Polysonics SX30

Portable Doppler Flowmeter
User Guide
P/N 1-0563-007

Revision J

Part of Thermo Fisher Scientific

Thermo SCIENTIFIC

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Contents

Chapter 1
Product Overview

Introduction

Thermo Fisher's Polysonics SX30 portable Doppler flowmeter generates two independent ultrasonic signals at different frequencies. By correlating these frequencies, the instrument automatically identifies and eliminates noise errors from sources such as variable frequency drives.

In addition, operation of the instrument is enhanced by an Expert System that allows the flowmeter to automatically "learn" the application parameters. As a result, the flowmeter can be easily commissioned in a fraction of the time required to configure competitive ultrasonic flowmeters.

Ordering Information

Refer to the following list of part numbers to order spare parts for your instrument.

Table 1–1.

Part Number	Description
22767-0001	Poly CD, specification sheet, meter installation video CD
1-0563-007	User guide
1-0561-005	HydraScan software manual
01008-0006	RS232 cable, standard serial, 6 ft., female to male, DB9
10228-0002	Power adapter, 90–264 Vac input, 15 Vdc output
10312-0001	Battery, 12 V, 7.0 A-hr, 24-hour continuous operation
10312-0002	Battery, 12 V, 7.0 A-hr, 12-hour continuous operation
10435-0007	Cable coupling, BNC (to extend 22688-0001, 2 required)
10520-0005	Thermo Fisher accessory bag with shoulder strap
10605-0001	Pipe strap, SS, 32-inch with 3/8 SS screw
10605-0003	Pipe strap, SS, 67-inch with 3/8 SS screw
10705-0003	Nut driver, 3/8-inch
10808-0002	Coupling compound, silicone RTV108, 2.8 oz.
10823-0005	Coupling compound, Sil-Glyde®, 4 oz.
20192-0001	SS tag

Part Number	Description
20336-0001	Quick mount clamp assembly (set of 2)
22366-0002	Cable adapter, dedicated transducer to portable meter
22490-0001	Cable adapter set, portable transducer to dedicated meter
22686-0002	PCB assembly, Doppler
22688-0002	Transducer cables (set), 16 ft. with BNC connectors
22689-0002	PCB assembly, motherboard
22702-0001	Front panel assembly, includes keypad and display
22703-0001	Transducer assembly (set of 2), 15 ft. cable length
22705-0002	PCB assembly, CPU
22262-0006	4–20 mA board

Specifications

Performance

Velocity Range: 0.2–18 ft./sec. (0.06–5.5 m/sec.)

Accuracy: ±1% of velocity full scale

Fluids: Liquids containing particulate or entrained gas bubbles

Pipe Size: 0.5–200 in. (12–5000 mm)

Physical

Transmitter: NEMA 6 (IP67), environmentally sealed, waterproof against accidental immersion, splash proof with lid open

Transducers

Two encapsulated dual frequency sensor heads

Encased in stainless steel shrouds, with stainless steel straps and quick clamps

Cable length: 16 ft. (5 m)

Weight: 11 lb. (4.9 kg) with 12-hr. battery

Dimensions: Refer to Figure 1–1

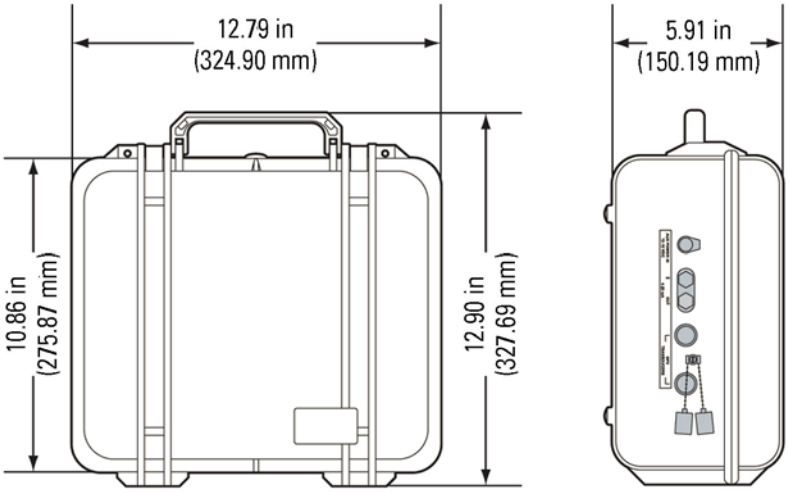


Figure 1–1.

Functional

Outputs: 4–20 mA (into 750 ohms), 12-bit, 5 kV opto-isolated; loop powered

Power Supply: Built-in lead acid gel battery, 90–264 Vac, 50/60 Hz

Standard: 12 hours continuous operation

Optional: 24 hours continuous operation

Charger

15 V at 1 A typical input supply voltage

2 A maximum

Mains supply voltage fluctuations to charger not to exceed ±10% of nominal supply voltage

Auxiliary Supply

12–15 Vdc auxiliary power port

15 V at 2 A typical supply voltage

Must be an SELV source: Auxiliary terminals are supplied from the SELV source as per IEC1010-1 Annex H

Keypad: 21-key with tactile action

Display: Backlit, 240 x 60 dot, high resolution graphics display

Data Logger: 90000 points, programmable in intervals of 30 s, 1, 5, 15, 30, and 60 min.

Programming: Via HydraScan software or integral keypad

Serial Interface: RS232 with DB9 connector

Temperature Range

Transducers: -40°F to 250°F (-40°C to 121°C)

Electronics

With CSA approval: 41°F to 104°F (5°C to 40°C)

Without CSA approval: -4°F to 140°F (-20°C to 60°C)

Environmental

Pollution degree: 2

Installation category: I for meter; II for battery charger

Approvals

Non-Hazardous Area Certification: Designed to meet CE and NRTL/C (CSA) for non-hazardous areas

Chapter 2
Installation & Wiring

Installing the Transducers

1. Select an installation site:

   Keep the following questions in mind when choosing a proper installation site:

   - Is the chosen section of pipe always full of liquid?
   - Are there at least 5 pipe diameters upstream and 3 pipe diameters downstream from any directional changes, pipe joints, or narrowing/widening of the pipe?

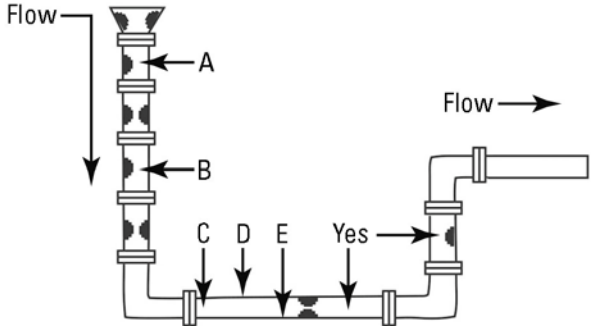


Figure 2–1.

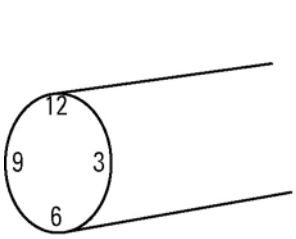
Conditions at locations A, B, C, D, and E can interfere with the transmission of the ultrasonic wave and yield inaccurate or unreliable flow readings:

- A: Pipe may not be full
- B: Down flow
- C: Too close to elbow
- D: Air collects at the top of the horizontal pipe
- E: Sediment collects at the bottom of the horizontal pipe

Note Selecting the proper installation location is essential to flow measurement reliability. Each application is unique and may require a variation of installation locations. ▲

2. Select a transducer orientation:

   Refer to Figure 2–2. If your application allows, install the transducers at the 3 and 9 o'clock locations. Ensure the transducers are parallel to each other along the pipe circumference.

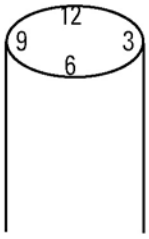


Transducer orientations on horizontal pipes

Good: 3 and 4 o'clock; 9 and 8 o'clock

Better: 2 and 4 o'clock; 10 and 8 o'clock

Best: 3 and 9 o'clock



Transducer orientations on vertical pipes

Good: 2 and 3 o'clock; 10 and 9 o'clock

Better: 2 and 4 o'clock; 10 and 8 o'clock

Best: 3 and 9 o'clock; Another directly opposite position

Figure 2–2.

3. Attach the transducers to the pipe strap:

   a. Use a screwdriver to loosen the mounting screw and slide the lock back on each transducer.

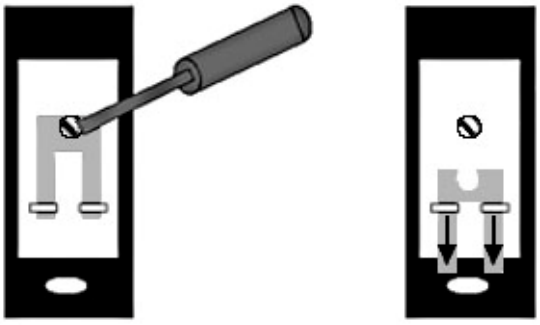


Figure 2–3.

b. Place the pipe strap across the mounting, and slide the lock back into place.

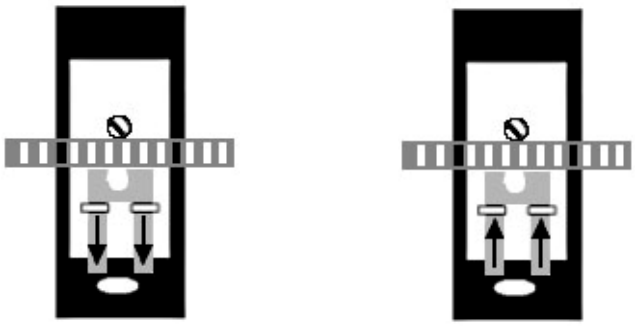


Figure 2–4.

c. Tighten the screws.

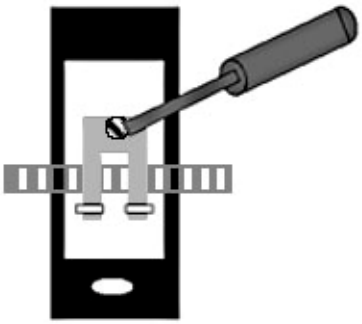


Figure 2–5.

4. Mount the transducers, ensuring the transducers face the same direction (as shown in Figure 2–6):

   a. Wrap the pipe strap around the pipe, and slide the end of the pipe strap through the tension nut assembly.

   b. Pull the strap tightly, and clamp the tension nut down to secure the strap to the pipe.

   c. Loosen the mounting screw of a transducer, and move the transducer to the 3 o'clock position on the pipe. Tighten the mounting screw to secure the transducer.

   d. Loosen the mounting screw of the second transducer, and move the transducer to the 9 o'clock position. Tighten the mounting screw to secure the transducer.

   e. Remove the strap from the pipe, and apply sonic coupling compound to each transducer surface.

   f. Reposition the strap on the pipe, placing the transducers in the proper positions.

g. Tighten the tension nut assembly with a 3/8-inch hex nut driver to secure the strap.

Note Increasing the pipe strap tension improves signal transmission. ▲

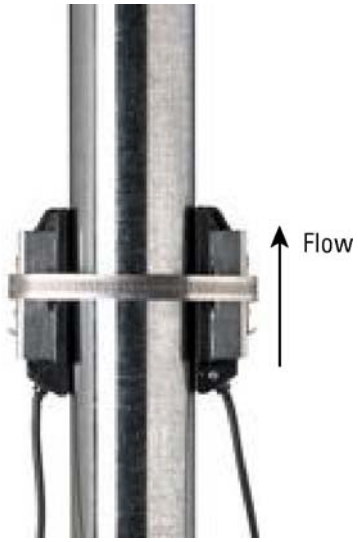


Figure 2–6.

Wiring

Wiring is accomplished using the connections on the side of the instrument enclosure. Refer to Figure 2–7 and the following sections.

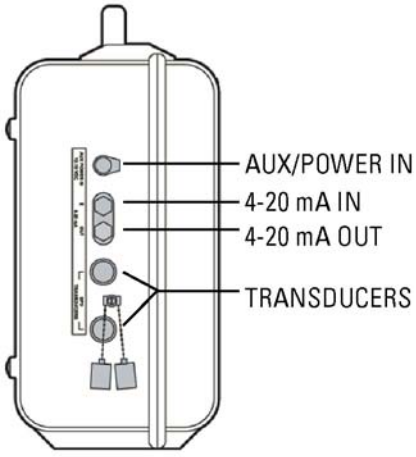


Figure 2–7.

DC Auxiliary Power

Locate the auxiliary power connector on the side of the instrument, and connect a minimum 10.5-V power supply that supplies 0.25 A.

Note The battery will not charge while the unit is operating from the auxiliary power source. ▲

Caution Avoid damaging the instrument: Do not use power supplies greater than 18 V. ▲

Transducers

Refer to Figure 2–7 to locate the transducer cable connections on the side of the instrument.

4–20 mA Current Loop

Locate the red (in) and black (out) 4-20 mA connectors on the side of the instrument. Connect as shown in Figure 2–8.

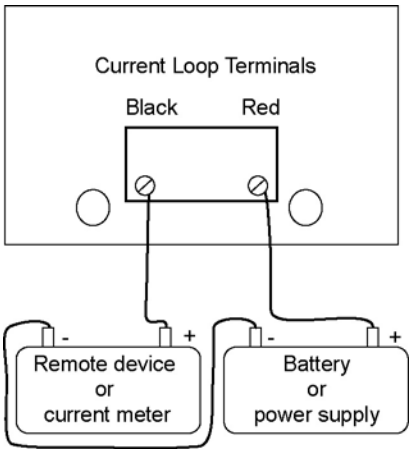


Figure 2–8.

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Chapter 3
Operation & Configuration

The Interface

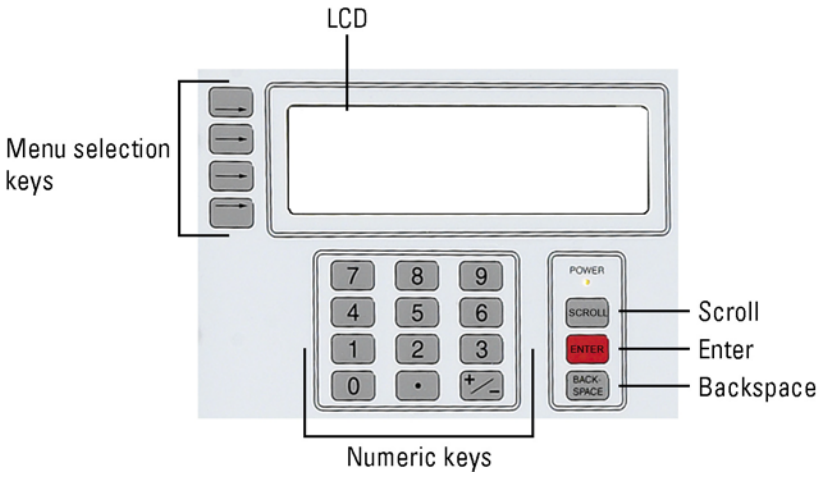

Figure 3–1. Keypad features

Following is a description of the components called out in Figure 3–1.

- LCD: Displays menu items.
- Scroll: Press to scroll to the next parameter displayed on the LCD
- Enter: Press once you have made an entry.
- Backspace: Deletes the last value entered.
- Numeric keys: Use to enter values when configuring the meter
- Menu selection keys: Press to select the corresponding menu item displayed on the LCD

Screen Contrast

1. Press the +/- key.

2. When the Adjust Contrast screen appears, press the +/- key again, and the software scrolls through the levels of contrast. Press the +/- key to stop the scrolling.

3. Use the scroll and backspace keys to make fine adjustments to the contrast.

Configuration

Note the following before configuring the meter:

- You must know the pipe internal diameter (ID) to ensure reliable flow measurements. If you do not know the pipe ID, go to Appendix A.
- There must be flow in the pipe when you start the meter.

There are two modes of operation. Consider using auto mode if your application is a constant process. The instrument default is the auto mode.

Apply power to the meter, and begin the configuration process by selecting Auto or Manual operating mode. Once you have completed the configuration process, you can access these screens from the Flow screen by selecting Setup > **Config**.

Auto Mode

1. Pipe ID screen:
   a. Enter the pipe ID, and press Enter.
   b. Use the scroll key to select the measurement units (inches, mm). Press Enter to select the unit.
   c. Select Next to move to the next screen.

2. Flow Units screen:
   a. Use the scroll key to select the flow units (US gallons, million gallons, cubic meters, oil barrels, Imperial gallons, cubic feet, liters, liquid barrels), and press Enter.
   b. Use the scroll key to select the time base for flow measurement (seconds, minutes, hours, days), and press Enter.
   c. Select Next to enter learn mode.

3. The meter displays status of the learning process. Refer to "Learn Mode Warnings" (Table 6–2 in Chapter 6) if you receive one of the following messages:
   - Invalid Signal, Can't Learn
   - No Flow, Can't Learn
   - Warning Low S Strength
   - Warning Poor S Strength

4. Once the meter completes the learning process, the Flow screen appears.
   a. If the flow reading is not accurate and you can verify the flow from a calibrated flowmeter or other certified source, perform a calibration.
   b. Refer to "Operating Mode Warnings" (Table 6–3 in Chapter 6) if the meter displays any of the following warnings:
      - Warning
      - Alarm
      - Failed/No Flow

Manual Mode

1. Pipe ID screen:
   a. Enter the pipe ID, and press Enter.
   b. Use the scroll key to select the measurement units (inches, mm). Press Enter to select the unit.
   c. Select Next to move to the next screen.

2. At the Flow Units screen:
   a. Use the scroll key to select the flow units (US gallons, million gallons, cubic meters, oil barrels, Imperial gallons, cubic feet, liters, liquid barrels), and press Enter.
   b. Use the scroll key to select the time base for flow measurement (seconds, minutes, hours, days), and press Enter.
   c. Select Next to continue.

3. Enter the Maximum Flow Rate. Select Next.

4. At this screen:
   a. Scroll through the options available for the Velocity Range (2, 4, 8, 16, 32 ft/s) and press Enter to select. Scroll to the next parameter.
   b. Enter a damping coefficient (0–99, 1 unit = 15 s). Press Enter, and scroll to the next parameter.

      The damping coefficient suppresses short term fluctuations in the indicated flow rate. Increasing the coefficient increases the response time to changes. Keep damping at a minimum unless the flow rate fluctuates wildly. In this case, increase damping just enough to reduce the fluctuation to an acceptable degree.

Note The Smart Filter used by the meter allows the damping function to smooth small fluctuations without diminishing the meter's response to large flow changes, even when configured with a high damping coefficient. ▲

c. Select regular or high Transmit Power, and press Enter.

In applications where the signal strength is low, the meter automatically selects high transmit power. You can manually select regular or high power in applications where the signal strength is marginal or where you feel increased or decreased power output may improve signal quality.

5. At the next screen:

a. Enter the Low Flow Cutoff. Press Enter, and scroll to the next parameter.

When a zero flow condition occurs, internal sloshing and other fluid movement can prevent the flowmeter from reading total zero. This can result in totalizer errors. Minimize these errors by setting a low flow cutoff that drives the flowmeter to zero for flow rates at or below specified value.

b. Enter the Signal Strength Cutoff, and press Enter.

c. Select Next to continue.

6. At this screen:

a. Enter the Signal Quality Cutoff, and press Enter.

b. Enter the SNR (signal-to-noise ratio), and press Enter.

c. Select Next.

7. This screen displays flow and velocity readings. You can also enter a site calibration factor:

a. Determine the flow using another source, and calculate the site calibration adjustment by dividing the actual flow by the meter flow.

b. Enter the site calibration adjustment.

c. Select Next.

8. At this screen:
   a. Scroll to the required totalizer unit (US gallons, Imperial gallons, million gallons, cubic feet, cubic meters, liters, oil barrels, liquid barrels) and press Enter.
   b. Scroll through the available scale factors (x 1, 10, 100, 1000, 10000), and press Enter to select.
   c. Determine whether to reset the totalizer and scroll to the appropriate selection. Press Enter.

9. Set the range at this screen:
   a. Enter the flow rate that equals the 4 mA (minimum) reading, and press Enter.
   b. Enter the flow rate that equals the 20 mA (maximum) reading, and press Enter.
   c. Select Next to move to the next setup screen.

10. Set the time and date at this screen, and press Next to continue.

11. Scroll through the available wall material options (carbon steel, cast iron, concrete liner, stainless steel, copper, plastic) and press Enter to select. Press Next to complete the configuration process.

HydraScan

You can also use the HydraScan software to configure the instrument. Refer to the HydraScan user guide (P/N 1-0563-005).

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Chapter 4
Flow Menu Items

Setup

You can access the Setup menu from the main Flow screen. The Setup menu displays the instrument version, serial number, and remaining battery power. It also contains 2 submenus: Reset and Config.

Reset

Select this item to reset all configuration parameters to defaults.

Config

Refer to Chapter 3 for details on setting configuration parameters. Each parameter is discussed in the section "Manual Mode."

FFT

Refer to "Checking the FFT" in Chapter 5.

Logset

To set up the data logging function using the instrument:

1. Select LogSet from the Flow screen.
2. The screen displays the number log points remaining. Select the log rate (intervals of 0.5, 1, 5, 15, or 60 minutes) and press Enter.
3. Turn the logger on.
4. Select Flow to return to the Flow screen.

Note You cannot select the file in which you want to store a specific log set. The meter saves the data in sequenced files (0 to 9). The meter advances to the next file each time the logger is turned on or when a file logs more than 9000 points. ▲

Accessing, Saving, & Loading Log Files

You can use HydraScan to download, save, load, and erase log files. Refer to the HydraScan user manual (1-0563-005).

Trend

Trend runs at a real-time rate of action. To view the flow trend, select Trend from the Flow menu.

Rate

From the Trend screen, select Rate. Scroll through the available rate options (0.1, 0.5, 1, 5, 15, 60 minutes/reading). Press Enter.

Max

The meter records the maximum flow, date, and time of the maximum flow since the last reset. You can view this information from the Max screen.

Reset the data by changing the Max field selection from “Set” to “Clear.”

Chapter 5
Troubleshooting & Maintenance

General Troubleshooting

The instrument has 3 modes of operation:

- Setup
- Learn
- Operating

Use the following table in conjunction with the learn mode and operating mode warning tables.

Table 5–1. Action code

Action	Description
A	1. Turn meter off. 2. Apply more compound. 3. Tighten the pipe strap. 4. Restart the meter to see if warning clears.
B	1. Reposition transducers. 2. See if signal strength increases. 3. See if warning clears. 4. Restart the meter.
C	1. Relocate transducers. 2. See if signal strength increases. 3. See if warning clears. 4. Restart meter.
D	1. Turn meter off, and remove the transducers. 2. Grind the pipe surface if it is rough or coated. 3. Remount the transducers. 4. Restart the meter. See if warning clears.

Learn Mode Warnings

The following table describes the learn mode warnings and appropriate corrective actions. Complete the corrective actions in the order presented.

Table 5–2. Learn mode warnings & corrective actions

Warning	Corrective Action
Invalid Signal, Can't Learn	1. Refer to Table 5–1 and complete actions A–D, checking the meter after performing each action to see if the problem was corrected. 2. Contact Thermo Fisher.
No Flow, Can't Learn	1. Check for flowing fluid. 2. Make sure the pipe is full. 3. Check connections. 4. Restart meter. See if warning clears. 5. Contact Thermo Fisher.
Warning Low S Strength	1. Turn meter off. 2. Refer to Table 5–1 and complete actions A–D, checking the meter after performing each action to see if the problem was corrected. 3. Contact Thermo Fisher.
Warning Poor S Quality	1. Go into operating mode. 2. Check the FFT.

Operating Mode Warnings

Warnings displayed while the meter is in operating mode contain a level of severity (Table 5–3) and a reason for the warning (Table 5–4).

Table 5–3.

Warning	Level of Severity
Warning	Flow reading marginal
Alarm	Flow reading unreliable
Failed/No Flow	Meter will not read flow and will read zero until fault clears

Table 5–4. Operating mode warnings & corrective actions

Warning	Corrective Action
PQ – Poor Signal Quality	1. Check the FFT. 2. Refer to Table 5–1 and complete actions B–D, checking the meter after performing each action to see if the problem was corrected. 3. Contact Thermo Fisher.
FS – Failed Signal Status	1. Refer to Table 5–1 and complete actions B–D, checking the meter after performing each action to see if the problem was corrected. 2. Check the FFT. 3. Contact Thermo Fisher.
IS – Invalid Signal	1. Check the FFT. 2. Contact Thermo Fisher.

Checking the FFT

1. From the Flow screen, select FFT.
2. Refer to Figures 5–1 through 5–6 to determine the FFT condition.
3. Refer to the table below to determine the corrective action.
4. Return to the Flow screen.

Table 5–5.

FFT Shape	Possible Cause	Corrective Action
Ideal Doppler	N/A	1. Restart the meter.
Broadband noise	Poor pipe coupling or multiple noise generators	1. Refer to Table 5–1 and complete action codes A-D, checking the meter after performing each action to see if the problem was corrected. 2. Relocate transducers. 3. Turn off source of noise.
Steady noise spike	Electromagnetic noise	1. Turn off source of noise. 2. Relocate transducers.
Fluctuating Doppler	Constantly changing flow or noise	1. Increase damping (reference "Configuration" in Chapter 3). 2. Relocate transducers.
No Doppler reflection I or II	Ultrasound signal not transmitting	1. Refer to Table 5–1 and complete action codes A-D, checking the meter after performing each action to see if the problem was corrected.

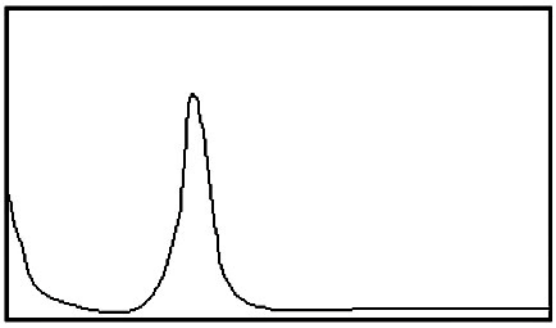

Figure 5–1. Ideal Doppler shape

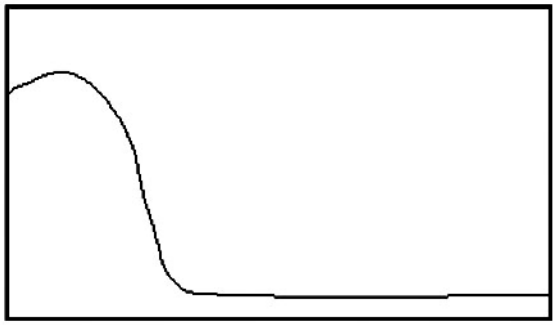

Figure 5–2. Broadband noise

Figure 5–3. Steady noise spike with Doppler

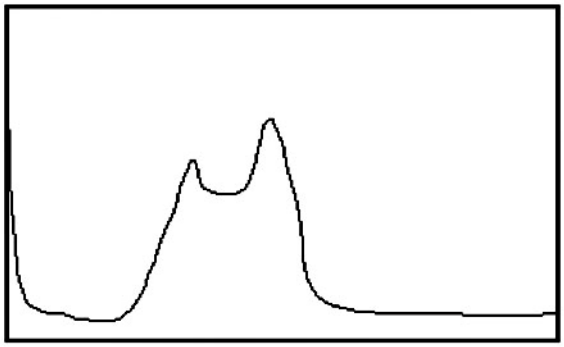

Figure 5–4. Fluctuating Doppler profile

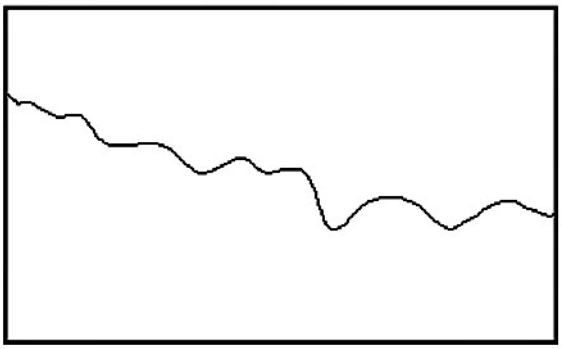

Figure 5–5. No Doppler reflection I

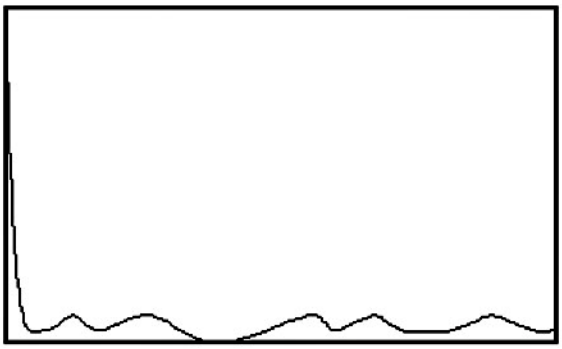

Figure 5–6. No Doppler reflection II

Signal Quality & Strength

Signal quality and signal strength are indicators of how well suited an application is for a Doppler flowmeter. To determine the quality of your application, go to the Flow screen. Note the %SS and SQ numbers in the bottom right corner. Refer to the following figure to determine the quality of the application. Also refer to Table 5–1 for actions you can take to attempt to improve signal quality and strength.

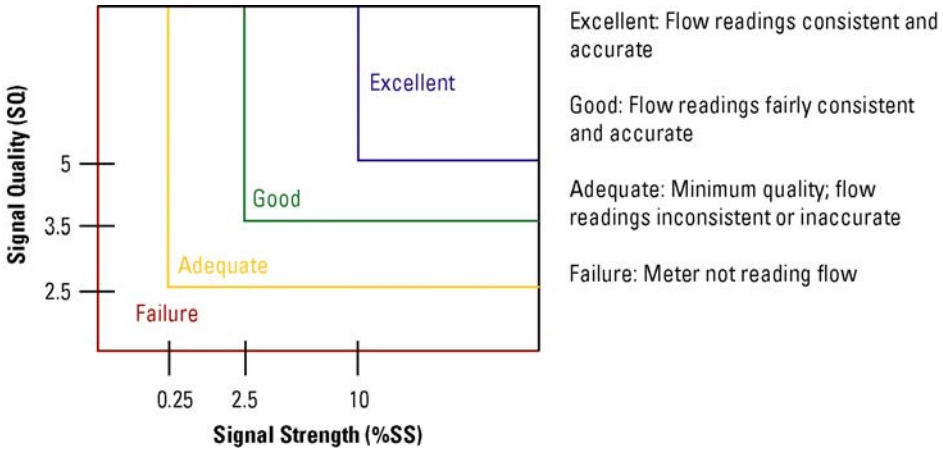

Figure 5–7.

Maintenance

General

The instrument is easy to maintain. The transducers and flowmeter are factory service only components and maintenance free. The following table describes the instrument components, appropriate maintenance, and a recommended schedule.

Table 5–6. Suggested maintenance

Component	Maintenance	How Often
Transducers	None: Factory service item	N/A
Coupling compound	Add more compound.	Annually, or whenever: 1. Compound diminishes 2. Repositioning transducers. 3. Relocating meter.
Flowmeter	None: Factory service item.	N/A
Pipe strap	Retighten	Annually
Cable connections	Ensure connections are secure. Remove any buildup within the connections.	Complete as part of your facility's routine maintenance.

Upgrades

The most current software is installed in the instrument prior to shipment. You can use the RS232 port and a remote terminal to upgrade the software as newer versions become available. Contact Thermo Fisher to obtain the most recent versions of the following software:

- WinLoader (used to upgrade meter software)
- Meter software
- HydraScan (data logging software)

Contact Information

The local representative is the first contact for support and is well equipped to answer questions and provide application assistance. Your representative also has access to product information and current software revisions. You can also contact Thermo Fisher directly.

In the United States:

Thermo Fisher Scientific

1410 Gillingham Lane

Sugar Land, TX 77478

Phone: 713-272-0404

Fax: 713-272-2272

In Canada:

Thermo Fisher Scientific

14 Gormley Industrial Avenue

Gormley, Ontario

L0H 1G0

Phone: 905-888-8808

Fax: 905-888-8828

On the Web:

www.thermofisher.com

If it becomes necessary to return an instrument:

1. Contact Thermo Fisher for a Return Material Authorization (RMA) number. **You must have the RMA number to return an instrument. The receiving dock will not accept shipments without the RMA number.**

2. Ensure the instrument is well packed, in its original shipping box if available.

3. Include a letter fully explaining the symptoms of the failure as well as detail describing the application where the unit was being operated. Also include a contact name, phone number, and purchase order authorizing repairs.

4. Write the RMA number on the outside of the shipping box.

5. Send the unit freight-paid to the address above.

Warranty

Thermo Scientific products are warranted to be free from defects in material and workmanship at the time of shipment and for one year thereafter. Any claimed defects in Thermo Scientific products must be reported within the warranty period. Thermo Fisher shall have the right to inspect such products at Buyer's plant or to require Buyer to return such products to Thermo Fisher plant.

In the event Thermo Fisher requests return of its products, Buyer shall ship with transportation charges paid by the Buyer to Thermo Fisher plant. Shipment of repaired or replacement goods from Thermo Fisher plant shall be F.O.B. Thermo Fisher plant. A quotation of proposed work will be sent to the customer. Thermo Fisher shall be liable only to replace or repair, at its option, free of charge, products which are found by Thermo Fisher to be defective in material or workmanship, and which are reported to Thermo Fisher within the warranty period as provided above. This right to replacement shall be Buyer's exclusive remedy against Thermo Fisher.

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Appendix A
Obtaining Pipe ID

If you do not know the pipe ID, try to get pipe OD using one of the following methods:

- Read the pipe OD and schedule on the pipe.
- Read the OD and schedule from system drawings.
- Use a tape measure to measure the pipe circumference and divide the measured circumference by 3.14.
- Use Thermo Fisher's Ultrasonic pipe Thickness Gauge (P/N 0704/0187), and perform the following calculation:

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Pipe ID = Pipe OD – (2 x Pipe Thickness).
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Table A–1. Steel, stainless steel, & PVC pipe standard schedules[1]

Nom. Pipe Size	OD	Sch. 5	Sch. 10 (light wall)	Sch. 20	Sch. 30	Sch. 40	Sch. 60	Sch. 80	Sch. 100	Sch. 120	Sch. 140	Sch. 160	Std. Wall	XSTG
1	1.315	1.185	1.097			1.049		0.957				0.815	1.049	0.957
1.25	1.660	1.530	1.442			1.380		1.278				1.160	1.380	1.278
1.5	1.900	1.770	1.682			1.610		1.500				1.338	1.610	1.500
2	2.375	2.245	2.157			2.067		1.939				1.687	2.067	1.939
2.5	2.875	2.709	2.635			2.469		2.323				2.125	2.469	2.323
3	3.500	3.334	3.260			3.068		2.900				2.624	3.068	2.900
3.5	4.000	3.834	3.760			3.548		3.364					3.548	3.364
4	4.500	4.334	4.260			4.026		3.826		3.624		3.438	4.026	3.826
5	5.563	5.345	5.295			5.047		4.813		4.563		4.313	5.047	4.813
6	6.625	6.407	6.357			6.065		5.761		5.501		5.187	6.065	5.761
8	8.625	8.407	8.329	8.125	8.071	7.981	7.813	7.625	7.437	7.187	7.001	6.813	7.981	7.625
10	10.750	10.482	10.420	10.250	10.136	10.020	9.750	9.562	9.312	9.062	8.750	8.500	10.020	9.750
12	12.750	12.438	12.390	12.250	12.090	11.938	11.626	11.374	11.062	10.750	10.500	10.126	12.000	11.750
14	14.000		13.500	13.376	13.250	13.124	12.812	12.500	12.124	11.876	11.500	11.188	13.250	13.000
16	16.000	15.670	15.500	15.376	15.250	15.000	14.688	14.312	13.938	13.562	13.124	12.812	15.250	15.000
18	18.00	17.670	17.500	17.376	17.124	16.876	16.500	16.124	15.688	15.255	14.876	14.438	17.250	17.000
20	20.00	19.634	19.500	19.250	19.000	18.812	18.376	17.938	17.438	17.000	16.500	16.062	19.250	19.000

Nom. Pipe Size	OD	Sch. 5	Sch. 10 (light wall)	Sch. 20	Sch. 30	Sch. 40	Sch. 60	Sch. 80	Sch. 100	Sch. 120	Sch. 140	Sch. 160	Std. Wall	XSTG
24	24.000	23.564	23.500	23.250	22.876	22.624	22.062	21.562	20.938	20.376	19.876	19.312	23.250	23.000
30	30.000	29.500	29.376	29.00	28.750	28.500							29.250	29.000
36	36.000		35.376	35.00	34.750	34.500					31.876	31.312	32.250	36.000
42	42.000			41.000	40.750	40.500							41.250	41.000
48	48.000					47.250							47.250	47.000

[1] All measurements in inches

Table A–2. Cast iron pipe standard classes[1]

Nom Pipe Size	Class A		Class B		Class C		Class D		Class E		Class F		Class G		Class H	
	OD	ID	OD	ID	OD	ID	OD	ID	OD	ID	OD	ID	OD	ID	OD	ID
3	3.80	3.02	3.96	3.12	3.96	3.06	3.96	3.00								
4	4.80	3.96	5.00	4.10	5.00	4.04	5.00	3.96								
6	6.90	6.02	7.10	6.14	7.10	6.08	7.10	6.00	7.22	6.06	7.22	6.00	7.38	6.08	7.38	6.00
8	9.05	8.13	9.05	8.03	9.30	8.18	9.30	8.10	9.42	8.10	9.42	8.10	9.60	8.10	9.60	8.00
10	11.10	10.10	11.10	9.96	11.40	10.16	11.40	10.04	11.60	10.12	11.60	10.00	11.84	10.12	11.84	10.00
12	13.20	12.12	13.20	11.96	13.50	12.14	13.50	12.00	13.78	12.14	13.78	12.00	14.08	12.14	14.08	12.00
14	15.30	14.16	15.30	13.98	15.65	14.17	15.65	14.01	15.98	14.18	15.98	14.00	16.32	14.18	16.32	14.00
16	17.40	16.20	17.40	16.00	17.80	16.20	17.80	16.02	18.16	16.20	18.16	16.00	18.54	16.18	18.54	16.00
18	19.50	18.22	19.50	18.00	19.92	18.18	19.92	18.00	20.34	18.20	20.34	18.00	20.78	18.22	20.78	18.00
20	21.60	20.26	21.60	20.00	22.06	20.22	22.06	20.00	22.54	20.24	22.54	20.00	23.02	20.24	23.02	20.00
24	25.80	24.28	25.80	24.02	26.32	24.22	26.32	24.00	26.90	24.28	26.90	24.00	27.76	24.26	27.76	24.00
30	31.74	28.98	32.00	29.94	32.40	30.00	32.74	30.00	33.10	30.00	33.46	30.00				
36	37.96	35.98	38.30	36.00	38.70	35.98	39.16	36.00	39.60	36.00	40.04	36.00				
42	44.20	42.00	44.50	41.94	45.10	42.02	45.58	42.02								
48	50.50	47.98	50.80	47.96	51.40	47.98	51.98	48.00								
54	56.66	53.96	57.10	57.10	57.80	54.00	58.40	53.94								
60	62.80	60.02	63.40	60.06	64.20	60.20	64.82	60.06								
72	75.34	72.10	76.00	72.10	76.88	72.10										
84	87.54	84.10	88.54	84.10												

[1]All measurements in inches

Note For pipes with cement linings, reduce the pipe ID by twice the lining thickness. Standard and double cement lining thicknesses are listed in the next table. ▲

Table A–3. Ductile iron pipe standard classes[1]

Nominal Pipe Size		Inside Diameter							Cement Lining	
	OD	Class 50	Class 51	Class 52	Class 53	Class 54	Class 55	Class 56	Std. Thickness	Double Thickness
3	3.96		3.46	3.40	3.34	3.28	3.22	3.16		
4	4.80		4.28	4.22	4.16	4.10	4.04	3.98		
6	6.90	6.40	6.34	6.28	6.22	6.16	6.10	6.04	0.125	0.250
8	9.05	8.51	8.45	8.39	8.33	8.27	8.21	8.15		
10	11.10	10.52	10.46	10.40	10.34	10.28	10.22	10.16		
12	13.20	12.58	12.52	12.46	12.40	12.34	12.28	12.22		
14	15.30	14.64	14.58	14.52	14.46	14.40	14.34	14.28		
16	17.40	16.72	16.66	16.00	16.54	16.48	16.42	16.36		
18	19.50	18.80	18.74	18.68	18.62	18.56	18.50	18.44	0.1875	0.375
20	21.60	20.88	20.82	20.76	20.70	20.64	20.58	20.52		
24	25.80	25.04	24.98	24.92	24.86	24.80	24.74	24.68		
30	32.00	31.22	31.14	31.06	30.98	30.90	30.82	30.74		
36	38.30	37.44	37.34	37.06	37.14	37.04	36.94	36.84		
42	44.50	43.56	43.44	43.32	43.20	43.08	42.96	42.84	0.250	0.500
48	50.80	49.78	49.64	49.50	49.36	49.22	49.08	48.94		
54	57.10	55.96	55.80	55.64	55.48	55.32	55.16	55.00		

[1]All measurements in inches

Note For pipes with cement linings, reduce the pipe ID by twice the lining thickness listed above. ▲

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Appendix B
Toxic & Hazardous Substances Tables*

*English and Chinese versions.

The Toxic and Hazardous Substances tables can be found on the following page.

Toxic & Hazardous Substances Table – SX30

For Chinese Regulation: Administrative Measure on the Control of Pollution Caused by Electronic Information Products

Names and Content of Toxic and Hazardous Substances or Elements

Parts Name	Toxic and Hazardous Substances or Elements (SX30)					
	Pb	Hg	Cd	Cr6+	PBB	PBDE
Housing	x	o	o	o	o	o
4-20 mA Output Board	x	o	o	o	o	o
Adapter Board	x	o	o	x	o	o
CPU Board	x	o	o	o	o	o
Doppler Board	x	o	o	o	o	o
Power Board	x	o	o	o	o	o
Key Pad Assembly	x	o	o	x	o	o
Cabling	x	o	o	o	o	o

○：Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in **SJ/T11363-2006**

X: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in **SJ/T11363-2006**

有毒有害物质名称及含量的标识格式

部件名称	有毒有害物质或元素 (SX30)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr6+)	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
外壳	x	o	o	o	o	o
4-20 mA 输出电路板	x	o	o	o	o	o
适配器电路板	x	o	o	x	o	o
CPU 电路板	x	o	o	o	o	o
多普勒电路板	x	o	o	o	o	o
电源板	x	o	o	o	o	o
键盘组件	x	o	o	x	o	o
缆线连接	x	o	o	o	o	o

○：表示该有毒有害物质在该部件所有均质材料中的含量均在**SJ/T 11363-2006**标准规定的限量要求以下

x: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出**SJ/T 11363-2006**标准规定的限量要求

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