KROHNE, Inc.

For Assistance Call 1-800-356-9464

Installation and Operating Instructions

OPTISOUND™ Series

2-Channel, Continuous, Remote Ultrasonic, Level Measurement System using:
VU31 Series Electronics and
VU32 Remote Sensing Elements

Preliminary Manual
Version September 2008

OPTISOUND™ Series

2-Channel, Continuous, Remote Ultrasonic, Level Measurement System, using: VU31 Series Electronics and VU32 Remote Sensing Elements

Contents

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Glossary of Terms

Distance	The measured distance from the sensor face to the target.
Distance Mode	Output signal increases as the distance increases (reverse acting output)
Distance to Zero Flow	This is the "No Flow" condition in a flume or weir. It may be to the bottom of the flume/weir, or depending on the type of flume/weir the "no flow" condition may be above the bottom of the flume/weir, with standing water below this point.
Fault Indication	Output goes to 3.7 mA or 22 mA (user selectable in configuration menu) during a fault condition such as Lost Echo or Near Zone. See Error Messages section
Flow Mode	Output increases as level (head height) increases. Output is non-linear with level and is based on Flume/Weir primary element characterization, or strapping table
Flow rate	The instantaneous flow rate measured in flow mode of operation.
Flume Size	A selection of the various throat sizes of specific flume and weir tables contained in the pre-programmed software.
Flume Type	A selection of the specific flume and weir types that have been pre-programmed in the software.
Gain Adjustment	The OPTISOUND's default gain setting is with SmartGain™, abbreviated a "HD" in the software code. Other gain settings are available for use in abnormal application requirements. Contact the factory before changing from "HD" mode.
HD Adjustments	SmartGain™ (sometimes seem abbreviated as "HD") provides an algorithm that permits the system to ignore most internal obstructions that are inside of the ultrasonic beam path. Changing an "HD" setting will allow this same algorithm to be used at different power settings. Consult factory before changing HD Adjustments.
Head Units	In Flow configuration the level measurement (bottom of flume/weir to surface of level) is referred to a head height. Enter the units in flow rate that will be used, GPM (Gallons per minute), MGD (Million Gallons per Day), M3/Hr (Cubic Meters per Hour)
Input Type	Allows the selection of Level, Distance, Volume or Flow. Based on user input type selection, the OPTISOUND menu items will only allow data entry in valid, related menus. I.e.: If Level is selected, menu's for distance, volume and flow are locked out.
Level	The measured distance from the sensor face to the target minus the tank height. Or, the distance from the tank bottom to the liquid surface.
Level Mode	Output signal increases as the level increases (direct acting output)
Lost Echo	A condition that occurs when the ultrasonic transmission does not return to the sensor. This could be due to foam, irregular surface, dished tank bottom, etc.
LRV	(Lower Range Value) The point at which the output signal is equal to 4 mA (0%). Also see Zero.
Max Flow	This is the maximum flow rate that is expected in a specific flume or weir. This is not necessarily the maximum flow that the flume/weir is capable of producing.
Maximum Capacity	Used in level to volume conversions, the maximum capacity of the vessel at a known maximum level point.
Near Zone	The distance below the sensor where the measurement cannot be made (12 inches/305 mm)

Glossary of Terms

Range	The maximum distance measurable from the sensor face
Range of Percent	The percentage of level or distance between the LRV (4 mA, 0%) point and the URV (20 mA, 100%), always enabled on the display.
Repetition Rate	This is the number of milliseconds that elapses between ultrasonic pulse transmissions. Longer repetition rates may be helpful if there are multiples reflections that are being picked up or if lost echoes are encountered due to intermittent presence of foam or agitator blades. Consult Factory before changing this parameter.
Sensor Offset	Used to tell the transmitter the amount of distance above or below the tank height that the sensor is mounted in order to calculate the tank volume.
Span	The point in the vessel where the output signal is equal to 20 mA (100%). Also see URV
Strapping Table	Correlates Level information to Volume information. A 21-point table that can be customized to accommodate an irregular shaped vessel, flume or weir. Information is entered as a Level “in” point vs. a Volume “out” point for all 21 possible points.
Tank Height	This is the measurement from the Tank Bottom to the face of the sensor.
Time Delay	Time delay allows signal averaging over the specified duration (0-90 seconds). Useful if wave action causes the output signal to be too “jumpy” for control / indication use.
Totalizer reset	The OPTISOUND has two totalizers, one that is a permanent record of the total volume that has been measured and a second totalizer that can be reset to zero by the user. The Reset Totalize can be reset to zero in the configuration software to allow the user to take periodic measurements from a reference point in time.
Totalizer Scale	The totalizer keeps record of the total volume that has passed through the flume/weir. In large flumes & weirs multipliers annotate this total volume. Each “count” on the totalizer can be representative of an exponential volume of water (X-100, X-1,000, X-10,000 or X-100,000 can be selected)
URV	(Upper Range Value) The point at which the output signal is equal to 20 mA (100%). Also see Span.
Volume	The level of the liquid in the vessel converted to volume based on tank strapping tables,
Zero	The point in the vessel where the output signal is equal to 4 mA (0%). Also see LRV.

Quick Start Menu

Menu Navigation:

1. Hold ENTER Button 5 seconds to access configuration menu.
2. Use UP & DOWN buttons to select menu items
3. Press ENTER button to change selected items
4. Hold ENTER button to go to previous menu or continue to hold to return to operate mode.
5. Press UP & DOWN buttons simultaneously to force target acquisition.

Channel #1

Function #	Description	Selections Available	Notes:
1.00.00	**Channel #1**		
1.01.01	Enable	Yes / No	
1.02.00	**Application Type**		
1.02.01	Application Type	Level / Flow	
1.03.00	**Level**		
1.03.01	Units	IN / FT / MM / CM / M	
1.03.02	Tank Height	User defined number	360” default
1.03.03	Offset	User defined number	0” default
1.04.00	**Volume**		
1.04.01	Vessel Type	Vertical. / Horizontal Cylinder - Flat / Dished / Hemi / Sphere / or Custom	
1.04.02	Load Standard Table	Vertical. / Horizontal Cylinder - Flat / Dished / Hemi / Sphere / or Custom	
1.04.03	Vessel Units	Gallons / M3 / Liters / Barrels / Imp. Gal.	
1.04.04	Vessel Capacity	User defined number	1000 Gal default
1.05.00	**Flow**		**Only shown when Flow is selected in 1.02.01**
1.05.01	Flow Type	Parshall / Submerged Flow Parshall / Palmer Bowlus / Trapez. Flume / Rect. Weir w/wo end, Custom	
1.05.02	Flume Size	Code from table or numeric value	
1.05.03	Flow Units	GPM / MGD / M3 Hr.	
1.05.04	Head Units	IN / FT / MM / CM / M	
1.05.05	Zero Distance	User defined number	Sensor face to zero flow
1.05.06	Delay	User defined number	1–10 seconds dampening

Quick Start Menu

Function #	Description	Selections Available	Notes:
1.05.07	Totalizer Scale	X100 / X1K / X10 K / X100K / X 1MGD	
1.05.08	Reset Totalizer	Yes / No	Allow user to reset the “reset totalizer”
1.06.00	**Strapping**		**Use for custom vessel and weir/flumes**
1.06.01	Max Points	2…21	
1.06.02	IN point #1	User defined number	
1.06.03	OUT point #1	User defined number	
1.06.04 – 1.06.43	IN / OUT points #2 - #21	User defined number	
1.07.00	**Range Configuration**		
1.07.01	Range Assign	Level / Volume / Flow / Distance	
1.07.02	LRV (4 mA)	User defined number	0” default
1.07.03	URV (20 mA)	User defined number	348” default
1.08.00	**System**		
1.08.01	Gain	SG / 100% / 84% / 67% / 50% / 32% / 17% / 8%	SG default
1.08.02	SG Adjust	User defined number Consult factory	20 default. Gain adjustment that follows SG curves.
1.08.03	Rep Rate	300 mS / 400 mS	300 default
1.08.04	Near Zone Fault	High / Low (22 mA / 3.7 mA)	
1.08.05	Lost Echo Fault	High / Low (22 mA / 3.7 mA)	
1.08.06	SW Rev	Read Only date code	Transducer SW version
1.09.00	**Calibrate**		
1.09.01	Point	Enter actual distance to target	Adjusts for change in velocity of sound.
1.09.02	Temperature	Enter Actual Temp @ transducer	
2.00 – 2.09	**Channel # 2**	**Same as Channel #1**	
3.00.00	**Relay #1**		
3.01.01	**Enable**	**Yes / No**	
3.01.02	Relay Type	Alarm / Control / Sample / Pump Altern.	Sample activation closes contact for 70 ms
3.01.03	Channel Assignment	Channel #1 or #2	
3.01.04	Assignment	Level / Volume / Flow / Range / Flow sum / Flow diff./ Submg / Trav Screen / LE / NZ / Dist.	
3.01.05	Setpoint	User defined number	
3.01.06	Deadband	User defined number	

Quick Start Menu

Function #	Description	Selections Available	Notes:
3.01.07	Sample Value	User defined number	Numeric value X totalizer setting
3.01.08	Time Delay	User defined number	0 – 99 sec.
3.01.09	Time Delay Mode	Forward / Reverse	
3.01.10	FailSafe	HLFS / LLFS	
3.02 – 3.06	**Relays #2 - #6**	**Same as Relay #1**	
4.01.00	**Analog output #1**		
4.01.01	Channel Assign	Channel #1 / #2	
4.01.02	Assignment	Level / Volume / Flow / Range / Flow Sum / Flow Diff./ Submg / Trav Screen / Dist	
4.01.03	Zero	User defined number	0% default
4.01.04	Span	User defined number	100% default
4.01.05	Damping	User defined number	0-99 seconds
4.01.06	Lock mA	User defined number	
4.01.07	Trim 4mA		
4.01.08	Trim 20 mA		
4.02.00	**Analog output #2**		
5.00.00	**System**		
5.01.00	**Password**		
5.01.00	Password Enable	Yes / No	
5.01.02	Change Password	Enter new password	
5.02.00	Miscellaneous		
5.02.01	Set Clock		
5.02.02	Reset Factory Defaults	Yes / No	
5.02.03	SW Rev	Read Only date code Receiver SW version	
5.02.04	Serial Number	Read Only	
5.03.00	**Data Logger**		
5.03.01	Enable	Yes / No	
5.03.02	Interval	5 seconds - 12 hours	
5.03.03	Duration	Read Only based on interval	
5.03.04	Overwrite	Yes / No	First in – First out
5.04.00	**Communications**		
5.04.01	Baud Rate	9600 / 19200	19200 default
5.04.02	Communication type	RS232 / RS485	RS232 default
5.04.03	Device ID	1 - 32	1 is default
6.00.00	**Display**		
6.01.00	**Configure**		
6.01.01	AutoScroll	Enable / Disable	
6.01.02	Scroll Rate	User defined number	10 sec. default

Quick Start Menu

Function #	Description	Selections Available	Notes:
6.01.03	Hide All	Yes / No	
6.01.04	Show All	Yes / No	
6.02.00	**Channel #1**		
6.02.01	Range	Show / Hide	
6.02.02	Level	Show / Hide	
6.02.03	Distance	Show / Hide	
6.02.04	Volume	Show / Hide	
6.02.05	Flow	Show / Hide	
6.02.06	Totalizer	Show / Hide	
6.02.07	Resettable Totalizer	Show / Hide	
6.02.08	Temperature	Show / Hide	
6.03.00	**Channel #2**		
6.03.01	Range	Show / Hide	
6.03.02	Level	Show / Hide	
6.03.03	Distance	Show / Hide	
6.03.04	Volume	Show / Hide	
6.03.05	Flow	Show / Hide	
6.03.06	Totalizer	Show / Hide	
6.03.07	Resettable Totalizer	Show / Hide	
6.03.08	Temperature	Show / Hide	
6.04.00	**Both**		**Channel #1 vs. Channel #2**
6.04.01	Flow Sum	Show / Hide	
6.04.02	Flow Diff	Show / Hide	
6.04.03	Submerged Flow	Show / Hide	
6.04.04	Traveling Screen	Show / Hide	
6.05.00	**Analog Output #1**		
6.05.01	Show AO 1	Show / Hide	
6.06.00	**Analog Output #2**		
6.06.01	Show AO 2	Show / Hide	

Section 1

Section 1: Introduction

1.1 Product Description

The KROHNE OPTISOUND™ Series Level Measurement System is a 2-Channel, 24-Volt, or Line Powered, assembly. Using ultrasonic technology, the OPTISOUND™ continuously and accurately measures Level & Distance up to a range of 30 feet, or Open Channel Flow. The measurement output is a 4-20 mA current signal or Digital Communications. Internal Strapping tables can convert the OPTISOUND output signal to be proportional to volume or Flow.

The OPTISOUND Sensing Element is made of CPVC for compatibility with a wide range of process materials.

1.2 Types of Output

Level Mode:

Output increases as the internal level of the vessel increases.
Level output is the most common type of output measurement.
Configuration is referenced from the bottom of the vessel.

Distance Mode:

Output increases as the distance increases away from the Sensing Element. Configuration is referenced from the Sensing Element Face.

Flow Mode:

Output increases as head height level increases (increasing flow rate). Output is non-linear with level changes and is based on the flow characteristic of a selected Flume, Weir, or strapping table for a custom primary flow device.

Fault Indication:

Output (assigned to the channel at fault) goes to 3.7 or 22 mA (user selectable) during a Lost Echo or Near Zone condition.
For all other faults, the output goes to 22 mA.

Possible Faults:
Near Zone
Lost Echo
No Sensor - Communications to Sensing Element was lost
Error 1 - Reserved
Error 2 - EEPROM Check Sum Error
Error 3 - Reserved
Error 4 - EEPROM Does not respond
Error 5 - Communications to sensor was lost (shown in Datalogger)
Error 6 - Reserved
Error 7 - Reserved
Error 8 - Unknown error occurred - Consult factory

1.3 System Specifications

- Power: VU31 24 VDC, 120 VAC
  VU32 24 VDC, 240 VAC
- Output: 4-20 mA, Analog or selected Digital
- Sensing Element: 6.5" CPVC Sensing Element rated:
  -40°F to +158°F (-40°C to +70°C)
- Sensing Element Mounting: ¾" / 2" NPT or ¾" / 2" BSP (G)
- Display: 2-Line, LCD, LED Backlight
  10 digit-Alpha-Numeric / 7 digit-Numeric
  Signal Strength, Relay, and Range Indicators
- Software: Level, Distance, Volume, Flow rate via user selectable Flume and Weir characterizations or 21-Point strapping table, Totalization via 1 resettable and 1 non-resettable totalizer. Differential Level (Channel #1 vs. Channel #2) for Submerged Flow, Sum, Difference, and Traveling Bar Screen Control, Pump Alternation, Batch Sample Activation.

1.4 Definition of Terms

Zero: (LRV)

The point at which the output signal is equal to 4 mA (0%)

Span: (URV)

The point at which the output signal is equal to 20 mA (100%)

Range:

The Maximum distance measurable from the Sensing Element face.

Near Zone:

The distance just below the Sensing Element face where the System cannot make a level measurement (12 inches / 305 mm).

Lost Echo:

A condition that occurs when the ultrasonic energy is not being returned to the Sensing Element. For example, a loss of echo may occur when large amounts of foam are present.

Strapping Table:

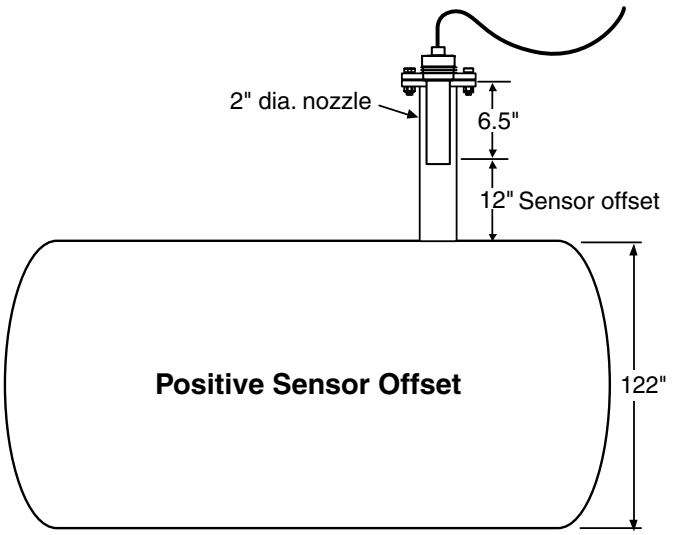
Displays the value of the input to level and output to volume or flow in percent in a 21-Point table. This also allows points to be changed to accommodate irregular shaped vessels and custom flume or weir characterizations.

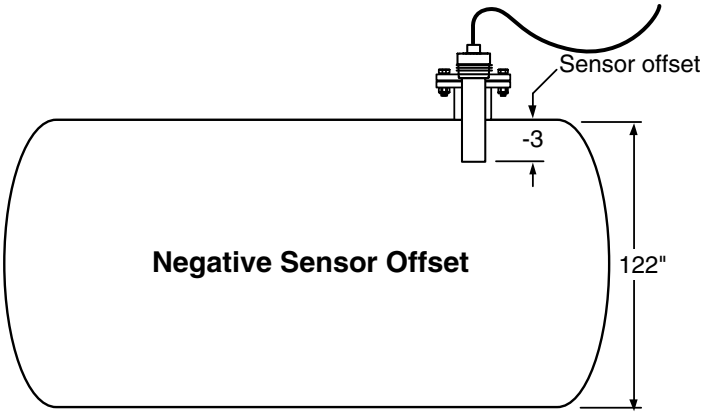
1.4 Definition of Terms (Continued)

Sensor Offset:

Sensor Offset is used to tell the OPTISOUND the amount of distance above or below the top of the tank that the Sensing Element face is located in order to calculate the tank volume. Sensor Offset can be applied in cases where:

- The Sensing Element protrudes below the top of the tank, or
- The Sensing Element is mounted above the top of the tank, or
- A pipe extension is installed to raise the Sensing Element face 12" above the tank height to compensate for the 12" Near Zone.
  - If the Sensing Element is mounted above the top of the vessel, a Positive value is entered in Sensor Offset.
  - If the Sensing Element is mounted below the top of the tank, a Negative value is entered in Sensor Offset.





1.4 Model Selection

OptiSound VU-31 Continuous Line Powered Ultrasonic Level system

Power
- 1 120 VAC, 24 VDC
- 2 240 VAC, 24 VDC

Output
- 1 2 Analog (Sink or Source) 4-20mA outputs with Modbus

Approvals - Electronics housing
- 1 FM, CSA, - Class I, Div. 2

Sensors/ Approvals
- 0 Without
- 1 One Sensor 3/4" / 2" NPT (FM / CSA Class I Div. 1)
- 2 Two Sensors 3/4" / 2" NPT (FM / CSA Class I Div. 1)
- 3 One Sensor 3/4" / 2" BSP (FM / CSA Class I Div. 1)
- 4 Two Sensors 3/4" / 2" BSP (FM / CSA Class I Div. 1)

Sensor #1 Cable length (approved IS for Class I, Div. 1, Zone 0, Zone 1)
- 0000 Without
- 0025 25 ft. continuous run - Standard
- 0050 50 ft. continuous run
- 0100 100 ft. continuous run
- 0150 150 ft. continuous run
- 0200 200 ft. continuous run
- 0300 300 ft. continuous run

Sensor #2 Cable length (approved IS for Class I, Div. 1, Zone 0, Zone 1)
- 0000 Without
- 0025 25 ft. continuous run - Standard
- 0050 50 ft. continuous run
- 0100 100 ft. continuous run
- 0150 150 ft. continuous run
- 0200 200 ft. continuous run
- 0300 300 ft. continuous run

VU-31	**-**					**-**		**-**	

Additional or Replacement Remote Ultrasonic Sensor for OptiSound VA-31 Continuous Level Measurement Systems

VU-32

Enclosure
- 1 CPVC

Mounting
- 1 2" NPT with 1/2" NPT electrical connections - Approvals:FM, CSA
- 2 2" BSP with M20 electrical connections - Approvals: FM, CSA

Interconnecting cable
- 0025 25 ft.standard
- 0050 50 ft. continuous run
- 0100 100 ft. continuous run
- 0150 150 ft. continuous run
- 0200 200 ft. continuous run
- 0300 300 ft. continuous run

VU-32	-	**1**		-	

Accessories

Part Number	Description
285-0001-188-01	316SS mounting bracket for OCF installation, 1 ft. extension
285-0001-188-02	316SS mounting bracket for OCF installation, 2 ft. extension
285-0001-188-04	316SS mounting bracket for OCF installation, 4 ft. extension

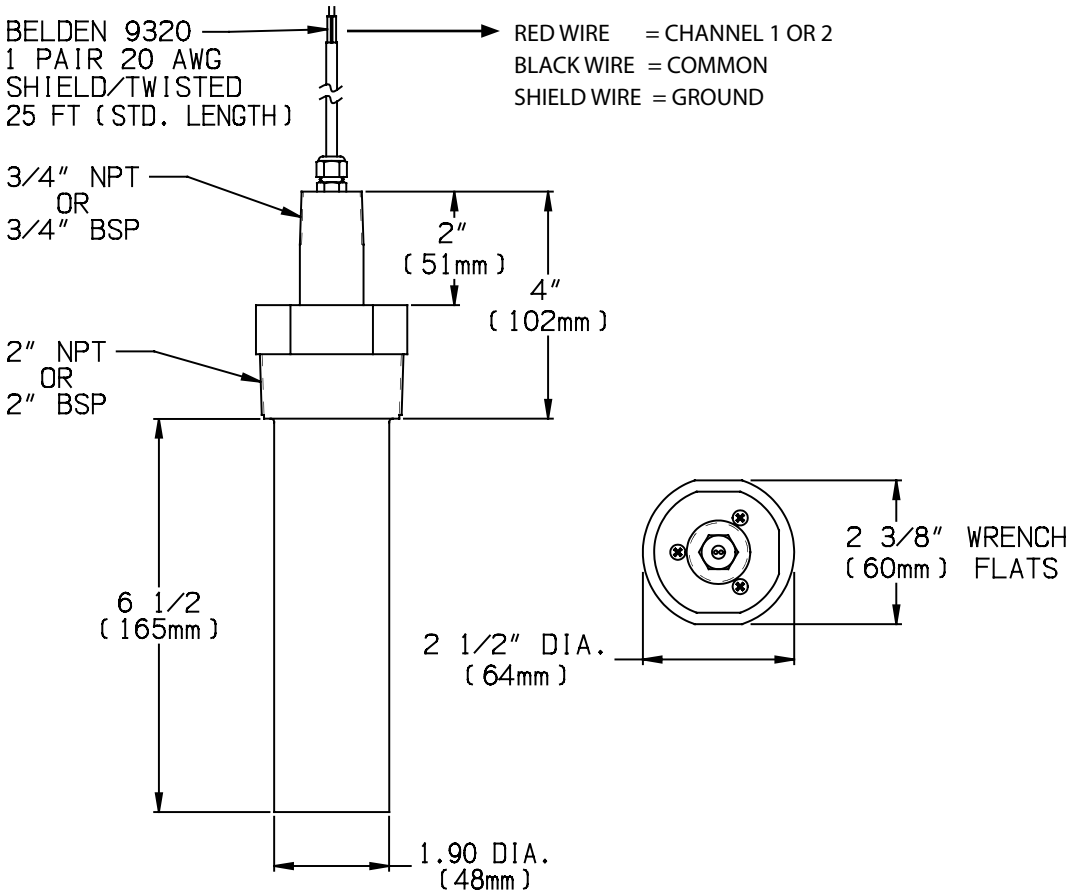
Section 2: Installation

2.1 Unpacking

Carefully remove the contents of the shipping carton and check each item against the packing list before destroying any packing material. If there is any shortage or damage, report it to the factory immediately.

2.2 Mounting the System

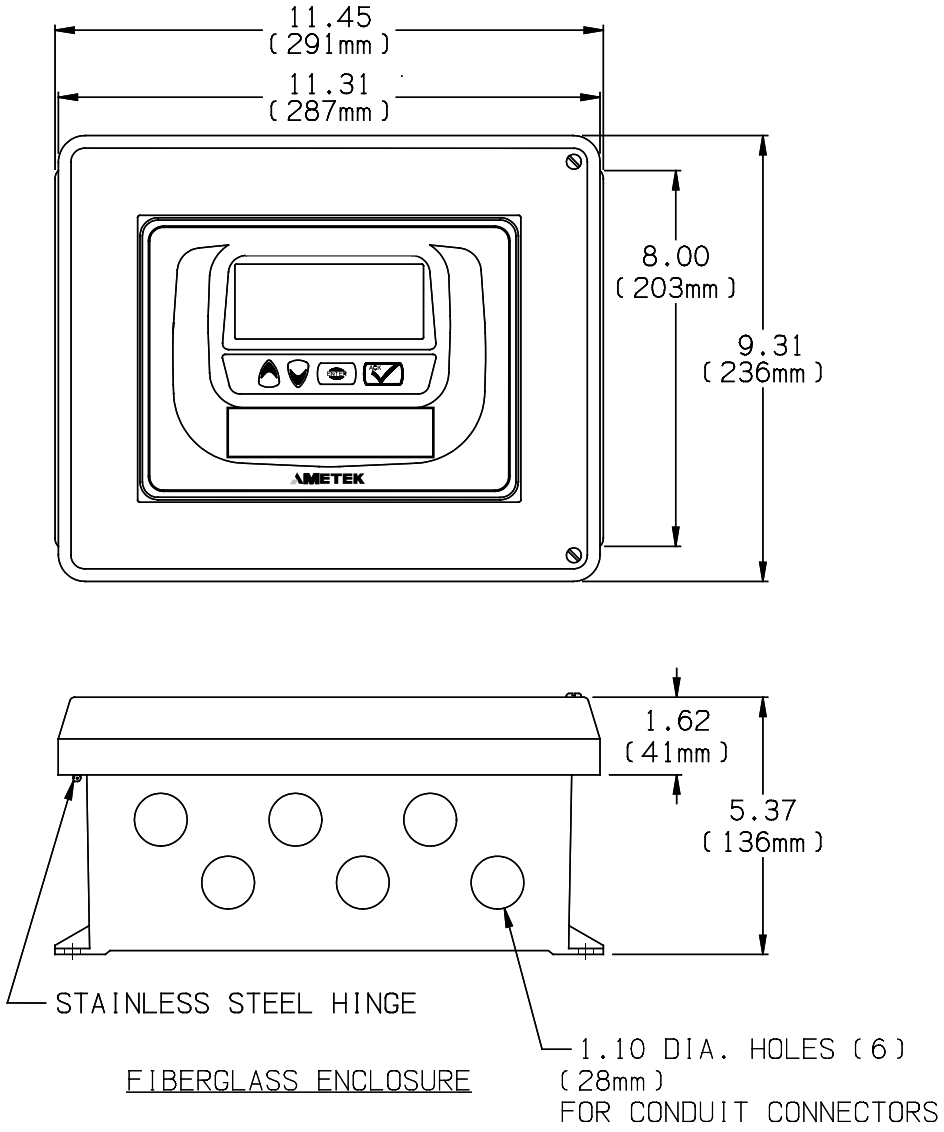
The OPTISOUND electronic Sensor is located within the tube assembly of the Sensing Element and is not serviceable by the user. Tampering with this construction will void any existing warranties.



Sensing Element Mounting Dimensions

Warning - Potential Electrostatic Charge Hazard
Special Coondition for Use:
For Zone 0 Installations care should be taken that the plastic Sensing Element be installed and used in such a way that the danger of Electrostatic charge is excluded. For use only on liquid process mediums. Avoid rapid contact between the process medium and the plastic Sensing Element.

2.3 Mounting the System (Continued)



Electronics Enclosure Mounting Dimensions

2.3 Mounting the System (Continued)

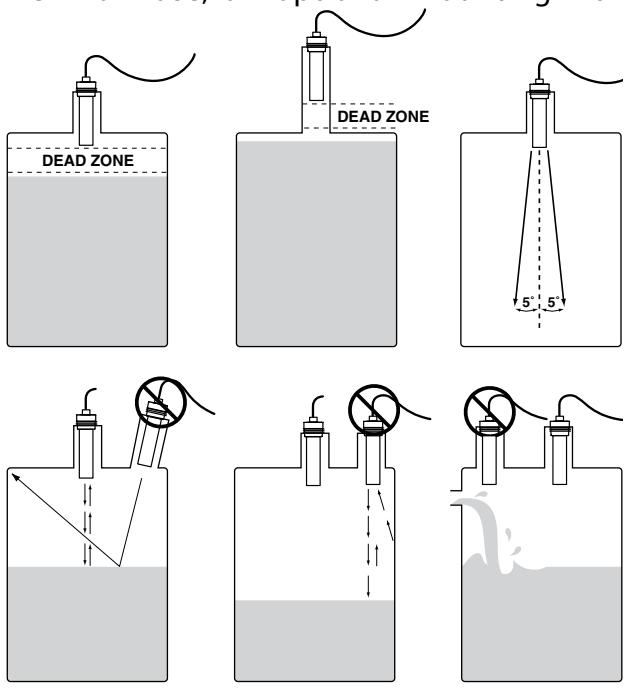
The OPTISOUND is designed for field mounting, but it should be mounted in a location as free as possible from vibration, corrosive atmospheres, and any possibility of mechanical damage.

For convenience when adjusting and configuring, place the OPTISOUND Series in a reasonably accessible location. Ambient temperature should be between -40°F to 158°F (-40°C to 70°C).

The Sensing Element must be mounted vertically and perpendicular to the liquid surface. When mounting the OPTISOUND Series Sensing Element, consideration must be given to the 12-Inch (305 mm) Near Zone. If the level rises to within 12 inches (305 mm) of the Sensing Element face, a user selectable 3.7 mA or 22 mA error signal is generated; Error message (*NEAR ZONE*) is indicated.

The conical beam of the OPTISOUND Series is approximately 10 degrees. Therefore it is necessary to ensure that there are no unnecessary obstructions within this beam path. Erroneous reflections can adversely affect system operation.

For Open Channel Flow use, an optional mounting kit is available for



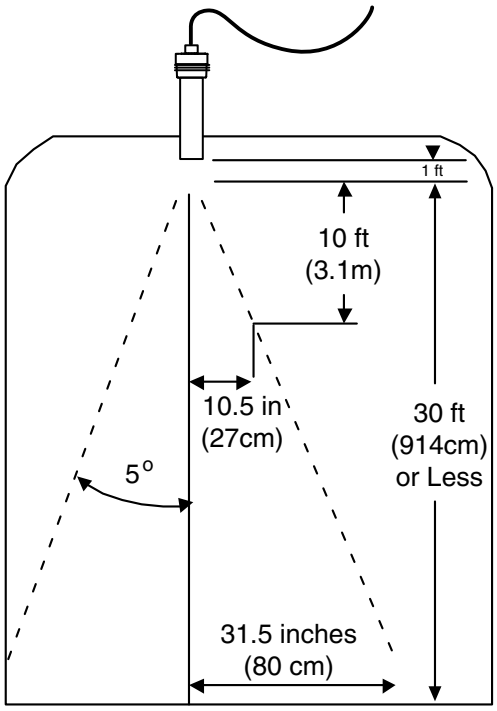
Mounting Recommendations

mounting above a flume or weir to position the system above the flow stream. The mounting kit allows movement vertically and horizontally for maximum placement.

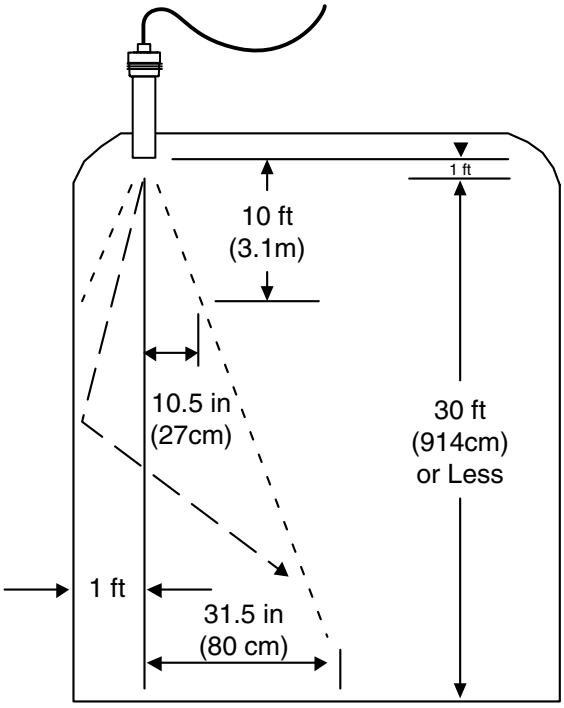
- Part # 285-0001-188 (316 SS)

Refer to drawings 285-0001-188-CD for Mounting Details.

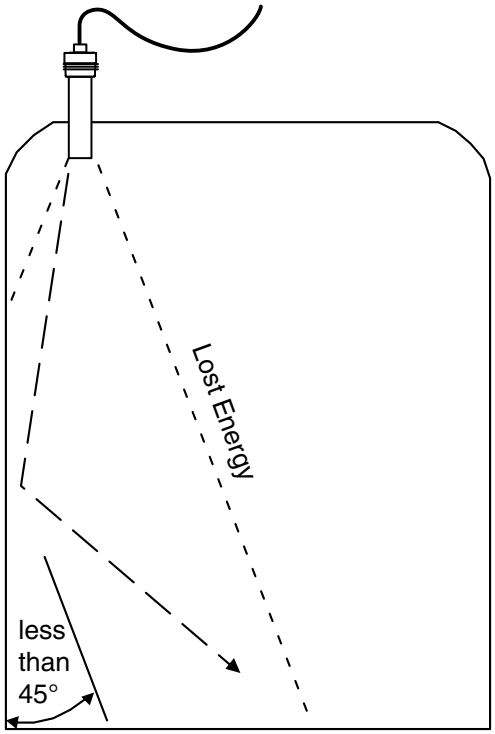
2.3 Installation Examples



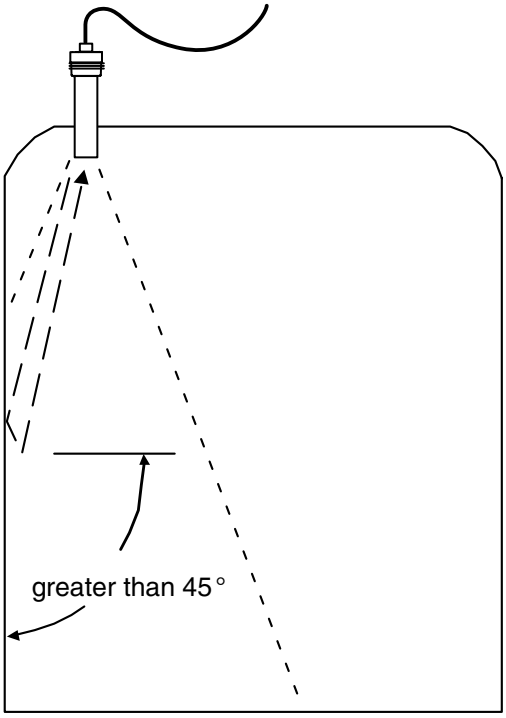
When there are no obstructions within the beam area, there is no chance of false echoes or readings.



Smooth wall in beam with no other obstructions will not cause false echoes.



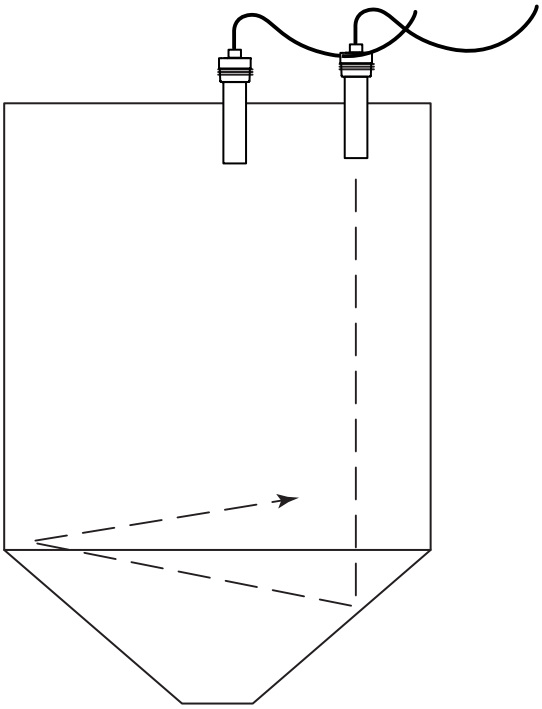
Protrusions from the wall at an angle less than 45° does not cause false echoes.



Protrusion from the wall at an angle greater than 45° may cause false echoes.

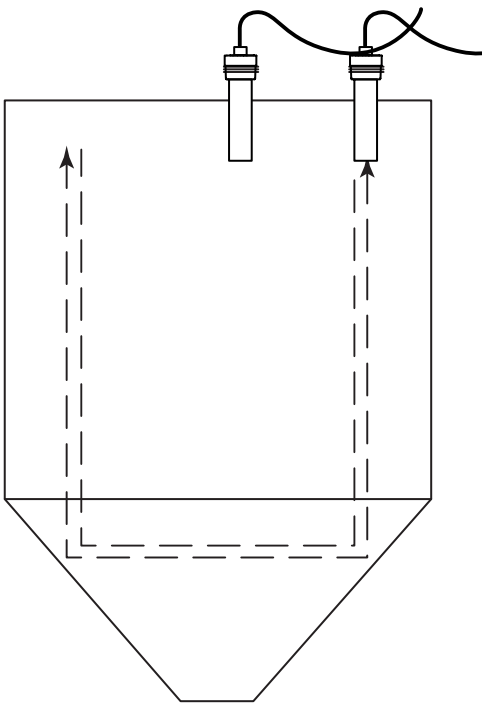
2.3 Installation Examples (Continued)

Preferred Location



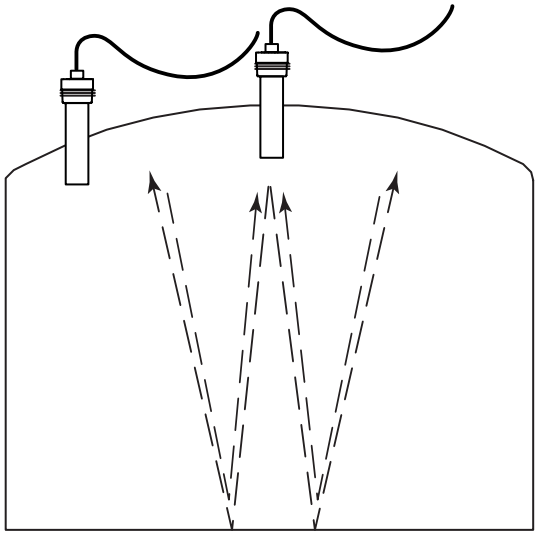
When mounted off center in conical bottom tanks, reflected echoes can reflect away from the Sensing Element in the conical bottom resulting in a lost echo. Move the Sensing Element to the center of the bin for best results.

Preferred Location



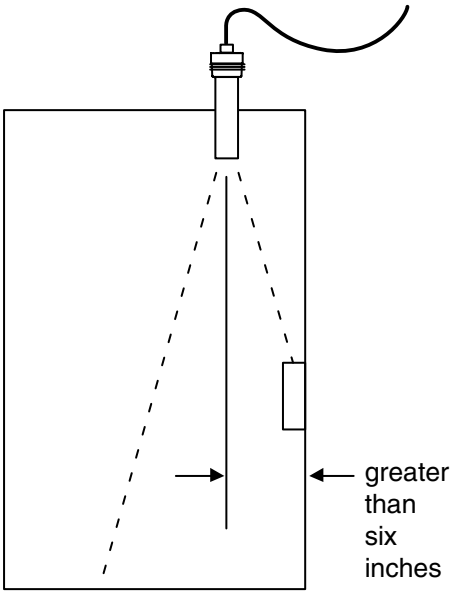
When mounted off center in conical bottom tanks, reflected echoes can be redirected back to the Sensing Element. Use 400 mS repetition rate to allow these echoes to subside before transmitting the next pulse and/or move the Sensing Element to another location.

Preferred Location



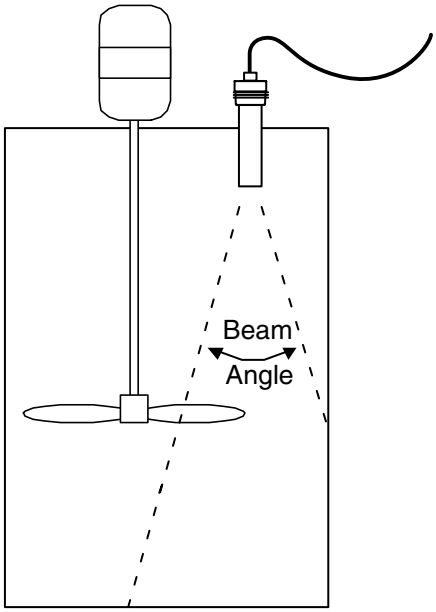
When mounted in the center of domed-roof tanks, reflected echoes can be redirected back to the Sensing Element. Use 400 mS repetition rate to allow these echoes to subside before transmitting the next pulse and/or move the Sensing Element to another location.

2.3 Installation Examples (Continued)

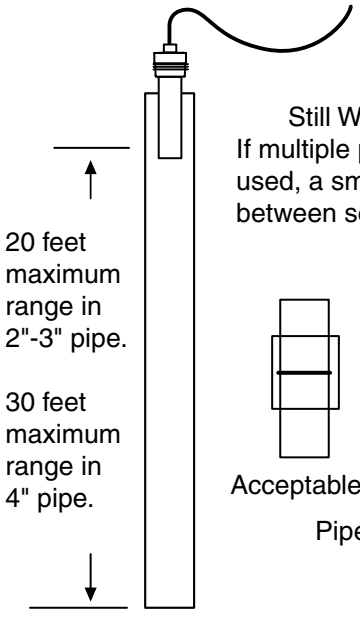


Mounted close to a wall or obstructions are present. Ability to ignore obstructions will depend on the exact size and location of the obstructions.

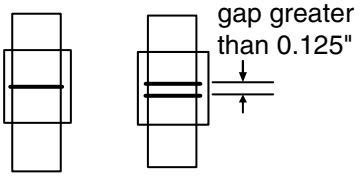
Use standard electronics with Smart Gain™ "SG"setting.



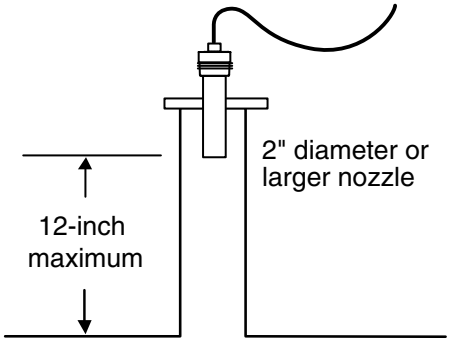
Agitators within the beam path



Still Well Installation
If multiple pipe sections are used, a smooth transition between sections is required.



Pipe joints



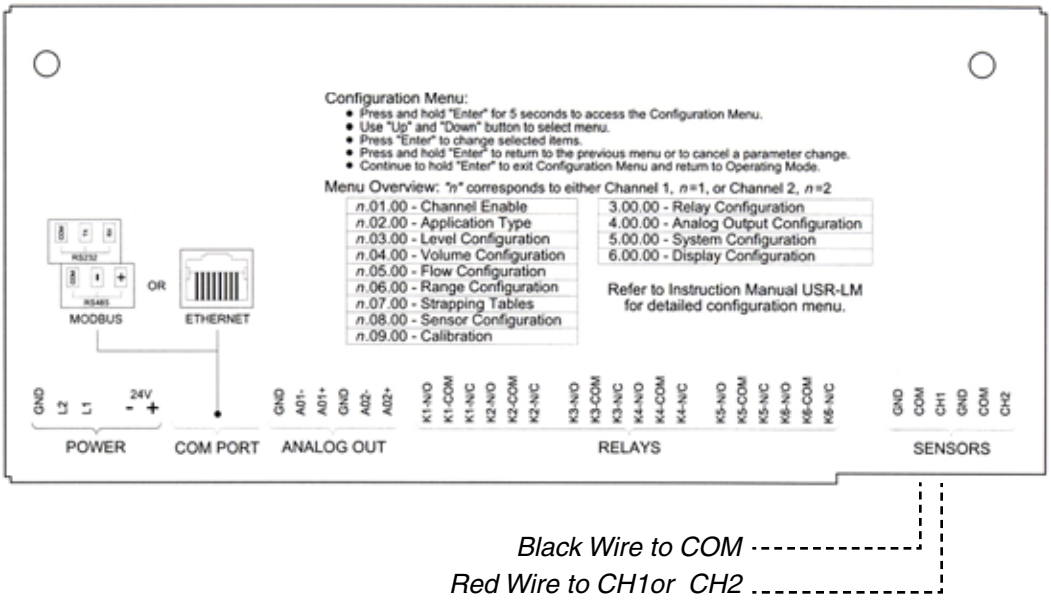
Recommended mounting when recessed in a nozzle.

2.4 Wiring the System

WARNING! If the OPTISOUND is located in a hazardous environment, do not open the enclosure cover or make / break any electrical connections without first disconnecting electrical power at the source. Ensure that wiring, electrical fittings and conduit connections conform to electrical codes and Approval Agency Control Drawings for specific location and environment.

Refer to the Wiring Diagram of the OPTISOUND.

Connect input power, Sensing Element relays, and signal leads to the terminal block as shown. It is recommended to use twisted, shielded pair to eliminate noise for both signal and Sensing Element lead extensions. The shield (or drain) wire should be grounded at the receiver.



Wiring Diagram
Wiring (12 - 22 AWG)

2.5 Installation Notes

1. Changes or modifications not expressly approved by KROHNE, Inc. could void the hazardous certification rating of the equipment.

2. OPTISOUND series and VU32 series are to be used only in the manner outlined in this manual; otherwise protection provided by the equipment may be impaired.

3. Use Copper wiring only. Use wiring rated for 90° C or higher when ambient is above 50° C.

4. Use wire gauge AWG 12 to AWG 22

5. All unused openings must be closed / plugged with suitable components to maintain protective rating of the enclosure (Type 4, 4X IP 65).

6. The equipment must not be installed directly in any process where the enclosure might be charged by the rapid flow of non-conductive media.

7. The equipment must only be cleaned with a damp cloth.

8. The Sensing Element has been supplied with a grounding connection. Check the local codes or authority having jurisdiction for grounding requirements.

9. Dust tight conduit seal must be used when installed in Class II and Class III environments

Section 3: LCD Display

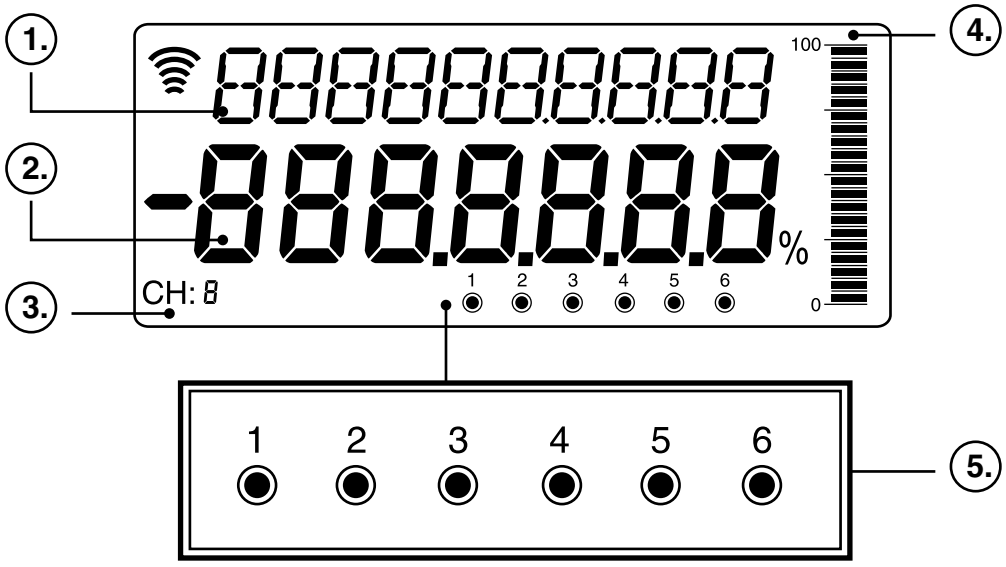
1. 10 digit Alpha numeric - Displays Data such as Units of Measurement and Description of Menu Item

2. 7 Digit Numeric - Displays the numeric values such as distance and Menu item number.

3. Channel - Displays the current input channel being viewed. If this display item is blank, the item being displayed is an Analog output or a differential value such as Traveling screen.

4. Range meter (0 - 100%) - To change the scale of the Range meter, change the Range setting in the Range Configuration menu. Refer to Menu Item n.6.00 Range - Config Menu. (Where n is the Channel Number).

5. Relays - The outer ring indicates that the relay is configured. The inner dot indicates the relay is in the alarm condition.



Section 3: LCD Display (Continued)

Using the Keypad in the Configuration Mode

- The "ENTER" button is used to access the configuration menu, and select items to be modified
- The UP and DOWN arrows are used in the configuration menu to change selections, and modify numeric values.
- Press and HOLD the ENTER button for 5 seconds to access the configuration menu.
- Use the UP and DOWN buttons to select menu items
- Press the ENTER button to change the selected item
- Press and HOLD the enter button to get to the previous menu, or continue to hold to exit the configuration menu.

Using the Keypad While in the Operating Mode

- Tapping the ENTER button changes the Displayed Channel (1 or 2), Differential Level, or the Analog Output Value (1 or 2)
- Tapping the UP or DOWN button changes the displayed variable (level, distance, temperature, etc)
- Pressing the UP and DOWN buttons simultaneously, forces target acquisition of current channel displayed
- Pressing the ACKNOWLEDGE button clears any previously un-acknowledged alarms.

Section 4: Configuration

4.1 System Configuration with Display / Keypad

Application Type:
Allows the user to select an appropriate "Application Type" for the application. The valid Application Types are:

- LEVEL *(also includes Distance and Volume measurements)*
- FLOW

Only one "Application Type" may be selected for each Channel. Once selected, only the Functions of the selected Application Type will be available.

Channel Settings
The OPTISOUND Channel Settings are made up of 6 separate functions for application set-up.

Strapping Table:
Allows the user to edit the 21-Point user defined table that can provide output signal as a percent of volume or flow.

Point Calibration:
Allows a 1-Point calibration based on a known distance from the Sensing Element face. This can adjust for any possible variations that may exist in the speed of sound, or to provide an optimized calibration data point in difficult applications, such as vapor.

System Settings:
Allows setting changes to the system configuration.

Display Settings:
Allows the system to Display or Hide different readings. Any or All may be selected and the display may automatically “cycle” for a selected interval.

4.2 Configuration Menu

To enter the Configuration Menu:

- Press and hold ″ENTER″ button for 5 seconds to access configuration menu.
- Use ″UP″″ and ″DOWN″ buttons to select menu.
- Press ″ENTER″ button to change selected item.
- Press and Hold ″ENTER″ button to go to the previous menu, or continue to Hold to exit configuration menu.
- Press ″UP″ and ″DOWN″ buttons simultaneously to force target acquisition. (Only on the Displayed Channel)

Fct.	Item	Description & Comment	Menu Selection Choices (default)
Fct. 1.00.00	**Channel 1**	**Channel #1 - all menu Function (Fct.) items starting with "1" refer to channel #1 only. Menu items starting with "2" are specific only to channel #2.**	
Fct. 1.01.00	Channel Enable	Allows the user to enable or disable channel #1 - if disabled, display and output signals will not be available for use.	Yes / No
Fct. 1.02.00	Application Type	Allows the user to select application type. The menu will only allow entries in applicable menu items.	
Fct. 1.02.01	APP Type	Allows the user to select basic application type for: Level – includes level, volume, range configuration, & strapping tables. Flow – Flow (open channel flow & submerged flow), Totalization, Batch Sampler Activation via relays & strapping tables for custom flumes/weirs	Level / Flow
Fct. 1.03.00	Level	Allows the user to select inputs for level measurement. Define units of measure for display; select tank height, and sensor offset value if different than tank height. Sensor Offset is typically only used in volumetric measurements to correlate a known volume to a known level. See Sections 4.3 for level measurements & Section 4.4 for distance measurements	
Fct. 1.03.01	Units	Allows the user to select the units label that will be used for the display and all units inputs for measurement values, relay set point values, LRV, URV, etc.	IN / FT / MM / CM / M
Fct. 1.03.02	Tank Height	Allows a user defined value for Tank Height. This is normally defined as the distance from the sensor face to the tank bottom and is used to correlate level vs. volume at a known level. If the sensor face is located at a different elevation than what is expressed in Tank Height, enter a value for Offset (Fct. 1.03.03)	User defined (360”)
Fct. 1.03.03	Offset	Typically not used in Level Mode, but can be used if sensor is located above (positive offset) or below (negative offset) the value that was entered for Tank Height. Edit the menu from the default display (Inches 000000.00) to correct offset value. Use up arrow button to increase numbers in a positive offset, use down arrow button to increase numbers in a negative offset.	User defined (0”)

4.2 Configuration Menu (Continued)

Fct.	Item	Description & Comment	Menu Selection Choices (default)
Fct. 1.04.00	Volume	Allows the user to select vessel shape, use a pre-selected strapping table defined by tank shape and known maximum capacity, and select volumetric units used for measurement conversions.	
Fct. 1.04.01	Vessel Type	Allows the user to select the basic vessel shape for volumetric conversion. Note: This selection is based on standard strapping tables and cannot be edited. Select Custom if the tank shape needs to be edited for maximum conversion accuracy.	VERTICAL HOR CYL FLAT HOR CYL DISHED HOR CYL HEMI SPHERE CUSTOM
Fct. 1.04.02	Copy to Strapping Table	Allows the user to copy and edit a standard strapping table to the 21-point custom strapping table. The “level vs. volume” data points can then be edited for optimized customization in Fct. 1.07.	VERTICAL HOR CYL FLAT HOR CYL DISHED HOR CYL HEMI SPHERE
Fct. 1.04.03	Vessel Units	Allows the user to select volumetric units that will be used for the display.	GALLONS / M3 / LITERS / BARRELS/ INPERIAL GALLONS
Fct. 1.04.04	Max Capacity	Allows a user defined numeric value for the maximum capacity in the vessel units selected that will be used in the “level vs. volume” strapping table.	User defined (1000GAL)
Fct. 1.05.00	Flow	Allows the user to select the primary flow element (flume / weir) type, size of selected element from code or numeric value (flow type dependant), enter units of flow to be measured, enter units of head (level) to be used, define the zero distance from sensor face to "no-flow" condition, define time delay to be used if surface turbulence is encountered, select totalizer scale (if used), and if the "reset totalizer" is to be reset by the user to zero volume. See Sections 4.5, & 4.8 for more detail	FLOW Menu shown only when Flow is selected in 1.02.01
Fct. 1.05.01	Flow Type	Allows the user to select the primary flow element for a list of pre-programmed flume/weir characterization tables. If the desired primary element is not listed, the strapping table may be entered as a custom user defined table in Function 1.07. See Section 4.6 for more detail on Submerged Flow	PARSHALL SUB FLOW PARSHALL PALMER BOWLUS/ TRAPEZ FLUME/ RECT WEIT W/WO END CUSTOM
Fct. 1.05.02	Flume Size	Allows the user a selection of flume throat size of flume type selected in Fct. 1.5.01, select the size code from the available listings in Section 4.2	CODE FROM TABLE OR NUMERIC VALUE – See Section 4.8
Fct. 1.05.03	Flow Units	Select if displayed units will be in GPM, MGD or M3/Hr	GPM / MGD / M3/HR
Fct. 1.05.04	Head Units	Allows user to edit the menu to select head (level) measurement units. This information is used for display indication and also if custom flume or weir information is generated in the 21-point strapping table.	IN / FT / MM / CM / M
Fct. 1.05.05	Zero distance	Allows the user to edit the menu to provide the distance from the sensor face to the "zero flow" point in the primary element (flume or weir). Check primary flow element drawings, not all primary elements have a zero flow reference point at the bottom.	User defined
Fct. 1.05.06	Delay	Time delay will act as signal averaging over the specified time 0-10 seconds. If a turbulent surface causes the analog signal to be unsteady, a few seconds of time delay can smooth out the signal.	User defined
Fct. 1.05.07	Totalizer Scale	Allows the user to edit the menu selection to select the totalizer scale. Every count on the totalizer will be multiplied by the selection made in this field.	X100, X1K, X10K, X100K, X1M
Fct. 1.05.08	Reset Totalizer	Allows the user to reset the Reset Totalizer to zero.	NO / YES

4.2 Configuration Menu (Continued)

Fct.	Item	Description & Comment	Menu Selection Choices (default)
Fct. 1.06.00	Range Config.	Allows the user to assign the range of measurement as viewed on the graphic display by specifying the 4 mA & 20 mA points (LRV/URV). The graphic display can be configured differently than the analog output signal. The graphic display is always in percent of the range values selected in LRV & URV.	
Fct. 1.06.01	Range Assign	Allows the user to select measurement type that will be represented on the graphic display	LEVEL / VOLUME / FLOW / DISTANCE
Fct. 1.06.02	LRV	Allows a user defined numeric value in the same unit of measurement selected, for the lower range value of the graphic display.	User defined (0")
Fct. 1.06.03	URV	Allows a user defined numeric value in the same unit of measurement selected, for the upper range value of the graphic display.	User defined (348")
Fct. 1.07.00	Strapping	Allows the user to enter a new, or modify a standard pre-programmed, strapping table. Define the number of points (2 minimum through 21 maximum points).	
Fct. 1.07.01	Max Points	Allows the user to define the number of required "break" points from a minimum of 2 to a maximum of 21 points for level vs. volume conversion / optimization.	2…21
Fct. 1.07.02	IN PT 1	Allows the user to enter a defined numeric value of level input to be used in conjunction with 1.07.03 for a volume output.	User defined
Fct. 1.07.03	OUT PT 1	Allows the user to enter a defined numeric value of volume to be output and is used in conjunction with 1.07.02 for a level input.	User defined
Fct. 1.07.04 to 1.07.43	IN / OUT Points 2 – 21	Allows the user to enter defined numeric values for "Level – In" points and "Volume – Out" points for strapping table points 2 – 21.	User defined
Fct. 1.08.00	Sensor	Allows the user to change the sensor settings.	
Fct. 1.08.01	Gain type	Should only be changed with the guidance of a KROHNE, Inc. representative. This item allows the user to change from the default SmartGain variable gain settings to a fixed gain level. Useful if foam is present that causes a Lost Echo fault. Consult Factory before making changes.	SG / 100% / 84% / 67% / 50% / 32% / 17% / 8% – Consult Factory
Fct. 1.08.02	SG Adjust	Should only be changed with the guidance of a KROHNE, Inc. representative. This item allows the user to change from the default SmartGain variable gain settings to an alternate variable gain level, but stilling allowing the system to ignore some obstructions within the beam path. Consult Factory before changing.	User defined – Consult Factory * Any change in this function will change 1.08.01 to "SG"
Fct. 1.08.03	Near Zone Fault	If the level moves into the Near Zone (12 inches from the sensor face), the user can select the current level the analog signal will assume (3.7 mA or 22 mA) during a fault condition.	HIGH / LOW (22 mA / 3.7 mA)
Fct. 1.08.04	Lost Echo Fault	If the echo is not returned to the sensor the user can select the current level (3.7 mA or 22 mA) the analog signal will assume during a fault condition.	HIGH / LOW (22 mA / 3.7 mA)
Fct. 1.08.05	Temp Units	Allows the user to select °F or °C for display	F / C
Fct. 1.08.06	Sensor Software Revision	Read Only. Provides a date code of the sensor software version.	Read Only
Fct. 1.09.00	Calibration	Allows the user to optimize the calibration due to changes in the velocity of sound in various media	

4.2 Configuration Menu (Continued)

Fct.	Item	Description & Comment	Menu Selection Choices (default)
Fct. 1.09.01	Point	A point calibration allows the system to reset the expected ultrasonic sound velocity to a new value. Consult factory before use. If vapors are present or a gas blanket is used, the ultrasonic velocity will be different than would be expected in a through-air application. This menu item is used to alter this calculated velocity. Edit this item with the actual distance to the known level and the system will back calculate the velocity that produces this level measurement.	Consult Manual (Factory Calibrated) See Section 8.2
Fct. 2.00.00	**Channel 2**	**Same as above with the prefix of "2" for system configuration of Channel #2**	**Same as channel #1**
Fct. 3.00.00	**Relays**	**Allows user configuration of the 6 SPDT relays. See Section 4.10 for more detail**	
Fct. 3.01.01	Enable	Allows relays to be enabled for use. Function 3.01 configures relay #1, functions 3.02 through 3.06 configure relays #2 through #6.	YES / NO
Fct. 3.01.02	Relay Type	Define relay type with the following descriptions: ALARM - relay used to indicate if an alarm set point has been exceeded, the relay will de-energize when set point is exceeded and stay in alarm until acknowledged by pressing the "ACK" button on OPTISOUND keypad. See Section 4.10.1 CONTROL - allows the relay to energize/de-energize based on set point and dead band entered. The "ACK" acknowledge button is not used in "control" mode. See Section 4.10.2 SAMPLE - allows the relay to be assigned as a "sample activation relay" for use with a Batch Sampler (typically used in Flow application). Used for a momentary contact closure to activate the sampler. See Section 4.10.3 PUMP - allows the relay to be programmed as part of a Pump Alternation scheme. See Section 4.10.4 MANUAL Alarm – Allows the user to manually put the relay into alarm, for test purposes. See Section 4.10.5 MANUAL Normal – Allows the user to return the relay to Normal operation.	ALARM CONTROL SAMPLE PUMP 1, 2, 3, 4, 5, 6 MANUAL ALARM MANUAL NORMAL
Fct. 3.01.03	Channel Assignment	Select to which channel the relay will be assigned.	CHANNEL 1 / CHANNEL 2
Fct. 3.01.04	Variable Assignment	Allows the user to select the input measurement unit that will be used for relay activation. Example: If “Level” has been selected and the selected level units are in mm, then relay assignment will also be in mm.	LEVEL / VOLUME / FLOW / RANGE / FLOW SUM / FLOW DIFF / SUBMG / TRAV SCREEN / L.E. / N.Z. / DIST
Fct. 3.01.05	Set point	A user defined numeric value based on the Variable Assignment type where the relay will activate.	User defined
Fct. 3.01.06	Dead Band	A user defined numeric value based on Variable Assignment type where the relay will de-activate. Example: if relay assignment type is “Level” a set point value may be 12 inches for relay set point activation and a dead band selection may be 36 inches; the relay will activate at 12" and de-activate at 48". Tip: Changing the relay fail safe direction (Fct. 3.02.11) can reverse the contact NO / NC states.	User defined

4.2 Configuration Menu (Continued)

Fct.	Item	Description & Comment	Menu Selection Choices (default)
Fct. 3.01.07	Sample value	This function is only used when Relay Type is set to SAMPLE. Used for Batch Sampler Activation, a user defined numeric value is entered that corresponds to how often this relay will activate. If the sampler needs to take a sample every 10,000 Gallons - then enter 10000.	User defined
Fct. 3.01.08	Sample Duration	This function is only used when Relay Type is set to SAMPLE. A user defined numeric value that corresponds to how long (in milliseconds) that the contact closure must be made. Check with sampler manufacturer to determine how long of a contact closure pulse is required to activate the sampler. Valid entries will range between 50 msec. to 1000 msec.	WIDTH OF SAMPLE PULSE 50 – 1000 mS
Fct. 3.01.09	Time Delay	A user defined numeric value between 0-99 seconds after the set point has been reached before the relay contact will close/open. (HLFS/LLFS)	User defined 0 – 99 seconds
Fct. 3.02.10	Time Delay Mode	Forward Acting - when the set point is reached the relay immediately goes into alarm, time delay is applied when the relay comes out of alarm. Reverse Acting - when set point is reached the time delay value is applied before the relay activates.	FORWARD / REVERSE
Fct. 3.02.11	Fail Safe	HLFS - relay is de-energized (in alarm) when level is above defined set point value. LLFS - relay is de-energized (in alarm) when level is below defined set point value.	HLFS / LLFS
Fct. 3.02 to 3.06	Relays 2 – 6	Same as above for relays 2 – 6	Same as above
Fct. 4.00.00	Analog Output	Configure Analog Outputs	
Fct. 4.01.00	Analog Output #1	All parameters in 4.01 are specific to analog output #1	
Fct. 4.01.01	Channel Assignment	Define which channel (#1 or #2) will be tied to the output signal terminals	CHANNEL 1 / CHANNEL 2
Fct. 4.01.02	Variable Assignment	Select the analog output signal assignment; level, distance, volume, flow, etc., that will represent this analog signal. If level is selected – the analog output will be in percent of Level. If volume is selected - the analog output will be expressed in percent of volume. See Section 4.7 (flow & sum difference), and Section 4.9 (traveling screen)	LEVEL / VOLUME / FLOW / RANGE / FLOW SUM / FLOW DIFF / SUBMG / TRAV SCREEN / L.E. / N.Z. / DIST
Fct. 4.01.03	4 mA Point	A user defined value based on Variable Assignment for the LRV (4 mA, 0%) of the analog signal.	User defined (0%)
Fct. 4.01.04	20 mA Point	A user defined value based on Variable Assignment for the URV (20 mA, 100%) of the analog signal.	User defined (100%)
Fct. 4.01.05	Damping	A user defined value between 0 – 99 seconds that allows the analog signal to be dampened. This is desirable is heavy agitation or turbulence cause the output signal to be too jumpy. Typically just a few seconds (5 – 10 sec.) of signal dampening is suitable.	User defined 0 – 99 seconds
Fct. 4.01.06	Lock mA	Allows the user to force the analog output signal to a user-defined value. The analog output will stay at this value until this menu item is exited.	User defined
Fct. 4.01.07	Trim 4 m	Allows the user to adjust the 4 mA output signal to match a plant mA standard. See Section 8.3	CONSULT MANUAL
Fct. 4.01.08	Trim 20 mA	Allows the user to adjust the 20 mA output signal to match a plant mA standard. See Section 8.3	CONSULT MANUAL
Fct. 4.02.00	AO #2	Same as above for Analog Output #2	Same as above

4.2 Configuration Menu (Continued)

Fct.	Item	Description & Comment	Menu Selection Choices (default)
Fct. 5.00.00	System	Allows user configuration of several miscellaneous system settings	
Fct. 5.01.01	Password Enable	Allows user to enable or disable password protection of configuration menu.	NO / YES
Fct. 5.01.02	Change Password	Allows a user generated a 7-character password to allow access to the configuration menu. To edit this item you will see a blinking cursor "_" followed by 6 o's (_oooooo). To edit use the up & down arrow buttons to select Up, Down, Enter or ACK - press the Enter button to make the selection, and the blinking cursor will move to the next position (o_ooooo). Repeat until all 7 positions have been entered. Record this password. Upon re-entering the configuration menu, this password will be required	ENTER NEW KEY SEQUENCE
Fct. 5.02.00	Miscellaneous		
Fct. 5.02.01	Set Clock	Edit to enter correct Date & Time.	User defined (Factory set)
Fct. 5.02.02	Reset Factory Defaults?	This allows the user to reset all configurable data to the default settings from the factory.	NO / YES
Fct. 5.02.03	System Software Revision	Read only code of the OPTISOUND receiver software version	Read Only
Fct. 5.02.04	Reset Counter	Read only count of the number of system resets.	Read Only
Fct. 5.03.00	Data Logger	Allows user enable and configuration of Data Logger. See Section 7	
Fct. 5.03.01	Enable	Allows the user to enable or disable the Data Logger	NO / YES
Fct. 5.03.02	Interval	Allows a user selection for the time interval between data collection points. Interval times between every 5 sec. to every 12 hours are selectable. The "Interval OFF" selection allows the data logger to be used only as an event recorder, based on user defined trigger values for Channel #1 and #2.	5 SECONDS – 12 HOURS / INTERVAL OFF
Fct. 5.03.03	Duration	"Read Only" – displays the maximum duration of data logger run time based on Interval selection.	Read Only duration of data logging – dependant on interval
Fct. 5.03.04	CH1 Trigger Assignment	Allows user selection of input variable (level, distance, volume or flow) of data to be used for event recordings.	DISTANCE / LEVEL / VOLUME / FLOW / OFF
Fct. 5.03.05	CH1 Trigger High Point	Allows a user defined high point as a trigger to the data logger event recorder. Measurements that exceed this High Point value will be recorded in the data logger.	User defined
Fct. 5.03.06	CH1 Trigger Low Point	Allows a user defined low point as a trigger to the data logger event recorder. Measurements that exceed this Low Point value will be recorded in the data logger.	User defined
Fct. 5.03.07	CH2 Trigger Assignment	Allows user selection of input variable (level, distance, volume or flow) of data to be used for event recordings.	DISTANCE / LEVEL / VOLUME / FLOW / OFF
Fct. 5.03.08	CH2 Trigger High Point	Allows a user defined high point as a trigger to the data logger event recorder. Measurements that exceed this High Point value will be recorded in the data logger.	User defined
Fct. 5.03.09	CH2 Trigger Low Point	Allows a user defined low point as a trigger to the data logger event recorder. Measurements that exceed this Low Point value will be recorded in the data logger.	User defined
Fct. 5.03.10	Overwrite	Allows the user to select the ability to overwrite previously recorded data once data registers are full on a data "first in – first out" basis.	NO / YES

4.2 Configuration Menu (Continued)

Fct.	Item	Description & Comment	Menu Selection Choices (default)
Fct. 5.03.11	Reset Data logger memory	Allows the user to clear the memory of the data logger.	NO / YES
Fct. 5.04.00	Communications	Allows the user to configure digital communication settings. See Section 5	
Fct. 5.04.01	Baud Rate	Allows the user to select between 9600 / 19200 baud rates. Default is 19200	9600 / 19200 (19200)
Fct. 5.04.02	Communications Type	Allows the user to select communication transfer via RS-232 or RS-485	RS232 / RS485 (RS232)
Fct. 5.04.03	Device ID	Allows the user to select the polling address of this system (1 – 32). Default position is "1"	1 – 32 (1)
Fct. 6.00.00	**Display**		
Fct. 6.01.00	Configure	Allows the user to configure display items	
Fct. 6.01.01	AutoScroll	Allow the user to enable or disable auto scroll feature. AutoScroll allows the automatic time based cycling of items that can be displayed. If AutoScroll is disabled, the user can still manually cycle through any desired display items by using the up or down arrow key.	ENABLE / DISABLE
Fct. 6.01.02	Scroll Rate	Allows a user defined time value (in seconds) that selected items will be displayed	User defined
Fct. 6.01.03	Hide ALL	Allows the user to hide all display options.	YES / NO
Fct. 6.01.04	Show ALL	Allows the user to show all display options.	YES / NO
Fct. 6.02.00	**CHANNEL 1**	**Allows the user to select to show or hide display options**	
Fct. 6.02.01	Range	Show / Hide	Show / Hide
Fct. 6.02.02	Level	Show / Hide	Show / Hide
Fct. 6.02.03	Distance	Show / Hide	Show / Hide
Fct. 6.02.04	Volume	Show / Hide	Show / Hide
Fct. 6.02.05	Flow	Show / Hide	Show / Hide
Fct. 6.02.06	Totalizer	Show / Hide	Show / Hide
Fct. 6.02.07	Resettable Totalizer	Show / Hide	Show / Hide
Fct. 6.02.08	Temperature	Show / Hide	Show / Hide
Fct. 6.03.00	CHANNEL 2	Allows the user to select to show or hide display options	
Fct. 6.03.01	Range	Show / Hide	Show / Hide
Fct. 6.03.02	Level	Show / Hide	Show / Hide
Fct. 6.03.03	Distance	Show / Hide	Show / Hide
Fct. 6.03.04	Volume	Show / Hide	Show / Hide
Fct. 6.03.05	Flow	Show / Hide	Show / Hide
Fct. 6.03.06	Totalizer	Show / Hide	Show / Hide
Fct. 6.03.07	Resettable Totalizer	Show / Hide	Show / Hide
Fct. 6.03.08	Temperature	Show / Hide	Show / Hide
Fct. 6.04.00	**Differential**	**Allows the user to display / hide any channel #1 vs. channel #2 difference / sum displays**	
Fct. 6.04.01	Flow Sum	Show / Hide	Show / Hide
Fct. 6.04.02	Flow Difference	Show / Hide	Show / Hide
Fct. 6.04.03	Submergence	Show / Hide	Show / Hide

4.2 Configuration Menu (Continued)

Fct.	Item	Description & Comment	Menu Selection Choices (default)
Fct. 6.04.04	Traveling Screen	Show / Hide	Show / Hide
Fct. 6.05.00	**Analog Output 1**	**Allows the user to display / hide Analog output #1**	
Fct. 6.05.01	Show AO 1	Show / Hide	Show / Hide
Fct. 6.06.00	**Analog Output 2**	**Allows the user to display / hide Analog output #2**	
Fct. 6.06.01	Show AO 2	Show / Hide	Show / Hide
Fct. 6.07.00	Clock	Allows the user to display / hide the real time clock	
Fct. 6.07.01	Show Clock	Show / Hide	Show / Hide

PRIMARY DEVICE CODES

TRAPEZOIDAL FLUME	
CODE	SIZE
1	SMALL 60 DEG16
2	LARGE 60 DEG
3	X-LARGE 60 DEG
4	3 FT 60 DEG
5	2 IN 45 DEG WSC
6	12 IN 45 DEG SRCRC
7	24 SRCRC

PALMER BOWLUS	
CODE	SIZE (IN)
1	4
2	6
3	8
4	10
5	12
6	15
7	18
8	21
9	24
10	27
11	30

PARSHALL	
CODE	THROAT (IN)
1	1
2	2
3	3
4	6
5	9
6	12
7	18
8	24
9	36
10	48
11	60
12	72
13	96

H - FLUME	
CODE	SIZE (IN)
1	6
2	9
3	12
4	18
5	24
6	30
7	36
8	54

V-NOTCH WEIR	
CODE	SIZE
1	22.5 DEG
2	30 DEG
3	45 DEG
4	60 DEG
5	90 DEG
6	120 DEG

Rectangular Weir - with or without End Contractions: Enter Crest Length
Trapezoidal Weir: Enter Crest Length
Leopold Lagco Flume: Enter Flume Size

4.3 **Level Application** (output increases as liquid level increases)

Configure as follows:

1. Select the desired channel to configure.
   n = either Channel 1.00.00 or Channel 2.00.00
2. Ensure the desired channel is enabled n.01.01
3. Select LEVEL in the application type menu n.02.01
4. Select the units of measurement in menu n.03.01
5. Enter the tank height in menu n.03.02 (for applications where tank dimensions are not important, you may enter in the distance from the Sensing Element face to the 4mA point)
6. Enter an Offset (if needed) in menu n.03.03. (this value is used to compensate for differences in elevation between the top of the tank and the Sensing Element face. It is only changed when the displayed level must agree with the actual tank height. In simple applications, where the tank height is not important, enter 0. - See Section 1.4 for more details.
7. Set the Range assignment to LEVEL in menu n.06.01
8. Assign the desired LRV (4mA value) in menu n.06.02
9. Assign the desired URV (20mA value) in menu n.06.03
10. Configure the analog output using menu 4.0n.00. Assignment should be set to LEVEL to provide a 4-20mA signal proportional to the level in the vessel. n = Analog Output Signal 1 or 2

4.4 Distance Application (Indication referenced from the Sensing Element Face)

Configure as follows:

1. Select the desired channel to configure.
   n = either Channel 1.00.00 or Channel 2.00.00
2. Ensure the desired channel is enabled n.01.01
3. Select LEVEL in the application type menu n.02.01
4. Select the units of measurement in menu n.03.01
5. Enter an Offset (if needed) in menu n.03.03 (typically set to 0).
6. Set the Range assignment to DISTANCE in menu n.06.01
7. Assign the desired LRV (4mA value) in menu n.06.02 (referenced from the Sensing Element face)
8. Assign the desired URV (20mA value) in menu n.06.03 (referenced from the Sensing Element face)
9. Configure the analog output using menu 4.0n.00. (Assignment should be set to DISTANCE to provide a 4-20mA signal proportional to the distance from the Sensing Element face) n = Analog Output Signal 1 or 2

4.5 Standard Flow Application

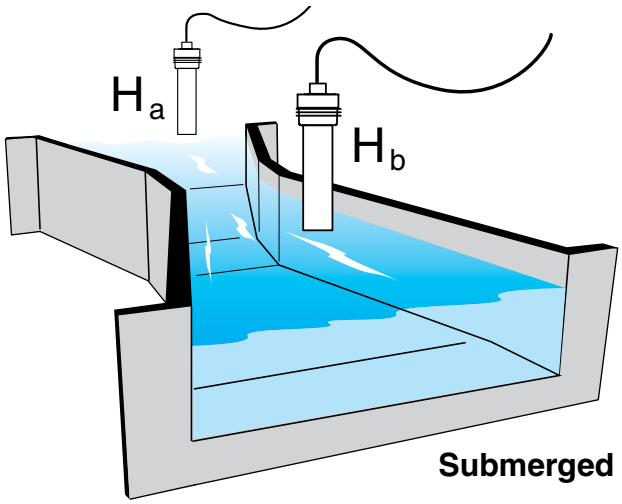
Standard Flow uses the head height/level of the selected channel and converts it to an output of flow. The relationship is determined by selecting the proper flume or weir used for the application. - See Section 4.8 for the list of available flumes and weirs. The strapping table may be used to create a custom flow table if a flume or weir is not available in the OPTISOUND.

Configure as follows:

1. Select the desired channel to configure.
   n = either Channel 1.00.00 or Channel 2.00.00
2. Ensure the desired channel is enabled n.01.01
3. Select FLOW in the application menu n.02.01
4. Select the FLOW TYPE in menu n.05.01
5. Select the FLUME SIZE in menu n.05.02 (see table for valid sizes)
6. Select FLOW UNITS in menu n.05.03
7. Select HEAD UNITS in menu n.05.04
8. Enter the distance from the Sensing Element face to the zero-flow point (zero distance) in menu n.05.05
9. Enter damping time in seconds (if desired) in menu n.05.08
10. Select the totalizer scale if desired in menu n.05.09
11. Assign the RANGE to FLOW in menu n.06.01
12. Assign the desired LRV (4mA value) in menu n.06.02
13. Assign the desired URV (20mA value) in menu n.06.03
14. Configure the analog output using menu 4.0n.00. (Assignment should be set to FLOW to provide a 4-20mA signal proportional to the flow rate.) n = Analog Output Signal 1 or 2

4.6 Submerged Flow in Parshall Flumes

The submerged flow selection uses both input channels per application. The submerged flow requires the measurement of both an upstream level (H_a) and a downstream level (H_b) to determine the actual flow rate. This relationship is submergence (H_b/H_a).



Channel 1 is H_a (upstream level)

Channel 2 is H_b (downstream level)

Submerged Flow Measurement

Configure as follows:

NOTICE Refer to menu items 1.00.00 for channel 1 and menu items 2.00.00 for channel 2

1. Select FLOW in the Application Type menu of both channels (menu item 02.00).
2. Select the SUBMERGED PARSHALL flume type for channel 1 (menu item 05.01).
3. Select the desired FLUME SIZE for channel 1 (menu item 05.02)

NOTICE See Section 4.8 for the proper flume size code for the Parshall flume.

4. Select the desired FLOW UNITS of channel 1 (menu item 05.03)
5. Select the desired HEAD UNITS for both channels (menu item 05.04)
6. Select the distance from bottom of the flume (0 head height) to the face of the Sensing Element of channel 1 (menu item 05.06)
7. Select the distance from bottom of the flume (0 head height) to the face of the Sensing Element of channel 2 (menu item 05.06)
8. Assign the desired relays and analog channels to the flow of channel 1 or % submergence (H_b/H_a).
9. To show the flow of channel 1 or % submergence values on the LCD display, enable these values in menu item 6.00.00

4.7 Flow Sum and Flow Difference

Flow sum computes the sum of channel 1 and channel 2, each of which are configured as individual channels. Flow difference computes the difference of the two channels (Channel 1- Channel 2)

Standard Flow uses the head height/level of the selected channel and converts it to an output of flow. The relationship is determined by selecting the proper flume or weir used for the application. See Section 4.8 for the list of available flumes and weirs. The strapping table may be used to create a custom flow table if a flume or weir is not available in the OPTISOUND.

Configure as follows:

Refer to menu items 1.00.00 for channel 1 and menu items 2.00.00 for channel 2

1. Select FLOW in the Application Type Menu of both channels (menu item 02.00).
2. Select the Flow Type for the Application of both channels (menu item 05.01).
3. Select Flume/Weir size for both channels (menu item 05.02)

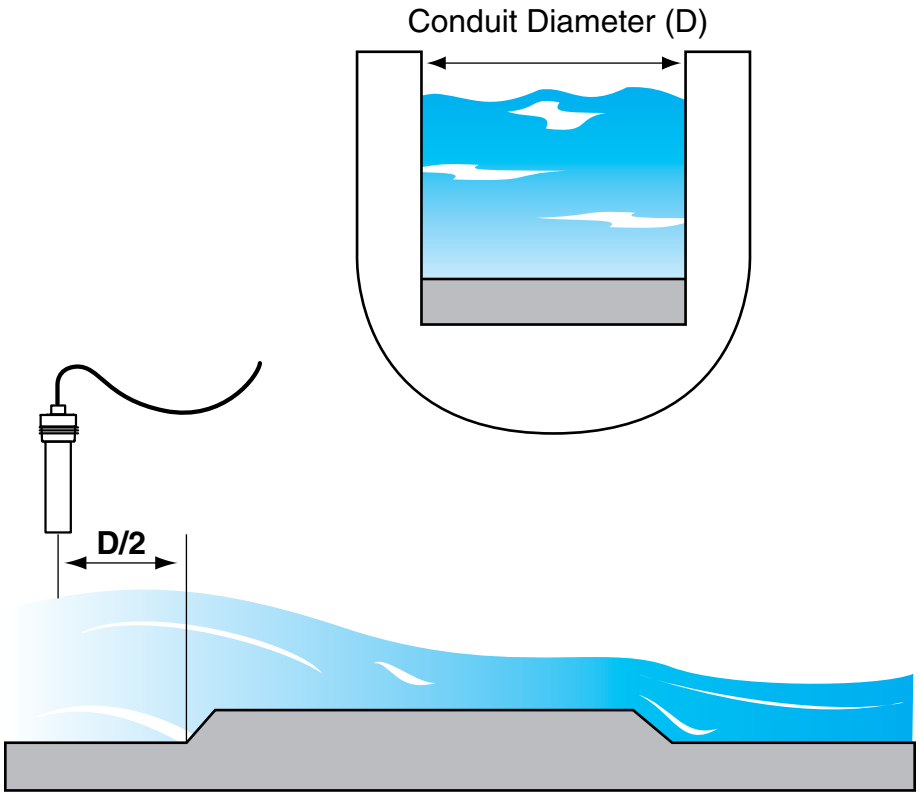
The flume/weir size menu item will be a value in head height units or as a code. See Section 4.8 for proper flume/weir size codes.

4. Select the desired flow units for both channels (menu item 05.03)
5. Select the desired head units for both channels (menu item 05.05)
6. Select the distance from bottom of the flume/weir (0 flow) to the face of both OPTISOUND Sensing Element (menu item 05.06)
7. Assign the desired relays and analog channels to FLOW SUM or FLOW DIFF.
8. To show the flow sum or difference values on the LCD display, enable these values in menu item 6.00.00

4.8 Types of Flumes and Weirs

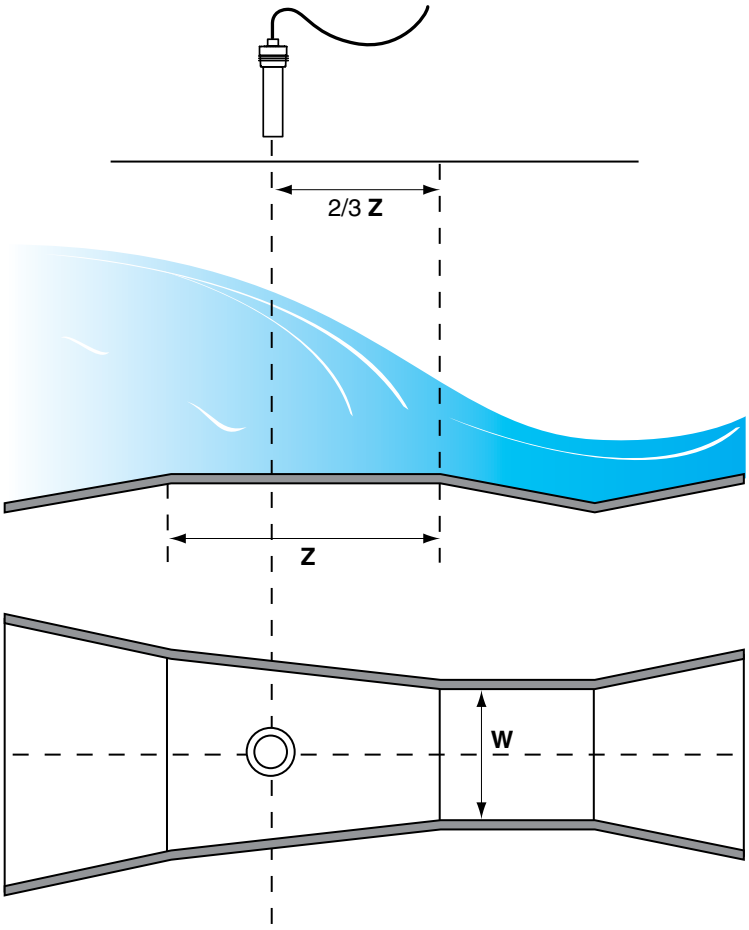
The OPTISOUND™ Supports the Following Flumes and Weirs:

Leopold-Lagco Flumes (Variable Sizes):



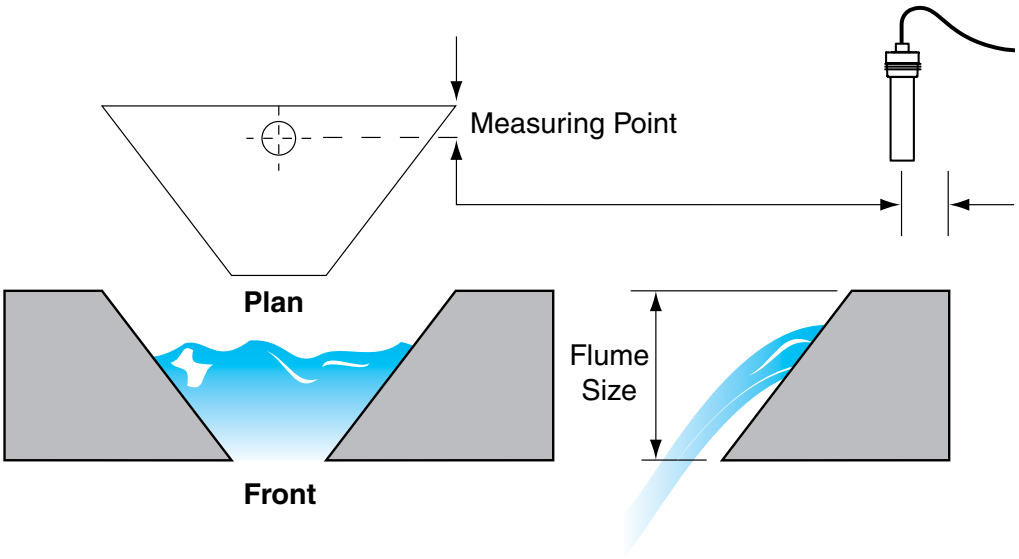
Parshall Flumes

Code	Inches	Millimeters
1	1	25
2	2	51
3	3	76
4	6	152
5	9	229
6	12	305
7	18	457
8	24	610
9	36	914
10	48	1219
11	60	1524
12	72	1829
13	96	2438



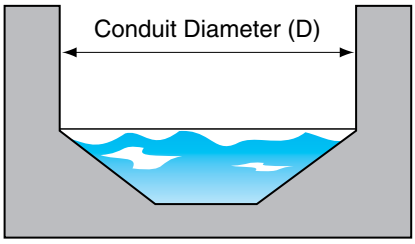
“H” Flumes

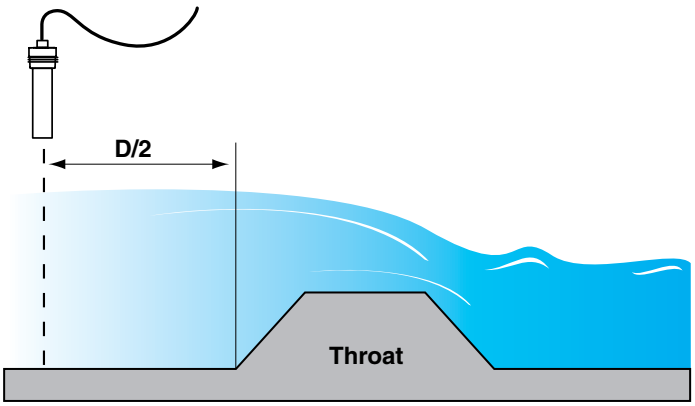
Code	Inches	Millimeters
1	6	152
2	9	229
3	12	305
4	18	457
5	24	610
6	30	762
7	36	914
8	54	1372



Palmer Bowlus Flumes

Code	Inches	Millimeters
1	4	102
2	6	152
3	8	203
4	10	254
5	12	305
6	15	381
7	18	457
8	21	533
9	24	610
10	27	686
11	30	762

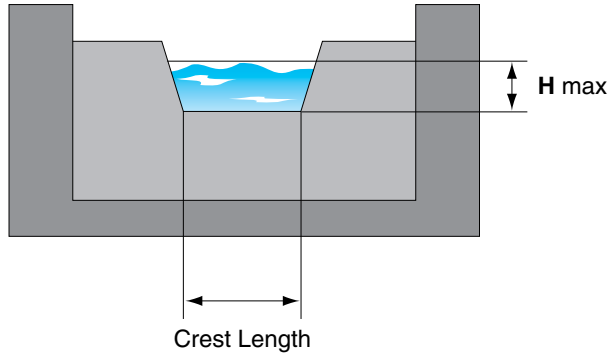


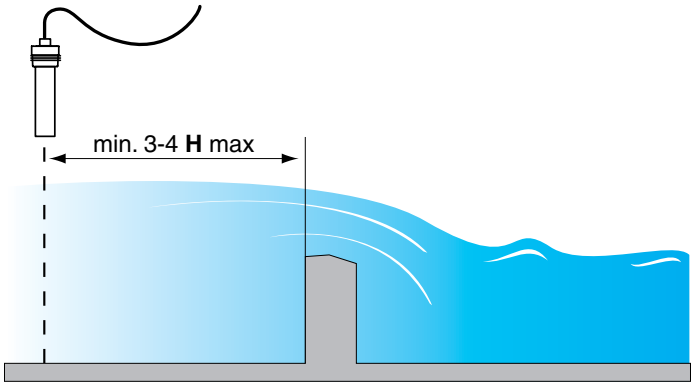


Trapezoidal (Cipolletti) Weir (Variable Sizes)

Trapezoidal (Cipolletti) Flume

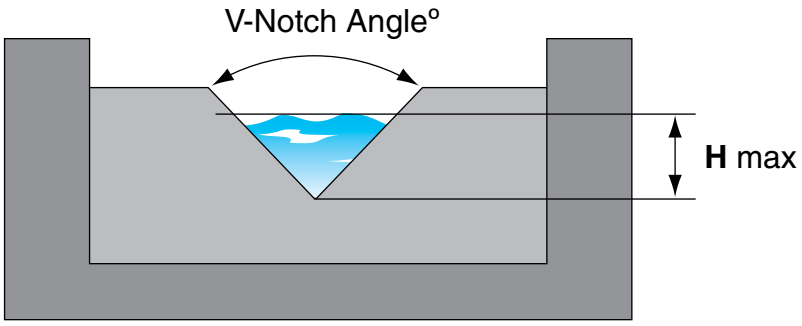
Code	Size
1	Small 60° V
2	Large 60° V
3	X Large 60° V
4	3 ft 60° V
5	2 in 45° WSC
6	12 in 45° SRCRC
7	24 in SRCRC

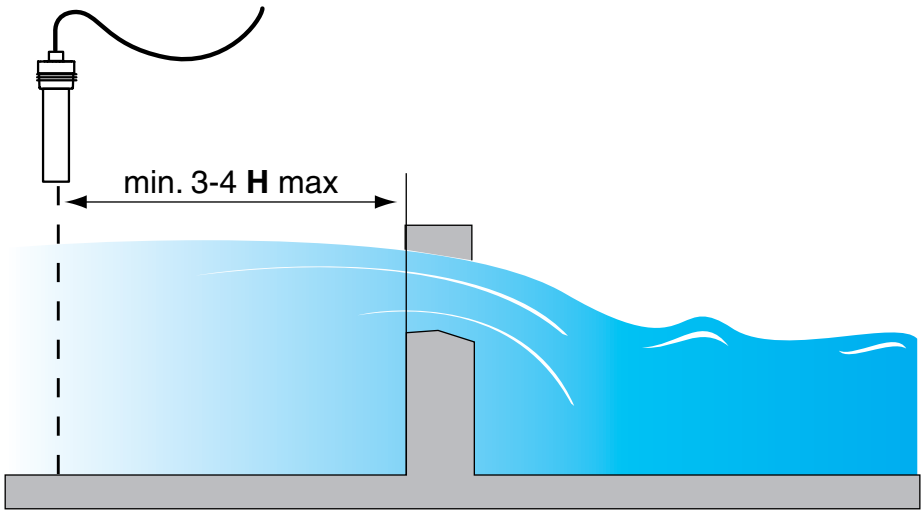




V-Notch Weirs

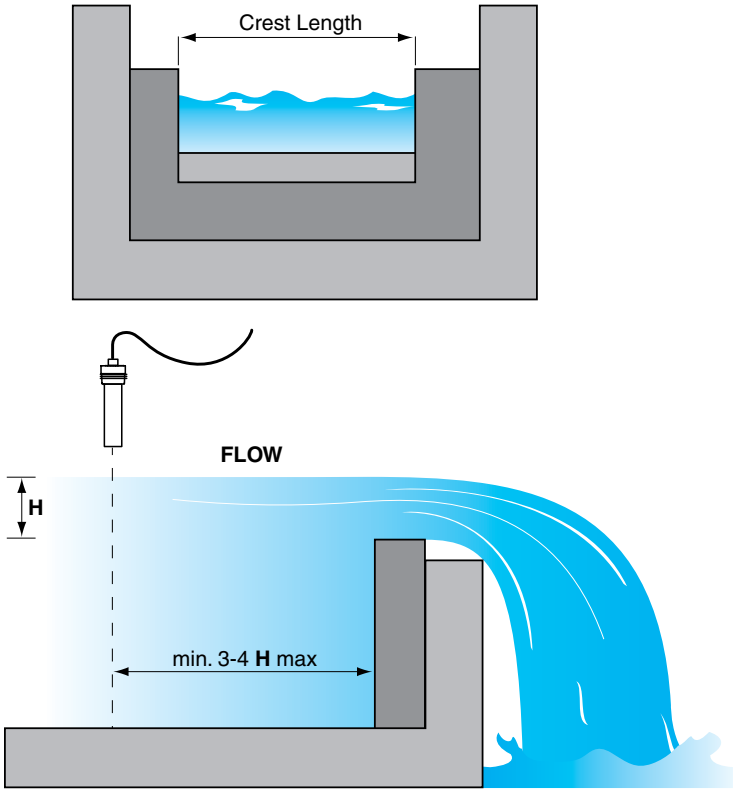
Code	Size
1	22.5°
2	30°
3	45°
4	60°
5	90°
6	120°



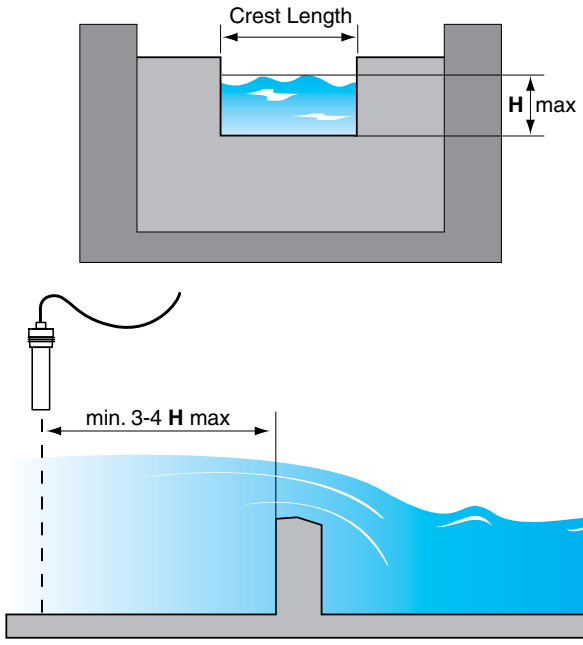


Rectangular Weirs (Variable Sizes)

Rectangular Weir with End Contractions



Rectangular Weir without End Contractions



4.9 Traveling Screen

The traveling screen measurement monitors the stream head height of both the upstream and downstream sides of the screen using both channel 1 and channel 2.

Channel 1 is H_a (upstream head height)
Channel 2 is H_b (downstream head height)

The relationship between the upstream and downstream sides is $H_a - H_b$.

Configure as follows:

NOTICE

Refer to menu items 1.00.00 for channel 1 and menu items 2.00.00 for channel 2

1. Select LEVEL in the Application Type menu of both channels (menu item 02.00).
2. Select the desired LEVEL UNITS for channel 1 (menu item 03.01)
3. Select the distance from 0 head height to the face of the Sensing Element of both channels in the tank height menu item (menu item 03.02)
4. Assign the desired relays and analog channels to TRAV SCRN
5. To show the traveling screen value on the LCD display, enable this value in menu item 6.00.00

4.10 Relays

The OPTISOUND includes 6 relays that may be configured for a number of different functions. These functions include Alarm, Control, Batch Sample Activation, Pump Alternation, and Manual Operation. All relays may be configured independently for any output assignment such as level, flow, volume, etc. The relay state depends on the set point, dead band, and failsafe settings of the selected relay. All relays may have a time delay of up to 99 seconds, and may be enabled or disabled (all relays are Disabled by default).

If the OPTISOUND loses power, all relays will change to the Alarm condition.

Glossary of Relay Terms

Set Point
The set point parameter is the upper value at which the relays change state (Alarm for HLFS or Normal for LLFS).

Dead Band
The dead band parameter determines the lower value at which the relays reset (Normal for HLFS or Alarm for LLFS). The lower value is calculated as Set Point - Dead Band.

Failsafe
The failsafe parameter determines the relationship between the assigned output value and the Alarm state of the relay. If failsafe is configured for LLFS, an Alarm condition will occur when the output value falls below the lower value (Set Point - Dead Band). If failsafe is configure for HLFS, an Alarm condition will occur when the output value exceeds the set point value.

Time Delay Mode
The time delay mode parameter determines when the time delay function will be active. If the time delay mode is set to FORWARD, the time delay function will delay the transition from Alarm to Normal. If the time delay mode is set to REVERSE, the time delay function will delay the transition from Normal to Alarm.

4.10.1 Relay Alarm Function (Latching)

Each relay may be configured for an alarm scenario. When a relay changes to the Alarm state, the relay will remain in the Alarm state until the user presses the Acknowledge button.

NOTICE When a system fault occurs, Alarm relays will automatically change to the Alarm condition.

Configure the relay(s) as follows:

NOTICE All relay parameters are configured in menu item 3.0n.00, where n is relays 1-6.

1. Change the RELAY TYPE to ALARM (menu item 0n.02)
2. Assign the desired input channel to the relay (menu item 0n.03)
3. Assign the desired output value to the relay (menu item 0n.04)
4. Change the SETPOINT value (menu item 0n.05)
5. Change the DEADBAND value (menu item 0n.06)
6. Change the Time delay, Time Delay Mode, and Failsafe as needed (menu items 0n.09, 0n.10, and 0n.11 respectively).

NOTICE When leaving the menu, the user may need to press the Acknowledge button to reset the relays.

4.10.2 Relay Control Function (Non-Latching)

Each relay may be configured for a control scenario. A relay configured as a control relay, will not latch in the Alarm state. When a normal condition occurs, the relay will change to the Normal condition. A control relay would be used for pump control, etc.

NOTICE When a system fault occurs, Control relays will automatically change to the Alarm condition.

Configure the relay(s) as follows:

NOTICE All relay parameters are configured in menu item 3.0n.00, where n is relays 1-6.

1. Change the RELAY TYPE to CONTROL (menu item 0n.02)
2. Assign the desired input channel to the relay (menu item 0n.03)
3. Assign the desired output value to the relay (menu item 0n.04)
4. Change the SETPOINT value (menu item 0n.05)
5. Change the DEADBAND value (menu item 0n.06)
6. Change the Time delay, Time Delay Mode, and Failsafe as needed (menu items 0n.09, 0n.10, and 0n.11 respectively).

4.10.3 Batch Sample Activation Function

Each relay may be configured for Batch Sample Activation. The activator operates according to a defined totalizer value. The assigned input channel must be configured for a flow application See Section 4.5. The normally off state of the relay is HLFS Normal. When a sample activation occurs, the relay changes to the Alarm condition for 50-1000 ms (user selectable) to activate the sampling.

Configure as follows:

NOTICE All relay parameters are configured in menu item 3.0n.00, where n is relays 1-6.

1. Change the RELAY TYPE to SAMPLE (menu item 0n.02)
2. Assign the desired input channel to the relay (menu item 0n.03)
3. Change the SAMPLE VALUE to the desired sample interval (menu item 0n.07)
4. Change the SAMPLE DURATION to the desired sample pulse width (menu item 0n.08)

   Example configuration:

   With this configuration, the relay will activate every 10,000 gallons.

   1. Set the Totalizer Scale of the assigned input channel to x1000
   2. Assign the Flow units to gallons/minute.
   3. Change the SAMPLE VALUE to 10 (gal x1000).

   Example configuration:

   With this configuration, the relay will activate every 100 gallons

   1. Set the Totalizer Scale of the assigned input channel to x1000
   2. Assign the Flow units to gallons/minute.
   3. Change the SAMPLE VALUE to 0.1 (gal x1000).

NOTICE All other relay parameters will have no effect.

4.10.4 Pump Alternation

The pump alternator allows the user to alternately turn on and off a set of up to six relays successively from one or more set points.

The number of PUMP Relay Types will determine the number of alternating relays. For a 2-pump alternator, one relay would be assigned as PUMP 1 Relay Type and another relay would be assigned as PUMP 2 Relay Type. The setpoint of PUMP 1 would be the pump-activate setpoint and the setpoint of PUMP 2 would be the high-level failsafe. If the level rises/falls too fast for pump 1 to handle, both relays will activate when the high-level failsafe setpoint is reached.

NOTICE

1. At least two relays must be assigned for pump alternation.
2. The setpoint of PUMP 1 must be the setpoint with the lowest Activate value.
3. The high-level failsafe setpoints should be arranged in increasing order (e.g., PUMP 2 setpoint < PUMP 3 setpoint < PUMP 4 setpoint < PUMP 5 setpoint < PUMP 6 setpoint).
4. The relays may be assigned to pumps in any order. However, no two relays may be assigned to the same PUMP.

For a 3-pump alternator starting with relay #1, configure:

1. Change the RELAY TYPE of relay #1 to PUMP 1 (menu item 01.02)
2. Change the SETPOINT and DEADBAND values of relay #1 to the desired Activation point (menu items 01.05 and 01.06, respectively)
3. Change the RELAY TYPE of relay #2 to PUMP 2 (menu item 02.02)
4. Change the SETPOINT and DEADBAND values of relay #2 to the desired high-level failsafe (menu items 02.05 and 02.06, respectively)
5. Change the RELAY TYPE of relay #3 to PUMP 3 (menu item 03.02)
6. Change the SETPOINT and DEADBAND values of relay #1 to the desired second high-level failsafe (menu items 03.05 and 03.06, respectively).

4.10.5 Manual Operation

All Relays may be configured independently for manual operation

For the manual operation, configure the relay(s) as follows:

NOTICE

All relay parameters are configured in menu item 3.0n.00, where n is relays 1-6.

For a HLFS Alarm Condition:

- Change the RELAY TYPE to MAN ALARM (menu item 0n.02)

For a HLFS Normal Condition:

- Change the RELAY TYPE to MAN NORMAL (menu item 0n.02)

NOTICE

All other relays parameters are ignored when a relay is configured for manual operation.

Section 5: Communications

5.1 Description

The OPTISOUND uses the Modbus protocol for communicating with a PC or devices such as a programmable logic controller. Modbus is a master-slave protocol that is openly published. Many PC programs currently exist for communicating with Modbus supported devices. The OPTISOUND supports the RTU transmission mode over RS-485 or RS-232.

5.2 Compatibility

The OPTISOUND supports all the required specifications and is conditionally complaint.

5.3 Implementation Class

The OPTISOUND uses the Basic Implementation Class of the Modbus protocol. The table below shows configurations capabilities of the basic implementation class.

	Basic
Addressing	Configurable address from 1 to 247
Broadcast	Yes
Baud Rate	9600, 19200 (19200 is default)
Mode	RTU
Parity	EVEN
Electrical Interface	RS485 2W-cabling **or** RS232
Connector Type	3 wire terminal (Adapter Cable Required for RS232)

5.4 Wiring

WARNING! If the OPTISOUND is located in a hazardous environment, do not open the enclosure cover or make / break any electrical connections without first disconnecting electrical power at the source. Ensure that wiring, electrical fittings and conduit connections conform to electrical codes and Approval Agency Control Drawings for specific location and environment.

5.4.1 Wiring for RS232

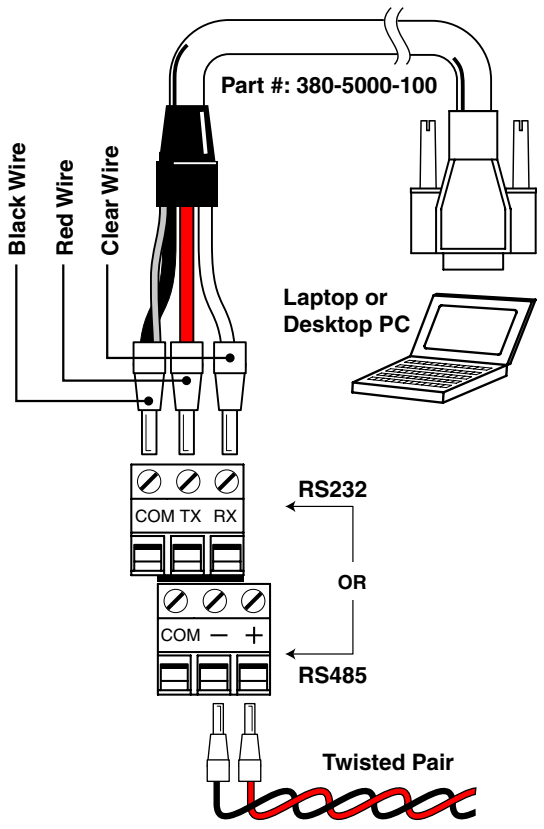
RS232 is designed for a cable length of 25 feet or less and is only used for point-to-point communications with a PC. An adapter cable must be used such as the 380-5000-100 to convert the DB9 connector of the PC to the 3 wire terminal on the OPTISOUND. The diagram below shows the proper wiring.

5.4.2 Wiring for RS485

RS485 is designed for cable lengths of to 4,000 feet. As many as 32 Modbus devices may be multi-dropped on the same bus. A twisted pair is used to connector the OPTISOUND to a host such as a PC with a RS485 converter or PC card. It is recommended that the twisted pair be shielded and at least 24 AWG. The shield should be connected to common only at one end.

NOTICE

If the RS485 bus already has terminating resistors installed, the jumper JP2 on the motherboard must be set to position 2-3. This will remove the built-in terminating resistor that is connected by default.



5.5 Configuration

5.5.1 Baud Rate

The Baud Rate may be changed in menu item 5.04.01. The default baud rate is 19200 bps.

5.5.2 Hardware Interface

The USonic may be configured for RS485 or RS232 in menu item 5.04.02. The default interface is RS232.

5.5.3 Device ID

The USonic may me configured for a Device ID of 1 to 247 in menu item 5.04.03. The Device ID is a unique address used to multi-drop the OPTISOUND with up to 32 Modbus devices using the RS485 Interface. For RS232, it is recommended to leave the Device ID set to 1 since RS232 cannot be multi-dropped. The default Device ID is 1.

Section 6

Section 6: Modbus Tables

6.1 Modbus Register Address Map

Channel Parameters *n* = Channel - 1			
Parameter	**Address**	**Data Type**	**Valid Values**
Range	30***n***001	Float	Read Only
Level	30***n***003	Float	Read Only
Dist	30***n***005	Float	Read Only
Volume	30***n***007	Float	Read Only
Flow	30***n***009	Float	Read Only
Totalizer	30***n***011	Long	Read Only
Resettable Totalizer	30***n***013	Long	Read Only
Temperature	30***n***015	Float	Read Only
Status	30***n***017	Word	Read Only ***(See Section 6.2.20)***
Channel Enabled	00***n***001	Boolean	0=False; 1=True
Application Type	40***n***001	Word	0-1 ***(See Section 6.2.1)***
Range Assignment	40***n***002	Word	0-3 ***(See Section 6.2.2)***
LRV (Lower Range Value)	40***n***003	Float	
URV (Upper Range Value)	40***n***005	Float	
Level/Head Units	40***n***007	Word	***(See Section 6.2.16)***
Tank Height/0 Distance	40***n***008	Float	
Sensor Offset	40***n***010	Float	Leave at 0 for Flow Applications
Vessel Type	40***n***012	Word	0-5 ***(See Section 6.2.3)***
Copy Std. Vessel to Strap Table	40***n***013	Word	0-4 ***(See Section 6.2.4)*** *Write Only*
Vessel Units	40***n***014	Word	***(See Section 6.2.17)***
Max Capacity	40***n***015	Float	
Flow Type	40***n***017	Word	0-10 ***(See Section 6.2.5)***
Flume Size	40***n***018	Float	***(See Section 4.8 for sizes)***
Flow Units	40***n***020	Word	***(See Section 6.2.18)***
Reserved	40***n***021	Float	
Flow Delay	40***n***023	Word	0-30 seconds
Totalizer Scale	40***n***024	Word	0-4 ***(See Section 6.2.6)***
Reserved	40***n***025	Word	
Reset Resettable Totalizer	40***n***026	Word	1 ***(To Reset Totalizer)*** *Write Only*
Reserved	40***n***027	Word	
Max. Strapping Points Defined	40***n***028	Word	2 - 21 points
Reserved	40***n***029	Word	
In Point 1	40***n***030	Float	
Out Point 1	40***n***032	Float	
In Point 2	40***n***034	Float	
Out Point 2	40***n***036	Float	
In Point 3	40***n***038	Float	
Out Point 3	40***n***040	Float	
In Point 4	40***n***042	Float	
Out Point 4	40***n***044	Float	

6.1 Modbus Register Address Map (Continued)

In Point 5	40***n***046	Float	
Out Point 5	40***n***048	Float	
In Point 6	40***n***050	Float	
Out Point 6	40***n***052	Float	
In Point 7	40***n***054	Float	
Out Point 7	40***n***056	Float	
In Point 8	40***n***058	Float	
Out Point 8	40***n***060	Float	
In Point 9	40***n***062	Float	
Out Point 9	40***n***064	Float	
In Point 10	40***n***066	Float	
Out Point 10	40***n***068	Float	
In Point 11	40***n***070	Float	
Out Point 11	40***n***072	Float	
In Point 12	40***n***074	Float	
Out Point 12	40***n***076	Float	
In Point 13	40***n***078	Float	
Out Point 13	40***n***080	Float	
In Point 14	40***n***082	Float	
Out Point 14	40***n***084	Float	
In Point 15	40***n***086	Float	
Out Point 15	40***n***088	Float	
In Point 16	40***n***090	Float	
Out Point 16	40***n***092	Float	
In Point 17	40***n***094	Float	
Out Point 17	40***n***096	Float	
In Point 18	40***n***098	Float	
Out Point 18	40***n***100	Float	
In Point 19	40***n***102	Float	
Out Point 19	40***n***104	Float	
In Point 20	40***n***106	Float	
Out Point 20	40***n***108	Float	
In Point 21	40***n***110	Float	
Out Point 21	40***n***112	Float	
Gain Type	40***n***114	Word	0-7 (***See Section 6.2.7)***
Smart Gain Adjustment	40***n***115	Word	Consult Factory
Repetition Rate	40***n***116	Word	0-1 (***See Section 6.2.8)***
Near Zone Analog Output	40***n***117	Word	0-1 (***See Section 6.2.9)***
Lost Echo Analog Output	40***n***118	Word	0-1 (***See Section 6.2.9)***
Point Calibration	40***n***119	Float	
Temp Calibration	40***n***121	Float	
Reacquire Target	40***n***123	Word	1 (***To Reacquire Target***)
Temperature Units	40***n***124	Word	(***See Section 6.2.19)***
Sensor Software Revision	40***n***125.12H	String	Read Only

6.1 Modbus Register Address Map (Continued)

Relay Parameters *n* = Relay - 1			
Parameter	**Address**	**Data Type**	**Valid Values**
Enable	050*n*01	Boolean	0=False; 1=True
Relay Status	150*n*01	Boolean	Read Only
Relay Type	450*n*01	Word	0-10 (***See Section 6.2.10)***
Channel Assignment	450*n*02	Word	0-1 (***See Section 6.2.11)***
Variable Assignment	450*n*03	Word	0-10 (***See Section 6.2.12)***
Setpoint	450*n*04	Float	
Dead Band	450*n*06	Float	
Sample Value	450*n*08	Float	
Time Delay	450*n*10	Word	0-99 seconds
TD Mode	450*n*11	Word	0-1 (***See Section 6.2.13)***
Failsafe	450*n*12	Word	0-1 (***See Section 6.2.14)***
Sample Duration	450*n*13	Word	50-1000 ms

Analog Output Parameters *n* = Analog Output Channel - 1			
Parameter	**Address**	**Data Type**	**Valid Values**
Analog Output	351*n*01	Float	Read Only
Channel Assignment	451*n*01	Word	0-1 (***See Section 6.2.11)***
Variable Assignment	451*n*02	Word	0-8 (***See Section 6.2.12)***
4 mA Point	451*n*03	Float	
20 mA Point	451*n*05	Float	
Damping	451*n*07	Word	0-99 seconds
Lock Analog Output Value	451*n*08	Float	
Trim 4mA	451*n*10	Float	
Trim 20mA	451*n*12	Float	

System Parameters			
Parameter	**Address**	**Data Type**	**Valid Values**
System Software Revision	453001.12H	String	Read Only
Reset Factory Defaults	453007	Word	1 (***To Reset Factory Defaults***)
System Reset Counter	453008	Word	Read Only
Alarm Acknowlege	453009	Word	Write Only

6.1 Modbus Register Address Map (Continued)

Data logging Parameters			
Parameter	**Address**	**Data Type**	**Valid Values**
Enable	053101	Boolean	0=False; 1=True
Interval	453101	Word	0-36 ***(See Section 6.2.15)***
Duration	453102.12H	String	Read Only
Overwrite Data Log Data	453108	Word	0=No; 1=Yes
Reset Datalog Memory	453109	Word	1 **(*Reset Memory*)** Write Only
CH1 Trigger Assignment	453110	Word	0-4 ***(See Section 6.2.21)***
CH1 Trigger High Point	453111	Float	
CH1 Trigger Low Point	453113	Float	
CH2 Trigger Assignment	453115	Word	0-4 ***(See Section 6.2.21)***
CH2 Trigger High Point	453116	Float	
CH2 Trigger Low Point	453118	Float	

6.2 Code and Unit Tables

The code and unit tables give meaning to the some of the parameters listed in the register map.

6.2.1 Application Type Codes

Code	Meaning
0	Level Application
1	Flow Application

6.2.2 Range Assignment Codes

Code	Meaning
0	Distance
1	Level
2	Volume
3	Flow

6.2.3 Vessel Type Codes

Code	Meaning
0	User Defined
1	Linear Vessel
2	Horizontal Cylinder
3	Horizontal Cylinder with Dished Ends
4	Horizontal Cylinder with Hemispherical Ends
5	Sphere

6.2 Code and Unit Tables (Continued)

6.2.4 Standard Vessel Codes *..Used to Copy Standard Vessel Table to Strapping Table*

Code	Meaning
0	Linear Vessel
1	Horizontal Cylinder
2	Horizontal Cylinder with Dished Ends
3	Horizontal Cylinder with Hemispherical Ends
4	Sphere

6.2.5 Flume/Weir Type Codes

Code	Meaning
0	H Flume
1	Leopold Lagco Flume
2	Parshall Flume
3	Submerged Parshall Flume
4	Palmer Bowlus Flume
5	Trapezoidal Flume
6	Rectangular Weir With End Contractions
7	Rectangular Weir Without End Contractions
8	Cippoletti Weir
9	V Notch Weir
10	User Defined

6.2.6 Totalizer Scale Codes

Code	Meaning
0	x100
1	x1,000
2	x10,000
3	x100,000
4	x1,000,000

6.2.7 Gain Type Codes

Code	Meaning
0	Smart Gain
1	Standard 100%
2	Standard 84%
3	Standard 67%
4	Standard 50%
5	Standard 32%
6	Standard 17%
7	Standard 8%

6.2 Code and Unit Tables (Continued)

6.2.8 Repetition Rate Codes

Code	Meaning
0	300ms
1	400ms

6.2.9 Analog Output Codes

Code	Meaning
0	down-scale current (3.7mA)
1	up-scale current (22mA)

6.2.10 Relay Type Codes

Code	Meaning
0	Alarm
1	Control
2	Sample
3	Pump 1 (For Pump Alternation)
4	Pump 2 (For Pump Alternation)
5	Pump 3 (For Pump Alternation)
6	Pump 4 (For Pump Alternation)
7	Pump 5 (For Pump Alternation)
8	Pump 6 (For Pump Alternation)
9	Manual Alarm
10	Manual Normal

6.2.11 Channel Assignment Codes

Code	Meaning
0	Channel 1
1	Channel 2

6.2.12 Variable Assignment Codes

Code	Meaning
0	Distance
1	Level
2	Volume
3	Flow
4	Percent of Range
5	Flow Sum
6	Flow Difference
7	Submergence
8	Traveling Screen
9	Lost Echo (Not Valid for Analog Outputs)
10	Near Zone (Not Valid for Analog Outputs)

6.2 Code and Unit Tables (Continued)

6.2.13 Time Delay Mode Codes

Code	Meaning
0	Forward Acting
1	Reverse Acting

6.2.14 Failsafe Codes

Code	Meaning
0	High Level Failsafe
1	Low Level Failsafe

6.2.15 Data Log Interval Codes

Code	Meaning
0	5 Seconds
1	10 Seconds
2	15 Seconds
3	20 Seconds
4	25 Seconds
5	30 Seconds
6	35 Seconds
7	40 Seconds
8	45 Seconds
9	50 Seconds
10	55 Seconds
11	1 Minute
12	5 Minutes
13	10 Minutes
14	15 Minutes
15	20 Minutes
16	25 Minutes
17	30 Minutes
18	35 Minutes
19	40 Minutes
20	45 Minutes
21	50 Minutes
22	55 Minutes
23	1 Hour
24	1.5 Hours
25	2 Hours
26	3 Hours
27	4 Hours
28	5 Hours

6.2 Code and Unit Tables (Continued)

29	6 Hours
30	7 Hours
31	8 Hours
32	9 Hours
33	10 Hours
34	11 Hours
35	12 Hours
36	Interval Trigger Off

6.2.16 Level Unit Codes

Code	Meaning
44	feet
45	meters
47	inches
48	centimeters
49	millimeters

6.2.17 Volume Unit Codes

Code	Meaning
40	gallons
41	liters
42	imperial gallons
43	cubic meters
46	barrels

6.2.18 Flow Unit Codes

Code	Meaning
16	gallons per minute
19	cubic meters per hour
23	million gallons per day

6.2.19 Temperature Unit Codes

Code	Meaning
32	degrees Celsius
33	degrees Fahrenheit

6.2 Code and Unit Tables (Continued)

6.2.20 Sensing Element Status Codes (Bit Enumerated)

Code (Decimal)	Code (Hexadecimal)	Meaning
0	00	Status OK
1	01	Lost Echo
2	02	Near Zone
4	04	Reserved
8	08	The Sensing Element Has Reset
16	10	Over Range
32	20	Under Range
64	40	Span Too Small
128	80	A Fault Occurred
129	81	Reserved
130	82	EEPROM Checksum Error
132	84	Reserved
136	88	EEPROM Response Error
144	90	Sensor Not Found (Communications Error)
160	A0	Reserved
192	C0	Reserved

NOTICE

All status values greater than 64 (Decimal) are considered fault conditions.

6.2.21 Data Log Trigger Assignment Codes

Code	Meaning
0	Distance
1	Level
2	Volume
4	Trigger Assignment Off

Section 7

Section 7: Data Logger

7.1 Description

The OPTISOUND has the ability to record over 24 months of time-stamped data. This data is extracted using OPTIVUe™. OPTIVUe™ is a PC program that will download the logged data from the OPTISOUND, and save it in a Comma Separated Variable File (.csv) for opening in programs such as Microsoft® Excel®. The USonicR Data Logger allows 36 diferent time intervals ranging from 5 seconds to 12 hours. The duration of data logging will depend on the interval selected.

The following data is logged:

Parameter/Value	Description
Channel Enable	Y=Yes; N=No
Application Type	L=Level; F=Flow
Distance	
Level	
Volume/Flow	Depends on Application Type
Percent of Range	%
Status	LE=Lost Echo; NZ=Near Zone
Temperature	°C or °F
Submergence	%
Analog Output 1	mA
Analog Output 2	mA
Relay Status 1-6	A=Alarm; N=Normal
Time Stamp	Time Format: M-D-YY H:MM:SS a/p

7.2 Configuration

7.2.1 Data Logger Enable

The Data Logger may be enabled or disabled in menu item 5.03.01. The Data Logger is disabled by default.

7.2.2 Logging Interval

The Data Logging Interval may my changed in menu item 5.03.02. The OPTISOUND allows 36 different interval values ranging from 5 seconds to 12 hours. The Interval Function may be disabled by selecting "OFF" for the Interval Parameter.

7.2.3 Logging Duration

This Parameter is read only. It indicates the logging duration based off of the interval.
Example:

1. If the Logging Interval was set to 5 seconds, the Duration value would be 2H 50M, for 2 hours and 50 minutes.
2. If the Logging Interval was set to 12 hours, the Duration value would be 2Y 294D, for 2 years and 294 days.

Due to the limited number of characters available on the LCD display, the duration values may not have space to display the nearest minute, if the duration is greater than 1 day.

7.2.4 Trigger Assignments

NOTICE

In addition to the data log interval, the data logger is capable of being triggered by two additional sources, or one source per input channel. Each trigger source has a corresponding high and low trigger point.
Example:
To configure the data logger to record a log point when the level of channel 1 rises above 180 inches and falls below 120 inches, configure the following:

1. Assign CH1 Trigger Assignment (menu item 5.03.04) to Level.
2. Change CH1 High Trigger Point (menu item 5.03.05) to 180 inches.
3. Change CH1 Low Trigger Point (menu item 5.03.06) to 120 inches.

7.3 Using OPTIVUe™

7.3.1 Overview

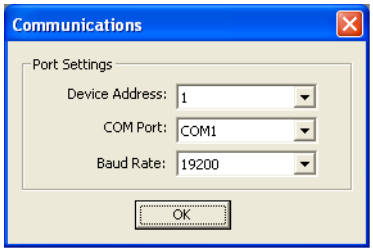
OPTIVUe™ is a PC program that will download the logged data from the OPTISOUND, and save it in a Comma Separated File (.CSV) for opening in programs such as Microsoft® Excel®.

7.3.2 Configuration

Choose Options->Communications in the menu to open the communications dialog box. The Communications dialog box allows the user to change the Device Address (Same as Device ID), the COM Port, and the Baud Rate. Change the Baud Rate and the Device Address to match the settings on the OPTISOUND that you wish to communicate with. OPTIVUe™ will communicate with either RS232 or RS485. An RS485 converter or PC card will be required for RS485.

7.3.3 Downloading Log Data

The OPTISOUND has a maximum of 2048 possible log points. You may select the



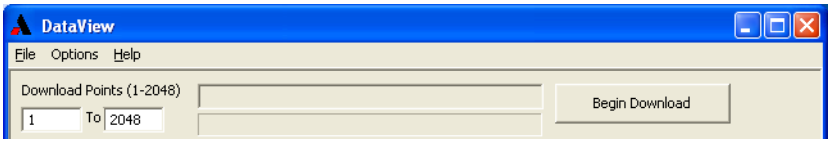
starting and ending points to download. Point 1 is the oldest point. If the user chooses to download points lowest to highest, the data will be downloaded as oldest to newest. The user may also download points highest to lowest. This will give the user the most recent logged data first.

Point 2048 will not be the newest point if the OPTISOUND has not yet logged at least 2048 points. For example, if the USonic has only logged 5 points since the first power-up, the newest point would be Point 5.

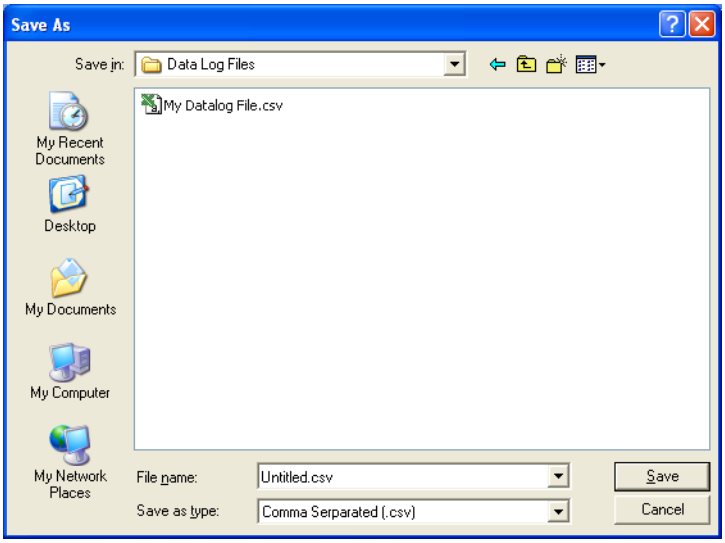
7.3.4 Saving Log Data

NOTICE

Choose File-> Save As to save the data to a CSV (Comma Separated Variable) file. This file may then be opened using programs such as



Microsoft® Excel® for analysis of the log data.



Section 8

Section 8: Troubleshooting

The OPTISOUND™ Series Ultrasonic Level Measurement System is designed to give years of unattended service. No periodic or scheduled maintenance is required.

8.1 Troubleshooting Procedures

If a problem should occur with the operation of the system, use the following procedure for troubleshooting.

1. Ensure wiring connections are correct.
2. If the liquid surface has severe turbulence in the area where the ultrasonic beam hits, consider increasing damping time.
3. Splashing of material or condensation on the Sensing Element face could cause unreliable measurements.
4. Any continuous ultrasonic signal (echo) can be adversely affected by significant foam on the liquid level surface. If this condition exists, please consult the factory for further application review and advice.
5. Ensure that the Sensing Element face is not recessed into a mounting nozzle, unless a SmartGain™ setting is used. Spurious reflections from the nozzle can cause faulty operation.
   Maximum Nozzle Length = 18.5" (470 mm)
6. To indicate a fault condition, the 4-20 mA signal locks to 22 mA (or 3.7 mA) . If output is locked at 22 mA (or 3.7 mA), check that:

   A) The level of the material has not violated the near zone (12 inches, 30 cm) from the Sensing Element face.
   B) The low calibration setting is not more that 360 inches (30 ft., 914 cm) from the Sensing Element face.
7. Test for 4 mA and 20 mA.
   A) Using the Display Keypad to force the output signal to a constant 4 mA or 20 mA.
8. If attempts to locate the difficulty fail, notify the local factory representative, or call KROHNE, Inc. directly.

   To aid in troubleshooting, please complete the information in Section 8.4 before calling the factory service department.

8.2 Optimized Field Calibration

The Configuration Menu Allows a 1-Point calibration based on a known actual distance. This can adjust for any possible variations that may exist in the speed of sound, or to provide an optimized calibration data point in difficult applications.

- Using the Display Keypad, enter the correct actual distance from the Sensing Element face to level. The OPTISOUND will use this data point as reference on all future readings, unless "Restore Factory Settings" is selected.

8.3 Analog Output Adjustment

Trimming the analog output to match a loop meter (This function is factory calibrated, and generally does not have to be adjusted)

TRIM 4mA (4.0n.07)

1. Measure the loop current (mA dc) on the desired analog output channel.
2. Menu 4.0n.07 will force the loop current to 4.00mA.
3. Using the keypad, enter the actual loop current indicated on your device (multimeter)
4. The receiver will recalibrate the analog output to match your entered value.

TRIM 20mA (4.0n.08)

1. Measure the loop current (mA dc) on the desired analog output channel.
2. Menu 4.0n.08 will force the loop current to 20.00mA.
3. Using the keypad, enter the actual loop current indicated on your device (multimeter)
4. The receiver will recalibrate the analog output to match your entered value.

8.4 Telephone Assistance

If you have questions about your KROHNE, Inc. equipment:

- Contact your local KROHNE, Inc. representative
- Call the KROHNE, Inc. Service department toll-free at: 1-800-356-9464 (US and Canada) (978 535 6060 in MA)

- Fax the following information to the Service department at: 978 535 1720.

To expedite assistance, please provide the following information:

Instrument Model Number: _____

Original Purchase order number: _____

Material being measured: _____

Temperature: _____

Pressure: _____

Agitation: _____

Brief description of the problem: _____

_____

Checkout procedures that have failed: _____

_____

8.5 Equipment Return / Warranty

In order to provide the best service, any equipment being returned for repair or credit must be pre-approved and have a return number issued by the factory.

In many applications, the equipment is exposed to hazardous materials.

- OSHA mandates that our employees be informed and protected from hazardous materials.
- Material Safety Data Sheets (MSDS) listing the hazardous material that the system has been exposed to must accompany any return.
- It is your responsibility to fully disclose all chemicals and decontaminate the returned items.

To obtain a return authorization number (RA#), contact the Service department at:
1-800-356-9464 (US and Canada) (978 535 6060 in MA)

Please provide the following information:

Model Number of Returned Equipment:_____

Serial Number: _____

Original Purchase Order Number: _____

Process Material that the equipment has been exposed: _____

MSDS for any hazardous materials

Billing Address:_____

Shipping Address: _____

Purchase Order Number for Repairs:_____

Please include a purchase order number even if the repair is under warranty. If repair is covered under warranty, you will not be charged.

Ship equipment freight prepaid to:
KROHNE, Inc.
7 Dearborn Road
Peabody, MA (USA) 01960

COD shipments will not be accepted.

KROHNE, Inc. warrants its products free of material defects or manufacturing defects for a period of 1 year after date of shipment.

8.6 Field Service

Trained field service personnel are available on a time-plus-expense basis to assist in start-ups, diagnosing difficult application or equipment problems, or in-plant training of personnel. Preventive Maintenance and Calibration Certification service contracts are also available to maintain plant efficiency. Contact the Service department for further information.

Section 9: System Specifications

9.1 System Specifications

Power Requirement
VU31 24 VDC (1A), 120 VAC
VU32 24 VDC (1A), 240 VAC
Maximum analog output load resistance = 1000 ohms.

Power Consumption
12 Watts

Ambient Operating Temperature
Electronics: -40°F to 158°F (-40°C to 70°C)
LCD Display: -4°F to 158°F (-20°C to 70°C)

Ambient Temperature Effect
+/- 0.1% per 1°F

Repeatability
0.1 inch (3 mm)

Resolution
0.125 inch (3 mm)

Response Time
Less than 1 second

Calibration
Zero & Span: to nearest .01 inch (3 mm)
Near Zone: 12 inches (305 mm)
Minimum span: 3 inches (76 mm)
Maximum span: 30 feet (9.1 m)

Output
4–20 mA DC (isolated)

Accuracy
0.15% of Max. Sensing Element range, or 0.2" (5mm)
whichever is greater

Temperature compensation
Automatic

Damping
0 to 99 seconds

Lost Echo
22 mA or 3.7 mA – field selectable

Near Zone
22 mA or 3.7 mA – field selectable

Pulse Repetition Rate
300 or 400 msec – field selectable

9.1 System Specifications (Continued)

Fail Safe
22 mA

Relays
(6) SPDT @ 5A 250VAC with 12 user defined trip points.

Enclosure
Fiberglass reinforced Polyester (FRP) to NEMA 4X (IP-66)

9.2 Sensing Element Specifications

Sensing Element
Material: CPVC
Pressure: -10 to 50 psig

Operating Temperature
-40 to 158°F (-40°C to 70°C)

Beam Angle
Conical, 10° typical, at the 3 db down point

Sensing Element Ingress Protection Rated to
NEMA 4X, NEMA 6/6P, IP 68

9.3 Modbus Specifications

Baud Rate: 19200

COM ID: COM 1

Data Bits: 8

Parity: Even

Stop Bit: 1

9.4 Software

Level, Distance, Volume, Flow rate via user selectable Flume and Weir characterizations or 21-Point strapping table, Totalization via 1 resettable and 1 non-resettable totalizer. Differential Level (Channel #1 vs. Channel #2) for Submerged Flow, Sum, Difference, and Traveling Bar Screen Control, Pump Alternation, Batch Sample Activation.

Data Logger
Up to 24 Month. Maximum time period dependant on sample rate.
Requires OPTIVUe™ PC Software to download the data.

9.5 Approvals

Model VU31-ab1c-0def-0ghi. VU31 Series Receiver

AIS / I, II, III / 1 / ABCDEFG / T4 Ta=70° C; - 420-0004-309-CD Entity; Type 4, 4X, IP65
I / 0 / AEx [ia] IIC / T4 Ta=70° C; - 420-0004-309-CD Entity; Type 4, 4X, IP65
NI / I / 2 / ABCD; S / II, III / 2 / EFG / T4 Ta=70° C; Type 4, 4X, IP65
I / 2 / IIC / T4 Ta=70° C; - 420-0004-309-CD Entity; Type 4, 4X, IP65

Entity Parameters:

Output Entity Parameters:

Uo (Voc) = 25.9 V, Io (Isc) = 69.5 mA, Po = 0.45 W, Co (Ca) = 100 nF, Lo (La) = 7.4 mH
Vt = 25.9 V, It = 139 mA, Po = 0.9 W, Ca = 100 nF, La = 1.8 mH

Model VU32-1a-0cde. Usonic VU32 Series Sensor

IS / I, II, III / 1 / ABCDEFG / T4 Ta=70° C; - 420-0004-309-CD Entity; Type 4, 4X, IP68
I / 0 / AEx ia IIC / T4 Ta=70° C; - 420-0004-309-CD Entity; Type 4, 4X, IP68
NI / I / 2 / ABCD; S / II, III / 2 / EFG / T4 Ta=70° C; Type 4, 4X, IP68
I / 2 / IIC / T4 Ta=70° C; - 420-0004-309-CD Entity; Type 4, 4X, IP68

Entity Parameters:

Output Entity Parameters:

Ui (vmax) = 30 V, Ii (Imax) = 150 mA, Pi = 1 W, Ci = 0, Li = 0

Class I, Division 2, Groups A, B , C, and D, Class II, Groups E, F, and G, Class III
Ex nC II C
420-0004-309-CD, Ambient Temperature
Range -40° C to + 70° C, T4, Type 4, 4x, and IP65 (receiver), IP68 (sensor)

Class I, Division 1, Groups A, B , C, and D, Class II, Groups E, F, and G, Class III
Ex ia II C T4

Entity Parameters:

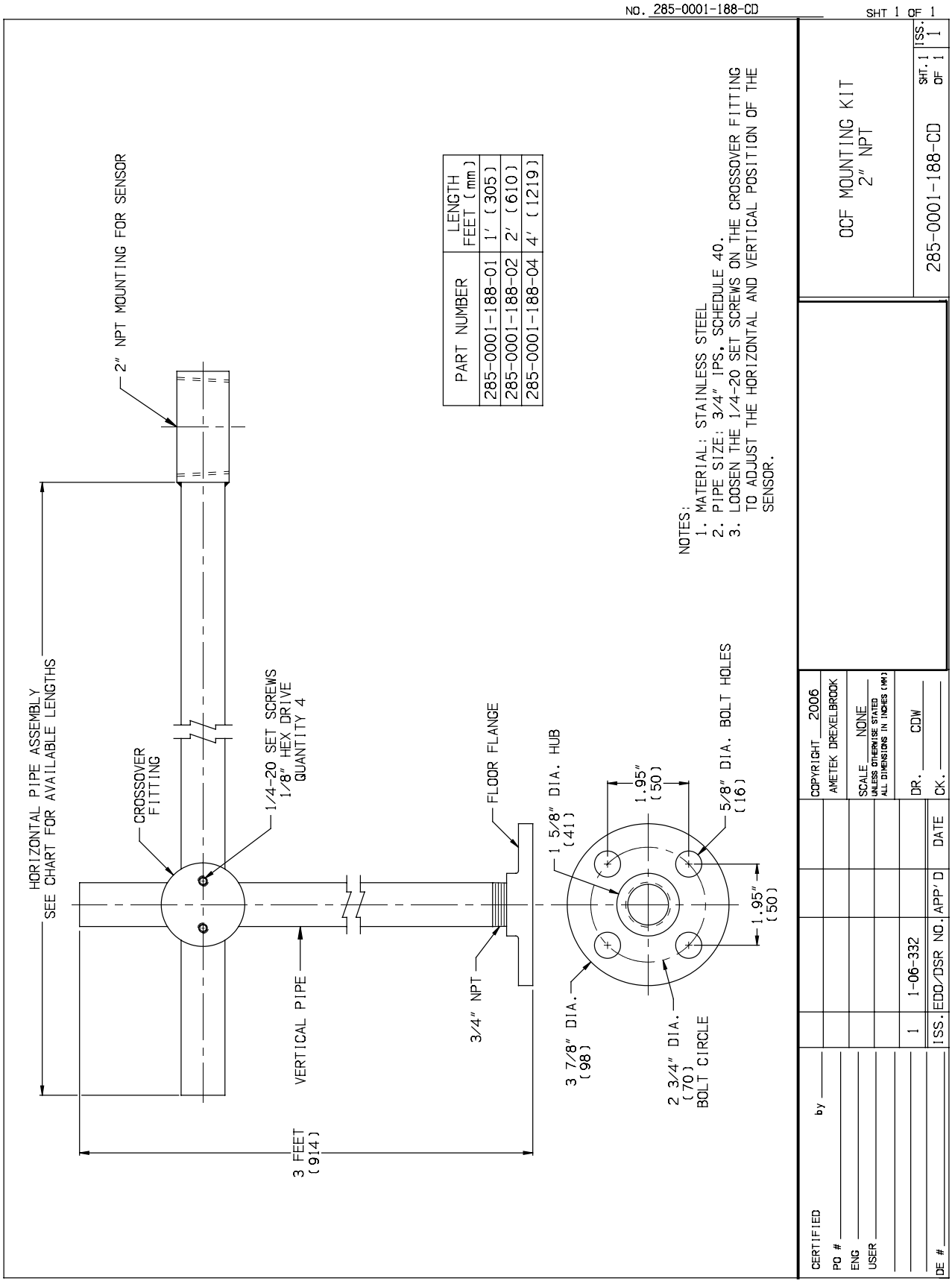
Ui (vmax) = 30 V, Ii (Imax) = 150 mA, Pi = 1 W, Ci = 0, Li = 0

PENDING - ATEX, CE Mark, IEC Ex, CEPEL, GOST
For Class I, Div. 2, Zone 2 hazardous locations with sensors suitable for Class I, Div. 1, Zone 0, Zone 1 hazardous locations.

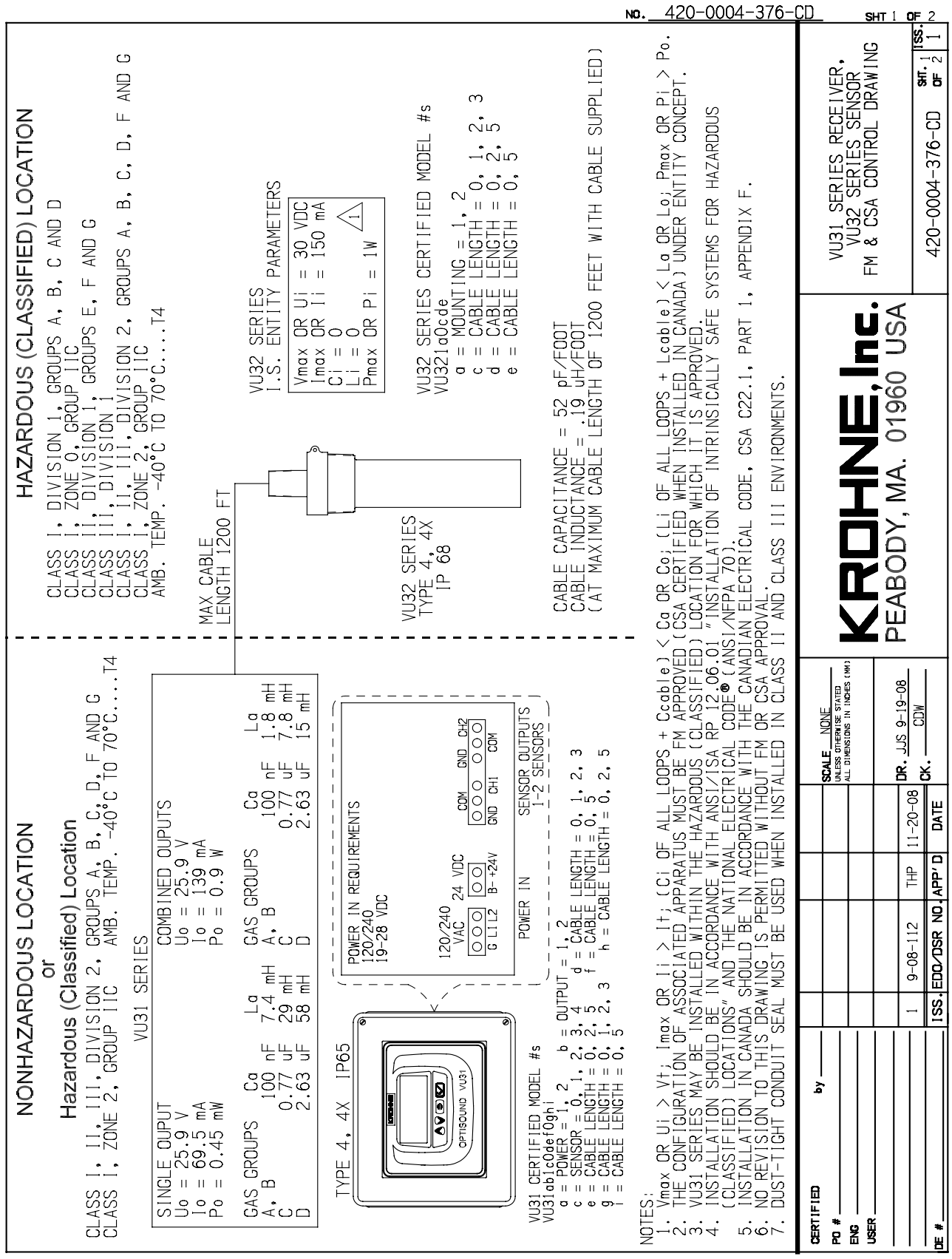
Section 10

Section 10: Drawings

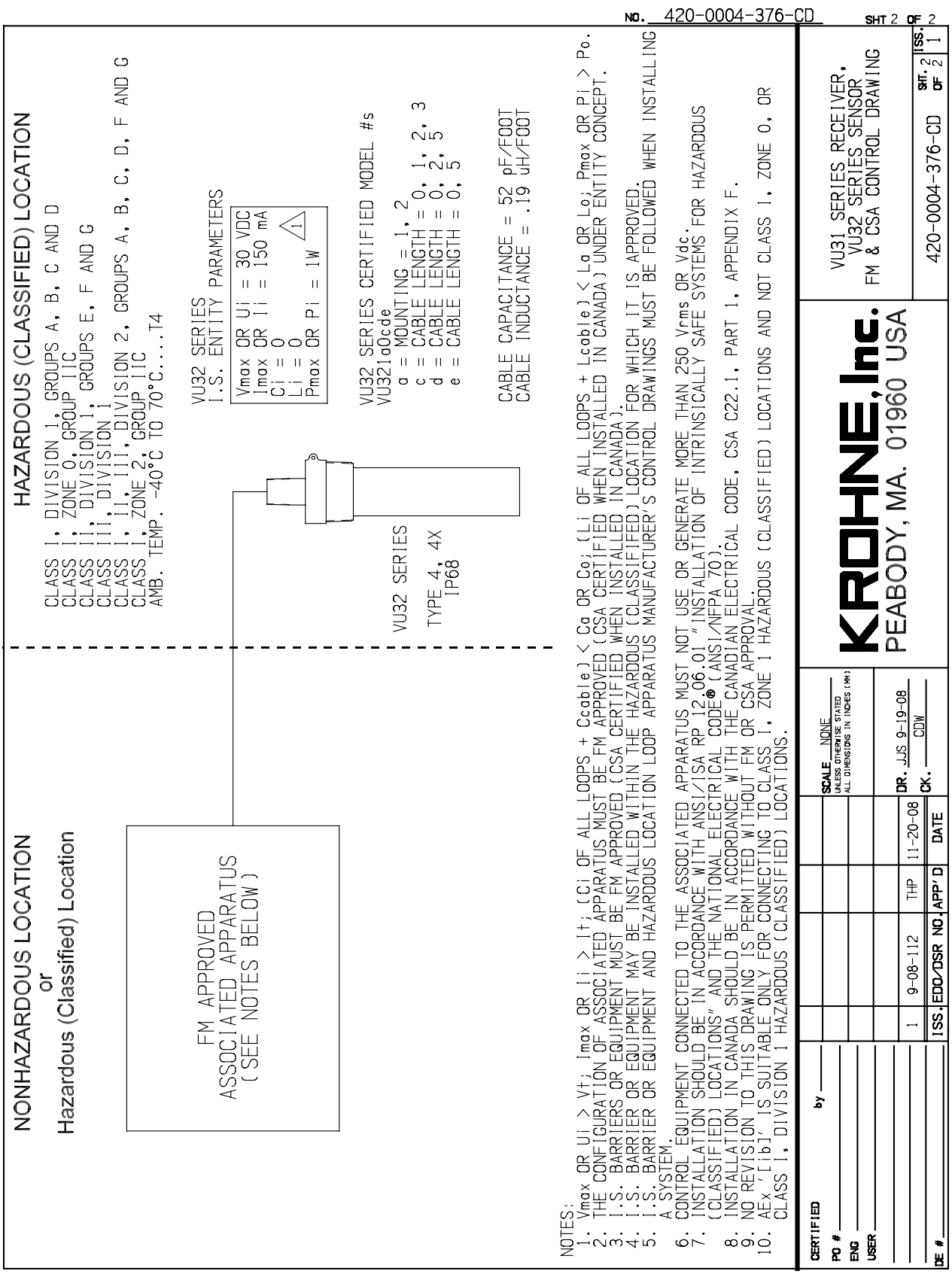
10.1 OCF Mounting Kit



10.2 FM Control Drawings



10.2 FM Control Drawings (Continued)



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