the right side of the screen, there is a vertical column of indicators for pumps B1 through B7. Each indicator consists of a circular button with a pump icon and a rectangular box showing a time and a label:

- B1: 0:00 LAG 4
- B2: 0:00 LAG 5
- B3: 0:00 LAG 6
- B4: 0:00 LAG 7
- B5: 0:00 LEAD 1
- B6: 0:00 LAG 2
- B7: 0:00 LAG 3

Navigation buttons are visible on the right side of the main table, including up, down, Esc, and left arrow keys.

Energized B1-B8

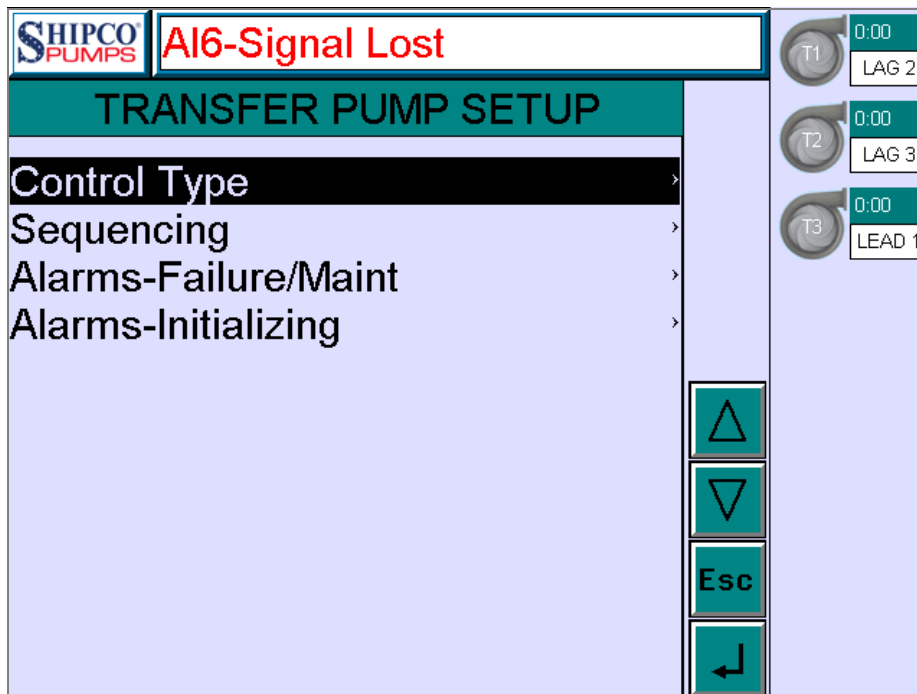
Toggle ON/OFF energized alarms for feed pumps where items B1-B8 refer to the physical feed pump.

Run Command 1-8

Toggle ON/OFF run command notices when a sequential feed pump (or run command digital sequence when *Control Type* is "Digital Signal", p. 39) is energized based on its run command input signal.

For example: *Energized B1* activates the first physical boiler feed pump. *Run Command 1* activates the pump sequentially known as LEAD1.

Transfer Pump Setup



Control Type (p. 48)

Changes how transfer pumps are staged on and off. Includes on delay and off delay timer which can be set by the user to prevent nuisance starts or short cycling.

Sequencing (p. 49)

Transfer pump sequencing and alternation adjustment.

Alarms-Failure/Maintenance (p. 50)

Adjust alarms for transfer pump failures and maintenance.

Alarms-Initializing (p. 51)

Adjust alarms for energizing transfer pumps and run command.

Transfer Pump Setup

Navigation

SHIPCO PUMPS | **A16-Signal Lost**

TRANSFER PUMP SETUP

Control Type

Sequencing

Alarms-Failure/Maint

Alarms-Initializing

T1 0:00 LAG 2

T2 0:00 LAG 3

T3 0:00 LEAD 1

Esc

SHIPCO PUMPS | **A16-Signal Lost**

Control Type

Number Of Pumps	3 Ea
Lead Pump Continuous	ON
Pump Off Delay	30 Sec
Lead1 Off *	36.00 in
Lead1 On	32.00 in
Lag2 Off	32.00 in
Lag2 On	27.00 in
Lag3 Off	15.00 in
Lag3 On	12.00 in
Lag4 Off	15.00 in
Lag4 On	11.00 in

LAG 2

LAG 3

LEAD 1

p. 48

SHIPCO PUMPS | **A16-Signal Lost**

Sequencing

Sequence	Alternate
Alternation Period	720 Hr
T1 Initial	1
T2 Initial	2
T3 Initial	3
T4 Initial	4

LAG 2

LAG 3

LEAD 1

p. 49

SHIPCO PUMPS | **A16-Signal Lost**

Alarms-Failure/Maint

Fault T1	ON
Fault T2	ON
Fault T3	ON
Fault T4	ON
Maintenance Interval	8760 Hr
Maintenance T1	ON
Maintenance T2	ON
Maintenance T3	ON
Maintenance T4	ON

LAG 2

LAG 3

LEAD 1

p. 50

SHIPCO PUMPS | **A16-Signal Lost**

Alarms-Initializing

Energized T1	OFF
Energized T2	OFF
Energized T3	OFF
Energized T4	OFF
Run Command 1	OFF
Run Command 2	OFF
Run Command 3	OFF
Run Command 4	OFF

LAG 2

LAG 3

LEAD 1

p. 51

Transfer Pump Setup

Control Type

SHIPCO PUMPS		A16-Signal Lost	
Control Type			
Number Of Pumps	3 Ea	T1	0:00 LAG 2
Lead Pump Continuous	ON	T2	0:00 LAG 3
Pump Off Delay	30 Sec	T3	0:00 LEAD 1
Lead1 Off *	36.00 in		
Lead1 On	32.00 in		
Lag2 Off	32.00 in		
Lag2 On	27.00 in		
Lag3 Off	15.00 in		
Lag3 On	12.00 in		
Lag4 Off	15.00 in		
Lag4 On	11.00 in		

Control Type

Transfer pumps are staged on at low water level and off at high water level in the **feed tank**.

Number of Pumps

Sets the number of transfer pumps from 0 up to 4 pumps.

Lead Pump Continuous

Toggles ON/OFF whether the pump in the LEAD1 position should be continuous running.

Pump Off Delay

How long the controller waits before it will stage off a transfer pump.

Lead1 Off

Water level in the feed tank must rise to this value before the LEAD1 transfer pump is staged off. **Note:** This value is ignored if *Lead Pump Continuous* is "ON".

Lead1 On

Water level in the feed tank must fall to this value before the LEAD1 transfer pump is staged on.

Lag2, Lag3, Lag4 Off

Water level in the feed tank must rise to the set value before the corresponding LAG transfer pump is staged off.





Lag2, Lag3, Lag4 On

Water level in the feed tank must fall to the set value before the corresponding LAG transfer pump is staged on.

Transfer Pump Setup

Sequencing

Sequence	Alternate
Alternation Period	720 Hr
T1 Initial	1
T2 Initial	2
T3 Initial	3
T4 Initial	4

Navigation buttons:    

Pump Status Indicators:

- T1: 0:00 LAG 2
- T2: 0:00 LAG 3
- T3: 0:00 LEAD 1

Sequencing

Sets transfer pumps to “Alternate” or “Manual”. Alternation allows the controller to automatically alternate pumps via LEAD-LAG sequence operation over a set cycle period. Manual allows the user to define pump sequence without alternation.

Alternation Period

When *Sequencing* is set to “Alternate” this is amount of time to elapse before pumps are signaled to alternate. Default is 720 hours (30 days). This is the same as adjusting *Cycle (Hr)* on the Transfer Feed Pumps screen.

T1-T4 Initial (Transfer Pump Sequence Position)

Adjusts the initial energizing sequence for transfer pumps where items T1-T4 refer to the physical transfer pump. When *Sequencing* is set to “Manual” then adjusting the sequence number for a transfer pump changes its LEAD-LAG position in the sequence.

Transfer Pump Setup

Alarms-Failure/Maintenance

SHIPCO PUMPS		A16-Signal Lost	
Alarms-Failure/Maint			
Fault T1	ON	T1	0:00 LAG 2
Fault T2	ON	T2	0:00 LAG 3
Fault T3	ON	T3	0:00 LEAD 1
Fault T4	ON		
Maintenance Interval	8760 Hr		
Maintenance T1	ON	△	
Maintenance T2	ON	▽	
Maintenance T3	ON	Esc	
Maintenance T4	ON	↩	

Fault T1-T4 (Feed Pump Fault Alarm)

Toggle ON/OFF fault alarms for transfer pumps where items T1-T4 refer to the physical transfer pump.

Maintenance Interval

Sets the amount of time to elapse before a recommended pump maintenance notice appears. This notice is based on each pump's maintenance run counter (p. 13) and is accompanied by an icon next to the pump on the Transfer Pumps screen. Default is 8760 hours (1 year).

Maintenance T1-T4 (Transfer Pump Fault Alarm)

Toggle ON/OFF maintenance alarm and icon for transfer pumps where items T1-T4 refer to the physical transfer pump.

Transfer Pump Setup

Alarms-Initializing

SHIPCO PUMPS		A16-Signal Lost	
Alarms-Initializing			
Energized T1	OFF	T1	0:00 LAG 2
Energized T2	OFF	T2	0:00 LAG 3
Energized T3	OFF	T3	0:00 LEAD 1
Energized T4	OFF		
Run Command 1	OFF		
Run Command 2	OFF		
Run Command 3	OFF		
Run Command 4	OFF		

Energized T1-T4

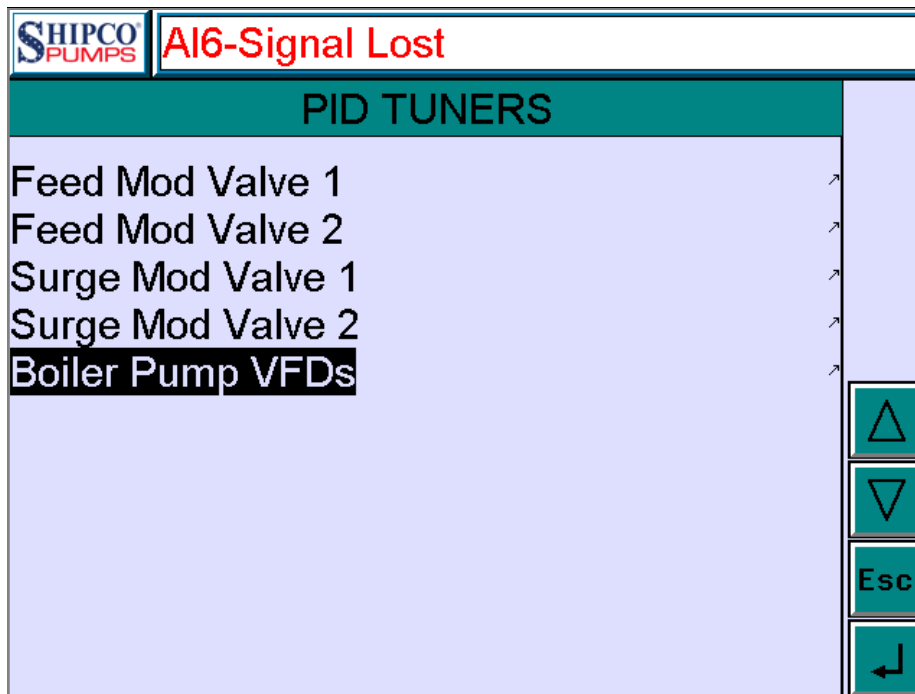
Toggle ON/OFF energized alarms for transfer pumps where items T1-T4 refer to the physical transfer pump.

Run Command 1-4

Toggle ON/OFF run command notices when a sequential transfer pump is energized based on its run command input signal.

For example: *Energized T1* activates the first physical transfer pump. *Run Command 1* activates the pump sequentially known as LEAD1.

PID Tuning



PID Loop Control Information

PID stands for Proportional–Integral–Derivative and is a control loop feedback mechanism for applications requiring continuous modulating control. Basically it consists of the following:

CV = Control Variable (what changes)

PV = Process Variable (what is monitored)

TV = 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 terms

$$e = TV - PV$$

$$CV = Pe + I \int_0^t e dt + D \frac{de}{dt} + \text{bias}$$

Feed Modulating Valve 1 & 2 (p. 54)

Configuration for a primary and/or secondary modulating feed valve for the feed tank.

Surge Modulating Valve 1 & 2 (p. 54)

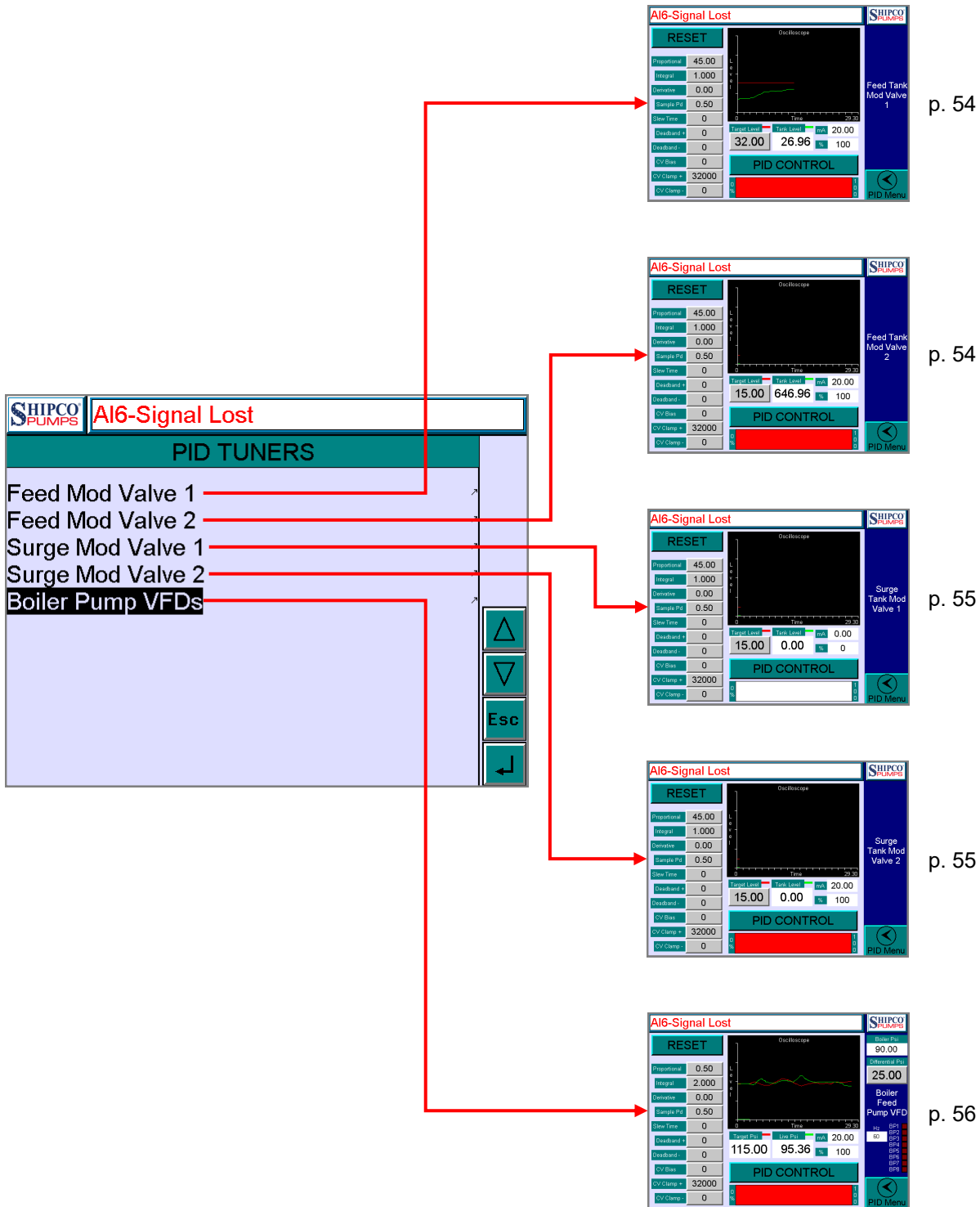
Configuration for a primary and/or secondary modulating feed valve for the surge tank.

Boiler Pump VFDs (p. 55)

Configures VFDs that drive boiler feed pumps.

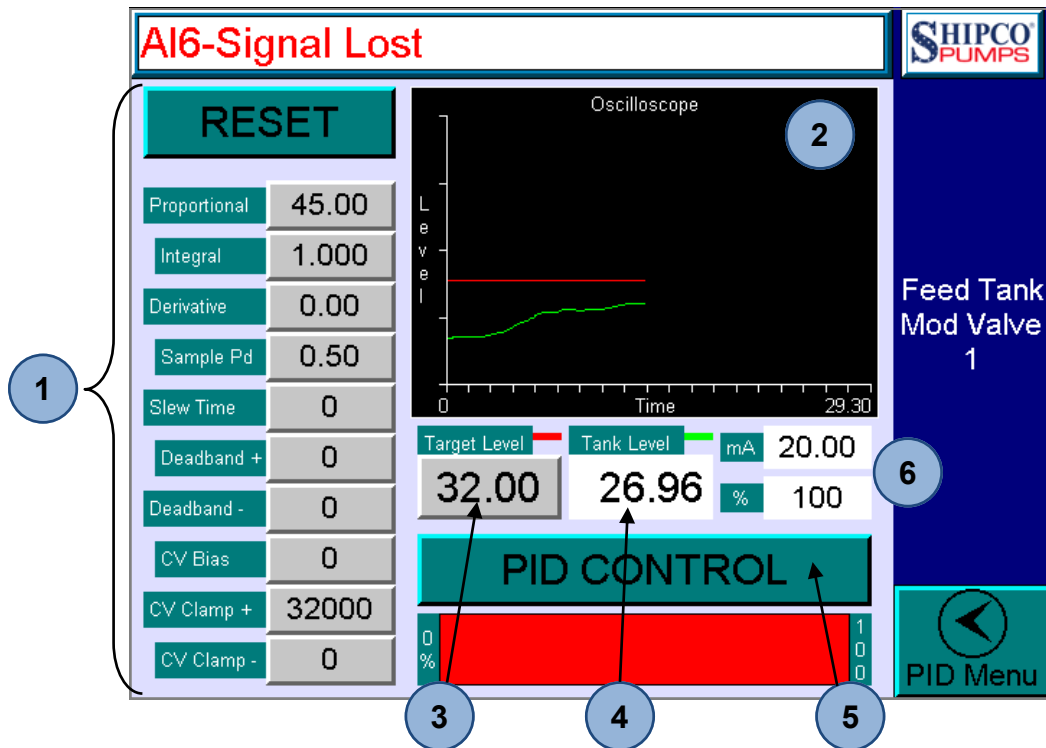
PID Tuning

Navigation



PID Tuning

Feed Mod Valve & Surge Mod Valve



Used for tuning modulating feed valves on a feed or surge tank. A modulating feed valve will variably modulate open or closed to increase or decrease the flow of water into the tank until the current tank level matches the target as closely as possible.

1. PID Functions / Reset

Proportional (%), Integral (rep/sec), Derivative (sec) as well as Sample Period (sec), Slew Time (sec), Deadband +/- (0 to 32000), CV Bias and CV Clamp +/- (-32000 to 32000) are all used for tuning the modulating valve. These values vary by application and are default set by the factory. PID Function factory defaults can always be restored by pressing Reset.

2. Oscilloscope

Displays the target water level versus current level changes over a brief period of time. Ideally the current tank level would closely match the target level.

3. Target Level

Press to change the target water level that should be maintained inside the tank expressed in inches.

4. Tank Level

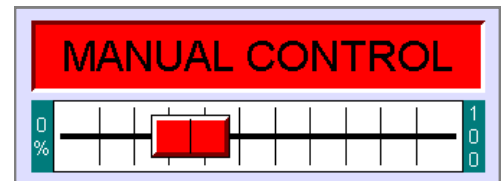
The current water level in the tank expressed in inches.

5. PID Control / Manual Control

Press to toggle between "PID Control" or "Manual Control" of the modulating feed valve. PID Control lets the controller automatically modulate the valve. When Manual Control is chosen an adjustable slider appears. The user can drag the slider between 0% and 100% where 0% indicates the modulating valve is fully closed (no flow) and 100% is fully open (maximum flow).

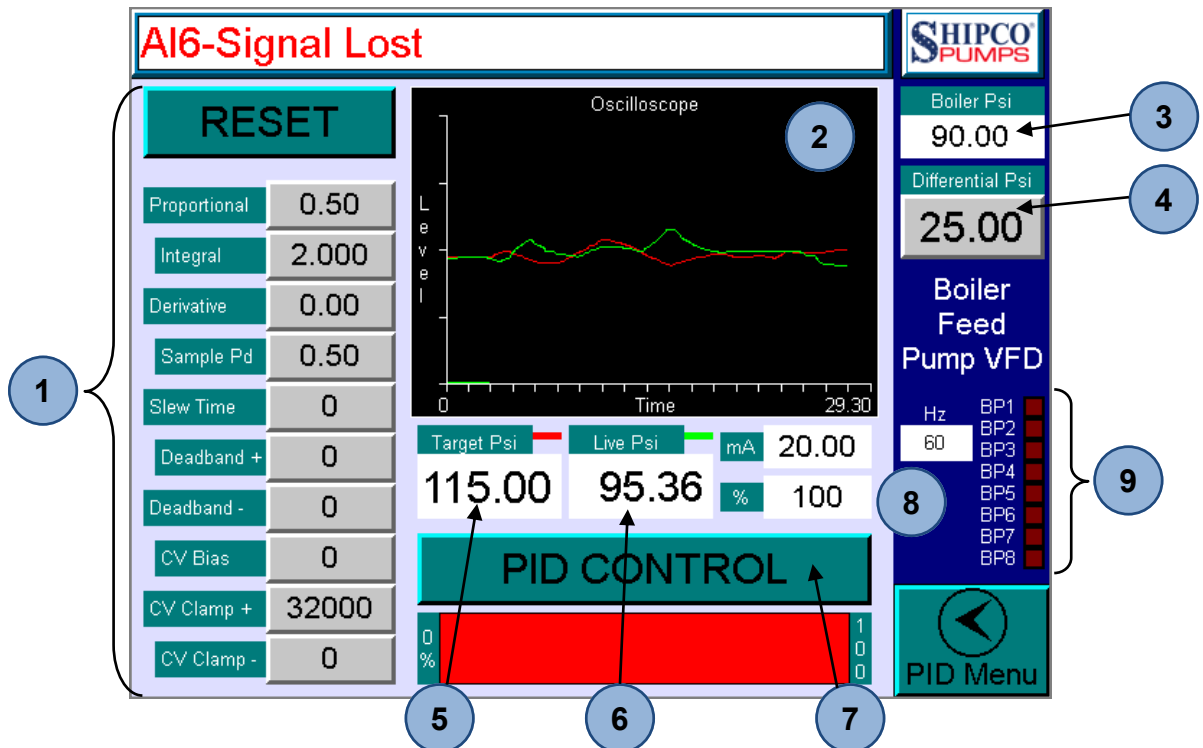
6. mA and %

Output expressed in mA and % of 4-20mA range.



PID Tuning

Boiler Pump VFDs



Used for tuning VFDs (variable frequency drives) that drive motors for feed pumps on a feed tank. VFDs variably increase or decrease the speed of the motor to maintain discharge pressure at boiler pressure plus differential pressure.

1. PID Functions / Reset

Proportional (%), Integral (rep/sec), Derivative (sec) as well as Sample Period (sec), Slew Time (sec), Deadband +/- (0 to 32000), CV Bias and CV Clamp +/- (-32000 to 32000) are all used for tuning the VFDs. These values vary by application and are default set by the factory. PID Function factory defaults can always be restored by pressing Reset.

2. Oscilloscope

Displays the target discharge pressure versus current discharge pressure over a brief period of time. Ideally the current discharge pressure would closely match the target pressure.

3. Boiler Pressure (psi)

The currently measured boiler operating pressure being reported from the steam header (sensor AI5-SHP) expressed in psi.

4. Differential Pressure (psi)

The differential pressure is added to the current boiler pressure to determine a target pressure. Default is 25 psi.

5. Target Pressure (psi)

The pump discharge pressure expressed in psi to be maintained by the VFDs; a result of the boiler pressure added to the differential pressure setting.

6. Live Pressure (psi)

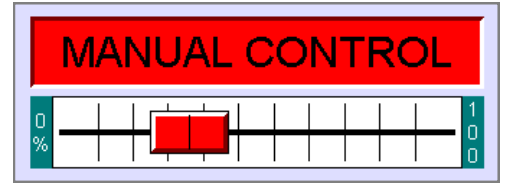
The currently measured pump discharge pressure expressed in psi.

PID Tuning

Boiler Pump VFDs (continued)

7. PID Control / Manual Control

Press to toggle between “PID Control” or “Manual Control” of the VFDs. PID Control lets the controller automatically control the speed of the VFDs. When Manual Control is chosen an adjustable slider appears. The user can drag the slider between 0% and 100% where 0% indicates the VFDs are at minimum speed and 100% is maximum speed.



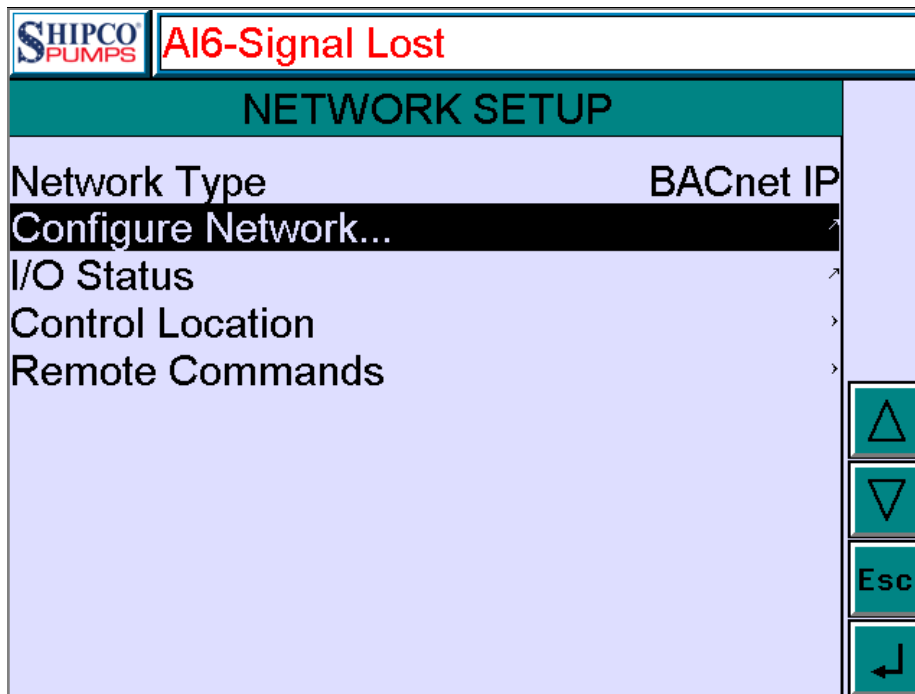
8. mA, % and Hz

Output expressed in mA and % of 4-20mA range. The speed of the VFDs given in hertz (Hz) is also displayed.

9. Pump indicator

To monitor boiler feed pump staging while adjusting PID.

Network Setup



Network Configuration Protocol (pp. 59-62)

Menu item varies based on configured network protocol. Possible items are: *BACnet IP*, *BACnet MSTP*, *Modbus Serial* and *Modbus TCP*. Each item refers to a different screen for possible configuration options. Protocol set by the factory.

I/O Status (p. 63)

Screen showing all analog and digital inputs and outputs for the controller and extended I/O.

Control Location & Remote Commands

Control Location and Remote Commands are a safety feature which allows an operator at the control panel to remove remote overrides by a building automation system (BMS).

Control Location (p. 64)

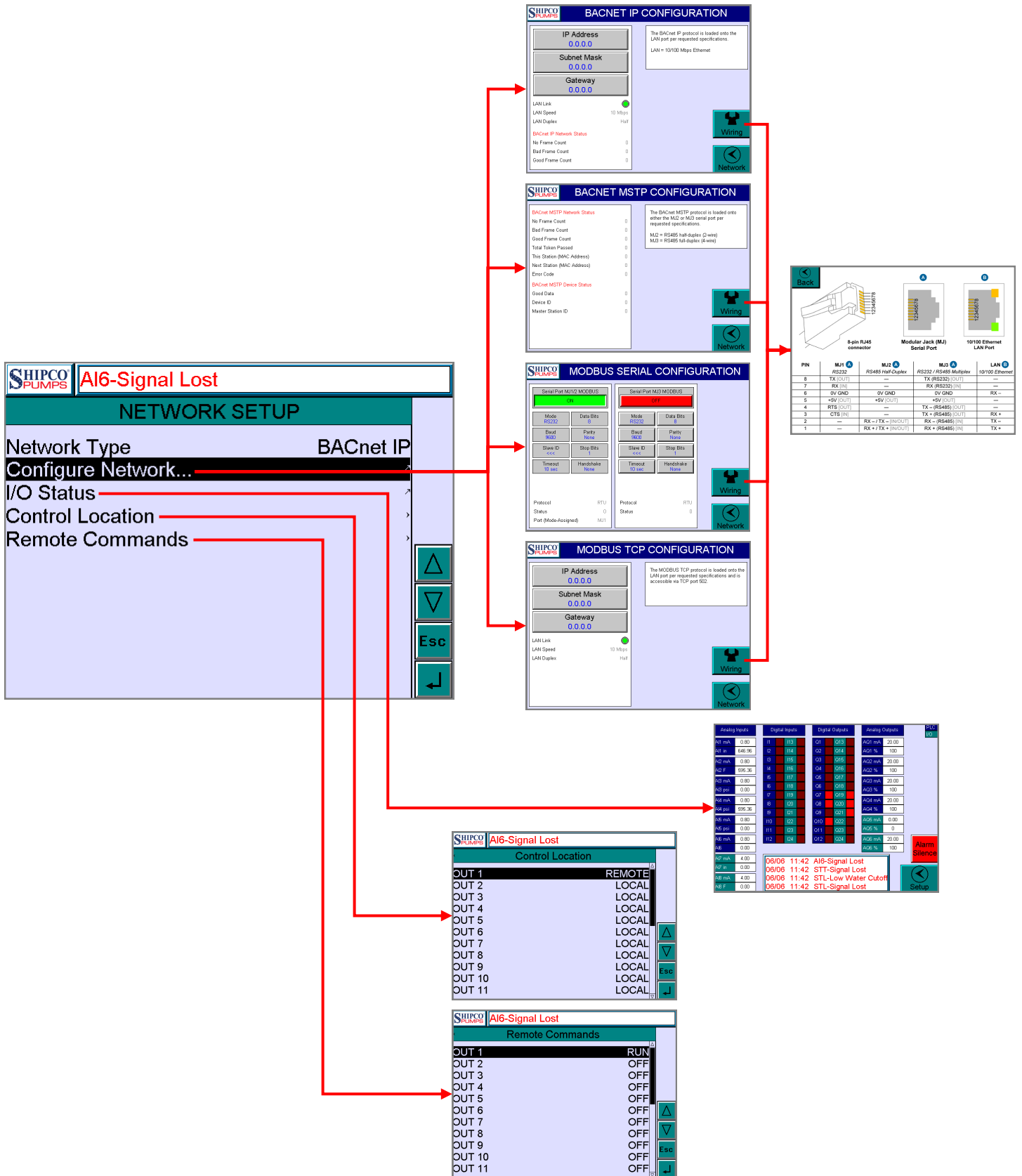
Changes the specified control output feature to be toggled LOCAL or REMOTE. Default LOCAL indicates the feature is handled by the controller. REMOTE indicates the feature should be overridden and command should be issued remotely which are toggled RUN or OFF in the Remote Commands menu.

Remote Commands (p. 65)

Allows the specified control output feature to be turned RUN or OFF when its Control Location is set to REMOTE.

Network Setup

Navigation



Network Setup

BACnet IP

SHIPCO PUMPS **BACNET IP CONFIGURATION**

IP Address
0.0.0.0

Subnet Mask
0.0.0.0

Gateway
0.0.0.0

LAN Link

LAN Speed 10 Mbps

LAN Duplex Half

BACnet IP Network Status

No Frame Count 0

Bad Frame Count 0

Good Frame Count 0

The BACnet IP protocol is loaded onto the LAN port per requested specifications.
LAN = 10/100 Mbps Ethernet

Wiring

Network

BACnet IP requires physical connection to the 10/100 Mbps Ethernet (LAN) port on the controller and communication occurs via UDP port 47808 (0xBAC0).

Ethernet Configuration

The controller must be manually assigned an individual IP, Subnet and Gateway address expressed in IPv4 dot-decimal notation. Consulting with local information technology (IT) or computer network personnel may be necessary to obtain this information.

Note: There are only a few configurable options for BACnet IP at this time. Unfortunately due to current limitation of the BACnet IP protocol implementation, the parameters listed below must be pre-programmed by the factory or adjusted via a program update per requested specifications.

Device ID BACnet Device Object Identifier; a network-wide unique number.

Network Setup

BACnet MSTP

SHIPCO PUMPS **BACNET MSTP CONFIGURATION**

BACnet MSTP Network Status

No Frame Count	0
Bad Frame Count	0
Good Frame Count	0
Total Token Passed	0
This Station (MAC Address)	0
Next Station (MAC Address)	0
Error Code	0

BACnet MSTP Device Status

Good Data	0
Device ID	0
Master Station ID	0

The BACnet MSTP protocol is loaded onto either the MJ2 or MJ3 serial port per requested specifications.

MJ2 = RS485 half-duplex (2-wire)
MJ3 = RS485 full-duplex (4-wire)

Wiring

Network

BACnet MSTP requires physical connection to the MJ1/2 or MJ3 modular RJ45 serial port on the controller and uses RS485 communication. Depending on the network environment RS485 cabling should be properly shielded to reduce interference from external electrical sources and use of grounding may or may not be necessary.

Serial Port Configuration

Note: There are no user configurable options for BACnet MSTP at this time. Unfortunately due to current limitation of the BACnet MSTP protocol implementation, the parameters listed below must be pre-programmed by the factory or adjusted via a program update per requested specifications.

Baud The baud rate or speed in bits per second. Baud rates are *19200*, *38400* (default), *57600* or *115200*.

Data Bits 8 bits

Parity Method of detecting errors in transmission. *None* (default), *Odd*, *Even*.

Stop Bits 1 bit

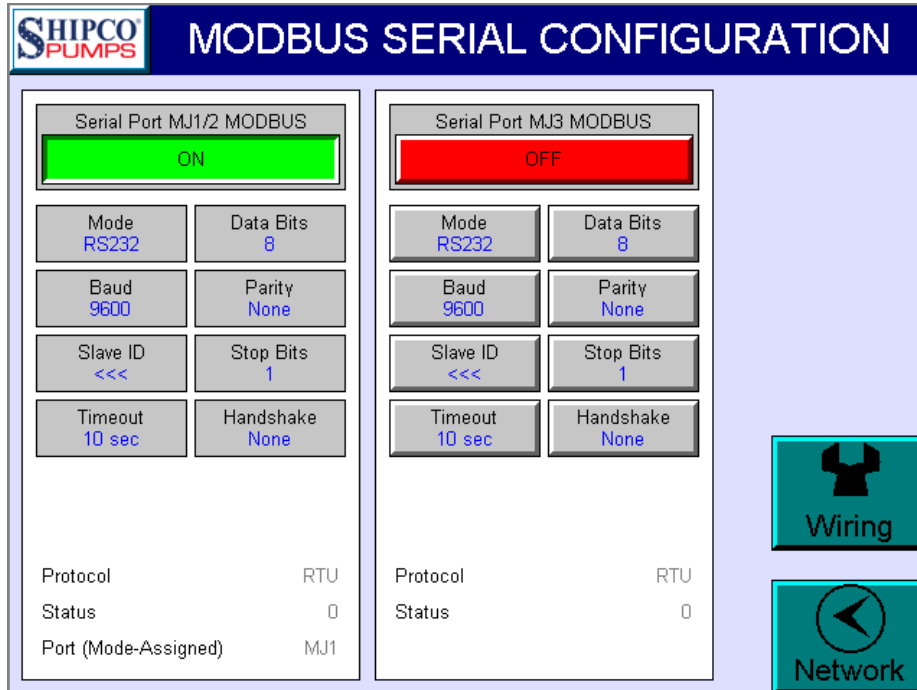
Handshake Serial flow control (if used). *None* (default), *XON-XOFF* (Software), *Hardware*, *MD Full* (Multi-drop full duplex), *MD Half* (Multi-drop half duplex).

MAC Address Used to identify devices on a single RS485 subnet; must be a number between 0 and 127.

Device ID BACnet Device Object Identifier; a network-wide unique number.

Network Setup

Modbus Serial (RTU/ASCII)



Serial Port MJ1/2 MODBUS		Serial Port MJ3 MODBUS	
ON		OFF	
Mode RS232	Data Bits 8	Mode RS232	Data Bits 8
Baud 9600	Parity None	Baud 9600	Parity None
Slave ID <<<	Stop Bits 1	Slave ID <<<	Stop Bits 1
Timeout 10 sec	Handshake None	Timeout 10 sec	Handshake None
Protocol	RTU	Protocol	RTU
Status	0	Status	0
Port (Mode-Assigned)	MJ1		

Modbus Serial (RTU/ASCII) requires physical connection to the MJ1/2 or MJ3 modular RJ45 serial port on the controller and uses RS232 or RS485 communication (Mode). Depending on the network environment RS485 cabling should be properly shielded to reduce interference from external electrical sources and use of grounding may or may not be necessary.

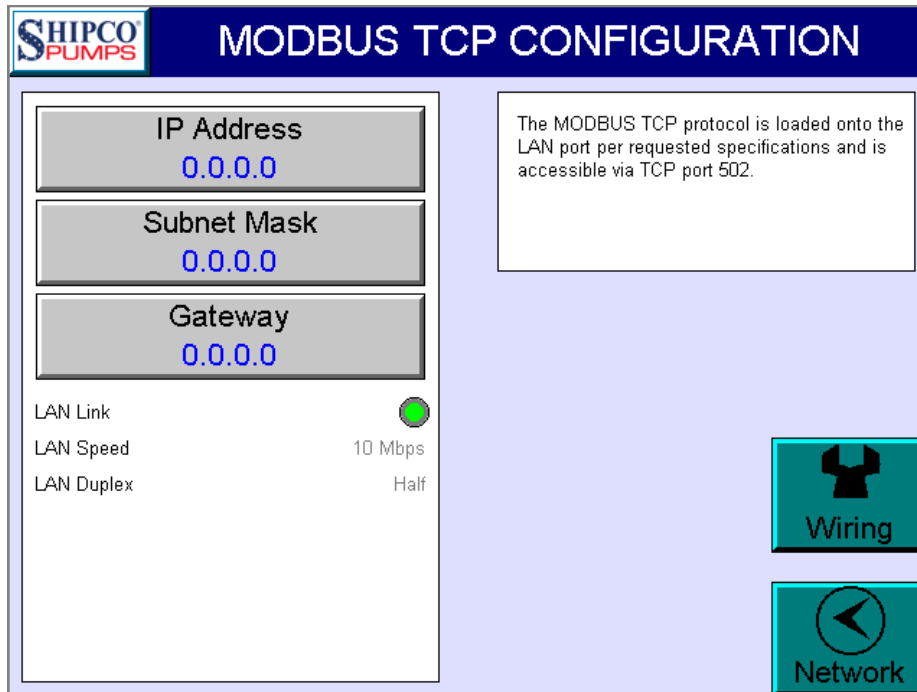
Serial Port Configuration

Pressing the ON/OFF button opens or closes the specified serial port. Setting to ON (green) opens the port and begins Modbus communication. Configuration options can be changed when the setting is OFF (red) and port is closed.

- Mode** Communication mode for the port; either *RS232* or *RS485*. Specific wiring must be done according to Mode setting.
- Baud** The baud rate or speed in bits per second. Baud rates are *300, 600, 1200, 2400, 4800, 9600* (default), *19200, 38400, 57600* or *115200*.
- Slave ID** A unique ID or address for the controller; must be a number between *1* and *247*.
- Timeout** Time in seconds the controller waits for a response; must be a number between *1* and *30*.
- Data Bits** Amount of data bits; either *8 bits* = RTU (default) or *7 bits* = ASCII. Changing this adjusts the protocol to RTU or ASCII automatically.
- Parity** Method of detecting errors in transmission. *None* (default), *Odd, Even, Mark, Space*.
- Stop Bits** Amount of stop bits; either *1 bit* (default) or *2 bits*.
- Handshake** Serial flow control (if used). *None* (default), *XON-XOFF* (Software), *Hardware, MD Full* (Multi-drop full duplex), *MD Half* (Multi-drop half duplex).

Network Setup

Modbus TCP



The screenshot shows the 'MODBUS TCP CONFIGURATION' screen from the SHIPCO PUMPS control interface. The screen is divided into several sections:

- IP Address:** 0.0.0.0
- Subnet Mask:** 0.0.0.0
- Gateway:** 0.0.0.0
- LAN Link:** Indicated by a green dot.
- LAN Speed:** 10 Mbps
- LAN Duplex:** Half
- Information Box:** The MODBUS TCP protocol is loaded onto the LAN port per requested specifications and is accessible via TCP port 502.
- Navigation Buttons:** 'Wiring' (with a plug icon) and 'Network' (with a back arrow icon).


Modbus TCP requires physical connection to the 10/100 Mbps Ethernet (LAN) port on the controller and communication occurs via TCP port 502.

Ethernet Configuration

The controller must be manually assigned an individual IP, Subnet and Gateway address expressed in IPv4 dot-decimal notation. Consulting with local information technology (IT) or computer network personnel may be necessary to obtain this information.

Network Setup

I/O Status

Analog Inputs		Digital Inputs		Digital Outputs		Analog Outputs		PLC I/O
AI1 mA	0.80	I1	I13	Q1	Q13	AQ1 mA	20.00	<div style="text-align: center;">Alarm Silence</div> <div style="text-align: center;">  Setup </div>
AI1 in	646.96	I2	I14	Q2	Q14	AQ1 %	100	
AI2 mA	0.80	I3	I15	Q3	Q15	AQ2 mA	20.00	
AI2 F	595.36	I4	I16	Q4	Q16	AQ2 %	100	
AI3 mA	0.80	I5	I17	Q5	Q17	AQ3 mA	20.00	
AI3 psi	0.00	I6	I18	Q6	Q18	AQ3 %	100	
AI4 mA	0.80	I7	I19	Q7	Q19	AQ4 mA	20.00	
AI4 psi	595.36	I8	I20	Q8	Q20	AQ4 %	100	
AI5 mA	0.80	I9	I21	Q9	Q21	AQ5 mA	0.00	
AI5 psi	0.00	I10	I22	Q10	Q22	AQ5 %	0	
AI6 mA	0.80	I11	I23	Q11	Q23	AQ6 mA	20.00	
AI6	0.00	I12	I24	Q12	Q24	AQ6 %	100	
AI7 mA	4.00	<div style="border: 1px solid black; padding: 5px;"> 06/06 11:42 AI6-Signal Lost 06/06 11:42 STT-Signal Lost 06/06 11:42 STL-Low Water Cutoff 06/06 11:42 STL-Signal Lost </div>						
AI7 in	0.00							
AI8 mA	4.00							
AI8 F	0.00							

I/O Status

Displays sensor and electrical contact status for analog and digital inputs and outputs. This screen is primarily used for diagnostic and/or troubleshooting.

Analog Inputs

Shows analog inputs AI1 to AI8 with 4-20 mA value and corresponding processed value. AI1 to AI6 are located on the controller; AI7 and AI8 are located on the extended I/O block.

Analog Outputs

Shows analog outputs AQ1 to AQ6 with 4-20 mA value and corresponding processed value. AQ1 to AQ4 are located on the controller; AQ5 and AQ6 are located on the extended I/O block.

Digital Inputs

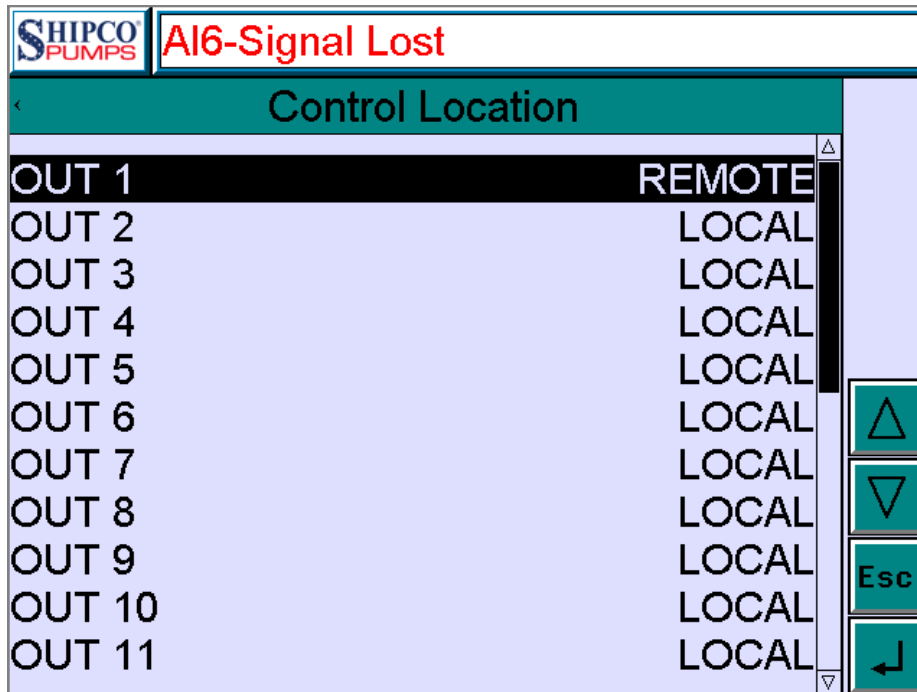
Shows digital inputs I1 to I24 with corresponding binary (ON/OFF) status indicator. I1 to I12 are located on the controller; I13 to I24 are located on the extended I/O block.

Digital Outputs

Shows digital inputs Q1 to Q24 with corresponding binary (ON/OFF) status indicator. Q1 to Q12 are located on the controller; Q13 to Q24 are located on the extended I/O block.

Network Setup

Control Location



Control Location

Changes the specified control output feature to be toggled LOCAL or REMOTE. Default LOCAL indicates the feature is handled by the controller. REMOTE indicates the feature should be overridden and command can be issued remotely via the Remote Commands menu or through communications registers.

RAW 0-32000 digitized sensor reading.

PROC Scaled sensor value. Controller works with decimal value $\times 100$ to do integer math and increase processing speed. To view properly this value needs divided by 100 after polling.

STATUS Live Boolean Value

CTRL 0 indicates controller has control.
1 indicates BMS system has control.

PWR 0 forces output off.
1 forces output on. If CTRL value is set to 0 this value is ignored and the controller has control.

Sample Output Pseudo-Logic (format applies to all digital outputs):

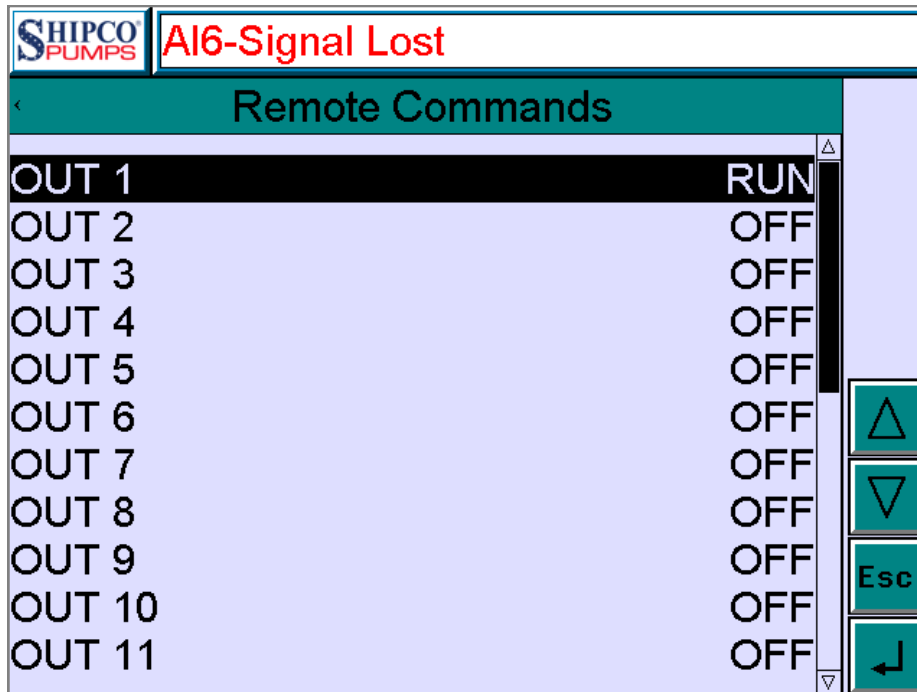
If (Controller Calls Output AND CTRL = 0) OR (PWR = 1 AND CTRL = 1) AND NOT Safety Override Then
Output = On AND STATUS = 1

Else

Output = Off AND STATUS = 0

Network Setup

Remote Commands



Remote Commands

Allows the specified control output feature to be toggled RUN or OFF when its corresponding Control Location is set to REMOTE. Toggling an output to RUN will override the controller and energize the specific output.

If the controller is connected to a BACnet or Modbus network, the commands listed on this screen allow the specified output feature to be RUN or OFF for manual remote override of said feature by changing the appropriate communication register (refer to Appendix "Communication Registers"). This screen is simply provided as a method to perform these actions via the controller if necessary.

OFF = 0

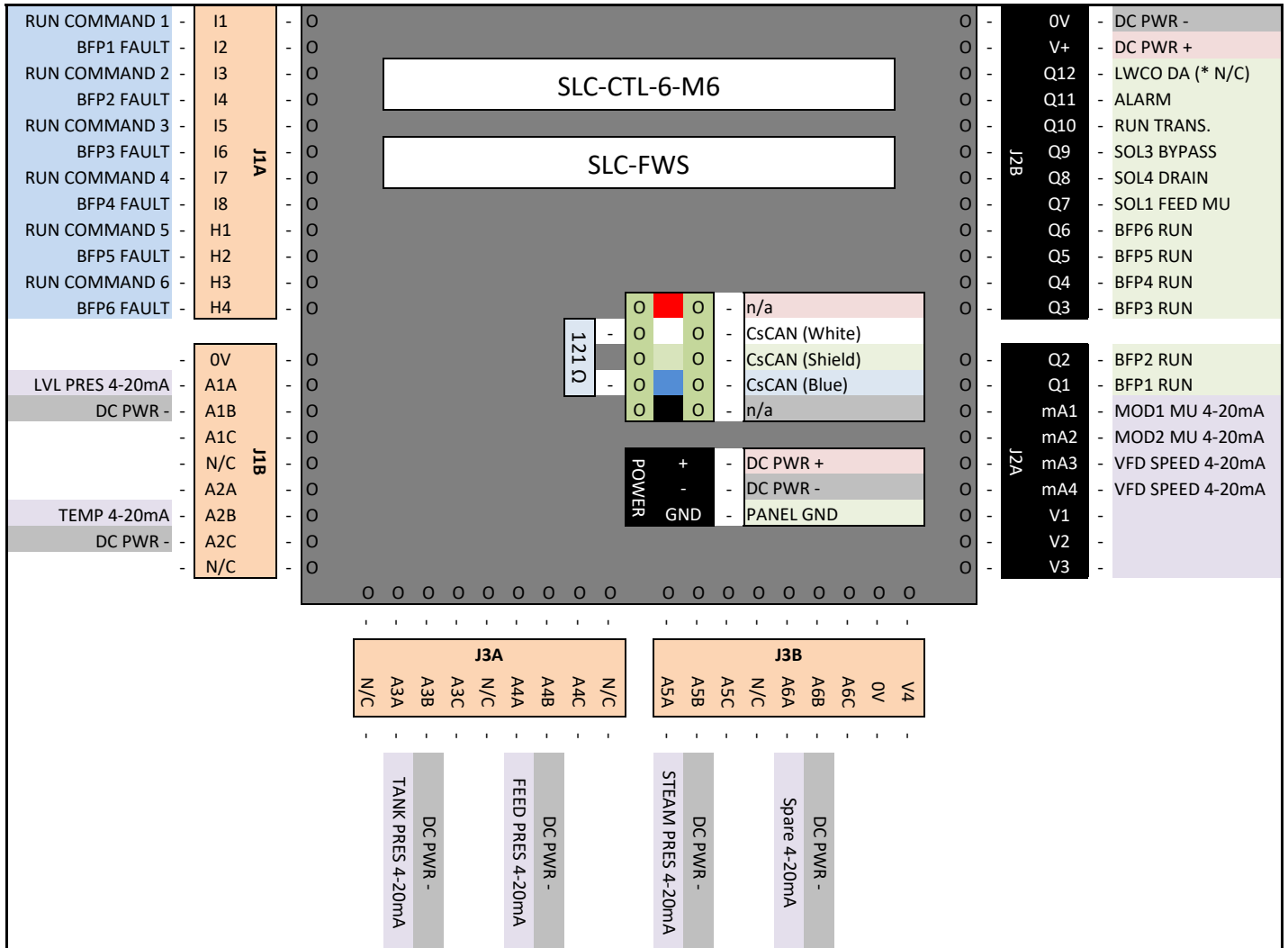
RUN = 1

For example, if a pump and motor is connected to energize via OUT1, a user must first set "OUT1" under Control Location to "REMOTE" thereby relinquishing control from the controller. To manually turn on said pump and motor remotely the user must set OUT1 to "RUN" on this screen (or "1" via register) and the motor turns on.

Appendix

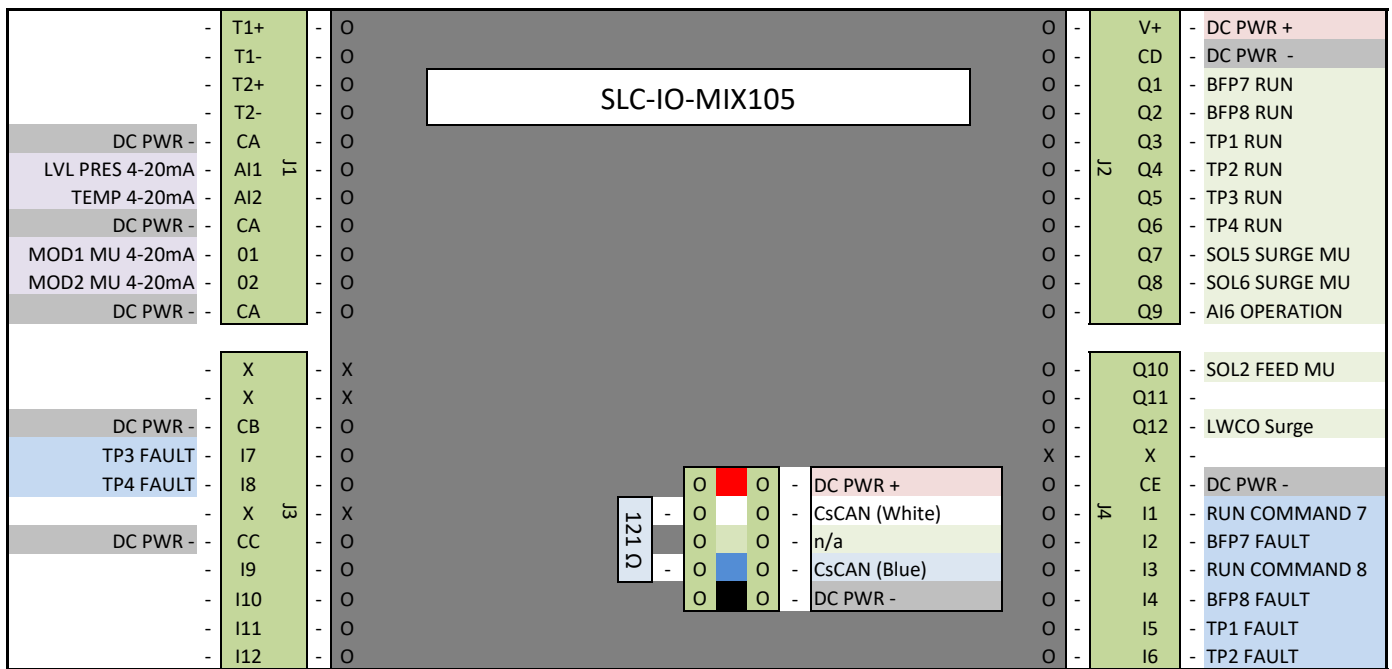
I/O Configuration

Controller (Boiler Feed / Deaerator Tank Panel)



I/O Configuration

Extended I/O Block (Surge Tank Panel)



Technical Data

Required Power (Steady State)

420mA @ 12VDC

230mA @ 24VDC

Inrush Current

25A for <1 ms @ 24VDC, DC Switched

Primary Power Range

10–30VDC

Real Time Clock

Battery Backed, Rechargeable Lithium Battery

Clock Accuracy

+/- 20 ppm maximum at 25°C (+/- 1 min/month)

Relative Humidity

5 to 95%, Non-Condensing

Operating Temperature

-10°C to +60°C, 0°C to 50°C for quoted T/C specs

Storage Temperature

-20°C to +60°C

Weight

4.375 lbs (1984.5g) (without I/O)

The SLC-FWS hardware used by Shipco® Pumps, Inc., which includes XL Series controllers and SmartBlock I/O module, is manufactured by Horner Automation Group. All technical specifications and images of hardware in this manual are used with permission.

Communication Registers (FWS version 3.13+)

#	Description	Group	Purpose	Type	Unit	Name	BAcnet	Modbus
1	Call for boiler feed pump 1	I01	Status	BOOL	1/0	%I1	BI 0	10001
2	Boiler feed pump 1 fault	I02	Status	BOOL	1/0	%I2	BI 1	10002
3	Call for boiler feed pump 2	I03	Status	BOOL	1/0	%I3	BI 2	10003
4	Boiler feed pump 2 fault	I04	Status	BOOL	1/0	%I4	BI 3	10004
5	Call for boiler feed pump 3	I05	Status	BOOL	1/0	%I5	BI 4	10005
6	Boiler feed pump 3 fault	I06	Status	BOOL	1/0	%I6	BI 5	10006
7	Call for boiler feed pump 4	I07	Status	BOOL	1/0	%I7	BI 6	10007
8	Boiler feed pump 4 fault	I08	Status	BOOL	1/0	%I8	BI 7	10008
9	Call for boiler feed pump 5	I09	Status	BOOL	1/0	%I9	BI 8	10009
10	Boiler feed pump 5 fault	I10	Status	BOOL	1/0	%I10	BI 9	10010
11	Call for boiler feed pump 6	I11	Status	BOOL	1/0	%I11	BI 10	10011
12	Boiler feed pump 6 fault	I12	Status	BOOL	1/0	%I12	BI 11	10012
13	Call for boiler feed pump 7	I13	Status	BOOL	1/0	%I13	BI 32	10033
14	Boiler feed pump 7 fault	I14	Status	BOOL	1/0	%I14	BI 33	10034
15	Call for boiler feed pump 8	I15	Status	BOOL	1/0	%I15	BI 34	10035
16	Boiler feed pump 8 fault	I16	Status	BOOL	1/0	%I16	BI 35	10036
17	Transfer pump 1 fault	I17	Status	BOOL	1/0	%I17	BI 36	10037
18	Transfer pump 2 fault	I18	Status	BOOL	1/0	%I18	BI 37	10038
19	Transfer pump 3 fault	I19	Status	BOOL	1/0	%I19	BI 38	10039
20	Transfer pump 4 fault	I20	Status	BOOL	1/0	%I20	BI 39	10040
21	Empty	I21	Status	BOOL	1/0	%I21	BI 40	10041
22	Empty	I22	Status	BOOL	1/0	%I22	BI 41	10042
23	Empty	I23	Status	BOOL	1/0	%I23	BI 42	10043
24	Empty	I24	Status	BOOL	1/0	%I24	BI 43	10044
25	Feed tank level input	A11	Raw	INT * 100	mA	%AI60	AI 59	30060
26	Feed tank level processed	A11	Proc	INT * 100	in	%AI61	AI 60	30061
27	Feed tank temperature input	A12	Raw	INT * 100	mA	%AI62	AI 61	30062
28	Feed tank temperature processed	A12	Proc	INT * 100	°F	%AI63	AI 62	30063
29	Feed tank pressure input	A13	Raw	INT * 100	mA	%AI64	AI 63	30064
30	Feed tank pressure processed	A13	Proc	INT * 100	psi	%AI65	AI 64	30065
31	Feed header pressure input	A14	Raw	INT * 100	mA	%AI66	AI 65	30066
32	Feed header pressure processed	A14	Proc	INT * 100	psi	%AI67	AI 66	30067
33	Steam header pressure input	A15	Raw	INT * 100	mA	%AI68	AI 67	30068
34	Steam header pressure processed	A15	Proc	INT * 100	psi	%AI69	AI 68	30069
35	Custom 4-20mA input	A16	Raw	INT * 100	mA	%AI70	AI 69	30070
36	Custom 4-20mA processed	A16	Proc	INT * 100	??	%AI71	AI 70	30071
37	Surge tank level input	A17	Raw	INT * 100	mA	%AI72	AI 71	30072
38	Surge tank level processed	A17	Proc	INT * 100	in	%AI73	AI 72	30073
39	Surge tank temperature input	A18	Raw	INT * 100	mA	%AI74	AI 73	30074
40	Surge tank temperature processed	A18	Proc	INT * 100	°F	%AI75	AI 74	30075
41	Output signal run B1	Q01	Status	BOOL	1/0	%Q1	BO 0	00001
42	Output signal run B1	Q01	Ctrl	BOOL	1/0	%M51	BV 50	03051
43	Output signal run B1	Q01	Pwr	BOOL	1/0	%M75	BV 74	03075
44	Output signal run B2	Q02	Status	BOOL	1/0	%Q2	BO 1	00002
45	Output signal run B2	Q02	Ctrl	BOOL	1/0	%M52	BV 51	03052
46	Output signal run B2	Q02	Pwr	BOOL	1/0	%M76	BV 75	03076
47	Output signal run B3	Q03	Status	BOOL	1/0	%Q3	BO 2	00003
48	Output signal run B3	Q03	Ctrl	BOOL	1/0	%M53	BV 52	03053
49	Output signal run B3	Q03	Pwr	BOOL	1/0	%M77	BV 76	03077
50	Output signal run B4	Q04	Status	BOOL	1/0	%Q4	BO 3	00004
51	Output signal run B4	Q04	Ctrl	BOOL	1/0	%M54	BV 53	03054
52	Output signal run B4	Q04	Pwr	BOOL	1/0	%M78	BV 77	03078
53	Output signal run B5	Q05	Status	BOOL	1/0	%Q5	BO 4	00005
54	Output signal run B5	Q05	Ctrl	BOOL	1/0	%M55	BV 54	03055
55	Output signal run B5	Q05	Pwr	BOOL	1/0	%M79	BV 78	03079
56	Output signal run B6	Q06	Status	BOOL	1/0	%Q6	BO 5	00006
57	Output signal run B6	Q06	Ctrl	BOOL	1/0	%M56	BV 55	03056
58	Output signal run B6	Q06	Pwr	BOOL	1/0	%M80	BV 79	03080

Communication Registers (FWS version 3.13+)

#	Description	Group	Purpose	Type	Unit	Name	BAcnet	Modbus
59	Feed Tank Sol1	Q07	Status	BOOL	1/0	%Q7	BO 6	00007
60	Feed Tank Sol1	Q07	Ctrl	BOOL	1/0	%M57	BV 56	03057
61	Feed Tank Sol1	Q07	Pwr	BOOL	1/0	%M81	BV 80	03081
62	Feed Tank Overflow	Q22	Status	BOOL	1/0	%Q8	BO 7	00008
63	Feed Tank Overflow	Q22	Ctrl	BOOL	1/0	%M58	BV 57	03058
64	Feed Tank Overflow	Q22	Pwr	BOOL	1/0	%M82	BV 81	03082
65	Bypass Sol3	Q09	Status	BOOL	1/0	%Q9	BO 8	00009
66	Bypass Sol3	Q09	Ctrl	BOOL	1/0	%M59	BV 58	03059
67	Bypass Sol3	Q09	Pwr	BOOL	1/0	%M83	BV 82	03083
68	Remote Transfer	Q10	Status	BOOL	1/0	%Q10	BO 9	00010
69	Remote Transfer	Q10	Ctrl	BOOL	1/0	%M60	BV 59	03060
70	Remote Transfer	Q10	Pwr	BOOL	1/0	%M84	BV 83	03084
71	Alarm Bell	Q11	Status	BOOL	1/0	%Q11	BO 10	00011
72	Alarm Bell	Q11	Ctrl	BOOL	1/0	%M61	BV 60	03061
73	Alarm Bell	Q11	Pwr	BOOL	1/0	%M85	BV 84	03085
74	Feed Pump Cut Off	Q12	Status	BOOL	1/0	%Q12	BO 11	00012
75	Feed Pump Cut Off	Q12	Ctrl	BOOL	1/0	%M62	BV 61	03062
76	Feed Pump Cut Off	Q12	Pwr	BOOL	1/0	%M86	BV 85	03086
77	Output signal run B7	Q13	Status	BOOL	1/0	%Q33	BO 32	00033
78	Output signal run B7	Q13	Ctrl	BOOL	1/0	%M63	BV 62	03063
79	Output signal run B7	Q13	Pwr	BOOL	1/0	%M87	BV 86	03087
80	Output signal run B8	Q14	Status	BOOL	1/0	%Q34	BO 33	00034
81	Output signal run B8	Q14	Ctrl	BOOL	1/0	%M64	BV 63	03064
82	Output signal run B8	Q14	Pwr	BOOL	1/0	%M88	BV 87	03088
83	Output signal run T1	Q15	Status	BOOL	1/0	%Q35	BO 34	00035
84	Output signal run T1	Q15	Ctrl	BOOL	1/0	%M65	BV 64	03065
85	Output signal run T1	Q15	Pwr	BOOL	1/0	%M89	BV 88	03089
86	Output signal run T2	Q16	Status	BOOL	1/0	%Q36	BO 35	00036
87	Output signal run T2	Q16	Ctrl	BOOL	1/0	%M66	BV 65	03066
88	Output signal run T2	Q16	Pwr	BOOL	1/0	%M90	BV 89	03090
89	Output signal run T3	Q17	Status	BOOL	1/0	%Q37	BO 36	00037
90	Output signal run T3	Q17	Ctrl	BOOL	1/0	%M67	BV 66	03067
91	Output signal run T3	Q17	Pwr	BOOL	1/0	%M91	BV 90	03091
92	Output signal run T4	Q18	Status	BOOL	1/0	%Q38	BO 37	00038
93	Output signal run T4	Q18	Ctrl	BOOL	1/0	%M68	BV 67	03068
94	Output signal run T4	Q18	Pwr	BOOL	1/0	%M92	BV 91	03092
95	Surge Tank Sol1	Q19	Status	BOOL	1/0	%Q39	BO 38	00039
96	Surge Tank Sol1	Q19	Ctrl	BOOL	1/0	%M69	BV 68	03069
97	Surge Tank Sol1	Q19	Pwr	BOOL	1/0	%M93	BV 92	03093
98	Surge Tank Sol2	Q20	Status	BOOL	1/0	%Q40	BO 39	00040
99	Surge Tank Sol2	Q20	Ctrl	BOOL	1/0	%M70	BV 69	03070
100	Surge Tank Sol2	Q20	Pwr	BOOL	1/0	%M94	BV 93	03094
101	Al6 Operation	Q21	Status	BOOL	1/0	%Q41	BO 40	00041
102	Al6 Operation	Q21	Ctrl	BOOL	1/0	%M71	BV 70	03071
103	Al6 Operation	Q21	Pwr	BOOL	1/0	%M95	BV 94	03095
104	Feed Tank Sol2	Q22	Status	BOOL	1/0	%Q42	BO 41	00042
105	Feed Tank Sol2	Q22	Ctrl	BOOL	1/0	%M72	BV 71	03072
106	Feed Tank Sol2	Q22	Pwr	BOOL	1/0	%M96	BV 95	03096
107	Empty	Q23	Status	BOOL	1/0	%Q43	BO 42	00043
108	Empty	Q23	Ctrl	BOOL	1/0	%M73	BV 72	03073
109	Empty	Q23	Pwr	BOOL	1/0	%M97	BV 96	03097
110	Transfer Pump Cut Off	Q24	Status	BOOL	1/0	%Q44	BO 43	00044
111	Transfer Pump Cut Off	Q24	Ctrl	BOOL	1/0	%M74	BV 73	03074
112	Transfer Pump Cut Off	Q24	Pwr	BOOL	1/0	%M98	BV 97	03098
113	Feed Mod Valve1	AQ1	Raw	INT * 100	mA	%AQ110	AO 109	40110
114	Feed Mod Valve1	AQ1	Proc	INT	%	%AQ111	AO 110	40111
115	Feed Mod Valve1	AQ1	Ctrl	BOOL	1/0	%M41	BV 40	03041
116	Feed Mod Valve1	AQ1	Pwr	INT	%	%AQ112	AO 111	40112

Communication Registers (FWS version 3.13+)

#	Description	Group	Purpose	Type	Unit	Name	BACnet	Modbus
117	Feed Mod Valve2	AQ2	Raw	INT * 100	mA	%AQ120	AO 119	40120
118	Feed Mod Valve2	AQ2	Proc	INT	%	%AQ121	AO 120	40121
119	Feed Mod Valve2	AQ2	Ctrl	BOOL	1/0	%M42	BV 41	03042
120	Feed Mod Valve2	AQ2	Pwr	INT	%	%AQ122	AO 121	40122
121	VFD Speed	AQ3	Raw	INT * 100	mA	%AQ130	AO 129	40130
122	VFD Speed	AQ3	Proc	INT	%	%AQ131	AO 130	40131
123	VFD Speed	AQ3	Ctrl	BOOL	1/0	%M43	BV 42	03043
124	VFD Speed	AQ3	Pwr	INT	%	%AQ132	AO 131	40132
125	VFD Retransmit	AQ4	Raw	INT * 100	mA	%AQ140	AO 139	40140
126	VFD Retransmit	AQ4	Proc	INT	%	%AQ141	AO 140	40141
127	VFD Retransmit	AQ4	Ctrl	BOOL	1/0	%M44	BV 43	03044
128	VFD Retransmit	AQ4	Pwr	INT	%	%AQ142	AO 141	40142
129	Surge Mod Valve 1	AQ5	Raw	INT * 100	mA	%AQ150	AO 149	40150
130	Surge Mod Valve 1	AQ5	Proc	INT	%	%AQ151	AO 150	40151
131	Surge Mod Valve 1	AQ5	Ctrl	BOOL	1/0	%M45	BV 44	03045
132	Surge Mod Valve 1	AQ5	Pwr	INT	%	%AQ152	AO 151	40152
133	Surge Mod Valve 2	AQ6	Raw	INT * 100	mA	%AQ160	AO 159	40160
134	Surge Mod Valve 2	AQ6	Proc	INT	%	%AQ161	AO 160	40161
135	Surge Mod Valve 2	AQ6	Ctrl	BOOL	1/0	%M46	BV 45	03046
136	Surge Mod Valve 2	AQ6	Pwr	INT	%	%AQ162	AO 161	40162
137	B-Fault B1	Alarm	Status	BOOL	1/0	%Q100	BO 99	00100
138	B-Fault B2	Alarm	Status	BOOL	1/0	%Q101	BO 100	00101
139	B-Fault B3	Alarm	Status	BOOL	1/0	%Q102	BO 101	00102
140	B-Fault B4	Alarm	Status	BOOL	1/0	%Q103	BO 102	00103
141	B-Fault B5	Alarm	Status	BOOL	1/0	%Q104	BO 103	00104
142	B-Fault B6	Alarm	Status	BOOL	1/0	%Q105	BO 104	00105
143	B-Fault B7	Alarm	Status	BOOL	1/0	%Q106	BO 105	00106
144	B-Fault B8	Alarm	Status	BOOL	1/0	%Q107	BO 106	00107
145	B-Maintenance Recommended B1	Alarm	Status	BOOL	1/0	%Q108	BO 107	00108
146	B-Maintenance Recommended B2	Alarm	Status	BOOL	1/0	%Q109	BO 108	00109
147	B-Maintenance Recommended B3	Alarm	Status	BOOL	1/0	%Q110	BO 109	00110
148	B-Maintenance Recommended B4	Alarm	Status	BOOL	1/0	%Q111	BO 110	00111
149	B-Maintenance Recommended B5	Alarm	Status	BOOL	1/0	%Q112	BO 111	00112
150	B-Maintenance Recommended B6	Alarm	Status	BOOL	1/0	%Q113	BO 112	00113
151	B-Maintenance Recommended B7	Alarm	Status	BOOL	1/0	%Q114	BO 113	00114
152	B-Maintenance Recommended B8	Alarm	Status	BOOL	1/0	%Q115	BO 114	00115
153	B-Energized B1	Alarm	Status	BOOL	1/0	%Q116	BO 115	00116
154	B-Energized B2	Alarm	Status	BOOL	1/0	%Q117	BO 116	00117
155	B-Energized B3	Alarm	Status	BOOL	1/0	%Q118	BO 117	00118
156	B-Energized B4	Alarm	Status	BOOL	1/0	%Q119	BO 118	00119
157	B-Energized B5	Alarm	Status	BOOL	1/0	%Q120	BO 119	00120
158	B-Energized B6	Alarm	Status	BOOL	1/0	%Q121	BO 120	00121
159	B-Energized B7	Alarm	Status	BOOL	1/0	%Q122	BO 121	00122
160	B-Energized B8	Alarm	Status	BOOL	1/0	%Q123	BO 122	00123
161	B-Run Command 1	Alarm	Status	BOOL	1/0	%Q124	BO 123	00124
162	B-Run Command 2	Alarm	Status	BOOL	1/0	%Q125	BO 124	00125
163	B-Run Command 3	Alarm	Status	BOOL	1/0	%Q126	BO 125	00126
164	B-Run Command 4	Alarm	Status	BOOL	1/0	%Q127	BO 126	00127
165	B-Run Command 5	Alarm	Status	BOOL	1/0	%Q128	BO 127	00128
166	B-Run Command 6	Alarm	Status	BOOL	1/0	%Q129	BO 128	00129
167	B-Run Command 7	Alarm	Status	BOOL	1/0	%Q130	BO 129	00130
168	B-Run Command 8	Alarm	Status	BOOL	1/0	%Q131	BO 130	00131
169	T-Fault T1	Alarm	Status	BOOL	1/0	%Q132	BO 131	00132
170	T-Fault T2	Alarm	Status	BOOL	1/0	%Q133	BO 132	00133
171	T-Fault T3	Alarm	Status	BOOL	1/0	%Q134	BO 133	00134
172	T-Fault T4	Alarm	Status	BOOL	1/0	%Q135	BO 134	00135
173	T-Maintenance Recommended T1	Alarm	Status	BOOL	1/0	%Q136	BO 135	00136
174	T-Maintenance Recommended T2	Alarm	Status	BOOL	1/0	%Q137	BO 136	00137

Communication Registers (FWS version 3.13+)

#	Description	Group	Purpose	Type	Unit	Name	BACnet	Modbus
175	T-Maintenance Recommended T3	Alarm	Status	BOOL	1/0	%Q138	BO 137	00138
176	T-Maintenance Recommended T4	Alarm	Status	BOOL	1/0	%Q139	BO 138	00139
177	T-Energized T1	Alarm	Status	BOOL	1/0	%Q140	BO 139	00140
178	T-Energized T2	Alarm	Status	BOOL	1/0	%Q141	BO 140	00141
179	T-Energized T3	Alarm	Status	BOOL	1/0	%Q142	BO 141	00142
180	T-Energized T4	Alarm	Status	BOOL	1/0	%Q143	BO 142	00143
181	FTL-Signal Lost	Alarm	Status	BOOL	1/0	%Q144	BO 143	00144
182	FTL-High High Water	Alarm	Status	BOOL	1/0	%Q145	BO 144	00145
183	FTL-High Water	Alarm	Status	BOOL	1/0	%Q146	BO 145	00146
184	FTL-Call For Transfer Pump	Alarm	Status	BOOL	1/0	%Q147	BO 146	00147
185	FTL-Low Water	Alarm	Status	BOOL	1/0	%Q148	BO 147	00148
186	FTL-Low Low Water	Alarm	Status	BOOL	1/0	%Q149	BO 148	00149
187	FTL-Low Water Cutoff	Alarm	Status	BOOL	1/0	%Q150	BO 149	00150
188	FTT-Signal Lost	Alarm	Status	BOOL	1/0	%Q151	BO 150	00151
189	FTT-High Alarm	Alarm	Status	BOOL	1/0	%Q152	BO 151	00152
190	FTT-Low Alarm	Alarm	Status	BOOL	1/0	%Q153	BO 152	00153
191	FTT-Pump Shutoff	Alarm	Status	BOOL	1/0	%Q154	BO 153	00154
192	FTP-Signal Lost	Alarm	Status	BOOL	1/0	%Q155	BO 154	00155
193	FTP-Exceeding ASME Code	Alarm	Status	BOOL	1/0	%Q156	BO 155	00156
194	FTP-Relief Valve Setting	Alarm	Status	BOOL	1/0	%Q157	BO 156	00157
195	FTP-Low Alarm	Alarm	Status	BOOL	1/0	%Q158	BO 157	00158
196	FHP-Signal Lost	Alarm	Status	BOOL	1/0	%Q159	BO 158	00159
197	FHP-High Alarm	Alarm	Status	BOOL	1/0	%Q160	BO 159	00160
198	FHP-Low Alarm	Alarm	Status	BOOL	1/0	%Q161	BO 160	00161
199	FHP-Standby Pump	Alarm	Status	BOOL	1/0	%Q162	BO 161	00162
200	SHP-Signal Lost	Alarm	Status	BOOL	1/0	%Q163	BO 162	00163
201	SHP-!Boiler Relief Valve!	Alarm	Status	BOOL	1/0	%Q164	BO 163	00164
202	STL-Signal Lost	Alarm	Status	BOOL	1/0	%Q165	BO 164	00165
203	STL-High High Water	Alarm	Status	BOOL	1/0	%Q166	BO 165	00166
204	STL-High Water	Alarm	Status	BOOL	1/0	%Q167	BO 166	00167
205	STL-Low Water	Alarm	Status	BOOL	1/0	%Q168	BO 167	00168
206	STL-Low Low Water	Alarm	Status	BOOL	1/0	%Q169	BO 168	00169
207	STL-Low Water Cutoff	Alarm	Status	BOOL	1/0	%Q170	BO 169	00170
208	STT-Signal Lost	Alarm	Status	BOOL	1/0	%Q171	BO 170	00171
209	STT-High Alarm	Alarm	Status	BOOL	1/0	%Q172	BO 171	00172
210	STT-Low Alarm	Alarm	Status	BOOL	1/0	%Q173	BO 172	00173
211	STT-Pump Shutoff	Alarm	Status	BOOL	1/0	%Q174	BO 173	00174
212	AI6-Signal Lost	Alarm	Status	BOOL	1/0	%Q175	BO 174	00175
213	AI6-High	Alarm	Status	BOOL	1/0	%Q176	BO 175	00176
214	AI6-Low	Alarm	Status	BOOL	1/0	%Q177	BO 176	00177
215	AI6-Operation	Alarm	Status	BOOL	1/0	%Q178	BO 177	00178
216	EMPTY	Alarm	Status	BOOL	1/0	%Q179	BO 178	00179
217	T-Run Command 1	Alarm	Status	BOOL	1/0	%Q180	BO 179	00180
218	T-Run Command 2	Alarm	Status	BOOL	1/0	%Q181	BO 180	00181
219	T-Run Command 3	Alarm	Status	BOOL	1/0	%Q182	BO 181	00182
220	T-Run Command 4	Alarm	Status	BOOL	1/0	%Q183	BO 182	00183

Note:

FWS version 3.13 contains an updated BACnet protocol specification which includes support for Binary objects and also detects far fewer points on the network for better performance which was not present in FWS 3.12 and earlier versions. Support for the following BACnet objects are provided with the corresponding instance number.

BI = Binary Input, BO = Binary Output, BV = Binary Value, AI = Analog Input, AO = Analog Output, AV = Analog Value

Communication Registers (FWS version 3.0–3.12)

#	Description	Group	Purpose	Type	Unit	BACnet	Modbus
1	Call for boiler feed pump 1	I01	Status	BOOL	1/0	AV 7000.1	30050.1
2	Boiler feed pump 1 fault	I02	Status	BOOL	1/0	AV 7000.2	30050.2
3	Call for boiler feed pump 2	I03	Status	BOOL	1/0	AV 7000.3	30050.3
4	Boiler feed pump 2 fault	I04	Status	BOOL	1/0	AV 7000.4	30050.4
5	Call for boiler feed pump 3	I05	Status	BOOL	1/0	AV 7000.5	30050.5
6	Boiler feed pump 3 fault	I06	Status	BOOL	1/0	AV 7000.6	30050.6
7	Call for boiler feed pump 4	I07	Status	BOOL	1/0	AV 7000.7	30050.7
8	Boiler feed pump 4 fault	I08	Status	BOOL	1/0	AV 7000.8	30050.8
9	Call for boiler feed pump 5	I09	Status	BOOL	1/0	AV 7000.9	30050.9
10	Boiler feed pump 5 fault	I10	Status	BOOL	1/0	AV 7000.10	30050.10
11	Call for boiler feed pump 6	I11	Status	BOOL	1/0	AV 7000.11	30050.11
12	Boiler feed pump 6 fault	I12	Status	BOOL	1/0	AV 7000.12	30050.12
13	Call for boiler feed pump 7	I13	Status	BOOL	1/0	AV 7000.13	30050.13
14	Boiler feed pump 7 fault	I14	Status	BOOL	1/0	AV 7000.14	30050.14
15	Call for boiler feed pump 8	I15	Status	BOOL	1/0	AV 7000.15	30050.15
16	Boiler feed pump 8 fault	I16	Status	BOOL	1/0	AV 7000.16	30050.16
17	Transfer pump 1 fault	I17	Status	BOOL	1/0	AV 7001.1	30051.1
18	Transfer pump 2 fault	I18	Status	BOOL	1/0	AV 7001.2	30051.2
19	Transfer pump 3 fault	I19	Status	BOOL	1/0	AV 7001.3	30051.3
20	Transfer pump 4 fault	I20	Status	BOOL	1/0	AV 7001.4	30051.4
21	Empty	I21	Status	BOOL	1/0	AV 7001.5	30051.5
22	Empty	I22	Status	BOOL	1/0	AV 7001.6	30051.6
23	Empty	I23	Status	BOOL	1/0	AV 7001.7	30051.7
24	Empty	I24	Status	BOOL	1/0	AV 7001.8	30051.8
25	Feed tank level input	A11	Raw	INT * 100	mA	AV 7010	30060
26	Feed tank level processed	A11	Proc	INT * 100	in	AV 7013	30061
27	Feed tank temperature input	A12	Raw	INT * 100	mA	AV 7020	30062
28	Feed tank temperature processed	A12	Proc	INT * 100	°F	AV 7023	30063
29	Feed tank pressure input	A13	Raw	INT * 100	mA	AV 7030	30064
30	Feed tank pressure processed	A13	Proc	INT * 100	psi	AV 7033	30065
31	Feed header pressure input	A14	Raw	INT * 100	mA	AV 7040	30066
32	Feed header pressure processed	A14	Proc	INT * 100	psi	AV 7043	30067
33	Steam header pressure input	A15	Raw	INT * 100	mA	AV 7050	30068
34	Steam header pressure processed	A15	Proc	INT * 100	psi	AV 7053	30069
35	Custom 4-20mA input	A16	Raw	INT * 100	mA	AV 7060	30070
36	Custom 4-20mA processed	A16	Proc	INT * 100	??	AV 7063	30071
37	Surge tank level input	A17	Raw	INT * 100	mA	AV 7070	30072
38	Surge tank level processed	A17	Proc	INT * 100	in	AV 7073	30073
39	Surge tank temperature input	A18	Raw	INT * 100	mA	AV 7080	30074
40	Surge tank temperature processed	A18	Proc	INT * 100	°F	AV 7083	30075
41	Output signal run B1	Q01	Status	BOOL	1/0	AV 9704.1	40054.1
42	Output signal run B1	Q01	Ctrl	BOOL	1/0	AV 9700.1	40050.1
43	Output signal run B1	Q01	Pwr	BOOL	1/0	AV 9702.1	40052.1
44	Output signal run B2	Q02	Status	BOOL	1/0	AV 9704.2	40054.2
45	Output signal run B2	Q02	Ctrl	BOOL	1/0	AV 9700.2	40050.2
46	Output signal run B2	Q02	Pwr	BOOL	1/0	AV 9702.2	40052.2
47	Output signal run B3	Q03	Status	BOOL	1/0	AV 9704.3	40054.3
48	Output signal run B3	Q03	Ctrl	BOOL	1/0	AV 9700.3	40050.3
49	Output signal run B3	Q03	Pwr	BOOL	1/0	AV 9702.3	40052.3
50	Output signal run B4	Q04	Status	BOOL	1/0	AV 9704.4	40054.4
51	Output signal run B4	Q04	Ctrl	BOOL	1/0	AV 9700.4	40050.4
52	Output signal run B4	Q04	Pwr	BOOL	1/0	AV 9702.4	40052.4
53	Output signal run B5	Q05	Status	BOOL	1/0	AV 9704.5	40054.5
54	Output signal run B5	Q05	Ctrl	BOOL	1/0	AV 9700.5	40050.5
55	Output signal run B5	Q05	Pwr	BOOL	1/0	AV 9702.5	40052.5
56	Output signal run B6	Q06	Status	BOOL	1/0	AV 9704.6	40054.6
57	Output signal run B6	Q06	Ctrl	BOOL	1/0	AV 9700.6	40050.6
58	Output signal run B6	Q06	Pwr	BOOL	1/0	AV 9702.6	40052.6

Communication Registers (FWS version 3.0–3.12)

#	Description	Group	Purpose	Type	Unit	BACnet	Modbus
59	Feed Tank Sol1	Q07	Status	BOOL	1/0	AV 9704.7	40054.7
60	Feed Tank Sol1	Q07	Ctrl	BOOL	1/0	AV 9700.7	40050.7
61	Feed Tank Sol1	Q07	Pwr	BOOL	1/0	AV 9702.7	40052.7
62	Feed Tank Overflow	Q22	Status	BOOL	1/0	AV 9704.8	40054.8
63	Feed Tank Overflow	Q22	Ctrl	BOOL	1/0	AV 9700.8	40050.8
64	Feed Tank Overflow	Q22	Pwr	BOOL	1/0	AV 9702.8	40052.8
65	Bypass Sol3	Q09	Status	BOOL	1/0	AV 9704.9	40054.9
66	Bypass Sol3	Q09	Ctrl	BOOL	1/0	AV 9700.9	40050.9
67	Bypass Sol3	Q09	Pwr	BOOL	1/0	AV 9702.9	40052.9
68	Remote Transfer	Q10	Status	BOOL	1/0	AV 9704.10	40054.10
69	Remote Transfer	Q10	Ctrl	BOOL	1/0	AV 9700.10	40050.10
70	Remote Transfer	Q10	Pwr	BOOL	1/0	AV 9702.10	40052.10
71	Alarm Bell	Q11	Status	BOOL	1/0	AV 9704.11	40054.11
72	Alarm Bell	Q11	Ctrl	BOOL	1/0	AV 9700.11	40050.11
73	Alarm Bell	Q11	Pwr	BOOL	1/0	AV 9702.11	40052.11
74	Feed Pump Cut Off	Q12	Status	BOOL	1/0	AV 9704.12	40054.12
75	Feed Pump Cut Off	Q12	Ctrl	BOOL	1/0	AV 9700.12	40050.12
76	Feed Pump Cut Off	Q12	Pwr	BOOL	1/0	AV 9702.12	40052.12
77	Output signal run B7	Q13	Status	BOOL	1/0	AV 9704.13	40054.13
78	Output signal run B7	Q13	Ctrl	BOOL	1/0	AV 9700.13	40050.13
79	Output signal run B7	Q13	Pwr	BOOL	1/0	AV 9702.13	40052.13
80	Output signal run B8	Q14	Status	BOOL	1/0	AV 9704.14	40054.14
81	Output signal run B8	Q14	Ctrl	BOOL	1/0	AV 9700.14	40050.14
82	Output signal run B8	Q14	Pwr	BOOL	1/0	AV 9702.14	40052.14
83	Output signal run T1	Q15	Status	BOOL	1/0	AV 9704.15	40054.15
84	Output signal run T1	Q15	Ctrl	BOOL	1/0	AV 9700.15	40050.15
85	Output signal run T1	Q15	Pwr	BOOL	1/0	AV 9702.15	40052.15
86	Output signal run T2	Q16	Status	BOOL	1/0	AV 9704.16	40054.16
87	Output signal run T2	Q16	Ctrl	BOOL	1/0	AV 9700.16	40050.16
88	Output signal run T2	Q16	Pwr	BOOL	1/0	AV 9702.16	40052.16
89	Output signal run T3	Q17	Status	BOOL	1/0	AV 9705.1	40055.1
90	Output signal run T3	Q17	Ctrl	BOOL	1/0	AV 9701.1	40051.1
91	Output signal run T3	Q17	Pwr	BOOL	1/0	AV 9703.1	40053.1
92	Output signal run T4	Q18	Status	BOOL	1/0	AV 9705.2	40055.2
93	Output signal run T4	Q18	Ctrl	BOOL	1/0	AV 9701.2	40051.2
94	Output signal run T4	Q18	Pwr	BOOL	1/0	AV 9703.2	40053.2
95	Surge Tank Sol1	Q19	Status	BOOL	1/0	AV 9705.3	40055.3
96	Surge Tank Sol1	Q19	Ctrl	BOOL	1/0	AV 9701.3	40051.3
97	Surge Tank Sol1	Q19	Pwr	BOOL	1/0	AV 9703.3	40053.3
98	Surge Tank Sol2	Q20	Status	BOOL	1/0	AV 9705.4	40055.4
99	Surge Tank Sol2	Q20	Ctrl	BOOL	1/0	AV 9701.4	40051.4
100	Surge Tank Sol2	Q20	Pwr	BOOL	1/0	AV 9703.4	40053.4
101	Al6 Operation	Q21	Status	BOOL	1/0	AV 9705.5	40055.5
102	Al6 Operation	Q21	Ctrl	BOOL	1/0	AV 9701.5	40051.5
103	Al6 Operation	Q21	Pwr	BOOL	1/0	AV 9703.5	40053.5
104	Feed Tank Sol2	Q22	Status	BOOL	1/0	AV 9705.6	40055.6
105	Feed Tank Sol2	Q22	Ctrl	BOOL	1/0	AV 9701.6	40051.6
106	Feed Tank Sol2	Q22	Pwr	BOOL	1/0	AV 9703.6	40053.6
107	Empty	Q23	Status	BOOL	1/0	AV 9705.7	40055.7
108	Empty	Q23	Ctrl	BOOL	1/0	AV 9701.7	40051.7
109	Empty	Q23	Pwr	BOOL	1/0	AV 9703.7	40053.7
110	Empty	Q24	Status	BOOL	1/0	AV 9705.8	40055.8
111	Empty	Q24	Ctrl	BOOL	1/0	AV 9701.8	40051.8
112	Empty	Q24	Pwr	BOOL	1/0	AV 9703.8	40053.8
113	Feed Mod Valve1	AQ1	Raw	INT * 100	mA	AV 1033	40110
114	Feed Mod Valve1	AQ1	Proc	INT * 100	%	AV 1034	40111
115	Feed Mod Valve1	AQ1	Ctrl	BOOL	1/0	AV 1000.5	40100.1
116	Feed Mod Valve1	AQ1	Pwr	INT * 100	%	AV 1150	40112

Communication Registers (FWS version 3.0–3.12)

#	Description	Group	Purpose	Type	Unit	BACnet	Modbus
117	Feed Mod Valve2	AQ2	Raw	INT * 100	mA	AV 1043	40120
118	Feed Mod Valve2	AQ2	Proc	INT * 100	%	AV 1044	40121
119	Feed Mod Valve2	AQ2	Ctrl	BOOL	1/0	AV 1000.6	40100.2
120	Feed Mod Valve2	AQ2	Pwr	INT * 100	%	AV 1250	40122
121	VFD Speed	AQ3	Raw	INT * 100	mA	AV 1054	40130
122	VFD Speed	AQ3	Proc	INT * 100	%	AV 1055	40131
123	VFD Speed	AQ3	Ctrl	BOOL	1/0	AV 1000.12	40100.3
124	VFD Speed	AQ3	Pwr	INT * 100	%	AV 1350	40132
125	VFD Retransmit	AQ4	Raw	INT * 100	mA	AV 1069	40140
126	VFD Retransmit	AQ4	Proc	INT * 100	%	AV 1070	40141
127	VFD Retransmit	AQ4	Ctrl	BOOL	1/0	AV 1000.9	40100.4
128	VFD Retransmit	AQ4	Pwr	INT * 100	%	AV 1360	40142
129	Surge Mod Valve 1	AQ5	Raw	INT * 100	mA	AV 1073	40150
130	Surge Mod Valve 1	AQ5	Proc	INT * 100	%	AV 1074	40151
131	Surge Mod Valve 1	AQ5	Ctrl	BOOL	1/0	AV 1000.7	40100.5
132	Surge Mod Valve 1	AQ5	Pwr	INT * 100	%	AV 1450	40152
133	Surge Mod Valve 2	AQ6	Raw	INT * 100	mA	AV 1083	40160
134	Surge Mod Valve 2	AQ6	Proc	INT * 100	%	AV 1084	40161
135	Surge Mod Valve 2	AQ6	Ctrl	BOOL	1/0	AV 1000.8	40100.6
136	Surge Mod Valve 2	AQ6	Pwr	INT * 100	%	AV 1550	40162
137	B-Fault B1	Alarm	Status	BOOL	1/0	AV 7900.1	00500
138	B-Fault B2	Alarm	Status	BOOL	1/0	AV 7900.2	00501
139	B-Fault B3	Alarm	Status	BOOL	1/0	AV 7900.3	00502
140	B-Fault B4	Alarm	Status	BOOL	1/0	AV 7900.4	00503
141	B-Fault B5	Alarm	Status	BOOL	1/0	AV 7900.5	00504
142	B-Fault B6	Alarm	Status	BOOL	1/0	AV 7900.6	00505
143	B-Fault B7	Alarm	Status	BOOL	1/0	AV 7900.7	00506
144	B-Fault B8	Alarm	Status	BOOL	1/0	AV 7900.8	00507
145	B-Maintenance Recommended B1	Alarm	Status	BOOL	1/0	AV 7900.9	00508
146	B-Maintenance Recommended B2	Alarm	Status	BOOL	1/0	AV 7900.10	00509
147	B-Maintenance Recommended B3	Alarm	Status	BOOL	1/0	AV 7900.11	00510
148	B-Maintenance Recommended B4	Alarm	Status	BOOL	1/0	AV 7900.12	00511
149	B-Maintenance Recommended B5	Alarm	Status	BOOL	1/0	AV 7900.13	00512
150	B-Maintenance Recommended B6	Alarm	Status	BOOL	1/0	AV 7900.14	00513
151	B-Maintenance Recommended B7	Alarm	Status	BOOL	1/0	AV 7900.15	00514
152	B-Maintenance Recommended B8	Alarm	Status	BOOL	1/0	AV 7900.16	00515
153	B-Energized B1	Alarm	Status	BOOL	1/0	AV 7901.1	00516
154	B-Energized B2	Alarm	Status	BOOL	1/0	AV 7901.2	00517
155	B-Energized B3	Alarm	Status	BOOL	1/0	AV 7901.3	00518
156	B-Energized B4	Alarm	Status	BOOL	1/0	AV 7901.4	00519
157	B-Energized B5	Alarm	Status	BOOL	1/0	AV 7901.5	00520
158	B-Energized B6	Alarm	Status	BOOL	1/0	AV 7901.6	00521
159	B-Energized B7	Alarm	Status	BOOL	1/0	AV 7901.7	00522
160	B-Energized B8	Alarm	Status	BOOL	1/0	AV 7901.8	00523
161	B-Run Command 1	Alarm	Status	BOOL	1/0	AV 7901.9	00524
162	B-Run Command 2	Alarm	Status	BOOL	1/0	AV 7901.10	00525
163	B-Run Command 3	Alarm	Status	BOOL	1/0	AV 7901.11	00526
164	B-Run Command 4	Alarm	Status	BOOL	1/0	AV 7901.12	00527
165	B-Run Command 5	Alarm	Status	BOOL	1/0	AV 7901.13	00528
166	B-Run Command 6	Alarm	Status	BOOL	1/0	AV 7901.14	00529
167	B-Run Command 7	Alarm	Status	BOOL	1/0	AV 7901.15	00530
168	B-Run Command 8	Alarm	Status	BOOL	1/0	AV 7901.16	00531
169	T-Fault T1	Alarm	Status	BOOL	1/0	AV 7902.1	00532
170	T-Fault T2	Alarm	Status	BOOL	1/0	AV 7902.2	00533
171	T-Fault T3	Alarm	Status	BOOL	1/0	AV 7902.3	00534
172	T-Fault T4	Alarm	Status	BOOL	1/0	AV 7902.4	00535
173	T-Maintenance Recommended T1	Alarm	Status	BOOL	1/0	AV 7902.5	00536
174	T-Maintenance Recommended T2	Alarm	Status	BOOL	1/0	AV 7902.6	00537
175	T-Maintenance Recommended T3	Alarm	Status	BOOL	1/0	AV 7902.7	00538
176	T-Maintenance Recommended T4	Alarm	Status	BOOL	1/0	AV 7902.8	00539

Communication Registers (FWS version 3.0–3.12)

#	Description	Group	Purpose	Type	Unit	BACnet	Modbus
177	T-Energized T1	Alarm	Status	BOOL	1/0	AV 7902.9	00540
178	T-Energized T2	Alarm	Status	BOOL	1/0	AV 7902.10	00541
179	T-Energized T3	Alarm	Status	BOOL	1/0	AV 7902.11	00542
180	T-Energized T4	Alarm	Status	BOOL	1/0	AV 7902.12	00543
181	FTL-Signal Lost	Alarm	Status	BOOL	1/0	AV 7902.13	00544
182	FTL-High High Water	Alarm	Status	BOOL	1/0	AV 7902.14	00545
183	FTL-High Water	Alarm	Status	BOOL	1/0	AV 7902.15	00546
184	FTL-Call For Transfer Pump	Alarm	Status	BOOL	1/0	AV 7902.16	00547
185	FTL-Low Water	Alarm	Status	BOOL	1/0	AV 7903.1	00548
186	FTL-Low Low Water	Alarm	Status	BOOL	1/0	AV 7903.2	00549
187	FTL-Low Water Cutoff	Alarm	Status	BOOL	1/0	AV 7903.3	00550
188	FTT-Signal Lost	Alarm	Status	BOOL	1/0	AV 7903.4	00551
189	FTT-High Alarm	Alarm	Status	BOOL	1/0	AV 7903.5	00552
190	FTT-Low Alarm	Alarm	Status	BOOL	1/0	AV 7903.6	00553
191	FTT-Pump Shutoff	Alarm	Status	BOOL	1/0	AV 7903.7	00554
192	FTP-Signal Lost	Alarm	Status	BOOL	1/0	AV 7903.8	00555
193	FTP-Exceeding ASME Code	Alarm	Status	BOOL	1/0	AV 7903.9	00556
194	FTP-Relief Valve Setting	Alarm	Status	BOOL	1/0	AV 7903.10	00557
195	FTP-Low Alarm	Alarm	Status	BOOL	1/0	AV 7903.11	00558
196	FHP-Signal Lost	Alarm	Status	BOOL	1/0	AV 7903.12	00559
197	FHP-High Alarm	Alarm	Status	BOOL	1/0	AV 7903.13	00560
198	FHP-Low Alarm	Alarm	Status	BOOL	1/0	AV 7903.14	00561
199	FHP-Standby Pump	Alarm	Status	BOOL	1/0	AV 7903.15	00562
200	SHP-Signal Lost	Alarm	Status	BOOL	1/0	AV 7903.16	00563
201	SHP-!Boiler Relief Valve!	Alarm	Status	BOOL	1/0	AV 7904.1	00564
202	STL-Signal Lost	Alarm	Status	BOOL	1/0	AV 7904.2	00565
203	STL-High High Water	Alarm	Status	BOOL	1/0	AV 7904.3	00566
204	STL-High Water	Alarm	Status	BOOL	1/0	AV 7904.4	00567
205	STL-Low Water	Alarm	Status	BOOL	1/0	AV 7904.5	00568
206	STL-Low Low Water	Alarm	Status	BOOL	1/0	AV 7904.6	00569
207	STL-Low Water Cutoff	Alarm	Status	BOOL	1/0	AV 7904.7	00570
208	STT-Signal Lost	Alarm	Status	BOOL	1/0	AV 7904.8	00571
209	STT-High Alarm	Alarm	Status	BOOL	1/0	AV 7904.9	00572
210	STT-Low Alarm	Alarm	Status	BOOL	1/0	AV 7904.10	00573
211	STT-Pump Shutoff	Alarm	Status	BOOL	1/0	AV 7904.11	00574
212	Al6-Signal Lost	Alarm	Status	BOOL	1/0	AV 7904.12	00575
213	Al6-High	Alarm	Status	BOOL	1/0	AV 7904.13	00576
214	Al6-Low	Alarm	Status	BOOL	1/0	AV 7904.14	00577
215	Al6-Operation	Alarm	Status	BOOL	1/0	AV 7904.15	00578
216	EMPTY	Alarm	Status	BOOL	1/0	AV 7904.16	00579
217	T-Run Command 1	Alarm	Status	BOOL	1/0	AV 7905.1	00580
218	T-Run Command 2	Alarm	Status	BOOL	1/0	AV 7905.2	00581
219	T-Run Command 3	Alarm	Status	BOOL	1/0	AV 7905.3	00582
220	T-Run Command 4	Alarm	Status	BOOL	1/0	AV 7905.4	00583

Note:

Due to a software limitation in FWS versions 3.0–3.12 the BACnet protocol specification only supports the 16-bit Analog Value object (displays as %R where %R1 = AV 1, %R2 = AV 2, etc.) and loads an exhaustive amount of points (~50000). For BACnet or Modbus registers containing a decimal value, the decimal indicates the corresponding bit number for the 16-bit binary value.

- BACnet AV 7000.3 = Analog Value 7000, bit 3
- Modbus 40100.5 = Function 3 - Read Holding Register 40100, bit 5

Example: Feed tank level processed (#26) (in inches)

AV 7013 or %R7013 reads "1926" (INT * 100) so divided by 100 = 19.26 inches

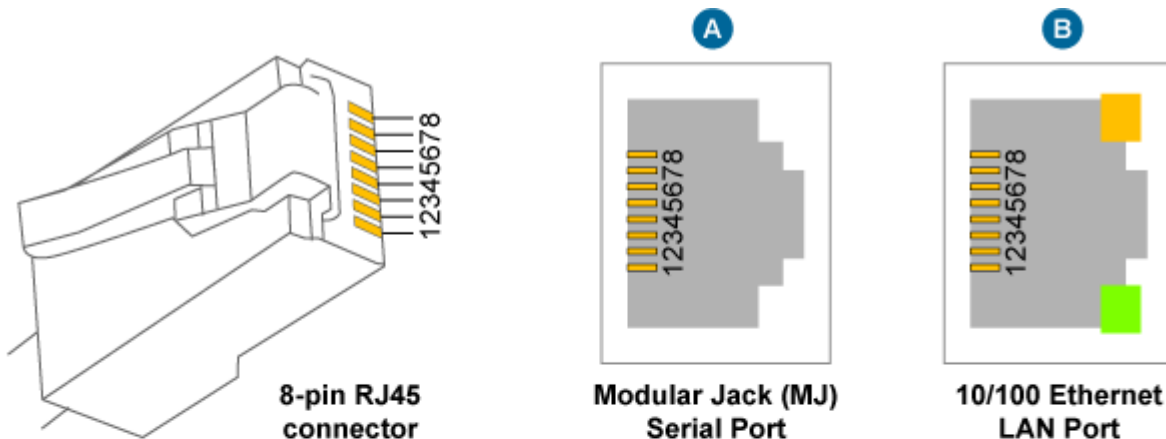
Example: Reading bits

In some cases the value may be read in Decimal format but must be evaluated in Binary format. AV 9704 or %R9704 reads "2052" in Decimal or "0000100000000100" in Binary where bits 3 and 12 are both 1.

Output signal run B3 (#41) = AV 9704.3 (refers to Analog Value 9704, bit 3) is engaged.

Feed Pump Cut Off (#74) = AV 9704.12 (refers to Analog Value 9704, bit 12) is engaged.

Communication Ports: Wiring and Pin-out



PIN	MJ1 A RS232	MJ2 A RS485 (2-wire)	MJ3 A RS232 or RS485 (4-wire)	LAN B 10/100 Ethernet
8	TX [OUT]	—	TX (RS232) [OUT]	—
7	RX [IN]	—	RX (RS232) [IN]	—
6	0V GND	0V GND	0V GND	RX -
5	+5V [OUT]	+5V [OUT]	+5V [OUT]	—
4	RTS [OUT]	—	TX - (RS485) [OUT]	—
3	CTS [IN]	—	TX + (RS485) [OUT]	RX +
2	—	RX - / TX - [IN/OUT]	RX - (RS485) [IN]	TX -
1	—	RX + / TX + [IN/OUT]	RX + (RS485) [IN]	TX +

Pictured above is the pin-out for each type of port connection using an 8-pin RJ45 connector. **Any wiring should have proper shielding and/or termination depending your network environment and configuration.**

MJ1/2 and MJ3 Serial Port

Protocols: Modbus RTU/ASCII or BACnet MSTP. The desired protocol must be loaded to a port by the factory per requested specifications.

The controller has a modular jack (MJ) serial port labeled **MJ1/2** (default). MJ1/2 is considered dual-purpose, ports MJ1 and MJ2 respectively, which varies on its mode setting for the protocol. MJ1 for RS232 and MJ2 for half-duplex (2-wire) RS485. Some controller models have a second port labeled **MJ3** which supports either RS232 or full-duplex (4-wire) RS485.

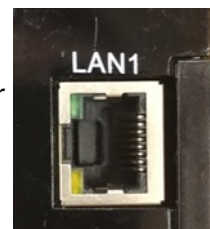
Note for RS485: Use of grounding (pin 6, 0V GND) for MJ2 and MJ3 may be required depending on network environment, but is typically not necessary.



LAN1 and LAN2 Ethernet Port

Protocols: Modbus TCP or BACnet IP. The desired protocol must be loaded to a port by the factory per requested specifications.

The controller has a 10/100 Mbps Ethernet port labeled **LAN1** (default). Some controller models have a second port labeled **LAN2**.



Communication Ports: RS485 Information

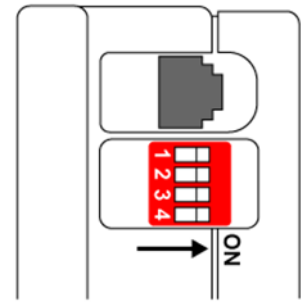


The MJ1/2 or MJ3 serial ports using RS485 communication have additional options available on the controller. Refer to “Wiring and Pin-Out” on the previous page for RS485 wiring information.

RS485 Termination

Proper RS485 termination minimizes reflections and improves reliability. The MJ2 (and MJ3) serial port allows an internal RS485 termination resistor to be placed across pins 1 and 2 by DIP switch setting. DIP switches are located on the side of the controller near the MJ1/2 and MJ3 serial ports. **Only the two devices physically located at the endpoints of the RS485 network should be terminated!**

PIN	NAME	FUNCTION	DEFAULT
1	MJ3 RS485 Termination	ON = Terminated	OFF
2	MJ3 Duplex	ON = Half	OFF
3		OFF = Full	OFF
4	MJ2 RS485 Termination	ON = Terminated	OFF



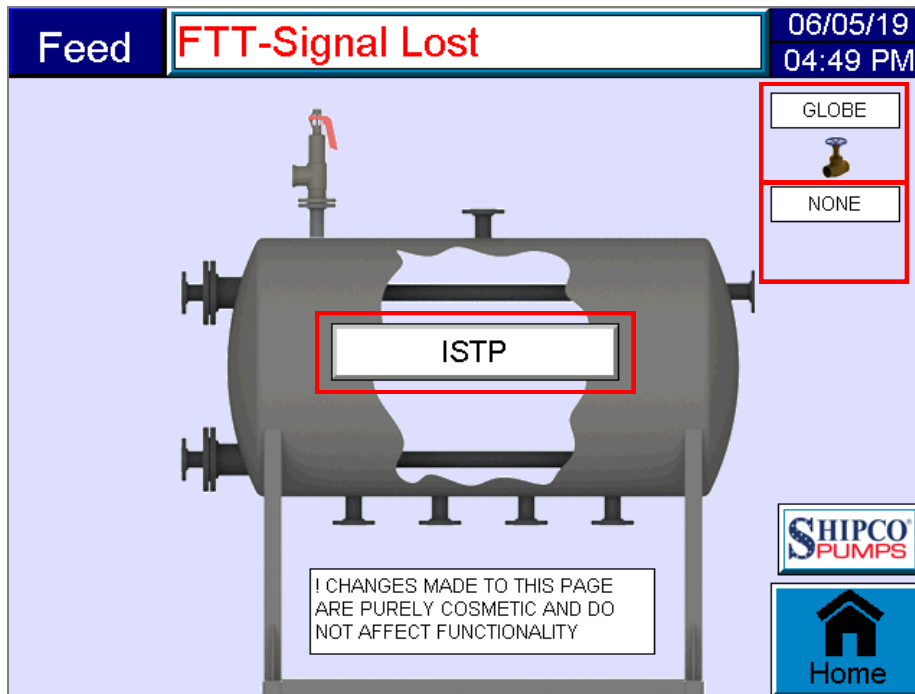
RS485 Biasing

RS485 biasing passively asserts a line-idle state when no device is actively transmitting, which is useful for multi-drop RS485 networking. Both the MJ2 and MJ3 serial ports allow internal bias resistors to be switched in, pulling pin 1 up to 3.3V and pulling pin 2 down to ground. On the controller, press the **System** button and select **Set Serial Ports** to enable RS485 biasing. If biasing is used, it should be enabled for only one of the devices attached to the RS485 network.

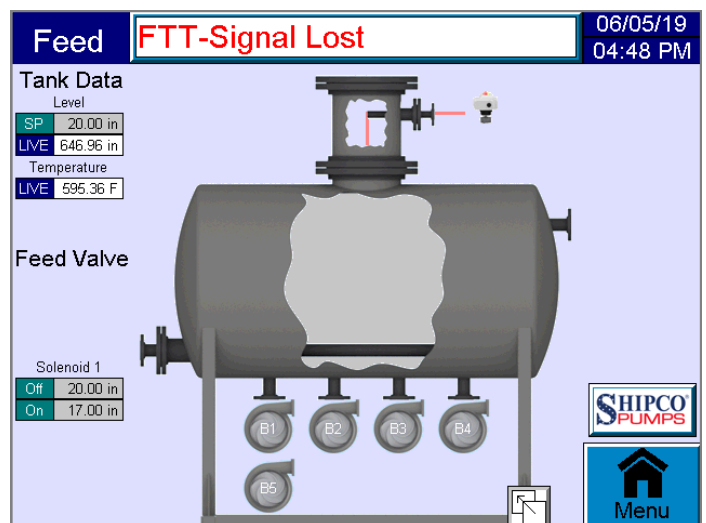
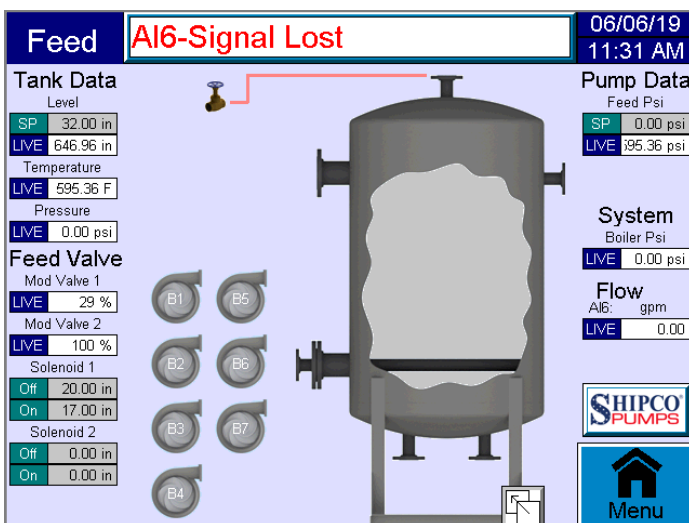
Unit Style Selection



Pressing the “Unit Style” button on the Feed Home or Surge Home screen will allow adjustment to the visual look of the unit. **These changes are purely cosmetic and do not affect unit operation.** When on this unit style adjustment screen, tap the center nameplate button to cycle through various visual styles. In addition, the type of feed or surge valve(s) can be changed by tapping on the valve nameplate.



Examples of visual screen adjustments:



TERMS AND CONDITIONS OF SALE

AGREEMENT

By entering your order or requesting a quote, you confirm that the following terms and conditions of sale are the legal agreement governing your purchase, and that no changes or additional or different terms will apply unless you have previously established a different written contract for these purchases with Shippensburg Pump Company, Inc., hereafter referred to as the Seller.

ORDER ACCEPTANCE

All orders are subject to acceptance by Seller at its general office in Shippensburg, Pennsylvania. Acceptance will be evidenced by Seller issuing its Sales Acknowledgement Form. The Sales Acknowledgement Form, together with any documents incorporated therein, shall constitute the entire agreement and may not be changed except in writing signed by Seller and Buyer. Publication and circulation of current price lists, catalogues and related literature by Seller shall not be deemed an offer to sell, but rather an invitation for offers to buy. Acceptance by Seller of the Buyer's order is expressly limited to the Terms and Conditions stated herein; any additional, inconsistent or different terms and conditions contained in the Buyer's purchase order or other documents supplied by Buyer are expressly rejected.

PAYMENT TERMS—PRICES

Payment terms are as follows: If the Buyer is a Credit Card Customer, the Buyer agrees to pay at the time of purchase the price, shipping and handling charges, taxes and duties quoted by the Seller. If the Buyer is an Account Holder, the Buyer agrees to pay invoices with payment terms of net thirty (30) days after date of invoice unless otherwise specifically agreed to in writing. If the Seller believes that the Buyer's financial condition requires it, the Seller reserves the right to require full or partial payment prior to manufacture or shipment. If the Buyer fails to make any payment when due, (1) the seller reserves the right to suspend performance and the Buyer agrees that any charges incurred prior to the suspension will be assessed to the Buyer and payable to the Seller; (2) the Buyer further agrees to pay a charge on the amount past due at the rate of 1½% per month (18% per year) or the maximum lawful rate, whichever is less. In the event of non-payment, the Buyer agrees to pay the Seller reasonable attorney's fees and court costs, if any incurred by the Seller to collect payment and interest charges. These terms shall apply to partial, as well as complete shipments of Product. Published prices are subject to change without notice and the right is reserved to invoice at prevailing prices at time of shipment unless otherwise specifically agreed to in writing. All quotations are conditional on 30 days acceptance unless stipulated otherwise in writing and to approved credit rating or reference, otherwise payment terms are cash with order or C.O.D.

DELIVERY—DELAYS

Shipping dates represent estimates only and are based on projected production schedules and commitments by suppliers. Seller shall not be liable for failure or delay in manufacturing or shipping Products, nor shall such failure or delay constitute grounds for cancellation if such failure or delay is directly or indirectly due to shortages of fuel or energy; acts of omissions of the Buyer; acts of God; war, riot, civil disturbances; labor difficulties; accident; inability to reasonably obtain materials; acts of transportation companies; or other causes of any kind whatever beyond the control of Seller. In the event of such delays, Seller reserves the right to make adjustments in price and delivery schedules.

FREIGHT TERMS

Prices are f.o.b. factory unless otherwise stated. Seller's responsibility ceases upon delivery to the transportation company at shipping point. It is the Buyer's responsibility to examine shipment upon arrival to ascertain if in good order. Any shortage or damage claims must be pursued by the Buyer. All weights shown on price sheets and literature are approximate. All packaging is standard domestic boxing, slat and wire crating and/or skidding. An additional charge will be made for full wooden crating or special packaging when specified on the order.

Seller will make every effort to consolidate orders and backorders wherever possible. Seller will not be responsible for excess charges due to their inability to consolidate shipments.

When requested by Buyer, shipments may be routed using premium carriers such as express or airfreight or the Buyer may specify the method or route of shipment. In such cases the shipment will be made on a "collect" basis and where applicable the freight allowance will appear as a separate line item on the product invoice, Seller reserves the right to select the transportation company where freight is allowed.

TAXES

In addition to the price stated, the amount of any present or future sales, use, excise or other similar tax applicable to the production, sale, use or transportation of the Products shall be paid by Buyer. In lieu of paying such taxes to Seller, Buyer may furnish Seller a Tax Exemption Certificate or Certificates acceptable to appropriate taxing authorities at any time prior to Seller's shipment of the Products.

CANCELLATIONS

Any order placed with Seller may be cancelled by the Buyer only upon payment of reasonable cancellation charges that shall include but not be limited to expenses already incurred, as well as material and labor commitments made by Seller.

SHIPMENT—TITLE—RISK OF LOSS

Shipment terms are f.o.b. Seller's facility, unless otherwise specifically agreed to in writing. Notwithstanding the granting of any allowances for shipping, title to and risk of loss for Products will pass to the Buyer when delivered to the Common carrier at the Seller's facility.

BACK CHARGES

All invoices shall be due and payable when submitted for payment in accordance with the provision entitled "Payment Terms—Prices." No withholding of funds, back charges, or credits against amounts otherwise due Seller will be permitted unless specifically agreed to in writing by Seller. Settlement of any amounts due Buyer will be negotiated as separate items and not as offsets against amounts otherwise due Seller from Buyer for Products sold hereunder.

RETURNED GOODS

Unused material of current manufacture can only be returned for credit with the written consent of Seller, under return goods policies existing at the date of the return. Products that are obsolete or made to special order are not returnable.

PATENT INDEMNITY

a. Patent Indemnity by Seller to Buyer

Seller agrees to indemnify and hold harmless the Buyer from and against all legal expenses which may be incurred, as well as all damages and costs (except all consequential and special damages and costs) which may be finally assessed against Buyer in any action for infringement of any United States Letters Patent by the Products delivered to Buyer hereunder; provided that the Buyer shall give Seller prompt written notice of any action, claim or threat of patent infringement suit, either oral or written, or of the commencement of any patent infringement suit against Buyer relating to Products sold by Seller to Buyer hereunder; and provided Buyer shall give Seller opportunity to elect to take over, settle, or defend any such claim, action or suit through counsel of Seller's own choice and under its sole direction, and at its sole expense, and provided that in the event Seller elects to take over, defend or settle same, Buyer will make available to Seller all defenses against any such claim, action, suit or proceeding known to or available to Buyer; and provided further that Seller shall have the right to substitute for any such Product or any part thereof claiming to

infringe the patent right of others, non-infringing Products which will give equally good service. If the use of any such Product or any part thereof should be enjoined, Seller shall have the right at its own expense, to take any of the following courses of action:

- i. To procure for Buyer the right to continue using such Product;
- ii. To replace said Product with a non-infringing Product;
- iii. To modify the Product so that it becomes non-infringing; or
- iv. To remove said Product and refund the purchase price, transportation costs and installation costs thereof.

b. Limitation

The foregoing provisions as to patent protection by Seller to Buyer shall not apply to any of the following:

- i. To any Product manufactured to the design or specification furnished by the Buyer;
- ii. To orders for special non-commercial Products which Seller has not sold or offered for sale to the public on the open commercial market;
- iii. To any infringement occasioned by modification by Buyer of any Product without Seller's written consent, or any infringement arising from the use of a Product with any adjunct or device added by the Buyer without Seller's written permission.

c. Patent Indemnity by Buyer to Seller

To the extent that Products delivered hereunder are manufactured pursuant to detailed designs furnished by Buyer, Buyer agrees to indemnify Seller and hold Seller harmless from all legal expenses which may be incurred, as well as all damages and costs, which may finally be assessed against Seller in any action for infringement of any United States Letters Patent by such Products delivered hereunder. Seller agrees to promptly inform the Buyer of any claim for liability made against Seller with respect to such Products and Seller agrees to cooperate with the Buyer in every way reasonably available to facilitate the defense against any such claim.

GOVERNING LAW

The validity, interpretation and performance of any order shall be governed by the Uniform Commercial Code ("UCC") as adopted by the state in which the Products are manufactured by Seller.

WARRANTY AND LIMITATION OF LIABILITY

Seller warrants for a period of eighteen (18) months from date of shipment from its factory or one (1) year from date of installation, whichever occurs first, that all Products furnished by it are free from defects in materials and workmanship.

Seller's liability for any breach of this Warranty shall be limited solely to replacement or repair, at the sole option of Seller, of any part or parts found to be defective during the Warranty period providing the Product is properly installed and is being used as originally intended. Buyer must notify Seller of any breach of this Warranty within the aforementioned Warranty period; defective parts must be shipped by Buyer to Seller, transportation charges prepaid.

IT IS EXPRESSLY AGREED THAT THIS SHALL BE THE SOLE AND EXCLUSIVE REMEDY OF THE BUYER. UNDER NO CIRCUMSTANCES SHALL SELLER BE LIABLE FOR ANY COSTS, LOSS, EXPENSE, DAMAGES, SPECIAL DAMAGES, INCIDENTAL DAMAGES OR CONSEQUENTIAL DAMAGES ARISING DIRECTLY OR INDIRECTLY FROM THE DESIGN, MANUFACTURE, SALE, USE OR REPAIR OF THE PRODUCT WHETHER BASED UPON WARRANTY, CONTRACT, NEGLIGENCE OR STRICT LIABILITY. IN NO EVENT WILL LIABILITY EXCEED THE PURCHASE PRICE OF THE PRODUCT.

THE WARRANTY AND LIMITS OF LIABILITY CONTAINED HEREIN ARE IN LIEU OF ALL OTHER WARRANTIES AND LIABILITIES, EXPRESSED OR IMPLIED. ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED BY SELLER AND EXCLUDED FROM THIS WARRANTY.

Seller neither assumes, nor authorizes any person to assume for it, any other Warranty obligation in connection with the sale of the Product. This Warranty shall not apply to any Product or parts of Products which (a) have been repaired or altered outside of Seller's facilities; or (b) have been modified or damaged through misuse, abuse, accident, neglect or mishandling by Purchaser or Purchaser's customer, erroneous voltage, modification, acts of God, or any other act not specifically stated; or (c) have been used in a manner contrary to Seller's instructions.

Products covered by this warranty are for the intended uses as described in the corresponding seller's instructions. Before using for any other application, user shall determine the suitability of the product for its intended use and user assumes all risk and liability in connection therewith.

No oral statement made by the seller, its agents, employees, or other representatives, concerning the product, its value, description, condition, design, specifications, performance, capability, durability, adaptability, or accuracy, shall be relied upon by the purchaser and is specifically and expressly excluded and invalidated as the basis for any bargain or warranty.

In the case of Products not manufactured by Seller, there is no Warranty from Seller, but Seller will extend to the Buyer any Warranty of Seller's supplier of such Products.

FORCE MAJEURE

Seller shall have no liability in respect of failure to deliver or perform, or delay in delivering or performing any obligations due to causes such as acts of omissions of Buyer; acts of God, fire, flood, war and civil disturbances; riot, acts of governments, currency restrictions, labor shortages or disputes, unavailability of materials, fuel, power, energy or transportation facilities, failures of suppliers or subcontractors to deliver on time and every other circumstance outside the reasonable control of Seller.

MODIFICATIONS

Unless otherwise provided, Seller reserves the right to modify the specifications of Products ordered by the Buyer providing that the modification will not materially affect the performance.

STORAGE CHARGE

If Buyer is unable to accept products in accordance with the applicable shipping schedule then Seller may arrange to store ordered Products and the cost of storage will be charged to Buyer.

ENTIRE CONTRACT

These provisions constitute all the terms and conditions agreed upon by the parties and shall replace and supersede any provisions on the face and reverse side of Purchase Order and any attachment thereto, or any prior general agreement inconsistent with the provisions hereof except that orders by Representatives with whom Seller has an Agreement shall be subject to the provisions of the Agreement. No modification hereof shall be valid unless in writing and duly signed by a person authorized by Seller. The provisions hereof shall not be modified by any usage of trade, or any course of prior dealings or acquiescence in any course of performance.