FLO-DETECTOR™

Model 302 SVS

OPERATOR'S MANUAL

Orientation-independent electromagnetic surface velocity measurement

AM-302-UM-001 • Revision A – Initial Commercial Release

We simplify professional flow measurement. • Measure with Confidence.

Welcome

Thank you for choosing the Aqua-Magnetics® FLO-DETECTOR™ Model 302 SVS. The FLO-DETECTOR is a professional surface velocity measurement system designed for engineers, municipalities, utilities, environmental professionals, and contractors. Powered by VectorSense™ orientation-independent sensing technology, it measures two orthogonal velocity components simultaneously and calculates the resultant surface velocity.

This Operator's Manual explains installation, operation, maintenance, calibration, and recommended field measurement techniques for the FLO-DETECTOR.

DOCUMENT IDENTIFICATION FLO-DETECTOR™ Model 302 SVS • AM-302-UM-001 • Revision A – Initial Commercial Release

Contents

Section 1 – Introduction

1.1 Product Overview

The FLO-DETECTOR™ Model 302 SVS is a portable orientation-independent surface velocity measurement system. Unlike conventional single-axis electromagnetic sensors, the VectorSense™ Sensor Head measures two horizontal velocity components and computes the resultant velocity in real time.

1.2 Typical Applications

Stormwater runoff investigations

Open-channel flow studies

Streams and rivers

Irrigation canals

Wastewater channels

Culvert evaluations

Flood investigations

Hydraulic engineering studies

1.3 System Components

Component	Purpose
Electronics Control Unit (ECU)	Signal processing, Wi-Fi, and system control
VectorSense™ Sensor Head	Electromagnetic velocity measurement
Telescoping Rod	Sensor positioning
Forearm Support	Operator stability
Battery System	Portable power
FLO-View™	Browser-based interface
PrecisionTow™	Individual factory calibration

ENGINEERING INSIGHT

The primary innovation of the FLO-DETECTOR is orientation-independent measurement. VectorSense™ calculates the resultant velocity from X and Y components, reducing the need for precise rotational alignment and improving repeatability between operators.

Section 2 – Safety

2.1 Introduction

The FLO-DETECTOR™ Model 302 SVS is intended for professional use in streams, stormwater systems, wastewater channels, irrigation canals, and other open-channel environments. While the instrument is simple to operate, field conditions can present significant hazards. The operator is responsible for evaluating site conditions and following all applicable safety procedures.

2.2 Safety Signal Words

Signal Word	Meaning
DANGER	Will result in death or serious injury if not avoided.
WARNING	Could result in death or serious injury.
CAUTION	May result in minor injury or equipment damage.
NOTICE	Important operating information.

2.3 General Safety

Read this manual before use. Inspect the instrument before each deployment. Never operate damaged equipment.

2.4 Water Hazards

Evaluate water depth, current, footing, weather, and escape routes before approaching the measurement location. Never enter flood waters or rapidly rising streams.

2.5 Traffic Hazards

Use high-visibility PPE and appropriate traffic control whenever working adjacent to roadways.

2.6 Confined Spaces

Do not enter permit-required confined spaces unless all applicable procedures, permits, monitoring, and rescue requirements have been satisfied.

2.7 Battery Safety

Use only approved batteries and chargers. Do not short battery terminals or expose batteries to excessive heat.

2.8 Instrument Handling

Do not lift the instrument by the sensor cable. Avoid striking the sensor head or electrodes against rocks or concrete.

2.9 PPE

Appropriate PPE may include safety glasses, gloves, safety footwear, a high-visibility vest, hard hat, and a personal flotation device when required.

2.10 Safe Operating Practices

Inspect the instrument, verify battery charge, connect to FLO-View™, assess the site, keep the ECU above the waterline, and maintain awareness of changing conditions.

BEST PRACTICE

Whenever practical, perform measurements from the bank using the telescoping rod instead of entering flowing water.

ENGINEERING INSIGHT

VectorSense™ minimizes the need for precise rotational alignment, allowing operators to spend more attention on selecting representative measurement locations and maintaining safe working practices.

Section 3 – Product Overview

3.1 System Overview

The FLO-DETECTOR™ Model 302 SVS is a complete surface velocity measurement system consisting of the Electronics Control Unit (ECU), the VectorSense™ Sensor Head, a telescoping measurement rod, ergonomic forearm support, rechargeable battery system, and FLO-View™ browser-based software.

Figure 3-1. FLO-DETECTOR™ assembled instrument.

3.2 Major Components

Item	Component	Function
1	Electronics Control Unit (ECU)	Processes signals, computes velocity, hosts FLO-View™
2	VectorSense™ Sensor Head	Measures X and Y velocity components
3	Telescoping Rod	Positions the sensor safely
4	Forearm Support	Improves stability and reduces fatigue
5	Bubble Level	Provides level reference
6	Battery Pack	Portable 12 V power
7	Battery Charger	Recharges battery pack

3.3 Electronics Control Unit

The ECU contains the excitation electronics, signal conditioning, Cortex M0 processor, Wi-Fi module, power management circuitry, and the embedded FLO-View™ web server. It continuously computes resultant velocity from the measured X and Y components.

3.4 VectorSense™ Sensor Head

The sensor head contains the electromagnetic excitation coil, four stainless steel electrodes, internal electronics, integrated bubble level, and polyurethane encapsulation. The assembly contains no moving measuring components.

3.5 Orientation-Independent Measurement

The primary purpose of the four-electrode design is to enable two-axis measurement. By simultaneously measuring orthogonal velocity components and calculating the resultant vector, VectorSense™ minimizes the need for precise rotational alignment during field measurements.

3.6 Telescoping Rod and Forearm Support

The lightweight rod and adjustable forearm support provide comfortable operation while allowing measurements from the bank whenever practical.

3.7 Battery System

The FLO-DETECTOR uses a rechargeable DeWalt® compatible lithium-ion battery. Batteries are easily exchanged in the field to maximize operating time.

3.8 FLO-View™

FLO-View™ is hosted directly on the ECU and accessed through a standard web browser using Wi-Fi Direct. No application download or internet connection is required.

ENGINEERING INSIGHT

The FLO-DETECTOR should be viewed as a complete measurement system rather than a sensor. VectorSense™, FLO-View™, and PrecisionTow™ work together to simplify professional flow measurement while improving repeatability.

Section 4 – Theory of Operation

4.1 Introduction

The FLO-DETECTOR™ Model 302 SVS measures surface water velocity using Aqua-Magnetics' proprietary VectorSense™ orientation-independent electromagnetic sensing technology. The system contains no moving measuring components and determines velocity electronically.

4.2 Electromagnetic Measurement Principle

When conductive water moves through the controlled magnetic field generated within the VectorSense™ Sensor Head, a voltage proportional to velocity is induced at the sensing electrodes. These low-level signals are amplified, filtered, digitized, and processed by the Electronics Control Unit.

Figure 4-1. VectorSense™ sensor head and four-electrode geometry.

4.3 The Limitation of Single-Axis Sensors

Conventional electromagnetic sensors measure velocity along a single sensing axis. Accurate measurements require careful rotational alignment with the direction of flow. Misalignment reduces the measured velocity and introduces operator-dependent variability.

Figure 4-2 Traditional sensor aligned with flow versus rotated sensor showing reduced measured component.

4.4 VectorSense™ Two-Axis Measurement

VectorSense™ uses four stainless steel electrodes arranged to independently measure two orthogonal horizontal velocity components (X and Y). The primary purpose of the four-electrode configuration is to enable orientation-independent measurement by minimizing the need for precise rotational alignment.

Figure 4-3. Four-electrode VectorSense™ sensor geometry.

4.5 Resultant Velocity

The Electronics Control Unit continuously computes the resultant surface velocity from the measured X and Y components.

$$\text{Resultant Velocity} = \sqrt{(X^2 + Y^2)}$$

The resultant velocity is displayed in FLO-View™ together with the individual X and Y components and flow angle.

4.6 Signal Processing

The Electronics Control Unit performs excitation control, low-noise amplification, analog filtering, analog-to-digital conversion, digital filtering, vector calculations, battery monitoring, and wireless communication. Processing occurs continuously in real time.

Figure 4-4 Signal processing block diagram.

4.7 Why Orientation-Independent Measurement Matters

Reduces operator alignment error

Improves repeatability between operators

Reduces setup time

Simplifies training

Allows operators to focus on representative measurement locations instead of sensor rotation

ENGINEERING INSIGHT

The value of VectorSense™ is not simply that it measures two axes—it is that the two-axis measurement is used to reduce one of the largest practical sources of field variability: rotational alignment. Proper leveling, immersion depth, and representative site selection remain essential for high-quality measurements.

CHAPTER SUMMARY

VectorSense™, FLO-View™, and PrecisionTow™ combine to form a complete measurement system. The two-axis electromagnetic architecture simplifies professional flow measurement while supporting repeatable, engineering-grade surface velocity measurements.

Section 5 – Package Contents

5.1 Introduction

Carefully inspect the shipping container upon receipt. If shipping damage is observed, notify the carrier immediately. Verify that all standard components are present before placing the instrument into service.

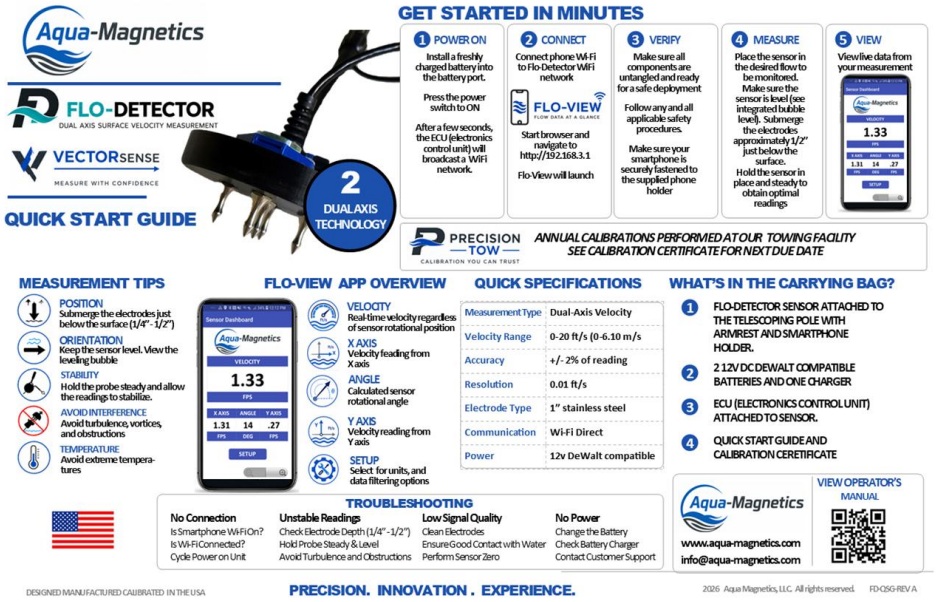

Figure 5-1. FLO-DETECTOR™ system reference.

5.2 Standard Package Contents

Item	Description	Qty	Verify
1	Electronics Control Unit (ECU)	1	☐
2	VectorSense™ Sensor Head	1	☐
3	Telescoping Measurement Rod	1	☐
4	Forearm Support Assembly	1	☐
5	10 ft Sensor Cable	1	☐
6	12 V DeWalt® Compatible Battery	2	☐
7	Battery Charger	1	☐
8	Operator's Manual	1	☐
9	Calibration Certificate	1	☐
10	Carrying Case	1	☐

5.3 Initial Inspection

Inspect the sensor head for shipping damage.

Verify that the electrodes are clean and undamaged.

Inspect the sensor cable and connectors.

Verify the bubble level is intact.

Confirm battery packs and charger are included.

Review the calibration certificate.

5.4 Missing or Damaged Items

If any components are missing or damaged, retain all packing materials and contact Aqua-Magnetics before placing the instrument into service.

NOTICE

Do not discard the shipping container until the instrument has been inspected and all components have been accounted for.

ENGINEERING INSIGHT

Every FLO-DETECTOR is individually calibrated using the PrecisionTow™ process before shipment. The calibration certificate supplied with the instrument documents the calibration of that specific serial number.

Section 6 – Specifications

6.1 General

The following specifications apply to the FLO-DETECTOR™ Model 302 SVS under normal operating conditions.

Velocity Transducer

Parameter	Specification
Measurement Method	Electromagnetic
Velocity Range	0–20 ft/s (0–6.09 m/s)
Accuracy	±2% of reading
Zero Stability	±0.05 ft/s (±0.015 m/s)
Resolution	0.01
Body Material	Black polyurethane, Shore 70D
Ingress Protection	IP68 (Sensor Head)
Electrodes	Stainless steel
Cable	10 ft (3.0 m)

Electronics

Parameter	Specification
Main Processor	ARM Cortex M0 (SAMD21)
Wireless	802.11 b/g/n Wi-Fi
User Interface	FLO-View™ browser-based interface
Communications	Wi-Fi Direct

Power

Parameter	Specification
Battery	12 V DeWalt® compatible Li-ion
Charging	External battery charger
Field Operation	Hot-swappable battery packs

Mechanical

Parameter	Specification
Sensor Dimensions	6 in diameter × 1.38 in high
Forearm Support	Adjustable
Measurement Rod	Telescoping

6.2 Recommended Operating Conditions

Keep the Electronics Control Unit above the waterline.

Immerse the sensor head approximately 1/2 in (13 mm) below the water surface.

Maintain the sensor level using the integrated bubble level.

Allow readings to stabilize before recording measurements.

ENGINEERING INSIGHT

Published specifications describe instrument performance. Measurement quality also depends on representative site selection, proper immersion depth, and good field technique.

Section 7 – Assembly & Getting Started

7.1 Introduction

This section describes assembly of the FLO-DETECTOR™ Model 302 SVS and preparation for field operation.

7.2 Unpack the Instrument

Remove all components from the carrying case and verify that the package contents match Section 5. Inspect for visible damage before assembly.

Figure 7-1 Placeholder: Open carrying case.

7.3 Install the Battery

Slide a fully charged DeWalt® compatible battery into the rear battery mount until the latch engages. Verify the battery is secure.

Figure 7-2 Placeholder: Battery installation.

7.4 Connect the Sensor

Connect the VectorSense™ Sensor Head cable to the ECU. Tighten the connector until fully seated. Do not overtighten.

Figure 7-3 Placeholder: Sensor cable connection.

7.5 Attach the Telescoping Rod

Secure the telescoping rod to the sensor assembly and verify all locking mechanisms are fully engaged.

Figure 7-4 Placeholder: Rod attachment.

7.6 Adjust the Forearm Support

Adjust the forearm support for a comfortable fit. Proper adjustment improves stability and reduces fatigue during extended measurements.

Figure 7-5 Placeholder: Forearm support adjustment.

7.7 Power On

Press the power switch. Allow the ECU to complete startup before attempting to connect.

7.8 Connect to FLO-View™

Using a phone or tablet, connect to the FLO-DETECTOR Wi-Fi network. Open a web browser and navigate to the FLO-View™ interface. No application installation or internet connection is required.

Figure 7-6 Placeholder: FLO-View home screen.

7.9 Pre-Measurement Check

Verify battery status, sensor communication, live velocity display, and bubble level before entering the field.

FIELD CHECKLIST

Battery fully charged

Sensor cable connected

Bubble level visible

FLO-View connected

Calibration certificate current

Sensor clean and free of debris

BEST PRACTICE

Complete assembly and verify communication before approaching the measurement location. This reduces setup time and distractions near flowing water.

ENGINEERING INSIGHT

The FLO-DETECTOR was engineered to minimize setup steps. VectorSense™ reduces alignment requirements while FLO-View™ eliminates app installation, allowing operators to begin collecting measurements quickly.

Section 8 – FLO-View™ Software

8.1 Overview

FLO-View™ is the browser-based user interface for the FLO-DETECTOR™. The application is hosted directly on the Electronics Control Unit (ECU) and accessed over Wi-Fi Direct using a standard web browser. No application download, software installation, or internet connection is required.

Figure 8-1. FLO-View™ main screen.

8.2 Connecting to FLO-View™

Install a charged battery and power on the ECU.

On the mobile device, open Wi-Fi settings.

Connect to the FLO-DETECTOR Wi-Fi network.

Open a supported web browser.

Navigate to the FLO-View™ interface.

Confirm that live velocity data is displayed.

8.3 Main Screen

Display Item	Description
Resultant Velocity	Primary displayed surface velocity
X Velocity	Horizontal X-axis component
Y Velocity	Horizontal Y-axis component
Flow Angle	Calculated flow direction

Battery Status	Remaining battery capacity
Units	Selected engineering units
Connection Status	Communication with ECU

8.4 Measurement Units

FLO-View™ supports selectable engineering units. Changing display units does not affect the underlying measurement.

8.5 Live Measurements

Velocity values are updated continuously. Allow readings to stabilize before recording results. Natural fluctuations caused by turbulence are normal and should not be interpreted as instrument error.

8.6 Settings

Velocity units

Display preferences

System information

Firmware version

Battery information

8.7 Disconnecting

Close the browser when finished. Power off the ECU after completing field measurements to conserve battery power.

TROUBLESHOOTING

Problem	Corrective Action
Cannot connect to Wi-Fi	Verify ECU is powered on and battery is charged.
No live velocity displayed	Check sensor cable connection.
Browser page unavailable	Reconnect to FLO-DETECTOR Wi-Fi and refresh the browser.

ENGINEERING INSIGHT

Hosting FLO-View™ on the ECU eliminates application installation, simplifies device compatibility, and allows virtually any modern phone, tablet, or computer with a web browser to operate the FLO-DETECTOR.

Section 9 – Field Measurement Techniques

9.1 Objective

The objective of every measurement is to obtain a representative surface velocity. The quality of the final measurement depends on site selection, sensor placement, and operator technique as much as instrument performance.

9.2 Selecting a Measurement Location

Whenever practical, select a straight reach of channel with uniform flow and stable water surface conditions.

Uniform flow with minimal turbulence

Straight channel section

Good operator access

Stable footing

Minimal floating debris

Avoid measurements immediately downstream of culvert outlets, bridge piers, hydraulic jumps, sharp bends, or large obstructions unless these conditions are the subject of the investigation.

Figure 9-1 Good versus poor measurement locations.

9.3 Sensor Position

Lower the VectorSense™ Sensor Head until the electrodes are immersed approximately 1/2 inch (13 mm) below the water surface. Use the integrated bubble level to keep the sensor level throughout the measurement.

Figure 9-2. Typical field measurement positioning.

9.4 Stabilizing the Reading

Hold the instrument steady.

Allow the displayed velocity to stabilize.

Observe natural fluctuations caused by turbulence.

Record the representative value.

9.5 Typical Applications

Application	Recommended Practice
Streams and Rivers	Select a straight reach with uniform depth and avoid eddies.
Stormwater Channels	Avoid splash zones and hydraulic jumps immediately below structures.
Culverts	Measure upstream or downstream where the flow becomes uniform.
Wastewater Channels	Keep the sensor free of floating debris and grease.
Irrigation Canals	Measure away from gates and control structures.

9.6 Wind, Waves, and Debris

Strong winds and floating debris can influence the water surface. Observe site conditions before taking measurements and relocate if debris repeatedly contacts the sensor.

9.7 Common Operator Errors

Error	Result
Measuring in turbulent water	Non-representative velocity
Holding the rod too rigidly	Operator-induced movement
Incorrect immersion depth	Reduced repeatability
Ignoring site conditions	Poor quality data

BEST PRACTICE

Observe the flow for 15–30 seconds before taking a measurement. Understanding the hydraulic conditions often improves measurement quality more than moving the instrument.

ENGINEERING INSIGHT

VectorSense™ reduces the need for precise rotational alignment, but it does not replace good field practice. Representative site selection, proper immersion depth, and careful observation remain essential for high-quality measurements.

CHAPTER SUMMARY

Professional flow measurements begin with professional field technique. By combining good hydraulic judgment with the orientation-independent capabilities of the FLO-DETECTOR™, operators can obtain fast, repeatable, and dependable surface velocity measurements.

Section 10 – Maintenance

10.1 Routine Maintenance

The FLO-DETECTOR requires minimal routine maintenance. Clean the sensor after each use and inspect the instrument before deployment.

10.2 After Each Use

Rinse sensor with clean water.

Remove debris from electrodes.

Dry ECU and cable.

Recharge battery.

10.3 Periodic Inspection

Inspect cable and connectors.

Verify bubble level.

Check battery contacts.

Review calibration due date.

10.4 Storage

Store the instrument clean and dry inside its carrying case. Remove the battery for long-term storage.

Section 11 – Troubleshooting

11.1 Overview

Most operational issues can be resolved through inspection of power, cable connections, and FLO-View™ communications.

COMMON PROBLEMS

No power – Verify battery installation and charge.

No sensor data – Inspect cable and connector.

Cannot connect to FLO-View™ – Reconnect to Wi-Fi and restart ECU.

Unstable readings – Verify representative flow conditions, immersion depth, and clean electrodes.

SERVICE

If problems persist, contact Aqua-Magnetics technical support.

Section 12 – Calibration

12.1 PrecisionTow™

Every FLO-DETECTOR is individually calibrated using the PrecisionTow™ process before shipment.

12.2 Recalibration

Annual factory recalibration is recommended or as required by your quality program.

12.3 Field Verification

Inspect electrodes.

Verify FLO-View™ operation.

Review calibration certificate.

Section 13 – Service

13.1 Factory Service

Contact Aqua-Magnetics before returning an instrument for evaluation or repair.

13.2 Before Shipment

Clean instrument.

Remove accessories not required.

Package securely.

Include problem description and serial number.

Section 14 – Warranty

14.1 Limited Warranty

Aqua-Magnetics warrants the FLO-DETECTOR against defects in materials and workmanship for the published warranty period.

14.2 Exclusions

Accidental damage

Unauthorized modification

Improper use

Normal wear items

14.3 Warranty Service

Contact Aqua-Magnetics for warranty evaluation before returning equipment.


Aqua-Magnetics

FLO-DETECTOR™ Model 302 SVS

Professional electromagnetic surface velocity measurement

www.aqua-magnetics.com
info@aqua-magnetics.com

AM-302-UM-001 | Revision A