



# e-MTV AQUAFORCE Packaged Booster System

## VARIABLE SPEED PUMPING SYSTEMS

<https://qr.xylemsales.com/wb31s4>




## 1 Introduction and Safety

### 1.1 Introduction

#### 1.1.1 Purpose of the manual

The purpose of this manual is to provide necessary information for:

- Installation
- Operation
- Maintenance


 **WARNING:**  
Carefully read the Instruction Manual to avoid serious personal injury and property hazards and to ensure safe use and proper care of this product.

**NOTICE:**  
Save this manual for future reference, and keep it readily available at the location of the unit. The information contained in this manual is intended to assist operating personnel by providing information on the characteristics of the purchased equipment. It does not relieve the user of the responsibility to adhere to local codes and ordinances and the use of accepted practices in the installation, operation and maintenance of this equipment. Further information pertaining to the installation, operation, and maintenance of your AquaForce e-MTV pump controller can be found in the IOMs for the associated equipment provided Maintenance section for a list of relevant manuals. Equipment cannot operate well without proper care. To keep this unit at top efficiency, follow the recommended installation and servicing procedures outlined in this manual.

### 1.2 Safety

 **WARNING:**

- The operator must be aware of safety precautions to prevent physical injury.
- Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment. This includes any modification to the equipment or use of parts not provided by Xylem. If there is a question regarding the intended use of the equipment, please contact a Xylem representative before proceeding.
- Do not change the service application without the approval of an authorized Xylem representative.

 **CAUTION:**  
You must observe the instructions contained in this manual. Failure to do so could result in physical injury, damage, or delays.




### 1.3 Safety terminology and symbols

#### About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully before handling the product. They are published to help prevent these hazards:



- Personal accidents and health problems
- Damage to the product and its surroundings
- Product malfunction

#### Hazard levels

Hazard level	Indication
 <b>DANGER:</b>	A hazardous situation which, if not avoided, will result in death or serious injury
 <b>WARNING:</b>	A hazardous situation which, if not avoided, could result in death or serious injury
 <b>CAUTION:</b>	A hazardous situation which, if not avoided, could result in minor or moderate injury
<b>NOTICE:</b>	Notices are used when there is a risk of equipment damage or decreased performance, but not personal injury.

#### Special symbols

Some hazard categories have specific symbols, as shown in the following table.

Electrical hazard	Magnetic fields hazard
 <b>Electrical Hazard:</b>	 <b>CAUTION:</b>

### 1.4 Environmental safety

#### The work area

Always keep the station clean to avoid and/or discover emissions.

#### Waste and emissions regulation

Observe these safety regulations regarding waster and emissions:

- Appropriately dispose of all waste.
- Handle and dispose of the processed liquid in compliance with applicable environmental regulations.
- Clean up all spills in accordance with safety and environmental procedures.
- Report all environmental emissions to the appropriate authorities.

#### Electrical installation

For electrical installation recycling requirements, consult your local electric utility.

## 1.5 Recycling guidelines

Always follow local laws and regulations regarding recycling.

## 1.6 User safety

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### General safety rules

These safety rules apply:

- Always keep the work area clean.
- Pay attention to the risks presented by gas and vapors in the work area.
- Avoid all electrical dangers. Pay attention to the risks of electric shock or arc flash hazards.
- Always bear in mind the risk of drowning, electrical accidents, and burn injuries.

### Safety equipment

Use safety equipment according to the company regulations. Use this safety equipment within the work area:

- Helmet
- Safety goggles
- Protective shoes
- Protective gloves
- Gas mask
- Hearing protection
- First-aid kit
- Safety devices

### NOTICE:

Never operate a unit unless safety devices are installed. Also see specific information about safety devices in other chapters of this manual.

### Electrical connections

Electrical connections must be made by certified electricians in compliance with all international, national, state, and local regulations. For more information about requirements, see sections dealing specifically with electrical connections.

### Precautions during work

Observe these safety precautions when you work with the product or are in connection with the product:

- Never work alone.
- Always wear protective clothing and hand protection.
- Stay clear of suspended loads.
- Always lift the product by its lifting device.
- Beware of the risk of a sudden start if the product is used with an automatic level control.
- Beware of the starting jerk, which can be powerful.
- Rinse the components in water after you disassemble the pump.
- Do not exceed the maximum working pressure of the pump.
- Do not open any vent or drain valve or remove any plugs while the system is pressurized. Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, or disconnect piping.
- Never operate a pump without a properly installed coupling guard.

### Wash the skin and eyes

Do the following if chemicals or hazardous fluids have come into contact with your eyes or your skin:

If you need to wash your...	Then
Eyes	<ul style="list-style-type: none"><li>• Hold your eyelids apart forcibly with your fingers.</li><li>• Rinse the eyes with eyewash or running water for at least 15 minutes.</li><li>• Seek medical attention.</li></ul>
Skin	<ol style="list-style-type: none"><li>1. Remove contaminated clothing.</li><li>2. Wash the skin with soap and water for at least one minute.</li><li>3. Seek medical attentions, if required.</li></ol>

## 2 Transportation and storage

### 2.1 Examine the delivery

#### 2.1.1 Examine the package

1. Examine the package for damaged or missing items upon delivery.
2. Record any damaged or missing items on the receipt and freight bill.
3. If anything is out of order, then file a claim with the shipping company.  
If the product has been picked up at a distributor, make a claim directly to the distributor.

#### 2.1.2 Examine the unit

1. Remove packing materials from the product.  
Dispose of all packing materials in accordance with local regulations.
2. To determine whether any parts have been damaged or are missing, examine the product.
3. If applicable, unfasten the product by removing any screws, bolts, or straps.  
Use care around nails and straps.
4. If there is any issue, then contact a sales representative.

### 2.2 Transportation guidelines

#### Lifting methods



#### WARNING:

- Assembled units and their components are heavy. Failure to properly lift and support this equipment can result in serious physical injury and/or equipment damage. Lift equipment only at the specifically identified lifting points. Lifting devices such as eyebolts, slings, and spreaders must be rated, selected, and used for the entire load being lifted.
- Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.



#### CAUTION:

Care should be taken to prevent damage due to dropping or jolting when moving the controller. Transportation damage should be brought to the carrier's attention immediately upon receipt.

### 2.3 Storage guidelines

#### Storage location

The product must be stored in a covered and dry location protected from extreme cold, heat, dirt, and vibrations.

#### NOTICE:

Protect the product against humidity, heat sources, and mechanical damage. Do not place heavy weights on the packed products.

#### Long-term storage

If the controller is stored for more than 6 months, these requirements apply:

- Store in a covered and dry location.
- Store the unit free from heat, dirt, and vibrations.
- Recommended storage includes but not limited to a tarp over the unit.

Extended storage of VFDs may require special attention prior to start-up. See manufacturer's IOM for details.

## 3 Product Description

### 3.1 General description

#### Description

The controller is a specific purpose programmable pump controller. This provides:

- Optimum pump control without the cost of general purpose control hardware.
- Software dedicated and established for the unit.
- Unique analog input protection of other members of the control family. In the event of a short circuit condition, the current limit circuitry prevents failure of the analog input components.

**NOTICE:**

Your controller should have a safety instruction decal. If the decal is missing or illegible, contact your representative for a replacement.



**WARNING:**

This product can expose you to chemicals including Lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to: [www.P65Warnings.ca.gov](http://www.P65Warnings.ca.gov).

### 3.2 Operational limits

**Temperature and ventilation**

All electrical equipment is susceptible to failure if operated in ambient temperatures outside of its rating. The OPERATING temperature range for this unit is 0 to 40°C. The relative humidity should not exceed 90% non-condensing. The unit should not be operated outside these extremes.

### 3.3 Nameplate information

**Important information for ordering**

Every pump station has a nameplate that provides information about the pump station. The pump station nameplate is located on the inside of the control enclosure door. When ordering spare parts, be prepared to identify the nameplate information when contacting the factory.

- Model
- Size
- Serial number
- Item numbers of the required parts

**Figure 1**



Model Number	The manufacturer's number to indicate the particular type of product which has been acquired.
Serial Number	A set of characters that uniquely identifies a single unit and can be used for traceability and warranty purposes.
Station Voltage	The rated voltage at which the station has been designed for. Should match the application site supply voltage.
Enclosure Type UL/NEMA	The designated UL/NEMA rating of the electrical enclosures.
System FLA	The full-load-ampereage at which the station can operate.
Largest Motor HP	The rated HP for the largest Pump in the system.
SCCR	"Short-Circuit Current Rating". Represents the maximum level of short-circuit current that a component or assembly can withstand.
Largest Motor HP	The rated HP for the largest Pump in the system.
Station Flow	The designed duty point, in GPM, LPH, etc.
Pump Boost	The difference between the input side of the pump station and the output side of the pump station.
Date Code	Marking of products to indicate their date of manufacture.

### 3.4 Main parts and functions

**Input voltage**

The VFD and AquaForce e-MTV Pump Controller can be set up to operate across a broad range of voltages. It was factory set to operate on the voltage shown on the nameplate. Check the VFD nameplate for the proper input and output voltages before wiring the VFD. The voltage tolerance is +10/-5% and phase to phase voltage must not have an imbalance greater than 5 VAC.

**Ground connections**

A grounding terminal is provided for a dedicated ground wire connection. All provisions of the National Electrical Code and local codes must be followed.



**WARNING:**

Conduit grounds are not adequate. A separate ground wire must be attached to the ground lug provided in the enclosure to avoid potential safety hazards.

**Power wiring**

Power wire types and sizes must be selected based upon conformance with the National Electrical Code and all local codes and restrictions.



**WARNING:**

Only copper (Cu) wire rated for 75°C (minimum) may be used for the power connections. Refer to the input current as listed on the nameplate affixed to the enclosure door when sizing wire.

**Output/motor disconnect**

It is necessary that any device which can disconnect the motor from the output of the VFD be interlocked to the emergency shutdown circuits of the VFD. This will provide an orderly shutdown if the disconnecting device is open circuited while the VFD is in operation. Failure to provide this interlock may result in damaged components due to improper installation.



**CAUTION:**

Metal filings can create electrical short circuits. Do not drill, saw, file or perform any operation on the VFD conduit entry plate while attached to the VFD.

**Analog signals**

Shielded cable (#22 AWG, Belden type 8762, Alpha #2411, or equal) should be installed for all D.C. control wiring. The shield must be terminated in the Controller panel. Do not connect the shield at the other end of the cable! Insulate the shield so that no electrical connection is made at the other end of the cable. A twisted pair of #22 AWG conductors (Belden 8442 or equal) can be used in place of shielded cable. The cable length must be limited to 5,000 feet for #22 AWG wire.

**Field connection diagrams**

Refer to the pump Installation, Operation, and Maintenance Manual for specific details unique to the pump.

Refer to the flow sensor/transmitter Installation, Operation, and Maintenance manual for specific details unique to the flow sensor/transmitter.

Job specific wiring and dimensional drawings and typical field connection diagram should be reviewed prior to unit installation and operation.

### 3.5 Glossary of terms

- **VFD** Variable Frequency drive; converts a constant power input into a variable power output for the motor; a device for controlling motor speed.
- **Alternation** Process of determining which pump will serve as lead pump and which pump will serve as lag pump.
- **Destage** To turn off a lag pump.
- **Lag pump** Standby pump which activates only when lead pump alone cannot efficiently provide sufficient pressure or flow rate.
- **Lead pump** Duty pump which runs continuously until a standby pump is required.
- **OIP** Operator Interface Panel.
- **PID** Proportional Integral Derivative; 3 variables required for error control.
- **PV (Process Variable)** Signal generated by a sensor which is set up to control the system.
- **Proof timer** Minimum time period before controller acknowledges an input; time period for which a signal must be stable before it is accepted by the controller as a sustained and valid signal.
- **Stage** To start a lag pump.
- **SP** Set point.

## 4 Installation

### 4.1 Field connections

#### Diagrams

Review the wiring diagrams and dimensional drawings before you install and operate the unit.

#### Electrical precautions



#### WARNING:

Electrical shock and potential circuit damage. Disconnect power before beginning installation. Failure to follow these instructions could result in serious personal injury or death and property damage.



#### WARNING:

- Prevent electrical shocks. Disconnect the power supply before beginning installation. **FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY, DEATH AND/OR PROPERTY DAMAGE.**
- Each motor must have a properly sized drive. Ground fault protection should be sized properly. Refer to local electrical codes for sizing and selection.
- Refer to the motor manufacturer's IOM for specific installation information.
- Motor can start automatically. Keep hands away from output shaft until motor is completely stopped and input power is removed from the motor control panel. Lockout main power switch while working near motor shaft.
- The use of motor disconnect switches is acceptable. Consult the factory for proper interlocking with variable frequency drives.
- Motor control equipment and electronic controls are connected to hazardous line voltages. When servicing electronic controls, there will be exposed components at or above line potential. Extreme care should be taken to protect against shock. Stand on an insulating pad and make it a habit to use only one hand when checking components. Always use accurate test meters when checking electrical components. Always work with another person in case of an emergency. Disconnect power when performing maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electronic control or rotating equipment.



#### DANGER:

Troubleshooting live control panels exposes personnel to hazardous voltages. Electrical troubleshooting must only be done by a qualified electrician. **FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY, DEATH, AND/OR PROPERTY DAMAGE.**

Guideline	Explanation
Make sure that the space around the pump package is sufficient.	This facilitates ventilation, inspection, maintenance, and service.
If you require lifting equipment such as hoist or tackle, make sure that there is enough space above the pump package.	This makes it easier to properly use the lifting equipment and safely remove and relocate the components to a safe location.
Protect the unit from weather and water damage due to rain, flooding, and freezing temperatures.	This is applicable if nothing else is specified.
Do not install and operate the equipment in closed systems unless the system is constructed with properly-sized safety devices and control devices.	Acceptable devices: <ul style="list-style-type: none"> <li>• Pressure relief valves</li> <li>• Compression tanks</li> <li>• Pressure controls</li> <li>• Temperature controls</li> <li>• Flow controls</li> </ul> <p>If the system does not include these devices, consult the engineer or architect in charge before you operate the pump.</p>

### 4.2 Earth (ground connections)



#### WARNING:

Conduit grounds are not adequate. A separate ground wire must be attached to the ground lug provided in the enclosure to avoid potential safety hazards.

A grounding terminal is provided for a dedicated earth (ground) wire connection. You must follow all provisions of the National Electrical Codes and local codes.

### 4.3 Sensor and control wiring

The following sections are based on the installation of standard AquaForce product. Because of customized software and hardware, the installing contractor should base all wiring connections on the wiring diagrams that accompany each controller. These sections are meant to complement, not replace, those wiring diagrams.

With certain bypass and control methods it is necessary to disable the adjustable frequency drive from running. This is accomplished by wiring from the terminals to each VFD's interlock terminals. Should this wiring be required, any jumpers which may be found on the VFD's interlock terminals should be removed.

The control family may be provided with the capability to accept many analog inputs. Typically all analog inputs must be 4-20 mA and powered by the 24 VDC power supply in the controller. All shields must be grounded in the controller only to prevent ground loops and improper signals.

Hardwire communications refers to the capability of the Controller to communicate with an energy management system. Standard communication features are listed below:

- **Remote Start/Stop** – Remove the jumper from Terminal X1-8 and install a switch as indicated on the wiring diagram. CLOSED CONTACT of this switch will provide the start signal.

### 4.4 Pump package and location guidelines



#### WARNING:

Assembled units and their components are heavy. Failure to properly lift and support this equipment can result in serious physical injury and/or equipment damage. Lift equipment only at the specifically identified lifting points. Lifting devices such as eyebolts, slings, and spreaders must be rated, selected, and used for the entire load being lifted. Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times. Care should be taken to prevent damage due to dropping or jolting when moving the controller. Transportation damage should be brought to the carrier's attention immediately upon receipt.

Take into consideration the occurrence of unwanted noise and vibration.

The best pump location for noise and vibration absorption is on a concrete floor with subsoil underneath.

## 4.5 System piping and unit installation- final checklist

1. Check that the unit base is properly leveled, grouted and secured.
2. Check that all lubrication points are properly lubricated per motor manufacturer's instructions.
3. Check that the shut-off valves to the transmitters open.
4. Check that the shut-off valves to the pump suction open.
5. Check that the shut-off valves to the discharge line open.
6. Check that the piping is properly supported to prevent strains on the unit.
7. Check that the system, including pumps and valves, are purged of debris and air.
8. This system requires the usage of an incoming and discharge isolation valves that are directly before and after the system. Note, these are to be supplied by the installer. This allows for isolation of system to perform maintenance.



### CAUTION: DO NOT RUN DRY. SEAL DAMAGE MAY OCCUR.

Inspect pump seal regularly for leaks. Replace as required. Failure to follow these instructions could result in injury or property damage.

## 4.6 Electrical wiring and control settings — final checklist

1. Check the unit nameplate or motor terminal connection to ensure the feeder line voltage corresponds to the unit voltage.



### WARNING:

Electrical shock and potential circuit damage. Disconnect power before beginning installation. Failure to follow these instructions could result in serious personal injury or death and property damage.

2. Check that feeder wires are correctly sized for the load.
3. Check that the fuses are correctly sized. They must not exceed 1.75 times the full load current of the motor. Usual sizing is 1.15 to 1.5 times the full load current.



### DANGER:

High voltage 3 phase power can kill. Disconnect and lockout power prior to servicing. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY, DEATH, AND/OR PROPERTY DAMAGE.



### WARNING:

Conduit grounds are not adequate. A separate ground wire must be attached to the ground lug provided in the enclosure to avoid potential safety hazards.

4. Check that the unit is properly grounded.
5. Make sure all the power terminals in the control panel have been tightened.

## 4.7 I/O

### Analog Inputs

The AquaForce e-MTV pump Controller is equipped with three analog input channels. The analog inputs must provide a 4-20 mA signal. Typically, analog inputs will be powered by the 24 V power supply within the panel. For analog inputs which source their own power, consult factory.

Shielded 22 AWG cable should be installed for all analog input wiring. The shield must be terminated in the AquaForce e-MTV Pump Controller. Do not connect the shield at the other end of the cable! Insulate the shield so that no electrical connection is made at the other end of the cable. A twisted pair of #22 AWG conductors can be used in place of shielded cable. The cable length must be limited to 2,500 feet for #22 AWG wire.

### Digital Inputs

The AquaForce e-MTV Pump Controller is equipped with (8) 24 VDC digital input channels. This signal voltage must be obtained from the 24 VDC power supply mounted to the subpanel. It is not recommended that other power sources be used without factory approval. All digital inputs are automatically assigned.

### Digital Output Module

The AquaForce e-MTV Pump Controller is equipped with (5) Relay Output channels.

### Analog Output

The AquaForce e-MTV Pump Controller is equipped with (3) analog output channels. All analog outputs operate at 0-10V

Table 1: Input-output Functionalities

Label	Description	Meaning	Configuration
Analog Input			
AIL1	Analogue input 1	Pressure Transmitter 1	4-20 mA
AIL2	Analogue input 2	Flow Transmitter	4-20 mA
AIL3	Analogue input 3	Pressure Transmitter 2	4-20 mA
Digital Input			
DIL1	Digital input 1	VFD1 Trip Feedback	
DIL2	Digital input 2	VFD1 On Feedback	
DIL3	Digital input 3	VFD2 Trip Feedback	
DIL4	Digital input 4	VFD2 On Feedback	
DIL5	Digital input 5	VFD3 Trip Feedback	
DIL6	Digital input 6	VFD3 On Feedback	
AIL8	Digital input 7	Pressure Switch	Digital Input
AIL9	Digital input 8	Remote Start/Stop	Digital Input
Digital Output (Relay Output)			
DO1	Digital output 1	VFD1 Start	NO
DO2	Digital output 2	VFD2 Start	NO

DO3	Digital output 3	VFD3 Start	NO
DO8	Digital output 4	VFD Reset Command	NO
DO12	Digital output 5	Hooter (Alarm)	NO - 24V DC
Analog Output			
AOL1	Analogue output 1	VFD_1_Speed	0-10V
AOL2	Analogue output 2	VFD_2_Speed	0-10V
AOL3	Analogue output 3	VFD_3_Speed	0-10V

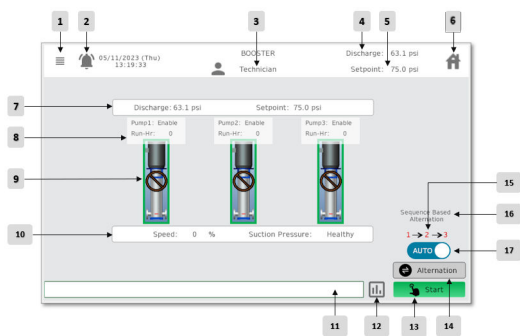
## 5 Operation and setpoint

### 5.1 General terms for navigation of system

To operate and to navigate this system, user has to consider several points as explained in details below:

- Once user completely powers up the system, the **Home** screen will be displayed.

Figure 5.1.1 – Home Screen



The Home screen has various buttons and information blocks as shown above and listed below.

- Menu button
  - Alarm Screen Navigation button
  - Current User Login Status
  - Current Discharge Pressure
  - Current PV setpoint
  - Home button
  - Discharge Bar
  - Pump Information
  - Pump Status
  - Pump Speed
  - Alarm Status Screen
  - Trend Screen Navigation button
  - System Start/Stop button
  - Manual Alternation
  - Pump Sequence
  - Alternation Method Selected
  - System Auto/Manual Button
- Top Bar shown below is common global header which will appear on all screens.

#### 5.1.2 – Global Header – Common for all Screens



- At any point when user clicks on the Home button, it will navigate to the home screen.

#### 5.1.3 – Global Header – Home Button



- Discharge Bar - The Station Discharge bar is located above the Pump. As shown in Figure 5.1.4, this bar shows Discharge pressure, Pressure, and Setpoint value. It also shows Flow and Monitoring Pressure values if respective sensor is setup.

#### 5.1.4 – Discharge Bar



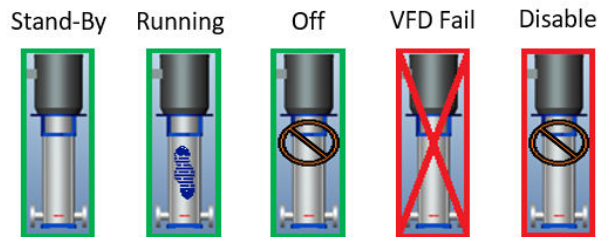
- Suction Bar - The Station Suction bar is located below the Pump as shown in Figure 5.1.5. This bar shows Suction pressure and % Speed of System.

#### 5.1.5 – Suction Bar



- On the Home screen, visualization of pumps will be animated as per their current status.

#### 5.1.6 – Pump Status



- Stand-By:** Pump is in standby while in Auto mode.
- Running:** Pump is running either in Auto/Manual mode.
- Off:** Pump is not running.
- Pump/VFD Fail:** Pump and/or VFD has a failure and is not running.
- Pump/VFD Disabled:** Pump and/or VFD is disabled for running.

Also, refer to point 8 for more detail on pump status.

- On the Home screen, there are buttons for system start/stop, automatic or manual operation mode selection, and manual pump sequence alternation.

#### 5.1.7 – Start/Stop, Auto/Manual & Alternation Buttons



- Operation Mode (Automatic / Manual):** It shows the current state of operation mode. (i.e., If it is showing manual, then at present, the system is in manual mode.) User can change the mode using this button. When system is running, operation mode cannot be changed.

These modes of operation can be accessed through the interface button [AUTO/MAN] on the home screen.

The available two modes of operation are described below.

- Automatic Mode:** Tap on [MAN] button shown in Figure 5.1.1 (13). The system will enter into auto mode and the text on [MAN] Button will change to [AUTO] and it will be highlighted as shown in Figure 5.1.8

#### 5.1.8 – System Mode Change Button in Auto Mode



- Manual Mode:** Tap on [AUTO] button. The system will enter into manual mode and the text on [AUTO] Button will change to [MAN] as shown in Figure 5.1.9.

#### 5.1.9 – System Mode Change Button in Manual Mode



To start system at any point of time, tap [Start] button. When the system is running, the text on [Start] button will change to [Stop] and Auto/Manual Button will be disabled.

In manual mode, the button for manual Speed control of pump becomes visible as shown in Figure 5.1.1 (10).

Text on this button displays the current set Speed of the system. On tapping



button, a numeric keypad will appear to enter the manual setpoint value.

- System Start/Stop:** It shows the command which can be performed by using this button (i.e. If it is showing "Start" then user can use this button

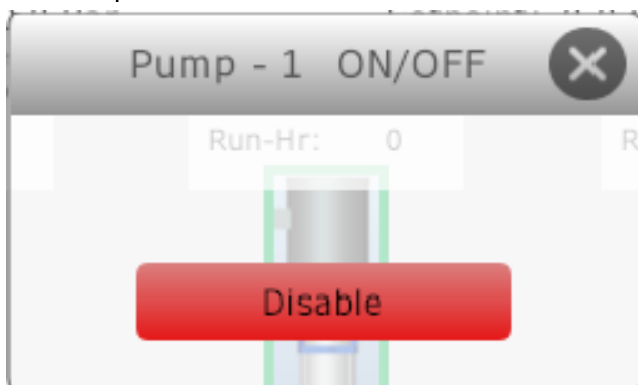
to start the system and if it shows "Stop" then user can use this button to stop.). This button is shown in Figure 5.1.1 (14).

- **Manual Alternation:** This button can be used to alternate pump sequence in automatic operation mode. When alternation method is selected on pump run hour base, this button gets disabled. This button is shown in Figure 5.1.1 (15).

8. Use pump bitmap to enhance as shown below for individual pump start/stop (enable/disable) page. In the event operation mode is changed to Auto, all pumps are forced to an enabled status. For manual mode, all pumps are forced to disabled. Below table shows the possible Pump status that could be showing in each case:

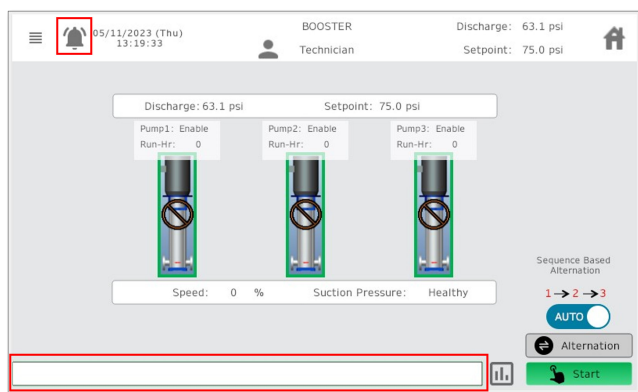
Pump	Auto	Manual
Enable	1. Running 2. Off 3. Fail 4. Standby	1. Running 2. Fail
Disable	1. Off 2. Fail	1. Off 2. Fail

### 5.1.12 – Pump On/Off control



9. If system has had any alarm, the last occurred alarm appears in alarm bar. To see list of current and history of alarms, user can touch alarm bar or alarm button as shown in below figure. On alarm screen, it shows all active alarms. If alarms are acknowledged, then it shows in blue otherwise it shows in red.

### 5.1.14 – Alarm bar and Button



10. On the main screen, trend button can be used to navigate to trend page, which shows the trend of parameters like Pressure, Setpoint and Flow set time interval. Individual parameters, Minimum and Maximum boundaries, can be set. Refer to section 5.8 for more detailed information.

11. To get the access for all setup parameters and menu, the user needs to login as a technician from Settings → Log On/Off Tab. Supervisor and Guest user (Default user) will have limited access. Supervisor Default Password = 1234.

12. To set the required parameters and configuration, user is required to click on Menu Buttons and from side menu bar user can navigate to the setup screens.

13. The system considers the page change as a confirmation for saving the parameter change, except where it has been asked for confirmation.

14. User can use the (Previous & Next ) Tabs to change the screens under the same menu.

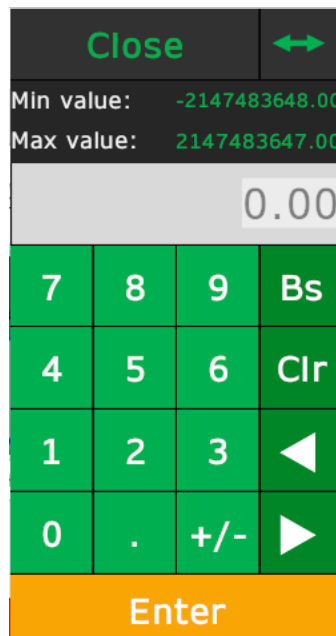
15. Select required functions /type /value from the dropdown menu. Controller does not allow any further HMI action until dropdown menu is expand-

ed (i.e. if user has not selected any value after opening the dropdown menu, it will not allow access to other functions.).

16. Two types of keypads are available to enter data into any system parameter. They are as follows:

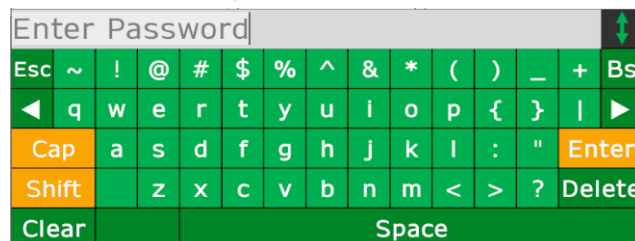
1. **Numeric Keypad:** If only numeric data is to be entered into any parameter then Numeric Keypad will pop up upon tapping the required parameter. Numeric Keypad is shown in Figure 5.1.15.
2. To enter any Numeric Data, Tap on the numbers shown and then tap to enter the data or tap to cancel the entered data.

### 5.1.15 – Numeric Keypad



3. To enter any Alpha Numeric Data, Tap on the Alphabetic Characters and Numbers shown and then tap ENTER to enter the data or tap Esc to cancel the entered data.

### 5.1.16 – Alpha Numeric Keypad



## 5.2 User types

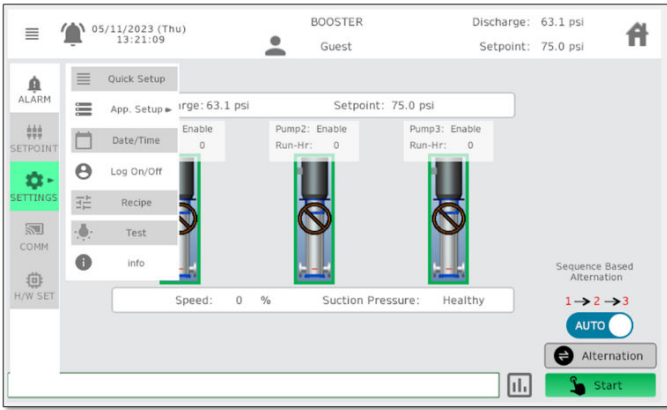
There are different types of users recognized by the system:

1. **Guest:** Only operation screens are accessible in view-only mode. **Users are logged in as a Guest by default.**
2. **Supervisor:** End-User configurable setup and operation screens are accessible. Supervisors must log-in using a password. The default Supervisor password is "1234".
3. **Technician:** All setup and operation screens are accessible. Technicians must log-in using a password. The default technician password will be provided to the certified installer at the time of installation.

### 5.2.1 Touch panel log In

Tap **[SERVICE]** from the Home Screen.

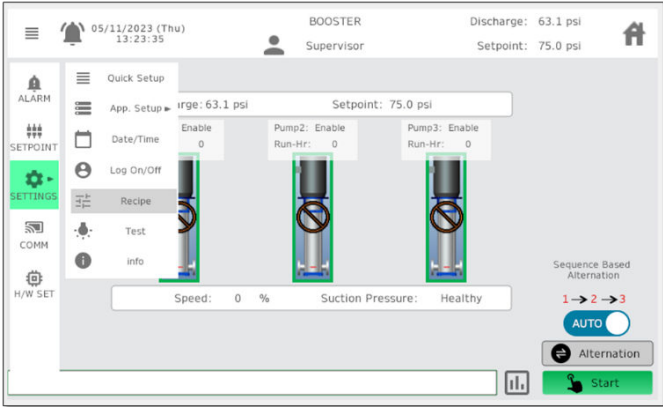
5.2.2 – Guest Service Screen



Note that when logged in as a Guest certain boxes are disabled, as shown in Figure 5.2.2. When logged in as a Supervisor more options will be made available, as shown in Figure 5.2.3.

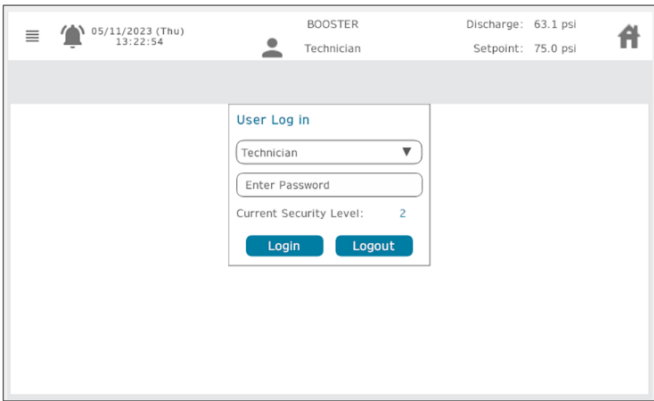
In order to enable all of these parameters, user has to be logged in as Technician.

5.2.3 – Supervisor Service Screen



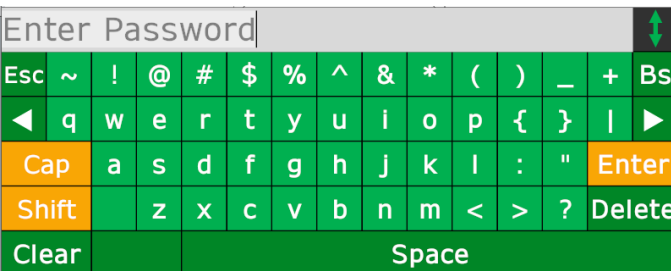
Tap [Log On/Off] from the Service Screen to change User type. It will navigate to Login Screen, as shown in Figure 5.2.4.

5.2.4 – Login Screen



To log in as a Technician, tap [Technician], and then tap on the empty [Password] field to enter the Technician password. This will bring up an enhanced screen shown in Figure 5.2.5.

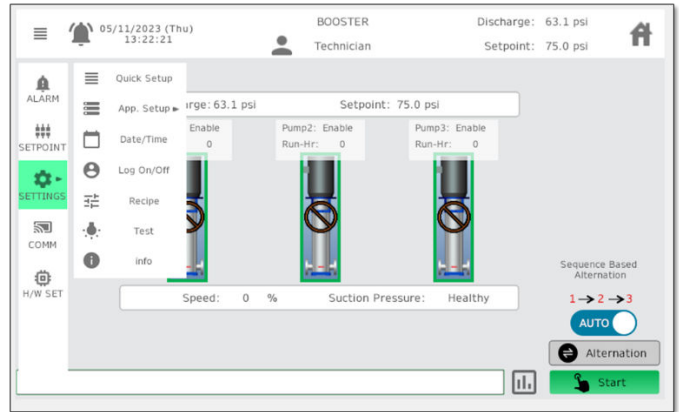
5.2.5 – Login Keypad



Enter your password and Tap Enter To login, Or Esc To cancel.

After entering the correct Password on Log On screen tap on [Log ON] or [Cancel] to abort. If Log in is successful, the Service Screen should appear as in Figure 5.2.7.

5.2.7 – Technician Service Screen



The same procedure can be followed to login as Supervisor. Make sure to log out before leaving system unattended.

Tap [Home Tab] to return to the Home Screen

5.3 Alarm/events

5.3.1 – Alarm Page

Date	Time	AlarmMessage	Value	AlarmStatus	AlarmType
05/11/2023	13:24:43	PUMP 3 VFD TRIPPED	0	Return	HHH
05/11/2023	13:24:32	PUMP 3 VFD TRIPPED	1	Active	HHH
05/11/2023	13:24:17	PT FAULT	0	Return	HHH
05/11/2023	13:24:16	PT FAULT	1	Active	HHH

When [Alarm] button is tapped, Alarm Page appears as shown in Figure 5.3.1. On this page list of current alarm with date and time stamp is available. There is a Color code to identify the Status of Alarm.

If the Alarm is highlighted in red, then the alarm is Active and not acknowledged. If the Alarm is highlighted in green, then the Alarm is Active and acknowledged.

Alarms can be acknowledged by tapping ACK SELECTED and ACK ALL button on [Alarm] page.

The Alarms which are no longer active will disappear automatically from [Alarm] page. Those alarms can be found in [Historical Alarm] page as shown in Figure 5.3.2. To open Historical alarm page, tap on [History] button available on [Alarm] page.

5.3.2 – Historical Alarm Page

Active Date	Active Time	AlarmMessage	AlarmStatus	AlarmType	ACK Date	ACK Time
05/11/2023	13:24:16	PT FAULT	Return	HHH		
05/11/2023	13:24:32	PUMP 3 VFD TRIPPED	Return	HHH		

Refer below table for more detail of each Alarm. Refer section 6.13 for additional information of troubleshooting.

Alarm Message	Description	Troubleshooting
LOW PRESSURE CUT OFF	System Pressure is Below Low system Pressure Setpoint.	
WATER SHORT-AGE	Suction Pressure is very low, or Pressure Switch is not working.	Check Pressure Switch at suction side.
FT FAULT	Flow sensor is not connected or faulty.	Check the flow meter connection and make sure flow meter is in working condition.
MAX FLOW CUT OFF	Output flow is more than Max flow setpoint.	
PT FAULT	Pressure Transmitter is not connected or faulty.	Check the PT connection and make sure PT is in working condition.
PT -1 FAULT	Pressure Transmitter-1 is not connected or faulty.	Check the PT-1 connection and make sure PT is in working condition.
PT -2 FAULT	Total Number of PT=2 and Pressure Transmitter-2 is not connected or faulty.	Check the PT-2 connection and make sure PT is in working condition.
HIGH PRESSURE CUT OFF	System Pressure is more the High system pressure setpoint.	
PUMP 1 VFD TRIPPED	VFD has detected any fault condition.	Check VFD Power, Check VFD screen to find the fault/error.
PUMP 2 VFD TRIPPED	VFD has detected any fault condition.	Check VFD Power, Check VFD screen to find the fault/error.
PUMP 3 VFD TRIPPED	VFD has detected any fault condition.	Check VFD Power, Check VFD screen to find the fault/error.
PUMP 1 VFD NOT READY	VFD is not stated after giving the start command.	Check VFD power Supply and make sure VFD is in ready Condition.
PUMP 2 VFD NOT READY	VFD is not stated after giving the start command.	Check VFD power Supply and make sure VFD is in ready Condition.
PUMP 3 VFD NOT READY	VFD is not stated after giving the start command.	Check VFD power Supply and make sure VFD is in ready Condition.

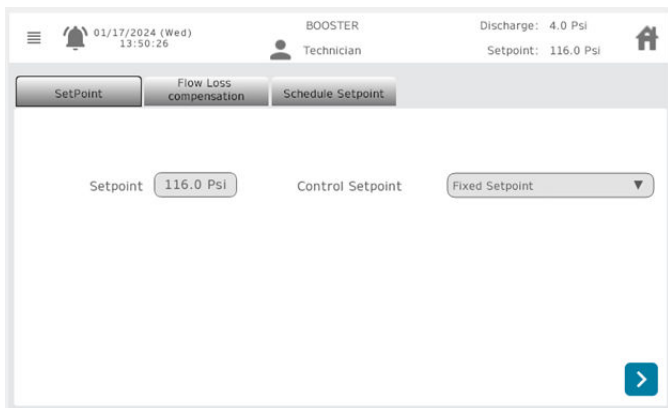
## 5.4 Set point

Sections under [Setpoint] tab are as follows:

### 5.4.1 Setpoint

Setpoints can be modified for the transmitter configured as the system pressure.

#### 5.4.1 – Setpoint Configuration Page

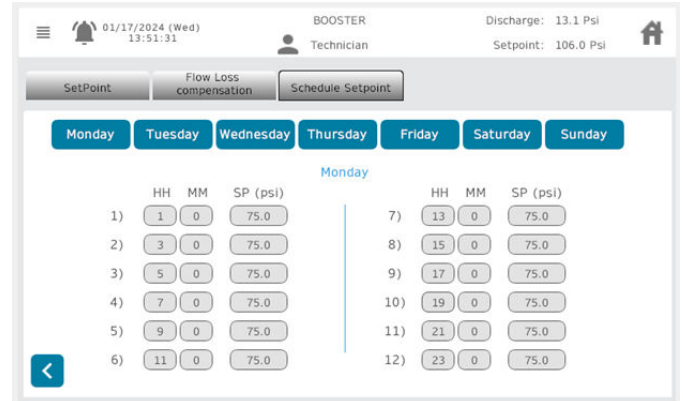


Three Control Set point options are available as shown in Figure 5. 1.

- **Fixed Setpoint** –When Fixed Setpoint is selected as Control Setpoint option, then Setpoint is considered from the value in Set Point 1, Set Point 2 and Set Point 3 as shown in figure 5.4.1.
- **Schedule Setpoint** - When Schedule Setpoint is selected as Control Setpoint option, then Setpoint is considered from Setpoint value(s) entered on Schedule Setpoint page as shown in Figure 5.4.2.

## 5.4.2 Schedule Setpoint

### 5.4.2 – Scheduled Setpoint Page



When Schedule Setpoint is selected as Control Setpoint option, then Setpoint is considered from Setpoint value(s) entered on Schedule Setpoint page as shown in Figure 5.4.2.

There is total 12 setpoint for each day of week. User can set different setpoints as per the requirement for each day of week.

If setpoint at 1:00 equals to 40, setpoint at 2:00 equals to 45 and setpoint at 3:00 equals to 50 than for the period of 1-2 setpoint value is 40 and its value changes to 45 on 2:00 and for the period of 2-3 setpoint value is 45 and at 3:00 setpoint value change to 50.

**Note: Setpoint Schedule must be set into increasing time order.**

### 5.4.3 Flow loss compensation

This energy savings feature allows user to compensate for the friction losses of system. As flow increases, the pressure losses due to friction in the system will increase accordingly. This feature will allow controller to modify the set point in real time based on the speed changes to compensate system friction loss. Figure 5.4.3 shows how this function works with setup parameters using an example of a three-pump system.

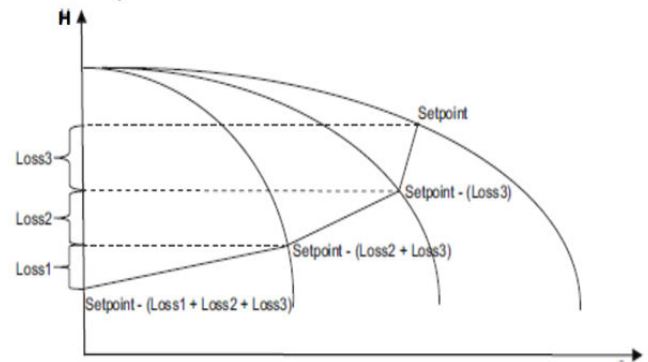
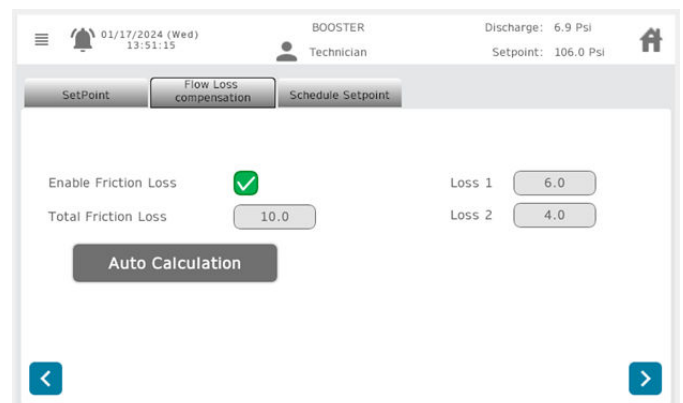


Figure 2: Flow loss compensation working example



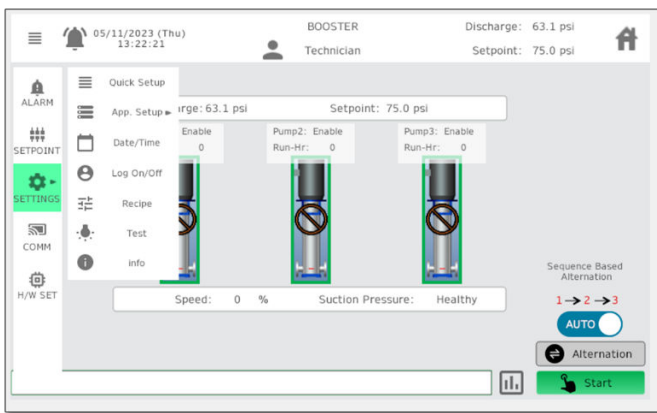
As Shown in Figure 5.4.4, The Friction Loss Compensation Page contains following parameters:

- Enable friction loss – Check the check box to enable friction loss compensation.
- Total friction loss – Total friction loss of the system in PSI. System Syzer tool from the Xylem website can be used to estimate friction loss.
- Auto calculation – Check the check box to calculate loss1 through 3 values automatically. Summation of Loss1 through 3 will be equal to total friction loss if calculated using this parameter. Value of Loss1 to 3 can be also over-written as required.
- Loss 1 – The max loss in PSI that will be compensated for one pump. This value will be used to adjust the set point when one pump is running.
- Loss 2 – The max loss in PSI that will be compensated for two pumps. This value will be used to adjust the set point when two pumps are running. This value will get subtracted from the set point as a fixed value when less than two pumps are running.
- Loss 3 – The max loss in PSI that will be compensated for three pumps. This value will be used to adjust the set point when three pumps are running. This value will get subtracted from the set point as a fixed value when less than three pumps are running.

## 5.5 Settings

[Settings] Button has multiple Sections under it. Tap on [Settings] button and the sub menu appear as shown in Figure 5.5.1

### 5.5.1 – Service button Drop down list



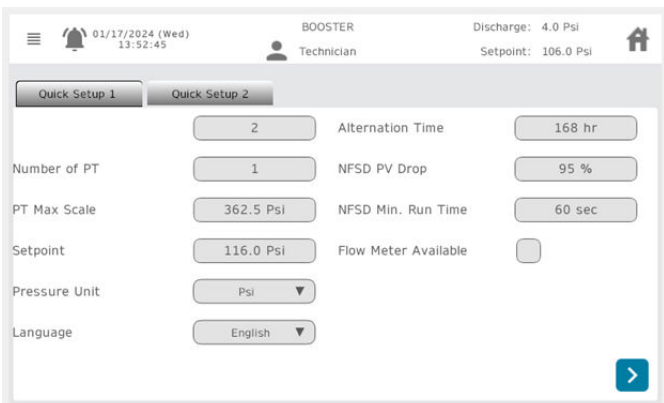
Each section under [Settings] button is explained in detail below.

### 5.5.1 Quick setup

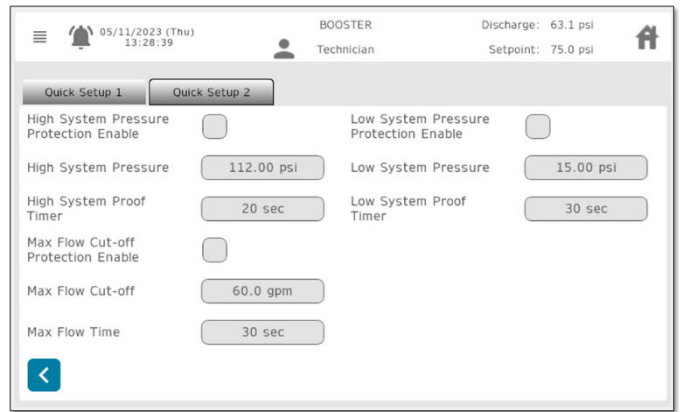
Navigate to **Quick Setup** Screen under **Service Tab** as shown in Figure 5.5.2 and Figure 5.5.3.

Quick Setup screens are mainly designed for giving quick access to the parameters which are required most and least required setup. For more settings, user can check respective setup under App Setup.

### 5.5.2 – Quick Setup 1



### 5.5.3 – Quick Setup 2



On Quick Setup 1 screen, it is considered that Pressure Transmitter 1 is connected at discharge as default. User need to set only max scale if in case it is different from default. Selection of Number of PT limited to Two. For more details please refer sensor setup section. Quick setup 2 screen covers protection functions. High system pressure threshold must be above the set point and low system threshold must be below setpoint in order to work properly. Max Flow Cut off protection is there if flow sensor is connected with system. Set the non-zero value in the respective protection's proof timer to enable.

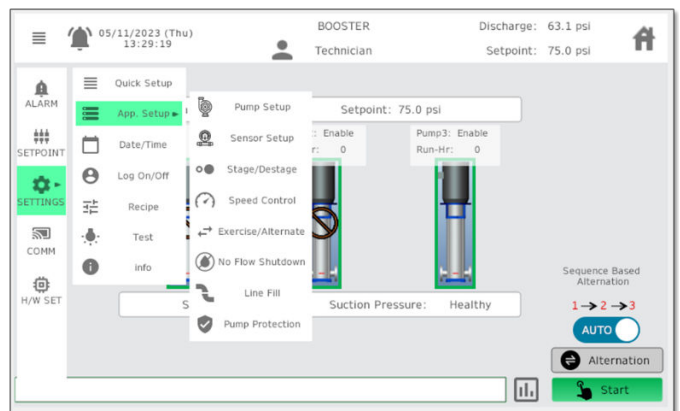
### 5.5.2 App setup

Sections under System Setup are:

- Pump Setup
- Sensor Setup
- Stage/Destage
- Speed Control
- Exercise/Alternation
- No Flow Shutdown
- Line Fill
- Pump Protection

These sections are explained in respective sections.

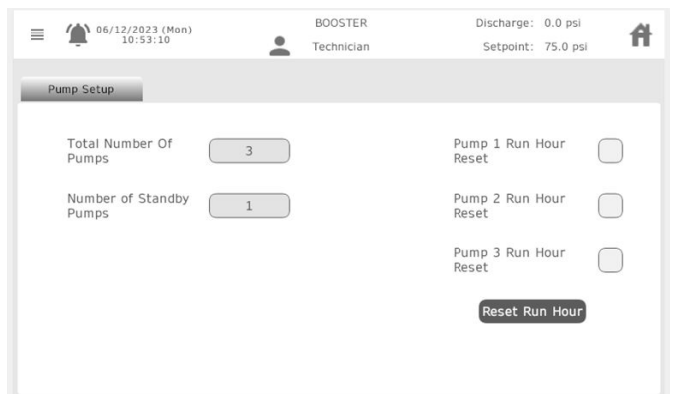
### 5.5.4 – App Setup Screen



### 5.5.3 Pump setup

Pump Setup contains two sections. Define total number of Pumps in this section and number of Standby Pumps in this section.

### 5.5.5 – Pump Setup



## 5.5.4 Sensor setup

[Sensor Setup] Screen is as shown in figure 5.5.4. This screen is used to setup the available sensors. Set Total Number of PT to Two, if redundant sensor is connected to AI 3. Set the PT max scale if it is different from the default value. Select the unit from the pressure Unit selection. Check the Flow meter available box if flow meter is connected to the system. Set the max scale if it is different from the default value. Select the unit for the flow from the Flow Unit selection.

### 5.5.6 – Sensor Setup Screen

## 5.5.5 Stage/Destage

Sections under [Stage/Destage] are:

### 5.5.5.1 PV stage / destage

[PV Stage/Destage] controls staging and destaging of pumps based on Speed and Process Variable (Pressure).

### 5.5.7 – PV Stage/ Destage

Following parameter needs to be configured in [PV Stage/Destage] Section:

- **Stage Frequency** - The maximum speed at which the lead pump will operate prior to starting a lag pump, Hz.
- **Stage Proof Timer** - Proof timer prior to starting lag pump, seconds.
- **Destage Frequency** - Enter the speed below which the lag pump will stop, Hz.
- **Destage Proof Timer** - Proof timer prior to stopping lag pump, seconds.
- **Sleep Frequency** - The lowest speed at which last pumps will operate prior to sleep, Hz. It must be greater or equal to minimum frequency.
- **Sleep Proof Timer** - The proof timer prior to stopping the last running pump when operating below the sleep frequency, seconds.

## 5.5.6 Speed control

Sections under [Speed Control] are:

### 5.5.6.1 PID setup

Set up [PID] Parameters for Automatic Controlling of Pump Speed through VFD Output.

### 5.5.12 – PID Setup

Following parameter needs to be configured in [PID] Section:

- Set the Integration value for PID Control.
- Proportional Gain – Set the Proportional value for PID Control.
- Integral Time – Set the Integration value for PID Control.
- Derivative Time – Set the Derivative time for PID
- Max Frequency – Select Max Frequency VFD output from the dropdown. There is 2 option available 50 Hz and 60 Hz.

## 5.5.7 Exercise/alternation

Sections under [Exercise/Alternation] are:

### 5.5.7.1 Exercise

#### 5.5.14 – Pump Exercise

Configure the below mentioned parameters for automatic exercising of the pump.

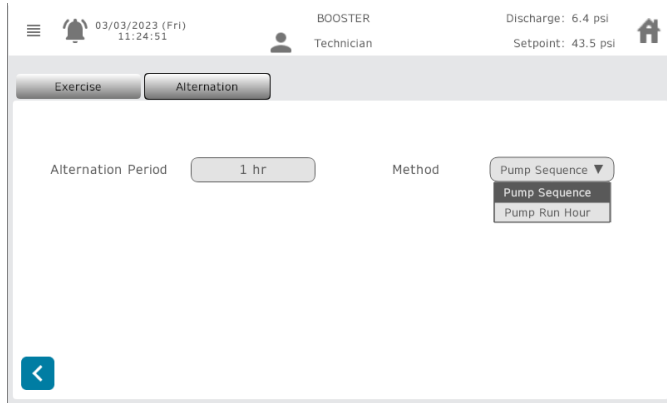
- **Enable** -check the Enable check box to enable the exercise feature.
- **Exercise delay time** – Amount of time for which all pumps are in ideal condition. (No Operation)

Pump exercising will ensure that no pumps go for long periods of time without running. Note that automatic alternation can also provide this functionality. Pump exercising will only occur when the system is not running for the Exercise delay time. All pumps will stage one by one for 10 sec.

### 5.5.7.2 Alternation

Two different options are available for Automatic Alternation of Pump Sequence. User can enable any one of the available two Alternation methods to alter the pump sequence.

### 5.5.15 – Alternation Screen

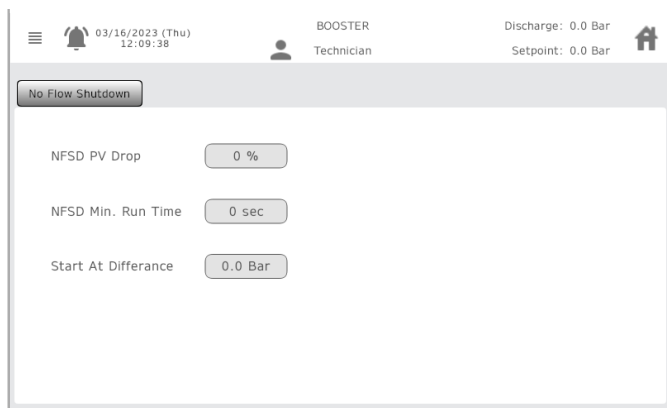


There are two method options to select the new Pump running sequence after alternation.

1. **[Pump Sequence]** – The Pump sequence will be based on pump number order. The next pump in sequence will become the lead pump after alternation. Alternation event will be based on time in hours or manual. Alternation period is the time after which pump sequence will change automatically.
2. **[Pump Run Hours]**– The pump sequence will be based on pump run hour, from lowest to highest run hour. The pump with the lowest run time will become the lead pump after alternation. Alternation event will occur only when system is restarting after all pumps have stopped.

### 5.5.8 No flow shutdown

#### 5.5.16 – No Flow Shut Down



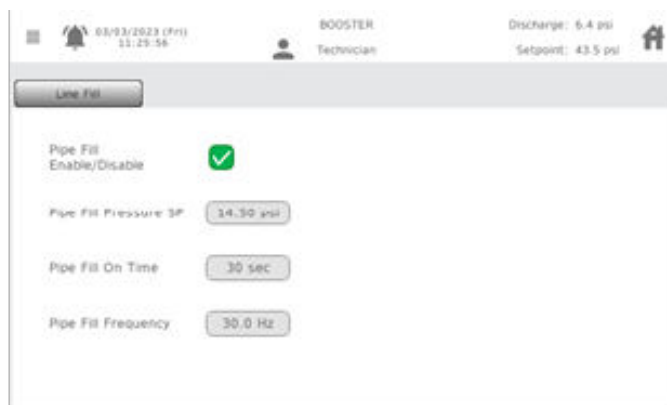
The **[No Flow Shut Down]** menu is displayed below:

- **NFSD PV Drop** - The % amount of Setpoint, which will be deducted from the PV setpoint when flow check condition is triggered.
- **NFSD Min. Run Time** - The time, in seconds, that the system will run at SP before it starts flow check.
- **Start At Difference** - The Minimum Difference between PV setpoint and discharge pressure to stage the pump and reset the No Flow Shut Down Alarm.

### 5.5.9 Line fill

To enable Line Fill, Check the **[Enable Line Fill]** checkbox available on **[Line Fill]** Screen.

#### 5.5.17 – Line Fill



Parameters Available on **[Line Fill]** Screen are:

- **Enable/Disable** – Check this box to enable this feature.
- **Pipe Fill Pressure SP** – Line Fill Mode will be triggered below this Pressure Setpoint when system is starting up in Auto Mode.
- **Pipe Fill on Time** – Enter the Time in Sec, Pipe fill Mode will run for this time period to reach at pipe fill frequency and after that system stops.
- **Pipe Fill Frequency** – System will run in pipe fill mode until it reaches this frequency (Hz).

### 5.5.10 Pump protection

There is total 3 different protections are there in the system as below:

1. High System Pressure
2. Low System Pressure
3. Max Flow Cutoff (if Flow Meter Available)

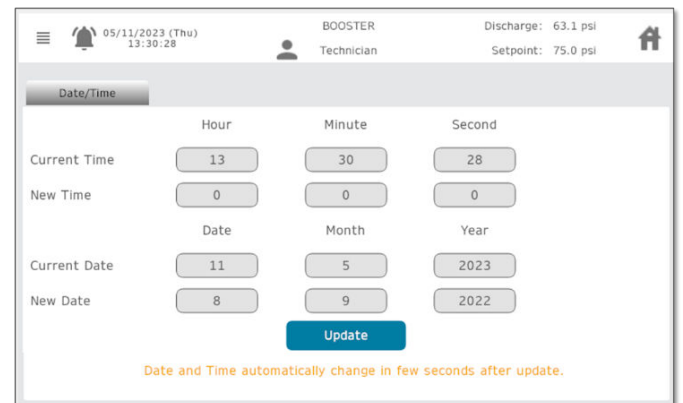
#### 5.5.18 – Pump Protection



- **Low System Pressure** – A Low system alarm triggers if the system pressure drops below low system pressure while system is running.
- **Low System Proof Timer** – The proof timer prior to triggering an alarm, in seconds.
- **High System Pressure** – Set the Pressure above which an alarm will be activated.
- **High System Proof Timer** - The proof timer prior to triggering an alarm, in seconds.
- **Max Flow Cut-off** – Set the Maximum flow above which an alarm will be activated.
- **Max Flow Time** - The proof timer prior to triggering an alarm, in seconds.

### 5.5.11 Date/time setting

#### 5.5.28 – Date/Time Setup Page



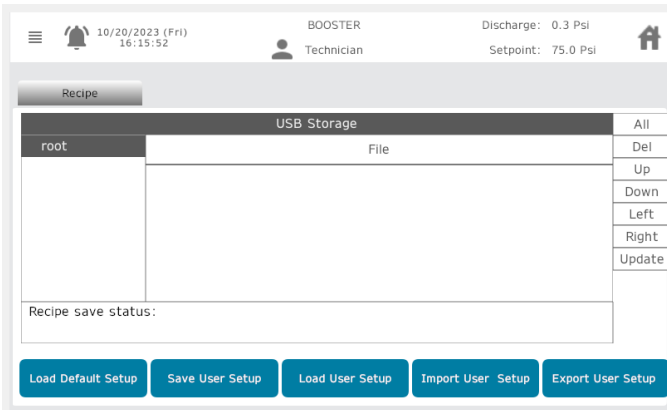
Date and Time can be set from **[Date/Time]** Page. Tap on **[Settings]** button and then tap on **[Date/Time/Display]** button to navigate to this page.

Following settings can be done from this page:

- **Month/Day/Year** – Enter the current **Month, Day and Year** in their respective input space as shown in Figure 5.5.28.
- **For example:** 1st January 2017 should be entered as 01st [Month], 01 in [Day] and 2017 in [Year]. Tap on **[Update]** button after entering Month, Day and Year to set the date.
- **Hour: Min.: Sec.** – Enter the hours using the 24 hour format and Minutes from 0 to 60 in their respective input space as shown in Figure 5.5.28. **For example:** 9:30 p.m. should be entered as 21 Hours and 30 Minutes.

## 5.5.12 Recipe

### 5.5.29 – Recipe Page



Recipe can be used to load and save User Defined Settings or Default Settings. Recipe page is shown in Figure 5.5.29.

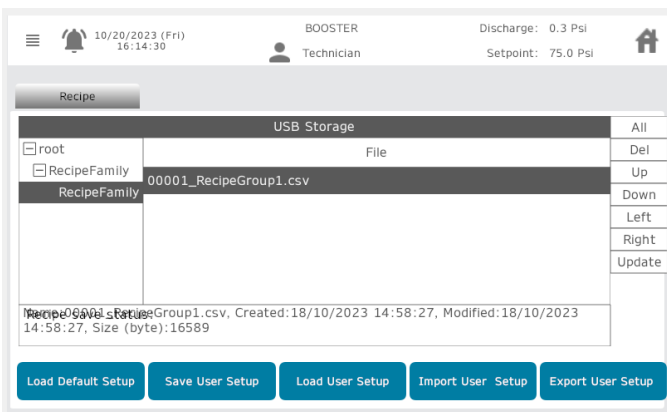
All Parameters and Setpoint Settings can be stored in Recipe and loaded back when required.

Tap on **[Load User Setup]** button on **[Recipe]** Page as shown in Figure 5.5.29, to load the settings defined by user. This will overwrite Default Setup. Default Setup will be saved for future use.

Tap on **[Save User Setup]** button on **[Recipe]** Page as shown in Figure 5.5.29, to save the settings defined by user. User can overwrite the default Setpoints and parameters and this setup can be saved for future use.

Tap on **[Load Default Setup]** button on **[Recipe]** Page as shown in Figure 5.5.29, to load the Default Settings. This will overwrite User Defined Setup. User Defined Setup will be saved for future use.

### 5.5.30 – USB access for Recipe



Users can load their Recipe from a USB stick or can take a backup of the existing User/Default Recipes into a USB stick if desired. Insert a USB in the USB slot available on back panel of HMI. When a USB is inserted into the slot, the Directory for USB will appear as shown in Figure 5.5.30.

Steps for Import and Export recipe CSV file through USB.

To Export the CSV of recipe following are the steps:

1. Click on USB storage.
2. Press **[Update]** button to see if the USB stick is available or not.
3. Press **[Export User Setup]** button then press **[Update]**.

To Import the CSV of recipe following are the steps:

1. Click on USB storage.
2. Press **[Update]** button to see if the USB stick is available or not.
3. Press **[Update]** then press **[Import User Setup]** button.

There are some utility buttons on the Recipe Screens which facilitates certain user operations:

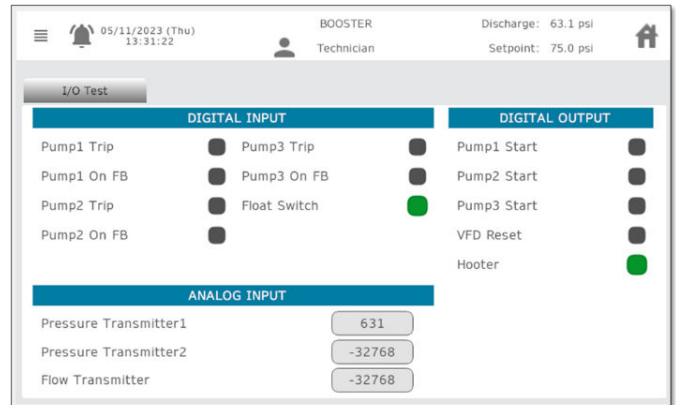
- **All** – [All] button is used to select all the files.
- **Del** – [Del] button is used to delete the existing recipe file from the default location or a USB stick.
- **Up** – [Up] button is used to navigate in up direction.
- **Down** – [Down] button is used to navigate in down direction.
- **Left** – [Left] button is used to navigate in left direction.
- **Right** – [right] button is used to navigate in right direction.
- **Update** – [Update] button is used to refresh the file system.

## 5.5.13 Test





Sections under **[Test]** are:

## 5.5.13.1 Test IO

### 5.5.35 – Test IO

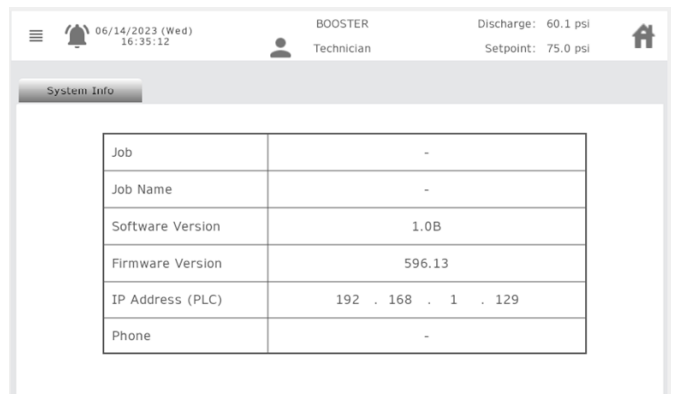


Testing of Digital inputs, Digital Outputs, Analog Inputs and Analog Outputs can be accomplished on the **[Test IO]** Page.

- **Digital Outputs** - Status of Digital Outputs can be checked by indication bulb. If the output is 1 then indication is  and if the output is 0 then indication is . Digital Outputs can only be read.
- **Digital Input** - Status of Digital Inputs can be checked by indication bulb. If the input is 1 then indication is  and if the input is 0 then indication is . Digital Inputs can only be read.
- **Analog Input** - Value of Analog Input can be monitored on the numeric display as shown in figure 5.5.35. Analog Inputs can only be read.

## 5.5.14 System information

### 5.5.14 – System info page



System information page provides details of information about system. Provides the details of Software version, Firmware version, IP address of PLC, Job number, Job name and technician number.

## 5.6 Communication

AquaForce e-MTV system supports four different communications Protocol. Those Communication protocols are explained in the following sections.

Only one communication protocol can be active at a time. The remaining communication protocols will be disabled.

The Communication protocol selection is done during the first installation of software. User doesn't have right to change it latter.

## 5.6.1 Modbus RTU



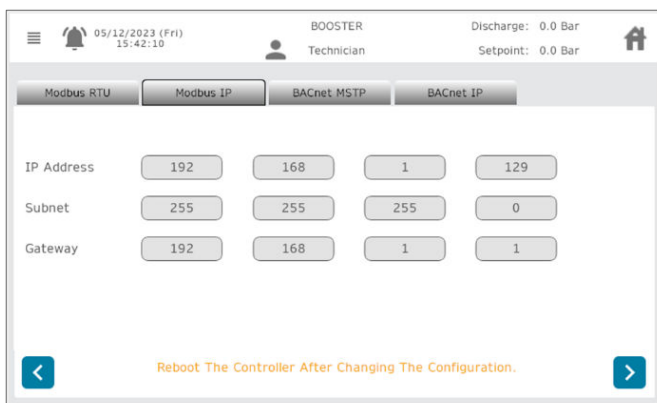
Figure 3: Modbus RTU Communication Page

Set the Slave ID, Baud rate and Parity on Modbus RTU page as shown in Figure 5.6.1. Slave ID must be unique for each device in the network. The baud rate must be the same for each device in the network.

To make these changes active in the controller, restart the controller. The changes will be incorporated into the controller.


## 5.6.2 Modbus IP

### 5.6.3 – Modbus IP Communication Page




Set the IP address, Subnet and Gateway on Modbus IP page as shown in figure 5.6.3. To make these changes active in the controller restart the controller and changes will be incorporated into the controller.

## 5.7 Trend screen

Just beside Alarm status display on the Home Screen, there is a button  to open Trend Screen as shown in Figure 5.1 (12). When this trend button is pressed, Trend Screen will open as shown in Figure 5.8.1

On this Trend Screen, graphical representation of parameters like Setpoint, Flow, Discharge Pressure, can be shown. Historical graphs for these parameters can also be seen by changing Trend Mode using **[Current/History]** button located at bottom end of Trend Screen.

Customized time span can be set by changing the value at  and select **Min/Hou/Sec/Day** from the dropdown.

**[Full/divide]** button is located at bottom left part of trend screen. On tapping this button, it will display the trends in one page or Divided in segments.

**[Current/History]** button located at bottom end of Trend Screen. On tapping this button user can change the trend mode from Current to history and vice versa.

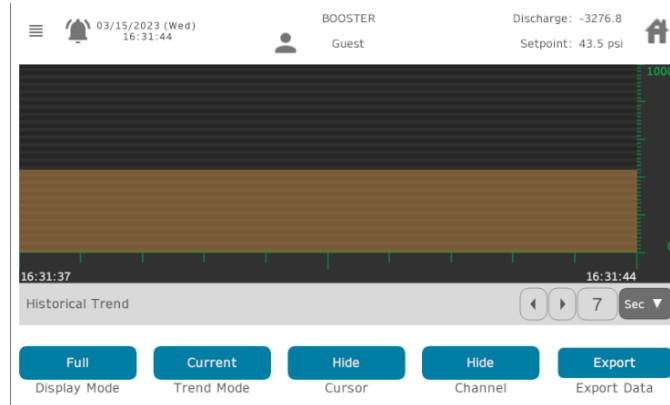
**[Hide/Show]** Channel button is located at bottom of trend screen. This button gives user option to Show/Hide channel details on the left side of trends Display. User can set min and max range of each channel and also Hide/Show individual

channel by tapping  button.

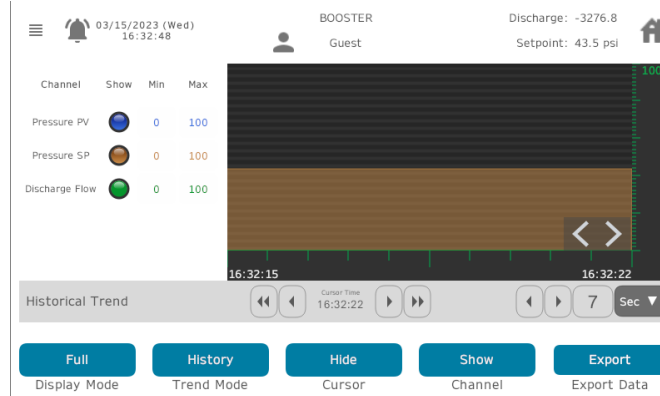
**[Hide/Show]** Cursor button is located at bottom of trend screen. This button gives user option to show/hide cursor.

**[Export]** button is located at bottom right corner of trend screen. This button gives user option to export trends data in Local Storage of HMI. User can copy that data in to USB drive from the recipe page.

### 5.8.1 – Current Trend Screen



### 5.8.1 – History Trend Screen



## 5.8 Parameter range table

SETPOINT MENU ITEMS				
Menu Item	Variable	Default	Range	Field Value
Setpoint	Setpoint	75	0-1000	
Schedule Setpoint	Setpoint Monday (All Times)	75	0-1000	
	Setpoint Tuesday SP (All Times)	75	0-1000	
	Setpoint Wednesday SP (All Times)	75	0-1000	
	Setpoint Thursday SP (All Times)	75	0-1000	
	Setpoint Friday SP (All Times)	75	0-1000	
	Setpoint Saturday SP (All Times)	75	0-1000	
	Setpoint Sunday SP (All Times)	75	0-1000	

Default values			
Menu Item	Variable	Default	Range
Flow Loss Compensation	Enable	No	Yes/No
	Total Flow Loss	0	0-1000
	Loss 1	0	0-1000
	Loss 2	0	0-1000
	Loss 3	0	0-1000

PUMP SETUP MENU ITEMS				
Menu Item	Variable	Default	Range	Field Value
Pump Setup	Total Number of Pumps	2	2-3	
	Number of Standby Pumps	0	0 - 1	

SENSOR SETUP MENU ITEMS				
Menu Item	Variable	Default	Range	Field Value
Sensor Setup	Number of PT	1	1-2	
	PT Max Scale	300	0-1000	
	Pressure Unit	Psi	Bar-psi	
	Flow max Scale	300	0-65535	

STAGE/DESTAGE SETUP MENU ITEMS				
Menu Item	Variable	Default	Range	Field Value
PV Stage/ Destage	Stage Freq	57	0-60	
	Stage Proof Timer	30	0-600	
	Destage Freq	51	0-60	
	Destage Proof Timer	30	0-600	
	Sleep Frequency	20	0-60	
	Sleep Proof Timer	30	0-600	

SPEED CONTROL MENU ITEMS				
Menu Item	Variable	Default	Range	Field Value
PID	P	0.15	-300-300	
	I	1	0-6000	
	D	20	0-6000	

EXERCISE/ALTERNATION MENU ITEMS				
Menu Item	Variable	Default	Range	Field Value
Exercise	Delay Time	168	0-1000	
Alternation	Alternation Period	168	0-1000	
	Method	Pump Seq	Pump seq-Run Hr based	

LINE FILL MENU ITEMS				
Menu Item	Variable	Default	Range	Field Value
Line Fill	Enable	No	Yes/No	
	Pipe Fill Pressure SP	0	0-1000	
	Pipe Fill ON Time	0	0-3600	
	Pipe File Freq	0	0-60	

NO FLOW SHUT DOWN MENU ITEMS				
Menu Item	Variable	Default	Range	Field Value
No Flow Shut Down	NFSD PV Drop (%)	2	0-100	
	NFSD Min Run Time (Sec)	60	0-1000	
	Start At Difference	10	0-1000	

PUMP PROTECTION SETUP - MENU ITEMS				
Menu Item	Variable	Default	Range	Field Value
Low System Pressure	Enable	Yes	Yes/No	
	Low system Pressure	60	0-1000	
	Low system proof timer	60	0-600	
High System Pressure	Enable	Yes	Yes/No	
	High System Pressure	112	0-1000	
	High System Proof timer	20	0-600	
Max Flow Cut-off	Enable	No	Yes/No	Enable
	Max Flow Cut-off	100	0-1000	
	Max Flow Time	30	0-600	

## 5.9 VFD Parameter table

VFD PARAMETERS			
LAC	Label	Set Value	Default
FRS	Nominal motor frequency	60 Hz	50 Hz
ACC	Acceleration ramp time	10 s	3 s
LSP	Low speed	Equal to Sleep Frequency*	0 Hz
HSP	High speed	60 Hz	50 Hz
L3A	DI3 assignment	Fault Reset	No
CRL3	AI3 current scaling parameter of 0%	4 mA	0 mA
R2	R2 assignment	Device running	Not assigned
AO1	AQ1 assignment	Motor frequency	Not configured
AOL1	AQ1 min output value	4 mA	0 mA
RSF	Fault reset input assignment	Digital input 3	Not assigned

\* Sleep Frequency is defined in the eMTV user setup manual.

## 6 Maintenance

### 6.1 Preface

The following is a description of the hardware, diagnostics, and corrective action to maintain a process being controlled by the Pump Controller.

#### NOTICE:

THE FOLLOWING SHOULD NOT BE INTERPRETED AS THE MAXIMUM CONFIGURATION OF THIS CONTROLLER, RATHER THIS DESCRIBES ITS APPLICATION AS A AQUAFORCE e-MTV PUMP CONTROLLER ONLY.

### 6.2 Technical overview

The Pump Controller is a microprocessor based dedicated pump controller unique to and exclusively manufactured by Xylem Goulds Water Technology. All aspects of this unit are strictly proprietary to Xylem Goulds Water Technology.

### 6.3 Digital Inputs

The controller has provision for digital inputs with an operating voltage of 24 VDC. This signal voltage must be obtained from the 24 VDC power supply mounted to the subpanel.

It is not recommended that other power sources be used without factory approval.

Customer connections are made directly to the terminals blocks wired to the digital input module.

### 6.4 Digital outputs

The controller has provision for relay outputs to control 240V 50/60 HZ devices. The relays are not removable. If defective, the digital output module must be returned to the factory for repair.

All relays operate as single pole single throw. Components are provided to reduce contact arc and extend electrical life.

Customer connections are made directly to the terminals blocks wired to the digital output module.

## 6.5 Analog inputs

Analog inputs are provided for process variables and optional transmitters. All analog inputs operate at 4-20mA. They must be powered from 24 VDC power supply included with the controller

## 6.6 Analog outputs

Analog outputs are provided for the speed reference to all VFDs. All analog outputs operate at 0-10V.

## 6.7 Memory

The logic is stored in a non-removable flash PROM chip which can only be updated from the USB & Ethernet program port on the CPU. The user setup data is stored in xml file format. The logged data for pressure & flow is stored in csv file format.

## 6.8 CPU

The CPU does not require any maintenance, and cannot be replaced as a field repair.

## 6.9 Power supply

The power supply provides 24 VDC for all digital and analog signals as well as the CPU. It is specifically rated only for the controller and other loads should not be applied without factory approval.

The power supply is protected with both primary and secondary fusing as indicated on the wiring diagram. The size of these fuses is indicated on a sticker inside each enclosure.



### DANGER:

Troubleshooting live control panels exposes personnel to hazardous voltages. Electrical troubleshooting must only be done by a qualified electrician. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY, DEATH, AND/OR PROPERTY DAMAGE.

## 6.10 Protection

**Analog inputs** – the analog inputs provided on the AquaForce e-MTV Pump Controller must be wired according to the wiring diagram that shipped with the unit.

**Digital Inputs** – as long as input power is derived from the integral 24 VDC power supply they are protected.

**Digital Outputs** – each output shall not exceed the ratings on the digital output module.

## 6.11 Instruments and their use

With the diagnostics described herein extensive instruments are not required. However, the instruments used should be quality units to meet the following at a minimum.

## 6.18 Troubleshooting

Issue	Remedy
VFD FAILURE	I. Cycle Power to VFD and Station
	II. Check power wiring and fuses for affected VFD.
	III. Check all wiring between VFD and PLC.
VFD NOT READY	I. Cycle Power to VFD and Station
	II. Check all wiring between VFD and PLC.
	III. Make sure that SW1 is at the "SINK EXT" position in VFD.
	IV. Check to be sure VFD is not in manual mode.
HIGH SYSTEM (Discharge):	I. Check application for high discharge pressure conditions. Does the mechanical gauge on the discharge header match the actual pressure displayed on the PLC?
	II. Check suction pressure conditions. Is suction pressure significantly higher than original system design point?
	III. Check Ramp Speed settings. Fast ramp speeds can increase the chance of over-pressurizing the system, especially with larger pumps.

Under no circumstances shall any instrument be used to test any on board components. Especially risky is an ohmmeter with battery voltage higher than TTL logic or applied with incorrect polarity.

## 6.12 AC/DC Voltmeter

- Input impedance shall not be less than 10 MEGOHM.
- Accuracy - AC  $\pm$  2% of Full Scale
- DC  $\pm$  3% of Full Scale
- Rated circuit to ground voltage = 1000V.

## 6.13 Ohmmeter

- Accuracy  $\pm$  2%
- Overload protection voltage = 1000V.

## 6.14 Millimeter

Accuracy  $\pm$  2% of Full Scale

## 6.15 Signal generator (analyzer) — recommended

1. Beta calibrator Model 434 20mA signal analyzer.
2. Altek calibrator Model 334 4-20mA loop analyzer.

Either instrument may be purchased from a Local Process Control Distributor.

### NOTICE:

If some other instrument is used it must float above ground, preferably battery powered.

## 6.16 Field repair

### 6.16.1 General

Typical field repair should include: replacing fuses, replacing input/output modules and assuring connections are correct and secure.



### DANGER:

Troubleshooting live control panels exposes personnel to hazardous voltages. Electrical troubleshooting must only be done by a qualified electrician. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY, DEATH, AND/OR PROPERTY DAMAGE.

## 6.17 Program updating

To update to a new version of the program the program must be downloaded through the USB port on the controller. This can be accomplished by one of the following means:

1. A factory authorized technician uploads on job site.
2. Replace the controller with one that has been pre-programmed at the factory.

Contact your Xylem representative for the preferred method of upgrading your software.

Issue	Remedy
LOW SYSTEM (Discharge):	I. Check application for low discharge pressure conditions. Does the mechanical gauge on the discharge header match the actual pressure displayed on the PLC?
	II. Are the pumps running in the correct direction?
	III. Check suction pressure conditions. Is suction pressure significantly lower than original system design point?
	IV. Is the system drawing a vacuum? Can the water supply keep up with demand?
	V. Could there be a broken pipe/leak in the system? In other words, does the system seem to be running in a 'open discharge' condition?
	VI. Check Ramp Speed settings. Slow ramp speeds can increase the chance of a rapid drop in system pressure.
WATER SHORTAGE:	Check application for legitimate 'low suction' pressure fault. Is a PRV set incorrectly?
	Could the system be drawing a vacuum?
	Check for open or closed switch contacts. Refer to wire diagrams for proper connection.

## 6.19 Maintenance(physical)

### 6.19.1 Electrical

No maintenance is required for the electrical panel except to keep the modules free of dirt and dust that might hold moisture. Cabinet door should be kept closed, and the components kept dry.

### 6.19.2 Mechanical

- If a Goulds pump was supplied it was lubricated at the factory. Future lubrication should be according to the instructions that came with the pump.
- If there is a danger of freezing, drain the pump. Inspect pump and system piping regularly.
- For leaky seals or gaskets and loose or damaged components, replace or repair as required.

## 7 Appendix

### 7.1 Modbus RTU and IP Point Table

Function Code	Points#	POINT DESCRIPTION	RANG/VALUE	Modbus Address	UNITS	Data Type	Installer Type
03	1	System Operation Mode	1 = Auto 0 = Manual	8967		BOOL	Boolean
03	2	VFD #3 On/Off	1 = On 0 = Off	8973		BOOL	Boolean
03	3	VFD #2 On/Off	1 = On 0 = Off	8974		BOOL	Boolean
03	4	VFD #1 On/Off	1 = On 0 = Off	8975		BOOL	Boolean
03	5	VFD #3 Trip	1 = Trip 0 = Ok	8979		BOOL	Boolean
03	6	VFD #2 Trip	1 = Trip 0 = Ok	8980		BOOL	Boolean
03	7	VFD #1 Trip	1 = Trip 0 = Ok	8981		BOOL	Boolean
03	8	PT Fault	1 = On 0 = Off	9002		BOOL	Boolean
03	9	Discharge Pressure	0 to Max scale	9053	PSI or BAR	REAL	Real 32 Bit
03	10	Set Point	0 to Span	9055		REAL	Real 32 Bit
03	11	Discharge Flow	0 to Max scale	9057	GPM or m <sup>3</sup> /h	REAL	Real 32 Bit
03	12	VFD Not Ready 1	1 = Not Ready 0 = Ready	9093		BOOL	Boolean
03	13	VFD Not Ready 2	1 = Not Ready 0 = Ready	9094		BOOL	Boolean
03	14	VFD Not Ready 3	1 = Not Ready 0 = Ready	9095		BOOL	Boolean
03	15	A2 fault or Flow Fault	1 = On 0 = Off	9107		BOOL	Boolean
03	16	A1 fault or PT-1 Fault	1 = On 0 = Off	9200		BOOL	Boolean
03	17	A3 Fault or PT-2 fault	1 = On 0 = Off	9201		BOOL	Boolean
03	18	System Speed	0 to 100	9233	%	REAL	Real 32 Bit
03	19	Pump 1 Run Hours	0 to 999	16392	Hours	DINT	Unsigned 32 bit
03	20	Pump 2 Run Hours	0 to 999	16394	Hours	DINT	Unsigned 32 bit
03	21	Pump 3 Run Hours	0 to 999	16396	Hours	DINT	Unsigned 32 bit
06	1	Alternation command	1 = Yes 0 = No	9202		BOOL	Boolean
03, 06	2	General Alarm or Hooter Acknowledge	1 = On 0 = Off	8539		BOOL	Boolean
06	3	System Reset or Alarm Reset	1 = On 0 = Off	8990		BOOL	Boolean

03, 06	4	Pump #1 Enabled	1 = Enabled 0 = Disabled	16384		BOOL	Boolean
03, 06	5	Pump #2 Enabled	1 = Enabled 0 = Disabled	16385		BOOL	Boolean
03, 06	6	Pump #3 Enabled	1 = Enabled 0 = Disabled	16386		BOOL	Boolean
03, 06	7	System Start/Stop	1 = Start 0 = Stop	17028		BOOL	Boolean

## 8 Product Warranty

### 8.1 Limited consumer warranty

**Warranty.** For goods sold for personal, family or household purposes, Seller warrants the goods purchased hereunder (with the exception of membranes, seals, gaskets, elastomer materials, coatings and other “wear parts” or consumables all of which are not warranted except as otherwise provided in the quotation or sales form) will be free from defects in material and workmanship for a period of one (1) year from the date of installation or two (2) years from the product date code, whichever shall occur first, unless a longer period is provided by law or is specified in the product documentation (the “Warranty”).

Except as otherwise required by law, Seller shall, at its option and at no cost to Buyer, either repair or replace any product which fails to conform with the Warranty provided Buyer gives written notice to Seller of any defects in material or workmanship within ten (10) days of the date when any defects or non-conformance are first manifest. Under either repair or replacement option, Seller shall not be obligated to remove or pay for the removal of the defective product or install or pay for the installation of the replaced or repaired product and Buyer shall be responsible for all other costs, including, but not limited to, service costs, shipping fees and expenses. Seller shall have sole discretion as to the method or means of repair or replacement. Buyer’s failure to comply with Seller’s repair or replacement directions shall terminate Seller’s obligations under this Warranty and render this Warranty void. Any parts repaired or replaced under the Warranty are warranted only for the balance of the warranty period on the parts that were repaired or replaced.

Seller shall have no warranty obligations to Buyer with respect to any product or parts of a product that have been: (a) repaired by third parties other than Seller or without Seller’s written approval; (b) subject to misuse, misapplication, neglect, alteration, accident, or physical damage; (c) used in a manner contrary to Seller’s instructions for installation, operation and maintenance; (d) damaged from ordinary wear and tear, corrosion, or chemical attack; (e) damaged due to abnormal conditions, vibration, failure to properly prime, or operation without flow; (f) damaged due to a defective power supply or improper electrical protection; or (g) damaged resulting from the use of accessory equipment not sold or approved by Seller. In any case of products not manufactured by Seller, there is no warranty from Seller; however, Seller will extend to Buyer any warranty received from Seller’s supplier of such products.

**THE FOREGOING WARRANTY IS PROVIDED IN PLACE OF ALL OTHER EXPRESS WARRANTIES. ALL IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO ONE(1) YEAR FROM THE DATE OF INSTALLATION OR TWO (2) YEARS FROM THE PRODUCT DATE CODE, WHICHEVER SHALL OCCUR FIRST. EXCEPT AS OTHERWISE REQUIRED BY LAW, BUYER’S EXCLUSIVE REMEDY AND SELLER’S AGGREGATE LIABILITY FOR BREACH OF ANY OF THE FOREGOING WARRANTIES ARE LIMITED TO REPAIRING OR REPLACING THE PRODUCT AND SHALL IN ALL CASES BE LIMITED TO THE AMOUNT PAID BY THE BUYER FOR THE DEFECTIVE PRODUCT. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY OTHER FORM OF DAMAGES, WHETHER DIRECT, INDIRECT, LIQUIDATED, INCIDENTAL, CONSEQUENTIAL, PUNITIVE, EXEMPLARY OR SPECIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF PROFIT, LOSS OF ANTICIPATED SAVINGS OR REVENUE, LOSS OF INCOME, LOSS OF BUSINESS, LOSS OF PRODUCTION, LOSS OF OPPORTUNITY OR LOSS OF REPUTATION.**

Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state.

To make a warranty claim, check first with the dealer from whom you purchased the product or call +1-847-966-3700 for the name and location of the nearest dealer providing warranty service.

### 8.2 Commercial warranty

**Warranty.** For goods sold to commercial buyers, Seller warrants the goods sold to Buyer hereunder (with the exception of membranes, seals, gaskets, elastomer materials, coatings and other “wear parts” or consumables all of which are not warranted except as otherwise provided in the quotation or sales form) will be (i) be built in accordance with the specifications referred to in the quotation or sales form, if such specifications are expressly made a part of this Agreement, and (ii) free from defects in material and workmanship for a period of one (1) year from the date of installation or two (2) years from the date of manufacture, whichever shall occur first, unless a longer period is specified in the product documentation (the “Warranty”).

Except as otherwise required by law, Seller shall, at its option and at no cost to Buyer, either repair or replace any product which fails to conform with the Warranty provided Buyer gives written notice to Seller of any defects in material or workmanship within ten (10) days of the date when any defects or non-conformance are first manifest. Under either repair or replacement option, Seller shall not be obligated to remove or pay for the removal of the defective product or install or pay for the installation of the replaced or repaired product and Buyer shall be responsible for all other costs, including, but not limited to, service costs, shipping fees and expenses. Seller shall have sole discretion as to the method or means of repair or replacement. Buyer’s failure to comply with Seller’s repair or replacement directions shall terminate Seller’s obligations under this Warranty and render the Warranty void. Any parts repaired or replaced under the Warranty are warranted only for the balance of the warranty period on the parts that were repaired or replaced. Seller shall have no warranty obligations to Buyer with respect to any product or parts of a product that have been: (a) repaired by third parties other than Seller or without Seller’s written approval; (b) subject to misuse, misapplication, neglect, alteration, accident, or physical damage; (c) used in a manner contrary to Seller’s instructions for installation, operation and maintenance; (d) damaged from ordinary wear and tear, corrosion, or chemical attack; (e) damaged due to abnormal conditions, vibration, failure to properly prime, or operation without flow; (f) damaged due to a defective power supply or improper electrical protection; or (g) damaged resulting from the use of accessory equipment not sold or approved by Seller. In any case of products not manufactured by Seller, there is no warranty from Seller; however, Seller will extend to Buyer any warranty received from Seller’s supplier of such products.

**THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ANY AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES, GUARANTEES, CONDITIONS OR TERMS OF WHATEVER NATURE RELATING TO THE GOODS PROVIDED HEREUNDER, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY EXPRESSLY DISCLAIMED AND EXCLUDED. EXCEPT AS OTHERWISE REQUIRED BY LAW, BUYER’S EXCLUSIVE REMEDY AND SELLER’S AGGREGATE LIABILITY FOR BREACH OF ANY OF THE FOREGOING WARRANTIES ARE LIMITED TO REPAIRING OR REPLACING THE PRODUCT AND SHALL IN ALL CASES BE LIMITED TO THE AMOUNT PAID BY THE BUYER FOR THE DEFECTIVE PRODUCT. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY OTHER FORM OF DAMAGES, WHETHER DIRECT, INDIRECT, LIQUIDATED, INCIDENTAL, CONSEQUENTIAL, PUNITIVE, EXEMPLARY OR SPECIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF PROFIT, LOSS OF ANTICIPATED SAVINGS OR REVENUE, LOSS OF INCOME, LOSS OF BUSINESS, LOSS OF PRODUCTION, LOSS OF OPPORTUNITY OR LOSS OF REPUTATION.**

### 8.3 Notice – Inclusion of third-party PLCs and associated software

This product includes Programmable Logic Controllers (PLCs) manufactured by Schneider electric to enable feedback control of the system. Schneider uses certain software versions in its PLC that Schneider knows to be potentially vulnerable. Xylem strongly advises that you, as the system operator, engage with Schneider to understand any support and security requirements of the PLC, including reviewing the support site. Any updates to this PLC require coordination between Schneider and Xylem. Please contact your Xylem sales representative with any such questions.

#### Notice - Industrial Control Protocols

Certain Industrial Control Protocols do not offer security protections at protocol level and may be exposed to additional Cybersecurity risk. Customer security precautions including physical security measures are an important layer of defense in such cases. Xylem's Goulds Water Technology AquaForce e-MTV Pump Controller is designed with the consideration that it would be deployed and operated in a physically secure location.

- Xylem suggests that physical access to cabinets and/or enclosures containing the Goulds Water Technology AquaForce e-MTV Pump Controller and the associated system should be restricted, monitored and logged at all times.
- Xylem recommends that customers inventory and document all industrial equipment running on their premises including model name, software version, and how devices are connected to each other and the local network.
- Xylem recommends creating and maintaining offline copies of configuration backups to all equipment involved in controlling critical processes.
- In cases where control commands for Xylem equipment are issued from SCADA or building management systems, Xylem recommends a regular check by operators to ensure the integrity of communications between these systems and Xylem equipment.
- Physical access to the communication lines should be restricted to prevent any attempts of wiretapping, sabotage. Best practice is to use metal conduits for the communication lines running between one cabinet to another cabinet.
- People with unauthorized physical access to the device could cause serious disruption of the device functionality. A combination of physical access controls to the location should be used, such as locks, card readers, and/or guards etc.
- Xylem's Goulds Water Technology AquaForce e-MTV Pump Controller supports the following physical access ports:
  - o RJ45 connector for removable keypad as well as Modbus RTU communications
  - o RJ45 for Modbus TCP communications
  - o Terminal block for Modbus RTU and other Digital IOs
- Xylem suggests access to above physical ports need to be restricted.

#### Xylem Product Cybersecurity

Xylem values your system security and the availability of your critical services. For more information on Xylem cybersecurity practices or to contact the cybersecurity team please visit [xylem.com/security](http://xylem.com/security).

## 9 Cybersecurity

### 9.1 Xylem product cybersecurity

Xylem performs appropriate due care in building security and resilience into products. Xylem performs the following security activities for defense-in-depth:

- Security engineers perform **threat modeling** to identify **testable controls**
- Code is scanned for flaws with **static analysis** tools and hardened
- **Product components are analyzed** and hardened
- Security controls are verified through **automated and manual tests**
- Xylem maintains relationships with customers, integrators, and the cybersecurity research community and the **Product Security Incident Response Team (PSIRT)** coordinates the collection, analysis, remediation, and responsible disclosure of vulnerability and remediation information to keep products secure
- Cloud connections, data flows, and cloud infrastructure are continuously monitored by the **Product Security Operations Center (PSOC)**
- Product security is **governed through a three lines of defense** model that includes: product developers, product security engineers, and audit staff

### 9.2 Notice – inclusion of third-party PLCs and associated software

This product includes Programmable Logic Controllers (PLCs) manufactured by Schneider Electric to enable feedback control of the system. As with all software, periodically vulnerabilities are discovered in software and the vendor will release patches or updates. Xylem will follow these releases and provide updates. Please contact your Xylem sales representative with any questions about the product or contact [product.security@xylem.com](mailto:product.security@xylem.com) regarding security questions.

### 9.3 Notice- inclusion of third-party PLCs and associated software

Certain industrial protocols (such as Modbus) do not offer security protections at protocol-level and may be exposed to additional cyber security risks. Customers using such protocols should implement the security recommendations provided.

### 9.4 Security recommendations for end-user

e-MTV is developed considering security best practices. The following guidance provides recommendation for secure operations, hardening and account management. In the table below: *Safeguards* describe the security guidance, *Security Context & Rationale* provide overview of security features and value of the security safeguard, and *References* provide additional resources for further investigation for implementing the recommended safeguards.

Table 2:

Safeguard	Security Context & Rationale	References
<b>Restrict physical access</b> <ul style="list-style-type: none"> <li>• <b>Ensure physical access to assets is limited. Include physical isolation to protect the environment and equipment therein.</b></li> <li>• <b>Ensure strict control over physical access in and out of the facility.</b></li> <li>• <b>Physical access to communication lines should be restricted.</b></li> </ul>	The communication ports have been hardened to restrict access and ensure integrity of device operations. This safeguard supports the ability to further limit exposure associated with physical threats to the device such as rogue/malicious device joining over Modbus.	ATT&CK for ICS: M0801 NIST SP 800-53 Rev5: AC-3, PE-3 ISA/IEC 62443-3-3: SR 2.1
<b>Ensure that the device is not exposed to internet, using below recommendations:</b> <ul style="list-style-type: none"> <li>• <b>Secure the network access to the device using VPN connections.</b></li> <li>• <b>Implement firewall &amp; define rules to protect device from Denial-of-service attempts.</b></li> <li>• Protect the network address information of device using Network Address Translation (NAT) technique.</li> </ul>	This safeguard ensures that data and SCADA controls are not exposed to internet. This also helps in preventing Man-in-the-middle attacks when the device is accessed via Modbus, because these protocols are insecure-by-design. We recommend using network segmentation and segregation to minimize access to sensitive information for those systems and people who don't need it, while ensuring that the organization can continue to operate effectively.	ATT&CK for ICS: M0930 NIST SP 800-95 NIST SP 800-44 v2 ISA/IEC 62443-3-3: SR 5.1, SR 7.1
Ensure cybersecurity policies, awareness, and training to the operators, administrators and other personnel.	This safeguard prevents social engineering attacks and promotes awareness related to cybersecurity.	ATT&CK for ICS: M0917 NIST SP 800-53 Rev5: AT-2 ISA/IEC 62443-2-4: SP.01

Safeguard	Security Context & Rationale	References
Ensure patch management is done regularly and updated appropriately. Xylem monitors updates to Schneider PLCs and when there are security updates Xylem will provide updated software. Ensure that the configuration recipe is backed up prior to installing any updates.	This safeguard prevents attacks related to using components with known vulnerabilities. Sometime vulnerabilities are discovered, and Xylem works with partners to deploy updates that improve security and resilience. This safeguard mitigates exploitation risks and ensures security patches are available, but it is up to operators to pay attention to updates through <a href="http://xylem.com/security">xylem.com/security</a> and to properly install them.	ATT&CK for ICS: M0951 NIST SP 800-53 Rev5: MA-2 ISA/IEC 62443-2-3
Ensure hardening guidelines are implemented, only desired ports and services should be open, and RBAC should be followed.	This safeguard helps in prevention of attacks due to misconfigurations or default configurations.	ATT&CK for ICS: M0937, M0918, M0801 NIST SP 800-53 Rev5: AC-3(7), SC-7(5) ISA/IEC 62443-3-3: SR 2.1, SR 5.1
Ensure strong password policy is implemented and default credentials should not be used, passwords must be changed periodically.	This safeguard will help in prevention of passwords and account takeover attacks.	ATT&CK for ICS: M0927 NIST SP 800-53 Rev5: IA-5 ISA/IEC 62443-3-3: SR 1.7
Conduct backups of the configuration recipe according to the directions provided in Section [5.5.12] of this IOM. In the cases where control commands for Xylem equipment are issued from SCADA or BMS, regularly check the integrity of communication between these systems and availability of backups.	The ability of up-to-date backups provides for recovery from control system failures or misconfigurations. This provides systems resilience, including against ransomware. Xylem can provide baseline system software (Schneider firmware and control software), but operators are responsible for their configurations.	ATT&CK for ICS: M0953 NIST SP 800-53 Rev5: CP-9 ISA/IEC 62443-3-3: SR 7.3
Implement specific inventory, logging and monitoring of hardware and report security-related incidents to Xylem at <a href="mailto:product.security@xylem.com">product.security@xylem.com</a> . These might include unexpected operations, confirmed tampering, or theft of the device.	Devices are hardened and Xylem provides PSIRT to help customers investigate potential security incidents. This safeguard supports the ability to track assets and recognize potential security events.	ATT&CK for ICS: M0947 NIST SP 800-53 Rev5: SM-8 ISA/IEC 62443-3-3: SR 1.11, SR 2.8, SR 3.4

For additional information see references:

1. ATT&CK for ICS available online: <https://attack.mitre.org/mitigations/ics/>
2. NIST SP 800-53 Rev 5 available online: <https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-53r5.pdf>
3. ISA/IEC 62443 standards available for purchase from ISA, IEC, or ANSI.

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IM358\_2.0\_en-US\_2024-06\_IOM\_e-MTV AQUAFORCE Packaged Booster System

