

AQUA-G

OPTIMAL PERFORMANCE & ENERGY EFFICIENCY

The AQUA-G is GATA's premier solution, expertly engineered for a wide range of water and wastewater pump applications. With its extensive set of features, AQUA-G is built to tackle the operational challenges of almost every water or wastewater pumping applications. Its seamless BMS integration makes it the ideal choice for complex systems and technologically advanced buildings.

- Water Supply
- Lifting Stations
- Firefighting
- HVAC systems

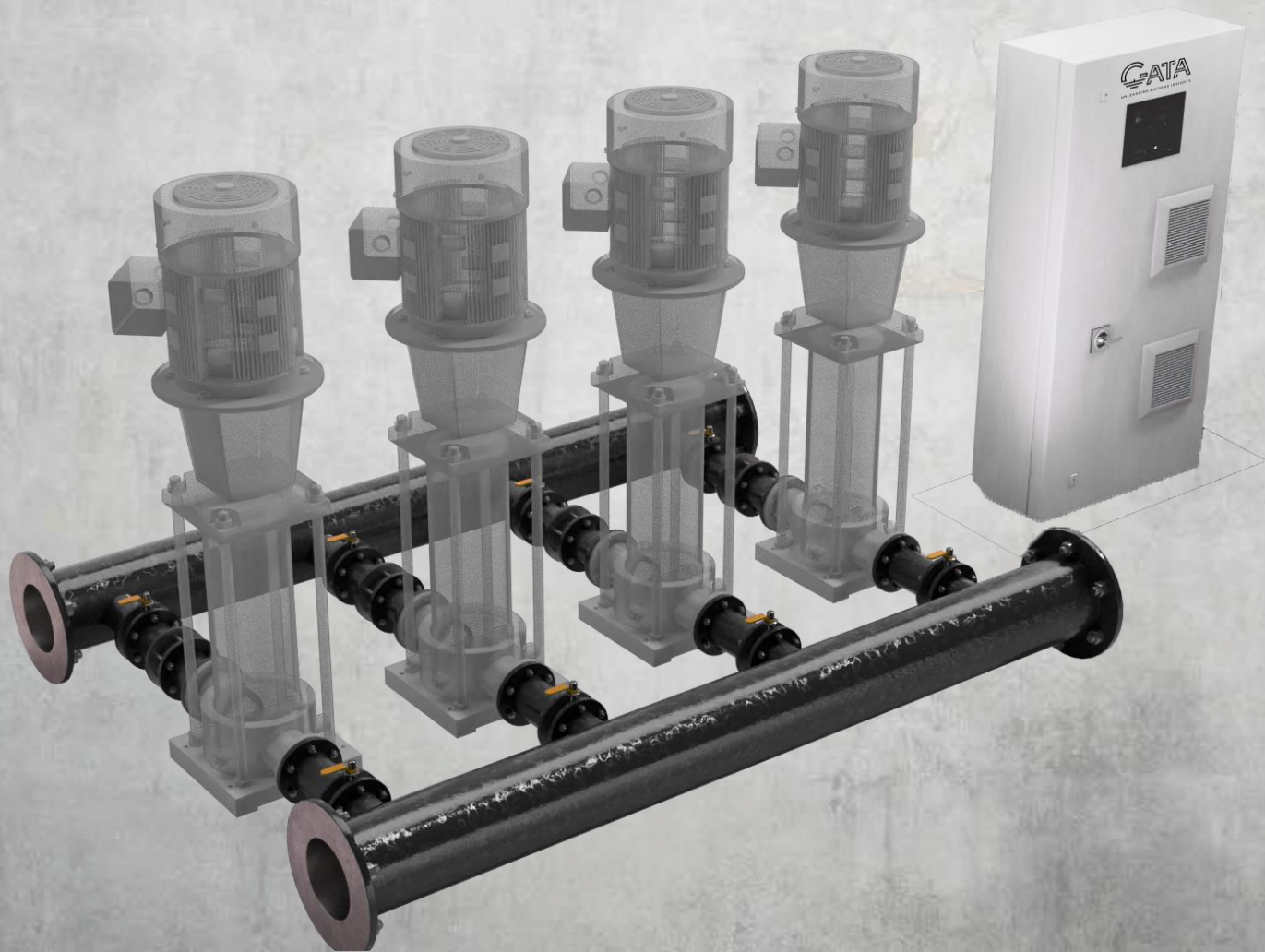


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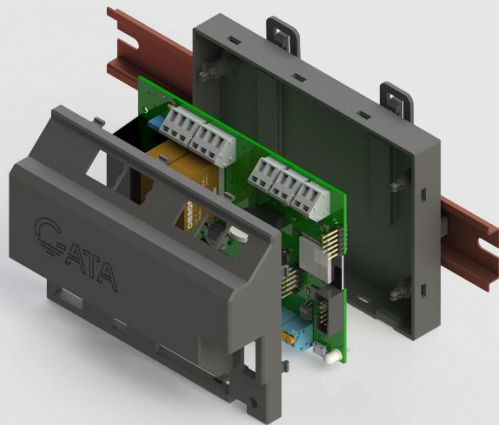
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1. Introduction

1.1 Overview of the AQUA-G Pump System Controller.


The AQUA-G Pump System Controller, developed by GATA, is a cutting-edge solution designed to optimize and manage pump operations across a variety of industrial, commercial, and infrastructure applications. Built with flexibility and scalability in mind, AQUA-G excels at providing seamless control for multiple types of pumps, offering advanced features like IoT connectivity, cloud-based management, and AI-powered machine learning. Whether controlling water pressure in a booster system, managing the flow in circulation systems, or ensuring safety in firefighting applications, AQUA-G is designed to deliver reliable and efficient performance in all environments.



 The controller integrates with both existing and new systems through a range of **industrial communication protocols**, making it suitable for integration into SCADA, BMS (Building Management Systems), and other advanced automation environments. Its ability to combine advanced energy management, predictive maintenance through AI, and cloud connectivity positions the AQUA-G controller as a leading solution in smart water and HVAC management systems.


1.2 Key Features

1.2.1 IoT and Cloud Computing.

 The **AQUA-G controller** is designed to leverage the power of the **Internet of Things (IoT)** and **cloud computing**, enabling:

Real-Time Monitoring and Control	Users can remotely access the pump controller via any connected device (PC, tablet, or smartphone), monitoring system performance in real time
Cloud-Based Data Storage	The system collects and stores performance data in the cloud, allowing for in-depth analysis of historical trends, system inefficiencies, and operational health. This data can be used to optimize performance and reduce costs.
Remote Diagnostics and Updates	System operators can diagnose faults, adjust settings, and deploy software up-dates without the need for physical presence at the pump site. This reduces downtime and simplifies system management.
Custom Alerts and Notifications	The IoT capability allows for real-time alerts and notifications to be sent via email, SMS, or push notifications, keeping the system’s operators informed of any anomalies or necessary adjustments.

1.2.2 Artificial Intelligence (AI) for Machine Learning.

 The AQUA-G controller employs **AI and Machine Learning (ML)** to offer a smart, self-learning control system that evolves based on the pump’s operational history:


- Predictive Maintenance:**

Through machine learning algorithms, the system can predict when pumps will require maintenance based on performance trends, reducing the risk of unexpected failures and downtime. This enables operators to schedule maintenance more efficiently and avoid costly breakdowns.
- Performance Optimization:**

The AI continuously analyzes data from the system to adjust parameters and optimize pump efficiency. This reduces energy consumption, extends the life of the pump, and improves overall system performance.
- Fault Prediction:**

The system can detect early signs of wear or operational faults before they lead to system failure, providing proactive insights that help maintain uptime and reduce operating costs.


1.2.3 Multi-Application Support.

 The versatility of the AQUA-G controller allows it to be deployed across a variety of applications, such as:

Application	Description
Booster Systems	Maintain constant water pressure in industrial, commercial, and residential settings.
Lifting Stations	Handle the control of pumps in wastewater management and sew-age applications, ensuring smooth and efficient operation.
Circulation Systems	Manage the flow in HVAC systems for both heating and cooling applications, providing consistent climate control while optimizing energy usage.
HVAC Applications	Control various types of pumps used in air conditioning, ventilation, and heating, ensuring that temperature and air quality are maintained at the desired levels.
Fire Fighting Systems	Comply with safety standards and provide reliable pump control for firefighting applications, ensuring that critical water supplies are delivered in emergency situations.

By supporting multiple applications, the AQUA-G controller offers a **one-stop solution** for pump management across different sectors, making it easier for facility managers and engineers to streamline their operations.

1.2.4 Supported Industrial Communication Protocols.

 One of the key strengths of the AQUA-G controller is its extensive support for a wide range of industrial communication protocols, ensuring that it can integrate seamlessly into different types of automation and monitoring systems:

Modbus (RTU & TCP/IP)	A widely used protocol in industrial automation systems, Modbus allows the AQUA-G controller to communicate with Programmable Logic Controllers (PLCs), Remote Terminal Units (RTUs) , and other devices for comprehensive control and monitoring.
BACnet	Primarily used in building management systems (BMS) , BACnet enables the controller to be integrated into systems that manage HVAC, lighting, fire detection, and security systems. This is particularly useful in commercial buildings where all systems are centrally managed.
Ethernet/IP:	As one of the most robust and high-speed industrial communication protocols, Ethernet/IP allows for real-time communication between the AQUA-G controller and other devices in an industrial setting, ensuring the immediate sharing of critical data.
Wireless Communication (Wi-Fi, Bluetooth)	For installations where physical wiring is not feasible, the AQUA-G controller supports wireless communication, allowing for easy setup and integration with IoT devices or remote systems without the need for additional infrastructure.

2. Safety Instructions



The **AQUA-G Pump System Controller** includes highly sensitive electronic hardware and is either provided as a **PCB (Printed Circuit Board)** or as part of a fully assembled electrical control panel. Ensuring proper safety procedures are followed is crucial for preventing in-jury, damage to the controller, and other hazards. The following safety instructions are intended to guide the safe installation, operation, and maintenance of the AQUA-G controller.

2.1 General Safety Precautions.

- Qualified Personnel Only:**



The handling, installation, and servicing of the **AQUA-G controller PCB or fully assembled panel** must be performed by qualified technicians or engineers with expertise in electronic systems and electrical controls. Mishandling can result in serious injury, equipment damage, or system failure.

- Read the Manual Thoroughly**



Before working with the AQUA-G controller, read and understand this manual in full. All users must be familiar with the operational requirements, safety instructions, and installation procedures.

- Static Electricity Precautions (For PCB):**



If handling the standalone PCB, precautions against electrostatic discharge (ESD) must be observed. Use anti-static wrist straps and mats to prevent damage to sensitive components.




- Personal Protective Equipment (PPE):**






Always wear appropriate PPE, such as insulated gloves and safety glasses, when handling electrical components, especially during installation or service work on the fully assembled electrical control panels.

2.2 Installation Safety Guidelines

2.2.1 For PCB Installations.

<p>Ensure Power is Off</p> 	<p>Before installing or connecting the AQUA-G controller PCB, make sure the power supply is completely turned off to avoid electrical shock and prevent damage to sensitive electronic components.</p>
<p>ESD Protection</p> 	<p>Use ESD-safe workstations and ensure proper grounding when handling the PCB to avoid static discharge that could damage the delicate electronic circuits.</p>
<p>Mounting the PCB</p> 	<p>Secure the PCB in an ESD-safe enclosure designed for electronics that require environmental protection from dust, moisture, and excessive temperatures. Ensure there is adequate ventilation to prevent overheating of electronic components.</p>

2.2.2 For Fully Assembled Panels:

<p>Secure Panel Mounting</p> 	<p>Mount the control panel securely on a solid, flat surface. The panel should be installed in a location that allows for adequate airflow and easy access for maintenance and operation.</p>
<p>Environmental Factors</p> 	<p>Ensure the panel is installed in a dry and well-ventilated environment, away from excessive moisture, heat, or corrosive substances. Direct sunlight and extreme temperature conditions should be avoided to prevent damage to both the panel and the internal PCB.</p>
<p>Mechanical Handling</p> 	<p>Use appropriate lifting equipment when installing larger, fully assembled panels to avoid injury or damage to the equipment.</p>

2.3 Electrical Safety Considerations.

<p>Verify Power Specifications</p>	<p>Before connecting the AQUA-G controller (whether as a PCB or panel), ensure that the supply voltage and phase match the specifications of the controller. Incorrect power input can result in electrical failure or damage to the controller’s sensitive electronic components.</p>
<p>Proper Grounding</p>	<p>Ensure that the AQUA-G PCB or panel is properly grounded in accordance with local electrical codes. Grounding is essential to prevent electric shock and protect the system from electrical faults.</p>
<p>Cable and Connector Management</p>	<p>For both PCB and panel setups, ensure that all wiring is properly terminated and secured. Use appropriate connectors and protective conduits to avoid damage to the wiring and maintain the integrity of connections.</p>
<p>Over-current Protection</p>	<p>Use circuit breakers, fuses, or other suitable protection devices to guard against over-current situations. These devices will prevent damage to both the PCB and any connected systems.</p>

2.4 Maintenance and Service Safety.

2.4.1 For Fully Assembled Panel Maintenance.

- Lockout/Tagout Procedures:**
Before beginning any maintenance work, ensure that the system is locked out and tagged out to prevent accidental re-energizing of the control panel while being serviced.
- Inspect Components Regularly:**
Regularly inspect the internal components of the panel, including the PCB, wiring, and terminals, for signs of wear, corrosion, or damage. Replace faulty components immediately to maintain operational reliability.

- Cooling and Ventilation Maintenance:**
For fully assembled panels, ensure that all cooling fans, ventilation slots, and filters are clean and free of obstructions. Proper airflow is necessary to prevent overheating of both the panel and the PCB inside.
- Use Original Spare Parts:**
When servicing either the PCB or the control panel, only use manufacturer-recommended parts and components to ensure compatibility and maintain the safety and functionality of the AQUA-G controller.

2.5 Emergency Procedures.

<p>Power Off in Emergency</p>	<p>In the event of an emergency, immediately disconnect the power supply to the AQUA-G controller PCB or control panel. This may be done using a master switch or disconnecting the mains power.</p>
<p>Fire Safety</p>	<p>In case of fire, use only Class C fire extinguishers (such as dry powder or CO2) suitable for electrical equipment. Do not use water-based extinguishers on electrical components.</p>
<p>Injury Response</p>	<p>In case of electric shock or injury, immediately seek medical help and apply local first-aid measures.</p>


3. System Overview


3.1 Pump Control Functions and Capabilities.





The AQUA-G controller provides advanced control capabilities for managing pump systems with high precision and flexibility. Key


functions include:

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Control of up to 8 Pumps:
In booster systems, AQUA-G can control up to 8 pumps with configurations that include **duty, standby, and pilot pumps**. Each pump type can have distinct control methods, optimizing system performance for different operational needs.
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Flexible Starting and Control Methods:
AQUA-G supports multiple starting and control methods, including **Direct On-Line (DOL), Star-Delta, Soft Starters, and Variable Speed Drives (VSD)** for both single and multiple pumps. The system can independently control pilot pumps with methods distinct from duty pumps, offering further flexibility and ensuring optimal energy use.
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Energy Efficiency and Smooth Operation:
AQUA-G provides both **fixed and variable pressure set points**, allowing the system to adjust to real-time demands and maximize energy savings. This feature helps maintain steady system operation, especially in applications with fluctuating pressure needs.
- 

Scheduler for Optimized Operation:
AQUA-G includes an advanced scheduling feature, allowing users to define specific operation times based on **dates, days, and hours**. This ensures the system runs only when needed, further enhancing energy efficiency and reducing wear on equipment.
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Comprehensive Protection:
The AQUA-G controller includes full protection mechanisms for both the pumps and the overall system. It detects issues such as **pipe leaks, blockages, empty pipes, or even pipe breakage**, ensuring system safety and preventing damage to both the pumps and the premises being supplied.

3.2 Supported Pump Applications.


3.2.1 Booster Systems.



The **AQUA-G controller** excels in managing complex booster systems, where water pressure needs to be maintained and optimized for various applications such as municipal water supplies, high-rise buildings, and commercial complexes. Key features for booster systems include:


Control of up to 8 Pumps	The system can manage up to 8 pumps, with configurations for duty, standby, and pilot pumps . Pilot pumps can operate under different starting and controlling methods, enhancing operational flexibility
Starting Configurations	Support for various pump starting methods, including Direct On-Line (DOL), Star-Delta, Soft Starters, and both single and multiple Variable Speed Drives (VSD).
Energy-Saving Modes	Options for fixed and variable pressure set points , allowing the system to adapt to changing demands and ensure smooth operation while saving energy.
Scheduled Operation	Users can define specific schedules for pump operation based on calendar dates, days, or hours, ensuring that the system runs only when necessary, leading to improved efficiency
Advanced Protection	AQUA-G offers leak detection, blockage detection and pipe break protection safeguarding the system and ensuring water delivery is safe and efficient.

3.2.2 Lifting Stations.

 The AQUA-G system provides full control for wastewater lifting applications, handling up to **6 pumps** working in parallel with the assistance of an **IO expansion board**. It is designed to manage various types of installations and complex wastewater scenarios, ensuring reliability and performance:


Installation Flexibility	AQUA-G supports both dry and wet installations for pumps, including systems that require solid separation . It can be customized to work with various types of pumps and lifting station designs.
Comprehensive Sensor Support	The system is compatible with a wide range of sensors and instrumentation, ensuring proper monitoring and control of the lifting process. It offers level sensors, flow meters , and other essential instruments to optimize the system's operation based on the specific lifting requirements.
Efficient Parallel Pump Control	With the help of the IO expansion board, AQUA-G can manage multiple pumps running in parallel, ensuring even distribution of workload and efficient wastewater management.

3.2.3 Circulation Systems.

 AQUA-G is ideal for managing **circulation systems** in HVAC or water distribution applications, offering energy-saving features and seamless integration into modern building automation systems:


- **Temperature Control:** AQUA-G can ensure consistent water temperature control, which is essential in HVAC circulation systems. This is achieved through optimized pump control, keeping the system running at the required flow rate and ensuring comfort and efficiency.
- **Variable Flow Management:** By controlling the pump's operation based on the real-time flow requirements, AQUA-G reduces energy consumption while maintaining consistent system performance.

3.2.4 HVAC Applications.

 For **HVAC systems**, the AQUA-G controller provides tailored pump management solutions that ensure optimal thermal regulation and efficient water or air movement within buildings:

- **Optimized Pump Scheduling:** The system can be programmed to operate pumps at different times of the day or in specific cycles to match the HVAC load, ensuring energy savings and efficient system performance.
- **Variable Speed Pump Control:** With support for multiple variable speed drives, AQUA-G ensures that pumps operate efficiently at different load levels, reducing wear and tear on the system while optimizing energy use.

3.2.5 Fire Fighting Systems.

 In critical fire-fighting applications, the AQUA-G controller offers reliable and robust pump control, ensuring that water is delivered promptly and effectively in emergencies:

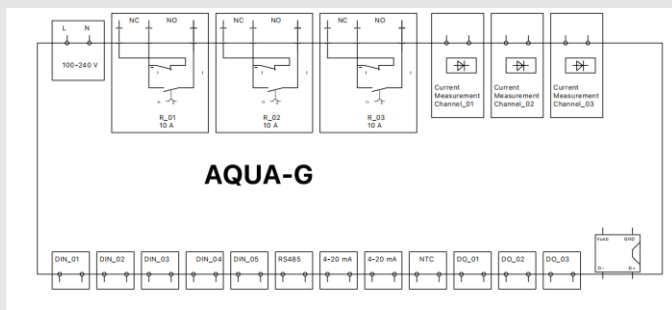
Redundancy and Safety	AQUA-G supports configurations with standby pumps to ensure that in the event of a failure, the system will switch seamlessly to an alternative pump.
Emergency Operation	The system includes features that prioritize pump operation during emergency conditions, ensuring that fire-fighting water supply is reliable when needed.
Protection Features	AQUA-G includes protection against low water pressure, ensuring that the fire suppression system remains operational under all conditions.

4. Controller Components

4.1 Main Controller Unit.



The AQUA-G main controller unit serves as the core of the system, managing all operations and ensuring reliable and efficient performance. It integrates advanced hardware and software features to support a wide range of industrial applications. Key components include digital and analog input/output channels, communication interfaces, and advanced control algorithms.



4.2 I/O Expansion Board.



The I/O expansion board extends the functionality of the main controller by providing additional input and output channels. It supports the following connections:

Digital Outputs (1–24)	Configurable for controlling relays or other actuators, grouped into commons for efficient wiring.
Digital Inputs (1–24)	Compatible with industrial switches, push buttons, and control signals.
Analog Inputs (AD1–AD6)	Supports 4-20mA current loops, 0-10V signals, or configurable as digital inputs.

4.3 Sensors and Actuators.



The AQUA-G controller supports a wide range of industrial sensors and actuators. Compatible sensors include:

- **Pressure sensors (4-20mA or 0-10V)**
- **Temperature sensors (NTC thermistors)**
- **Flow sensors**
- **Level sensors**



Actuators, such as pumps, valves, and relays, can be directly controlled using the digital and analog outputs.

4.4 Display and User Interface.



The AQUA-G controller can be monitored and controlled through a full computer interface. Users can connect to the system via Bluetooth, USB, Ethernet, or Wi-Fi. The user interface is accessible on Android, iOS, Windows, or web platforms, MAC, Linux providing flexibility and ease of use.

4.5 Communication Ports and Interfaces.



The AQUA-G controller features multiple communication interfaces to ensure seamless integration with industrial systems:

RS485	RS485 ports for half-duplex communication.
Ethernet	High-speed network connectivity for IoT applications and remote control.
USB	Direct connection for setup and monitoring.
Bluetooth	Wireless connection for portable devices.
Wi-Fi	Enables wireless communication for remote access and control.

4.6 Power Supply Requirements.



The AQUA-G controller operates with a power input range of ~100-240V AC. It includes dedicated power terminals for the main board

and I/O expansion board:

Main Board	Requires 100-240V AC input.
Expansion Board	Supports 24V DC and 3.3V DC power inputs for peripherals and sensors and is driven by the main board. I/O Connections

4.7 I/O Connection.



The AQUA-G controller offers versatile input/output connections to interface with a wide range of industrial equipment:

- **Digital Outputs**
- **Digital Inputs**
- **Analog Inputs**

5. Installation Guidelines

5.1 Pre-Installation Requirements.



Ensure the installation site is suitable for the AQUA-G controller. Key considerations include:

- **A stable, vibration-free surface to mount the controller.**
- **Adequate space for ventilation around the controller to prevent overheating.**
- **Accessibility for maintenance and wiring.**
- **A dust-free and moisture-free environment.**

5.2 Environmental Considerations



The AQUA-G controller should be installed in an environment that meets the following conditions:

- **Operating temperature: 0°C to 70°C.**
- **Humidity levels: Less than 90% RH, non-condensing.**
- **Protection from exposure to corrosive gases or chemicals.**
- **Protection from direct sunlight or high-intensity light sources.**

5.3 Mounting the Controller.



Follow these steps to mount the AQUA-G controller securely:

- **Ensure the mounting surface is stable and capable of supporting the controller's weight.**
- **Use the mounting brackets provided with the controller.**
- **Secure the controller using appropriate screws and hardware.**
- **Leave at least 10 cm of clearance around the controller.**

5.4 Electrical Connections.



Proper electrical connections are critical for the safe and efficient operation of the controller:

- **Connect the power supply to the specified terminals: 100-240V AC for the main board.**
- **Use cables of appropriate gauge and insulation to handle the electrical load.**
- **Ground the controller properly to prevent electrical hazards.**
- **Ensure all wiring connections are tight and secure to prevent accidental disconnections.**

5.5 Connecting Pumps and Peripheral Devices.



When connecting pumps and other peripheral devices, follow these guidelines:

- Use the digital and analog output terminals to connect pumps, valves, and other actuators.
- Connect sensors such as pressure, flow, and temperature sensors to the appropriate input terminals.
- Verify the compatibility of all connected devices with the controller's specifications.
- Label all connections for easy identification during maintenance.

6. Configuration and Setup

6.1 Initial Power-Up and Basic Configuration.



- 1) Connect the controller to the appropriate power supply as specified in the installation guidelines.
- 2) Turn on the controller and observe the initial boot sequence on the display. Ensure all connected peripherals, such as sensors and pumps, are powered on and communicating with the controller.
- 3) Access the user interface through the display, Bluetooth, USB, or Ethernet connection.
- 4) Follow the on-screen instructions for the initial setup, including selecting the desired language, setting the system clock, and configuring network settings for cloud or local access.

6.2 System Calibration.



- 1) Calibrate the connected sensors for accurate readings:
 - Pressure Sensors: Configure the range and perform zero and span adjustments.
 - Flow Sensors: Define the minimum and maximum flow rates for the system.
 - Temperature Sensors: Verify readings against a reference thermometer.
- 2) Calibrate pump parameters such as:
 - Motor power (kW) and current limits (A).
 - Start/stop frequency to avoid excessive cycling.
 - Test the calibration settings by running a short diagnostic cycle.

6.3 Setting Operating Parameters.



- 1) Define the operating parameters for the system:
 - Set Points: Configure pressure, flow, or temperature set points as per the application requirements.
 - Control Modes: Select between manual, automatic, or hybrid control modes.
 - Pump Rotation Schedule: Set rotation intervals to ensure equal wear across all pumps.
- 2) Configure alarms and notifications for key conditions such as low pressure, over-temperature, or pump faults.

6.4 Application-Specific Settings.

6.4.1 Booster System Configuration.



- 1) **Configure the controller to maintain constant pressure within the system by setting:**
 - Primary pressure set point.
 - Minimum and maximum pressure limits.
 - Pipe filling parameters to prevent water hammer during startup.
- 2) **Set duty and standby pump schedules to ensure redundancy and reliability.**

6.4.2 Lifting Station Configuration.



- 1) **Set the lift station operating levels:**
 - Low level for pump start.
 - High level for pump stop.
 - Emergency high level to trigger alarms and backup pumps.
- 2) **2. Configure the controller for parallel pump operation with load balancing to ensure efficiency and reliability.**

6.4.3 HVAC and Circulation System Settings.



- 1) Define the desired flow rate or temperature set points for heating or cooling applications.
- 2) Enable variable speed control for pumps to optimize energy efficiency.
- 3) Integrate the controller with building management systems (BMS) via supported protocols (e.g., BACnet).

6.4.4 Fire Fighting System Settings.



- 1) **Configure the system to prioritize pump operation during emergencies by enabling:**
 - Emergency high-pressure mode.
 - Standby pump activation in case of failure of the primary pump.
- 2) **Ensure compliance with NFPA standards by setting required operational parameters for fire suppression systems.**

7. HMI (Human-Machine Interface)

7.1 Navigating the HMI

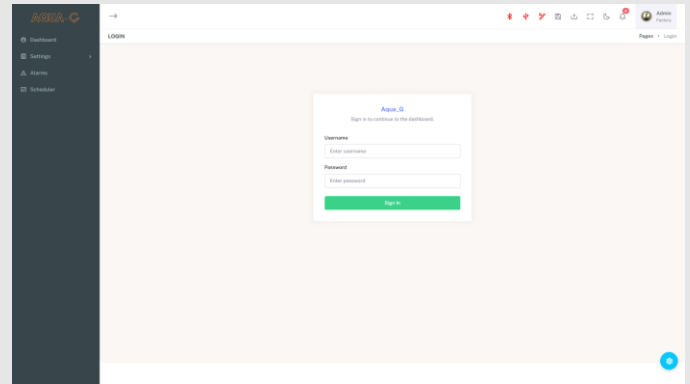


The Aqua-G controller can be controlled and monitored through Bluetooth or USB from any platform. Aqua-G supports desktop applications, Android apps, iOS apps, and web apps, making it accessible and versatile for various user preferences.

7.2 Login Page.



The login page is the initial interface where users can access the system using their username and password. The Aqua-G controller supports three levels of user access to ensure appropriate control and security:



7.2.1 Factory Level Access.



Users with factory level access have full control over all features and settings, including advanced configurations and system updates. This level is intended for technical staff responsible for comprehensive system management.

7.2.2 Admin Level Access.



Admin level users have significant control over the system, allowing them to edit most settings. However, access to certain advanced features and configurations is restricted. This level is designed for system administrators who manage day-to-day operations.

7.2.3 User Level Access.

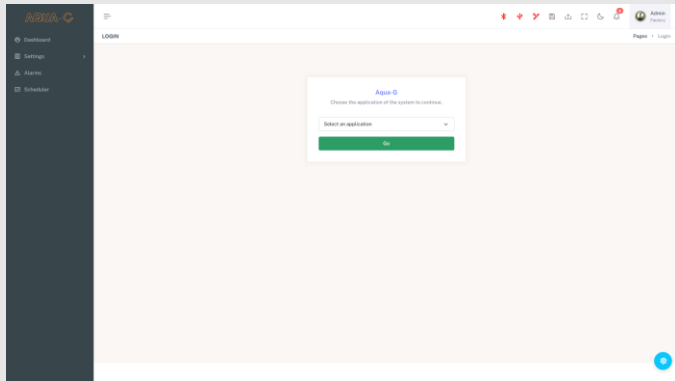


Users with this level of access can monitor system operations and adjust operational parameters, such as setpoint. This level is suitable for general users who need to ensure the system runs efficiently without making extensive changes to the configuration.

7.3 Application Selection.

After logging in for the first time, users are directed to the application selection page. This page allows users to choose the specific application for the Aqua-G controller from the following options:

- **Pump Booster**
- **HVAC**
- **Fire Fighting**
- **Circulation**

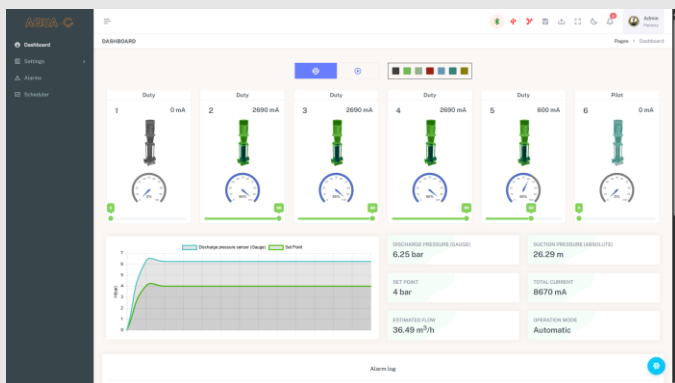


7.4 Dashboard.

After selecting the application, the user is redirected to the dashboard, which provides a comprehensive view of the system's operation.

7.4.1 Operation Modes.

Manual Mode: In this mode, users can control the pumps manually. For pumps equipped with a VFD, users can adjust the speed. For mains-operated pumps, users can enable or disable them. The dashboard indicates the selected application as a multi-VFD system, where each pump has a dedicated VFD.



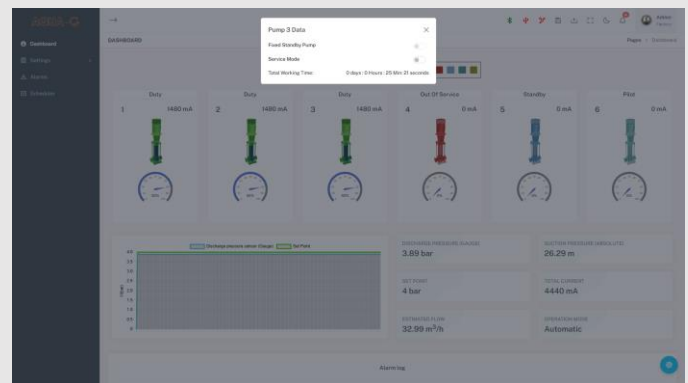
7.4.2 Automatic Mode.



In automatic mode, the system starts the operation of the pumps based on their type and the specific application of the system, whether it is multi-VFD, single VFD, multi-drive with bypass, direct online, or star-delta. This mode aims to achieve the desired setpoint of pressure with the lowest power consumption and highest efficiency.

7.4.3 Pump Types.

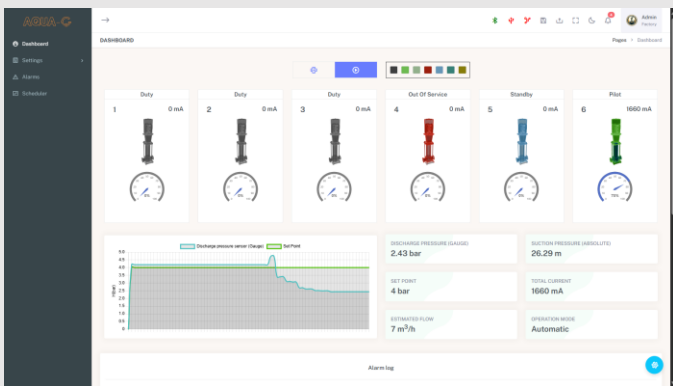
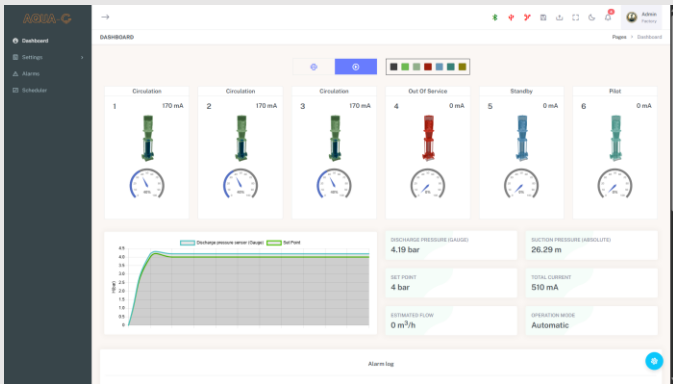
Duty Pumps	These are the main pumps responsible for meeting the system's primary requirements.
Pilot Pumps	Smaller pumps that operate at the start of the system to reach the setpoint efficiently, aiming to reduce power consumption.
Fixed Standby Pump	This pump remains inactive unless a duty pump is tripped or set out of service. When the controller detects a need for full capacity, it will activate the fixed standby pump.
Scheduled Standby Pump	Unlike fixed standby pumps, these are rotated according to a schedule. The scheduler alternates them to ensure all pumps have equal working hours, enhancing the longevity and maintenance balance of the system.
Out of Service	When a pump is taken out of operation, it will not be used in automatic mode unless returned to operation.



7.4.4 Circulation.



When the setpoint is achieved, and the user wishes to maintain system flow with a defined number of pumps operating at a specified percentage.

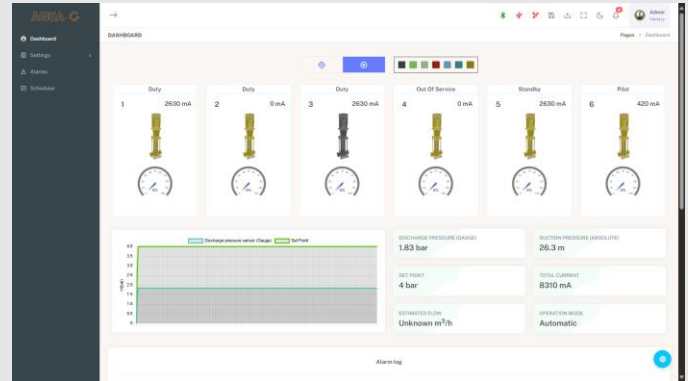


7.4.5 Pump states.



Each pump type and mode is represented by a unique color for easy identification. The modes include:

Running	Indicates the pump is operating, with a percentage shown for VFD-equipped pumps or "ON" for mains-operated pumps.
Stopped	The pump is not working.
Tripped	The controller has lost communication with the pump's VFD, or there is a fault in the pump operation.



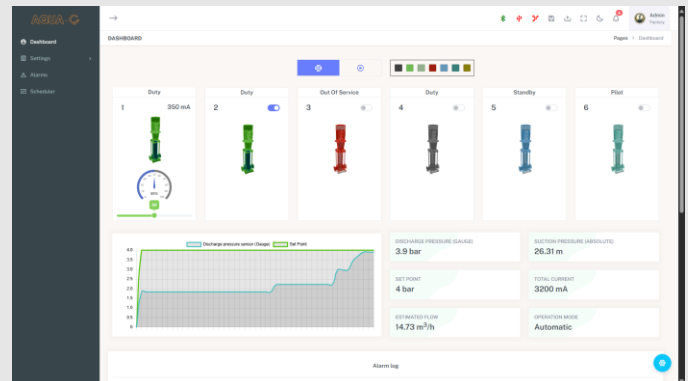
The Aqua-G controller supports various types of speed control to ensure optimal pump performance and efficiency:

7.4.6 Single VFD.



In this configuration, a single Variable Frequency Drive (VFD) controls the speed of one pump, while the other pumps are mains operated.

The control algorithm manipulates the baseload pump (the pump with the VFD) along with the mains-operated pumps to achieve the highest efficiency and performance.



7.4.7 Multi VFD / Multi VFD with Bypass.

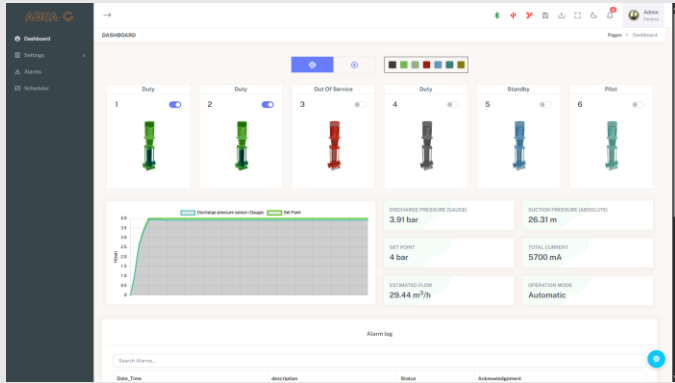


In a multi-VFD configuration, each pump is equipped with its own VFD, allowing for independent speed control of each pump. This provides greater flexibility and efficiency in managing the system's overall performance. The multi-VFD with bypass adds an additional layer of reliability by allowing the system to bypass a VFD in case of a fault, ensuring continuous operation.

7.4.8 Direct Online / Star-Delta.



For pumps operated directly online or in a star-delta configuration, speed control is not available. These pumps run at a fixed speed determined by the mains power supply. This setup is typically used for simpler applications where variable speed control is not necessary.



7.4.9 Alarm History.

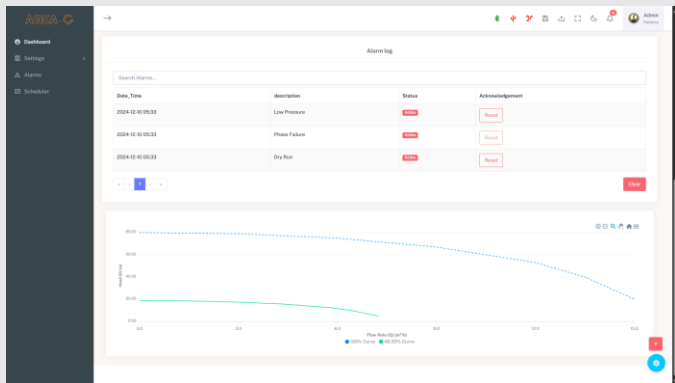


The dashboard also includes an alarm history section that enables the user to monitor all alarms that occurred in the system over the past three months. It shows whether the alarm is active or not and allows the user to acknowledge active alarms.

7.4.10 Pump Curve Graph.



Additionally, the dashboard features a pump curve graph, which plots the 100% operation curve of the running pumps, whether they are pilot or duty pumps, alongside the current speed curve of the pumps. This helps in visualizing and analyzing pump performance and efficiency.



7.5 Pump Configuration Page.



The pump configuration page is divided into two main sections: Units Number and Units Configuration.

7.5.1 Units Number Section.



This section includes three settings to define the number of different types of pumps in the system:

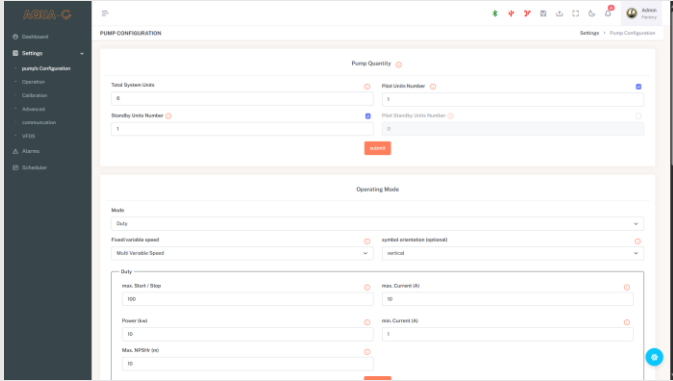
Total System Units	Specifies the total number of pumps in the system, including both duty and pilot pumps.
Pilot Units Number	Indicates the number of connected pilot pumps. Note that pilot pumps with VFD should be set with the highest Modbus ID in the system.
Standby Units Number	Defines the number of standby pumps that will operate in case of a failure or when other pumps are out of service.

7.5.2 Units Configuration Section.



This section allows the user to input detailed data for each pump, including whether the pump is a duty pump or a pilot pump. The settings available in this section are:

Mode	Select whether the pump is a Duty or Pilot pump.
Speed Control	Define the type of speed control for the pump (e.g., multi-variable speed).
Power (kW)	Enter the power rating of the pump.
Max. Current (A)	Specify the maximum current the pump can draw.
Min. Current (A)	Specify the minimum current the pump can draw.
Max. NPSHr (m)	Enter the maximum Net Positive Suction Head required for the pump.
Max. Start/Stop	Define the maximum number of start/stop cycles per hour.
Pump Orientation	Choose the orientation of the pump (horizontal or vertical). This setting affects the graphical representation in the HMI only.



By configuring these settings, users can ensure that the Aqua-G controller optimally manages each pump based on its specifications and operational requirements.

7.5.3 Pump Operation Page.



The pump operation page is used to control the automatic operation of the system and set its parameters. This page includes several sections, each with specific settings to ensure efficient and reliable pump operation.

7.5.4 Operation Section.

Set Point	In the case of a fixed set point, this setting will be activated, and the system in automatic operation will aim to maintain the discharge pressure at this specified point.
Cut-In	The pressure points at which, if the discharge pressure drops below it, the duty pump will start to operate, and any working pilot pumps will shut down.
Cut-Off	The pressure point that triggers a rapid shutdown of the pump until the system reaches the set point.
Ramp Up / Down %:	The maximum change in any pump's speed per second, either increasing or decreasing.
Pilot Pump Cut-In	The pressure point that will trigger the pilot pumps to start if all system pumps are not working.

Change Over Time	The time in minutes that will make the scheduler switch the pumps to maintain equal working time for all pumps in the system.
Low Pressure Trigger Time	The time in seconds that will trigger a low-pressure alarm if the system remains below the cut-in pressure for this duration.
High Pressure Point	This point will shut all the pumps immediately if this pressure is reached. It should be set above the cut-off point.

7.5.5 Minimum Performance Pumps.



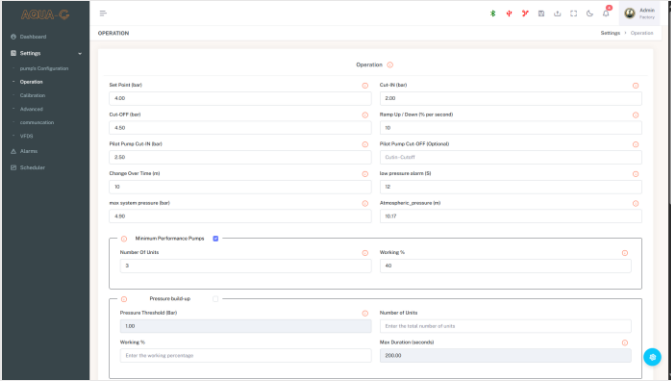
These pumps aim to circulate water to maintain flow when the set point is achieved, and all other pumps are shut off. Users can enter the number of units to work and the operation percentage of each.

7.5.6 Pressure builds up.



This operation occurs only at the start of operation when the pipes are empty of water. It has three inputs:

Working %	If the percentage is set to 73% the number of units will work with this percentage of speed till the pressure build up phase finishes.
Number of units	the number of pumps that will work to build up the pressure with the specified percentage.
Max Duration	The maximum duration for the pipe filling operation. If the pressure threshold is not reached within this time, the pipe filling will stop, and normal automatic operation will begin.
Pressure Threshold	The pressure that, when reached, will stop the pipe filling operation.

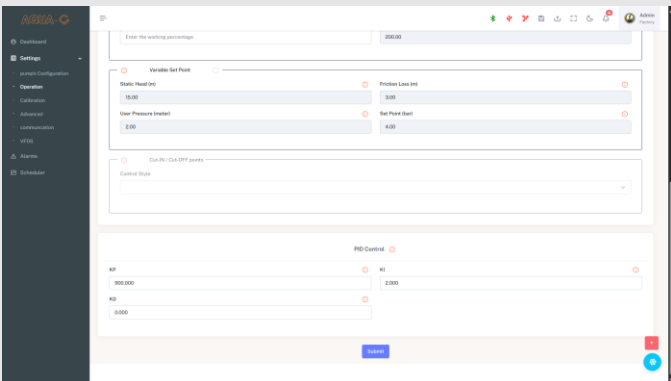


7.5.7 Variable Set Point.

Static Head (meters):	The height of the water column.
User Pressure (Bar):	The pressure required to end water user to have.
Set Point	the max variable set point which the system will try to lower it to save power Without affecting the end user water pressure.
Friction Loss (meters):	The estimated friction loss in the system.

7.5.8 PID Control.

KP, KI, KD: Proportional, Integral, and Derivative gains for fine-tuning the PID control algorithm used on automatic mode.



By setting these parameters correctly, users can ensure that the Aqua-G controller maintains optimal pump performance and system efficiency.

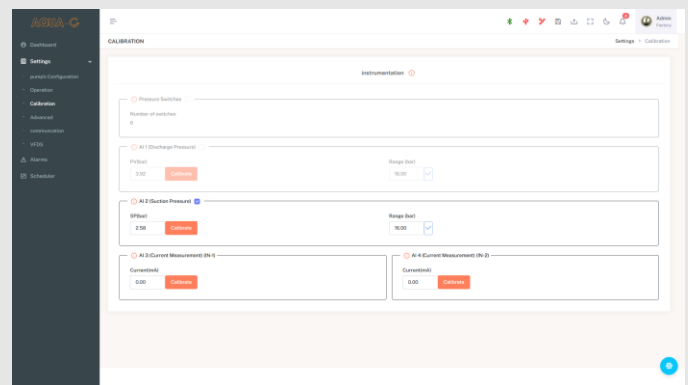
7.6 Calibration.

The calibration page allows users to enable and calibrate sensors connected to the Aqua-G controller. Depending on the system configuration, users can

calibrate various sensors to ensure accurate readings and optimal performance.

Pressure Switches	Enable and calibrate the number of pressure switches connected to the system.
Discharge Pressure Sensor	Calibrate the discharge pressure sensor to ensure accurate pressure readings. This is essential for maintaining the desired system pressure.
Suction Pressure Sensor	Calibrate the suction pressure sensor to monitor the suction pressure accurately. This helps in preventing issues related to low suction pressure.
Current Measurement	The Aqua-G controller can measure the current for pumps up to 15 amperes. This section allows for the calibration of current sensors to ensure precise current measurements.

By properly calibrating these sensors, users can ensure the Aqua-G controller operates efficiently and accurately, providing reliable data for system management and optimization.

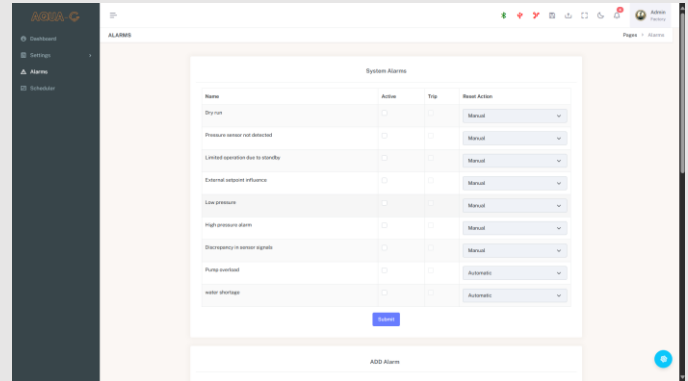


7.7 Alarm Page

The alarm page lists all the possible alarms in the system. Each alarm can be activated and configured to trip the automatic operation of the system until the alarm is acknowledged. The reset behavior can be set to either manual or automatic by the user.

Dry Run	Occurs when a pump operates without sufficient water, potentially causing damage to the pump.
Pressure Sensor Not Detected	Indicates a failure in detecting the pressure sensor, which is critical for system operation.
Limited Operation Due to Standby	The system is operating in a limited capacity because it is relying on standby pumps.
External Setpoint Influence	The system is working with the secondary set point due to the pressure falling below the acceptable limit, indicating a potential issue with pump operation or demand for the time input in the low pressure trigger time setting on the operation page.
Low Pressure	The system pressure has fallen below the acceptable limit, indicating a potential issue with pump operation or demand
High Pressure Alarm	The system pressure has exceeded the safe limit, which could damage the system components
Discrepancy in Sensor Signals	There is a mismatch or error in the readings from the sensors, indicating a potential fault.
Phase Failure	A phase in the electrical supply has failed, potentially causing improper pump operation.
Pump Tripped on Duty Range	A pump has tripped while operating in its duty range, indicating a possible fault or overload.
Pump Overload	The pump is drawing more current than its rated capacity, indicating an overload condition.
Cavitation	Occurs when vapor bubbles form in the liquid being pumped, potentially causing damage to the pump impeller and other components.

By configuring these alarms, users can ensure timely alerts and appropriate responses to maintain the system's safety and efficiency.

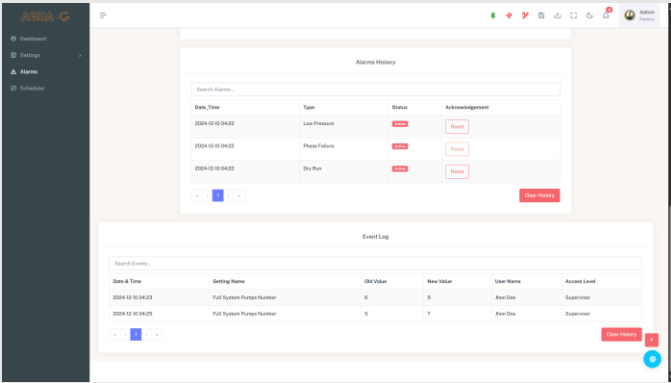


7.7.1 Event Logging.

The event logging section on the alarm page records all significant changes and events within the system. This includes adjustments to settings, system status changes, and other critical actions. Each log entry provides detailed information for tracking and auditing purposes.

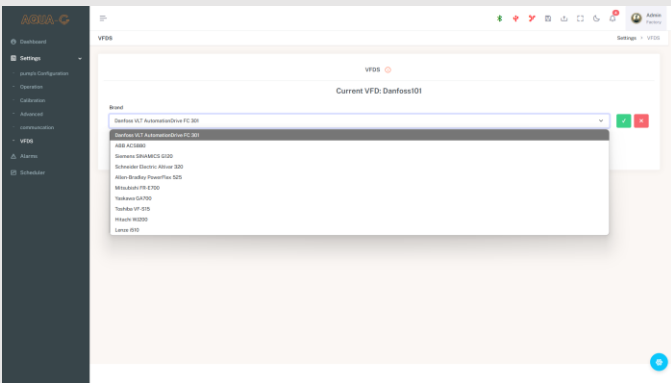
Date & Time	The exact timestamp of when the event occurred.
Setting Name	The specific setting or parameter that was changed or the event that took place.
Old Value	The previous value of the setting before the change.
New Value	The updated value of the setting after the change.
Username	The name of the user who made the change or initiated the event.
Access Level	The access level of the user, indicating their permissions within the system (e.g., Supervisor, Admin, user).

This event log helps in maintaining a comprehensive history of system operations and user activities, ensuring transparency and accountability. Users can review the log to understand changes made over time and to troubleshoot any issues that arise based on past events.



7.8 VFD Page.

The Aqua-G system can work with any VFD (Variable Frequency Drive) type. The user can define the Modbus addresses required to work with any VFD and add it to the list. This flexibility allows the system to be compatible with various brands and models of VFDs.



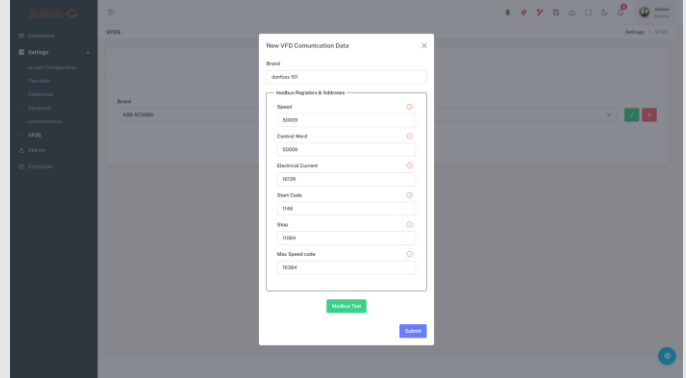
7.8.1 Adding New VFD.

To add a new VFD, the user must enter the following details:

Brand Name	The name of the VFD brand.
Speed Control Register Address	The Modbus register address for speed control.
Control Word Value	The value used to control the VFD.
Electrical Current Register Address	The Modbus register address for reading electrical current.
Start Code	The control word for starting the VFD.

Run Forward Code	The control word for running the VFD in the forward direction.
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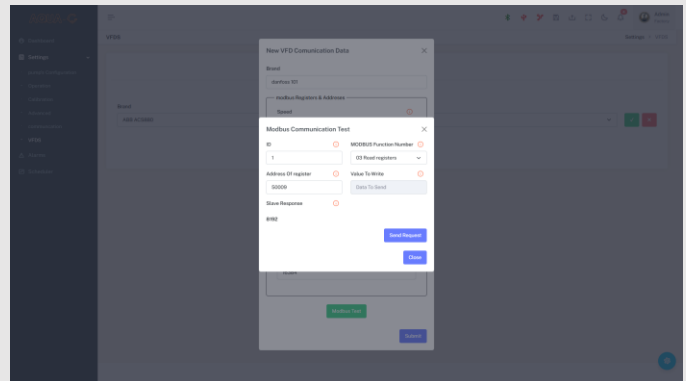
Max Speed Code	The value corresponding to 100% speed on the VFD.
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7.8.2 Testing Modbus Communication.

The user can test the entered values by clicking the "Modbus Test" button. This feature allows the user to read from or write to the connected VFD to ensure proper communication.

ID	The Modbus ID of the VFD.
Modbus Function Number	The function code for the Modbus operation (e.g., read registers).
Address of Register	The specific register address to communicate with.
Value to Write	The data to send to the VFD (for write operations).
Slave Response	The response received from the VFD.



By configuring these settings, users can ensure the Aqua-G controller properly interfaces with the VFDs, allowing for efficient and reliable pump control.

7.9 Scheduler Page.



On the scheduler page, the user can configure the date and time settings for the system and set up automatic start and stop operations. The scheduler allows for precise control over when the system operates, either by specific dates and times or on a recurring weekly schedule.

7.9.1 Date and Time Settings



Set System Date and Time: The user can update the system's date and time to ensure synchronization with real-world time.

7.9.2 Scheduled Operations



By Date: Users can add specific start and stop dates and times for the system's automatic operation. This feature is useful for planning operations around specific events or time periods.

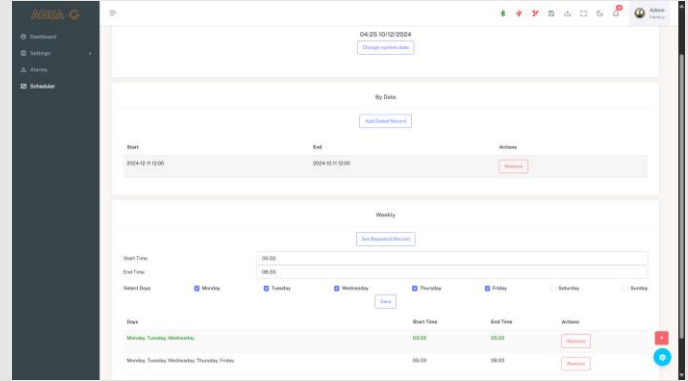
Start	The date and time when the system should begin automatic operation.
End	The date and time when the system should stop automatic operation.
Actions	Options to remove scheduled entries.



Weekly: Users can set recurring schedules for the system to start and stop automatically on specified days of the week at certain times.

This feature is ideal for regular maintenance schedules or optimizing operational hours.

Days	The days of the week when the system should operate.
Start Time	The time of day when the system should begin operation.
End Time	The time of day when the system should stop operation.
Actions	Options to remove scheduled entries.



By utilizing the scheduler, users can ensure that the Aqua-G system operates efficiently and according to planned schedules, reducing the need for manual intervention and optimizing energy usage.

7.10 Advanced Page

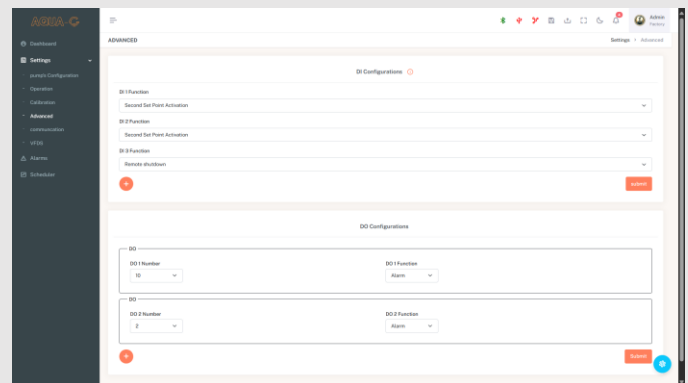


On the advanced page, the user can customize the digital inputs on the board. The Aqua-G controller supports an extension board that offers a variety of digital and analog inputs and outputs, allowing users to extend the system's capabilities.

7.10.1 Digital Input Customization



Users can set the function of each digital input to tailor the system to their specific needs.



By configuring these inputs, users can enhance the functionality and responsiveness of the Aqua-G system, ensuring it meets the requirements of complex and varied operational environments.

8. Advanced Features

8.1 IoT and Cloud Connectivity.

8.1.1 Setup for Cloud Integration.

The AQUA-G controller leverages IoT capabilities to provide seamless cloud integration. The setup process involves:

- **Configuring the controller's network settings via Ethernet, Wi-Fi.**
- **Registering the controller with the cloud service to enable data synchronization and remote access.**
- **Setting up user accounts and permissions for secure access to cloud-based features.**

8.1.2 Remote Monitoring and Control via Cloud.

Users can remotely monitor and control the AQUA-G system through any connected device, including smartphones, tablets, or

PCs. Cloud-based features include:

- **Viewing real-time system performance metrics such as pressure, flow rate, and energy consumption.**
- **Remotely adjusting operating parameters, schedules, and control modes.**
- **Receiving instant notifications for alarms, faults, or maintenance reminders.**
- **Accessing historical data and reports for performance analysis.**

8.1.3 Data Analytics and Reporting.

The cloud platform provides advanced analytics and reporting tools to enhance system performance and decision-making. Features include:

- **Generating custom reports on energy consumption, pump efficiency, and maintenance trends.**
- **Visualizing data through interactive dashboards and graphs.**
- **Identifying inefficiencies and optimizing system performance using AI-driven insights.**
- **Scheduling automated reports to be sent to users via email or other communication channels.**

8.2 Artificial Intelligence and Machine Learning.

8.2.1 Predictive Maintenance and Performance Optimization.

The AQUA-G controller utilizes machine learning algorithms to predict maintenance needs and optimize performance. Key capabilities include:

- **Monitoring system trends to detect early signs of wear or faults.**
- **Predicting the remaining lifespan of components such as pumps and motors.**
- **Automatically scheduling maintenance to prevent unexpected breakdowns and reduce downtime.**
- **Continuously optimizing operating parameters to improve efficiency and extend system life.**

8.2.2 Self-Learning Capabilities.

Through self-learning, the AQUA-G system adapts to changing operating conditions over time. This feature includes:

- **Learning system behaviors and adjusting control algorithms for improved performance.**
- **Analyzing historical data to refine predictive models.**
- **Automatically tuning PID settings to ensure stability and efficiency.**

8.3 Communication Protocols.

8.3.1 Modbus, Ethernet/IP, and BACnet Support.

The AQUA-G controller supports a wide range of industrial communication protocols for seamless integration:

Modbus (RTU and TCP/IP)	Enables communication with PLCs, RTUs, and SCADA systems.
Ethernet/IP	Ensures real-time data exchange in complex industrial environments.
BACnet	Facilitates integration with building management systems for HVAC, lighting, and fire safety.

8.3.2 Integration with SCADA and BMS Systems.



The AQUA-G controller is designed for easy integration with SCADA

(Supervisory Control and Data Acquisition) and BMS (Building Management Systems). This ensures centralized monitoring and control of all connected systems, enhancing efficiency and coordination.

8.3.3 Wireless Communication Options (Wi-Fi, Bluetooth).



Enhanced security protocols to protect against unauthorized access or data breaches.

Wireless communication options provide flexibility in system installation and access. Key features include:

Wi-Fi	Enables remote monitoring and control without the need for physical connections.
Bluetooth	Allows for local access to the system via mobile devices for quick diagnostics and configuration.

9. Pump Protection and Safety Features.

9.1 Pump Overload Protection.



The AQUA-G controller includes advanced pump overload protection to safeguard motors and electrical components. Key features include:

Real-Time Current Monitoring	Continuously monitors the current drawn by each pump to detect overcurrent conditions.
Configurable Overload Limits	Allows users to set maximum allowable current values for each pump based on their specifications.
Automatic Shutoff	In the event of an overload, the controller will stop the affected pump to prevent motor damage and system failures.
Alarm Notifications	Generates alarms to alert users about overload conditions and the need for corrective actions

9.2 Dry-Run Protection.

Dry-run protection prevents pumps from operating without adequate water supply, which can cause severe damage. This feature includes:

Pressure and Flow Monitoring	Continuously checks pressure and flow rates to ensure water is present.
Automatic Detection	Identifies dry-run conditions based on predefined thresholds for pressure and flow.
Pump Shutdown	Stops the pump immediately when a dry-run condition is detected, protecting the impeller and motor.
Alarm Notifications	Alerts operators to investigate and address the cause of the dry-run condition.

9.3 Over-Temperature Monitoring.



Over-temperature monitoring ensures the safe operation of pumps by preventing overheating. Features include:

Temperature Sensor Integration	Monitors the operating temperature of the pump and motor in real-time.
Configurable Temperature Limits	Users can define maximum temperature thresholds based on pump specifications.
Automatic Cooling Mechanisms	Triggers auxiliary cooling systems or shuts down the pump to prevent damage.
Alarm System	Issues warnings and alarms when temperatures exceed safe limits, prompting timely intervention.

9.4 Leak Detection and Alarm Systems.



The AQUA-G controller provides leak detection and alarm features to ensure system integrity and safety. Key functionalities include:

Pressure Drop Monitoring	Detects abnormal pressure drops that indicate potential leaks.
Water Sensor Integration	Supports external sensors to identify leaks in the system or surrounding area.
Automated Alerts	Notifies operators of leaks via alarms and notifications through the user interface or cloud.
Emergency Shutoff	Stops pump operation to minimize water loss and prevent further damage to the system.

9.5 Automatic Restart Features.



The automatic restart functionality ensures minimal downtime by restarting pumps after resolving specific fault conditions. This

feature includes:

Configurable Restart Logic	Allows users to define conditions for automatic restarts, such as after a power outage or minor fault.
Delayed Restart	Introduces a programmable delay to prevent damage from rapid cycling.
Safety Checks	Verifies that operating conditions are normal before initiating a restart to avoid repeated faults.
Status Notifications	Informs operators about the restart status and any additional actions needed.

10. Energy Efficiency and Performance Optimization

10.1 Variable Frequency Drive (VFD) Integration.



The AQUA-G controller supports seamless integration with Variable Frequency Drives (VFDs) to ensure efficient and precise control of pump operations. Key features include:

Universal Compatibility	Compatible with a wide range of VFD brands and models, ensuring flexibility in system design.
Dynamic Speed Control	Adjusts pump speed based on real-time system demands to reduce energy consumption and wear.
Soft Start and Stop	Minimizes mechanical stress on pumps and piping by gradually ramping up or down the motor speed.
Enhanced Monitoring	Monitors motor speed, current, and operational status to optimize performance and detect faults early.

10.2 Energy-Saving Modes.



The AQUA-G controller incorporates advanced energy-saving modes to minimize power consumption while maintaining system performance. Features include:

Variable Pressure Set Points	Adjusts pressure dynamically based on demand, ensuring efficient operation without compromising output.
Minimum Performance Mode	Maintains a minimum flow or pressure during low-demand periods to save energy
Pump Rotation Scheduling	Rotates pumps in operation to balance usage and extend the lifespan of each unit, reducing maintenance costs.

10.3 Pump Sequencing and Load Balancing.

The AQUA-G controller ensures optimal operation of multiple pumps through intelligent sequencing and load balancing. Key functionalities include:

Duty and Standby Pumps	Automatically assigns pumps to duty or standby roles based on system requirements.
Load Sharing	Distributes workload evenly across all active pumps to prevent overloading and ensure consistent performance.
Adaptive Scheduling	Adjusts pump operation schedules based on historical usage and real-time demand trends.

10.4 Optimizing System Efficiency with AI.

Artificial Intelligence (AI) enhances the AQUA-G controller's ability to optimize system efficiency by analyzing data and adapting to changing conditions. Features include:

Predictive Adjustments	Uses machine learning algorithms to predict demand fluctuations and adjust parameters proactively.
Energy Consumption Analysis	Identifies patterns in energy usage to recommend efficiency improvements.
Self-Learning Algorithms	Continuously refines control strategies based on historical data to improve performance over time.
Real-Time Optimization	Monitors system conditions and dynamically adjusts pump operation to achieve the lowest possible energy consumption without compromising output.

11. Maintenance and Troubleshooting

11.1 Routine Maintenance Procedures.

To ensure optimal performance and longevity of the AQUA-G Pump System Controller, regular maintenance is recommended:

- **Inspect Wiring and Connections:** Verify that all electrical connections are secure and free from corrosion.
- **Clean Components:** Remove dust and debris from the controller housing, cooling fans, and vents.
- **Sensor Calibration:** Check and re-calibrate sensors, including pressure, flow, and temperature, to ensure accuracy.
- **Check Pump Performance:** Monitor pump efficiency and operational parameters regularly.
- **Log Maintenance Activities:** Maintain a detailed log of inspections and performed maintenance for future reference.

11.2 Common Errors and Solutions.

Address common issues quickly using the following troubleshooting guide:

- **Controller Not Powering On:** Check the power supply and circuit breakers.
- **Incorrect Sensor Readings:** Verify sensor connections and re-calibrate if necessary.
- **Pump Not Operating:** Inspect wiring, check for tripped alarms, and ensure pump settings are correct.
- **Communication Errors:** Ensure proper cabling and configuration for RS485, Ethernet, or wireless communication.
- **Overheating:** Clean ventilation and check environmental conditions to maintain optimal operating temperature.

11.3 Troubleshooting Faults and Alarms.

The AQUA-G controller is equipped with an advanced alarm system to alert users to potential issues. Troubleshooting tips include:

Dry-Run Alarm	Verify water levels and pump suction conditions.
Overload Alarm	Check pump motor load and reduce excessive demands
High-Pressure Alarm	Inspect pressure sensors and system blockages
Communication Faults	Reconfigure communication settings or check for damaged cables
Historical Logs	Use the event log to identify recurring faults and implement preventive measures.

11.4 Firmware Updates and Software Upgrades.



Keep the AQUA-G controller up to date with the latest firmware and software for improved functionality and security:

Check for Updates	Regularly check the manufacturer's website or cloud platform for firmware updates.
Backup Settings	Save system configurations before performing updates to prevent data loss.
Update Procedure	Follow the on-screen instructions or use a USB drive to install updates.
Verify Operation	After updating, test the system to ensure all features are functioning as expected.
Update Over the Air (OTA)	If the system is online, firmware updates can be performed over the air without the need for manual intervention. This ensures the controller stays updated with minimal effort.

12. Fire Fighting System Features

12.1 NFPA Compliance and Standards.



The AQUA-G controller complies with the National Fire Protection Association (NFPA) standards to ensure reliability and safety in fire-fighting applications:

- **NFPA 20 Compliance:** Adheres to standards for the installation and operation of stationary fire pumps.
- **System Testing:** Includes built-in testing features to validate compliance with NFPA requirements.
- **Documentation:** Provides detailed records of system performance, testing, and maintenance for audit purposes.

12.2 Emergency Operation Modes.



The AQUA-G controller is equipped with advanced emergency operation modes to ensure continuous performance during critical situations:

High-Pressure Mode	Automatically prioritizes high-pressure delivery during emergencies
Manual Override	Allows operators to take direct control of pump operations in case of system faults.
Fail-Safe Operation	Ensures pumps remain operational even during partial system failures

12.3 Redundancy and Backup Control.




To guarantee uninterrupted operation, the AQUA-G controller offers redundancy and backup features:

- **Standby Pumps:** Activates standby pumps automatically if a duty pump fails.
- **Load Sharing:** Balances workload across multiple pumps to prevent overloading any single unit.
- **Backup Power Integration:** Supports connection to backup power supplies for reliable operation during outages.
- **System Monitoring:** Continuously monitors all pumps and backup systems to ensure readiness.


13. Industrial Protocol Integration

13.1 Configuring Communication Protocols.

 The AQUA-G controller supports a range of industrial communication protocols for seamless integration into diverse systems. Configuring these protocols involves:


Selecting the Protocol	Choose the appropriate protocol (Modbus, BACnet, Ethernet/IP) from the controller’s interface.
Setting Parameters	Define baud rate, parity, data bits, and stop bits for serial communication protocols.
Addressing	Assign unique device IDs or IP addresses for networked systems
Testing Connectivity	Use built-in diagnostic tools to verify communication with connected devices

13.2 Integration with Industrial Control Systems.

 The AQUA-G controller integrates seamlessly with industrial control systems, enabling centralized management of operations. Key features include:


- SCADA Compatibility:**
 Supports Supervisory Control and Data Acquisition (SCADA) systems for real-time monitoring and control.
- PLC Integration:**
 Communicates with Programmable Logic Controllers (PLCs) to execute automation sequences.
- Building Management Systems (BMS):**
 Interfaces with BMS for HVAC, lighting, and fire safety applications.
- IoT Platforms:**
 Connects to cloud-based platforms for remote monitoring and advanced analytics.

13.3 Protocol-Specific Setup: Modbus, BACnet, etc.

 Each communication protocol has unique configuration requirements:

Modbus	Configure register maps, coil settings, and function codes for RTU or TCP/IP modes
BACnet	Define device instance numbers and enable specific services for BMS integration
Ethernet/IP	Specify IP addresses, subnet masks, and gateways for industrial Ethernet communication

13.4 Real-Time Data Sharing and Monitoring.

 The AQUA-G controller facilitates real-time data sharing and monitoring to enhance operational efficiency:

Live Dashboards	Displays current system status, operational metrics, and alarms.
Data Logging	Captures historical data for performance analysis and troubleshooting.
Event Notifications	Sends alerts via email or SMS for critical events.
Third-Party Integration	Shares data with external analytics tools and visualization software.

14. AI-Driven Predictive Maintenance

14.1 How Machine Learning Enhances Maintenance.

Machine learning algorithms in the AQUA-G controller analyze operational data to predict maintenance needs and improve performance. Features include:

Pattern Recognition	Detects anomalies and trends in pump behavior.
Fault Prediction	Identifies potential issues before they escalate into system failures.
Automated Recommendations	Suggests maintenance actions based on historical data and real-time conditions.

14.2 Predictive Analysis for Reducing Downtime.

Predictive analysis minimizes system downtime by addressing issues proactively. Key functionalities include:

- Performance Tracking:**
 Continuously monitors pump efficiency and alerts users to deviations.
- Maintenance Scheduling:**
 Uses predictive insights to plan maintenance during low-demand periods.
- Cost Reduction:**
 Reduces repair costs by preventing catastrophic failures.

14.3 System Health Monitoring.

The AQUA-G controller provides comprehensive system health monitoring to ensure reliable operation:

Real-Time Diagnostics	Continuously evaluates pump performance and system parameters.
Health Scores	Assigns a health score to each component based on operational data.
Historical Trends	Analyzes historical data to identify recurring issues and optimize system performance.

15. IoT Data Management and Analytics

15.1 Cloud-Based Data Collection.

The AQUA-G controller utilizes IoT technology to collect and store data in the cloud. Features include:

Secure Data Transfer	Uses encrypted communication protocols to ensure the safety of transmitted data.
Data Logging	Continuously records key operational parameters such as pressure, flow rate, and energy consumption.
Centralized Storage	Stores historical data on cloud servers for easy access and long-term analysis.
Backup and Recovery	Ensures data integrity and availability, even during local system failures.

15.2 Real-Time Analytics and Monitoring.

The AQUA-G controller enables real-time analytics and monitoring for proactive decision-making:

- Live Data Visualization:**
 Displays operational metrics through interactive dashboards.
- Trend Analysis:**
 Identifies patterns and trends to predict future performance.
- Anomaly Detection:**
 Alerts users to deviations from normal operating conditions.
- KPI Monitoring:**
 Tracks key performance indicators to ensure system efficiency and reliability.

15.3 Automated Reports and Insights.



Automated reporting tools in the AQUA-G system simplify data interpretation:

- **Customizable Reports:**
Generate reports tailored to specific operational needs.
- **Scheduled Delivery:**
Automatically sends reports to designated users via email or cloud platforms.
- **Insightful Analysis:**
Highlights inefficiencies and recommends corrective actions.
- **Compliance Reporting:**
Generates reports to meet regulatory and operational standards.

15.4 Custom Dashboards for Remote Access.



The AQUA-G controller provides customizable dashboards for remote system management:

User-Specific Views	Tailor dashboards to display the most relevant data for each user.
Real-Time Updates	Refreshes data continuously for accurate monitoring.
Device Compatibility	Access dashboards via desktop, tablet, smartphone, web browser.
Cloud Integration	Sync dashboards with cloud platforms for global accessibility.

16. User Accounts and Permissions

16.1 User Authentication and Access Control.



The AQUA-G controller employs robust user authentication and access control mechanisms to enhance security:

Login Credentials	Requires username and password for system access.
Session Management	Tracks active user sessions to prevent unauthorized access.
Access Logs	Maintains a record of login attempts and user activities for auditing purposes.

16.2 Setting Permissions for Different User Roles.



User roles in the AQUA-G system are designed to provide appropriate levels of control and functionality:

- **Factory Level Access:**
Grants full access to all system features, intended for technical staff.
- **Admin Level Access:**
Allows significant control over system settings but restricts advanced configurations.
- **User Level Access:**
Enables monitoring and basic parameter adjustments, suitable for general operators.
- **Custom Roles:**
Define unique roles and permissions based on organizational needs.

16.3 Remote User Management.



The AQUA-G controller supports remote management of user accounts and permissions through the cloud:

Account Creation	Add new users remotely and assign roles.
Permission Updates	Modify access levels without needing physical access to the controller.
User Deactivation	Disable accounts instantly in case of security concerns
Activity Monitoring	Track user activities in real time to ensure compliance with security policies

17. Appendices

17.1 Technical Specifications.



The AQUA-G Pump System Controller is designed with the following technical specifications:

Power Input	100-240V AC for the main controller, 24V DC for peripherals.
Communication Ports	RS485, Ethernet, USB, Wi-Fi, and Bluetooth.
Supported Protocols	Modbus RTU/TCP, BACnet/IP, Ethernet/IP.
Operating Temperature	0°C to 70°C
Humidity	Up to 90% RH, non-condensing
Digital Inputs	24 channels (expandable).
Analog Inputs	4-20mA, 0-10V configurable (6 channels).
Digital Outputs	24 channels for relays or actuators

17.2 Glossary of Terms.

IoT	Internet of Things, enabling devices to communicate over the internet.
VFD	Variable Frequency Drive, used to control pump motor speed.
SCADA	Supervisory Control and Data Acquisition, for centralized monitoring.
BMS	Building Management System, for managing building utilities.
PID	Proportional-Integral-Derivative, a control loop feedback mechanism.
RS485	A standard for serial data communication.

17.3 Application Examples.

- Municipal Water Supply:**
 Ensures constant pressure in distribution networks.
- High-Rise Building:**
 Maintains water pressure at various elevations.
- Industrial Processes:**
 Controls water flow and pressure for manufacturing operations.

17.4 Communication Protocol Settings.



Configuration details for supported communication protocols:

Modbus RTU	Baud rate: 19200, Parity: None, Stop bits: 1.
BACnet	Device instance number: Unique for each controller.
Ethernet/IP	IP Address: Static

18. Warranty and Support

18.1 Warranty Information.



The AQUA-G Pump System Controller comes with a standard 2-year

warranty covering:

- **Manufacturing defects.**
- **Faulty components.**

Warranty claims require proof of purchase and adherence to installation guidelines.

18.2 Service and Support Contact Details.

For assistance, contact our support team:

- **Email:** info@gatasys.com
- **Phone:** +97144532833
- **Website:** www.gatasys.com

Our team is available 24/7 to assist with technical queries, installation support, and warranty claims.

18.3 Frequently Asked Questions (FAQs)

- 1) **How do I update the firmware?**
Download the latest firmware from the official website and follow the update guide if the update over the air is not available on the system.
- 2) **What is the maximum number of pumps the system can control?**
The system can manage up to 8 pumps with an expansion board.
- 3) **Can the controller integrate with third-party systems?**
Yes, it supports Modbus, BACnet, and Ethernet/IP for seamless integration.
- 4) **How do I reset the controller to factory settings?**
Access the settings menu and select 'Factory Reset'. Ensure all important data is backed up.