FS-SERIES FLOW METERS

Ultrasonic Flow Meters for Water & Corrosive Aqueous Solution Measurement and Control

168
mL/min

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Warranty Information

Confidentiality
The information contained in this manual may be confidential and proprietary and is the property of Pyxis Lab, Inc. Information disclosed herein shall not be used to manufacture, construct, or otherwise reproduce the goods described. Information disclosed herein shall not be disclosed to others or made public in any manner without the express written consent of Pyxis Lab, Inc.

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Warranty Term
The Pyxis warranty term is thirteen (13) months ex-works. In no event shall the standard limited warranty coverage extend beyond thirteen (13) months from the original shipment date.

Warranty Service
Damaged or dysfunctional instruments may be returned to Pyxis for repair or replacement. In some instances, replacement instruments may be available for short duration loan or lease.

Pyxis warrants that any labor services provided shall conform to the reasonable standards of technical competency and performance effective at the time of delivery. All service interventions are to be reviewed and authorized as correct and complete at the completion of the service by a customer representative or designer. Pyxis warrants these services for 30 days after the authorization and will correct any qualifying deficiency in labor provided that the labor service deficiency is exactly related to the originating event. No other remedy, other than the provision of labor services, may be applicable.

Repair components (parts and materials), but not consumables, provided during a repair, or purchased individually, are warranted for 90 days ex-works for materials and workmanship. In no event will the incorporation of a warranted repair component into an instrument extend the whole instrument's warranty beyond its original term.

Warranty Shipping
A Repair Material Authorization (RMA) Number must be obtained from Pyxis Technical Support before any product can be returned to the factory. Pyxis will pay freight charges to ship replacement or repaired products to the customer. The customer shall pay freight charges for returning products to Pyxis. Any product returned to the factory without an RA number will be returned to the customer. To receive an RMA you can generate a request on our website at Request Return or Repair - Pyxis Lab, Inc. (pyxis-lab.com)

Pyxis Technical Support
Contact Pyxis Technical Support at +1 (866) 203-8397 ext. 2., or by emailing service@pyxis-lab.com

1 Introduction

The new Pyxis FS-Series are state-of-the-art ultrasonic flowmeters that operate on the principle of transit time difference. In this flow measurement method, the propagation speed of ultrasonic waves downstream is faster than upstream, and the transit time difference is directly proportional to the flow rate. The FS-100 series provides a measurement range of 0–3,000 mL/min, while the FS-200 series extends the range to 0–10,000 mL/min; both offer a resolution of 1 mL for precise water flow measurement.

The FS-Series flowmeters are ideal for flow measurement and are offered in two liquid end materials of construction, for standard water (FS-100/FS-200) and highly corrosive aqueous applications (FS-101/FS-201). The sensors advanced PCB design offers built-in temperature compensation to eliminate the effect of temperature with instantaneous, accumulated, and controlled water flow based on user setpoint within the sensor itself.

FS-100/200 Series Ultrasonic Flow Meter

All FS-Series flowmeters are powered by a 24 VDC/2W power supply and provide both 4–20 mA and RS-485 Modbus output signals for connection to any OEM controller, PLC or DCS.

1.1 Main Features

- Real -time flow rate trend chart
- Combination of 2 × isolated 4–20 mA signal and 1 × isolated RS-485 output (Modbus RTU).
- Ultrasonic flowmeter with local display, available in 0–3,000 mL/min (FS-100 series) and 0–10,000 mL/min (FS-200 series) measurement ranges.
- Built in temperature sensor automatically compensates for the effect of temperature on flowrate.
- Monitor and display instantaneous flowrate and accumulated volume.
- Integrated user defined flow rate setpoint with PID output control for 4-20mA regulating valve/pump
- Large color LED indicator for operational state indication.
- CPVC Liquid End for common water flow measurement applications (FS-100/FS-200).
- Ryton PPS / GF Polymer Liquid End for highly corrosive solution flow measurement applications (FS-101/FS-201).

2 Specifications

2.1 FS-100 Series (Low-Flow Range) Specifications

Table 1

Item	FS-100	FS-101
P/N	54200	58542
Supported Fluid	Liquids (water)	Corrosive Aqueous Solution[1]
Supported Fluid Temperature	4ºC ~ 49ºC (40ºF ~120ºF)	
Wet End Material of Construction	UPVC + PPS Plastic + GF Polymer + Epoxy+ Fluorine Rubber	PPS Plastic + GF Polymer + Epoxy + Fluorine Rubber
Sample Inlet Pressure	7.25 – 100 psi (0.05 – 0.689MPa)	
Sample Inlet /Outlet	1/2 - inch NPT	
Flow Path Inner Diameter	5mm	
Rated Flow Range	0 – 3,000 mL/min	
Minimum Flow Rate Detection	10mL/min	
Resolution	1mL/min	
Maximum Error	$\pm$10mL/min or ±1% of the value, whichever is greater	
Display	1.44" Color 128 x128 Resolution	
Analog Outputs[2]	1# 4-20mA for flow rate 2# 4-20mA for regulating valve	
Digital Output	1 × Isolated RS485, Modbus RTU	
Power Supply	22-26V DC, 2W	
Operation Temperature	32 – 122 ºF (-0 – 50 ºC)	
Storage Temperature	-4 – 158 ºF (-20 – 70 ºC)	
Dimension (H x W x D)	145mm H x 50 mm W x 61.5mm D	
Weight	~ 600 g	
Humidity	5 – 95% No Condensation	
Protection	IP-65	
Regulation	CE / RoHS	

(1) Refer to the separate document "Chemical Reagent Compatibility Comparison and Reference for FS-100/200 and FS-101/201" prior to use for measurement of any chemical or corrosive aqueous solution

(2) The flow control module supports only one 4-20mA (flow rate) output for connection to another device. The second 4-20mA output is reserved exclusively for controlling the regulating valve.

(3) Specifications are subject to change without notice. Contact service@pyxis-lab.com for any questions.

2.2 FS-200 Series (High-Flow Range) Specifications

Item	FS-200	FS-201
P/N	54081	51488
Supported Fluid	Liquids (water)	Corrosive Aqueous Solution[1]
Supported Fluid Temperature	4°C ~ 49°C (40°F ~120°F)	
Wet End Material of Construction	UPVC + PPS Plastic + GF Polymer + Epoxy+ Fluorine Rubber	PPS Plastic + GF Polymer + Epoxy + Fluorine Rubber
Sample Inlet Pressure	7.25 – 100 psi (0.05 – 0.689MPa)	
Sample Inlet /Outlet	1/2 - inch NPT	
Flow Path Inner Diameter	12 mm	
Rated Flow Range	0 – 10,000 mL/min	
Minimum Flow Rate Detection	10mL/min	
Resolution	1mL/min	
Maximum Error	$\pm$40mL/min or ±1% of the value, whichever is greater	
Display	1.44" Color 128 x128 Resolution	
Analog Outputs[2]	1# 4-20mA for flow rate 2# 4-20mA for regulating valve	
Digital Output	1 × Isolated RS485, Modbus RTU	
Power Supply	24V DC, 2W	
Operation Temperature	32 – 122 °F (-0 – 50 °C)	
Storage Temperature	-4 – 158 °F (-20 – 70 °C)	
Dimension (H x W x D)	145mm H x 50 mm W x 61.5mm D	
Weight	~ 600 g	
Humidity	5 – 95% No Condensation	
Protection	IP-65	
Regulation	CE / RoHS	

(1) Refer to the separate document "Chemical Reagent Compatibility Comparison and Reference for FS-100/200 and FS-101/201" prior to use for measurement of any chemical or corrosive aqueous solution

(2) The flow control module supports only one 4-20mA (flow rate) output for connection to another device. The second 4-20mA output is reserved exclusively for controlling the regulating valve.

(3) Specifications are subject to change without notice. Contact service@pyxis-lab.com for any questions.

3 Unpacking Instrument

Remove the instrument and accessories from the shipping container and inspect each item for any damage that may have occurred during shipping. Verify that all items listed on the packing slip are included. If any items are missing or damaged, please contact Pyxis Customer Service at service@pyxis-lab.com.

3.1 Standard Accessories

- One **FS-Series** ultrasonic flowmeter (Refer to models as outlined in Specifications Table)
- Includes one **CE-FE-4.9** Flying Lead Cable with Explosion-proof Female 7-Pin Adapter – 1.5m/4.9 feet (P/N: 50762)
- The full instrument manual is available for download at Support Documents - Pyxis Lab, Inc. (pyxis-lab.com)

3.2 Optional/ Replacement Accessories

The following optional accessories can be ordered from Pyxis Customer Service (order@pyxis-lab.com) or Pyxis E-Store at https://pyxis-lab.com/shop/

Table 2

Accessory Name	Part Number
MA-AC-7US Power outlet adapter cable with USA/Type A plug 110VAC-24VDC	26398
MA-AC-7EU Power outlet adapter cable with EU/DIN plug 230VAC-24VDC	28787
MA-AC-7UK Power outlet adapter cable with UK plug 230VAC-24VDC	25802
CE-FE-4.9 Flying Lead Cable w/Explosion-proof Female 7-Pin Adapter – 1.5m/4.9ft	50762
FS-100 Ultrasonic Flowmeter, 0-3000ml/min for Common Water Flow Measurement	54200
FS-101 Ultrasonic Flowmeter, 0-3000ml/min for Corrosive Aqueous Solution Flow Measurement	58542
FS-200 Ultrasonic Flowmeter, 0-10,000ml/min for Common Water Flow Measurement	54081
FS-201 Ultrasonic Flowmeter, 0-10,000ml/min for Corrosive Aqueous Solution Flow Measurement	51488
Nano-Flow^{TM} Control Module FS-100 Ultrasonic Flow Meter + Regulating valve	21329
Nano-Flow Plus^{TM} Control Module FS-200 Ultrasonic Flow Meter + Regulating valve	20867
Nano-Feed^{TM} Control Module FS-101 Ultrasonic Flow Meter + Fluid Pulse Dampener	28080
FS-Series Pulsation Dampener Replacement for Nano-Feed Module	24441

4 Dimension & Installation
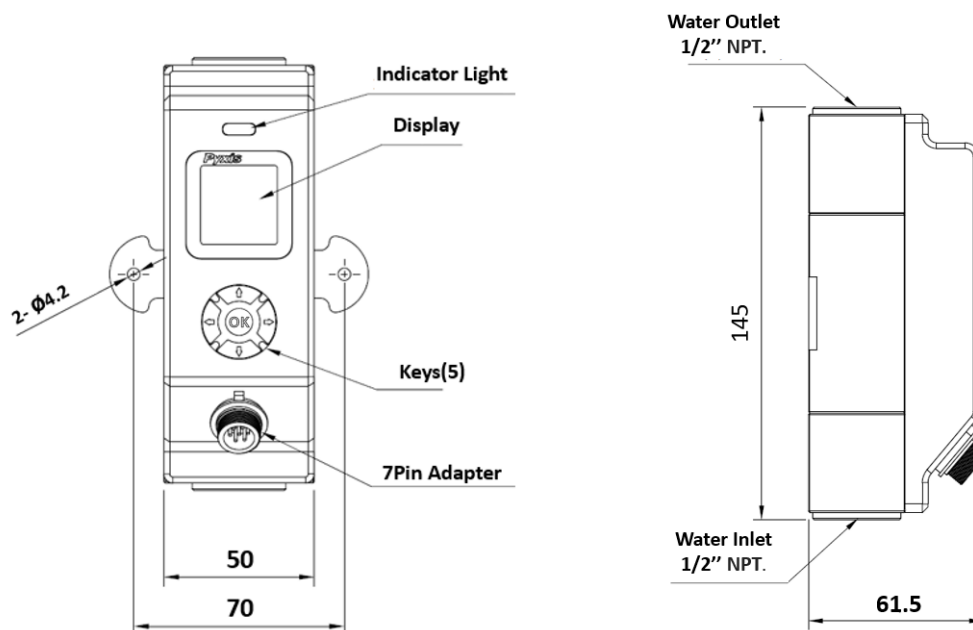
4.1 FS-100/200 Series Dimension(mm)

Figure 1

4.2 Correct Mounting Format

When measuring liquids, the flow meter should be installed in a <u>vertical pipe that the fluid flows from the bottom up</u>.
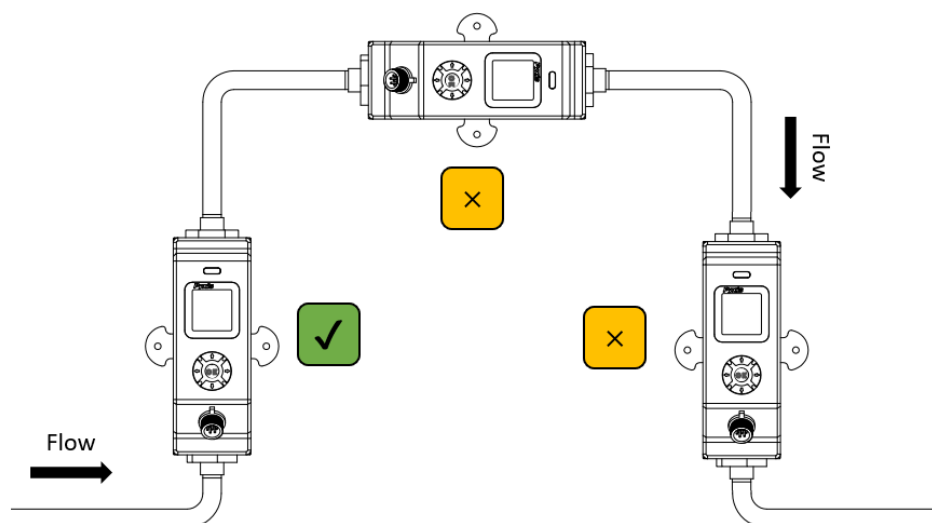

Figure 2

4.3 Panel Mounting

Required Mounting Materials:

- 2 × M4*16 Allen screws
- 2 × M4 Spring pad
- 2 × M4 Flat pad
- 2 × M4 Nuts

NOTE: The package may contain additional mounting parts, but only the above materials are required for installation.

Panel Mounting Procedure:

1. Use the mounting plate on the FS-Series as a template to mark the positions of two holes.
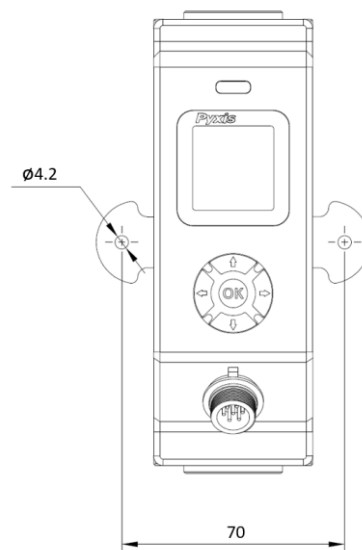2. Drill the holes: ∅ 4.2mm

Figure 3

3. Install the FS-Series using the mounting materials and tighten the screws snuggly.
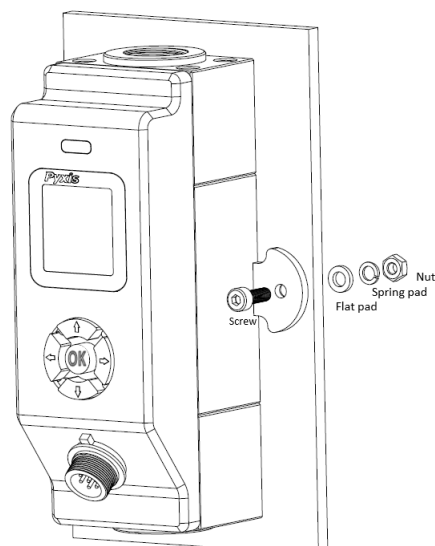
Figure 4

4.4   Nano-Flow™ Series Control Module for Water

Sold separately, the Pyxis Nano-Flow™ and Nano-Flow PLUS™ Control Modules are stand-alone water flow measurement and control solutions designed for use in critical cooling and process-water sample flow applications. This unique platform provides precise flow measurement and regulation and may be installed upstream of inline sensors in water systems that are subject to pressure and flow variation challenges.

The Nano-Flow series modules are offered in a convenient and easy to integrate micro-panel mounted format for rapid installation, setup and maintenance. Each micro-panel assembly integrates an ultrasonic flowmeter with display and a pre-mounted regulating valve controlled through a simple-to-program user interface: the Nano-Flow module is equipped with the Pyxis FS-100, while the Nano-Flow PLUS module is equipped with the Pyxis FS-200.

Table 3

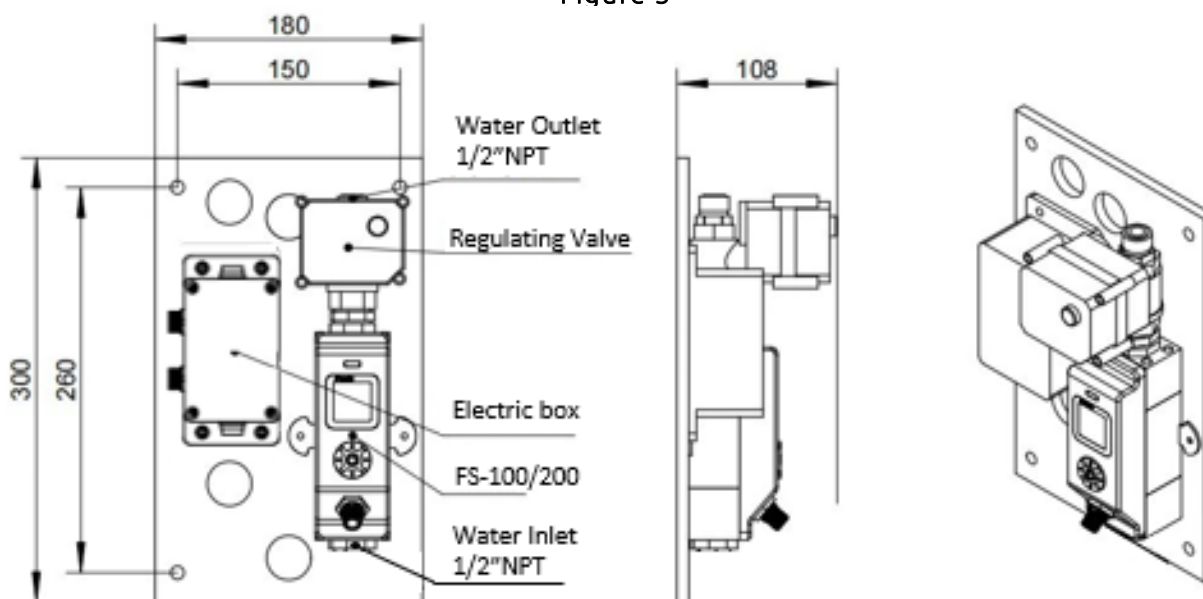| Item	P/N	Description
Nano-Flow™ Control Module	21329	FS-100 Ultrasonic Flow meter + Regulating valve
Nano-Flow PLUS™ Control Module	20867	FS-200 Ultrasonic Flow meter + Regulating valve

Figure 5

Figure 6

4.5 Nano-Feed™ Control Feed Module for Corrosive Aqueous Solution

Sold separately, the Pyxis Nano-Feed™ Chemical Feed Module is a stand-alone flow measurement solution designed for pulsed chemical metering pump applications. The module combines a pulse dampener at the inlet with the Pyxis FS-101 ultrasonic flow meter, which uses PPS+GF wetted materials optimized for corrosive liquid environments.

Nano-Feed module should be Installed in the chemical feed line downstream of the metering pump and upstream of the injection point, Nano-Feed smooths the pulsating discharge typical of diaphragm pumps, enabling stable flow indication and more accurate confirmation of the delivered chemical dosage.

Table 4

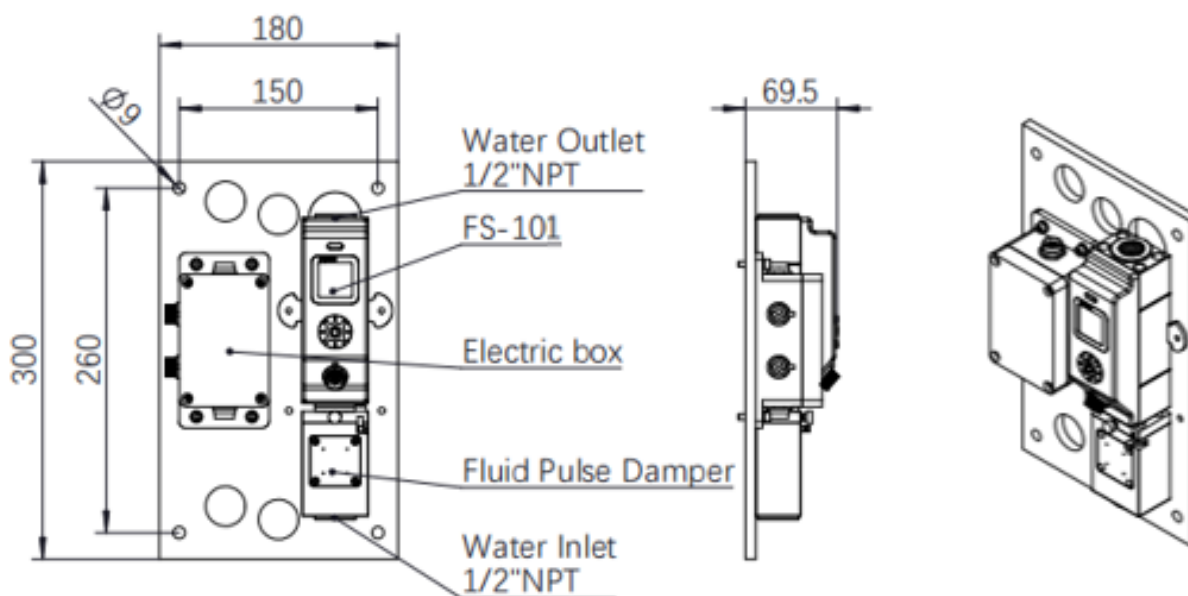| Item	P/N	Description
Nano-Feed™ Module	28080	FS-101 Ultrasonic Flow meter + Pulsation Dampener

Figure 7

Figure 8

5   FS-Series Electrical Connection

The FS-Series flowmeters provide 2x 4-20mA and 1x RS-485 output signals.

- The 1# 4-20mA output (white wire) provides the sensor flow signal to be connected to a receiving device.

- The 2# 4-20mA output (green wire) is used to drive a regulating valve in the Nano-Flow™ series panel solutions. For users who purchase the FS-100/FS-200 series as stand-alone flowmeters, this 4–20 mA flow-control lead should remain unconnected and the wire end should be insulated with electrical tape.

Users should use the CE-FE-4.9 7-Pin Explosion-proof Female Adapter / Flying Lead Cable (P/N 50762) provided with each FS-Series package, and refer to the Table 5 below for proper connections.

NOTE Pyxis offers outlet plug in power supply adapter cables in both USA-Type A, EU-DIN and UK formats for those desiring to power the FS-Series via outlet. See Optional/ Replacement Accessories Section for details.

Table 5

Wire Color	Designation
Red	24V +
Black	Power Ground / 4-20 mA-
White	1# 4-20 mA+ for Flow Rate
Green	2# 4-20 mA+ for Flow Control
Blue	RS-485 A
Yellow	RS-485 B
Silver	Earth Ground

Table 6

FS-Series Flowmeters 4-20mA Scaling		
Model	1#4-20mA (White Wire) Scaling	2#4-20mA(Green Wire) Scaling
FS-100	Flow Rate : 4mA = 0 mL/min, 20mA = 3000 mL/min	Flow control: 4mA = regulating ball valve fully closed, 20mA= regulating ball valve fully open
FS-101		
FS-200	Flow Rate : 4mA = 0 mL/min, 20mA = 10,000 mL/min	
FS-201		

6 FS-Series Operation

## 6.1 Key Functions

OK - Enter Key
- Turn on the Setting Menu from the home screen.
- In the Setting Menu: enter the **selected submenu**.
- In option lists: confirm the **selected option**.
- In value adjustment screens: execute the **cursor-selected action** (e.g., *Yes* to save, *Cancel* to discard).
- **Special case**: In the Device Information screen, press OK to return to the previous screen or press and hold OK to restore factory settings.

◄► - Left / Right Key
- In the Setting Menu: turn pages.
- In value adjustment screens: move the cursor to the left or right.
- **Special case**: In home screens: turn on/off the Trend Chart display

▲▼ - Up / Down Key
- To increase or decrease the displayed value. Long press for coarse adjustment, short press for fine adjustment
- In submenus: select items.
- In option lists: move between available options.
- **Special case**: In Home screen, press ▼ to pause/resume the timer, or press and hold ▼ to reset the timer.

Indicator Light

Keys (5)
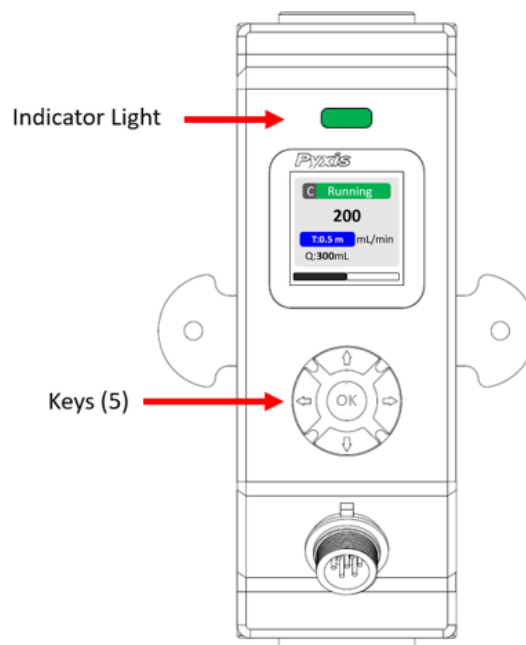
6.2 LED Status Indicator Light

The status LED is used for a quick visualization of the flowmeter status.

Table 7

LED Behavior	Status
Green	Normal Running
Red [1]	Alarm Information

(1) This indicator light will turn RED under the following conditions:
- Flow rate exceeds the maximum range
  - 3,000 mL/min for FS-100/FS-101
  - 10,000mL/min for FS-200/FS-201
- In flow rate control (C) mode, the flow fails to reach the setpoint for over 2 minutes.
- Flow rate exceeds user-defined upper or lower alarm limits.

6.3   Home Screen

Upon power-up, the flowmeter automatically begins monitoring real-time flowrate (3) and calculating sample accumulated flow (6). A built-in timer (4) is also activated simultaneously and is used as the time base for sample flow accumulation.

Functional Areas

Table 8

NO.	Description	
1	Flow Detection Mode [1]	
2	Working Status (same color as LED status indicator)	
3	Flow Rate Value	
4	Timer [2] (unit: auto range, **s** = seconds, **m** = minutes, **h** = hours, **d** = days)	
5	Unit of measured flow value	
6	Accumulated Flow Value [3] (unit: auto range, ml, l, kl)	

(1) **R** = Average Flow Rate Mode / **M** = Instantaneous Flow Rate Mode / **C** = Flow Rate Control Mode
    NOTE For C-Mode please refer to Section 6.6 for programming details.

(2) This timer serves as the time base for calculating total accumulated flow. The timer can be set by pressing the ▼ key.

- **Pause or Resume the Timer Display:** Press ▼ key momentarily and release.
  When the timer is paused, the accumulation of total flow is also paused. Flow will not be added to the totalizer until the timer is resumed.
- **Reset the Timer:** Press and hold ▼ key for about two seconds.
  Resetting the timer will also clear the accumulated flow and restart both time and flow accumulation from zero.

(3) The timer and the accumulated flow totalizer are functionally linked. Any operation that pauses or resets the timer will directly affect the accumulated flow calculation.

6.4   Trend Chart

From the home screen, Press ◄ or ► to open the trend chart display. The flow values are shown as a line graph, indicating the real-time trend. Press ◄ or ► again to return to the home screen.
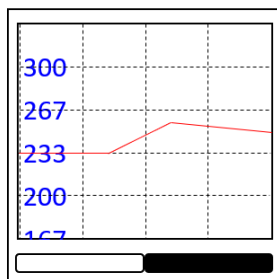

Figure 9

6.5 Alarm Settings

Press ◄ or ► in the setting menu and select *[Alarm]*. From Alarm settings screen, press▲ or▼ to adjust the displayed number, then press◄ to move the cursor to "Yes".
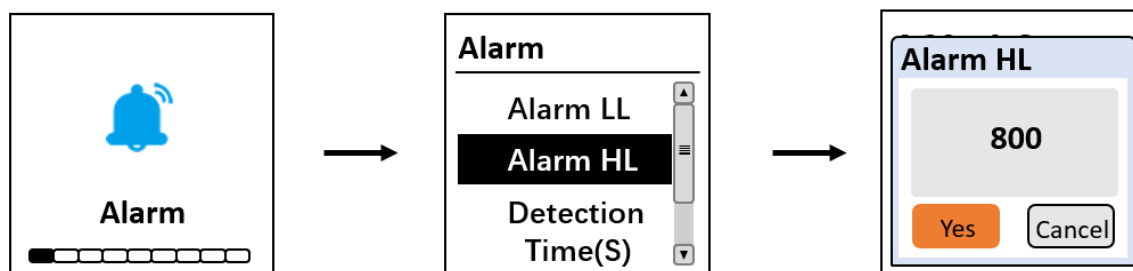

Figure 10

After the limits are defined, select **Detection Time (s)** and adjust the value in the same way.
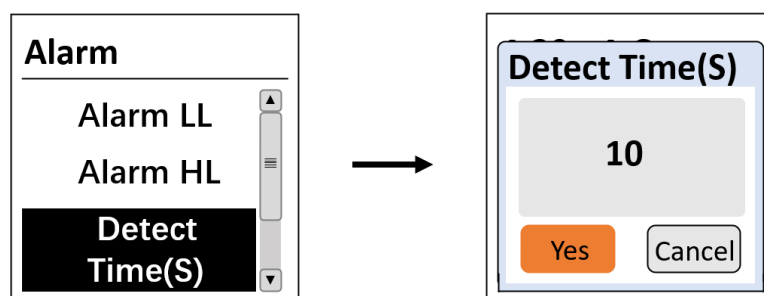*NOTE* *To enable the alarm function, the Detection Time(s) must ≥ 1 second.*

Figure 11

The Upper Alarm (Alarm HL) and **Lower Alarm (Alarm LL) limit** are constantly compared with flow rate value. Once the flow rate value exceeds the alarm upper limit or falls below the alarm lower limit, and the duration time is longer than the user programmed detection time, the main screen and LED indicator will display a red alarm status as shown in **Figure 12**.
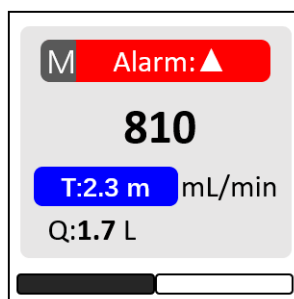
Figure 12

6.6 Set the Operating Mode for the Flowmeter

To set the operating mode of the flowmeter, select *[Pattern]* from the Setting Menu. In the submenu, choose **Work Pattern** to open the option list. The following operating modes are available:

- **Flow Rate** = Display the <u>average</u> flow rate.
- **Flow Meter** = Display the <u>instantaneous</u> flow rate.
- **Flow Control*** = Set a desired constant flow rate.

NOTE The Flow Control mode should be used with a regulating valve. Pyxis offers a "Turn-Key" flow control solution called Nano-Flow^{TM}, see Section 4.4 for more details.
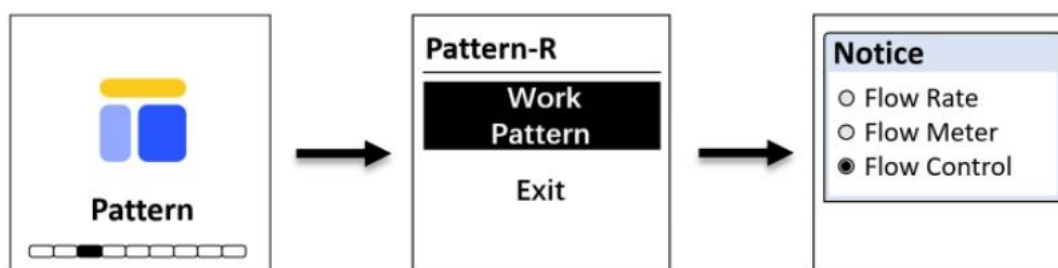
Figure 13

If the user selects **Flow Control(C)** mode, a preset flow rate must be entered (**Figure 14**). The FS-100/200 will control the regulating valve or pump according to the preset flow rate.
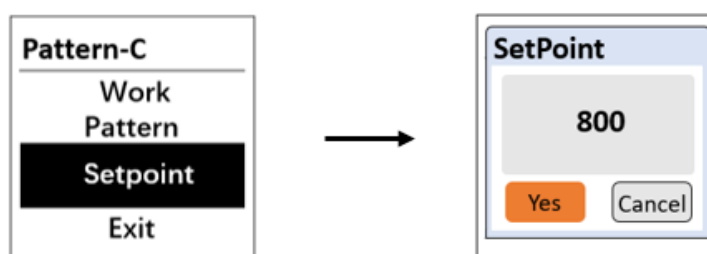

Figure 14

NOTE If the actual flow rate does not reach the preset flow rate, and duration time is longer than two minutes, the main screen and LED indicator will display red alarm status Flow Control Err *.*
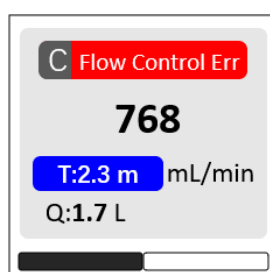

Figure 15

6.7 Flow Regulating Valve Output - 4-20 mA Span

The FS-Series flowmeters control the valve position of the regulating ball valve or smart pump by outputting the 4-20 mA signal. After the user assigns a desired flow set point in **Flow Control (C)** mode, the FS-Series will automatically calculate the error between the actual flow rate and the setpoint flow rate and adjust the appropriate 4-20mA output value through the preprogrammed PID algorithm to regulate the valve. This advanced capability and feature provides turn-key and real-time application use resulting in the sample flow rate infinitely close to the user programmed setpoint value. See process diagram below.
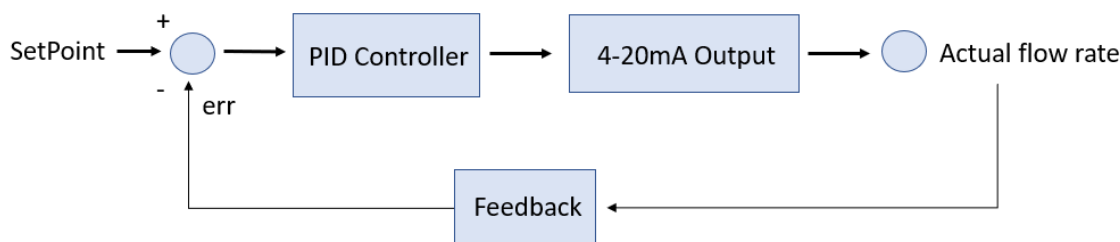

Figure 16

6.8 Flow Measurement Output - 4-20 mA Span

To change the 4–20 mA output corresponding to the flow rate, select *[4–20mA Out]* from the Setting Menu. In the submenu, adjust the output assignment as required, see Figure 17. *NOTE* Refer to *Table 6* for the default 4–20 mA output scaling of the FS-100/200 series flowmeters.
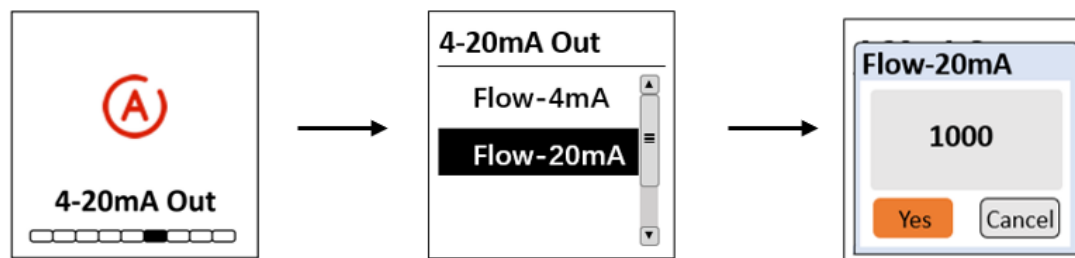

Figure 17

6.9 Modbus Communication Settings

To adjust the Modbus communication parameter, select *[Com]* from the setting menu.
The following communication settings are available:

● **Modbus Address** *(Range: 1~247, default: 95)*

● **Baud Rate** *(Options: 9600 / 38400 / 57600 / 115200, default: 9600)*

● **Parity** *(Options: None / Odd / Even, default: Even)*

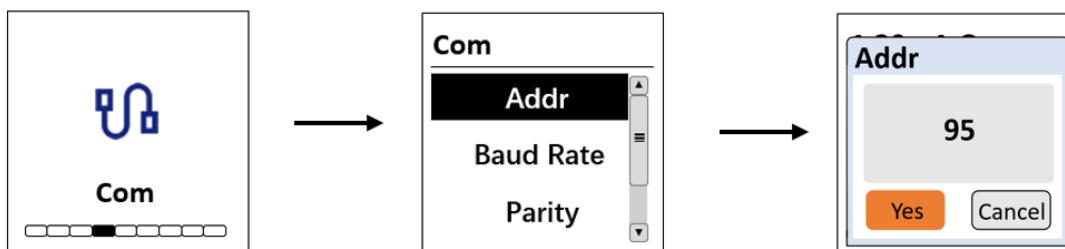

Figure 18

6.10 Calibration

During ZERO & SLOPE calibration, the flowmeter must be set to <u>instantaneous flow mode</u>.
NOTE *Please refer to Section 6.6 to set the operating mode for FS-Series).*

6.10.1 Two-Point Calibration

<u>Zero Calibration</u>: This function is used to correct the <u>instantaneous flow rate</u> to "ZERO".
IMPORTANT NOTE *To perform zero calibration <u>the pipe must be filled with fluid and the fluid should not be moving.</u>*
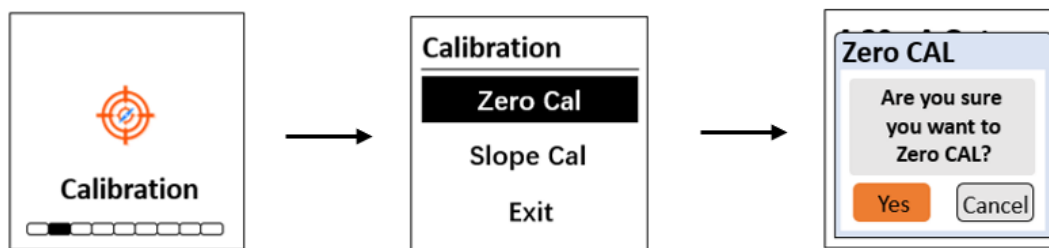

Figure 19

<u>Slope Calibration</u>: This function is used to calibrate the <u>accumulated flow value</u>. Determine the accumulated flow value of the sample water over a period of time by using the electronic balance. The user can customize the sampling time to their preference.

1. Turn off the water valve and place the water outlet line in a beaker.

2. From the main screen, <u>reset the Accumulated Flow Value (Q) to 0.00mL</u> by pressing and holding the ▼ key for about two seconds.

3. Short Press the ▼ key to restart the calculation of the accumulated flow value. Turn on the water valve and fill the beaker with water.

4. Navigate to <u>Slope Calibration</u> screen and enter the measured value of the shot amount as noted by the electronic balance (as grams). *NOTE* *1-mL of water weighs 1-gram.*
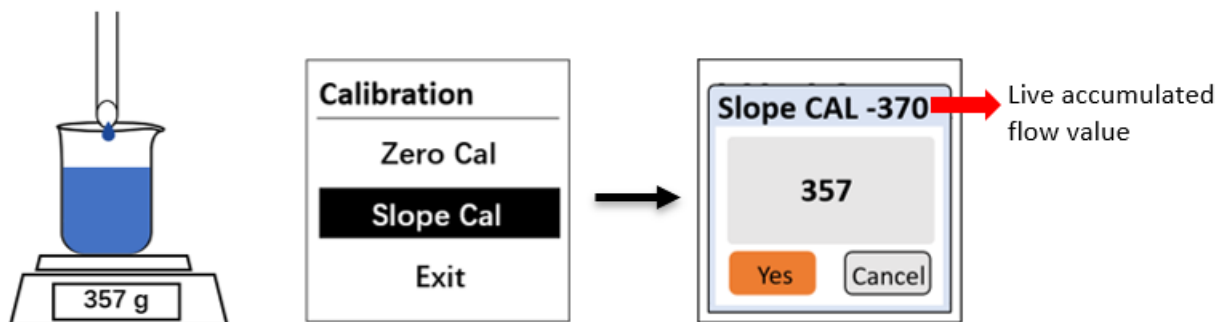

Figure 20

5. If the calibration was successful, the interface will return a message "calibration succeed".

6.11 Display Screen Orientation Settings

To adjust the display orientation, select *[Screen]* from the setting menu. In the submenu, choose **Clockwise rotation** to open the option list, then use ▲/▼ to select the desired rotation angle and press **OK** to confirm.
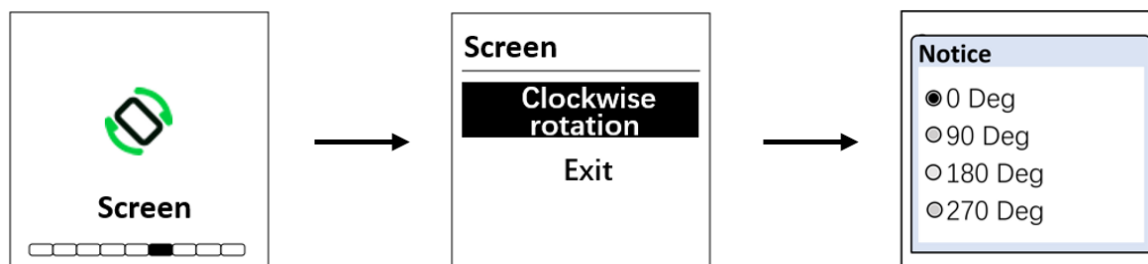

Figure 21

6.12 Language Settings

To change the display language, select *[Language]* from the setting menu. In the submenu, choose **Language** again to enter the option list, then use ▲/▼ to select the desired language and press **OK** to confirm.

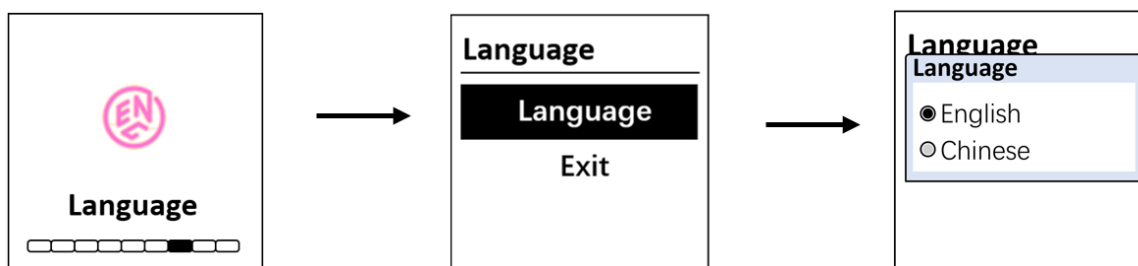Figure 22

6.13 Device Information

To view the device information, select *[Info]* from the setting menu. The first screen, **DEVICE INFORMATION**, contains the device name, serial number, software version, and hardware version. The second screen is the **DIAGNOSIS** screen, which displays raw parameters related to the measurement. The third screen displays the current Modbus communication parameters. Provide an image of both the **DEVICE INFORMATION** screen and the **DIAGNOSIS** screen when you contact Pyxis (service@pyxis-lab.com) for troubleshooting your device or call +1 (866) 203-8397 ext 2.
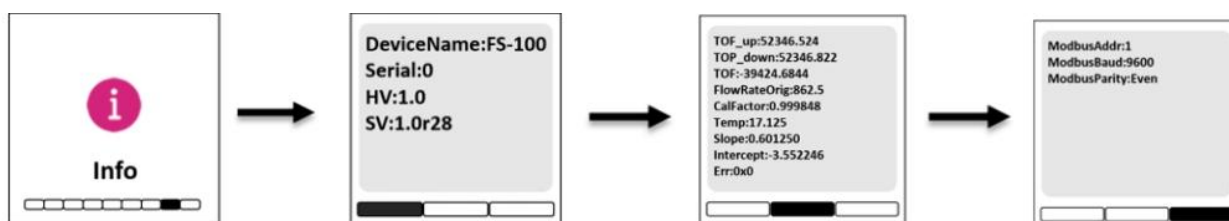

Figure 23 Device Information, Diagnosis and Modbus Parameters

6.14   Restore to Factory

If user wants to restore all device settings to factory default parameters, Navigate to *[Info]* screen (**Figure 24**). Press and hold the **OK** key for about two seconds. The device will automatically reboot, and all parameters will be reset to factory defaults.
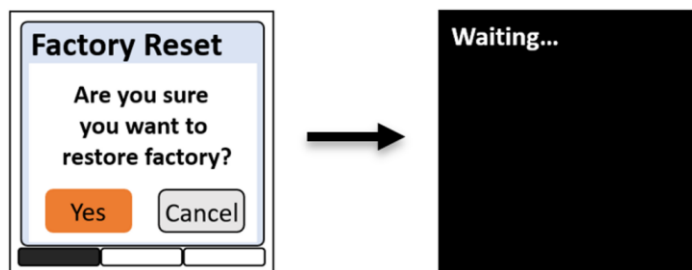
Figure 24

7   Communication Using Modbus RTU

The FS-100/FS-200 series ultrasonic flowmeters are configured as a Modbus slave device. In addition to flow rate mL/min value, many operational parameters, including warning and error messages, are available via Modbus RTU connection. The complete register map is documented in *Communication with Pyxis Digital Probes*. Contact Pyxis Lab Customer Service (service@pyxis-lab.com) for access.

8   Contact Pyxis Lab

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