1 YEAR
WARRANTY

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User's Guide

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FPD-4000 SERIES
Positive Displacement Flow Meters

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e-mail: info@omega.com

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Table of Contents

Safety Definitions and Information

Do not attempt to install or use your AW Gear Meters product until you have read the safety instructions in this section. Save this manual and keep it in an easily accessible place.

Unpacking

Separate the flow meter from packaging materials and check for any visual signs of damage. If you determine there has been damage caused by shipping, file a claim with the shipping company. If the flow meter appears to have been improperly assembled or does not operate properly, return the product for replacement or repair (see Limited Warranty information at the end of this manual).

Quick Start

To set up, install and operate your flow meter quickly, follow these step-by-step instructions. Detailed installation, operational, and maintenance instructions begin on page 5 in this manual. More information is also available in the Maintenance Guide appropriate for your flow meter.

Install Pickup Sensor

Before attaching the sensor to the flow meter, check for any potential clearance issues. It may be easier to install the sensor after you have installed the flow meter in the line.

CAUTION: Whether the sensor requires tool or hand installation, tighten with hand-tighten torque only.

NOTICE: Some flow meters are shipped with the sensor already installed.

Flush Piping

If feasible, flush piping to remove dirt and debris before installing flow meter.

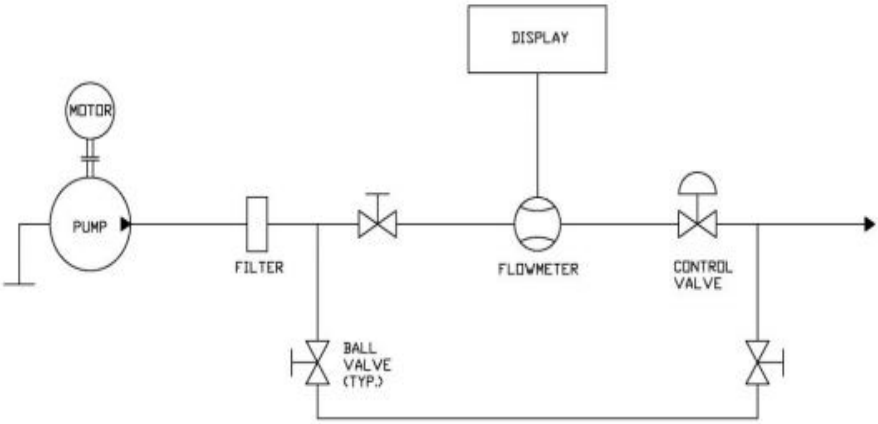
Filtration

Filtration is recommended to prevent contaminants from entering the flow meter. See flow meter Data Sheet for specific filter, including mesh weight and size.

Location

It's best to install the flow meter upstream from control valves and fluid regulators, if possible. See Figure 1.

Figure 1: Typical flow meter installation with bypass



Orientation

Positive displacement gear flow meters can be installed either a horizontal or vertical (flow up) orientation. 2-3 psi of backpressure is required to assure the meter is always full of fluid. No straight run pipe is required upstream or downstream of the meter.

Flow Direction

Flow direction is marked with an arrow on the flow meter. See Figure 2.

Figure 2: Flow direction indication on label

Description and Principle of Operation

Positive Displacement Flow Meter

OMEGA positive displacement flow meters are similar in design to the gear pump. However, the principle of operation is reversed: instead of the gears driving the medium, the medium drives the gears. A non-intrusive sensor detects the movement of the gear. As each tooth passes the sensor, the sensor produces a square-wave pulse and measures a discrete volume of liquid. The resulting pulse train is proportional to the actual flow rate, providing a highly accurate representation of the fluid flow. All flow meters are designed with highly wear-resistant moving parts to provide exceptionally long service life. The materials of construction are:

- stainless steel or high-strength aluminum housing
- stainless steel gears
- either tungsten carbide sleeve bushings or stainless steel ball bearings (depending on model)

The fluids you are metering should be compatible with these materials.

All-in-One Pickup Sensor

The FPD-4000 Series comes with an all-in-one sensor that easily mounts on the flow meter and has 3 different output types available. We have equipped the sensor with a Bluetooth feature, which allows users to use a mobile app to setup the sensor and view real time outputs with their smart devices. The sensor comes equipped with an integrated linearizer for voltage and current outputs. This sensor is RoHS-compliant and utilizes surface mount components and a more up-to-date circuit design.

Installation

Preferred Flow Direction

The preferred flow direction is marked with an arrow on the meter showing the flow direction in which the flow meter was calibrated (see figure 2). However, the flow meters have bi-directional flow capabilities and are often used for bi-directional flow applications. Since the meters indicate flow in both directions, if reverse flow detection is not desired, install a check valve up-stream of the flow meter.

Preferred Orientation

The preferred orientation for mounting gear meters, especially in low flow and or low viscosity applications, is so that the internal shaft/gear assembly is in a horizontal orientation (housing bolts facing sideways, not up/down). This allows for the least amount of internal drag due to mass of gears.

Location

It is important to make sure that the flowmeter is always full of fluid and never partially filled. Do this by making sure there is always a small amount of backpressure on the meter, usually 2 to 5 psi minimum.

Create backpressure by making sure there is some flow restriction downstream from the flowmeter such as a check valve, regulator, or piping rising above location of flowmeter. See Figure 1.

Backpressure from control valving is beneficial for stable running. In similar fashion, if a flowmeter is installed with fluid flow in a downward direction, the fluid cannot exit the flowmeter directly into a container with no restriction due to the fact the meter will not be full of fluid, causing inaccurate measurement.

CAUTION: Eliminate all dirt, debris and metal shavings from the piping, as the liquid must be free from any particles larger than what the manufacturer's specifications allow. Install any recommended filtration before operation, as potential plugging most often occurs at startup.

Filtration

Filtration depends on the model. Make sure to follow proper filtration requirements for your specific model. Because the internal assembly has very small clearances, small filter sizes are required, especially for ball-bearing flowmeter versions.

NOTE: Filters are meant to filter out impurities in the fluid stream. If you are measuring fluids with fillers, even if the fillers are smaller than the maximum recommended filter size, please consult the factory for correct meter selection.

Installing a Bypass

If possible, install a bypass around the flow meter, and flush existing piping with the appropriate liquid before first use. See Figure 1.

Pickup Sensor Installation

Before attaching the sensor to the flow meter, check for any potential clearance issues. It may be easier to install the sensor after the flow meter has been installed in the line.

CAUTION: Do not use a wrench or Channellock®* to aid in hand installing the pickup sensor.

CAUTION: Whether the sensor requires a tool to install or is hand installed, tighten to hand-tighten torque only. Over tightening may cause damage to the sensor and as a result it may not function properly.

Pickup Sensor Location

Locate the pickup and wiring away from A/C motors, actuators, heaters, relays, etc. Use only shielded cable and if possible, a dedicated power supply for the electronics. If sharing power with other devices in the system, be aware that power-draw spikes from other equipment could cause a surge into the sensor, which in turn can cause sensor to give erroneous pulses. Ensure clean power supplies that utilize a true earth ground. Install Intrinsic Safety Barriers if the circuit is intended to be intrinsically safe.

Figure 3: Flow meter with pickup sensor installed

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Operation

CAUTION: Before installing, operating or attempting maintenance on a flow meter, read the appropriate Maintenance Guide. As with any precision-engineered device, always operate and maintain the equipment in accordance with the manufacturer's instructions.

Overview

Flow meters are designed to measure the flow of liquids, which assist in cooling and lubrication. Always close meters to air except when air is part of an automated purge cycle, such as certain paint systems. In this case, the air segments are typically under 1 or 2 seconds and are interspersed with lubrication liquid for a scrubbing effect; in addition, the air segments are short enough that the flow meter does not dry out.

CAUTION: Do not dry lines using only pressurized air, as this will lead to premature wear.

Running the Flow Meter

Never run the flow meter dry or spin with air only. Gear flow meters are precision-engineered flow devices. Always maintain them in a clean, lubricated condition with the internal parts wet at all times. Do not allow air or water to contact the internal parts except in short (1-2 second) cycles as part of an automated flush. If you flush meter with water, make sure to run non-corroding fluid through the meter afterwards. Even stainless steel meters will stain or corrode from the minerals in most water.

Ramp Up

Do not increase flow to a full flow condition instantaneously. Gear flow meters are rugged yet precise instruments that respond almost instantaneously to changes in fluid flow. To avoid damage to the system, increase flow to maximum over a few seconds rather than instantaneously and do not inject high flow speeds into an empty flow meter.

Regular Cleaning

Designing and maintaining a flush procedure that keeps the flow meter internals clean and wet is critical to optimum performance and minimum maintenance. Cleaning cycles vary due to the differences in coatings, equipment, and cleaning fluids, and some testing may be prudent to determine the most efficient method. More corrosive fluids may also require more frequency flush cycles, or if meter sits idle for longer periods of time, such as between shifts, flushing may also be required more often. Consult with the fluid manufacturer for recommended cleaning fluids.

NOTE: During line shutdowns such as overnight and over weekends, flush and leave meters filled with proper cleaning fluid under pressure to allow any residue that may have built up to soak and dissolve.

End of Shift and Overnight Preparations

At the end of a shift or overnight, leave cleaning fluid in the flow meter under pressure, to soak. This helps keep unflushed residual fluids from drying, and facilitates subsequent startups. Opening a flow meter after a flush cycle helps determine if the purge is thoroughly cleaning the flow meter.

Breakdown

NOTE: Full breakdown instructions are included in the Maintenance Guide.

NOTE: If you remove a flow meter from the line during maintenance, do not allow fluids to dry inside. Clean the internals immediately, lubricate them, and cap the fluid ports.

NOTE: Clean the carbide surfaces at the point where the gear rotates on the shaft. Buildup here may occur as a thin smear and may be difficult to see, but causes friction and accelerate additional buildup later when the gears are reinstalled. Spin the gears by hand to verify that they rotate freely on the shaft and apply a suitable lubrication fluid before closing the flow meter. After tightening the bolts, a short squirt of shop air will briefly spin the gears, which should be easily audible.

CAUTION: Do not overspin gears if using shop air to verify free rotation of gears prior to installation.
CAUTION: Do not use wrenches or a Channellock to aid in re-installing the pickup sensor by hand. Whether you are installing the sensor with a tool or by hand, tighten to hand-tighten torque only.

Plugging

In the event of plugging, the flow meter passes a reduced volume of fluid with an increased backpressure and no frequency output. Careful installation is important because this is the time when contaminants such as tape or metal shavings can enter the flow meter. Filters should be in line to prevent oversized particles from entering the flow meter.

In the event the flow meter needs to be returned to the factory for further evaluation, flush the flow meter in place and cap the ports. Pack carefully (with original packing materials, if possible) prior to shipping to prevent damage.

Filtration

Filtration is recommended to prevent contaminants from entering the flow meter. If the flow meter is plugged, a reduced flow can still be observed from the nozzle or outlet, as fluid pressure squeezes fluid through the flow meter. Should this occur, review the cleaning and maintenance procedures in the following sections.

Maintenance

Follow these general guidelines for operating and maintaining your positive displacement flow meter.

Use the Maintenance Guides

Always review the Maintenance Guides provided with the flow meter (download additional copies at www.awgearmeters.com) prior to attempting any maintenance work. The majority of down time and repairs is the result of breakages due to improper maintenance actions, lack of training or rough handling.

Flow Testing

Do not use water for flow testing. The viscosity of water is too low to produce accurate results unless the flow rate is elevated, and the internals would then have to be dried and lubricated to avoid corrosion or scaling. If system calibration is necessary, the preferred calibration fluid is the actual fluid to be metered. Alternatively, using a fluid with a viscosity of approximately 30 cSt* such as mineral oil or thinned glycerin is recommended.

Plugging and Filtration

Filtration is recommended to prevent contaminants from entering the flow meter. Should the flow meter become plugged, a reduced flow may still be observed from the outlet as fluid pressure will squeeze fluid through the flow meter – visual flow does not necessarily mean that the flow meter's gears are turning. If contaminants are causing the plugging, install filtering. If particle buildup repeatedly causes plugging, review the cleaning and maintenance procedures in the Regular Cleaning section on page 8. Because of the considerable differences in fluid types and in-plant procedures, some trial and error may be required to determine the ideal flushing or cleaning regimen.

Calibration

A calibration factor (k-factor) is established at the factory on a preferred calibrating fluid. This number, which is provided with the flow meter either on a Calibration Data Sheet or on a tag attached to the flow meter, is usually accurate for a wide variety of fluids and should not usually be changed. Should the data sheet become lost, contact the factory for a duplicate copy. See the Calibrations section on page 12 for a calibration verification procedure.

**cSt is a unit of kinematic viscosity that equals one hundredth of a stoke.*

Storage

When the flow meter is idle or stored for any extended period, perform the following:

1. Clean the internals thoroughly with the appropriate fluid
2. Lubricate with a light oil or other non-corrosive fluid
3. Cap or plug the ports to prevent drying

Flow Meter Do's and Don'ts

DO: Leave flushing fluid in the lines overnight or during extended off-times. This keeps internals wet, prevents residual fluids from drying, and facilitates startups.

DO: Follow the Maintenance Guide instructions when opening and cleaning a flow meter. During cleaning, separate the gears from the shafts. On carbide bearings, clean inside the center of the gear bearing and on the outer surface of the shafts at the point where the gear rotates on the shaft. Apply a suitable lubricating fluid before closing the flow meter. After tightening the bolts, a short squirt of shop air will briefly spin the gears, which should be easily audible.

DO: Install and maintain filters. Install the recommended filter to eliminate potential plugging. Should plugging occur, the flow meter will still pass fluid but with no signal output.

DO: Check electrical compatibility between the flow meter's output signal and the input of the PLC. If signals are not being detected at startup, first check wiring and electrical compatibility.

DO: Verify reliable grounding of electrical parts, as per installation guidelines. A dedicated power supply is recommended. Voltage spikes on shared power lines, negligent grounding and sloppy wiring will likely produce erratic readings and chronic maintenance.

DO: Install the flow meter immediately upstream of the regulator or control valve. The control valve provides backpressure, which stabilizes the flow.

DON'T: Allow air into the flow meter. Always keep the flow meter internally wet.

DON'T: Dry lines using pressurized air. Flow meters are designed to flow liquids. Close meters to air except when air is part of an automated purge cycle. Do not dry lines after purging.

DON'T: Allow materials to dry inside the flow meter. When a flow meter is removed from the line during maintenance, clean the internals immediately, lubricate the gears, and cap the fluid ports.

DON'T: Over tighten the pick-up sensor beyond hand tight. When installing the pickup sensor, turn it in lightly to a hand-tight torque. Do not use a wrench on the pickup as over tightening may cause a dimple of metal under the sensor nose to protrude into the gear cavity and interfere with the gear's rotation.

DON'T: Use water or solvent for calibration or test purposes. Water or solvent may not turn the gears at low flow and may leave the impression that the flow meter is not functioning. A calibration factor (kfactor) is issued with the flow meter, which is valid for most fluids except water or equivalent viscosities.

Calibrations

Each flow meter is calibrated and given a "k-factor" using a standard calibrating fluid at the factory. This number is accurate for all fluids with most viscosities, except the most water-like. There should be no need to change this except for fluid viscosities below 30cSt.

If flow readings are too high

If the display shows significantly more than the volume actually dispensed or shows flow when there is definitely no flow, this most likely indicates an electrical noise problem. In such cases, turn off nearby motors, heaters or relays, check cable shielding, and establish a clean ground independent of other electrical devices before repeating accuracy tests. If the problem continues, it may be necessary to relocate the offending device or reroute cabling away from noise sources.

If flow readings are too low

If the display shows significantly less than the volume actually dispensed, most likely the flow meter has a high slippage factor, and the fluid is bypassing the gears and the k-factor may require adjustment. Dirt or dried material can also keep gears from rotating freely.

If it is necessary to adjust the existing k-factor

Trigger at least 500ml of your sample fluid in a steady stream at approximately the desired flow rate into a graduated beaker. Compare the volume in the beaker to the volume on the display. Do not time the operation; merely measure the volume dispensed. Repeat the sample 3 times and take an average. If the result is outside an acceptable margin, adjust the k-factor by the percentage

of difference between the average beaker sample and the average displayed total. If the error is not rectified, clean the flow meter thoroughly and repeat the procedure. Do not use water for this test. For most accuracy results, calibrate using fluid to be measured with flowmeter.

If it is necessary to re-calculate a new k-factor

You will first need a data-collecting instrument to count pulses produced by the flow meter. Trigger at least 500ml of your sample fluid in a steady stream at approximately the desired flow rate into a graduated beaker.Divide the number of pulses by the volume dispensed and the result is your new k-factor in the units of your sample. In the example above, the k-factor units would be impulses/ml.

Trouble-Shooting Guide

PROBLEM	POSSIBLE CAUSE	SOLUTION
Flow meter indicates lower than actual.	Viscosity of fluid is less than 30 cst.	Decrease the k-factor by percent error.
	Excessive pressure differential across flow meter, causing gears to bind.	Reduce flow rate, reduce fluid viscosity.
	Debris in measuring chamber.	Clean flow meter; change or add filter.
	Upper housing has dimple from over tightening sensor.	Replace upper housing.
Flow meter indicates higher than actual.	Air in lines.	Add air eliminator.
	Electro-magnetic interference.	Ground flow meter and all electronics.
	Reverse fluid flow.	Add check valve.
Indicator shows flow when there is no flow.	Fluid oscillates.	Check pump, add check valve, increase backpressure.
	Electro-magnetic interference.	Ground flow meter and all electronics. Use shielded cable and relocate away from electrical noise.
No flow indication.	No fluid flow.	Check pump.
	Debris in measuring chamber or gears.	Clean flow meter, change or add filter.
	Sensor not installed properly.	Check sensor is installed to hand tight. Review sensor guide.
	Faulty wiring.	Check sensor connection and readout connection.
	Faulty sensor.	Replace sensor.
	Upper housing has dimple from over-tightening sensor.	Replace upper housing.
Erratic system indication.	Ground loop in shielding.	Ground shield one place only. Re-route cables from electrical noise.
	Pulsating fluid flow.	Add pulse dampener.

All-In-One Sensor

Technical Specifications

Supply Voltage Range
12-24VDC ±10%
Max current draw 40-100mA
(model-specific, contact factory)

Analog Output Options
4-20mA & 0-10V - Default
0-5V, 1-5V & 2-10V - Available
through PC Toolkit or mobile app

Standard Max Output
+2.5% of max scaling (20.5mA/5.125V
/10.25V)

Error Indication
+10% of max scaling (22mA/5.5V/11V)

Analog Output Resolution
16 bit

Analog Output Update Time
100mSec minimum

Ambient Temperature
-40°F to 185°F (-40°C to 85°C)

Pulse/Frequency Output:
Push/Pull output - default
Sinking or Sourcing optional.
Easy setup through PC Toolkit.

Bluetooth® Option
Easy setup, scaling, and adjusting.

**Contains Transmitter Module FCC ID: 12208A-01*

Materials of Construction

- Housing: Anodized Aluminum
- Pickup: 303 Stainless Steel body with Zytel cap
- Seal: Chloroprene Rubber (CR)

Dimensional Drawing

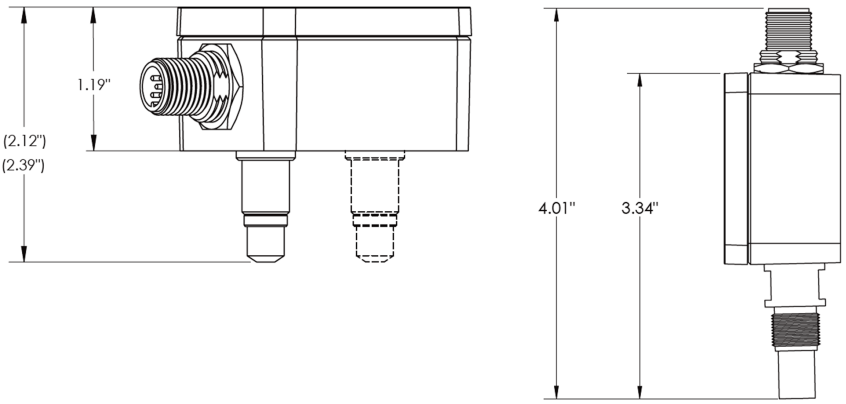

Figure 4: Flow sensor styles: Flush mount (left) is standard; M14 thread-in style is for high temperature applications

Industry Standard M12-A Connectors

5 PIN

PULSE OUTPUT

1: 12-24VDC
2: GROUND
3: FREQ OUT 1
4: FREQ OUT 2
5: N/C

ANALOG + PULSE

1: 12-24VDC
2: GROUND
3: mA OUT
4: V OUT
5: FREQ OUT 1

8 PIN

ANALOG + PULSE + MODBUS

1: 12-24VDC
2: GROUND
3: FREQ OUT 1
4: FREQ OUT 2
5: mA OUT
6: V OUT
7: MODBUS +
8: MODBUS -

Figure 5: Cable Pin-outs

Signal Outputs

Frequency

Each model of sensor comes equipped with a frequency output. Single pulse versions need to be specified as Sinking or Sourcing when ordered. For all others, frequency out can be set to 3 different output types; Push-Pull, Sinking, and Sourcing. Push-pull is the default setting, and all other options can be set using the Bluetooth app or computer toolkit.

Analog

Current Output - The sensor offers a sourced 4-20 mA output that can be scaled via the Bluetooth app or computer toolkit. Current output is referenced to supply ground.

Voltage Output - The sensor offers 4 types of Voltage outputs; 0-5, 1-5, 0-10, 2-10 Volts. Default output is 0-10V and can be changed via the Bluetooth app and computer toolkit. Voltage output is referenced to supply ground

Input Source

For versions with dual pick-ups, the sensor offers 5 different choices on the frequency output lines; Signal 1, Signal 2, Signal 1+2, Direction, and Limits.

Signal 1 - Outputs frequency from pick-up 1 (leads signal 2 by 90° phase shift)

Signal 2 - Outputs frequency from pick-up 2 (trails signal 1 by 90° phase shift)

Signal 1+2 - Outputs 2x the frequency. Users using this output must multiply the k-factor by 2

Direction - Outputs a high or low signal based on the flow direction. In forward direction, sensor will output a high signal equal to the supply voltage. In reverse flow direction, sensor will output a low signal.

Limits - Outputs a high or low signal based off the selected limit source, Total or Rate.

Test Mode

The sensor comes equipped with a push button that allows the sensor to output a set frequency on the signal output lines. There are 3 modes of operation, indicated by the green LED on the board. (D2 for frequency boards and D4 for analog and Modbus)

Mode 1 - Standard operating mode indicated with 1 green LED that blinks every 3 seconds

Mode 2 - Outputs 10 Hz frequency. For dual sensor versions, it outputs on both signal outs with signal 1 leading signal 2 by a 90 degree phase shift.

Mode 3 - Outputs 50 Hz frequency. For dual sensor versions, it outputs on both signal outs with signal 2 leading signal 1 by a 90 degree phase shift.

Bluetooth Application

Sensor App Overview

For the Modbus and Analog versions of this product a Bluetooth app for Android devices (Android 10 or newer operating systems) is available that allows scaling of the analog output wirelessly. The application can be found on the OMEGA website or on the Google Play store.

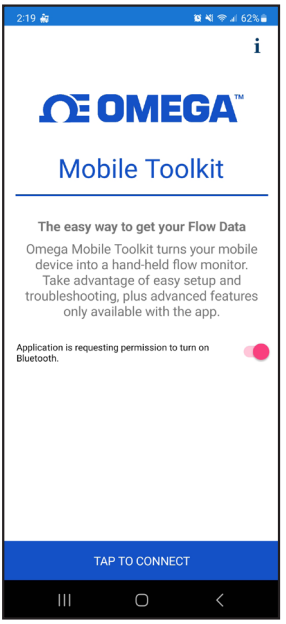

Figure 6: Main Menu

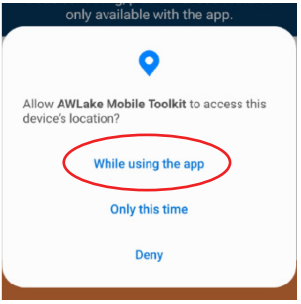

Figure 7: Location Permission

Allow device location for the app, or devices will not appear in search list.

Getting Started

Download and open the application. It will ask to turn on Bluetooth, if not already on. Press the button at the bottom to scan for devices (Figure 6). The default name of the device will be the same as the serial number on the outside of the device. Tap on the name to connect. Once connected the device name will appear at the top of the display with flow rate, Voltage output, and Current output. (Figure 8)

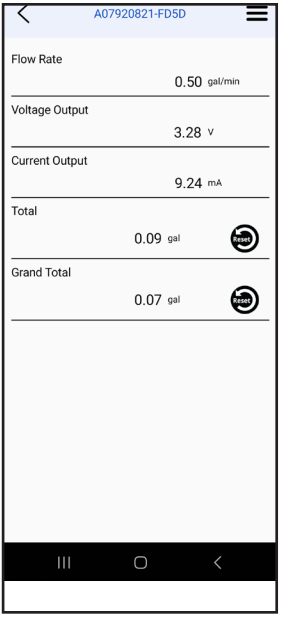

Figure 8: Device Menu

Menu Navigation

Press the three lines in the top right corner to access the setup menu (Figure 9)

System Settings: Adjust K-factor, Filter, Flow Units, Flow Time Base, Max Flow Rate, Max Flow Units, Max Time Base, and Bluetooth name

Output Settings: Where outputs can be forced to certain values or output type can be selected (Voltage type only)

Output Calibration: Calibrate analog outputs (consult factory)

Linearizer Table: Allows user to select custom K-factors for different points in the flow range

Diagnostics: Shows raw input frequency

About Bluetooth Device: Displays device type, Bluetooth name, firmware version, and serial number

Factory Reset: Defaults all user settings back to factory settings

Disconnect: Used to disconnect from device

Exit: Closes application

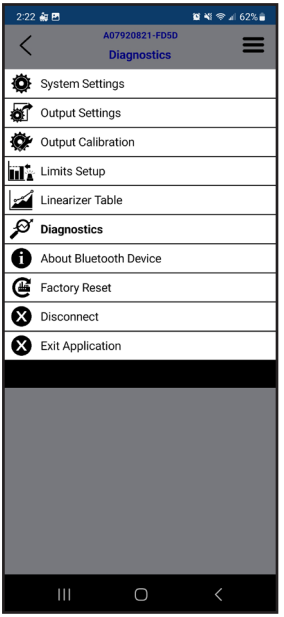

Figure 9: Setup Menu

System Settings

This menu allows users to scale the sensor to output correct analog signal and display correct flow rate in the desired units and time base. It will also allow for filtering of the output. (Figure 10)

After any option is changed press SET for it to take effect. Use back button on phone to return to main screen.

K-Factor: The flow meter scaling factor in pulses/gal (found on calibration sheet)

Digital Filter: Smooth out erratic input frequency. Only effects analog signals. There are four options to choose from:

- **Off:** No filtering
- **Low:** Most filtered, low sensitivity. (Corner frequency ¼ Hz)
- **Medium:** Medium sensitivity. (Corner frequency 1 HZ)
- **High:** Least filtered, high sensitivity. (Corner frequency 10 Hz)

Flow Units: Real time flow rate units

Flow Time Base: Real time flow time base unit

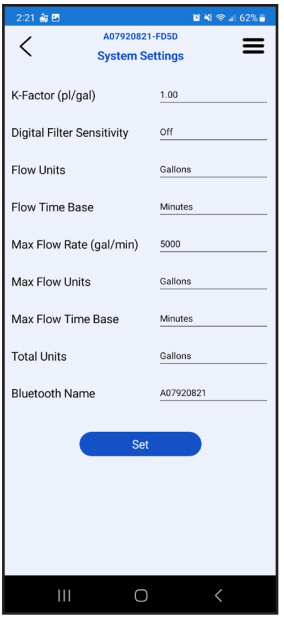

Figure 10: System Settings

Max Flow Rate: The flow rate at which the analog output should be at its max.

Max Flow Units: Selects what unit to scale flow in.

**Flow units will affect Max Flow Rate. Verify both after changing flow units.*

Max Flow Time Base: Can be set to Sec, Min, Hours, and Days.

**Time base will affect the Max Flow Rate. Verify max flow rate is correct after changing time base.*

Bluetooth Name: The name that will appear when searching for the device. Connection will be lost after changing the Bluetooth name and will require reconnection. Name is limited to 19 characters. Some characters on the phone are invalid to use. Examples: $, %, ^ symbols

Output Settings

Forced Outputs

This menu will provide the option to force one or both outputs to a certain value. Along with this ability, Voltage output type will also be selectable. (Figure 5)

To activate, Move the slider to the right. Enter in desired forced output and press SET to store information.

**Note: Forced output will not output a value when only being powered by USB. Information will not be stored until SET is pressed and forced value will revert back to previous value or state if output value is outside of the range.*

Forced output limitations: When forcing an output, it must be in between the analog out specifications and will go to the third decimal place.

Ex. 4-20mA output Forced output: 6.25mA
0-10V output Forced output: 7.5V

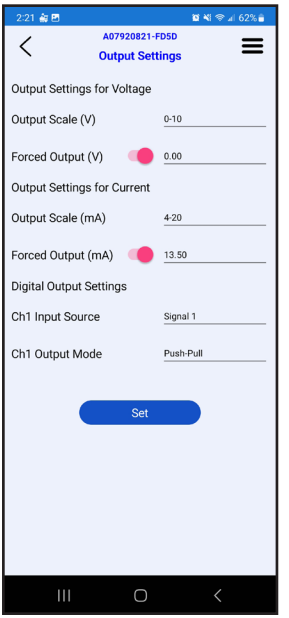

Figure 11: Output Settings

Digital Output Settings

Input Source - User can choose between 5 digital input sources depending on sensor version. Input sources include: Signal 1, Signal 2, Signal 1+2, Direction, and Limit. See page 16 for further descriptions.

Output Mode – User has the option to select the output type of the signal. The 3 options include: Push-Pull, Sinking (NPN), and sourcing (PNP). See Page 17 for further descriptions.

Output Calibration

WARNING: Modifying these outputs could result in inaccurate analog signals.

This menu is provided to adjust the sensor analog output to correspond correctly with the analog output of the input device.

** This menu is intended for use with slight output differences between the sensor output and customer input device. These values are factory calibrated before shipping to match meters that are calibrated annually.*

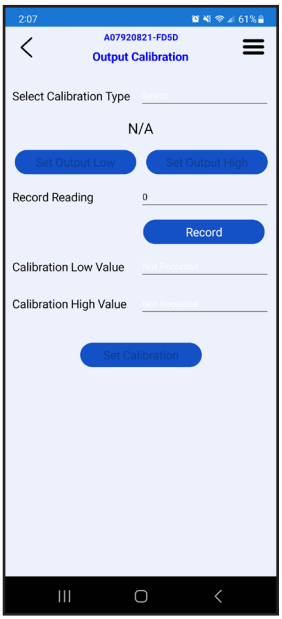

Figure 12: Output Calibration

Select Calibration Type: From this menu both mA and Voltage outputs may be calibrated. (Figure 6)

1. Select which output type to be calibrated; mA or Voltage
2. Press **Set Output Low**, then enter in the value on user's device into Record Reading
   a. Ex. If sensor is being calibrated to a multimeter, enter in reading from multimeter to Record Reading
3. Press **Record** button
4. Now press **Set Output High** to calibrate the high end of the output
5. Enter in High reading from input device to Record Reading
6. Press **Record** button
7. Verify both Calibration high and low values are correct and press **Set Calibration**
8. Use back button on phone to navigate to the main menu

***WARNING: Do not do 2 calibrations in a row. After calibration is finished, exit the app and restart the device.**

Limits

The limit screen is used to set the parameters that trigger the outputs. To use this function, set the Input Source on the Output Settings menu to Limit. The limit has 4 types of triggers: Rate, Total, Grand Total, and Cycle Output.

Rate – Output will go high when flow rate is within the given parameters and low when it goes outside. Select a threshold/ target rate, then select the percentage the flow rate that is allowed to drift from that threshold. Example: a 10% bound on a threshold of 20 gpm would give a rate range of 18–22 gpm.

Total – Output will go high when Total goes above the threshold value.

Grand Total – Output will go high when Grand Total goes above threshold value.

Cycle Output – Output will change state between high and low every time the threshold total is reached. To achieve one pulse per desired output, divide that value by 2. For example, to get 1 pulse per gallon set threshold to 0.5 gallons.

Cycle Output limited to 5Hz or 300 pulses per minute

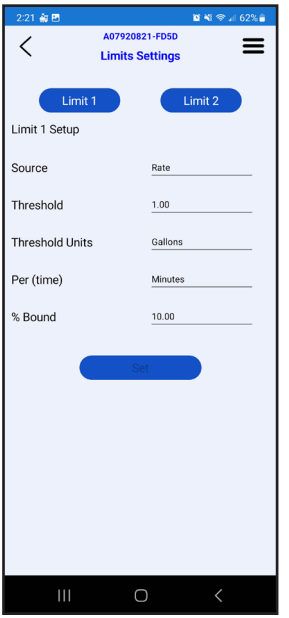

Figure 13: Limits

Linearizer

The linearizer function is designed to correct for devices that will vary in a nonlinear way as a device changes in flow/frequency. It can take nonlinear input and change it to a more linear analog output. (Figure 14)

Ex. Looking at a meter that has a range of 0.5-2 GPM. If at 0.5 GPM (=100HZ) it has a K-factor of 1800, at 1.5 GPM (=200Hz) it has a K-factor of 1850, and at 2.0 GPM (=300Hz) it has a K-factor of 1900. Using a linearizer would ensure the most accurate results over the full range of flow.

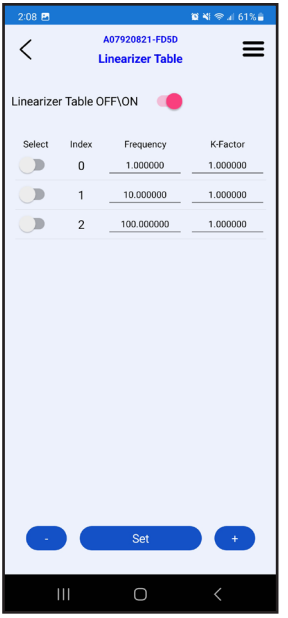

Figure 14: Linearizer Table

Turn On Linearizer: Press the slider to turn the linearizer On and Off. The Slider will turn pink to indicate it is On. Press the Set button for selection to take place.

Changing Values: To change values in the table, press on the desired data point that needs changing. Enter in new values and press the Set button to save the changes.

Entering New Values: To enter in values to the linearizer, press the (+) button. This will bring up the option to type in a desired frequency and corresponding K-factor. After values are entered, press Add, this should input the values into the table. Continue to the next Row and repeat the process for each additional value needed. There are 10 rows available, but it is not required to fill them all. When desired amount of points are entered, press SET to save the changes.

Deleting Values: To Remove a value, press the slider next to the row that needs to be delete. The slider will turn Pink to indicate the row is selected. When all desired rows are selected, press the (-) button to remove them. Press Set to save the changes.

Sensor Modbus Registers

RS485 Settings

- 1 Start Bit
- 8 data Bit
- No Parity Bit
- 1 Stop Bit
- 9600 Baud Rate

Example of Use

Below is a screenshot of the Modbus registers in Modbus Poll. 32-bit float registers are being read in Big-Endian. Integers (Int) are set up as Signed values. And the total resets are set up as single write coils.

Name	Register Start Address	Register Count	Value type	Value Units/ Description
Input Registers (read-only register addresses, read function byte 0x04)				
Raw Frequency Input	5000	2	32 Bit Float	(Hz)
Flow Rate (Users units)	5002	2	32 Bit Float	User Selected
Total (Users Units)	5004	2	32 Bit Float	User Selected
Grand Total (Users units)	5006	2	32 Bit Float	User Selected
Write Coils (Write coil addresses, read function byte 0x05 or 0x0ff00) Single Coil functions only				
Reset Total	1000	1	Bool	0 - False - Normal Mode 1- True - Reset (0x0ff00)
Reset Grand Total and Total	1001	1	Bool	0 - False - Normal Mode 1- True - Reset (0x0ff00)

Name	Register Start Address	Register Count	Value type	Value Units/ Description
Holding Registers (read-write register addresses, read function byte 0x03, write function byte 0x06 for single or 0x10 for multiple registers)				
K-Factor	3000	2	32 Bit Float	
Max Flowrate	3002	2	32 Bit Float	
Flow Rate Time Base	4000	1	Int	0 - Seconds 1 - Minutes 2 - Hours 3 - Days
Flow Rate Volume Unit	4001	1	Int	0 - Pulses 1 - Ounces 2 - Gallons 3 - Barrels (Oil) 4 - Cubic Centimeters 5 - Cubic Meters 6 - Milliliters 7 - Liters
Max Flow Time Base	4002	1	Int	0 - Seconds 1 - Minutes 2 - Hours 3 - Days
Max Flow Volume Unit	4003	1	Int	0 - Pulses 1 - Ounces 2 - Gallons 3 - Barrels (Oil) 4 - Cubic Centimeters 5 - Cubic Meters 6 - Milliliters 7 - Liters
Total Volume Units	4004	1	Int	0 - Pulses 1 - Ounces 2 - Gallons 3 - Barrels (Oil) 4 - Cubic Centimeters 5 - Cubic Meters 6 - Milliliters 7 - Liters

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OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

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1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
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