TSC

TSC Fuel Polishing Controller Operation Manual

INTELLIGENT FILTRATION CONTROLLER

Approved v1.3

5400 Division Dr. | Fort Myers, FL 33905
239 690-9589 | Toll Free 877-425-4239 | FAX 239 690-1195
www.AXI-International.com

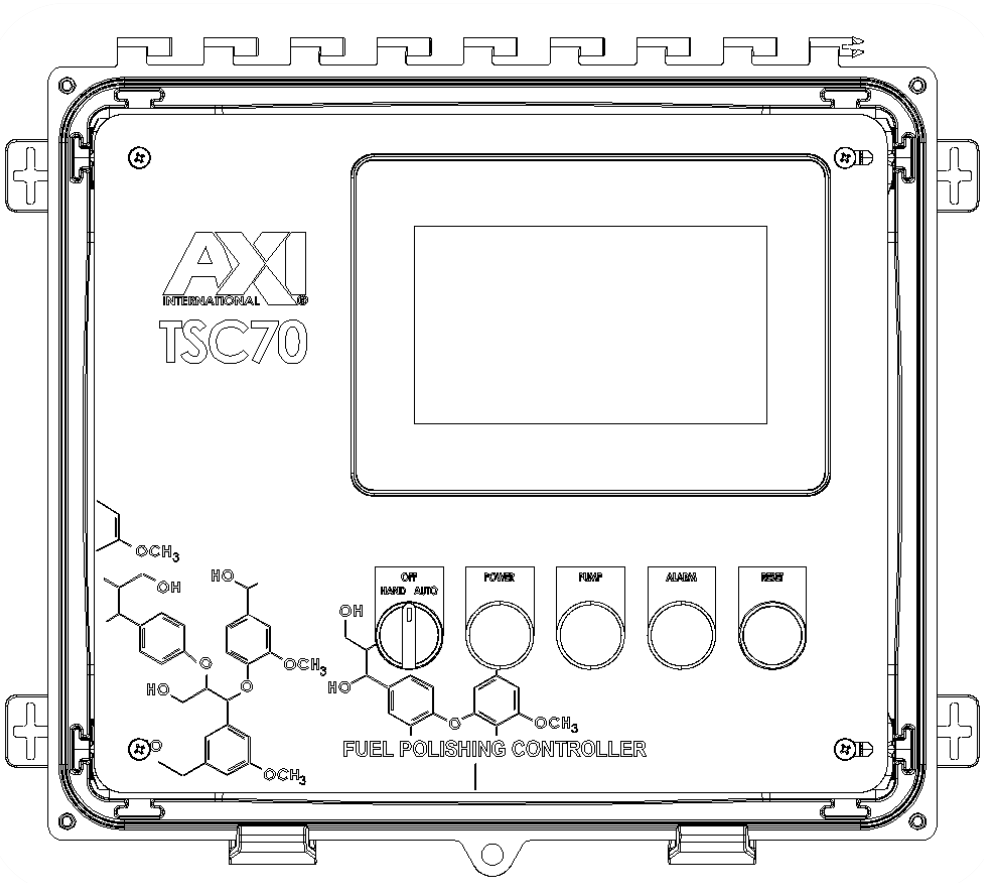

AXI
INTERNATIONAL
TSC70
ON
HAND AUTO
POWER
PUMP
ALARM
RESET
FUEL POLISHING CONTROLLER

Table of Contents

General Overview

Controller Specifications

Rated Dimensions	70 Series 14” x 12” x 6” (35.6 cm x 30.5 cm x 15.2 cm) (H x W x D) 80 Series 16” x 14” x 8” (40.6 cm x 35.6 cm x 20.3 cm) (H x W x D)
Construction	Polycarbonate UL-508A, NEMA 4X
PLC Hardware	Unitronics 7” Touchscreen HMI, 24VDC System
Communication	Remote Access (VNC), Modbus TCP/IP[1], Modbus RTU[2], Email, Bacnet[2], and Summary Alarm (Dry-Contact)
Rated Power	70 Series 120V/60Hz/1Ph, 208-230V/60Hz/1Ph, or 230V/50Hz/1Ph 80 Series 208-230V/60Hz/1Ph, 240V/60Hz/3Ph, or 480V/60Hz/3Ph
Operating Temperature	Minimum 14°F (-10°C) Maximum 122°F (50°C)
System Weight	70 Series ≈ 25 lbs. (11.4 kg)[3] 80 Series ≈ 30 lbs. (13.6 kg)[3]
Available Options	Pressure Transmitters, Multi-Tank (4 Tanks Max), Multi-Point (8 Pair Max), Auto Water Drain, Flow Control, and Fuel Heating

System Compatibility

TSC70 120V/60Hz/1Ph	FPS SXF, FPS MXF, or FPS LXF STS 7003, STS 7004, STS 7010, STS 7020, or STS P35 MTC HC50[4]
TSC70 230V/50Hz/1Ph	FPS SXF, FPS MXF, or FPS LXF STS 7003, STS 7004, STS 7010, STS 7020, STS 7030, and STS P35 MTC HC50[4] and MTC HC90
TSC70/TSC80 208-230V/60Hz/1Ph	STS 7030 and STS P35 MTC HC50[4] and MTC HC90
TSC80 240V/60Hz/3Ph	STS 7030 MTC HC90
TSC80 480V/60Hz/3Ph	STS 7030 and STS 7040 MTC HC90, MTC HC150, and MTC HC300

[1] Feature allows for multiple master devices to scan simultaneously, limited by controller socket availability.
[2] Configuration requires additional options to be provided as noted in the Controller Identification section.
[3] Esitmate based on a standard controller with no additional upgrades.
[4] The controller is not provided as standard and must be added as an upgrade.

Getting Started

Primary Inspection

☐	Upon arrival, the system and accessories must be visually inspected before installation. Improper handling during shipping may cause physical or electrical problems. Immediately report or note any damage to the shipper.
☐	Confirm that the electrical diagrams provided match the controller diagram number.
☐	Verify that field power at the installation location matches the requirements shown on the wiring diagram.
☐	Check all electrical terminals and connections for tightness.
☐	Verify that all field wiring is the proper temperature rating and wire gauge (AWG) per the wiring diagrams.
☐	Familiarize the installation team with the requirements of the complete installation to prevent system damage.
☐	Thoroughly review this manual to ensure the system is installed as required.

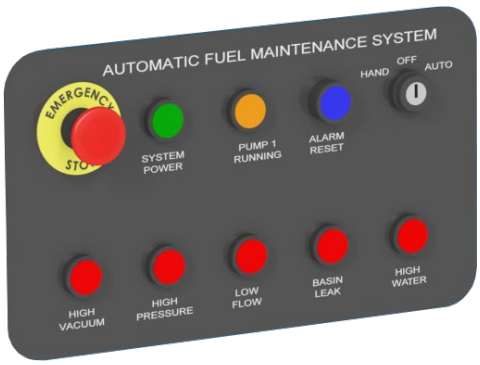
Controller Overview

The design includes a sealed control enclosure that provides NEMA 4X type protection from the environment[5]. It will include a transparent cover (not shown in any images in this manual) with latches to secure closure when not in use. By using a transparent cover, the user can see the status of the indicators[6] without opening the cover.

The controller can be supplied in 2 different configurations with one as a stand-alone controller to be mounted near the system upon installation and the other being factory-installed into the fuel polishing system enclosure.

When the controller is factory installed inside the mechanical enclosure, it will typically have the remote interface as described in the Remote Interface section. This is to allow quick access to system status information and high-level controls without the need to first open the system enclosure doors.

Local Interface



Remote Interface

[5] When installed with devices that match the enclosure rating. See ANSI/NEMA 250-2020 for information.
[6] When built with a local interface only.

Local Interface

This configuration will have all the status indicators, control features, and HMI placed inside of the controller enclosure.

The included indicator lights offer status information regarding **“POWER”** (Green)[7], **“PUMP RUNNING”** (Amber)[7], and summary **“ALARM”** (Red)[7] states. The system’s operational mode can be selected with the **“HAND/OFF/AUTO”** selector switch[7]. There is also a single alarm **“RESET”**[7] pushbutton that is used to clear inactive system alarms.

There will be no external status indication provided outside of the controller enclosure and no Emergency Stop device is provided with this configuration. The installation can make use of a user-supplied emergency stop device that uses a normally closed contact that is rated for the system’s max current rating as shown in the wiring diagram for the system.

Remote Interface

This configuration will have all the status indicators and some control features places outside of the controller enclosure. The HMI will remain inside of the controller enclosure.

For this interface upgrade, a single summary alarm indicator is replaced with a set of individual status indicators for quicker identification of specific alarm conditions. The **“HIGH VACUUM”** (Red), **“HIGH PRESSURE”** (Red), **“LOW FLOW”** (Red), **“HIGH WATER”** (Red), and **“BASIN LEAK”** (Red) status indicators all deal with major maintenance alarm conditions to notify the user when the system needs servicing.

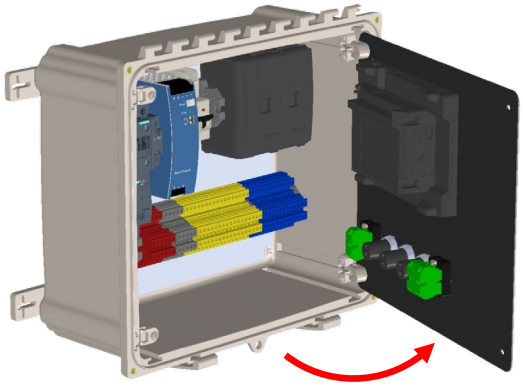
The standard **“HAND/OFF/AUTO”** selector switch will be upgraded to a keyed selector switch to prevent unauthorized tampering with the system’s current operational mode.

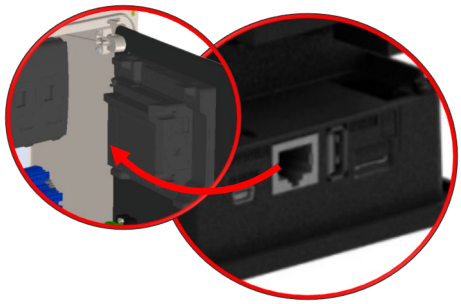
The user will gain a built-in **“EMERGENCY STOP”** mushroom pushbutton that will break the pump run signal directly and signal the PLC to alert the system of the condition.

Inside the Controller

Warning! To avoid the risk of electric shock, make sure that the power supply to the system is disconnected and ensure that the system is at zero volts, before working on any of the system’s electrical components.

The controller cover plate that houses the HMI can be swung out of the way to access the terminal blocks for installation and the branch-circuit protection devices as indicated in the wiring diagrams. 4 retaining screws hold the plate firmly in place. To open the cover, fully remove the 2 screws on the left edge of the cover plate. Then loosen, by one-half turn, each of the 2 screws on the right edge of the cover plate, allowing them to slide along the slots in the plate.





[7] Re-located to the enternal system enclosure door when using the Remote Interface configuration.

Controller Cover Swing *PLC Obstructed Connections*

There are parts of the controller that the user may need to access that are located on the right side of the PLC behind the cover plate. The micro SD-Card slot and the USB (DOK) port are used for system alarm record, storage, and backup transfer operations.

The standard components within the enclosure are outfitted with a motor contactor, power supply, branch circuit protection device(s), PLC/HMI, and field wire terminals. Additional components may be installed and will be indicated on the controller's wiring diagrams.

The breaker(s) in the controller are for branch circuit protection only and the installation must include a customer installed disconnect and appropriate system earth ground for the controller as indicated on the wiring diagrams.

Expansion Module

The I/O expansion port and the serial COM ports will be required for specific features that need additional I/O for functionality or expanded communication. Modules must be installed following the wiring diagrams to function properly.

The expansion module comes with 2 components, the PLC side and the I/O side. The PLC side will be installed on the back of the HMI as indicated below.

Expansion Module

Module Location

This module will not be installed when there are no expansions to the controller I/O required. This will depend on the controller configuration.

Ethernet Network

This standard RJ-45 style connection is intended to be used for any TCP/IP communications. It is recommended that the cable be shielded for signal integrity. The RJ-45 connection is located on the back of the HMI adjacent to the USB connection and is labeled **"Ethernet"**.

Ethernet RJ-45 Port

This is not to be confused with the unlabeled PLC Expansion Module connection that looks similar to the RJ-45 port.

SD-Card

The system requires a micro SD-Card to be installed for all system operations that require data storage, file creation, and the Alarm Notification Email functionality to work. The card size will determine the capacity of alarm logs and other backup data. The suggested minimum card size is 8GB.

Without the card installed, the system will be unable to write the alarm history log files as required. This will prevent the alarm tool to create the alarm history logs necessary for both functions to operate properly.

USB Storage Drive

This device will be used for applying software and firmware updates to the PLC as required. Instructions on this process will be provided by contacting the manufacturer.

This device will also allow the user to make backups of files such as the alarm logs and screenshots by pulling them from the installed SD-Card device.

Warning! The mini-USB connection on the PLC is not user-friendly and is only used for factory programming. Do not try to use this port or you may cause damage not covered under warranty.

Serial COM Port

This connection is required for any serial communication upgrades and will need to be installed in the PLC expansion and terminal header. Remove the communication port cover on the PLC and the expansion adapter. If installed, gently press the card into place until it clicks.

Serial Communication Module

Module Location

The PLC communication card will need to have the termination switches set to internal termination on the bottom of the card and will need to be set before installation.

Warning! If there is an I/O expansion module installed, it will block access for the removal of the COM module for adjusting the termination and replacement. Failure to remove the expansion port before removing the COM module will cause damage to the module.

Installation

Mounting

The enclosure has 4 adjustable mounting feet on the rear surface that are used to mount the controller. It should be installed where the surface is rigid and can support the weight of the controller along with additional conduit and wiring needed for the installation.

Warning! Keep the controller away from extreme vibrations as this can cause damage or dislodge the components within the controller. There should also be sufficient distance from any devices that can emit high levels of electromagnetic radiation as this may interfere with the reliable operation of the controller.

To maintain the NEMA rating of the enclosure, all fittings installed on the controller must be at least the same rating as the enclosure. Some devices that maintain the rating are cord grips and conduit fittings.

Flexible Cord Grip

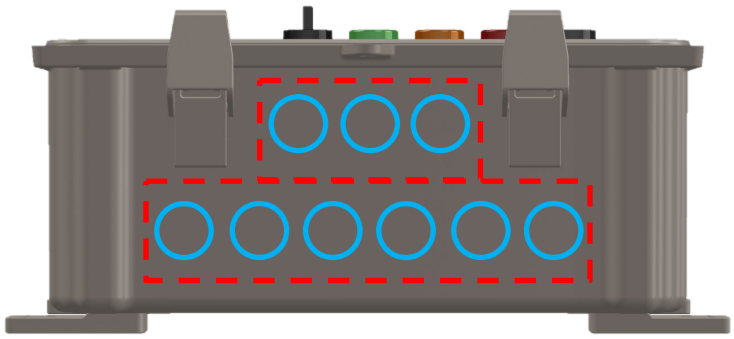
Rigid Cord Grip

Push-in Conduit

EMT Steel Conduit

For all multiconductor cables, the installation shall use the cord grip style fitting sized according to the wires used. Only make the penetrations for the devices to be installed. All other penetrations for customer wiring shall be done in the field.

The location of the fitting is not specific, but the A/C voltage devices are all located on the left side of the controller and all the D/C voltage devices are located on the right side of the controller. The I/O lines should be focused on the right side of the controller to leave enough air space between the A/C and D/C wiring for ease of installation.



Enclosure Penetration Locations

The communication lines will be added as needed for external monitoring. It is recommended that the conduit for communication and voltage carrying lines be separated to prevent noise from affecting the data signals.

The suggested horizontal spacing of the cord grip style devices is 1.8” center to center with approximately 2” from the back edge of the enclosure as shown in the blue circles above. The circle sizes are not representative of the device size.

Ensure all devices installed will clear the door latches and any items inside of the controller including the backplate upon which the controller is built.

Wiring Connections

This panel is constructed to comply with UL-508A[8] build practices and is labeled with the appropriate markings for safe installation and operation. Please comply will all labeled instructions.

Use wiring gauge (AWG) and temperature ratings according to specification in the provided wiring diagram. Connect system power to a separate protected feeder circuit disconnect or breaker as indicated in the electrical diagrams. The system may only be connected to properly grounded, clean, and stable power sources for operator safety.

Warning! If the voltage provided to the system is not free of electrical noise, an inline power filter must be installed to prevent PLC and power circuit problems that may damage the equipment. The electrical installation must follow all applicable federal, state, and local rules, laws, standards, and regulations.

Remote Alarm Monitoring

The controller provides an auxiliary output dry-contact, voltage-free, signal that provides an alert of any alarm condition present on the system. Please see the provided wiring diagram for contact rating, connection, and location.

The dry contact will indicate a summary alarm for any system alarm condition such as high vacuum, high pressure, low flow, overload relay triggered, emergency stop, etc.

Remote System Interrupt

The System Controller provides one terminal for remote system interrupt as indicated in the External Shutdown section. Please see the provided wiring diagram for contact rating, connection, and location.

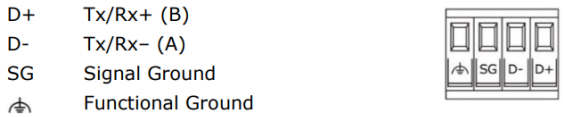
The internal 24VDC power is carried through the connection terminals mentioned above; no power or current-carrying wiring interlock should be connected to these terminals.

RS-485 Serial Communication

This communication module is for optional features that are provided separately. The wiring configuration for the serial connection must have the necessary termination resistors installed or utilize the module's internal termination switches.

Warning! If there is an expansion module (connection port) installed, it will block access for the removal of the COM module for adjusting the termination and replacement.

Serial Termination Switches



Serial Communication Terminals

[8] See UL 508a Training on Industrial Control Panels | UL for information on the standards.

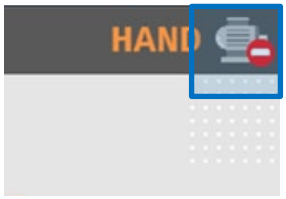
Please ensure the A/B lines and signal ground are connected to the screw terminal connectors as applicable to your installation for the communication module. It is recommended that the communication line be a twisted pair, shielded, cable to prevent any noise from affecting the signal.

System Operation

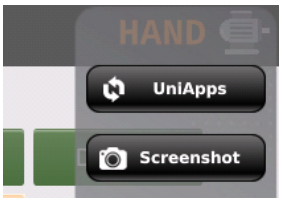
User Access Control

Accessing Hidden Menu

To access the hidden menu, the user will need to long-press the top-right corner of the screen for 5 seconds. The hidden menu will appear offering controls like login/logout, password changes, screenshot capturing, and access to toggle between the **"UniApps"** and **"UserApp"** software.



Menu Location



UserApp Menu

UniApps Menu

Some items in the menu will not be visible unless there is an authorized user account logged in. When the account is logged out, the application will automatically switch back to the UserApp.

Logging in

The user may log in to the PLC for various actions including settings changes and program updates. The login authentication is handled through the User Access Control (UAC) which requires a username and password to be provided. The user can log in by pressing the **"LOGIN"** button on the Global Menu or by accessing the hidden menu in the top-right corner of the HMI.

- **"Username"** default value is *'TECH'*
- **"Password"** default value is *'9999'*

This user account login will allow access to the tools necessary to configure and control your equipment as designed.

The user account login will automatically timeout requiring the user to log in again to continue control. This is to ensure that the UAC is locked when there is no approved user actively interfacing with the system.

Changing the Password

The user may change the user account password[9] to prevent unauthorized PLC access. To update this information, expand the hidden menu as shown in the Accessing Hidden Menu section and select **"Change Password"**. From the pop-up dialog, the current password and a new password must be entered to complete the password change.

Warning! There is no recovery method for the user account password once it is changed. A lost password will require the PLC software to be reinstalled and all the configurations to be completed again.

[9] Requires elevated user permissions. See the User Access Control section for more information.

UniApps

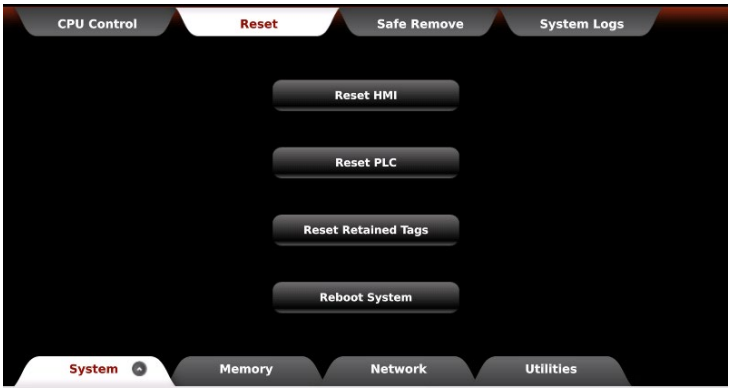
UniApps is a collection of applications that allow the user to configure several options including the PLC settings, date and time, and network settings.

Warning! Do not modify any sections not instructed below without first contacting AXI International as this could break your controller and require servicing not covered under warranty.

Once logged in to the PLC, the UniApps can be accessed via the hidden menu in the top right corner of either the Home or Menu screens. **"UniApps"** will appear as the first item in the drop-down menu.

While in the UniApps environment, the user may return to the Home screen by pressing and holding the top right corner again and selecting **"UserApp"** from the drop-down menu.

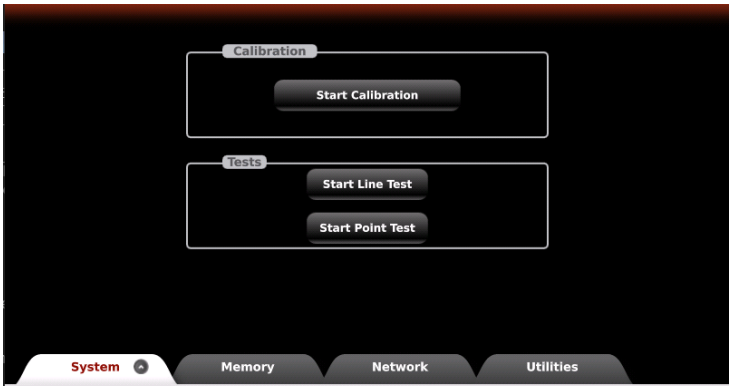
Applications are grouped by function with **"System"**, **"Memory"**, **"Network"**, and **"Utilities"** tabs located at the bottom of the screens for quick navigation.



PLC Reset

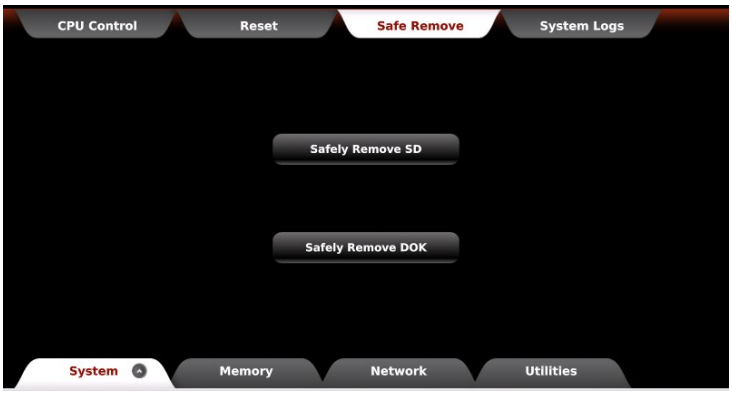
The controller may periodically need to be rebooted. This can be accomplished through the UniApps **"Control"** application found under the **"System"** tab. Select the **"Reset"** tab at the top of the screen to access the available reset/reboot options.

Warning! Using the **"Reset Retained Tags"** button will factory reset all user settings, requiring a complete system setup to be performed. Do not perform this step without first contacting the manufacturer.



Screen Calibration

If the screen is not responding properly to touch input, the operator may perform a screen calibration with the UniApps **"Touchscreen"** application found under the **"System"** tab. Using this application, the user may calibrate the touch screen or perform line-and-point tests to assess the sensitivity and accuracy of the built-in display.



Safe Hardware Removal

Before removing a USB drive or SD card, navigate to the **"Safe Remove"** tab at the top of the screen and select **"Safely Remove SD"** for the SD card or **"Safely Remove DOK"** for the USB drive to prevent file corruption.

General Navigation

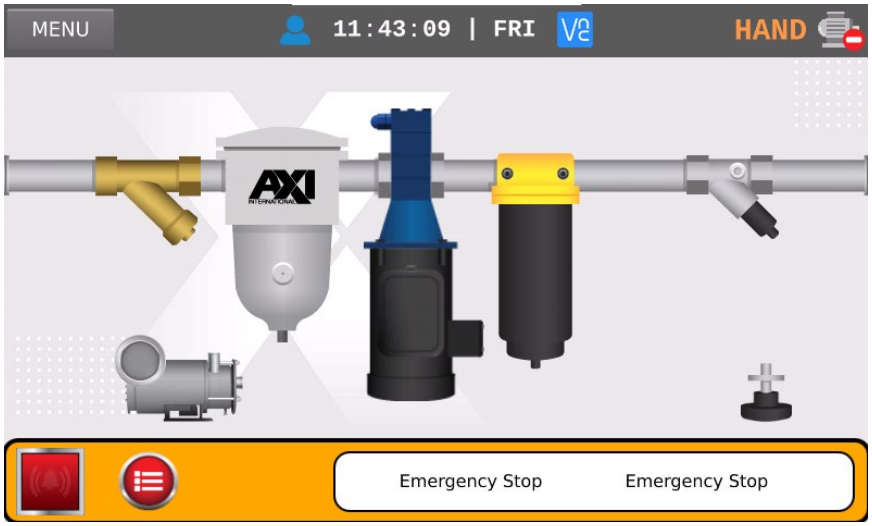
To operate the TSC controller, apply control power to the unit. Ensure the system's selector switch is in the **"OFF"** position. Place all control and branch circuit protection breakers in the **"ON"** position.

Screen Layout

Upon the initial power cycle of the TSC Controller, you will be greeted by the **"HOME"** screen. This displays a global header followed by a simplified graphical representation of your fuel polishing system's components and options.

The global header, not visible on some alarm screens, contains the **"MENU"** button, which takes you to the Global Menu screen. It also contains relevant control information like the current Time/Date, system operation mode, remote access connection status, and status of the main system pump.

The home screen will give the user an overview of the current operational condition of their system. Each component will change color to represent its current state. For example, the pump will turn green to indicate it is running while filters will turn yellow or red to indicate that the corresponding sensor is in an alert or alarm state respectively.



Home Screen Layout

On all screens that are not alarm utilities, there will be a Status Banner that will appear to display currently active alarms. The color of the banner itself will change per the severity of the alarm as described in the Notification Severity section.

The global header's pump status icon will represent the pump's current operational status by changing appearances. A solid green icon indicates that the pump is running. A greyed-out icon indicates that the run operation is on standby. An overlay of the red disabled icon indicates that the pump operation is currently being halted by a system interrupt or some alternate process being run.

Pump Running Status

Pump Standby Status

Pump Interrupt Status

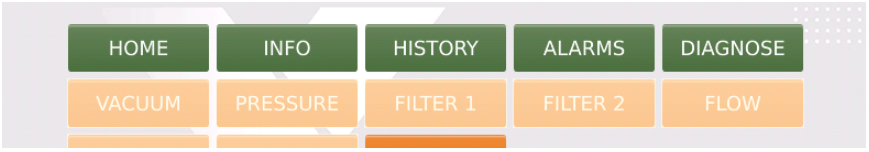
In a configuration that includes the P35 option, the pump and all icon references will refer to the external signal provided to the pump controller which sends fuel to the system as shown in the provided wiring diagram.

Global Menu

The user may access the global menu from any screen via the global header's **"MENU"** button as described in the Screen Layout section. The menu screen contains groups of navigational buttons organized by color for easy identification.

- Green indicates information type screens.
- Orange indicates control type screens.
- Blue indicates the scheduling screens for runtime.
- Grey indicates the configuration screens.

Buttons will be disabled when the feature is not available or when the user is not currently logged in with the appropriate permissions level. The disabled[10,11] buttons will visibly be faded when compared to active buttons.



Global Menu Screen (Active vs. Disabled Buttons)

Exiting the global menu by touching the **"BACK"** button in the top-left corner of the global navigation screen will return you to the page that was active before pressing the **"MENU"** button.

Runtime Modes

The controller operation allows the system to run when there are no alarms or interruptions that cause the system to halt. All systems will operate with the **"HAND/OFF/AUTO"** selector switch as discussed in the Controller Overview section.

System Mode Textual Indicator

[10] Requires elevated user permissions. See the User Access Control section for more information.
[11] Requires additional configurations to be enabled as detailed in the Controller Identification section.

The global header's textual indicator, next to the pump icon, represents the current PLC triggered mode. If the system is not reflecting the expected mode of operation, there may be errors or active alarms keeping the system in a safe mode.

Auto Mode

The system can be switched into **"AUTO"** mode by rotating the **"HAND/OFF/AUTO"** selector switch to the relevant position.

- **All automated equipment:**

  The PLC will activate the system pump during the user-scheduled runtimes. The system will continue to run until the scheduled runtime has ended or until an operational alarm that prevents safe operation has been triggered. The system will resume operation immediately after resolving the stop condition.

- **All MTC equipment:**

  The user is now able to depress the remote pendant switch to toggle the system pump on/off. The pump will run continuously until there is an operational alarm that prevents safe operation. After resolving the stop condition, the user must reactivate the system pump by depressing the remote pendant switch.

- **Remote Run – *If Applicable***

  When the system is in "AUTO" there is an additional feature that allows a remote user to enable the system to run using an external run signal. The system can run based on either the preset runtime schedules or in "REMOTE" when the user provides the external run signal.

  In "REMOTE", the PLC will activate the system pump and will continue to run until the external run signal has been removed, the system is taken out of AUTO Mode, or an operational alarm that prevents safe operation has been triggered. The system will resume operation immediately after resolving the stop condition.

  Note: Optional hardware is required to enable the Remote Run feature.

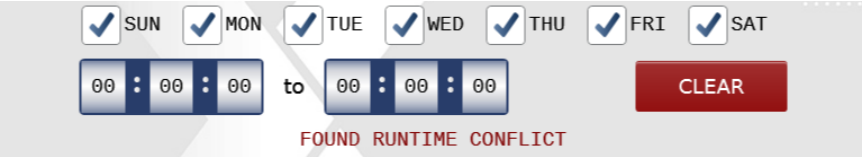
Hand Mode (Manual)

The system can be switched into **"HAND"** mode by rotating the **"HAND/OFF/AUTO"** selector switch to the relevant position.

The system pump will activate and run indefinitely until there is an operational alarm preventing safe operation. After resolving the stop condition the system will immediately resume operation.

Setting Runtime Schedule

The system runtime schedule is set by navigating to the **"TANK 1"** screen from the global menu. The user may select up to two independent operating schedules to allow for AM and PM, alternating days, or any combination run cycle.



Tank 1 Runtime Schedule Control

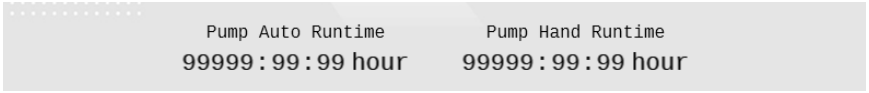
The main runtime cycle can be configured by setting the duration (start and stop time) and selecting the days the polishing operation will run. Touching the clear button will reset the schedule[12].

Additional runtimes are configured in the same way. The software will inform the user if there are conflicts with currently active runtime schedules and prevent the pump from running during those conflicted times.

[12] Requires elevated user permissions. See the User Access Control section for more information.

Runtime Tracking

The system can track the total time the system pump has run in both **“AUTO”** and **“HAND”** modes using a runtime totalizer. To view and reset the totalizer(s), navigate to the **“SETTINGS”** screen from the global menu. The information will be represented at the bottom of the screen.



Runtime Totalizers (Hours:Minutes:Seconds)

Each runtime is accrued only when the pump is active in the corresponding mode. The runtimes can be reset by using a sequence of button presses from the controller interface. To reset the **“Pump Auto Runtime”**, turn the system selector switch to **“AUTO”** and depress the alarm **“RESET”** button for 10 seconds. The value will be reset, indicating that the time has been cleared. The same steps can be used to reset the **“Pump Hand Runtime”** runtime with the system selector switch in the **“HAND”** position.

System Settings

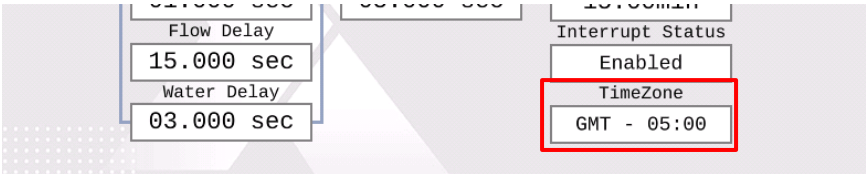
Date and Time

When the user is logged in with a valid user account, they can quickly configure the controller's date and time parameters by simply touching the date or time in the global header.

Date and Time Configuration Input

The time is configured in 24-hour format to allow for easy configuration of schedule and event triggers for the controller. This cannot be changed to a non-24 hour format.

The system **"TimeZone"** offset can be adjusted by navigating to the **"SETTINGS"** screen from the global menu.



TimeZone Offset Input

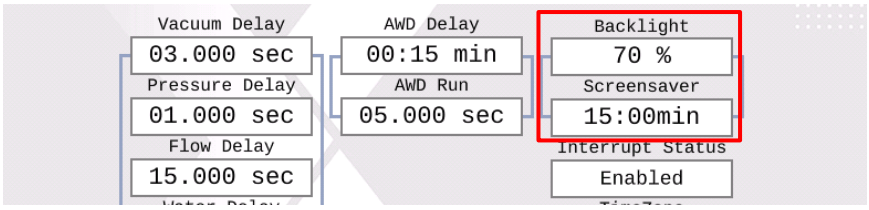
The **"TimeZone"** is only applicable to network-related functions, like email and remote access, and does not need to be set for non-network use.

Screensaver

The screen will timeout only when no touchscreen interaction has occurred for the length of the **"Screensaver"** timer and there are no Remote Access users connected during that same period.

When a local user touches the screen or a Remote Access user connects to the PLC (after a brief delay) the PLC will automatically switch back to the global menu screen and re-adjust the brightness, as set by the user.

The system **"Backlight"** level and the **"Screensaver"** timeout can be adjusted by navigating to the **"SETTINGS"** screen from the global menu.

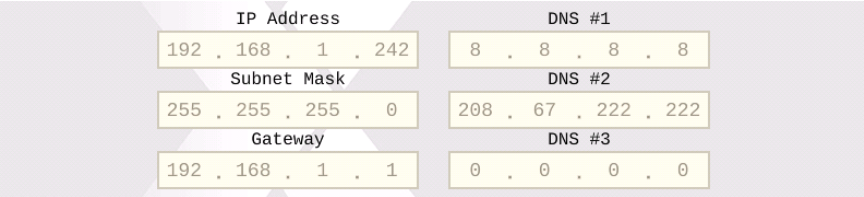


Backlight and Screensaver Settings

The **"Screensaver"** input value[Error! Bookmark not defined.] is the desired debounce time in minutes and seconds. The **"Backlight"** input value[Error! Bookmark not defined.] is the desired value in percent where the allowable range is *15% to 100%*.

Network Settings

The UserApp screen **"NETWORK"** allows configuration[13] of the PLC IP, Mask, Gateway, and 3 DNS options components and the current status of the connections. To use Modbus, email, or remote access features, the network connection properties for the controller must be configured.



Networks Settings

Well-known public servers include 8.8.8.8 and 8.8.4.4 (Google) as well as 208.67.222.222 and 208.67.220.220 (OpenDNS). All network communication is done using the **"Panel IP Settings"** configuration. For the PLC to reach out on the internet, the PLC settings must be allowed on the router/gateway the PLC is connected to.

To set an IP address outside the current range (i.e. changing 192.168.1.200 to 192.172.1.200), the gateway must first be set to 0.0.0.0. After the new IP address has been entered, the gateway can be set for the new network.

There must be a valid **"DNS"** configured for **Email** functions to operate. The UniApps software can send a network ping to confirm that the connection works. Under UniApps, navigate to the **"Network"** tab, select **"Ethernet"**, and touch the **"Ping"** tab to use the utility.

Network Ping Utility (Host Address)

Enter the email server address in the **"Enter Host"** field and touch the **"Ping"** button to test. If the test is successful, there will be a green checkbox at the bottom of the screen. If the test is not successful, there may be network settings issues or an incorrectly configured **"DNS"** server address.

Remote Access

The remote access feature allows users to remotely connect to the HMI and interact with the PLC over the network. To use this feature, the PLC must have a valid static IP address assigned and be able to connect to the system network. This will allow a maximum of 8 concurrent connections to the PLC with all connections controlling the same screen.

Remote Access Indicator

[13] Requires elevated user permissions. See the User Access Control section for more information.

While connected, the valve disable and the tank transfer functions for the Multi-Tank Polishing upgrade will both be inoperable.

There will be an icon to indicate that the PLC is being remotely accessed when a remote connection is active. There are 2 modes of connection:

- Full access connections allow remote users to touch buttons and interact with the screens.
- View-only connections do not allow remote users to interact with the PLC.

Active VNC remote access connections and their origins can be monitored by navigating to the **"Network"** tab under UniApps, selecting **"VNC Server",** and choosing **"Connectivity"**.

The password for VNC access can be updated by navigating to the **"System"** tab under UniApps and selecting the **"Access Control"** button to open the configuration screen. Here, the user can select the **"Legacy"** tab at the top of the screen and press the **"Change Passwords"** button to modify the passwords. The user may use any VNC software that will connect to the PLC with the following parameters:

- **"Password"** default value for view-only connections is *'VNCview1'*
- **"Password"** default value for full access connections is *'Admin42'*

Only the VNC view-only and full access passwords can be changed as required. After modifying any parameters, select **"Apply"** to save your settings.

Email Operation

This system can utilize email messaging for various functions like daily check-ins and alarm notifications to inform the user remotely of any changes in equipment operations. The user can modify the PLC **"System Name"** that the email references in the email subject as well as the recipient address(es) that each email will be sent to[14] from the **"Email"** screen. The **"Recipients"** field can contain multiple email addresses, each separated by a comma with a maximum total length of 200 characters.

Email Settings

Alarm Notification Emails

By selecting the **"Send on New Alarm"** checkbox on the **"Email"** screen, the system can be instructed to send out email notifications when any new alarm is created in the alarm utility tool. These email notifications have the option to attach the most recent alarm log as a CSV file should the **"Attach Alarm Logs"** checkbox also be selected.

[14] Requires elevated user permissions. See the User Access Control section for more information.

Report/Daily Check-ins

When the user configures the system to send daily check-ins, they will have to select the **"Daily Check-in"** checkbox on the **"Email"** screen and enter a daily time in which the email will be sent. The email will then be sent at the time specified for each day of the week.

The following examples demonstrate the email content under automatic reporting conditions. This content will be sent to the user when the user initiates a test via the **"STATUS"** button, a new alarm is generated, or the system reaches the **"Daily Check-in"** period.

```
AXI Fuel Polisher Automated Report

System Run Mode: OFF
External Interrupt: OFF
System Pump: STANDBY

Active Alarms/Messages: 1
Summary Entries: 1
Alarm ACK Pending: NO
Alarm Summary: (CABINET LEAK, ) Review alarm history log on the controller
for additional alarm information.
```

Content Heading

System Status

Alarm Information

Diagnostic Reports

When the user is diagnosing system-related issues, they may have a report sent by email using the **"REPORT"** button on the **"Email"** screen. This will include all the pertinent information to assist in Technical Assistance and Ordering with AXI International.

```
AXI Fuel Polisher Diagnostics Report

Application: TSC 2021 Mark II - 2.5.1
PLC Serial: W6RCBA30006
Configuration: (4102) TSCX0LXXX.XX-8P
Hardware: US7-B5-R38, UAG-CX-XKP125, UID-0808R, UID-0808R, UAC-CX-01RS4

Ladder Error Number: 0x1 Function Index: 0x6
System Error Code: 0x0  Occurrence Time: 0
Error Message:
```

Content Heading

System Information

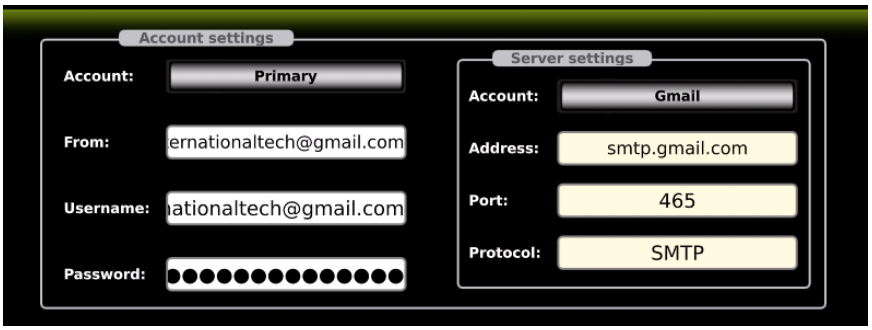
System Errors

Email Configuration

To use the email feature, there must be a valid email account configured. It requires the PLC to have a valid internet connection and properly configured DNS server(s) to function as described. The account properties that will be required to set up the email functionality are as follows:

- Address to send mail **"From"** (ensure the account has the rights to use the specified from address)
- Email account **"Username"** (some accounts use the full email address)
- Email account **"Password"**
- Account email server **"Address"** (e.g. smtp.gmail.com)
- Account email server **"Port"**

The account settings for the email used to send messages from the PLC can be configured by navigating to the **"Network"** tab under UniApps and selecting the **"Email Accounts"** button.



Email Configuration Utility

Ensure that all information is entered correctly and press "**Apply"** to save the configuration.

Modbus Communication

The Modbus points for monitoring include status, alarm, and analog values. These values are available as Modbus function calls for coils and holding registers where the Modbus register map indicates the data location in the memory. This map document should be referenced for all monitoring points.

Parameter Description	Type	Address	Data	Trigger	Format/Units
System Heartbeat	Coil	00001	bit	1	High
System In Manual	Coil	00002	bit	1	TRUE
System In Automatic/Remote	Coil	00003	bit	1	TRUE
System Turned Off	Coil	00004	bit	1	TRUE
Emergency Stop	Coil	00005	bit	1	Alarm
Cabinet Leak	Coil	00006	bit	1	Alarm
Pump Overload	Coil	00007	bit	1	Alarm
External Interrupt	Coil	00008	bit	1	TRUE
Alarms Active	Coil	00009	bit	1	Alarm
Pump Running	Coil	00010	bit	1	TRUE
High Vacuum Alarm	Coil	00011	bit	1	Alarm
High Vacuum Alert	Coil	00012	bit	1	TRUE
High Pressure Alarm	Coil	00013	bit	1	Alarm
High Pressure Alert	Coil	00014	bit	1	TRUE
Differential Pressure 1/2 Alarm	Coil	00015	bit	1	Alarm
Differential Pressure 2/3 Alarm	Coil	00016	bit	1	Alarm
Low Flow Alarm	Coil	00017	bit	1	Alarm
Low Flow Alert	Coil	00018	bit	1	Alarm
High Flow Alarm	Coil	00019	bit	1	Alarm
High Water Alarm	Coil	00020	bit	1	Alarm
AWD Active	Coil	00021	bit	1	TRUE
High Water Drum	Coil	00022	bit	1	Alarm
Valves Traveling	Coil	00049	bit	1	TRUE
Transfer Selected	Coil	00050	bit	1	TRUE

Tank 1 Overfilled	Coil	00051	bit	1	Alarm
Tank 2 Overfilled	Coil	00052	bit	1	Alarm
Tank 3 Overfilled	Coil	00053	bit	1	Alarm
Tank 4 Overfilled	Coil	00054	bit	1	Alarm
Random Valve Selection	Coil	00065	bit	1	TRUE
Parallel Valve Pairing	Coil	00066	bit	1	TRUE
Valve Outputs Active	Coil	00067	bit	1	TRUE
Pump Bleed Active	Coil	00068	bit	1	TRUE
Vacuum Header Failed	Coil	00069	bit	1	Alarm
Pressure Header Failed	Coil	00070	bit	1	Alarm
Heater Required	Coil	00081	bit	1	TRUE
Heater Running	Coil	00082	bit	1	TRUE
Cooldown Active	Coil	00083	bit	1	TRUE
Low Temperature Alarm	Coil	00084	bit	1	Alarm
High Temperature Alarm	Coil	00085	bit	1	Alarm
Supply Valve 1 Selected	Coil	00097	bit	1	TRUE
Return Valve 1 Selected	Coil	00098	bit	1	TRUE
Supply Valve 2 Selected	Coil	00099	bit	1	TRUE
Return Valve 2 Selected	Coil	00100	bit	1	TRUE
Supply Valve 3 Selected	Coil	00101	bit	1	TRUE
Return Valve 3 Selected	Coil	00102	bit	1	TRUE
Supply Valve 4 Selected	Coil	00103	bit	1	TRUE
Return Valve 4 Selected	Coil	00104	bit	1	TRUE
Supply Valve 5 Selected	Coil	00105	bit	1	TRUE
Return Valve 5 Selected	Coil	00106	bit	1	TRUE
Supply Valve 6 Selected	Coil	00107	bit	1	TRUE
Return Valve 6 Selected	Coil	00108	bit	1	TRUE
Supply Valve 7 Selected	Coil	00109	bit	1	TRUE
Return Valve 7 Selected	Coil	00110	bit	1	TRUE
Supply Valve 8 Selected	Coil	00111	bit	1	TRUE
Return Valve 8 Selected	Coil	00112	bit	1	TRUE
Supply Valve 1 Alarm	Coil	00113	bit	1	Alarm
Return Valve 1 Alarm	Coil	00114	bit	1	Alarm
Supply Valve 2 Alarm	Coil	00115	bit	1	Alarm
Return Valve 2 Alarm	Coil	00116	bit	1	Alarm
Supply Valve 3 Alarm	Coil	00117	bit	1	Alarm
Return Valve 3 Alarm	Coil	00118	bit	1	Alarm
Supply Valve 4 Alarm	Coil	00119	bit	1	Alarm
Return Valve 4 Alarm	Coil	00120	bit	1	Alarm
Supply Valve 5 Alarm	Coil	00121	bit	1	Alarm
Return Valve 5 Alarm	Coil	00122	bit	1	Alarm
Supply Valve 6 Alarm	Coil	00123	bit	1	Alarm
Return Valve 6 Alarm	Coil	00124	bit	1	Alarm

Supply Valve 7 Alarm	Coil	00125	bit	1	Alarm
Return Valve 7 Alarm	Coil	00126	bit	1	Alarm
Supply Valve 8 Alarm	Coil	00127	bit	1	Alarm
Return Valve 8 Alarm	Coil	00128	Bit	1	Alarm
Hardware Inputs	Coil	24577	bit(s) 1-40	1	High
Hardware Outputs	Coil	20481	bit(s) 1-28	1	High
Vacuum Sensor	Register	15	floating point		in-Hg
Pressure Sensor 1	Register	17	floating point		PSI
Pressure Sensor 2	Register	19	floating point		PSI
Pressure Sensor 3	Register	21	floating point		PSI
Flow Rate	Register	23	floating point		GPM
Fuel Temperature	Register	25	floating point		Fahrenheit

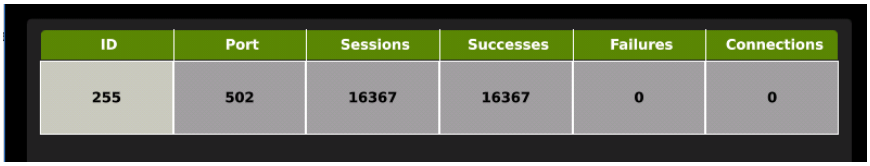
There are 2 types of Modbus available, TCP/IP and RTU[2]. TCP/IP only requires an ethernet connection to the PLC and a configured IP address for operation. RTU requires additional hardware for using serial RS485 communication. Both forms of remote monitoring may be used simultaneously.

Modbus TCP/IP

The system will allow multiple Modbus client (master) devices to connect and scan for Modbus data concurrently using the same port data. The **"ID"** will not discriminate against incoming connections and will return the same data with any ID value request. The PLC will respond to any request on the **"Port"** where the PLC IP address resides. The ethernet slave Port is not user-configurable.

- Port fixed value is *'502'*
- ID fixed value is *'255*

Under UniApps, select the **"Network"** tab at the bottom of the screen and then select the **"MODBus"** button to open the Modbus tools. Select the **"Ethernet Slave"** tab to view the status parameters.



Modbus TCP/IP Connection Information

The remaining fields shown will hold information regarding the status of the Modbus communications and the currently connected clients which may be useful for troubleshooting.

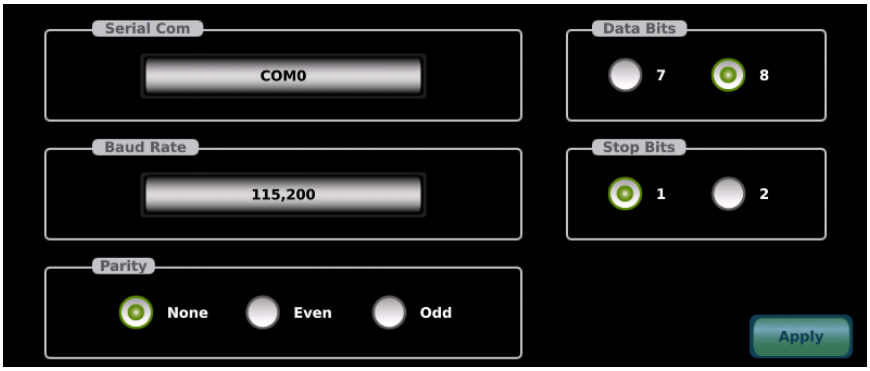
Modbus RTU

The RTU communications rely on the RS485 serial device option to be installed. The module is installed in the PLC communications expansion slot as shown in the RS-485 Serial Communication section. The serial configuration will allow the user to set the **"Baud Rate"**, **"Parity"**, **"Data Bits"**, and **"Stop Bits"**.

The communication settings for the serial device can be set by navigating to the **"Network"** tab under UniApps and selecting the **"Serial (RS)"** button to open the serial configuration screen.

- **“Serial Com”** fixed value is ‘COM0’
- **“Baud Rate”** default value is ‘115,200’
- **“Parity”** default value is ‘None’
- **“Data Bits”** default value is ‘8’
- **“Stop Bits”** default value is ‘1’

To prevent issues, ensure the parameters are configured to match the communication parameters of the RS485 network that the PLC will be communicating with.



Serial RS485 Configuration Utility

The user may configure the **“ID”** for the PLC to use when communicating via Modbus RTU by navigating to the **“Network”** tab under UniApps and selecting the **“MODBus”**. To view the status parameters, select the **“Serial Slave”** tab.

Modbus TCP/IP Connection Information

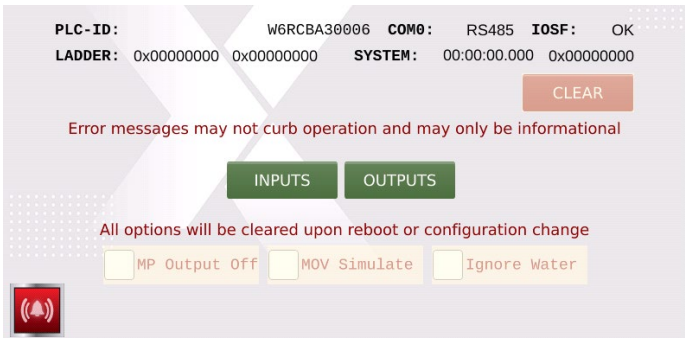
Touch the field for **“ID”** to enter a valid number ranging from 1 to 247. Changes will require a PLC reboot to take full effect. This **“ID”** will need to be unique for all serial slaves on the network to prevent conflict.

- **“ID”** default value is *‘1’*.

The remaining fields shown will hold information regarding the status of the Modbus communications and the currently connected clients which may be useful for troubleshooting.

System Information

To assist in troubleshooting improper system operations, there are screens accessible from the global menu that provide diagnostic and system information. When you are reaching out to customer support there may be a need to retrieve information from these pages.



Diagnostics Screen

Overview Screen

Diagnostics

The PLC may incur errors outside of normal operation that will register as ladder/system errors on the **"DIAGNOSE"** screen which is accessible from the global menu. These values can be useful for troubleshooting purposes and should not be cleared without first consulting the manufacturer. When you are instructed to clear the errors, the **"CLEAR"** button[15] will reset the error values.

The user may require the ability to see which inputs or outputs are currently active. These can be monitored by touching the corresponding **"INPUTS"** or **"OUTPUTS"** buttons.

There are options for testing to enable specific features. **"MP Output Off"** will disable the outputs for the multi-point option for initial testing. **"MOV Simulate"** will override valve inputs to exclusively troubleshoot wiring issues. **"Ignore Water"** will ignore the Watect sensor input to allow the controller alarm to be reset and assist in flushing the water sensor contacts in the water separator bowl.

Overview

Additional system information for troubleshooting is available from the **"INFO"** screen which can be accessed from the global menu by pressing the **"INFO"** button. The **"CONFIG"** value is the same string that is detailed in the Controller Identification section. The **"SOFTWARE"** section gives details about the PLC application that is specific by version (X.X.X). The remaining fields are lists of the configuration and hardware that are installed.

The indicators at the bottom-right of the screen show the current status of the removable media. A red cross-out overlay symbol indicates that the device is not connected to the PLC. When connected, the lock symbol will show the status of the drive's write capability along with the percentage of capacity used. The battery indicator shows the PLC memory backup battery condition.

[15] Requires elevated user permissions. See the User Access Control section for more information.

Alarm Utility

General Overview

The system has an alarm utility that will announce and track any messages within the system. There are different levels of messaging severity that uses this utility. All messages will be referred to as alarms since they use this utility. The different types of alarm notifications are critical, major, minor, and warning. The utility includes history and active banners that will help quickly convey status information to the user.

Warning! If the controller presents an alarm that is not discussed in any section of this manual, contact AXI immediately for a resolution to avoid potential damage to the equipment.

Notification Severity

The system's alarms are first categorized by severity followed by priority. The priority is used to help sort the urgency of each alarm grouped in the same severity level. This will be based on the type of response required. The severity groups are separated as follows:

- **Critical** – Indicate an alarm typically resulting from conditions that will lead to the spilling of diesel fuel (e.g., Tank Critical High Level Alarm and System Leak Alarm) and therefore will also stop the system from running.
- **Major** – Indicate an alarm typically resulting from conditions that prevent the system from operating safely (e.g., High Pressure Alarm, High Vacuum Alarm, etc.) and therefore will also stop the system from running.
- **Minor** – Indicate an alarm typically resulting from the failure of optional hardware (e.g., T1S Fail Alarm, Heater Low Alarm, Ect…) and therefore will not typically stop the system from running.
- **Warning** – Indicate an alarm typically occurring as a result of the system trying to convey to the user a given process is ongoing (e.g., Fuel Heater Active, Low Battery, etc.) and therefore will not typically stop the system from running.

Status Banner

The active alarm status banner will be visible on all non-alarm screens anytime there are active alarms. This utility will show the highest alarm severity color as the background of the banner with scrolling active alarm messages.

The banner can be expanded to display the alarm summary page by pressing the circular button on the left side of the bar. The banner can also be minimized by pressing the flashing alarm icon in the far left corner of the bar.

Critical Banner

Major Banner

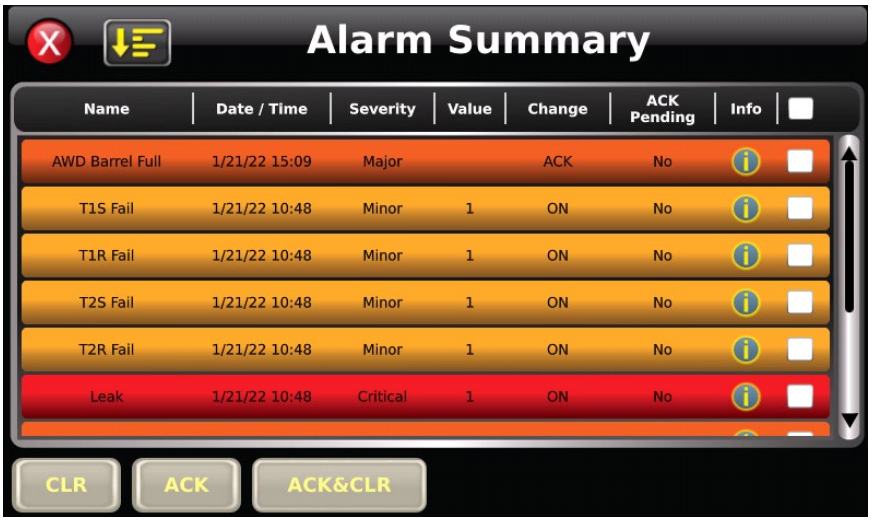
Minor Banner

Warning Banner

Alarm Summary

Active alarms can be viewed once the user has logged in by selecting the **"ALARMS"** button from the global menu. The **"Alarm Summary"** screen lists the name of each active alarm, the date and time each alarm was triggered, and each alarm's corresponding severity.

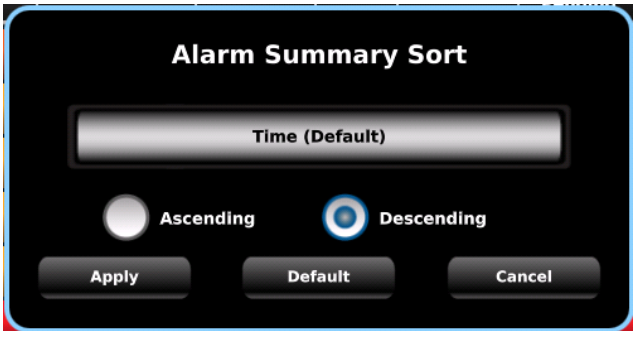
Records that have been cleared via the **"CLR"** button will be removed from the summary page list when they are no longer active. If cleared when still active, they will remain on the summary list.



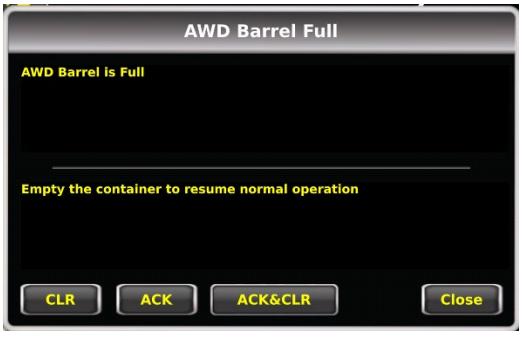
Alarm Summary Utility

The list has an **"Info"** column that can be accessed by selecting the info symbol in the corresponding alarm row. The info screen will give the operator additional information about the alarm condition and details on how to resolve the condition.

Alarms can be sorted by severity, name, time, etc. by selecting the sort icon in the top left corner of the **"Alarm Summary"** screen. A window will appear displaying a combo box to select a sorting parameter (time, severity, name, etc.) along with a set of radio buttons to select the sorting order.



Alarm Summary Sort Window



Alarm Info Screen

The operator can acknowledge and/or clear the alarms with the corresponding **"ACK"**, **"CLR"**, and **"ACK&CLR"** buttons at the bottom of the **"Alarm Summary"** and info screens.

Once acknowledged, the corresponding **"ACK Pending"** column value will change from **"Yes"** to **"No"** to indicate which alarms have been previously reviewed. Multiple alarms may be selected for batch acknowledgment or clearing by checking their corresponding checkboxes in the checkbox column. All alarms can be selected by selecting the first checkbox located on the column title row.

Alarm History

The alarm history can be viewed by selecting the **"HISTORY"** button from the global menu[16]. This screen will list all historical alarm records stored on the PLC's SD-Card during the power cycle. This information can only be removed when the operator clears the list of information with the **"CLR"** button at the top of the **"Alarm History"** screen.

This list can be sorted in the same manner as the **"Alarm Summary"** screen and will detail the time and date that the last change to the corresponding alarm event occurred via the **"Date Time"** column.

This information can be helpful when troubleshooting the system or for modifying service schedules to account for filtration contamination.

Alarm History Utility

To clear the alarm history, press the **"CLR"** button, and a pop-up window will appear asking for confirmation. To exit the **"Alarm History"** screen, press the **"CLOSE"** button in the top right corner.

Warning! When the list is cleared, there is no recovery of the data. Please ensure the system is not left logged in to prevent unauthorized clearing of the history.

System Notifications

Transmitter Error

The system can detect if any transmitter sensor is disconnected from the controller. A sensor that is disconnected will show a value much lower than the minimum setting.

If the sensors are installed backwards in a differential filter configuration, the system can detect this condition. An incorrectly installed sensor may be detectable by monitoring for a negative differential during system pump operation.

Both conditions will trigger a transmitter error state by activating all the condition-specific system alarm indicators on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface.

[16] Requires elevated user permissions. See the User Access Control section for more information.

The controller will create a new **"Major"** severity alarm log with high priority that will display on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

High Vacuum Alert

When the vacuum exceeds the system's vacuum **"Alarm Point"** setpoint, the system will go into a high vacuum alert state for the duration of the Vacuum Debounce period.

When the system is equipped with the analog vacuum option and the vacuum exceeds the system's vacuum **"Alert Point"** setpoint, the system will also go into a high vacuum alert state.

This state will be indicated by flashing the condition-specific **"HIGH VACUUM"** status indicator on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface.

For systems with a local interface, the summary **"ALARM"** status indicator will not flash if a separate alarm state has already illuminated the indicator.

The controller will also create a new **"Warning"** severity alarm log with high priority that will display on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

High Vacuum Alarm

When the vacuum exceeds the system's vacuum **"Alarm Point"** setpoint for a longer duration than the Vacuum Debounce period, the system will go into a high vacuum alarm state. This state will be indicated by activating the condition-specific **"HIGH VACUUM"** status indicator on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface.

The controller will also create a new **"Major"** severity alarm log with high priority that will display on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

High Pressure Alert

When the pressure exceeds the system's pressure **"Alarm Point"** setpoint, the system will go into a high pressure alert state for the duration of the Pressure Debounce period.

When the system is equipped with the analog pressure option and the pressure exceeds the system's pressure **"Alert Point"** setpoint, the system will also go into a high pressure alert state.

This state will be indicated by flashing the condition-specific **"HIGH PRESSURE"** status indicator only present on systems with a Remote Interface configuration.

For systems with a local interface, the summary **"ALARM"** status indicator will not flash if a separate alarm state has already illuminated the indicator.

The controller will also create a new **"Warning"** severity alarm log with high priority that will display on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

High Pressure Alarm

When the pressure exceeds the system's pressure **"Alarm Point"** setpoint for a longer duration than the Pressure Debounce period, the system will go into a high pressure alarm state. This state will be indicated by activating the condition-specific system **"HIGH PRESSURE"** status indicator on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface.

The controller will also create a new **“Major”** severity alarm log with high priority that will display on both **“Alarm Summary”** and **“Alarm History”** screens in addition to an active alarm status banner.

Filter Alert

If the system is equipped with the analog differential pressure option and the pressure exceeds the system’s pressure **“Alert Point”** setpoint, the system will go into a filter alert state.

With this configuration, the system will also go into a filter alert state for the duration of the Differential Debounce period should the pressure exceed the system’s pressure **“Alarm Point”** setpoint.

This state will be indicated by flashing the condition-specific **“HIGH PRESSURE”** status indicator only present on systems with a Remote Interface configuration.

For systems with a local interface, the summary **“ALARM”** status indicator will not flash if a separate alarm state has already illuminated the indicator.

The controller will also create a new **“Warning”** severity alarm log with high priority that will display on both **“Alarm Summary”** and **“Alarm History”** screens in addition to an active alarm status banner.

Filter Alarm

If the system is equipped with the analog differential pressure option and the pressure exceeds the system’s pressure **“Alarm Point”** setpoint for a longer duration than the Differential Debounce period, the system will go into a filter alarm state. This state will be indicated by activating the condition-specific **“HIGH PRESSURE”** status indicator only present on systems with a Remote Interface configuration.

The controller will also create a new **“Major”** severity alarm log with high priority that will display on both the **“Alarm Summary”** and **“Alarm History”** screens in addition to an active alarm status banner.

High Water Alert

When the water level in the system’s water separator triggers the water sensor, the system will go into a high water alert state for the duration of the Water Detection Debounce period. This state will be indicated by flashing the condition-specific **“HIGH WATER”** status indicator on systems with a Remote Interface or the summary **“ALARM”** status indicator for systems with a Local Interface.

For systems with a local interface, the summary **“ALARM”** status indicator will not flash if a separate alarm state has already illuminated the indicator.

High Water Alarm

When the water level in the system’s water separator triggers the water sensor for a longer duration than the Water Detection Debounce period, the system will go into a high water alarm state. This state will be indicated by activating the condition-specific **“HIGH WATER”** status indicator on systems with a Remote Interface or the summary **“ALARM”** status indicator for systems with a Local Interface.

The controller will also create a new **“Major”** severity alarm log with high priority that will display on both the **“Alarm Summary”** and **“Alarm History”** screens in addition to an active alarm status banner.

Low Flow Alert

If the flow drops below the expected flow rate, the system will go into a low flow alert state for the duration of the set Flow Debounce period. This state will be indicated by flashing the condition-specific **"LOW FLOW"** status indicator on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface.

For systems with a local interface, the summary **"ALARM"** status indicator will not flash if a separate alarm state has already illuminated the indicator.

Low Flow Alarm

If the flow drops below the expected flow rate for a longer duration than the Flow Debounce period, the system will go into a low flow alarm state. This state will be indicated by activating the condition-specific **"LOW FLOW"** status indicator on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface.

The controller will also create a new **"Major"** severity alarm log with high priority that will display on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

Leak Alarm

If enough fluid accumulates in the leak basin to lift the leak detection switch, the system will go into a leak alarm state. This state will be indicated by activating the condition-specific **"BASIN LEAK"** status indicator on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface.

The controller will also create a new **"Critical"** severity alarm log with urgent priority that will display on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

Shutdown Alarm

If the emergency stop is activated, the system will go into a shutdown alarm state. This state will be indicated by activating all condition-specific status indicators on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface.

The controller will also create a new **"Major"** severity alarm log with high priority that will display on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

Overload Alarm

When an overcurrent condition is detected by the motor starter device, the system will go into an overload alarm state, affecting the system pump operation. This state will be indicated by activating all condition-specific status indicators on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface.

The controller will also create a new **"Major"** severity alarm log with high priority that will display on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

Shutdown Alert

If there is currently a condition inhibiting the motor operation, the HMI will indicate via the motor halt icon symbol as detailed in the Screen Layout section.

If the system is configured to indicate the shutdown condition as selected in the External Shutdown section, all condition-specific status indicators on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface will flash.

For systems with a local interface, the summary **“ALARM”** status indicator will not flash if a separate alarm state has already illuminated the indicator.

The controller will also create a new **“Warning”** severity alarm log with low priority that will display on both the **“Alarm Summary”** and **“Alarm History”** screens in addition to an active alarm status banner.

Battery Alert

If the battery level is low, the system will go into a battery alert state. The controller will create a new **“Warning”** severity alarm log with high priority that will display on both the **“Alarm Summary”** and **“Alarm History”** screens in addition to an active alarm status banner.

To minimize the possibility of data corruption, this alert log will persist until the battery is replaced.

Battery Alarm

If the battery level falls to zero, or the battery is removed, the system will go into a battery alarm state. This state will be indicated by activating all condition-specific status indicators on systems with a Remote Interface or the summary **“ALARM”** status indicator for systems with a Local Interface.

The controller will also create a new **“Warning”** severity alarm log with high priority that will display on both the **“Alarm Summary”** and **“Alarm History”** screens in addition to an active alarm status banner.

This alarm log will be persistent until the battery is replaced to minimize the possibility of data corruption.

System Protection

System Vacuum Monitoring

Systems that include an in-built fuel pump will have vacuum detection placed before the inlet of the pump to monitor excessive vacuum and prevent pump damage from occurring.

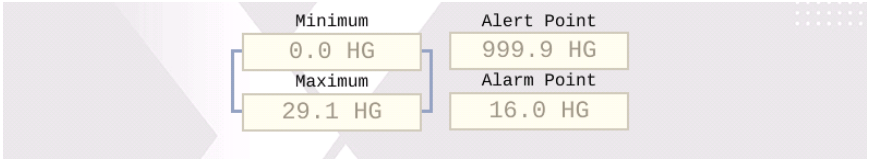
Discrete (Switch) Vacuum Monitoring

This configuration will include an electrical switch in which the contacts are normally closed until the negative pressure exceeds the hardware setpoint indicating a high vacuum reading.

Analog (Transmitter) Vacuum Monitoring

This configuration requires the optional pressure transmitter[17] which uses a device that converts the system vacuum into a current in the standard range of 4-20mA. This gives the user the ability to set independent **"Alert Point"** and **"Alarm Point"** setpoints within the measuring range of the sensor.

To view the status of the transmitter, or to modify the configuration, navigate to the vacuum transmitter configuration screen by selecting the **"VACUUM"** button on the global menu.



Vacuum Transmitter Configuration

The **"Minimum"** and **"Maximum"** parameters refer to the sensing range of the device and should only be modified by a qualified technician[18]. If the **"Alert Point"** value is not set (0.0 in-Hg), the system will not monitor for the alert condition[18].

- **"Minimum"** default value is *0.0 HG*.
- **"Maximum"** default value is *29.1 HG.*
- **"Alert Point"** default value is *0.0 HG.*
- **"Alarm Point"** default value is *12.0 HG.*

The sensor graphic on the configuration screen will indicate the maximum vacuum value reached via a telltale needle that holds at the maximum value until it is reset when the pump runs again.

When the sensor value rises above the **"Alert Point"**, the system will go into a High Pressure Alert state to signal imminent servicing is required.

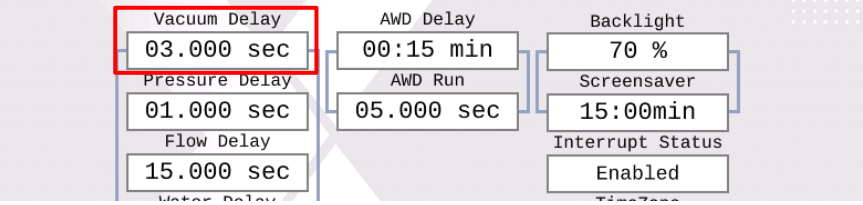
Vacuum Debounce

To account for false positives from system start-up vacuum fluctuations and electrical noise, a debounce period is used to delay the trigger for this condition. The system pump must be running and the sensor must be indicating a constant high vacuum state for the duration of the debounce to trigger the alarm.

[17] Not included in the base configuration as shown in the Controller Identification section.
[18] Requires elevated user permissions. See the User Access Control section for more information.

To change the delay length, navigate to the **"SETTINGS"** screen from the global menu and select the **"Vacuum Delay"** input box to enter the desired debounce time in seconds and milliseconds[19].

- **"Vacuum Delay"** default value is *3 seconds* with a maximum of *5 seconds.*



Vacuum Sensor Delay Settings

Once the vacuum level increase above the **"Alarm Point"** setpoint, the debounce period will commence.

During the debounce period, the system will go into a High Vacuum Alert state to signal that the debounce is active. After the debounce period is complete, the controller will go into a High Vacuum Alarm state to signal that servicing is required.

After the alarm condition has been triggered, the user must resolve the high vacuum condition and reset the alarms from the controller to resume operation.

System Pressure Monitoring

Systems will have pressure detection placed after the outlet of the pump to monitor excessive pressure and prevent pump damage from occurring.

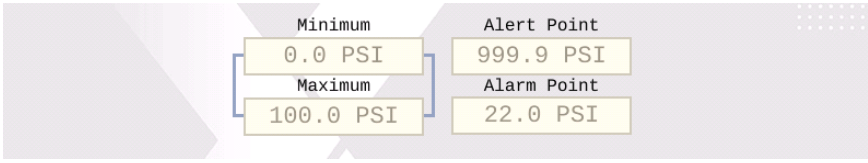
Discrete (Switch) Pressure Monitoring

This configuration will include an electrical switch in which the contacts are normally closed until the pressure exceeds the hardware setpoint indicating a high pressure reading.

Analog (Transmitter) Pressure Monitoring

This configuration requires the optional pressure transmitter[20] which has a device that converts the system pressure into a current in the standard range of 4-20mA. This gives the user the ability to set independent **"Alert Point"** and **"Alarm Point"** setpoints within the measuring range of the sensor.

To view the status of the transmitter, or to modify the configuration, navigate to the pressure transmitter configuration screen by selecting the **"PRESSURE"** button from the global menu.



Pressure Transmitter Configuration

[19] Requires elevated user permissions. See the User Access Control section for more information.
[20] Not included in the base configuration as shown in the Controller Identification section.

The **“Minimum”** and **“Maximum”** parameters refer to the sensing range of the device and should only be modified by a qualified technician[21]. If the **“Alert Point”** value is not set (0.0 PSI), the system will not monitor for the alert condition.

- **“Minimum”** default value is *0.0 PSI*.
- **“Maximum”** default value is *100.0 PSI.*
- **“Alert Point”** default value is *0.0 PSI.*
- **“Alarm Point”** default value is *22.0 PSI.*

The sensor graphic on the configuration screen will indicate the maximum pressure value reached via a telltale needle that holds at the maximum value until it is reset when the pump runs again.

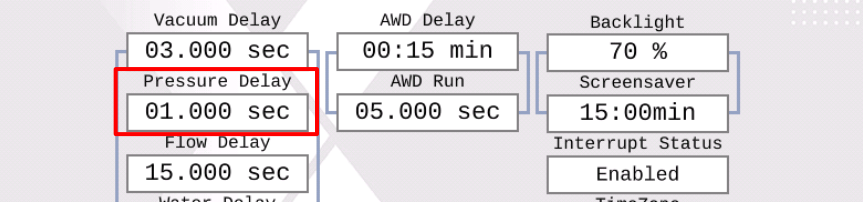
When the sensor value rises above the **“Alert Point”** the system will go into a High Pressure Alert state to signal imminent servicing is required.

Pressure Debounce

To account for false positives from system start-up pressure fluctuations and electrical noise, a debounce period is used to delay the trigger for this condition. The system pump must be running, and the sensor must be indicating a constant high pressure state for the duration of the debounce to trigger the alarm.

To change the delay length, navigate to the **“SETTINGS”** screen from the global menu and select the **“Pressure Delay”** input box to enter the desired debounce time in seconds and milliseconds[21].

- **“Pressure Delay”** default value is *1 second* with a maximum of *3 seconds*.



Pressure Sensor Delay Settings

Once the pressure level increase above the **“Alarm Point”** setpoint, the debounce period will commence.

During the debounce period, the system will go into a High Pressure Alert state to signal that the debounce is active. After the debounce period is complete, the controller will go into a High Pressure Alarm state to signal that servicing is required.

After the alarm condition has been triggered, the user must resolve the condition and reset the alarms from the controller to resume operation.

Differential Filter Monitoring

Systems that require the differential filter option will utilize a differential pressure (positive pressure application) detection device around each monitored filter housing to ensure the terminal differential capacity of the vessel is not exceeded.

[21] Requires elevated user permissions. See the User Access Control section for more information.

Discrete (Switch) Differential Monitoring

This configuration will include an electrical switch in which the contacts are normally closed until the differential pressure exceeds the hardware setpoint indicating a high differential pressure reading.

Analog (Transmitter) Differential Monitoring

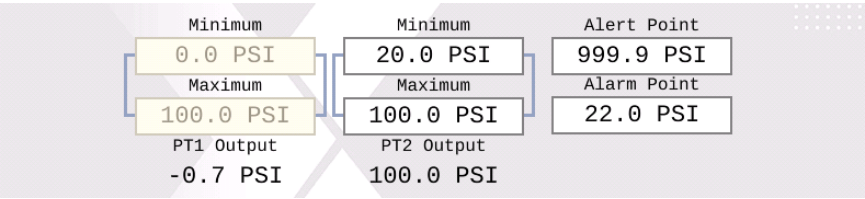
This configuration has multiple pressure transmitters[22] that convert the system pressure, corresponding to the sensor location, into a current in the standard range of 4-20mA. This gives the user the ability to set independent **"Alert Point"** and **"Alarm Point"** setpoints within the measuring range of the sensor.

- **"Alert Point"** default value is *0.0 PSI.*
- **"Alarm Point"** default value is *22.0 PSI*.

The sensors that make up the analog differential are installed on both the inlet and outlet of the vessel that is being monitored. Each device can be configured independently of the other and have the resulting differential value calculated in the PLC. The following default values apply to both the "high side" and the "low side" sensor devices. As an example, filter 1's differential will use "**PT1"** and **"PT2"** sensors.

- **"Minimum"** default value is *0.0 PSI*.
- **"Maximum"** default value is *100.0 PSI.*

To view the status of the transmitter, or to modify the configuration, navigate to the pressure transmitter configuration screen by selecting the **"PRESSURE"** button from the global menu.



Filter Transmitter Configuration

The **"Minimum"** and **"Maximum"** parameters for each half of the differential refer to the sensing range of the device and should only be modified by a qualified technician[23].

If the **"Alert Point"** value is not set (0.0 PSI) or is set to the **"Alarm Point"** value, the system will not monitor for the alert condition[23].

The sensor graphic on the configuration screen will indicate the maximum pressure value reached via a telltale needle that holds at the maximum value until it is reset when the pump runs again.

When the sensor value rises above the **"Alert Point"**, the system will go into a Filter Alert state to signal imminent servicing is required.

[22] Not included in the base configuration as shown in the Controller Identification section.
[23] Requires elevated user permissions. See the User Access Control section for more information.

Differential Debounce

To account for false positives from system start-up pressure fluctuations and electrical noise, the same debounce period for System Pressure Debounce is used to delay the trigger for this condition. The system pump must be running, and the sensor must be indicating a constant high differential state for the duration of the debounce to trigger the alarm.

Once the differential level increases above the **"Alarm Point"** setpoint, the debounce period will commence.

During the debounce period, the system will go into a Filter Alert state to signal that the debounce is active. After the debounce period is complete, the controller will go into a Filter Alarm state to signal that servicing is required.

After the alarm condition has been triggered, the user must resolve the condition and reset the alarms from the controller to resume operation.

Water Detection

Water separation takes place continuously within the primary filter/water separator during the polishing process. The water level within the vessel is monitored through a water detection device with a probe located on the surface of the vessel housing.

Once the water level reaches the level of the probes, the system will shut down until the necessary servicing has been performed; The water must be manually drained via the drainage port at the bottom of the filter housing.

Manual Water Drain

This configuration will include an electrical switch in which the contacts are normally closed until the water level reaches the probe's positions indicating a high water level reading

Water Detection Debounce

To account for false positives from system start-up fluid movement, level fluctuations, and electrical noise, a debounce period is used to delay the trigger for this condition. The sensor must indicate a constant high water condition for the duration of the debounce to trigger the alarm.

To change the delay length, navigate to the **"SETTINGS"** screen from the global menu and select the **"Water Delay"** input box to enter the desired debounce time in seconds and milliseconds[24].

- "**Water Detection Delay**" default value is *3 seconds*.

Water Sensor Delay Settings

In configurations with the automatic water drain[25] upgrade, the debounce period will be extended as indicated in the Automatic Water Drain section.

[24] Requires elevated user permissions. See the User Access Control section for more information.
[25] Not included in the base configuration as shown in the Controller Identification section.

If the water sensor is providing inaccurate readings, the user may temporarily ignore the sensor input to attempt to wash away any contaminants on the probe using the **"Ignore Water"** sensor function as described in the Diagnostics section.

Once the water level increases above the probes, the debounce period will commence.

During the debounce period, the system will go into a High Water Alert state to signal that the debounce is active. After the debounce period is complete, the controller will go into a High Water Alarm state to signal that servicing is required.

After the alarm condition has been triggered, the user must resolve the high water condition and reset the alarms from the controller to resume operation.

Fuel Flow Monitoring

Systems will have flow detection placed on the outlet side of the pump to monitor for conditions that fall below the expected flow rate. This is to prevent pump damage caused by running the pump dry for an extended period.

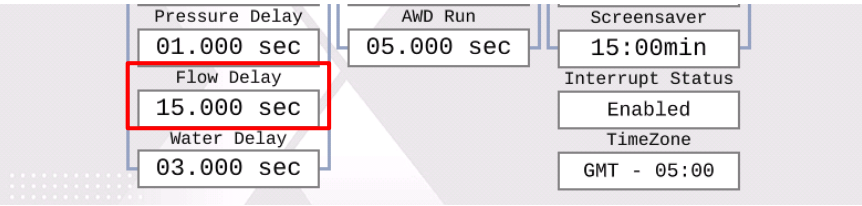
This configuration will include an electrical switch in which the contacts are normally closed when the flow exceeds the hardware setpoint indicating good flow.

Flow Debounce

To account for false positives from system start-up air pockets, flow fluctuations, and electrical noise, a debounce period is used to delay the trigger for this condition. The system pump must be running and the sensor must be indicating a constant low flow state for the duration of the debounce to trigger the alarm.

To change the delay length, navigate to the **"SETTINGS"** screen from the global menu and select the **"Flow Delay"** input box to enter the desired debounce time in seconds and milliseconds[26].

- "**Flow Delay**" default value is *10 seconds* with a maximum of *15 seconds*.



Flow Sensor Delay Settings

In configurations with a P-35 passive filtration operation, the debounce period is infinite and will never cause the system to create a low flow alarm.

Once the flow rate falls below the device hardware setpoint, the debounce period will commence.

During the debounce period, the system will go into a Low Flow Alert state to signal that the debounce is active. After the debounce period is complete, the controller will go into a Low Flow Alarm state to signal that servicing is required.

Once the alarm condition has been triggered, the user must resolve the condition and reset the alarms from the controller to resume operation.

[26] Requires elevated user permissions. See the User Access Control section for more information.

Leak Detection

Systems will have a float switch located in the leak basin to detect if there is a fuel leak present likely caused by a failure in the plumbing or faulty installation of removable devices.

This will include an electrical switch in which the contacts are normally closed when there isn't a sufficient volume of fluid in the leak basin to lift the buoyant float.

Once the switch changes to an open circuit, the system will go into a Leak Alarm state, signaling that there is an unsafe condition that requires immediate resolution. There is an input filter that prevents the device from triggering false alarms due to electrical noise and minor system vibrations.

Once the alarm condition has been triggered, the user must resolve the condition and reset the alarms from the controller to resume operation.

Emergency Stop

This device is a true E-Stop device that will interrupt the PLC signal to the motor contactor to perform emergency shutdown operations. The PLC additionally monitors the state of the **"EMERGENCY STOP"** mushroom pushbutton device to alert the controller of changes in operation.

It consists of a normally-closed set of contacts provided by a universally identifiable device located externally on the controller that indicates safe operation unless tripped.

In systems that do have a Remote Interface, the circuit for an external (supplied by others) emergency stop pushbutton is jumpered as indicated on the wiring diagram.

Once the switch changes to an open circuit, the system will go into a system Shutdown Alarm state to signal there is an all-stop condition triggered by the operator. There is an input filter that prevents the device from triggering false alarms due to electrical noise.

Once the alarm condition has been triggered, the user must resolve the condition and reset the alarms from the controller to resume operation.

System Pump Motor Overload

Systems equipped with a motor overload relay module will send a signal to the PLC when there is an overcurrent condition detected by the motor starter device.

This configuration will include a set of contact switches in which one contact is normally open until the motor current exceeds the hardware setpoint indicating a motor overload condition.

- Adjustable factory overload current setpoint depends on the FLA for the motor supplied.

The other contact will be a normally closed circuit that is wired in line with the pump run output signal from the PLC to the coil of the motor contactor to prevent the contactor from staying energized closed during an overload situation.

Once the switch changes to a close circuit, the system pump must be running and the system will go into an Overload Alarm state to signal there is an issue with the system pump-motor. There is an input filter that prevents the device from triggering false alarms due to electrical noise.

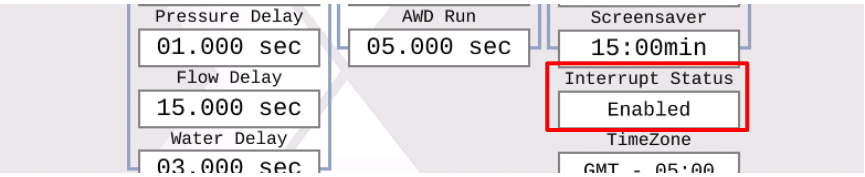
Once the alarm condition has been triggered, the user must resolve the condition by addressing the cause of the over-current and triggering the overload relay **"Reset"** on the face of the overload relay device inside the controller enclosure (refer to panel layout diagram for exact location) and then reset the alarms from the controller to resume operation.

External Shutdown

Systems not using the "MTC" configuration will have the option to use an externally supplied, voltage-free, contact to signal the controller to inhibit pump operation. This signal will be a normally open switch that is connected to the input as indicated on the electrical diagram.

Once the switch changes to a closed-circuit the system will go into a Shutdown Alert state and signal there is an inhibit active which will halt the pump operation until the condition is removed.

To change the system indication option, navigate to the **"SETTINGS"** screen from the global menu and select the **"Interrupt Status"** drop-down field[27].



Interrupt Indication Input

If the option for **"Interrupt Status"** is **"Enabled"**, the system will additionally indicate the external shutdown condition by flashing all condition-specific status indicators on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface.

For systems with a local interface, the summary **"ALARM"** status indicator will not flash if a separate alarm state has already illuminated the indicator.

PLC Memory Battery

The PLC provides a battery monitoring feature that generates an alarm condition when the charge falls below a certain level, indicating that the battery is either low, missing, or damaged.

If the battery is not providing appropriate power when the external system power is removed, the PLC data may be factory reset which will require commissioning again.

If the battery level is low, the system will trigger a Battery Alert to indicate that servicing is required. If the battery level falls to zero, or the battery is removed, the system will trigger a Battery Alarm to indicate failure is imminent.

Battery Good

Battery Low

Battery Missing/Empty

There is an additional battery status indicator on the **"INFO"** Screen that will display the current condition of the battery.

[27] Requires elevated user permissions. See the User Access Control section for more information.

Automatic Water Drain

Operation Overview

This function requires the optional Automatic Water Drain (AWD)[28] upgrade to enhance the manual servicing required whenever a high water condition is detected. The upgrade operation will attempt to automatically drain the system's water-holding vessel into an external water holding barrel by using the standard water detection sensor and a single drain pump.

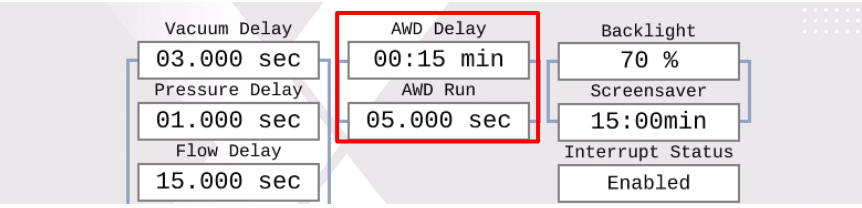
This function does not rely on a certain mode for operation and will carry out the same routine in both **"HAND"** and **"AUTO"** mode so long as the system pump is running. If the pump is not running, the process will hold until a scheduled run is active.

The operation uses a time-based method of water removal that relies on the information provided by the water sensor on the base equipment. When a high water condition is triggered for a duration longer than the Water Detection Debounce period, the system pump will be interrupted for the duration of the **"AWD Delay"** timer. After this period, the automated water draining process will begin for the duration of the **"AWD Run"** timer.

For systems with a P-35 passive filtration operation, the external pump will not be interrupted while the automated draining process occurs.

To change the timer settings, navigate to the **"SETTINGS"** screen from the global menu and select either the **"AWD Delay"** or **"AWD Run"** input boxes to enter the desired time in seconds and milliseconds[29].

- **"AWD Delay"** default value is *15 seconds*.
- **"AWD Run"** default value is *5 seconds* (adjusted to installation conditions).



Auto Water Drain Settings

Water Holding Barrel

The external water holding barrel contains a normally closed contact device that will open when a full condition is detected. Once the switch changes to an open circuit, the system will go into a High Water Alert state and trigger a High Barrel Alarm to signal that manual servicing will be needed. There is an input filter device that prevents the device from triggering false alarms due to electrical noise.

If the holding tank is full and the system's sensor triggers a high water condition for a duration longer than the Water Detection Debounce period, the system will not activate the AWD process but will instead trigger a High Water Alarm condition, requiring manual servicing.

[28] Not included in the base configuration as shown in the Controller Identification section
[29] Requires elevated user permissions. See the User Access Control section for more information.

Settling Period

Once the water separator has reached a high water level, a High Water Alert condition will be triggered, prompting the system to remove water from the separator should the condition persist beyond the Water Detection Debounce period.

After the Water Detection Debounce period, the **"AWD Delay"** timer will count down while the contents of the water separation vessel are allowed to settle without agitation. If at any time during the settling period, the high water condition is removed, the process will terminate and the system will resume normal operation.

Draining Period

At the end of the settling period, the AWD drain solenoid valve will open and the drain pump will begin running to remove the water from the system's water-holding vessel to an external water holding barrel.

The **"AWD Run"** timer will begin counting down once the drain pump starts running. If the timer completes counting before the high water condition is cleared, the system will indicate a High Water Alarm condition.

If the condition is removed before the timer completes counting, the drain pump will continue to run for the remainder of the **"AWD Run"** timer.

When the **"AWD Run"** timer completes, the drain pump will deactivate and the system pump will resume operation.

System Notifications

High Water Alert

When the water level in the external water holding barrel triggers a full condition, the system will go into a high water alert.

The system will also go into a high water alert state for the duration of the Water Detection Debounce period should a high water level condition occur in the water separation.

This state will be indicated by flashing the condition-specific **"HIGH WATER"** status indicator on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface.

For systems with a local interface, the summary **"ALARM"** status indicator will not flash if a separate alarm state has already illuminated the indicator.

The controller will also create a new **"Warning"** severity alarm log with low priority that will display on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

High Water Alarm

When the water level in the system's water separator triggers the water sensor for longer than the set Water Detection Debounce period and the AWD operation fails to clear the condition, the system will go into a high water alarm state. This state will be indicated by activating the condition-specific **"HIGH WATER"** status indicator on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface.

The controller will also create a new **"Major"** severity alarm log with high priority that will display on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

To reset the alarm when the draining process fails to clear a high water condition, the operator may manually drain the bowl or override the water sensor using the **Error! Reference source not found.**screen.

High Barrel Alarm

When the external water holding barrel detects a full condition, the system will go into a high barrel alarm state. This state will be indicated by activating the summary **"ALARM"** status indicator for systems with a Local Interface.

The controller will also create a new **"Major"** alarm with medium priority on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

Water Drain Active Alert

When the AWD operation is active, the system will go into a process active alert state for the duration of the water drain process.

The controller will create a new **"Warning"** severity alarm log with low priority that will display on both the **"Alarm Summary"** and **"Alarm History"** screens.

Multi-Tank Polishing

Operation Overview

This function requires an optional 2T, 2TL, 3T, or 4T flow path feature to provide a means for polishing multiple tanks with a single system. This feature utilizes Motor Operated Valves (MOVs) to select one of the connected tanks for fuel recirculation.

This feature will be configured with either L-Port (3 way) or Straight-Port (2 way) valves that are programmed to ensure that only one tank's supply and return valve is opened at a time to prevent unexpected fuel transfers between tanks.

The system has an in-built method to transfer fuel from one tank to another via the manual operation mode that can be activated by a verified user as shown in the User Access Control section.

There will be additional hardware required (not supplied by the manufacturer) that allows the controller to sense overfilled fluid level conditions in each tank. This input is known as the Critical High (CRH) level input and must be wired to a live device in the tank to ensure safe operation as detailed in the Visually, there is no difference between the L-Port and Straight-Port valve configurations on the HMI.

In addition to status indication, the valve icons serve as buttons. To select the desired tank for fuel recirculation, simply press one of the corresponding valve icons while in **"HAND"** mode and wait for the valves to travel accordingly.

Tank Overfill section.

The valves for each tank will be controlled to open the path for the active tank. Upon the system going into standby, the valves will not close but instead, remain in the last active position.

There will be a sequential priority for valve control to prevent overloading the power supply due to simultaneous valve travel. Priority will be given to **"Tank 1"** valves followed by **"Tank 2",** and, if applicable, **"Tank 3"** and 4.

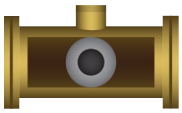
Valve Control

In the L-Port configuration, the tanks use one pair of valves to control the isolation of tank 1 and tank 2 as indicated in the electrical diagrams. In contrast, with the Straight-Port configuration, the tanks use a series of valve pairs per individual tank, as indicated in the electrical diagrams.

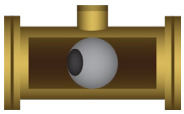
Each valve will have inputs for controlling the direction of movement and endpoint outputs that signal the PLC when the valve has reached the end positions. The valve actuator includes a resistive heater element that helps create a temperature differential to prevent condensation from forming on the electronics. It is recommended that this always be on to protect the actuator.

The status of the valves can be viewed by navigating to the **"TANKS"** screen from the global menu.

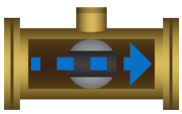
The valve body will indicate the current position of the valve as shown below:



Valve Position Closed



Valve Position Unknown



Valve Position Open

The actuator will additionally signal the current state of the motor as shown below:

Unavailable *Available* *Selected* *Error* *Energized* *Traveling*

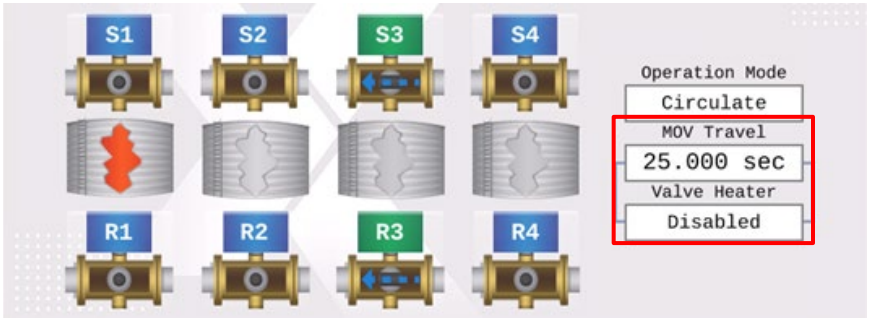
Each valve will take some time to travel from one position to the other. There will be a delay timer to ensure proper operation of each valve known as the **"MOV Travel"** timer. If the valve is not in the expected position before the timer completes, the system will trigger a MOV Failure Alarm and cause the corresponding tank to shut down.

Traveling valves will halt in any position when the system shuts down due to an alarm condition. They will resume operation when the condition is cleared.

To change the **"MOV Travel"** time or activate/deactivate the **"Valve Heater"** elements, navigate to the **"TANKS"** screen from the global menu and press the corresponding input box. For **"MOV Travel"**, users can input the desired travel time in seconds and milliseconds[30]. For **"Valve Heater"**, users can choose the desired value from the input's drop-down menu[30].

The **"MOV Travel"** value may require fine-tuning to ensure the valve has ample time to travel while also making sure the system does not wait too long to identify a failed valve.

- **"MOV Travel"** default delay period is *25 seconds.*
- **"Valve Heater"** default value is '*Disabled*'



Multi-Tank Valve Settings

Visually, there is no difference between the L-Port and Straight-Port valve configurations on the HMI.

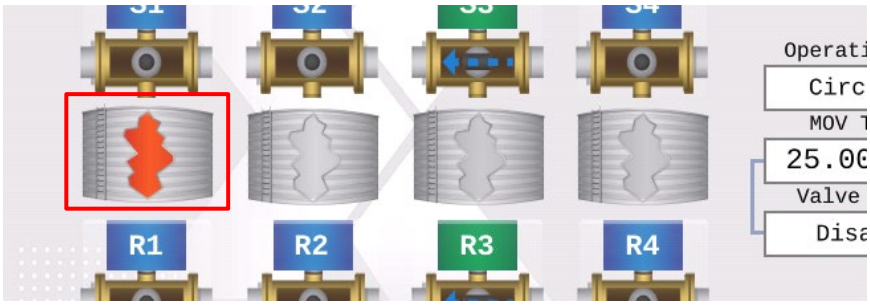
In addition to status indication, the valve icons serve as buttons[30]. To select the desired tank for fuel recirculation, simply press one of the corresponding valve icons while in **"HAND"** mode and wait for the valves to travel accordingly.

Tank Overfill

This feature is to ensure there is no unexpected fuel transfer between tanks during normal operation, resulting in an overfill condition. The switch will be a normally closed device that will open when an unsafe critical high condition for the tank is detected.

Once the switch changes to an open circuit, the system will go into a Tank Overfill Alarm state and halt all operations to signal there is an all-stop condition that must be resolved. This condition is self-clearing and will only be active when the sensor continues to detect an overfill condition.

[30] Requires elevated user permissions. See the User Access Control section for more information.



Multi-Tank Overfill Indication

The **"TANKS"** screen will provide additional indication of a tank overfill condition with the corresponding tank icon displaying fuel in its cutaway section.

This condition can be resolved by using some of the fuel in the overfilled tank via external loads or by using the manual Tank Transfer (CRH Resolution) operation to move fuel from the overfilled tank to another one of the connected tanks.

Automatic Tank Recirculation:

When in **"AUTO"** mode, tank selection can be handled automatically via a set of daily runtime schedules. Each tank has its own runtime schedule and corresponding scheduling screen which can be accessed from the global menu by pressing one of the **"TANK 1"**, **"TANK 2"**, **"TANK 3"**, or **"TANK 4"** buttons. Once on the desired scheduling screen, the tank's schedule can be set as covered in the Setting Runtime Schedule section.

Each of the tank schedules will be continuously checked for overlap. If there is an overlap or incorrect setting detected, the system will notify the user by activating the Schedule Conflict Alert. Any scheduling overlap will also result in a **"Runtime Schedule Conflict"** indication on the scheduling page.

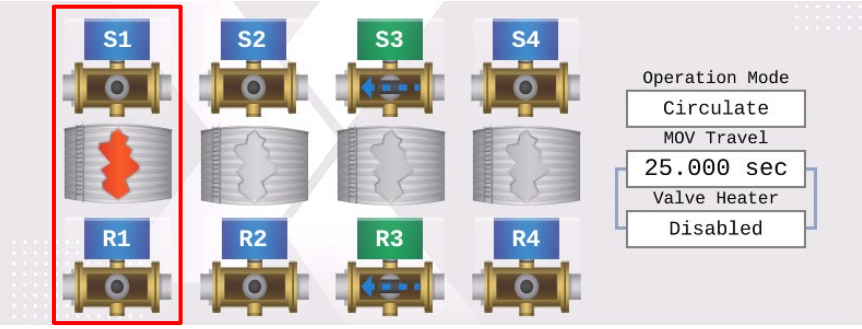
There will be a 1 minute rest period between any scheduled runtime, allowing the system to shut down fully before continuing onto the next active tank's runtime schedule. The controller will automatically reroute the fuel lines to the next appropriate tank, opening the corresponding valves once the previous tank's valves are fully closed.

Manual Tank Recirculation:

When in **"HAND"** mode, users can manually select an available tank for indefinite recirculation of its fuel or valve troubleshooting purposes.

Once the system's selector switch is in the **"HAND"** position for a period greater than *5 seconds*, the system will start recirculating fuel from the tank that was last active.

If the selector switch was in the **"HAND"** position then briefly moved to another position and back to the **"HAND"** position again, the tank selection will change, rotating in a round-robin fashion (1 → 2 → 3 → 1 → etc. for a 3 tank system).



Multi-Tank Manual Control

Alternatively, manual tank selection can occur on the **"TANKS"** screen. To select the desired tank for fuel recirculation, simply press one of the corresponding valve icons and wait for the valves to travel accordingly.

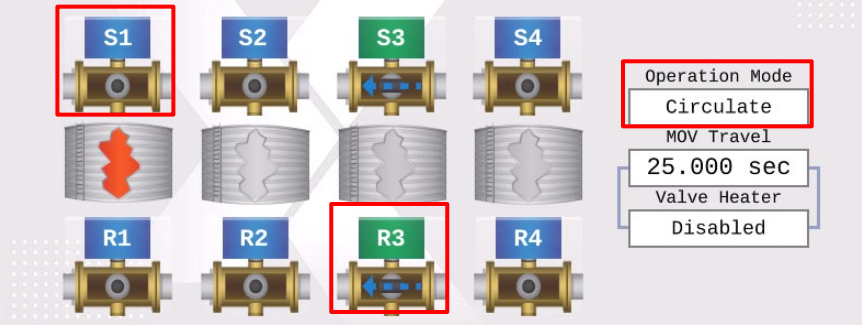
Tank Transfer (CRH Resolution)

Warning! This process must be monitored at all times by an on-site technician to ensure the tanks do not get to a catastrophic overflow situation. It is highly recommended that only trained technicians perform this operation.

If the fuel level in the destination tank is within acceptable limits and the fuel level in the source tank is critically high, the user can initiate a manual transfer process to correct the overfill condition in the source tank.

With the system in **"HAND"** mode, the user can manually transfer fuel between the connected tanks. To perform this operation, the user must change the **"Operation Mode"** from **"Circulate"** to **"Transfer"** by selecting the **"Operation Mode"** input box on the **"TANKS"** screen[31].

Anytime the system is switched out of **"HAND"** mode, the **"Operation Mode"** will reset to **"Circulate"**, not allowing any fuel transfers to occur outside of manual operation.



Multi-Tank Fuel Transfer Control

The user can begin a transfer process by selecting a source and destination tank via the **"TANKS"** screen. To select the desired source and destination tank, simply press one of the corresponding supply (**"S1"**, **"S2"**,etc.) and return (**"R1"**, **"R2"**,etc.) valve icons. Once the valves have traveled to their proper positions, the pump will begin to transfer fuel from the source tank to the destination tank.

Should the fuel level within the destination tank reach an overfill state, the controller will stop the system pump from running and the user will be notified of the condition via a new Tank Overfill Alarm.

[31] Requires elevated user permissions. See the User Access Control section for more information.

Only selecting a destination tank with an acceptable fuel level will allow the system pump to operate in transfer mode.

To stop a fuel transfer, the user may either change the **"Operation Mode"** on the **"TANKS"** screen or turn the system selector switch out of the **"HAND"** position.

System Notifications

Schedule Conflict Alert

When an overlap between two or more runtime schedules is detected, the system will go into a schedule conflict alert state. This state will be indicated by a **"Runtime Schedule Conflict"** message on the tank scheduling page.

The controller will also create a new **"Warning"** alarm with high priority on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

MOV Failure Alarm

When a valve fails to achieve the expected position within the time set by the **"MOV Travel"** timer, the system will go into a MOV failure alarm state. This state will be indicated by activating the summary **"ALARM"** status indicator for systems with a Local Interface.

Only the operation of the associated tank will be affected by preventing the user from selecting the valves placed in an error state, thus preventing fuel recirculation for that specific tank.

The controller will also create a new **"Minor"** alarm with high priority on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

Warning! Do not attempt to move the valve with the actuator override while the controller is in control of the valve travel. This can cause permanent damage to the valve, not covered under warranty. Due to this limitation, it is advised that during maintenance the valves that will be overridden to manually drive be disconnected from the PLC during service.

Tank Overfill Alarm

When fuel reaches a critically high level in one of the tanks, the system will go into an overfill alarm state. This state will be indicated by activating the summary **"ALARM"** status indicator for systems with a Local Interface.

Unless in **"Transfer"** mode, this condition will affect the operation of all tanks by preventing users from recirculating fuel from any of the connected tanks.

The controller will also create a new **"Critical"** alarm with urgent priority on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

Multi-Point Circulation

Operation Overview

Multi-Point fuel polishing adds additional supply and return ports to the tank, each individually activated by a Solenoid Operated Valve (SOV). This flow path feature allows the fuel polishing system to create different flow paths within the tank to maximize its cleaning coverage between common tank obstructions. Up to 8 pairs of supply and return SOVs can be included in an installation.

The system can detect individual valve failures as high vacuum and pressure conditions trigger the Header Monitoring devices installed on the supply and return headers respectively. These sensors will be referred to as MPFP header switches in order to be differentiated from the system's standard vacuum and pressure sensors.

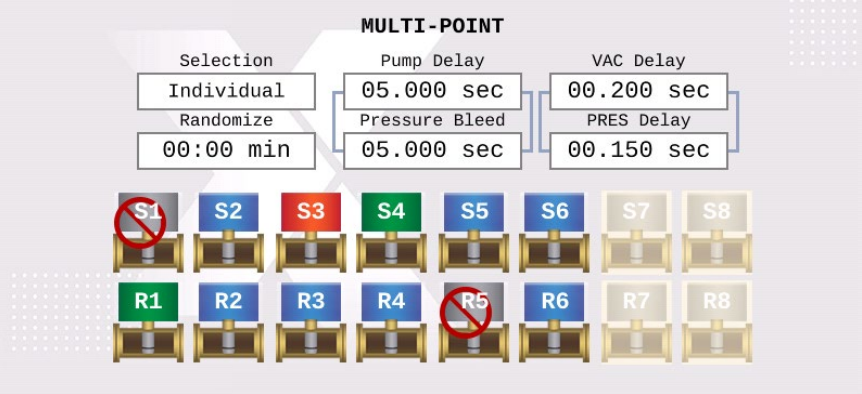
To run, the system requires a pair of supply and return valves to be selected and successfully activated via user input or automated selection. When a valid pair of supply and return valves have been selected and the system is scheduled to run, the selected valves will activate, triggering a **"Pump Delay"** period. The pump will begin to operate when the delay period is completed and the selected valves have successfully opened.

When the valve **"Selection"** mode is set to **"Individual"** (manual selection) and the system has no valid valve choice selected, it will not operate until a valid valve pair has been selected by the user.

When the valve **"Selection"** mode is set to **"Randomize"** or **"Pairs"** (automated selection) and there are no valid choices available due to valve failures or disabling, the system will shut down and trigger an MPFP Failure Alarm.

After a failed valve is detected or the scheduled run completes, the system will keep the valves energized for the duration of the **"Pressure Bleed"** timer to remove excess pressure from the headers.

To change any of the configurable parameters of the operation, navigate to the **"MPFP"** screen from the global menu and press the desired input box to edit the contained value. From this screen, users can choose the valve **"Selection"** mode, adjust operational timers, enable/disable individual valves, and monitor the status of each valve.



Multi-Point Configuration & Control Screen

Solenoid Valve Control

Each valve will have an individual output to control its activation from the controller. When any valve has been selected to run, its output will be energized to open the valve and its position will be assumed as such. When any valve is no longer selected, its output will cease to be energized to close the valve and its position will also be assumed as such. There is no

valve position feedback to the controller, leaving the proper operation to be inferred by the feedback or lack thereof from the MPFP Header Monitoring devices.

Only a single supply and single return valve can be activated at a given time. A new pair of valves will only be activated when a new, valid, selection is chosen and the currently active valves are no longer energized.

All valves operation will halt when the system shutdowns due to an active alarm. Valve operation will resume once the alarm condition has been addressed and cleared.

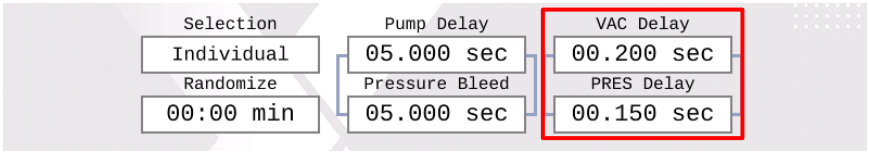
Header Monitoring

Each supply and return header will have a vacuum or pressure detection device that will be mounted on the respective header to detect potential valve failure conditions (e.g. high vacuum and high pressure conditions).

To account for false positives, a debounce period is used to delay the trigger for any valve failure condition. Should a high pressure or high vacuum condition persist beyond the duration of the debounce timer, the energized valve on the respective header will be faulted and a Valve Failure Alarm will be triggered.

To change the delay length for the MPFP header switches, navigate to the **"MPFP"** screen from the global menu. Select the **"VAC Delay"** input box, for the supply header switch, or the **"PRES DELAY"** input box, for the return header switch, and enter the desired debounce time in seconds and milliseconds.

- "**PRES Delay**" default value is *0.2 seconds* not to exceed *1 second*.
- "**VAC Delay**" default value is *0.15 seconds* not to exceed *1 second*.



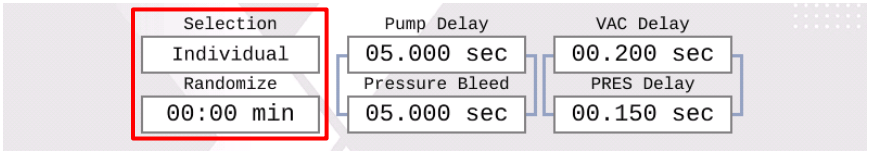
Multi-Point Sensor Delay Settings

Once the MPFP vacuum or pressure switch has been triggered, the respective debounce period will commence.

During the debounce period, the system will go into a Valve Failure Alert state to signal that the debounce is active. After the debounce period is complete, the controller will go into a Valve Failure Alarm state, signaling that the associated valve on the respective header has failed. This will prevent faulted valves from being selected and require a new valid valve pair selection before system operation can continue.

Valve Selection

Valve selection will occur differently based on the current **"Selection"** mode and **"Randomize"** timer duration. To change the **"Selection"** mode or the **"Randomize"** timer, navigate to the **"MPFP"** screen from the global menu and press the desired input box to edit the contained value.



Multi-Point Valve Selection Settings

Valves that were active during the last run event will be the currently active valves the next time the system operation is required. Should a valve alarm condition be triggered, the controller will respond based on the current **"Selection"** mode.

- **"Pairs"** Selection Mode:

  This automated selection mode will only allow the controller to select valve pairs with matching numbers. For example, when supply valve #1 (S1) is selected, return valve #1 (R1) must also be selected.

  A new valid valve pairing will be automatically selected after the **"Randomize"** timer. Once the new valve pair has been activated, the **"Randomize"** timer will reset.

  Should the valve pairing result in an invalid selection due to one of the valves being or becoming unavailable, a new valid pair will be selected to prevent system downtime.

  Should no valid supply and return valve pairing be available for selection due to valve failure or manual disabling, a MPFP Failure Alarm will be triggered.

- **"Randomize"** Selection Mode:

  This automated selection mode will allow the controller to randomly select valves without any regard to the valve numbering. For example, any supply valve can be randomly paired with any return valve to complete the current valve pairing.

  A new valve pairing will be automatically selected after the **"Randomize"** timer. Once the new valve pair has been activated, the **"Randomize"** timer will reset.

  Should the randomized valve selection result in an invalid valve pairing due to one of the valves being or becoming unavailable, a new valid pair will be randomly selected to prevent system downtime.

  Should no supply or return valves be available for selection due to valve failure or manual disabling, a MPFP Failure Alarm will be triggered.

- **"Individual"** Selection Mode:

  This manual selection mode will allow the user to select any available supply and return valves to create an active pairing.

  In this selection mode, the system will not run until a supply and return valve selection has been made.

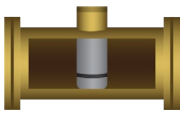
  To make a valve selection, navigate to the **"MPFP"** screen from the global menu and press one of the available supply and return valve icons.

The "**MPFP**" screen will show the status of all connected valves as well as which valves are available for selection. Valve selection does not require the operator to be logged in.

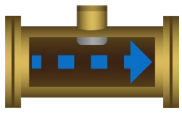
Multi-Point Overview

Valves that are not included in the installation will have visibly faded icons and will not be available for selection.

The valve icon body will indicate the current position of the corresponding valve as indicated by the valve numbering on the actuator above.



Valve Position Closed



Valve Position Open

The valve icon actuator will additionally signal the state of the valve as shown below.

Unavailable

Disabled

Available

Selected

Energized

Error

Valves that are not available will be indicated with a grey actuator. If the valve has been manually disabled by the operator, it will feature a red cross-circle overlay.

Valves that have been faulted due to a valve failure condition will feature a red actuator and will also not be available for selection.

Valves that are available for selection will feature a blue actuator while valves that are currently selected will feature a green actuator.

Once the system energizes (to open) the selected valve, a lighting bolt overlay will appear over the actuator.

All valve outputs can be disabled for commissioning and debugging via the **"MP Output Off"** checkbox on the Diagnostics screen. This should only be done per the system operation manual or AXI support.

Warning! This operation will prevent the system from operating automatically and must be supervised to prevent system leaks or equipment damage from extended operation.

Disabling Valves

Users can selectively disable valves from operation for troubleshooting or repair purposes. To disable a valve, long-press the corresponding valve icon on the **"MPFP"** screen for greater than *5 seconds*[32]. When the valve is disabled, its icon will feature a red cross-circle overlay and the valve will not be available for selection.

To toggle a valve out of the disabled state, long-press the corresponding valve icon again for greater than *5 seconds.*

System Notifications

Valve Failure Alert

When a high vacuum or pressure condition has been detected by one of the MPFP header switches, the system will go into a valve failure alert state for the duration of the **"VAC Delay"** or **"PRES DELAY"** debounce period respectively. This

[32] Requires elevated user permissions. See the User Access Control section for more information.

state will be indicated by flashing the condition-specific **“HIGH VACUUM”** or **“HIGH PRESSURE”** status indicator on systems with a Remote Interface or the summary **“ALARM”** status indicator for systems with a Local Interface.

For systems with a local interface, the summary **“ALARM”** status indicator will not flash if a separate alarm state has already illuminated the indicator.

Valve Failure Alarm

When a high vacuum or pressure condition has been detected by one of the MPFP header switches and the condition persists beyond the corresponding **“VAC Delay”** or **“PRES DELAY”** debounce timer, the system will go into a valve failure alarm state. This state will result in the creation of a new **“Minor”** severity alarm log with high priority that will display on both the **“Alarm Summary”** and **“Alarm History”** screens in addition to an active alarm status banner.

The faulted valve will feature a red actuator on the **“MPFP”** screen and will no longer be available for selection.

To reset the failed valve, the operator must reset the controller alarms.

If the valve has persistent failures, it is recommended that the valve be manually disabled to prevent unwanted alarm conditions during troubleshooting and repair.

MPFP Failure Alarm

If the system is running and no valid valve pair selection is available to satisfy the active automated valve **“Selection”** mode, the system will go into an MPFP alarm state. This state will be indicated by activating all condition-specific status indicators on systems with a Remote Interface or the summary **“ALARM”** status indicator for systems with a Local Interface.

The controller will also create a new **“Major”** severity alarm log with high priority that will display on both the **“Alarm Summary”** and **“Alarm History”** screens in addition to an active alarm status banner.

Fuel Heating

Operation Overview

The optional fuel heater operation adds the ability to maintain a set temperature for the stored fuel in freezing conditions. This option consists of an externally supplied immersion heater and dedicated heater controller to coordinate the heating of fuel based on feedback from a tank-installed RTD temperature probe. This sensor will detect changes in the temperature of the fuel as a whole and may not account for localized temperature variations.

Please ensure the sensor is installed near the generator fuel pickup per the equipment installation instructions.

Warning! The heater and heater controller power circuit must be installed according to the wiring diagrams provided with the appropriate branch circuit protective devices.

When the fuel's temperature falls below the set temperature range, the system controller will begin recirculating the fuel from the tank while also signaling the heater controller to activate the connected immersion heater. This operation will continue until the fuel's temperature falls within the set temperature range as recorded by the RTD temperature probe.

After the heater circuit has completed a heating operation, the heater will be disengaged and the pump will continue to operate until the **"Heater Cooldown"** period has expired. This cooldown timer is used to ensure any remaining heat is removed from the heater to prevent the fuel from being overheated.

In either mode of operation, the heater will be halted immediately should the system mode selector switch be moved to the **"OFF"** position. In this case, the **"Heater Cooldown"** period will not occur to allow the heater element to sufficiently cool after an operation. For this reason, this shutdown process is not recommended.

A dedicated heater graphic, present on both the **"HOME"** and **"HEATER"** screens, will indicate the current status of the fuel heater at any given time. One of three distinct states will be displayed:

Heater Off

Heater Active

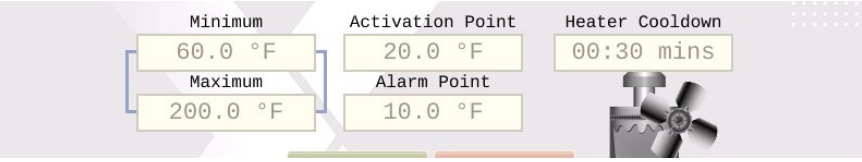
Heater Cooling (Spinning Fan)

Analog (RTD) Temperature Monitoring

The RTD temperature probe converts the monitored fuel temperature conditions within the tank into a current in the standard range of 4-20mA. This gives the user the ability to set independent **"Alarm Point"** and **"Activation Point"** setpoints within the measuring range of the sensor.

To view the status of the RTD probe, or to modify the configuration parameters, navigate to the **"HEATER"** screen from the global menu and press the desired input box to modify the contained value.

- **"Minimum"** default value is *0° F.*
- **"Maximum"** default value is *200° F.*
- ***"Activation Point"*** default value is *40° F.*
- **"Alarm Point"** default value is *30° F.*
- **"Heater Cooldown"** default value is *20 minutes.*



Fuel Heater Configuration Screen

The **"Activation Point"** should not be adjusted too high as this will cause the fuel polisher to run excessively and require more frequent servicing.

The **"Minimum"** and **"Maximum"** parameters for the RTD temperature probe refer to the sensing range of the device and should only be modified by a qualified technician[33].

The sensor graphic on the configuration screen will indicate the lowest fuel temperature value reached via a telltale needle that holds at the minimum value.

When the measured fuel temperature falls below the **"Alarm Point"** setpoint, the system will go into a Low Temperature Alarm state, signaling that the fuel temperature is too low. This condition will clear when the temperature rises above the alarm point by the amount of the temperature sensor deadband (factory set to 1° F above the setpoint).

When the measured fuel temperature rises above 75° F, the system will go to a High Temperature Alarm state and inhibit the Fuel Heater from operating in any mode. The heater cooldown process will run indefinitely until the recorded fuel temperature is no longer higher than 75° F. This condition will clear when the temperature falls below the alarm point by the amount of the temperature sensor deadband (factory set to 1° F below the setpoint).

Automatic Fuel Heating

This mode allows the fuel heating operation to be executed automatically should the measured temperature fall below the **"Activation Point"**. To activate this mode, ensure the system mode selector switch is set to the **"AUTO"** position. The Fuel Heater will operate within the temperature sensor deadband (Factory set to 1° F above the **"Activation Point"**) and will shut off once the measured temperature goes above the upper band limit.

A Heater Required Alert will be activated for the duration of the heating operation and will clear once the operation is complete and the fuel's temperature is above the **"Activation Point"**.

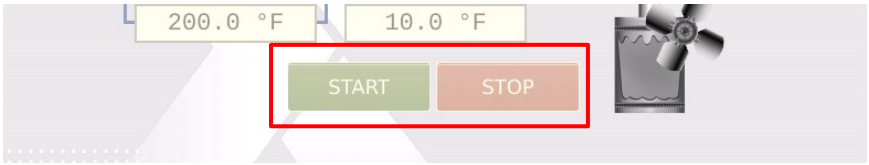
If the heater is required to run and the system is not in a scheduled run window, it will activate the system pump and run for the duration of the required heating period. This will only be allowed when there are no system alarms. If the system is actively circulating in a scheduled run window, the heater will run for the required heating period and then disable without affecting the scheduled fuel polishing run.

Manual/Hand Mode

This mode allows the user to manually activate the fuel heater for indefinite fuel heating or troubleshooting purposes. To enable this mode, ensure the system mode selector switch is set to the **"HAND"** position. In this mode, the temperature is only monitored for heater activation with a Low Temperature Alarm or heater disabling with a High Temperature Alarm.

[33] Requires elevated user permissions. See the User Access Control section for more information.

The operator can manually activate the heating process, when there are no system alarms, by navigating to the **“Heater”** screen from the global menu and pressing the **“Start”** button. The operator can similarly stop the heating process by pressing the **“Stop”** button.



Fuel Heater Manual Control

There is no standard temperature range monitoring that will start or stop the heater process when in manual mode. This is reliant on the operator to begin and end, except in the case of an emergency heater cooldown.

Cooling Period

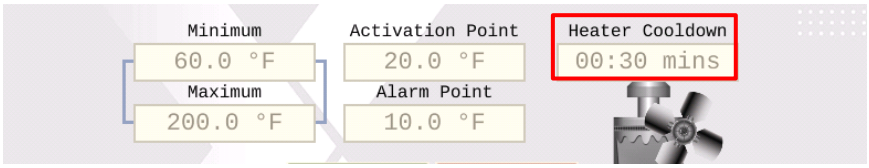
At the end of each heating period, the system will go into a cooldown period to remove excess heat from the heater coils, decreasing the resting temperature of the fuel heater. The system will indicate that the heater is cooling down with a spinning fan on the dedicated heater graphic on both the **“HOME”** and **“HEATER”** screens. The remaining **“Heater Cooldown”** time will also be displayed on the **“HEATER”** screen.

When the cooldown process starts, the beginning fuel temperature will be logged and compared to the fuel temperature at the end of the cooldown period. If the temperature rose by more than the temperature sensor deadband at the end of the cooling period when compared to the start temperature, the system will activate a Heating Error Alarm.

When the system has an active Heating Error Alarm, the cooling period will run continuously until the operator resets the alarm condition.

The Heating Error Alarm will not prevent the heater from engaging in automatic mode when the temperature falls below the activation point.

The operator is may modify the **“Heater Cooldown”** time to allow the element to cool down fully. This setting can be modified by navigating to the **“HEATER”** screen from the global menu and pressing the **“Heater Cooldown”** input box.



Fuel Heater Cooldown Settings

The timer is configurable in minutes and seconds and will indicate the remaining cooldown period when the timer is counting down.

If the pump is interrupted during the **“Heater Cooldown”** period due to the system going into alarm or the system mode selector switch being turned to the **“OFF”** position, the system will trigger the Cooldown Not Complete Alarm state to indicate an incomplete cooling process.

System Notifications

RTD Probe Error

If the sensor is disconnected or operating outside the sensor's operation range, the system will go into an RTD error alarm state. This state will inhibit the fuel heater from running.

The controller will create a new **"Minor"** alarm with high priority that will display on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

Low Temperature Alarm

When the measured fuel temperature falls below the **"Alarm Point"** setpoint, the system will go into a low-temperature alarm state. This state will be indicated by flashing all condition-specific status indicators on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface.

The controller will also create a new **"Minor"** severity alarm log with urgent priority that will display on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

High Temperature Alarm

When the measured fuel temperature rises above 75° F, the system will go to a high-temperature alarm state and inhibit the Fuel Heater from operating in any mode. This state will be indicated by flashing all condition-specific status indicators on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface.

The controller will also create a new **"Minor"** severity alarm log with urgent priority that will display on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

Heater Required Alert

When the measured fuel temperature falls below the **"Activation Point"**, the system will trigger a heater required alert. This alert will clear once the fuel's temperature rises above the set **"Activation Point".**

The controller will create a new **"Warning"** severity alarm log with high priority that will display on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

Cooldown Not Complete Alarm

If the **"Heater Cooldown"** period is interrupted, The system will go into a cooldown not complete alarm state. This state will be indicated by flashing all condition-specific status indicators on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface.

The controller will also create a new **"Major"** severity alarm log with high priority that will display on both the **"Alarm Summary"** and **"Alarm History"** screens in addition to an active alarm status banner.

Heating Error Alarm

If the temperature at the end of the heating operation rises by more than the temperature sensor deadband at the end of the cooling period, the system will go into a heater error alarm state. This state will be indicated by flashing all condition-specific status indicators on systems with a Remote Interface or the summary **"ALARM"** status indicator for systems with a Local Interface.

The controller will also create a new **“Major”** severity alarm log with high priority that will display on both the **“Alarm Summary”** and **“Alarm History”** screens in addition to an active alarm status banner.

AXI International Limited Warranty

AXI International makes every effort to assure that its products meet high quality and durability standards and expressly warrants the products described herein against defects in material and workmanship for a period of one (1) year from the date of purchase. This warranty is not intended to supplant normal inspection, care and service of the products covered by the user, and shall not obligate AXI International to provide free service during the warranty period to correct breakage, maladjustment, or other difficulties arising out of abuse, misuse, or improper care and maintenance of such products. Our express warranty is subject to the following terms and conditions:

This warranty shall only extend to and is only for the benefit of original purchaser(s), or end customer(s) who use the products covered hereby and subject to the terms and conditions herein. This warranty is not an on-site warranty. Travel requests will be at the discretion of AXI International. Defective systems and ancillary products will require a return authorization number and shipping to AXI International's factory in Fort Myers, FL. Any warranty claim received by AXI International after one (1) year from the date of purchase will not be honored even if it is claimed that the defect occurred prior to one (1) year from the date of purchase. Claims outside of this one (1) year period, and for claims not listed within, payment, repair, or service will be awarded at the sole and exclusive discretion of AXI International.

This **Warranty shall NOT** apply to the following:

1. Damage or deterioration caused by normal wear and tear.
2. Failures caused by any external cause or act of God, such as accident, collision, theft, vandalism, riots, wars, re, freezing, lightning, earthquakes, windstorms, hail, volcanic eruptions, floods, tornados or hurricanes.
3. Failures due to alterations, adjustments, unauthorized changes to the product(s), neglect or improper storage, repair and/or maintenance.
4. Failures due to abuse or application of the product(s) for uses other than for which it/they are designed or intended by AXI International, including but not limited to, improper installation or location in a harsh, corrosive or saltwater environment.
5. Failures resulting from attachments, accessory items, and parts not sold by AXI International.
6. Repairs by any party other than those authorized by AXI International.
7. Failures resulting from user's delay in making the product available for inspection by AXI International after notifying AXI International of a potential product problem.
8. Cosmetic damage, discoloration, rusting, corrosion or scratches from applied paint.
9. Replacement of consumables such as, but not limited to, fuses, lamps, filters, etc.
10. Additional expenses for repair after normal business hours, i.e., overtime or holiday labor rates.
11. Expenses for rental of equipment during downtime and/or performance of warranty repairs.
12. Expenses related to investigating performance complaints and/or troubleshooting where no manufacturing defect is found.

In addition to the limitations above, this warranty shall not apply to products (1) which have been tampered with, altered or repaired by anyone other than AXI International without the express prior written consent of AXI International (2) which have been installed improperly or subject to misuse, abuse, accident, negligence of others, improper operation or maintenance, neglect or modification, or (3) which have had the serial number altered, defaced or removed.

The liability of AXI International under this warranty is limited to the repair or replacement of the defective product. AXI International assumes NO LIABILITY for labor charges or other costs incurred by any purchaser incidental to the service, adjustment, repair, return, removal or replacement of products. AXI INTERNATIONAL ASSUMES NO LIABILITY FOR ANY GENERAL, SPECIAL, INCIDENTAL, CONSEQUENTIAL, CONTINGENT OR OTHER DAMAGES UNDER ANY WARRANTY, EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE, WITH THE RESPECT TO THE PRODUCTS COVERED BY THIS WARRANTY POLICY, EXCEPT AS EXPRESSLY PROVIDED FOR HEREIN. AXI INTERNATIONAL ASSUMES NO LIABILITY FOR ANY GENERAL,

SPECIAL, INCIDENTAL, CONSEQUENTIAL, CONTINGENT OR OTHER DAMAGES EVEN IF SUCH DAMAGES ARE A DIRECT RESULT OF AXI INTERNATIONAL'S NEGLIGENCE. NO EMPLOYEE, AGENT, REPRESENTATIVE OR DISTRIBUTOR IS AUTHORIZED TO MAKE ANY WARRANTY ON BEHALF OF AXI INTERNATIONAL OTHER THAN THE EXPRESS WARRANTY PROVIDED FOR HEREIN.

AXI International reserves the right at any time to make changes in the design, material, function and specifications of its products. Any such changes shall not obligate AXI International to make similar changes in such products that were previously manufactured.

To the fullest extent permitted by law, any claims against AXI International are limited to the remedies as expressly set forth in this warranty and any other further claims, such as but not limited to, compensation for any damage incurred other than to the AXI International product, are hereby excluded.

Warranty Claim Procedure

To make a claim under this warranty, please see Contact Information and provide: Name and location where unit was purchased, the date and receipt of purchase, model number, serial number, and a detailed explanation of the problem you are experiencing. The Customer Service Representative may, at the discretion of AXI International, arrange for a Field Engineer to inspect your system. If the inspection reveals a defect covered by its limited warranty, AXI International will either repair or replace the defective parts or products. AXI International assumes no liability, if upon inspection, AXI International or its representative determines that there is no defect or that the damage to the system resulted from causes not within the scope of this limited warranty and customer shall be responsible standard rates incurred by AXI International, as established from time to time by AXI International

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Technical Assistance and Ordering

Controller Identification

CONTROLLER *FEATURES*

Example Identification:

TSC 70 RH 240 . 12.4 - STD 2TL . AWD PT DF RS4

MODEL *SERIES* *INT.* *POWER* *MOTOR FLA* *OPERATION* *PATH* *UPGRADES*

Controller:

	Model		Series		Interface		Power	FLA
SFC	LCD/Buttons	**50**	(SFC Only)[34]	**L**	Local (50/70/80 Series)	**120**	120V/60Hz/1Ph (50/70 Series)	
TSC	Touchscreen	**70**	(SFC/TSC)	**R**	Remote (70/80 Series)	**208**	208-230V/60Hz/1Ph (70/80 Series)	
		80	(SFC/TSC)	**RH**	Remote with Enc. Heater (70/80 Series)	**230**	230V/50Hz/1Ph (50/70 Series)	
						240	240V/60Hz/3Ph (80 Series)	
						480	480V/60Hz/3Ph (80 Series)	

Features:

	Operation		Path		Upgrades[35]
STD	Standard (50/70/80 Series)	**1T**	No upgrade single tank operation	**BSE**	Base configuration
MTC	Mobile System (70/80 Series)	**2TL**	2-Tank L-Port (STD Config.)	**AWD**	Auto Water Drain (70/80 Series)
FH	Fuel Heater (TSC Model)	**2T**	2-Tank (STD/PFS Config.)	**FT**	Flow Transmitter (TSC Model)
PFS	Passive Filtration (70/80 Series)	**3T**	3-Tank (TSC + STD/PFS Config.)	**PT**	Pressure Transmitters (70/80 Series)
MP	Multi-Point Flow Valves	**4T**	4-Tank (TSC + STD/PFS Config.)	**DF**	Differential Filter Monitoring (70/80 Series)[36]
TC	Multi-Tank Control Valves	**2P**	2-Pairs (TSC + MPFP Config.)	**RS4**	Serial RS485 Comm. (TSC)
		3P	3-Pairs (TSC + MPFP Config.)	**BAC**	Bacnet Ethernet Comm. (TSC)
		4P	4-Pairs (TSC + MPFP Config.)		
		5P	5-Pairs (TSC + MPFP Config.)		
		6P	6-Pairs (TSC + MPFP Config.)		
		7P	7-Pairs (TSC + MPFP Config.)		
		8P	8-Pairs (TSC + MPFP Config.)		

[34] Must be configured with the SFC Model and Local Interface with no other options.
[35] Multiple additions may be selected where compatible.
[36] When paired with the PT+DF or FT upgrade, 70 Series limited to P4 or T2 option maximum.

Contact Information

For technical assistance and ordering please have your serial number ready and call, email, or inquire at:

Email: info@axi-international.com
Phone: +1-239-690-9589
Website: https://axi-international.com/contact-us/

AXI International
5400 Division Dr.
Fort Myers, FL 33905

Please provide the following information
Serial Number of your system along with detailed descriptions of the issue for our support team to diagnose the concern. The drawings/parts list included in the original equipment submittal is the most accurate source of information to collect component part numbers.