

q.wave™ Gen 2 Water Conditioning System

ENGINEERING MANUAL

Technical Specifications, Installation, Operation and Maintenance

Version 1.0

Prepared by
q.wave engineering team

Document Classification
Engineering Manual

Document Purpose

This manual provides technical information for the installation, operation, maintenance, and engineering evaluation of the **q.wave™ Gen 2 Water Conditioning System**.

It is intended for engineers, researchers, laboratory personnel, and technical professionals responsible for equipment installation, operation, and performance evaluation.

Engineering Notice

This manual contains engineering information intended to support the installation, operation, maintenance, and laboratory evaluation of the **q.wave™ Gen 2 Water Conditioning System**.

Proprietary control algorithms, firmware architecture, and confidential design information are not disclosed in this document.

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EXECUTIVE SUMMARY

The **q.wave™ Gen 2 Water Conditioning System** is an **Adaptive Digital Water Conditioning Platform** designed for laboratory research, pilot-scale validation, and industrial water treatment applications.

The system combines adaptive sensing, embedded digital processing, and an integrated treatment zone into a compact inline platform capable of fully automatic operation. Operating conditions are continuously monitored, allowing the embedded controller to automatically manage the conditioning process using a proprietary adaptive control algorithm.

Designed for continuous-flow operation, the **q.wave™ Gen 2** provides stable and repeatable operating conditions suitable for engineering evaluation, laboratory studies, and industrial process applications.

The system is applicable to a wide range of water treatment environments, including laboratory research, cooling water systems, irrigation water, industrial process water, scale control studies, corrosion evaluation, and pilot-scale demonstration projects.

The **q.wave™ Gen 2** incorporates an **Adaptive Sensor Module**, an **Embedded Digital Processing Controller**, an **Integrated Treatment Zone**, a **SUS304 Stainless Steel Hydraulic Assembly**, and a **Dedicated Independent Earth Ground System**, providing a robust platform for reliable long-term operation.

The embedded controller platform has been evaluated for **Electromagnetic Compatibility (EMC)** in accordance with applicable Korean certification requirements. The controller operates with a **maximum internal operating frequency of 1.5 kHz**, and the evaluated platform demonstrated compliance with applicable EMC test requirements, including conducted emissions, radiated emissions, electrostatic discharge (ESD), electrical fast transient (EFT), surge immunity, and RF immunity.

This manual provides the technical specifications, installation procedures, operating guidelines, maintenance recommendations, and engineering information required for the proper application and evaluation of the **q.wave™ Gen 2 Water Conditioning System**.

Technical Highlights

- **Adaptive Digital Water Conditioning Platform**
- **Fully Automatic Continuous Inline Operation**
- **Adaptive Sensor Module**
- **Embedded Digital Processing Controller**
- **Integrated Treatment Zone**
- **SUS304 Stainless Steel Hydraulic Assembly**
- **Dedicated Independent Earth Ground System**

- **Maximum Internal Operating Frequency: 1.5 kHz (KC EMC Evaluated Controller Platform)**
- **EMC Evaluated for Conducted Emissions, Radiated Emissions, ESD, EFT, Surge, and RF Immunity**
- **Designed for Laboratory, Pilot-Scale, and Industrial Water Treatment Applications**

SECTION 1

PRODUCT OVERVIEW

1.1 Product Description

The **q.wave™ Gen 2 Water Conditioning System** is an **Adaptive Digital Water Conditioning Platform** designed for laboratory research, pilot-scale validation, and industrial water treatment applications.

The system combines adaptive sensing, embedded digital processing, and an integrated treatment zone into a compact inline platform capable of fully automatic operation. Designed for continuous-flow applications, the system provides stable and repeatable operating conditions suitable for engineering evaluation and long-term operation.

The **q.wave™ Gen 2** is intended for applications involving cooling water, industrial process water, irrigation water, laboratory research, scale control studies, corrosion evaluation, and pilot-scale demonstration systems.

1.2 Design Philosophy

The **q.wave™ Gen 2** has been developed to provide a reliable and repeatable water conditioning platform through the integration of hydraulic engineering and adaptive digital control.

Rather than relying on manual adjustment during operation, the system continuously manages the conditioning process using an embedded digital controller and operates automatically once electrical power, water flow, and the required grounding have been established.

This design supports consistent operation while minimizing routine operator intervention.

1.3 Typical Applications

The **q.wave™ Gen 2** is suitable for a wide range of laboratory and industrial applications, including:

- Laboratory Research
- Pilot-Scale Validation
- Cooling Water Systems
- Industrial Process Water
- Agricultural Irrigation
- Scale Control Studies
- Corrosion Evaluation
- Water Conditioning Performance Assessment

1.4 Key Features

- Adaptive Digital Water Conditioning Platform
- Fully Automatic Continuous Operation
- Inline Water Treatment Configuration
- Embedded Digital Processing Controller
- Integrated Treatment Zone
- SUS304 Stainless Steel Construction
- Dedicated Independent Earth Ground System
- Maximum Internal Operating Frequency: **1.5 kHz** (KC EMC Evaluated Controller Platform)
- Designed for Laboratory, Pilot-Scale, and Industrial Applications



1.5 Technical Highlights

Item	Description
Product Name	q.wave™ Gen 2 Water Conditioning System
System Type	Adaptive Digital Water Conditioning Platform
Operation	Fully Automatic
Installation	Inline Vertical Configuration
Hydraulic Material	SUS304 Stainless Steel
Controller	Embedded Digital Processing Controller
Maximum Internal Operating Frequency	1.5 kHz (KC EMC Evaluated Controller Platform)
Grounding	Dedicated Independent Earth Ground

SECTION 2

SYSTEM CONFIGURATION

2.1 System Overview

The **q.wave™ Gen 2 Water Conditioning System** is designed as an integrated inline water conditioning platform consisting of five primary subsystems. Each subsystem performs a dedicated function while operating together as a single automated system.

The platform combines hydraulic engineering, adaptive sensing, embedded digital processing, and an integrated treatment zone to provide continuous and repeatable operation.

2.2 Major Components

Component	Function
Adaptive Sensor Module	Acquires operating characteristics from the incoming water stream.
Embedded Digital Processing Controller	Processes sensor information and manages system operation using a proprietary adaptive control algorithm.
Integrated Treatment Zone	Primary conditioning section where digitally controlled conditioning is applied during water flow.
Hydraulic Assembly	Provides a continuous inline flow path through the sensing and treatment sections.
Independent Earth Ground System	Provides a stable electrical reference for normal controller operation.

2.3 Water Flow Path

The q.wave™ Gen 2 utilizes a vertical inline flow configuration designed for continuous operation.

The process sequence consists of:

Water Inlet > Adaptive Sensor Module > Integrated Treatment Zone > Water Outlet

The embedded controller continuously receives information from the sensor module and automatically manages the conditioning process throughout system operation.

2.4 System Configuration

The q.wave™ Gen 2 integrates the following engineering functions into a single compact platform:

- Adaptive Digital Control
- Continuous Inline Water Flow
- Integrated Treatment Zone
- Automatic System Operation

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- Dedicated Independent Earth Ground

The modular design simplifies installation, operation, and maintenance while providing stable operating conditions for laboratory and industrial applications.

2.5 Typical System Layout

Figure 2-1 illustrates the major functional elements of the q.wave™ Gen 2 Water Conditioning System.



the functional flow of the system.

Figure 2-2 illustrates

Water Inlet > Adaptive Sensor Module > Embedded Digital Processing Controller > Integrated Treatment Zone > Water Outlet

SECTION 3

TECHNICAL SPECIFICATIONS

The **q.wave™ Water Conditioning System** is available in five standard models designed for laboratory, commercial, agricultural, and industrial water treatment applications. Each model utilizes the same adaptive digital control platform while accommodating different pipe sizes and installation requirements.

3.1 Model Identification

Model	Pipe Size	Typical Application
q.wave™ 100	1 in.	Residential, Laboratory & Pilot Systems
q.wave™ 200	2 in.	Commercial Buildings
q.wave™ 300	3 in.	Agriculture & Irrigation
q.wave™ 400	4 in.	Industrial Water Systems
q.wave™ 600	6 in.	Large Industrial & Municipal Water Systems

3.2 Controller Platform Characteristics

The q.wave™ controller platform integrates adaptive sensing, embedded digital processing, and automatic system control into a single embedded architecture designed for continuous inline operation.

Parameter	Specification
Controller Platform	Embedded Digital Processing Controller
Control Method	Proprietary Adaptive Digital Control
Operating Mode	Fully Automatic Continuous Operation
Operating Frequency (Controller Platform)	Maximum Internal Operating Frequency: 1.5 kHz (<i>Verified during KC EMC Certification Testing</i>)
Sensor Interface	Adaptive Sensor Module
Control Output	Digitally Controlled Conditioning Signals
User Adjustment	Not Required

3.3 Mechanical Specifications

Item	Specification
Housing Material	SUS304 Stainless Steel
Hydraulic Assembly	SUS304 Stainless Steel
Standard Pipe Sizes	1", 2", 3", 4", 6"
Installation Type	Vertical Inline
Flow Direction	Bottom Inlet → Top Outlet

3.4 Electrical Specifications

Item	Specification
Input Voltage	120 VAC
Input Frequency	60 Hz
Power Supply	Single Phase
Controller	Embedded Digital Processing Controller
System Operation	Fully Automatic

3.5 Hydraulic Specifications

Item	Specification
Hydraulic Configuration	Continuous Inline Flow
Treatment Zone	Integrated Treatment Zone
Water Flow Direction	Bottom Inlet → Top Outlet
Hydraulic Material	SUS304 Stainless Steel

3.6 Grounding Requirements

Proper grounding is essential for normal operation of the q.wave™ controller platform.

A **Dedicated Independent Earth Ground** is recommended to provide a stable electrical reference for the embedded controller.

Direct grounding to metallic water piping is not recommended. Where a building grounding system is used, its suitability should be verified prior to installation.

Item	Specification
Ground Type	Dedicated Independent Earth Ground
Function	Stable Electrical Reference
Building Ground	Acceptable after verification
Direct Water Pipe Ground	Not Recommended

3.7 Environmental Conditions

Item	Specification
Installation Location	Indoor or Protected Outdoor
Operating Environment	Non-Hazardous Area
Cooling Method	Natural Air Cooling
Service Access	Front Access Recommended

3.8 Electromagnetic Compatibility (EMC)

The embedded controller platform has been evaluated in accordance with applicable Korean **Electromagnetic Compatibility (EMC)** certification requirements.

The controller platform operates with a **maximum internal operating frequency of 1.5 kHz**, as verified during **KC EMC certification testing**.

The evaluated controller platform demonstrated compliance with applicable EMC test requirements, including:

- Conducted Emissions
- Radiated Emissions
- Electrostatic Discharge (ESD)
- Electrical Fast Transient (EFT)
- Surge Immunity
- RF Immunity

3.9 General Technical Characteristics

Parameter	Specification
System Type	Adaptive Digital Water Conditioning Platform
Installation Configuration	Vertical Inline
Operation Mode	Fully Automatic
Hydraulic Flow	Continuous Inline Flow
Grounding	Dedicated Independent Earth Ground
Applicable Models	q.wave™ 100 / 200 / 300 / 400 / 600

3.10 Certification Summary

Item	Status
EMC Evaluation	KC Certified Controller Platform
Maximum Internal Operating Frequency	1.5 kHz
Applicable EMC Tests	Conducted Emissions, Radiated Emissions, ESD, EFT, Surge, RF Immunity

SECTION 4

INSTALLATION

4.1 General

The **q.wave™ Water Conditioning System** is designed for vertical inline installation in laboratory, commercial, agricultural, and industrial water systems.

Prior to installation, verify that the installation location provides adequate space for piping connections, electrical wiring, inspection, and routine maintenance.

Installation shall be performed by qualified personnel in accordance with applicable local electrical and plumbing codes.

4.2 Site Requirements

Before installation, confirm the following conditions:

- Stable and level mounting surface
- Accessible water piping
- 120 VAC, 60 Hz electrical supply
- Dedicated Independent Earth Ground
- Adequate service clearance around the equipment
- Indoor or weather-protected installation location

4.3 Hydraulic Installation

Install the unit in the correct flow direction as indicated on the equipment.

Flow Direction

Bottom Inlet → Top Outlet

After completing all hydraulic connections:

- Verify pipe alignment.
- Tighten all fittings securely.
- Inspect the system for leakage before energizing the controller.

4.4 Electrical Installation

Connect the controller to a **120 VAC, 60 Hz, single-phase** power source.

The electrical installation shall comply with all applicable local electrical codes.

Do not energize the controller until hydraulic installation and grounding have been completed.

4.5 Grounding

The **q.wave™ Water Conditioning System** requires a **Dedicated Independent Earth Ground** to provide a stable electrical reference for the embedded controller platform.

Direct grounding to metallic water piping is not recommended.

Where an existing building grounding system is used, verify that it provides an appropriate electrical reference before connection.

4.6 Initial Start-Up

After installation has been completed:

1. Verify all hydraulic connections.
2. Confirm electrical power is available.
3. Verify the ground connection.
4. Open the water supply.
5. Check for leakage.
6. Energize the controller.
7. Verify normal system operation.

No programming or manual adjustment is required during start-up.

4.7 Installation Inspection Checklist

Inspection Item	Status
Hydraulic Connections	V
Water Leakage Check	V
Electrical Connection	V
Independent Earth Ground	V
Water Flow Direction	V
Controller Operation	V

Installation Notes

- Install the system in the specified flow direction.
- Do not modify the controller or internal wiring.
- Maintain sufficient clearance for future service.
- Follow all applicable electrical and plumbing regulations.
- Verify proper grounding before system operation.

SECTION 5

OPERATION

5.1 General

The **q.wave™ Water Conditioning System** is designed for fully automatic operation. Once electrical power, water flow, and the required Independent Earth Ground have been established, the system operates continuously without user adjustment.

The embedded controller automatically manages the conditioning process during normal operation.

5.2 Operating Sequence

During normal operation, the system performs the following sequence:

1. Water enters the system through the process inlet.
2. The Adaptive Sensor Module monitors the incoming water.
3. The Embedded Digital Processing Controller processes the sensor information.
4. Digitally controlled conditioning signals are applied within the Integrated Treatment Zone.
5. Conditioned water exits through the process outlet.

The operating process is continuous and fully automatic.

5.3 Indicator Lights

The front panel is equipped with two LED indicators that display the operating status of the system.

Indicator	Color	Description
Power	Red	Indicates that AC power is supplied to the controller.
Operation	Green	Indicates that the controller is operating normally.

Normal Operating Condition

Power	Operation	System Status
Red ON	Green ON	Normal operation

If the **Power** indicator is OFF, verify the incoming power supply.

If the **Power** indicator is ON and the **Operation** indicator is OFF, inspect the electrical connection, grounding system, and controller before returning the system to service.

5.4 Routine Inspection

The following items should be inspected periodically during normal operation.

Inspection Item	Recommended Check
Water Flow	Verify continuous flow
Hydraulic Connections	Check for leakage
Electrical Power	Verify normal power supply
Ground Connection	Verify secure connection
Indicator Lights	Confirm normal operation

5.5 Shutdown Procedure

To remove the system from operation:

1. Turn OFF the electrical power.
2. Close the water supply if maintenance is required.
3. Relieve system pressure before servicing.
4. Inspect the equipment before restarting.

Operational Notes

- No user programming or parameter adjustment is required during normal operation.
- Maintain continuous water flow whenever the system is energized.
- Verify the Independent Earth Ground before operation.
- Perform periodic visual inspections to ensure proper system performance.

Recommended Figure

Figure 5-1. Front Panel Indicators

- **POWER** — AC Power Available
- **OPERATION** — Normal Controller Operation

SECTION 6

MAINTENANCE & SAFETY

6.1 General

The **q.wave™ Water Conditioning System** is designed for long-term continuous operation with minimal routine maintenance.

Under normal operating conditions, maintenance is limited to periodic inspection of the hydraulic, electrical, and grounding systems.

6.2 Routine Maintenance

The following maintenance activities are recommended to ensure reliable system performance.

Maintenance Item	Recommended Interval
Visual Inspection	Monthly
Hydraulic Connections	Monthly
Water Leakage Check	Monthly
Electrical Connections	Every 6 Months
Ground Connection	Every 6 Months
Equipment Cleaning	As Required

6.3 Safety Precautions

Observe the following precautions before servicing the equipment.

- Disconnect electrical power before maintenance.
- Relieve system pressure before disconnecting piping.
- Do not modify the controller or internal wiring.
- Use only qualified personnel for installation and service.
- Verify proper grounding before returning the equipment to operation.

6.4 Storage

If the equipment will remain out of service for an extended period:

- Disconnect electrical power.
- Drain water from the hydraulic assembly if freezing temperatures are possible.
- Store the equipment in a clean and dry location.
- Protect the controller from moisture and physical damage.

6.5 Troubleshooting

Condition	Recommended Action
Power Indicator OFF	Verify AC power supply and electrical connection.
Operation Indicator OFF	Verify controller operation and ground connection.
Water Leakage	Inspect hydraulic fittings and piping connections.
Abnormal Operation	Disconnect power and contact q.wave Engineering.

6.6 Technical Support

For technical assistance, product information, or service support, please contact:

q.wave Engineering

Wesley Chapel, Florida, USA

Website: www.qwave.us

Email: goodohwithus@gmail.com

Maintenance Summary

Item	Requirement
Routine Maintenance	Periodic Inspection Only
Mechanical Service	As Required
Electrical Service	Qualified Personnel Only
Ground Verification	Recommended Every 6 Months
Controller Adjustment	Not Required

End of Manual

This manual provides the technical information required for the installation, operation, maintenance, and engineering evaluation of the **q.wave™ Water Conditioning System**. For product updates, technical documentation, and support information, contact **q.wave Engineering**.

