Installation and Operating Instructions

MetriSonic MS-30

Continuous Ultrasonic Level

M371E

March 2025

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MetriSonic

Continuous Ultrasonic Level Transmitter

Table of Contents

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 MS-30'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 MS-30 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.

Glossary of Terms

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)
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 MS-30 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.

1.00	**Input Type**	**Select Application Type**
1.01	Type	Level / Distance / Volume / Flow
2.00	**Level**	**Enabled Only When Level Selected**
2.01	Units	Inches / Feet / Meters / Centimeters / Millimeters
2.02	Tank Height	User Defined Numeric Value
2.03	Sensor Offset	User Defined Numeric Value
2.04	LRV	User Defined Numeric Value
2.05	URV	User Defined Numeric Value
3.00	**Distance**	**Enabled Only When Distance Selected**
3.01	Units	Inches / Feet / Meters / Centimeters / Millimeters
3.02	LRV	User Defined Numeric Value
3.03	URV	User Defined Numeric Value
4.00	**Volume**	**Enabled Only When Volume Selected**
4.01	Level Units	Inches / Feet / Meters / Centimeters / Millimeters
4.02	Tank Height	User Defined Numeric Value
4.03	Sensor Offset	User Defined Numeric Value
4.04	Vessel Type	Vertical / Hor Cyl Flat / Hor Cyl Dished / Hor Cyl Hemi / Sphere / Custom
4.05	Load Standard Table	Vertical / Hor Cyl Flat / Hor Cyl Dished / Hor Cyl Hemi / Sphere
4.06	Vessel Units	Gallons / M3 / Liters / Barrels / Imperial Gallons
4.07	Max Capacity	User Defined Numeric Value
4.08	LRV	User Defined Numeric Value
4.09	URV	User Defined Numeric Value
5.00	**Flow**	**Enabled Only When Flow Selected**
5.01	Flume Type	Parshall / Palmer Bowlus / Trapezoidal Flume / Rect Weir W/ End Contr. / Rect Weir W/o End Contr. / Trapezoidal Weir / V-Notch Weir / Custom / H-Flume / Leopold Lagco
5.02	Flume Size	Code from Table / or / Numeric Value

Quick Start Menu

5.03	Flow Units	GPG/ MGD / M3/HR / LPS / LPM
5.04	Max Flow	User Defined Numeric Value
5.05	Head Units	Inches / Feet / Meters / Centimeters / Millimeters
5.06	Distance to Zero	User Defined Numeric Value
5.07	Sensor Offset	User Defined Numeric Value (Used Only With Custom Flumes)
5.08	Totalizer Scale	X1 / X10 / X100 / X1k / X10k / X100k / X1Mil
5.09	Reset Totalizer?	No / Yes
6.00	**Strapping Table**	**Enabled When Volume or Flow Selected**
6.01	Max Points	0…21
6.02	In Pont 1	User Defined Numeric Value
6.03	Out Point 1	User Defined Numeric Value
6.04-6.43	In / Out Points	User Defined Numeric Value
7.00	**System Settings**	
7.01	Temperature Units	F / C
7.02	Gain Adjustment	Hd / Hd High / 100% / 84% / 67% / 50% / 32% / 17% / 8%
7.03	HD Adjustment	Numeric Value (Consult Factory)
7.04	Rep Rate	300ms / 400ms / 700ms / 1500ms
7.05	Echoes	1-10 Consult Factory
7.06	Damping Time	User Defined Numeric Value
7.07	Near Zone Fault	High / Low
7.08	Lost Echo Fault	High / Low / LST VAL
7.09	Lock Ma Output	User Defined Numeric Value
7.10	Trim 4ma	User Defined Numeric Value
7.11	Trim 20ma	User Defined Numeric Value
7.12	Hart Mode	Normal / DCS (X100)
7.13	Polling Address	0…15
7.14	Restore Factory Defaults?	No / Yes
7.15	Password	Edit Password
7.16	Password Enabled?	No / Yes
7.17	Contrast	0…10…50
8.00	**Display**	
8.01	Toggle?	No / Yes
8.02	Level	Enable / Disable
8.03	Distance	Enable / Disable
8.04	Volume	Enable / Disable
8.05	Flow	Enable / Disable
8.06	Total	Enable / Disable
8.07	Resettable Total	Enable / Disable
8.08	mA Output	Enable / Disable
8.09	Temperature	Enable / Disable
9.00	**Calibration**	
9.01	Point Calibration	Enter Distance To Product

Quick Start Menu

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

Section 1: Introduction

1.1 Product Description

The JOWA USA's MetriSonic MS-30 instrument is a Two-Wire (Integral) assembly. Using ultrasonic technology, the MS-30 continuously and accurately measures **Level** up to a range of 30 feet or **Open Channel Flow**. The measurement output is a 4-20 mA current signal or HART® digital communications.

The Ultrasonic sensor is made of CPVC for compatibility with a wide range of process materials.

1.2 Model Available

The Metrisonic Model MS-30

1.3 System Specifications:

- **Power:** 19 to 30 Vdc
- **Output:** 2-Wire, 4-20 mA, HART
- **Sensor:** 6.5" CPVC sensor rated: -40°F to +160°F (-40°C to +71°C)
- **Sensor Mounting:** 2" NPT or 2" BSP, CPVC
- **Display Option:** 2-Line, 7 digit LCD
- **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.

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 transducer face.

Near Zone:
The distance just below the transducer face where the transmitter 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 transducer. 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 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 transmitter the amount of distance above or below the top of the tank that the transducer face is located in order to calculate the tank volume. Sensor Offset can be applied in cases where:

- The transducer protrudes below the top of the tank, or
- The transducer is mounted above the top of the tank, or
- A pipe extension is installed to raise the transducer face 12 inches above the tank height to compensate for the 12-Inch Near Zone. **See Section 5.8.1.**

1.5 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 transducer. Configuration is referenced from the Transducer 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.

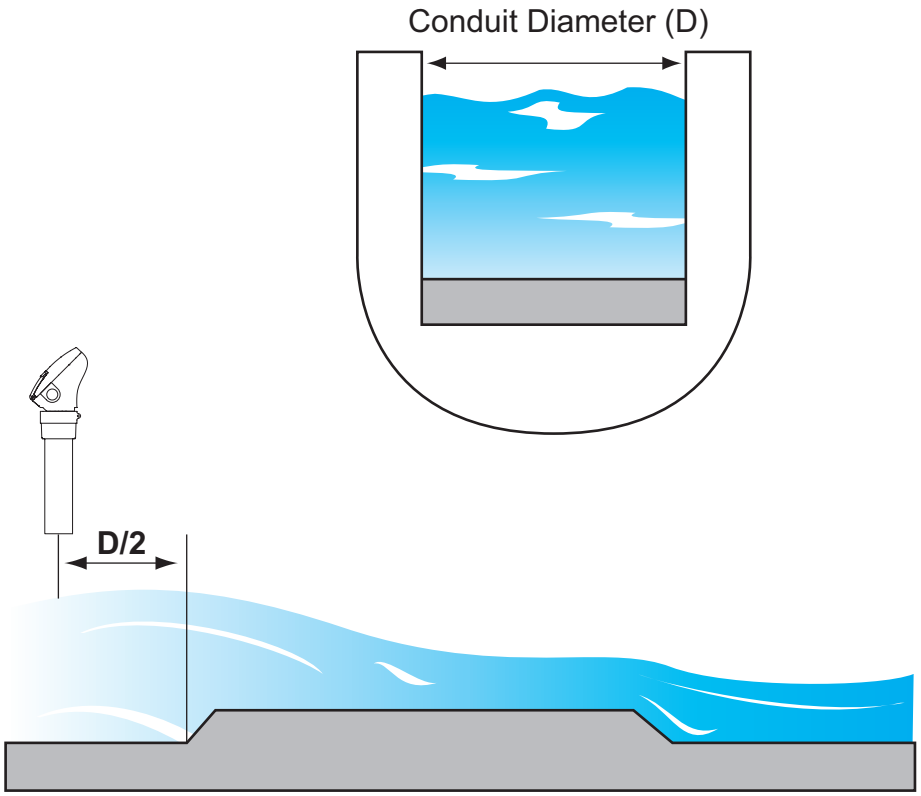
Fault Indication:

Output goes to 3.7 or 22 mA (user selectable) during a fault condition such as Lost Echo or Near Zone violations.

1.6 Types of Flumes and Weirs

The MS-30 Supports the Following Flumes and Weirs:

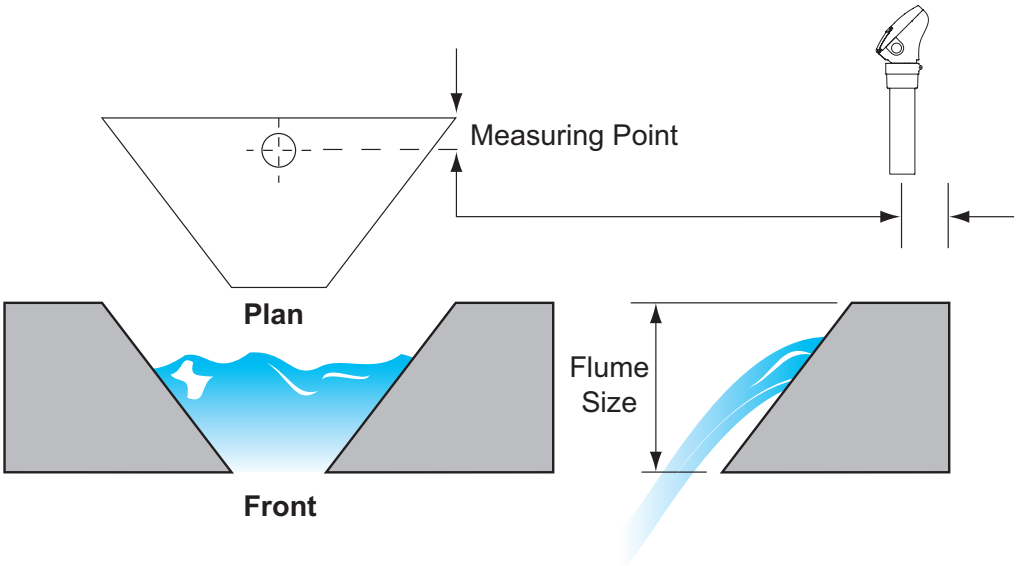
Leopold-Lagco Flumes (Variable Sizes):



1.6 Types of Flumes and Weirs (Continued)

"H" Flumes:

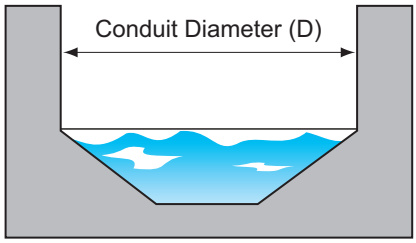
Code	Inches	Millimeters
1	6	152
2	9	229
3	12	305
4	18	457
5	24	610
6	30	762
7	36	914
8	54	1372

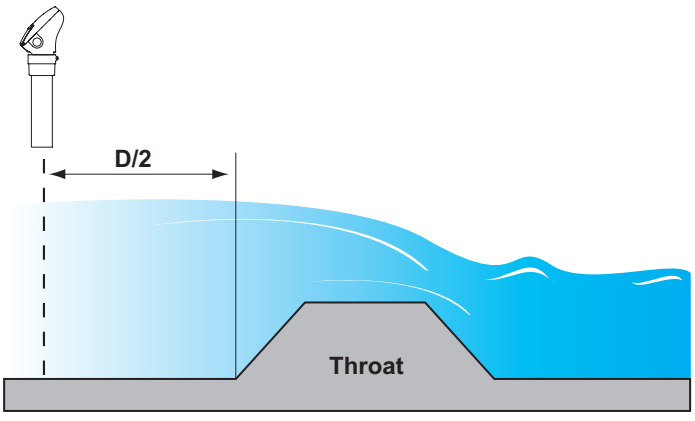


1.6 Types of Flumes and Weirs (Continued)

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



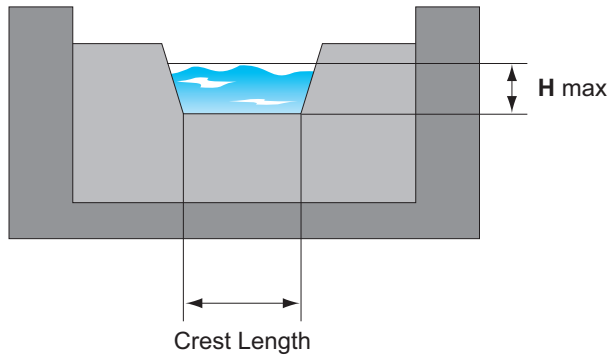


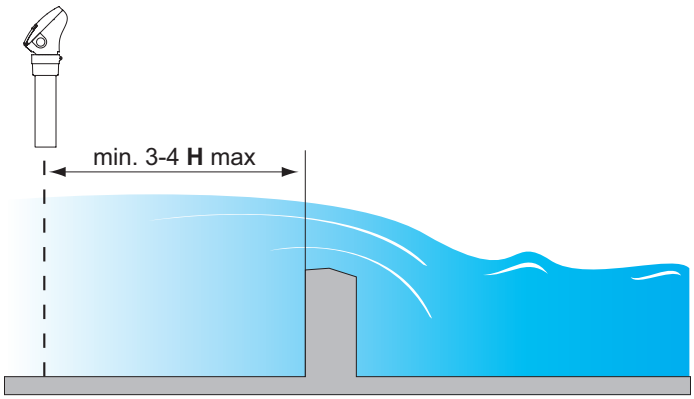
1.6 Types of Flumes and Weirs (Continued)

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

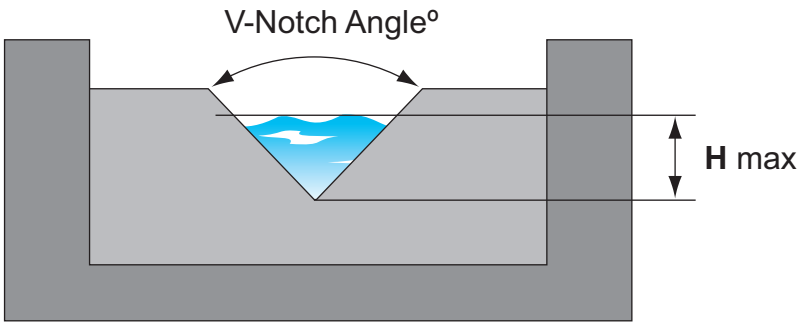


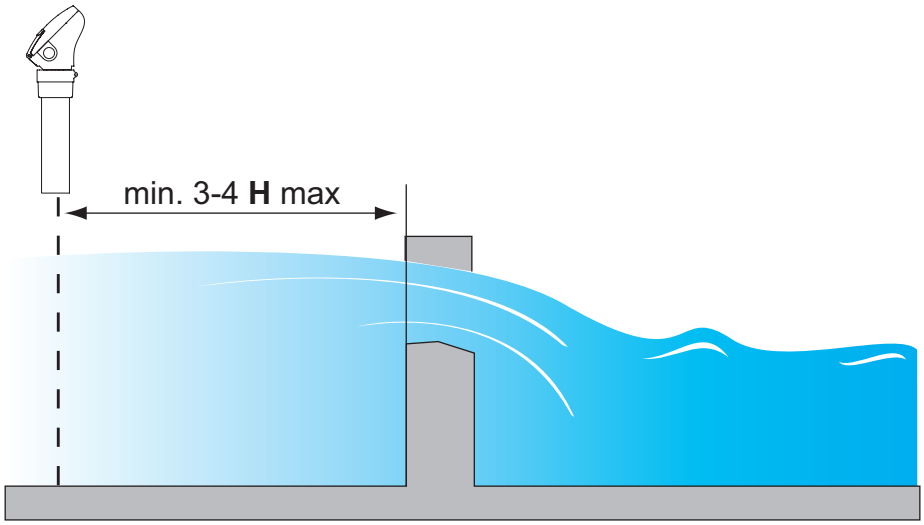


1.6 Types of Flumes and Weirs (Continued)

V-Notch Weirs:

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

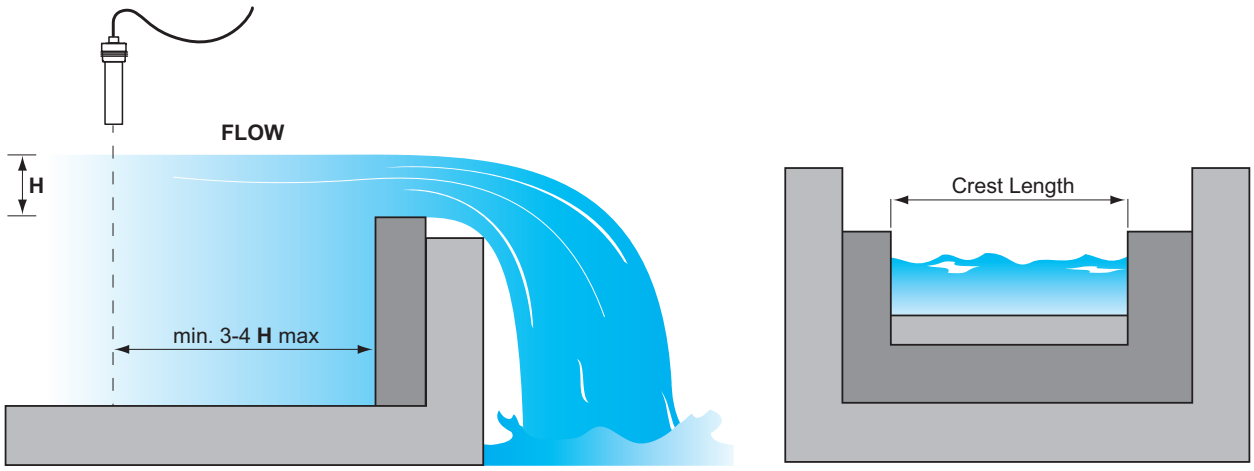




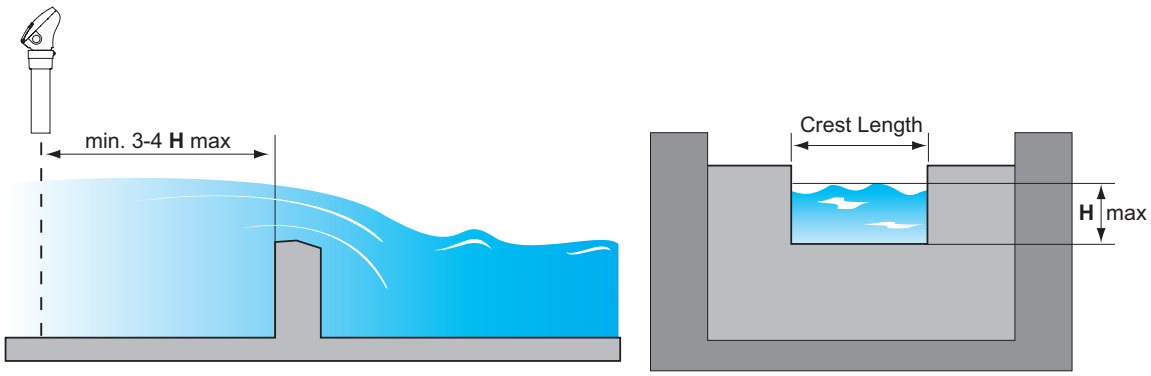
1.6 Types of Flumes and Weirs (Continued)

Rectangular Weirs (Variable Sizes):

Rectangular Weir with End Contractions



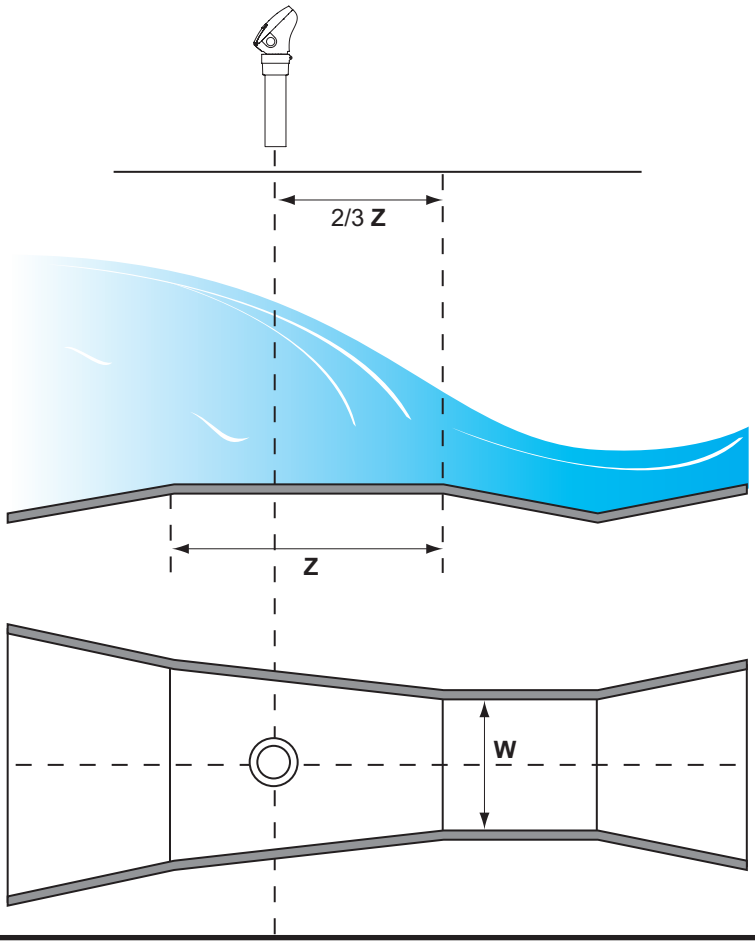
Rectangular Weir without End Contractions



1.6 Types of Flumes and Weirs (Continued)

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



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 Transmitter

The MS-30 transmitter is available only as an integral construction. The electronic transmitter is located within the tube assembly of the sensor and is not serviceable by the user. Tampering with this construction will void any existing warranties. **See Figure 2-1** for standard mounting dimensions.

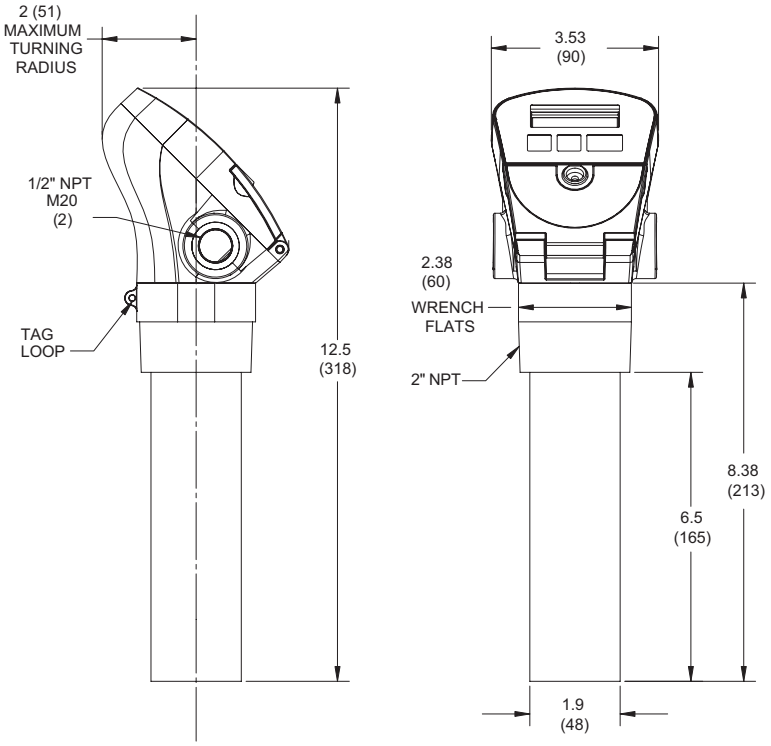


Figure 2-1
Mounting Dimensions

Warning - Potential Electrostatic Charge Hazard
Special Coondition for Use:
For Zone 0 Installations care should be taken that the plastic sensor 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 sensor.

2.2 Mounting the Transmitter (Continued)

TheMS-30 Series transmitter 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 MS-30 Series in a reasonably accessible location. Ambient temperature should be between -40°F to 158°F (-40°C to 70°C).

The transmitter must be mounted vertically with transducer perpendicular to the liquid surface. When mounting the MS-30 Series transmitter, consideration must be given to the 12-Inch (305 mm) Near Zone. If the level rises to within 12 inches (305 mm) of the sensor face, a user selectable 3.7 mA or 22 mA error signal is generated; Error message (nEAr) is indicated.

The conical beam of the MS-30 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 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)

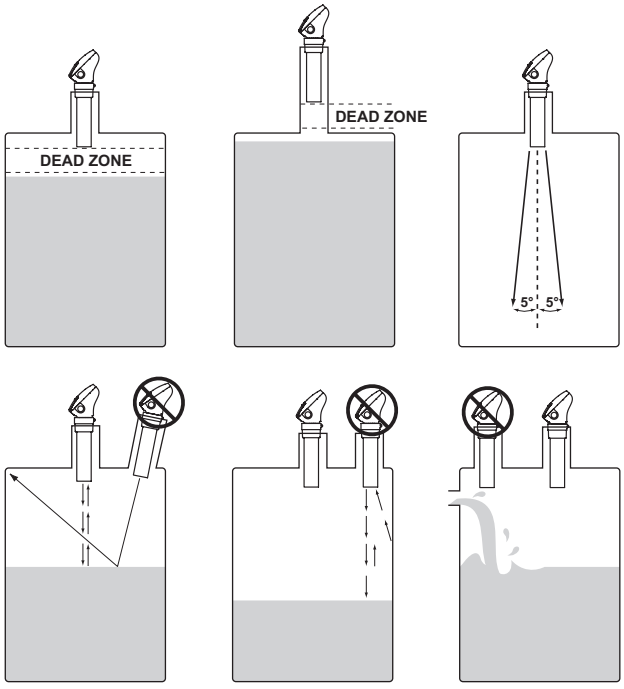


Figure 2-2 Mounting Recommendations

2.3 Wiring the Transmitter

WARNING! If the MS-30 Series transmitter 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.

See Figure 2-3 for the wiring diagram of the MS-30 Series transmitter.

Connect 2-wire input power / signal leads to the terminal block as shown. It is recommended to use twisted, shielded pair to eliminate noise. The shield (or drain) wire should be grounded at the power source and left floating at the MS-30 Series Transmitter end.

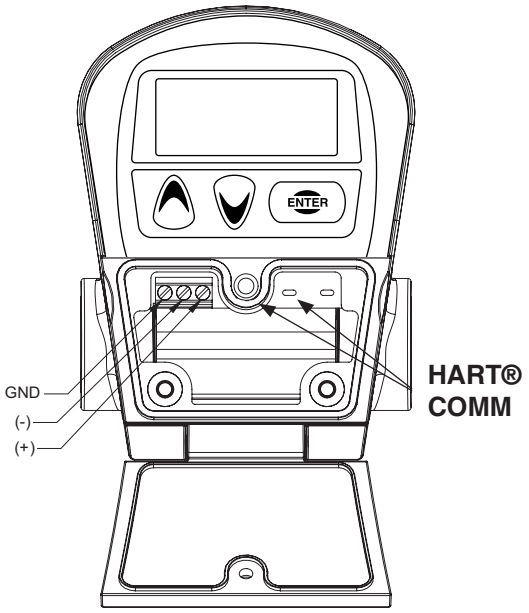
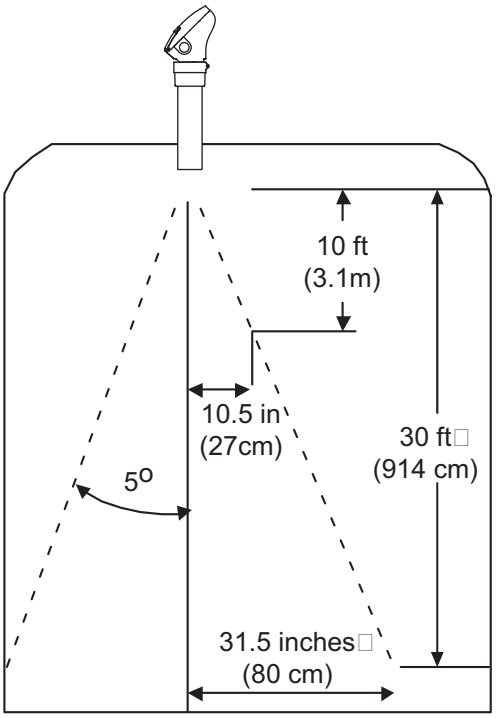
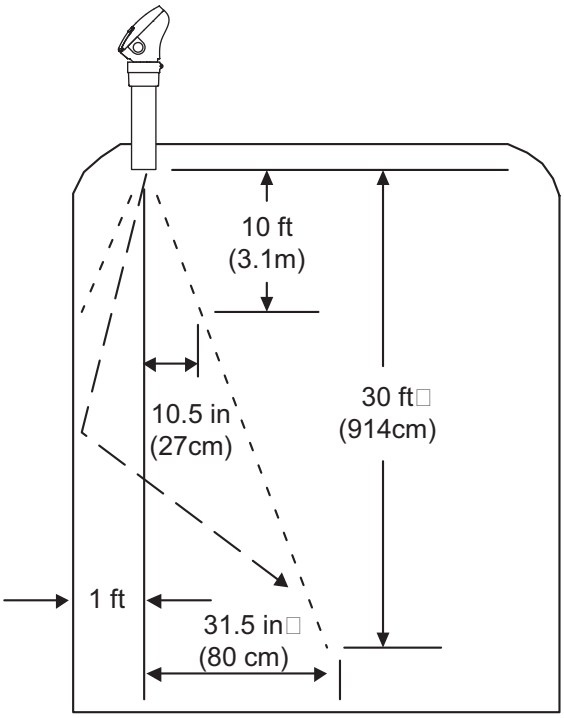


Figure 2-3
Wiring (14 - 22 AWG)

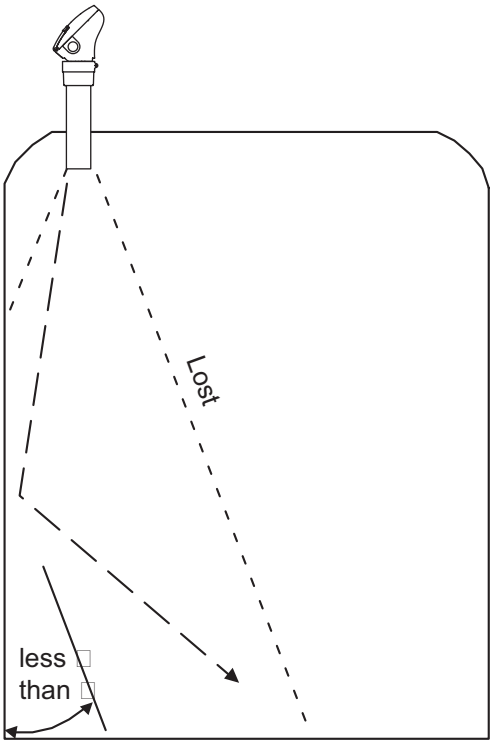
2.4 Installation Examples



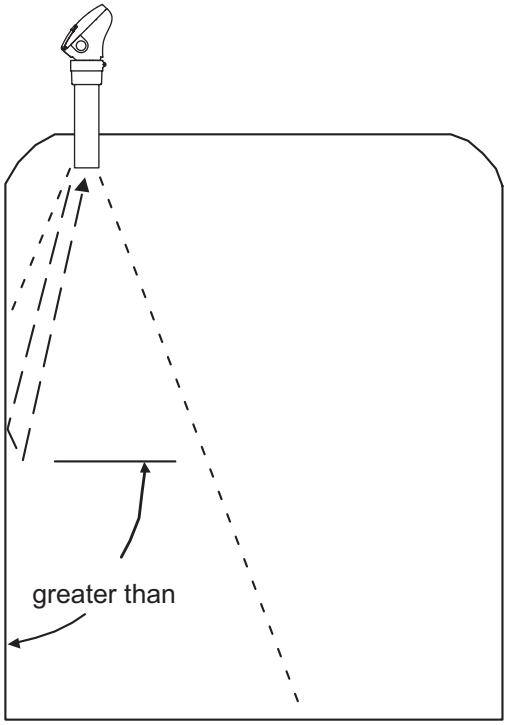
When there are no obstructions within the beam area, there is no chance of false echoes or readings.



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

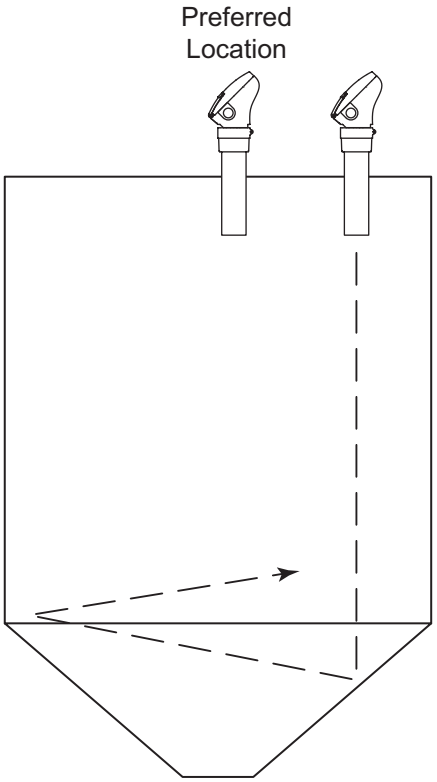


Protrusions from the wall at an angle less than 45 degrees does not cause false echoes.

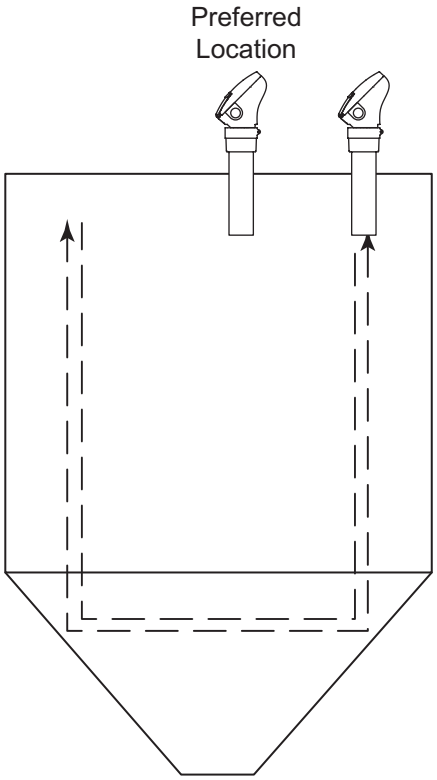


Protrusion from the wall at an angle greater than 45 degrees may cause false echoes.

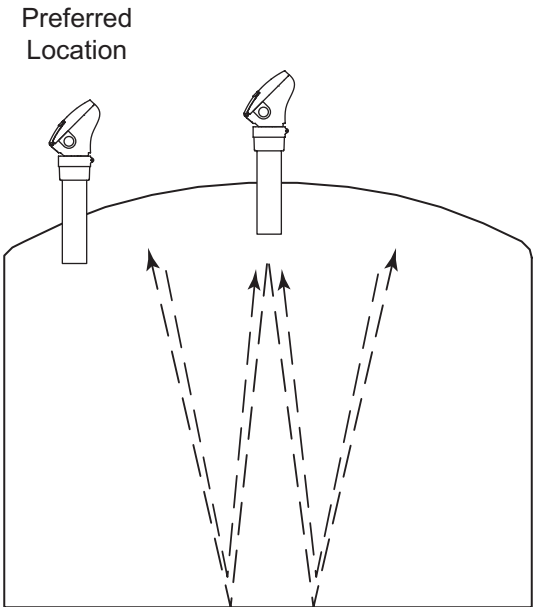
2.4 Installation Examples (Continued)



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

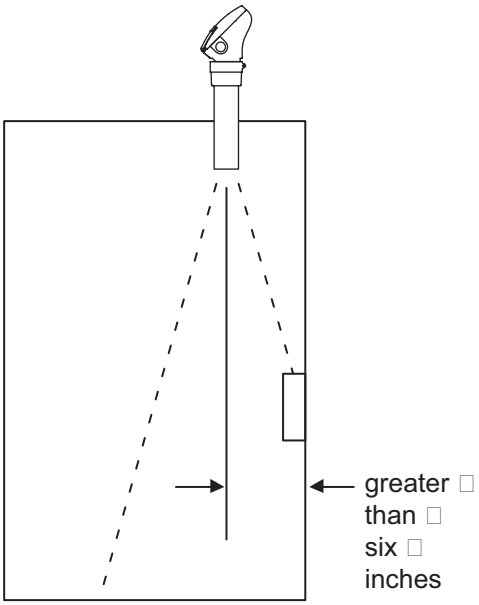


When mounted off center in conical bottom tanks, reflected echoes can be redirected back to the transducer. Use 400 mS pulse repeat rate to allow these echoes to subside before transmitting the next pulse and/or move the transducer to another location.



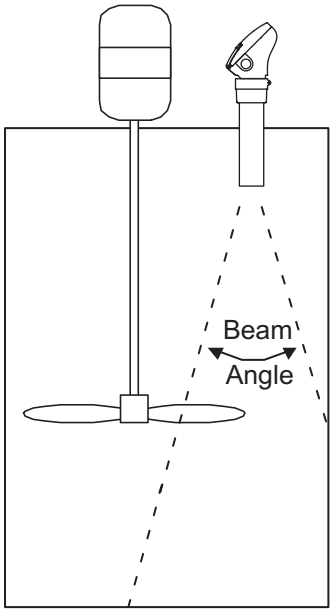
When mounted in the center of domed-roof tanks, reflected echoes can be redirected back to the transducer. Use 400 mS pulse repeat rate to allow these echoes to subside before transmitting the next pulse and/or move the transducer to another location.

2.4 Installation Examples (Continued)

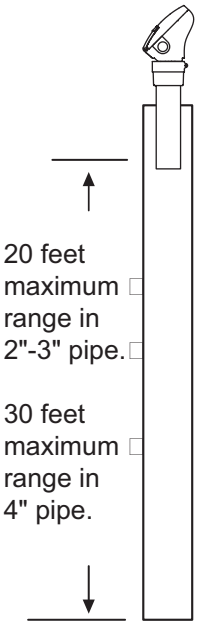


Mounted close to a wall or obstructions are present. Ability to ignore obstructions will depend on the exact size and location of the obstructions.

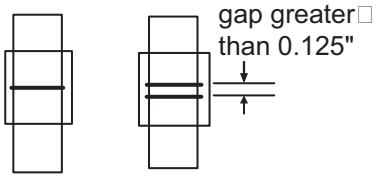
Use standard electronics with high discrimination setting.



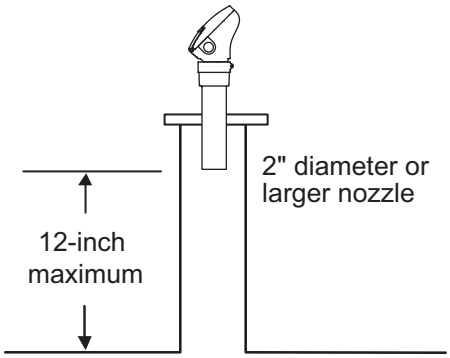
Agitators within the beam path



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.

Section 3: Configuration

3.1 System Configuration with Display / Keypad

The MS-30 system configuration is made up of 9 separate Functions (Fct.) for system and application set-up per the following:

Input Type:

Function 1.0 allows the user to select an appropriate "Input Type" for the application. The valid Input Types are:

- LEVEL (Fct 2.00)
- DISTANCE (Fct 3.00)
- VOLUME (Fct 4.00)
- FLOW (Fct 5.00)

Only one "Input Type" may be selected for the aplication. Once selected, only the Functions of the selected Input Type will be available.

Strapping Table:

Function 6.00 allows the user to edit the 21-Point user defined table that can provide output signal as a percent of volume or flow.

System Settings:

Function 7.00 allows setting changes to the system configuration.

Display Settings:

Function 8.00 allows the system to display readings in different formats. Any or all may be selected and the display will “cycle” through any or all selected, every 10 seconds.

Calibration:

Function 9.00 allows a 1-Point calibration based on a known distance from the transducer 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.

3.2 Configuration Menu

To enter the Configuration Menu:

- Press and Hold the "Enter" Button for approximately 5 seconds.
- Use the "Up" and "Down" Buttons to scroll through the available menu selections.
- Press "Enter" to access sub-menu items.
- Use the "Up" and "Down" Buttons to adjust settings.
  Settings that can be adjusted will be "flashing".
- Press "Enter" to accept the adjustment...Or...
- Press and Hold the "Enter" Button for approximately 5 seconds to exit to the previous menu level.

3.3 Menu Functions (See Section 3.5 for display abbreviations)

Function	Item	Description & comment	Menu Selection Choices
Fct. 1.00	**Input Type (TYPE)**	**Allows the user to navigate the menu based on the appropriate menu item selected (Level, Distance, Volume, Flow). Measurement items not selected cannot be accessed in the menu to reduce needed keystrokes and reduce information errors.**	
Fct. 1.01	Level Type (TYPE)	Edit the menu to select Level, Distance, Volume, or Flow. Press ENTER and the default setting will flash, use arrow buttons to cycle through available selections, press Enter again to make selection. Press and Hold Enter key to back out to previous menu item.	LEVEL DISTANCE VOLUME FLOW
Fct. 2.00	**Level Menu (LEVEL)**	**Allows system configuration for level. Only enabled when Level is selected in Fct. 1.01**	
Fct. 2.01	Level Units (UNITS)	User selects the units of measurement by "editing" the menu to select either Feet, Inches, Meters, Centimeters, of Millimeters	FEET INCHES METERS CENTIMETERS MILLIMETERS
Fct. 2.02	Tank Height (T_HGT)	Required for accurate Level measurement (Level = Distance - Tank Height). Edit the menu to reflect the correct distance from tank bottom to sensor face	Enter tank height as measured from tank bottom to sensor face
Fct. 2.03	Sensor Offset (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.	Enter the distance from the maximum tank level (reference point, if different from Tank Height) to sensor face.
Fct. 2.04	LRV	The point in the vessel that the output signal equals 4 mA (0%). Edit the menu to enter the distance from the tank bottom (reference point) to the 4 mA (0%) point	Enter the level unit point where 4 mA will occur, referenced from tank bottom.
Fct. 2.05	URV	The point in the vessel that the output signal equals 20 mA (100%). Edit the menu to enter the distance from the tank bottom (reference point) to the 20 mA (100%) point. This value must not be within the 12 inch Near Zone of the sensor face or an Error Message (NZSEUP) will be displayed.	Enter the level unit point where 20 mA will occur, referenced from tank bottom.
Fct. 3.00	**Distance (DISTNCE)**	**Allows the system configuration for distance. Only enabled when Distance is selected in Fct. 1.01**	

3.3 Menu Functions (Continued)

Function	Item	Description & comment	Menu Selection Choices
Fct. 3.01	Distance Units (UNITS)	User selects the units of measurement by "editing" the menu to select either Feet, Inches, Meters, Centimeters, of Millimeters	FEET INCHES METERS CENTIMETERS MILLIMETERS
Fct. 3.02	LRV	The point in the vessel that the output signal equals 4 mA (0%). Edit the menu to enter the distance from the sensor face (reference point) to the 4 mA (0%) point. This value must not be within the 12 inch Near Zone of the sensor face or an Error Message (NZSEUP) will be displayed.	Enter the level unit point where 4 mA will occur, referenced from sensor face.
Fct. 3.03	URV	The point in the vessel that the output signal equals 20 mA (100%). Edit the menu to enter the distance from the sensor face reference point) to the 20 mA (100%) point.	Enter the level unit point where 20 mA will occur, referenced from sensor face.
Fct. 4.00	**Volume (VOLUME)**	**Allows the system configuration for volume. Only enabled when Volume is selected in Fct. 1.01**	
Fct. 4.01	Level Units (L UNITS)	User selects the level units of measurement for input conversion by "editing" the menu to select either Feet, Inches, Meters, Centimeters, of Millimeters.	FEET INCHES METERS CENTIMETERS MILLIMETERS
Fct. 4.02	Tank Height (T_HGT)	Required for accurate maximum Level to maximum Volume Conversion. Edit the menu to reflect the correct distance from tank bottom to sensor face.	Enter tank height as measured from tank bottom to sensor face or maximum capacity reference point.
Fct. 4.03	Sensor Offset (OFFSET)	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.	Enter the distance from the maximum tank volume reference point, (if different from Tank Height) to sensor face.
Fct. 4.04	Vessel Type (VES_TYP)	Edit the menu to select the vessel shape that is being used. A strapping table will be generated based on Vessel shape (Vertical Cylinder, Horizontal Cylinder with Flat Ends, Horizontal cylinder with Dished Ends, Horizontal cylinder with Hemispherical Ends, or a Sphere. A Custom (User Defined) selection can also be made that will require the use of the 21-point strapping table to correlate level to known volumes. Information entered in Tank Height, Maximum Capacity and Sensor Offset is used to generate the correct table.	VERT HC_F HC_D HC_H SPHERE CUSTOM
Fct. 4.05	Load Standard Table into Strapping Table (LOADSTD)	Allows the user to enter a standard strapping table for volume conversion. Edit the menu to select the tank shape that best fits the application. This information can be later modified in Fct. 6.00 Strapping Table to generate a more accurate level to volume conversion table for custom or irregular tank shapes.	VERT HC_F HC_D HC_H SPHERE
Fct. 4.06	Vessel Units (V UNITS)	Allows the user to enter the volume units that will be used for display purposes. Edit the menu to make this selection. Press ENTER and the default setting will flash, use arrow buttons to cycle through available selections, press Enter again to make selection.	GALLONS M3 (cubic meters) LITERS BBL (barrels) IMPGAL (imperial gallons)

3.3 Menu Functions (Continued)

Function	Item	Description & comment	Menu Selection Choices
Fct. 4.07	Maximum Capacity (MAX CAP)	Allows user to enter the volume of the vessels maximum capacity that correlates to the Tank Height level.	Enter maximum capacity in vessel units selected.
Fct. 4.08	LRV	The point in the vessel that the volume equals 4 mA (0%). Edit the menu to enter the distance from the tank bottom to the 4 mA (0%) point.	Enter the volume unit point where 4 mA will occur, referenced from tank bottom.
Fct. 4.09	URV	The point in the vessel that the volume equals 20 mA (100%). Edit the menu to enter the distance from the tank bottom to the 20 mA (100%) point. This value must not be within the 12-inch Near Zone of the sensor face or an Error Message (NZSEUP) will be displayed.	Enter the volume unit point where 20 mA will occur, referenced from tank bottom.
Fct. 5.00	**Flow (FLOW)**	**Allows the system configuration for open channel flow measurements. Only enabled when Flow is selected in Fct. 1.01**	
Fct. 5.01	Flume Type (FLO_TYP)	Allows user selection of software supported flume / weir types. Select from Parshall, Palmer-Bowlus, Trapezoidal Flume, Rectangular Weir With end contractions, Rectangular Weir With Out end contractions, Cipolletti (Trapezoidal) Weir, V-Notch Weir, "H" Flume, Leopold-Lagco, or CUSTOM (user defined, enter level to flow relationship in the 21-point strapping table).	PARSH PB TRAP F RECT W RECT WO TRAP W V NOCH CUSTOM H FLUME LEO LAG
Fct. 5.02	Flume Size (F SIZE)	Allows user selection of flume “throat size” of flume type selected in Fct. 5.01, select the size code from the available listings in Section 1.7	Consult Manual for specific code based on flume weir type and size.
Fct. 5.03	Flow Units (F UNITS)	Select if displayed units will be in GPM, MGD or M3/Hr. LPS (Liters Per Second), LPM	GPM / MGD / M3/HR / LPS / LPM
Fct. 5.04	Max Flow (MAX FLO)	Edit this menu to reflect the maximum flow rate expressed in the flow units selected in Fct. 5.03	Enter the maximum flow value in selected Flow Units
Fct. 5.05	Head Units (H 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.	FEET INCHES METERS CENTIMETERS MILLIMETERS
Fct. 5.06	Distance to Zero Flow (0 DST)	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.	Enter the distance from sensor face to the zero flow level
Fct. 5.07	Sensor Offset (OFFSET)	If the flume/weir is selected from the preprogrammed menu selections, no user input is required, offset equals zero. If using custom characterization in strapping tables, enter the distance from maximum flow (20 mA) point to the sensor face.	Enter distance from Max Flow (Fct. 5.04) to sensor face. Not used if flume type and size are from menu selection.
Fct. 5.08	Totalizer Scale (T 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.	X1 X10 X100 X1K X10K X100K X1Mil
Fct. 5.09	Totalizer Reset? (RESET?)	There are two totalizers contained in the MS-30. The user can reset one of the totalizer. This menu item allows the user to reset the resettable totalizer by editing the menu to "Yes". At this point the Reset Totalizer will reset to zero and start counting once returned to the operate mode.	NO / YES

3.3 Menu Functions (Continued)

Function	Item	Description & comment	Menu Selection Choices
Fct. 6.00	**Strapping Table (STRAP)**	**Allows the system configuration for the strapping table. Enabled when Flow or Volume is selected in Fct. 1.01. The strapping table is a look-up table of level vs. volume (or flow rate) that is entered by the user based on known parameters.**	
Fct. 6.01	Maximum Points (MAX PNT)	The strapping table is capable of 21 points, from 0% to 100% in 5% increments. Depending on how many "break points" that may be needed for vessel, flume or weir, enter the number of break points for this selection by editing this menu item.	2…21
Fct. 6.02	In Point 1 (INPT 1)	Edit this menu item to enter the "level" information for the first point	Enter input 1, the units of measure will be dependant on Input Type and Units selected
Fct. 6.03	Out Point 1 (OUTPT 1)	Edit this menu item to enter the "volume/flow rate" information for the first point	Enter output 1, the units of measure will be dependant on Volume Type and Units selected
6.04 - 6.43	In/Out Points 2-21	Enter Level "IN" points and Volume / Flow rate "Out" Points for each of the break points entered in Fct. 6.01	Enter Input / Output for the number of break points entered for Maximum Points in Fct. 6.01
Fct. 7.00	**System Settings (SYSTEM)**	**Allows the system configuration for various parameters of the system setting.**	
Fct. 7.01	Temperature Units (TMP UNT)	Allows the user to select if temperature will be displayed in degrees Fahrenheit or Celsius	°F °C
Fct. 7.02	Gain Adjustment (GAIN)	Should only be changed with guidance from a JOWA USA representative. This item allows the user to change from the default HD setting (SmartGain™) to a fixed power level. Useful if foam is present that causes a Lost of Echo fault. Consult Factory before use. HD_HIGH - Use in foamy or vaporous conditions	HD HD HIGH 100% 84% 67% 50% 32% 17% 8% Consult Factory before use.
Fct. 7.03	HD Adjustment (HD GAIN)	Should only be changed with guidance from a JOWA USA representative. This item allows the user to change from the default HD setting (SmartGain™) to a lower variable power level, but still allowing the system to ignore some obstructions within the beam path. Consult Factory before use.	User numerical entry between 0 - 100 Consult Factory before use.
Fct. 7.04	Repetition Rate (PR RATE)	In some cases it may be desirable to change the transmission repetition rate. Normal default is 300 ms. Longer Repetition rates may be useful in some instances of intermittent presence of foam, or agitator blades in the beam path. Consult Factory before use.	300 MS / 700 MS / 1100ms / 1500ms Consult Factory before use.
Fct. 7.05	Acquisition (ECHOES)	Defines the number of echoes that must be received to determine a valid level acquisition. Default setting is 4 return echoes. If the level surface is rough and uneven, this setting may be set to a lower number to validate a level acquisition. If there are disturbances in the vessel that cause intermittent false target acquisitions, this number may be increased. **Consult Factory before use.**	1 – **4** – 10 maximum **Consult Factory before use.**
Fct. 7.06	Time Delay (DAMPING)	Time delay will act as signal averaging over the specified time 0-90 seconds. If a turbulent surface causes the analog signal to be unsteady, a few seconds of time delay can smooth out the signal.	User numerical entry 0 – 90
Fct. 7.07	Near Zone Fault (NZ OUT)	If the level moves into the Near Zone (12 inches from sensor face) the user can, in this menu item select the current level the analog signal will assume (3.7 mA or 22 mA) during a fault condition.	HIGH (22 mA) LOW (3.7 mA)

3.3 Menu Functions (Continued)

Function	Item	Description & comment	Menu Selection Choices
Fct. 7.08	Lost Echo Fault (LE OUT)	If the echo is not returned to the sensor, the user can, in this menu item select the current level the analog signal will assume (3.7 mA or 22 mA) during a fault condition. Last Known Value (LST_VAL) - Will hold the output current and reading to the last received value before the lost echo condition. USE WITH EXTREME CAUTION!	HIGH (22 mA) LOW (3.7 mA) LST VAL
Fct. 7.09	Force Current (LOCK mA)	This menu item allows the user to edit a mA current level that the system will constantly generate only while in this menu item. To return to a normal operating mode (normal mA outputs), exit the menu or Enter 0.00 mA to return to normal.	User defined numeric value
Fct. 7.10	Trim 4 mA (TRIM 4)	This menu item allows the user to edit the 4.0 mA output current to match a known meter. The valid range is from 3.5 to 4.5 mA. This allows the system to change it's 4.0 mA reference current level to match a standard.	User defined numeric value between 3.5 – 4.5 mA
Fct. 7.11	Trim 20 mA (TRIM 20)	This menu item allows the user to edit the 20.0 mA output current to match a known meter. The valid range is from 19 to 21 mA. This allows the system to change its 20.0 mA reference current level to match a standard.	User defined numeric value between 19 – 21 mA
Fct. 7.12	HART Mode (HART MD)	If operating in the digital HART mode this menu item allows the user to match the input requirements of a DCS/PLC by either assigning a X1 multiplier or an X100 multiplier that is need by some DCS/PLC's. Check with you DCS/PLC to see if this is necessary.	NORMAL - (output % X 1) DCS - (output % X 100)
Fct. 7.13	Polling Address (POLL)	If operating in the digital HART mode this menu item allows the user to assign a polling address to the transmitter valid entries are 1-15. A "0" polling address indicates analog output operation - and is the default.	Select polling address between 1 – 15 (address "0" used for all analog outputs)
Fct. 7.14	Restore Factory Defaults? (RST FAC)	Selecting Yes will reset all configured parameters to the Factory Default positions, just like it came out of the box. This is useful if too many technicians have made configuration changes to the point where no one knows how or if this system is correctly configured. Start from the beginning again.	YES / NO
Fct. 7.15	Change Password (CHG PAS)	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 or Enter - press the Enter button to select 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.	Select UP, DOWN, ENTER for each digit of a seven digit password.
Fct. 7.16	Password Enabled? (PASS EN)	Edit this menu item to activate the password. Selecting Yes will make the password Required the next time the Menu is entered.	YES / NO
Fct. 7.17	Contrast (CONTRAST)	This item allows the user to change the display contrast depending on ambient lighting conditions. Default is 10, available range is 0-50.	0 - 50
Fct. 7.18	Low Offset (LO OFST)	Ping energy level setting for Low Gain Amplifier. Consult Factory Before Use	User numerical entry (-1, 0 +1) Consult Factory Before Use
Fct. 7.19	High Offset (HI OFSET)	Ping energy level setting for High Gain Amplifier. Consult Factory Before Use	User numerical entry (-1, 0 +1) Consult Factory Before Use

3.3 Menu Functions (Continued)

Function	Item	Description & comment	Menu Selection Choices
Fct. 7.20	Pipe Length (PIPE_L)	This item allows the user to enter the length of the pipe in which the MS-30 is installed.	0 (Edit length in inches), - for open air (no pipe) use 0"
Fct. 7.21	Pipe Diameter (PIPE_D)	This item allows the user to enter the diameter of the pipe in which the MS-30 is installed.	2", 3", 4", 6", 8", 10", 12" (Pipe diameters greater than 12" are treated as open-air installations)
Fct. 8.00	**Display Toggle (DISPLAY)**	**Allows the system configuration for the desired display options. Use this menu to select which displays will be available to view during operation.**	
Fct. 8.01	Toggle? (TOGGLE)	This menu item allows the user to select if the display will automatically cycle through the display choices or manually cycle through the display options selected. Manually cycle the display options selected by pressing any arrow key during operation.	YES / NO If YES, unit will scroll every 10 seconds If NO, unit can be manually advanced through all enabled selections using up/down arrow keys
Fct. 8.02	Display Level? (LEVEL)	This item allows you to select (or deselect) Level as a desired display.	ENABLE / DISABLE
Fct. 8.03	Display Distance? (DISTNCE)	This item allows you to select (or deselect) Distance as a desired display.	ENABLE / DISABLE
Fct. 8.04	Display Volume? (VOLUME)	This item allows you to select (or deselect) Volume as a desired display.	ENABLE / DISABLE
Fct. 8.05	Display Flow? (FLOW)	This item allows you to select (or deselect) Flow rate as a desired display.	ENABLE / DISABLE
Fct. 8.06	Display Totalizer? (TOTAL)	This item allows you to select (or deselect) the non-resettable Totalizer as a desired display.	ENABLE / DISABLE
Fct. 8.07	Display Reset Totalizer? (R TOTAL)	This item allows you to select (or deselect) the user resettable Totalizer as a desired display.	ENABLE / DISABLE
Fct. 8.08	Display Current Output? (OUTPUT)	This item allows you to select (or deselect) milliamp output current as a desired display.	ENABLE / DISABLE
Fct. 8.09	Display Temperature? (TEMP)	This item allows you to select (or deselect) the internal sensor temperature compensator as a desired display.	ENABLE / DISABLE
* Note Range Percent is always present for display and can not be enabled or disabled.			
Fct. 9.00	**Calibration (CAL)**	**This menu item allows the user to calibrate the system if ultrasonic velocities other than through air are present.**	
Fct. 9.01	Point (PT CAL)	A point calibration allows the system to reset the expected ultrasonic 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 menu item with the actual distance to the known level and the system will back calculate the velocity that produces this level measurement.	User defined numeric value of actual distance from liquid level to sensor face. Allows adjustment up to +/- 25%

3.4 Error Messages

--LOST-- . . . . . Lost Echo
--NEAR-- . . . . . Near Zone
NO COM / BAD COM . . Communications Error
Between Display and Transmitter
EEPROM . . . . . EEPROM Error
--SETUP-- . . . . . Setup Error Parameter
Setup beyond Range of Transmitter
TEMP . . . . . Temperature Sensor Error
NRSEUP . . . . . Parameter Setup in Near Zone
--UNDER-- . . . . . Under Range
--OVER-- . . . . . Over Range
--SPAN-- . . . . . Span too Small

3.5 Menu / Display Abbreviations

Display	Definition
0 DIST	Distance to Zero Flow
CAL	Optimized Calibration
CM	Centimeters
CUSTOM	User Defined
DAMPING	Input time delay
DCS	HART DCS
DISPLAY	Display
DIST	Distance
FLO_TYP	Flume Type
FLOW	Flow
FT	Feet
GAIN	Gain Adjust
GPM	Gallons per Minute
HC_D	Horizontal Cylinder – Dished ends
HC_F	Horizontal Cylinder – Flat ends
HC_HEMI	Horizontal Cylinder – Hemispherical ends
H FLUME	H Flume
IN	Inches
LEOLAG	Leopold Lagco
LEV	Level
LEVEL	Level
LOGFCT	Logic Function
LOST	Lost Echo
LRV	LRV
M3	Cubic Meters per hour
MAX_CAP	Maximum Capacity
M	Meters
MGD	Million Gallons Per Day
MM	Millimeters
NEAR	Near Zone

Display	Definition
NORMAL	HART Normal
OFFSET	Sensor Offset
PARSH	Parshall
PASWRD	Password
PB	Palmer Bowlus
PTCAL	Point Calibration
RECT W	Rectangular with end contractions
RECT WO	Rectangular without end contractions
RESETP	Reset? Yes or No
RNG	Range
RP RATE	Repetition Rate
RTL	Reset Totalizer
SPHERE	Sphere
STRAP	Strapping Table
SUREP	Confirm
TEMP	Temperature Display
T_HGT	Tank Height
TL	Totalizer
TRAP F	Trapezoidal Flume
TRAP W	Trapezoidal Weir
TYPE	Input Selection
UNITS	Unit Selection
URV	URV
VERT	Vertical
VNOTCH	V Notch
VOL	Volume
X 100	X100
X 1K	X1000
X 10K	X10000
X 100 K	X100000

Section 4: Troubleshooting

The MS-30 Series Ultrasonic Level system is designed to give years of unattended service. No periodic or scheduled maintenance is required.

4.1 Troubleshooting Procedures

If a problem should occur with the operation of the transmitter, 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 transducer face could cause unreliable measurements.

4. Any continuous ultrasonic transmitter 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 transducer face is not recessed into a mounting nozzle, unless a high discrimination 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 transducer face.
   B) The low calibration setting is not more that 360 inches (30 ft., 610 cm) from the transducer face.

7. Test for 4 mA and 20 mA.

   A) Using PC Software, HART Communicator, or Display Keypad (Access Fct.7.07) 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 JOWA USA directly.

   To aid in troubleshooting, please complete the information in Section 4.5 before calling the factory service department.

4.2 Optimized Field Calibration

Configuration Menu Function 9.00 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 PC Software, HART Communicator, or Display Keypad (Access Fct. 9.00) and enter the correct actual distance from the transducer face to level. The MS-30 will use this data point as reference on all future readings, unless "Restore Factory Settings" is selected.

4.3 Troubleshooting the Loop Connections.

Specific transmitter loop connections vary with each installation, but in general are connected in a similar manner to the typical transmitter loop in Figure 4-1.

When troubleshooting the loop connection, verify the following items.

- Loop devices are wired in series.
- There is at least 250 ohms total loop resistance.
- There is at least 19 Vdc available for the transmitter when a loop current of 4 mA is flowing.
- **Refer to Figure 4-1**

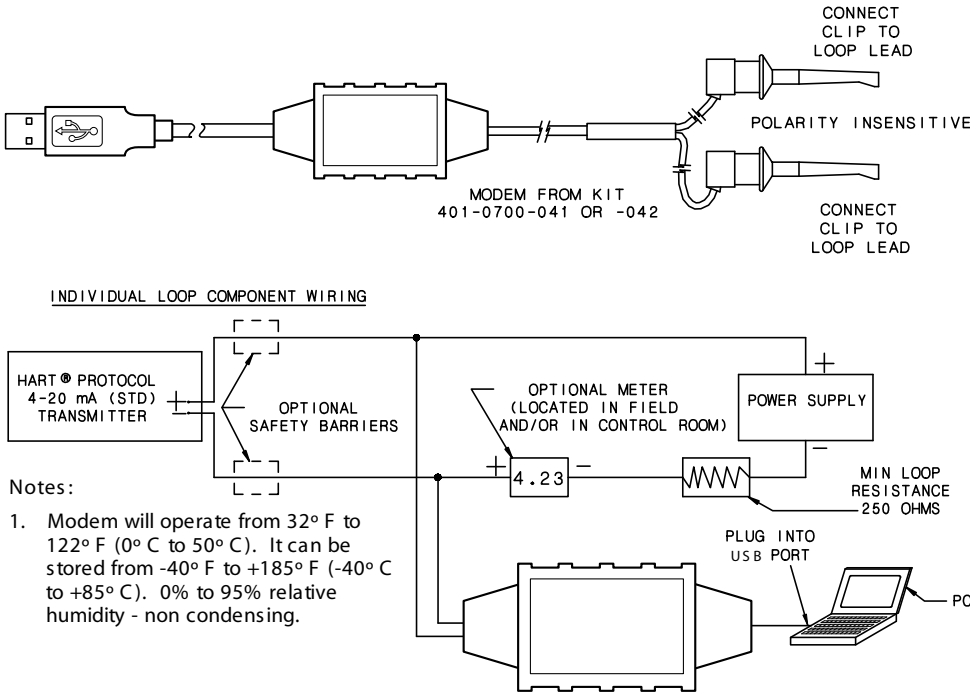
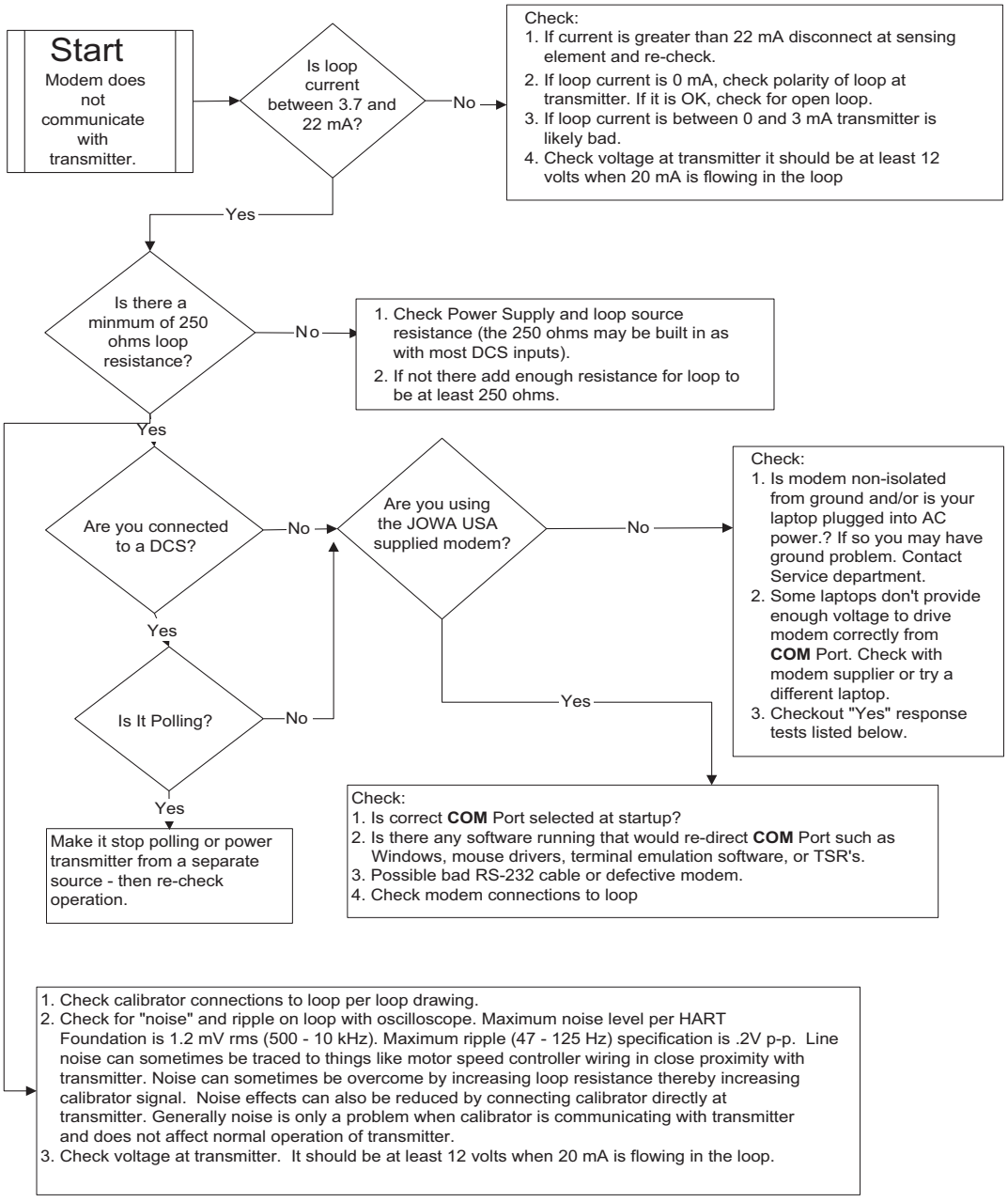


Figure 4-1
Typical Transmitter Loop

4.3 Troubleshooting the Loop Connections (Continued)



4.4 Diagnostic Messages

Message	Cause	Solution
LOST	Lost Echo	1) Ensure the level is within the measurement range of the transducer. 2) Look for any obstructions that may be interfering with the return echo.
NEAR	Near Zone Violation	The level has entered the transducers Near Zone. Insure that there is no level or obstructions within 12 inches of the transducer face.

4.5 Telephone Assistance

If you have questions about your JOWA USA equipment:

- Contact your local JOWA USA representative
- Call the JOWA USA Service department toll-free at:
  1-800-861-1560 (US and Canada) or
  978-486-9800 (Outside North America)
- Fax the following information to the Service department at: 978-486-0170.

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: _____

_____

_____

_____

4.6 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.

4.6 Equipment Return (Continued)

To obtain a return authorization number (RA#), contact the Service department at:
1-800-861-1560 (US and Canada) or
978-486-9800 (Outside North America).

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:
JOWA USA Inc.
59 Porter Road
Littleton, MA 01460

COD shipments will not be accepted.

JOWA USA warrants its products free of material defects or manufacturing defects for a period of 1 year after date of shipment.

4.7 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 5:

Section 5: Configuration and Calibration With HARTWin™

This section instructs the user how to use the JOWA USA 401-700-20/40 Series PC calibrator software to configure and calibrate the MS-30™ Transmitter.

5.1 General Description

The 401-700-20/40 software package allows the use of any Windows® 9X/NT/2000/XP-based personal, laptop, or notebook computer to calibrate the HART® Protocol transmitter.

The MS-30 transmitter is compatible with HARTWin™ 2.4 or greater.

5.2 Model Number

4 0 1 - 0 7 0 0 - 0 2 X / 4 X
2X= 1 PC Software Package includes:
RS232 Modem Assembly 401-0700-004 *(Figure* 5-1*).*

2X=2 PC Software Package includes:
Contents in 401-0700-021, HARTWin™ version 2.1 or greater on a CD-ROM.

4X=1 PC Software Package includes:
USB Modem Assembly 401-0700-007 (Figure 5-1a).

4X=2 PC Software Package includes:
Contents in 401-0700-41, Utilities and Drivers on a CD-ROM, and HARTWin™ version 2.3 or greater on a CD-ROM.

4 0 1 - 0 7 0 0 - 0 3 1
HARTWin™ version 2.X on a CD-ROM.

5.3 System Requirements

PC Requirements
Windows® 95, 98, ME, 2000, XP.
The USB modem is not compatible with Windows® 95, 98 First Edition, or NT. It is recommended that the software be installed on a hard drive with 20 megabytes or more of space available.

Input to Modem
RS232 or USB Port, from one of the COM serial ports (COM1, COM2, etc..). The PC provides operating power for the modem but not for the transmitter.

Output (to Transmitter being Calibrated)
4-20 mA in HART® Protocol.

5.4 Installing The RS232 Modem

Refer to Figure 5-1 for a connection diagram and use the following procedure to install the hardware that is necessary to run the PC software.

1. Connect the RS232 JOWA USA Modem 401-700-004 to one of the **COM** serial ports (**COM1**, **COM2**, etc.) of the computer.

2. Connect the Modem's 4-20 loop connectors to the transmitter loop.

3. Turn on the computer.

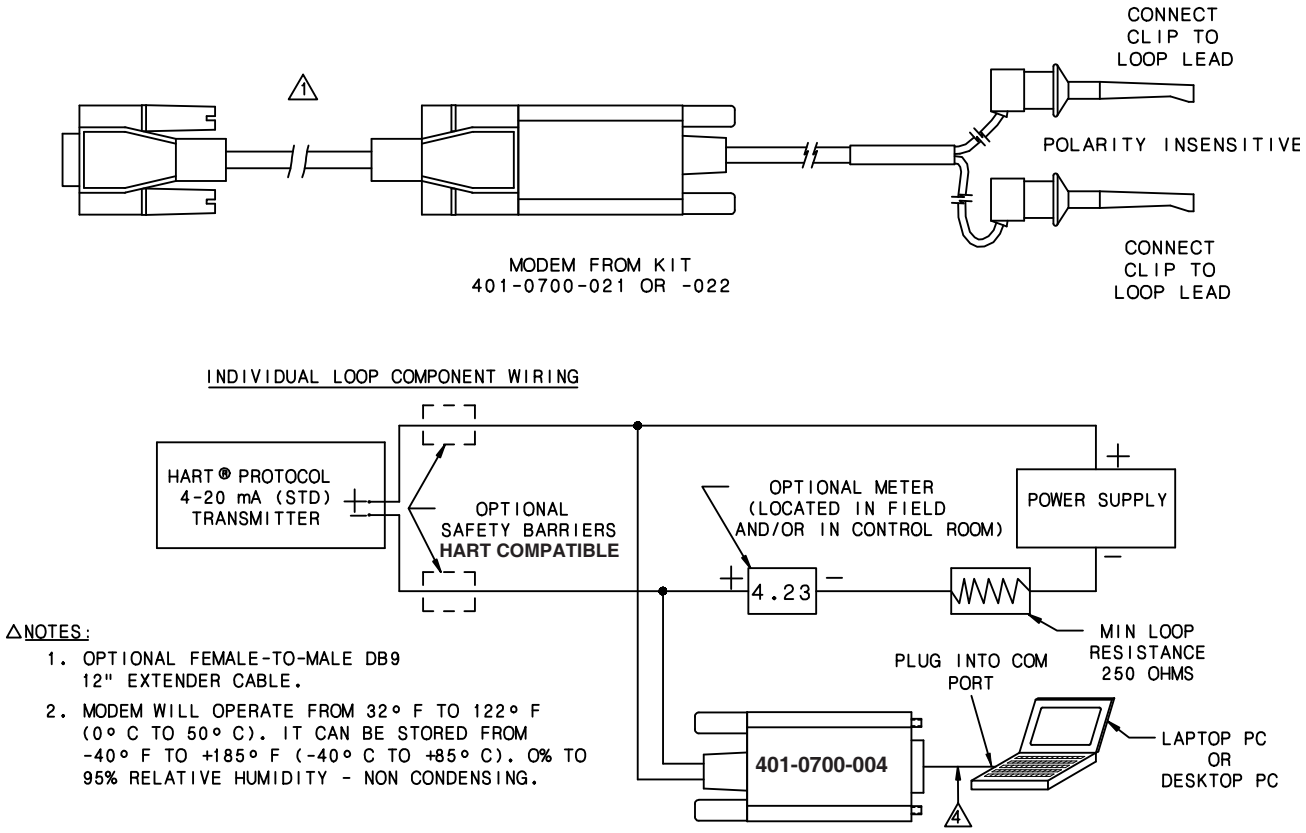


Figure 5-1
RS232 Modem Assembly & Loop Connection

5.5 Installing The USB Modem

Refer to Figure 5-1a for a connection diagram and use the following procedure to install the hardware that is necessary to run the PC software.

1. Turn on the computer
2. Install Modem Software:

   It is highly recommended the USB drivers be installed BEFORE you plug in the modem.

   Install the USB Drivers by inserting the Modem Installation Disk into CD Drive of the computer.

   If program does not "Auto-Run", select "D:\setup" (where D is the letter representing the CD Drive)

   Be Sure to Select the USB interface in the setup prompt.

   Follow any "On-Screen" Instructions.
3. Connect the JOWA USA Modem 401-700-007 to a **USB** port on the computer. With the USB drivers already installed, the computer will detect the modem and assign a COM PORT number.
4. Connect the Modem's 4-20 loop connectors to the transmitter loop.

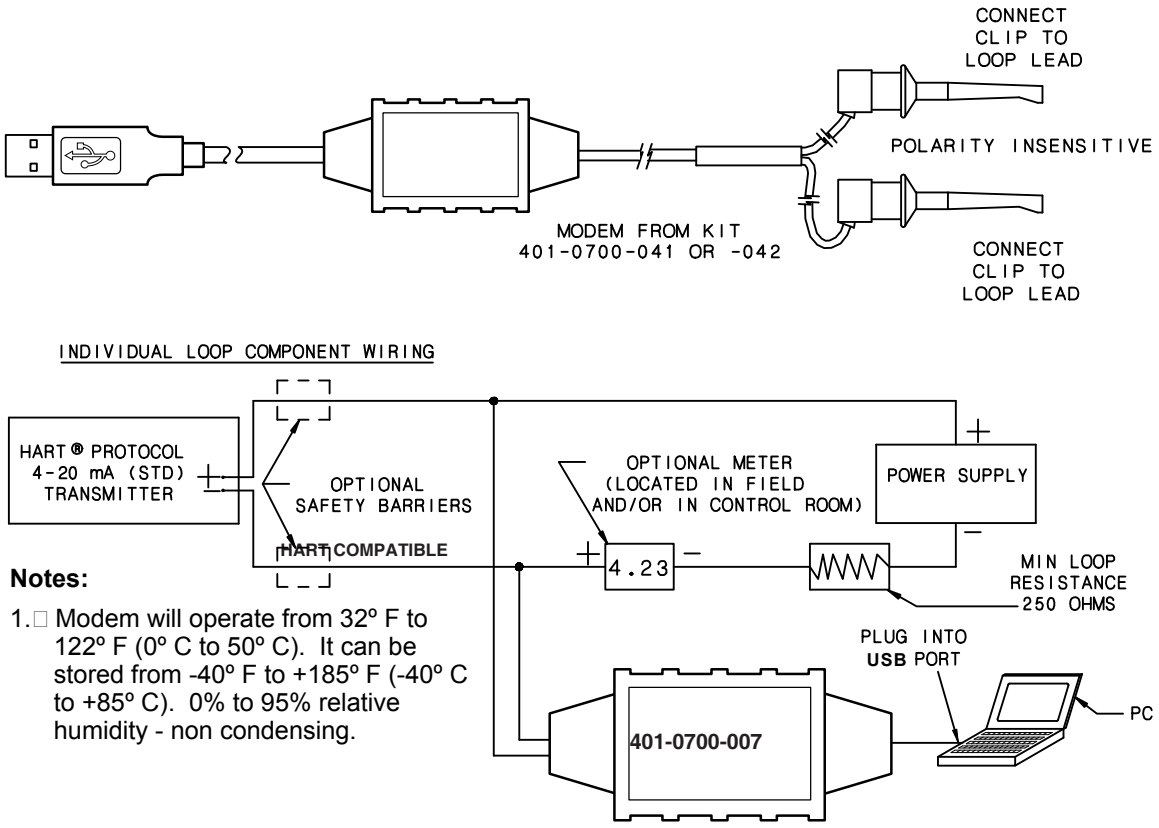


Figure 5-1a
USB Modem Assembly & Loop Connection

5.6 Install the Windows Version HARTWin™ Software on Hard Drive

Installation is simple.

1. Place the 401-700-031 CD into the CD drive (usually drive D:).
2. If program does not "Auto-Run", select "D:\setup" (where D is the letter representing the CD Drive).
3. Follow "On-Screen" instructions in **Setup** to create program file.
4. Once loaded, double click "HartWin" icon and the program should run under its own window.
5. Select communication port [**Com 1, Com 2,** etc.] then click "**OK**."

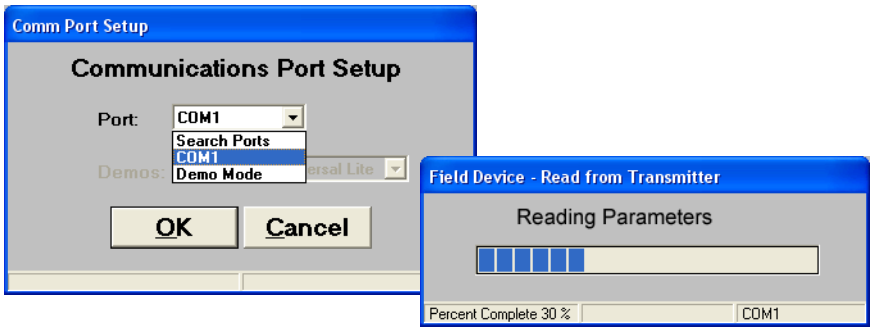


Figure 5-2
Selecting COM Ports

6. If you are not sure which communication port you are using (such as when first using a USB modem), select "Search Ports," then OK. The software automatically will seek out the correct one. In either case the software begins to communicate with the HART protocol transmitter and returns with a view (below) containing "name plate data," Tag ID and all default or existing configuration information. This is the same as if you clicked on the Read Transmitter function button.
7. The next view appears automatically, displaying current transmitter database for calibration set-up for your selected Tag ID. The Scratch Pad will automatically show the last message (last user, last calibration, etc.) up to 32 characters. If this is a new transmitter, the Tag ID is user-defined. Serial number, transmitter software version, range, etc. is automatically entered from the "name plate data" embedded in the transmitter.

5.7 Description of Function Keys

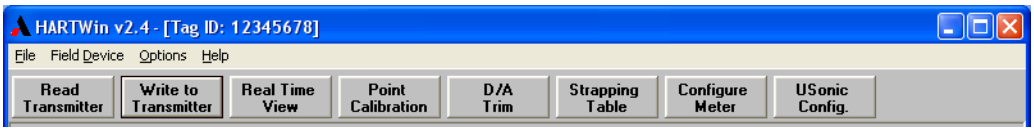


Figure 5-3
HARTWin™ Function Keys

HARTWin™ automatically communicates all "Name Plate Data" from the transmitter

The following paragraphs describe the function buttons. The data fields are described in Section 3.7- Configuration.

Read Transmitter [F3 on keyboard]
Reads all pertinent data from the transmitter and displays it on the screen. The Read function also updates the real time window. Keep in mind that it takes several seconds to load the information from the transmitter. When the load is complete, the screen shows the transmitter parameters. This command is also used when connecting to another transmitter.

Write to Transmitter [F5 on keyboard]
Sends new or edited configuration data to the transmitter. Data fields that have been edited but not sent to the transmitter are displayed in red.

Real Time View [F4 on keyboard]
Displays the real time values of Level, Volume, Distance, Temperature, Loop Current, percentage, and Status.

Point Calibration [F6 on keyboard]
Calibrates the MS-30™ transmitter using Point calibration.

D/A Trim
Allows a field reference meter to be connected to the transmitter for adjusting transmitter output current.

Strapping Table
Displays the values of the Input to Level or Head, and Output to Volume or Flow in percent in a 21-Point table. Allows points to be changed to accommodate Irregularly Shaped Vessels and Custom Flumes.

Configure Meter
Configures the Display used for local indication.

MS-30 Configuration
Provides necessary configuration parameters for the Ultrasonic measurement.
Repetition Rate - Near Zone Fault Current - Lost Echo Current - Gain Mode - Variable Gain.

5.8 Configuration

Configuration involves uploading information to the transmitter that is specific to the application being measured. Ex. Flow, Level, Distance, or Volume.

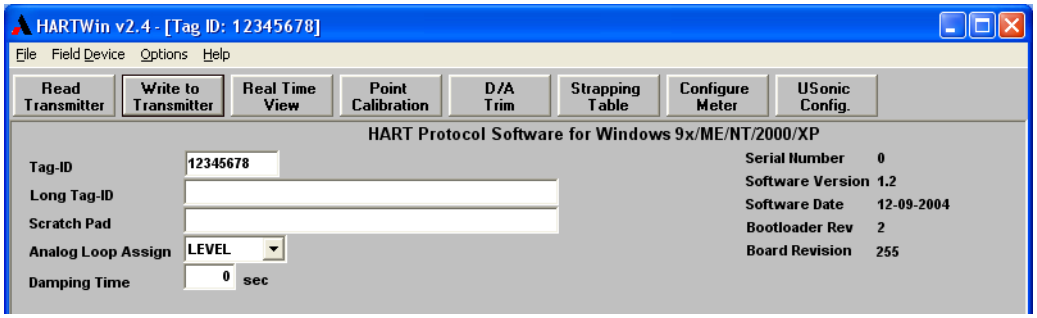


Figure 5-4
Selecting Configuration

1. Begin configuration by using **Tag ID** (8 characters) or **Long Tag** (32 characters) to identify the unit or vessel. Use the **Scratchpad** (32 characters) to record the date of calibration or other similar notes. Press Tab or Enter on your keyboard.

2. Select **Level, Distance, Volume,** or **Flow** in the **Analog Loop Assign** selection box. Press Tab or Enter on your keyboard.

- **Level Configuration** sets the output to follow the level of the material being measured.
- **Distance Configuration** sets the output to follow the distance from the face of the transducer.
- **Volume Configuration** sets the output to follow the strapped volume in the vessel. For example, gallons in a horizontal vessel.
- **Flow Configuration** sets the output to follow the flow of a flume or weir. Ex. Gallons per Minute, using a parshall flume.

3. Edit **Damping Time** from 0-90 seconds, if desired.
4. Click on **Write to Transmitter**.
5. Move to **Level Configuration** section of menu.

5.8.1 Level Configuration

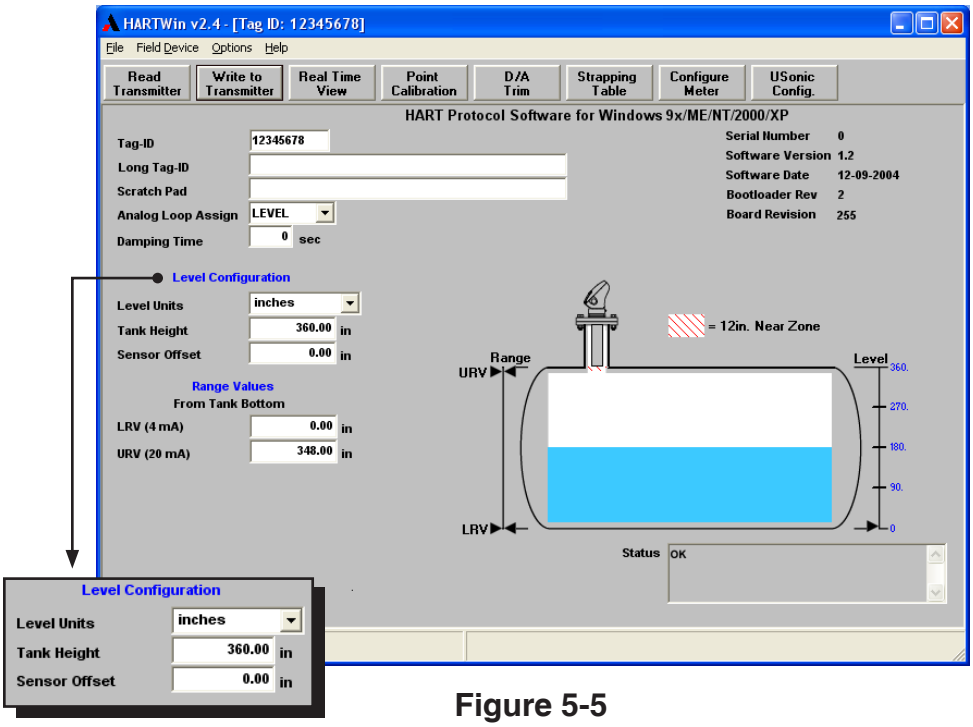


Figure 5-5
Level Configuration Menu

1. Select **Level Units**. The default is Inches. Choose the units that correspond to the level measurement.

2. Edit the Tank Height to agree with the actual tank height (not the length of the sensing element).

3. Enter a **Sensor Offset Value**.

   The software calculates the maximum tank volume based on the value entered in the **Tank Height** field. With **0.0** entered as the **Sensor Offset** value, the software assumes the transducer face is mounted flush with the top of the tank (**Tank Height**).

   Sensor Offset is used to tell the software the amount above or below the top of the tank that the transducer is located in order to calculate the tank volume.

5.8.1 Level Configuration (Continued)

NOTICE

Sensor Offset can be applied in cases where:

- The transducer protrudes below the top of the tank or,
- The transducer is mounted above the top of the tank or,
- A pipe extension is installed to raise the transducer face 12 inches above the tank height to compensate for the 12-Inch Near Zone.
- **See Figure 5-5**
- If the transducer is mounted above the top of the vessel, a positive value is entered in Sensor Offset .
- If the transducer is mounted below the top of the tank, a negative value is entered in **Sensor Offset**.

4. Click on **Write to Transmitter**.

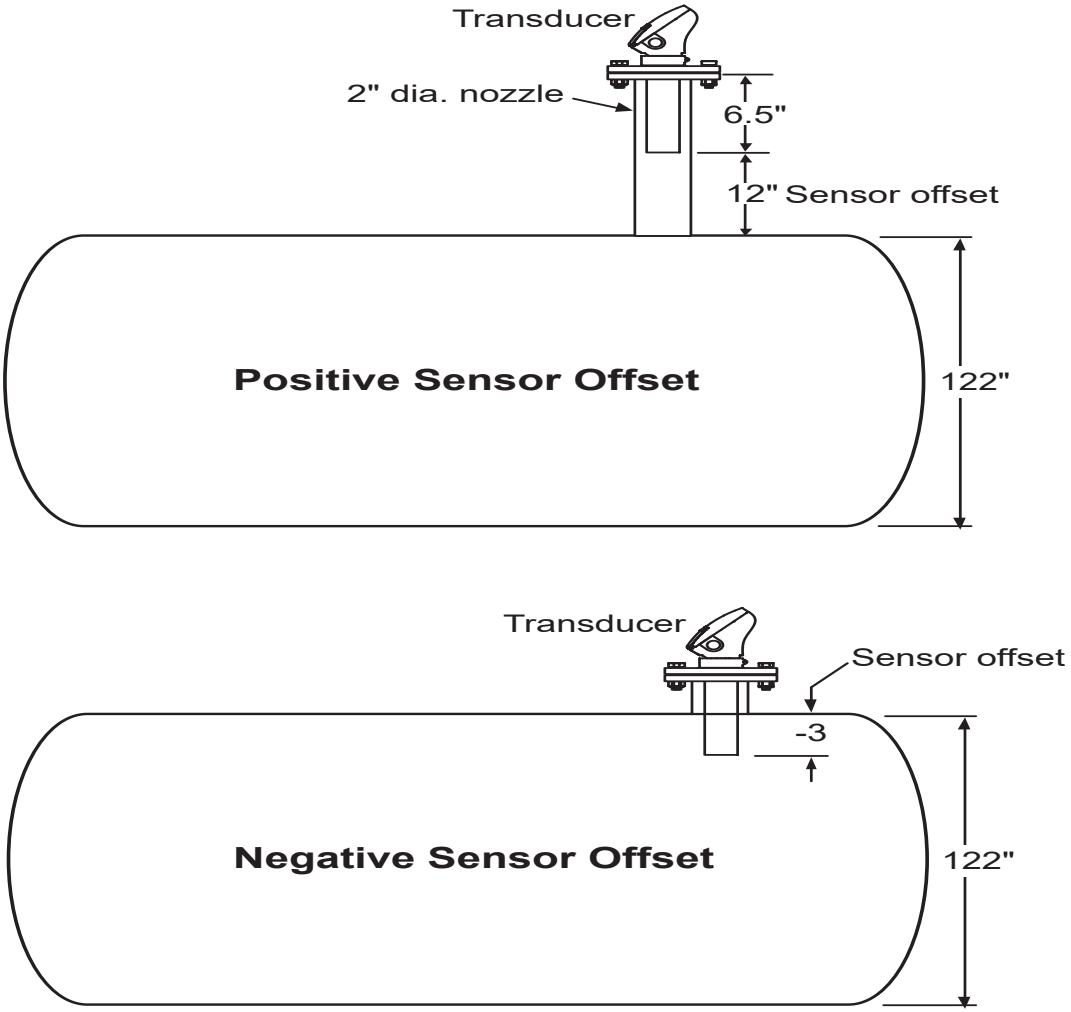


Figure 5-5
Sensor Offset

5.8.2 Distance Configuration

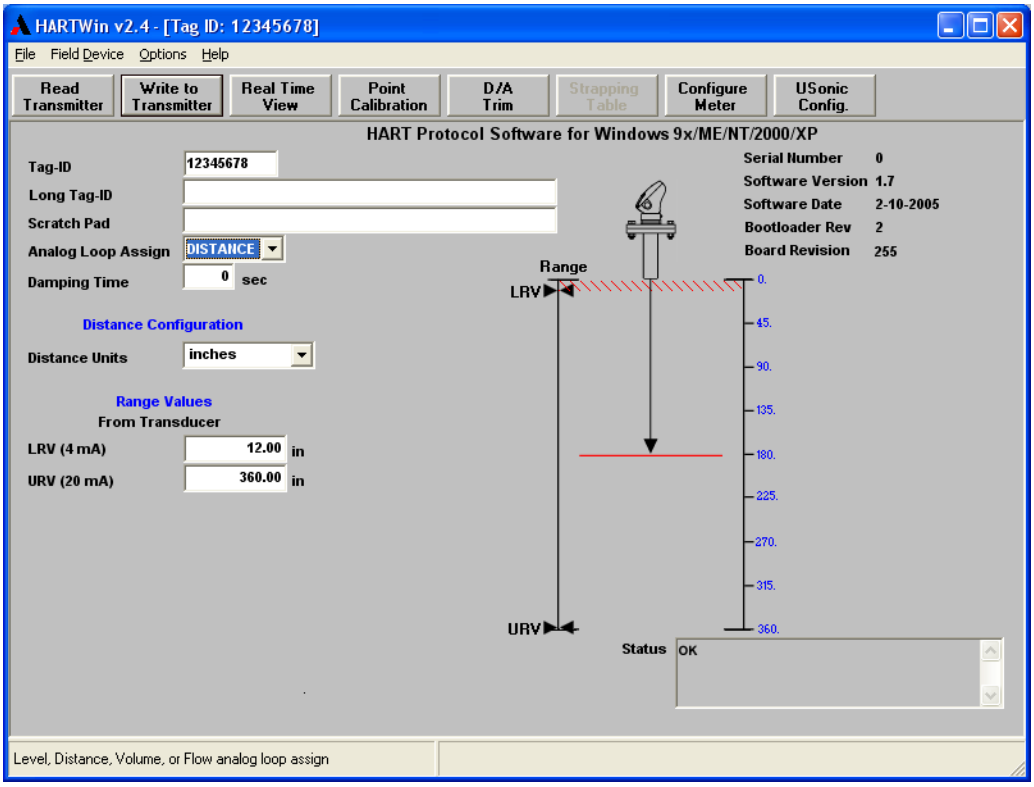
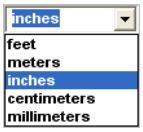


Figure 5-6
Distance Configuration Menu



1. Select **Distance Units**.
   The default is Inches.
   Press Enter and Choose the units that correspond to the Distance Measurement.

2. Choose **Write to Transmitter**.

5.8.3 Volume Configuration

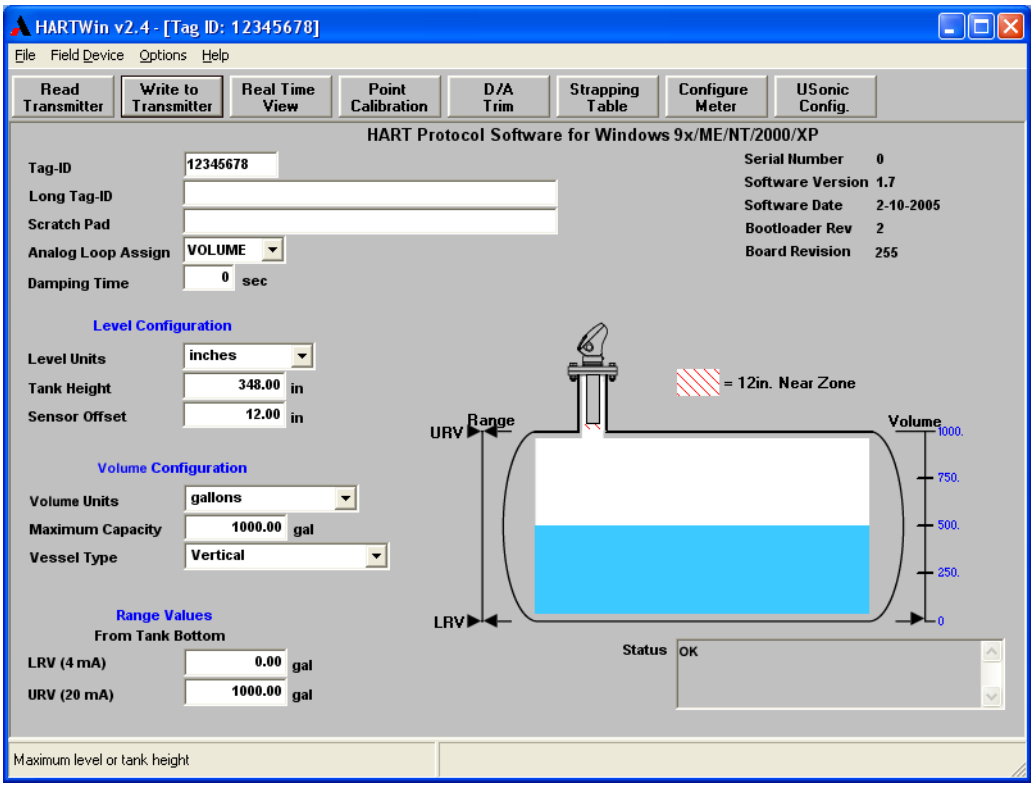
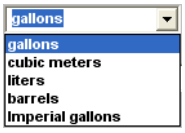
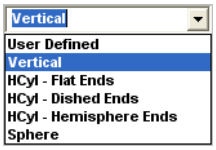


Figure 5-7
Volume Configuration Menu



1. Select **Volume Units** .The default is gallons. Press **Enter** and choose the units that correspond to the volume measurement.
   Default selection is gallons .
   Press **Tab** or **Enter**.

2. Edit the **Maximum Capacity** of the vessel. Enter 100 for percent if the volume units are not known or needed.
   Press **Tab** or **Enter**.



3. Select **Vessel Type**. Default selection is Vertical.

   NOTICE If a Custom Vessel Type is required, select **User Defined. See Section 5.8.9**

4. Click on **Write to Transmitter**.

5.8.4 Flow Configuration

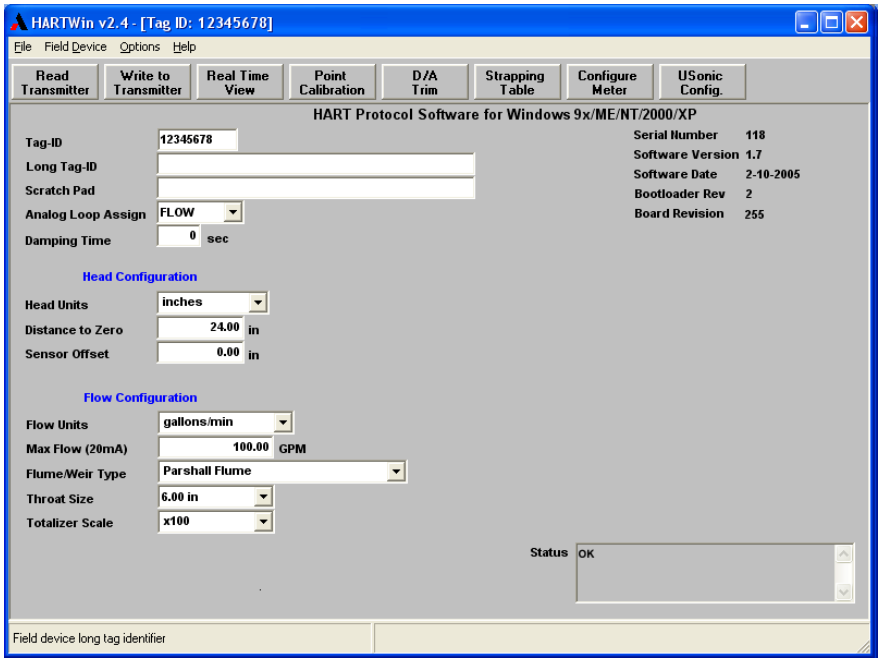
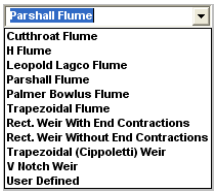


Figure 5-8
Flow Configuration Menu

1. Select **Head Units**. The default selection is Inches.
2. Enter Distance to Zero (The value that defines the distance from the Transducer Face to the bottom of the Flume / Weir at Zero Flow). This value also corresponds to the 4 mA (0% of Range) point.
3. Enter the Sensor Offset Value. **See Section 5.8.1**

4. Select **Flow Units**. The default value is "Gallons Per Minute". Press Enter and choose the units that correspond to the Flow Measurement.
5. Edit the Max. Flow - The Maximum Flow corresponds to the 20 mA (100% of Range) Point.



6. Select the **Flume/Weir Type**. The default selection is Parshall Flume.

   If none of the selections are appropriate for the application, Select **User Defined**. A Custom Strapping Table will need to be created. **See Section 5.8.9**

7. Edit or select the appropriate **Flume/Weir Size**.

   A Selection Box or Edit Box will appear, depending on the Flume / Weir selected. If an Edit Box appears, the selected Flume / Weir supports any size. **See Section 1.5**

8. Click on Write to Transmitter.

5.8.4 Flow Configuration (Continued)

Totalizer Configuration (Available Only when Flow Measurement is Selected)

1. **Select Totalizer Scale**
   Default value is x 100.
   Select the scale of the total flow to be displayed.

2. **Reset the Totalizer**
   This resets the second total flow.
   Select **Field Device - Reset Total Flow** in the HARTWin Menu.

5.8.5 Lower Range Value (LRV) and Upper Range Value (URV)

LRV and URV may be referenced from the following:

Level Configuration - Tank Bottom
Distance Configuration - Transducer Face
Volume Configuration - Tank Bottom
Flow Configuration - LRV = Zero Flow / URV = Max Flow

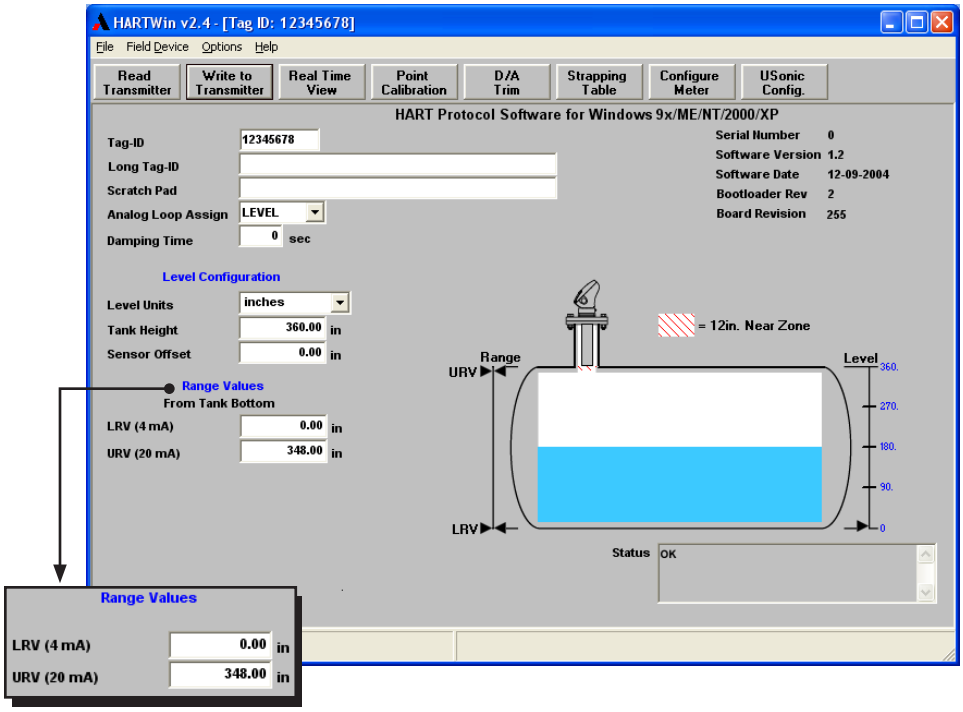


Figure 5-9
Entering LRV and URV Values

1. Enter a Lower Range Value.
   LRV - The 4 mA point, or 0% of Range.

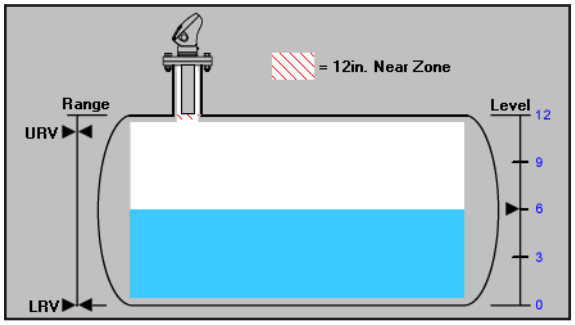
2. Enter an Upper Range Value.
   URV - The 20 mA point, or 100% of Range.

3. Click on Write to Transmitter.

5.8.5 LRV and URV (Continued)

Entering LRV and URV in the Level Mode

Example #1
Tank is 12 feet tall. Set **Tank Height** to 12 feet.
LRV (4 mA point) is 0 feet (bottom of tank).
URV (20 mA point) is 11 feet. (Bottom of tank to transducer face minus 12 inch near zone.)



Example #2
Tank is 31 feet tall (one foot farther than range of transmitter).
Set **Tank Height** to 31 feet.
LRV (4 mA point) is 1 foot. (Tank height of 31 feet minus maximum range of 30 feet equals 1 foot.)
URV (20 mA point) is 30 feet (Bottom of tank to transducer face minus 12 inch near zone.)

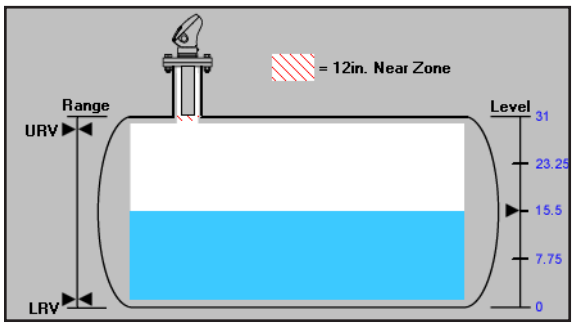


Figure 5-10
LRV and URV Values

5.8.6 Ultrasonic Configuration

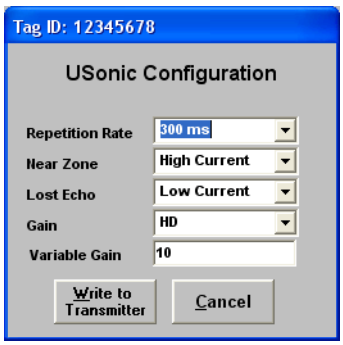


Figure 5-11
Ultrasonic Configuration Menu

Repetition Rate

An application might require a longer repetition rate, depending on the type of vessel and material being measured.

For instance:

- Increasing the repetition rate to 400 ms is required any time that the tank roof is curved. A longer repetition rate ensures that transmitter is not affected by reflected sound waves from the curved roof.

- A lengthened repetition rate also helps reduce loss of echo due to foam.

Near Zone and Lost Echo Fault Outputs

Select the output current of a Near Zone and Lost Echo fault condition.

Low Current: 3.7 mA

High Current: 22 mA

NOTICE

Application Notes for Near Zone and Lost Echo Settings

- Application requires Overfill Prevention (no spills)
  Material cannot go over high point
  Near Zone typically set 22 mA
  Lost Echo typically set 22 mA

- Application requires Low Level Prevention (pump will not run dry)
  Material cannot go below low point
  Near Zone typically set 22 mA
  Lost Echo typically set 3.7 mA

5.8.6 Ultrasonic Configuration (Continued)

Gain

Select the gain setting for the ultrasonic instrument.

HD (High Discrimination)

- High discrimination mode automatically reduces the effect of nuisance echos created when mounting the transducer in a nozzle or mounting the transducer inside a pipe up to 14 inches above the tank opening.

- The high discrimination mode reduces any effect from agitator blades and/or small obstructions. It also reduces system interference caused by electrical noise.

- The high discrimination mode should not be used in applications where foam is present.

Standard Gain

- Accesses step gain selection.

- The step gain settings can be used to decrease the ultrasonic return signal and avoid noise interference.

- For example, the power produced to shoot the 30-Foot signal could possibly cause nuisance reflections from irregular sidewalls, tank obstructions, or agitator blades. By reducing the gain of the transmitter using the step gain settings, the effect of nuisance reflections can be eliminated.

1. Click on Write to Transmitter to save the configuration.

2. Click Cancel to exit MS-30 configuration.

3. MS-30 configuration is now complete.

5.8.7 Point Calibration

Point calibration increases the accuracy of the measurement and compensates for atmospheres other than air by using the actual distance to the Transducer Face for calibration.

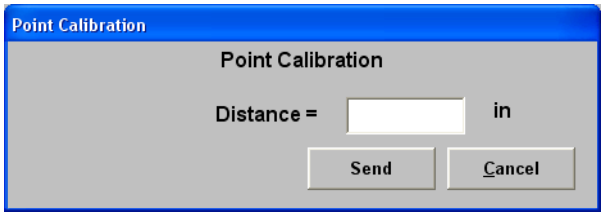


Figure 5-12
Point Calibration Menu

1. Measure the distance from the Transducer Face to the surface of the material being measured. For best results, the material should be lowered to the bottom of the vessel.

2. Click on **Point Calibration**

3. Enter the actual distance.

   The Actual Distance entered cannot exceed +/-25% of the factory setting.
   Example: If the transmitter was indicating a distance of 60".
   The minimum Actual Distance entered can be no less than 45".
   The maximum Actual Distance entered can be no greater than 75".

4. Click on **Send**

5.8.8 Configure Meter

The 7-Digit Display can be configured to display Status Messages and any Calculated Value. (4-20 mA, % of Range, Distance, Temp., etc.)

The Configure Meter Function allows the user to select the values that can be viewed on the display. Pressing the Up or Down Buttons on the keypad will allow the user to scroll through all of the enabled values.

NOTICE

Percent of Range is always enabled.

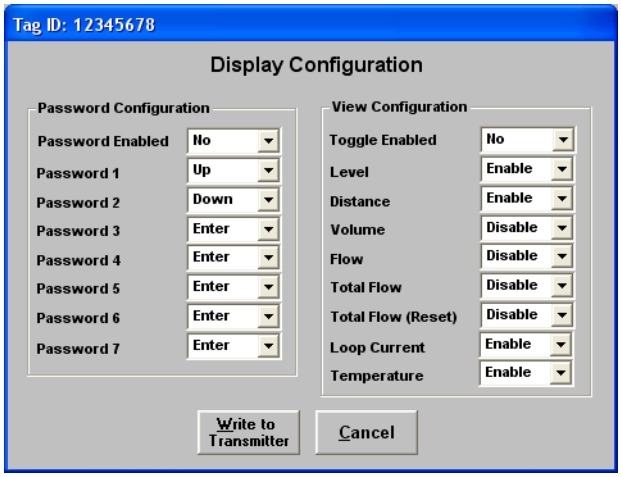


Figure 5-13
Display Configuration

View Configuration

- **Toggle Enabled** - This Enables or Disables the Auto-Scrolling feature of the display.

- If this function is Enabled, all of the Enabled Views will automatically scroll every 10 seconds.

NOTICE

This would be useful if the user was unable to reach the keypad to scroll manually.

5.8.8 Configure Meter (Continued)

Password Configuration

Password Enabled
This Enables or Disables the Password Required to enter the Menu.

Password 1-7
This selects the keypad sequence values of the password to enter the menu on the display.
Password 1 is the value for the first keypress.
Password 7 is the value for the last keypress.

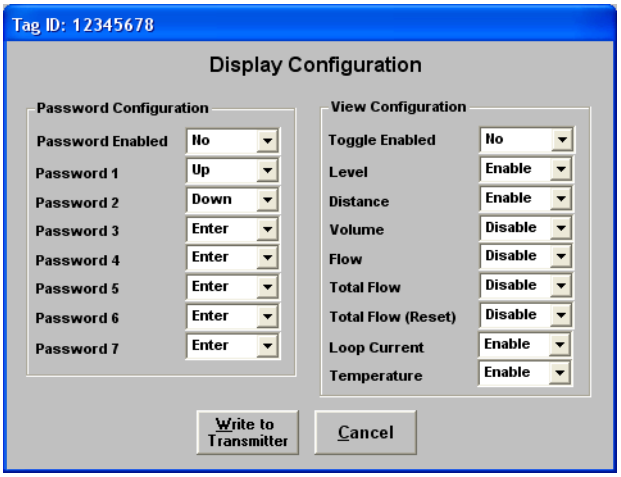


Figure 5-13
Display Configuration

NOTICE

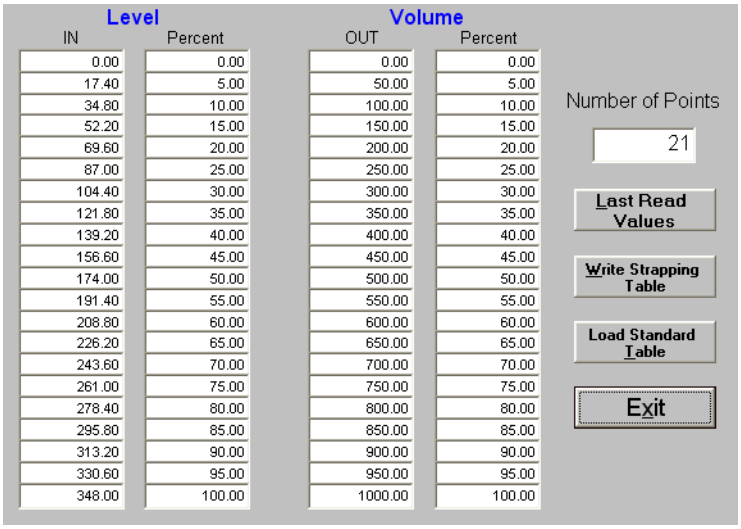
Example:
Figure 5-13 shows a keypress sequence of:
Up - Down - Enter - Enter - Enter - Enter - Enter.
This would be the sequence required to Enter the Menu on the display if the password was enabled.

5.8.9 Strapping Table

The Strapping Table is a 2-21 Point, table used to create a Custom non-linear output relationship to Level or Head Height.

Flow Applications
Several pre-defined Flume/Weir types are available **See Section 5.8.4**. If none of the pre-defined Flume / Weir types are appropriate for the application, a Custom Strapping Table will be necessary.

Volume Applications
Several pre-defined vessel types are available **See Section 5.8.3**. If none of the pre-defined vessel types are appropriate for the application, a Custom Strapping Table will be necessary.



Level IN	Level Percent	Volume OUT	Volume Percent
0.00	0.00	0.00	0.00
17.40	5.00	50.00	5.00
34.80	10.00	100.00	10.00
52.20	15.00	150.00	15.00
69.60	20.00	200.00	20.00
87.00	25.00	250.00	25.00
104.40	30.00	300.00	30.00
121.80	35.00	350.00	35.00
139.20	40.00	400.00	40.00
156.60	45.00	450.00	45.00
174.00	50.00	500.00	50.00
191.40	55.00	550.00	55.00
208.80	60.00	600.00	60.00
226.20	65.00	650.00	65.00
243.60	70.00	700.00	70.00
261.00	75.00	750.00	75.00
278.40	80.00	800.00	80.00
295.80	85.00	850.00	85.00
313.20	90.00	900.00	90.00
330.60	95.00	950.00	95.00
348.00	100.00	1000.00	100.00

Figure 5-14
Strapping Table for Volume

Load Standard Table (Volume Only)

If the application does not match one of the pre-defined vessel types, but the application is similar, a pre-defined vessel type may be loaded into the Strapping Table for custom editing.

To load a pre-defined Vessel Type into the Strapping Table:
Press the "**Load Standard Table**" button within the Strapping Table Window and select the desired vessel.

Pre-defined Vessel Types:
- Linear (Vertical Tank)
- Horizontal Tank with Flat Ends
- Horizontal Tank with Hemispherical Ends
- Spherical Tank

5.8.9 Strapping Table (Continued)

Plan your table by filling out the table below.

- Use the first column which lists every 5% between 0 and 100%
  or
  Fill in your own values in column 2.
- Fill out column 3 with output values corresponding to those listed in column 1 or 2.

Point	**% Level/Head** Standard Preset Values	**% Level/Head** Optional Values	**Output Values** Selected Units
1	0		
2	5		
3	10		
4	15		
5	20		
6	25		
7	30		
8	35		
9	40		
10	45		
11	50		
12	55		
13	60		
14	65		
15	70		
16	75		
17	80		
18	85		
19	90		
20	95		
21	100		

Section 6: System Specifications

6.1 Transmitter Specifications

Power Requirement:
12.0 to 30 Vdc - Voltages in excess of 30 Vdc will cause permanent damage.

Load Resistance = V supply – 12.0 / 0.02

- Minimum supply voltage is 19 volts at 4 mA
- For example:
  V supply = 24 V and maximum load resistance = 600 ohms.

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:
0.1inch (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:
2-wire signal loop: 4 – 20 mA DC (isolated)

Accuracy:
0.15% of maximum sensor range

Temperature Compensation:
Automatic

Damping:
0 to 90 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

Fail Safe:
22 mA

6.2 Transducer Specifications

Sensor
Material: CPVC
Pressure: -10 to 50 psig
2" NPT / BSP Process Connection

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

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

6.3 Enclosure Specifications

MS-30 PBT-RF (Valox 420 SEO UV Stabilized) to NEMA 4X (IP 66)
3/2" NPT / M20 Electrical/Conduit Entries

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