Instruction Manual · July 2005

million
in one

VS 100

VELOCITY SENSOR

MILLTRONICS

Safety Guidelines: Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

Qualified Personnel: This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

Unit Repair and Excluded Liability:

- The user is responsible for all changes and repairs made to the device by the user or the user's agent.
- All new components are to be provided by Siemens Milltronics Process Instruments Inc.
- Restrict repair to faulty components only.
- Do not reuse faulty components.

Warning: This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.

Note: Always use product in accordance with specifications.

Contact SMPI Technical Publications at the following address:

Technical Publications
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- For a selection of Siemens Milltronics level measurement manuals, go to: **www. siemens.com/processautomation**. Under Process Instrumentation, select *Level Measurement* and then go to the manual archive listed under the product family.
- For a selection of Siemens Milltronics weighing manuals, go to: **www. siemens.com/processautomation**. Under Weighing Technology, select *Continuous Weighing Systems* and then go to the manual archive listed under the product family.

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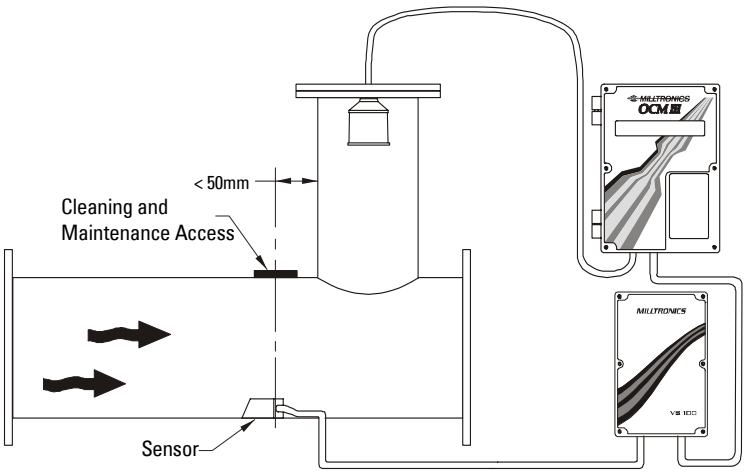
Introduction

The Milltronics Velocity Sensor VS 100 uses the Doppler Effect to measure velocity in open channels or round pipes.The VS 100 system consists of an electronic transceiver and sensor. The VS 100 has voltage, mA, and frequency outputs allowing the velocity measured by the VS 100 to be used by different flow monitoring controllers like the Siemens Milltronics Open Channel Meter OCM III or EnviroRanger ERS 500.

The Doppler Effect specifies that when a transmitted wave is reflected, a change occurs in the frequency of the return wave. The VS 100 uses this change to determine stream velocity within a channel. As the velocity of the stream increases, the frequency of return wave changes, becoming greater than the transmitted wave. This change between the two wave frequencies is then used to calculate the velocity of one specific moving particle in the stream. In channels, rivers, and streams, waves will bounce off air particles and suspended matter.

The VS 100 applies the Doppler Principle to calculate velocity in a channel by transmitting an ultrasonic signal into the channel stream. It reads and averages thousands of return frequency patterns to determine average velocity of the channel. The VS 100 has constant coefficients so that the voltage, mA, or frequency outputs are proportional to the velocity measured. This electronic velocity information is used by flow monitoring equipment such as the OCM III and ERS 500 in applications requiring a velocity input as the equipment combines the velocity reading with the stream depth and channel geometry to calculate flow.



Specifications

Electronics

Type

- Doppler - Ultrasonic

Velocity Measuring Range

- 0.05 to 4.5 m/s, 0.16 to 15 ft/s
- minimum depth 30 mm (1.2")

Accuracy

- Velocity in water with a uniform velocity profile and speed of sound of 1480 m/s:
  - maximum error of ± 0.03 m/s over a range of 0.05 to 1.5 m/s
  - ± 2% of reading over a range of 1.5 to 4.5 m/s

Resolution

- 1 mm/s, 0.003 ft/s

Temperature

- -20 to 80 °C (-4 to 176 °F)

Voltage Input

- 9 to 30 V DC (power consumption: 80 mA max.)

Signal Output

- voltage: 0 to 4.5 V (1 V / 1m/sec flow)
- current: 4 to 20 mA: 4 mA = 0 m/sec, 20 mA = 4.5 m/sec
- frequency: 1.78 x 10^{-3} m/sec / Hz, 1000 Hz = 1.78 m/sec

Cable

Type

- RG174/U

Length

- 7.5 m (25 ft)
- 15 m (50 ft)

Sensor

Temperature

- 0 to 80 °C (32 to 176 °F)

Material

- Polyurethane Body and Cable

Transducer

- crystals

Sensor Approval

- cEntela EX ia IIB T4
  Ci = 0.1µF,
  Li = 0.1 µH
- see *Intrinsically Safe Barrier Connection* on page 14 for more information

Transmitter Enclosure

Material

- Polycarbonate

Ingress Protection

- Type 4X, NEMA 4X, IP65

Mounting

Screw Jack Bands

Metric	Imperial
150 mm	6"
200 mm	8"
250 mm	10"
300 mm	12"
380 mm	15"
460 mm	18"

Metric	Imperial
500 mm	20"
560 mm	22"
610 mm	24"
760 mm	30"
915 mm	36"

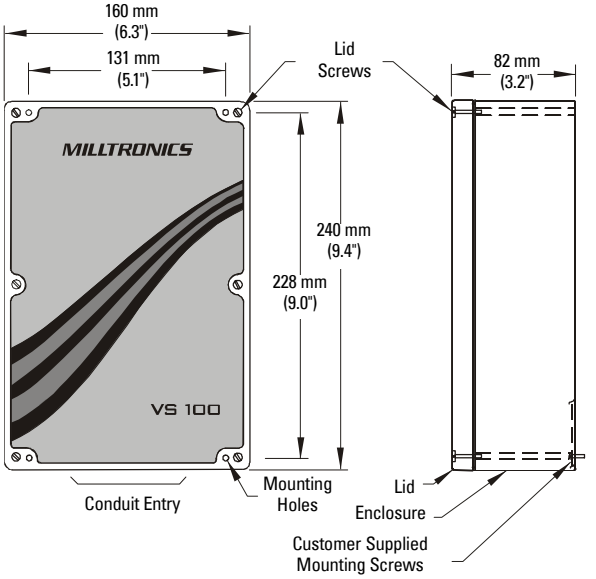
- (sensor and location mounting hardware included)

Flat Bottom Plate

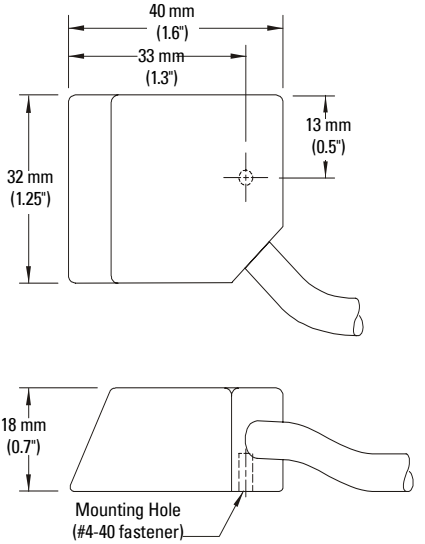
- 300mm x 300mm x 3.1mm (12" x 12" x 1/8")

VS 100 Dimensions

Transmitter



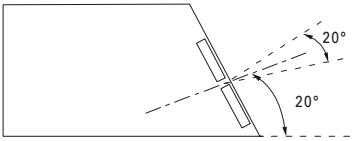
Sensor



Sensor Installation

The installation procedures and placement of the VS 100 sensor are crucial for optimum performance. Please consider the location carefully, and install the VS 100 properly.

Angles of View



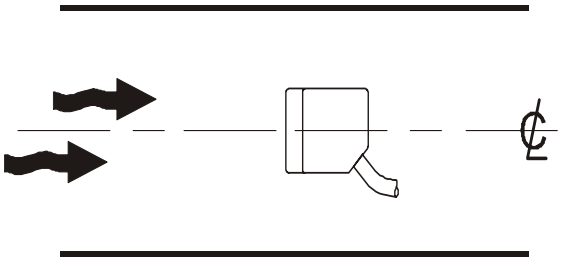
The VS 100 angle of view is 20° from horizontal. The beam angle is 20°. Keep the beam angle area clear of obstacles.

Channel Installation

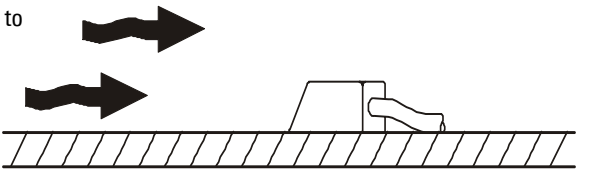
For channel installation, account for location and installation angle. Please note the following:

- Install the sensor in the center of the channel whenever possible.
- Install the sensor parallel to the bottom surface
- Install sensor wiring properly

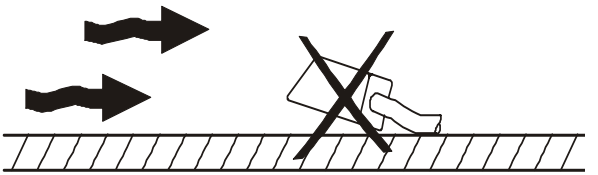
Center installation for optimum flow exposure.



Install parallel to surface to meet flow directly.



Improper installation can lead to measurement error and equipment damage.



Pipe Installation

When installing the VS 100 sensor in a pipe, be sure to account for pipe configurations and obstacles that can affect flow profiles:

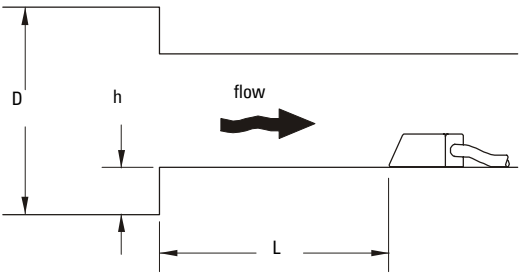
- profile changes
- valves
- intrusion and pipe angles
- curvatures
- steps

Use the formulas provided to calculate your most effective location.

Formula Definition Chart		
D	=	Pipe Diameter
h	=	Obstacle Measurement
L	=	Safe Installation Distance
α	=	Angle
V	=	Velocity

Profile Changes

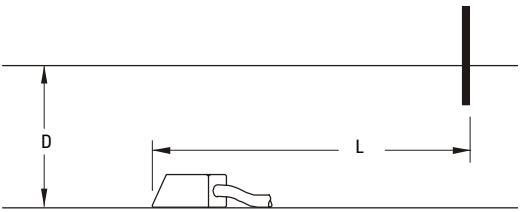
Pipe Profile	Adjustment
h $\leq$ 2.5% of D	L $\geq$ 3 x D (min.)
h > 2.5% of D	L = distance to stabilize without other obstructions



Valves

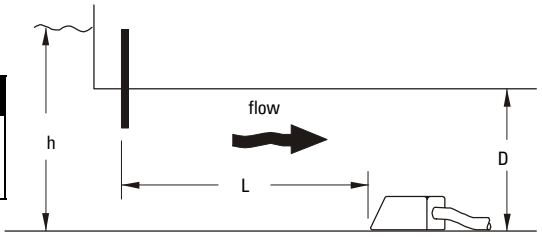
Sensor upstream from valve

Pipe Profile	Adjustment
valve obstacle	L = 3 x D



Sensor downstream from valve

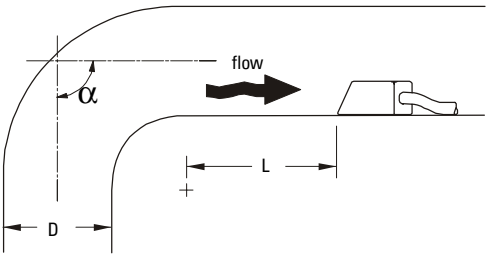
Pipe Profile	Adjustment
valve obstacle	L ≥ distance to stabilize flow + 2 x D.



Curved Pipe

If V > 1 m/s:

Pipe Profile	Adjustment
$\alpha > 15^{o}$	L = distance to stabilize surface flow.

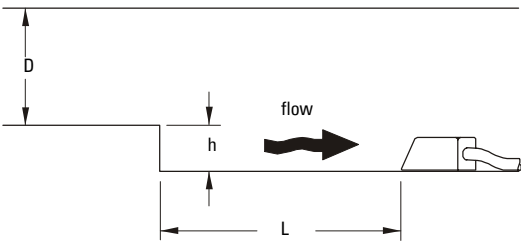


If V < 1 m/s:

Pipe Profile	Adjustment
$\alpha > 15^{o}$	L ≥ 3 x D (min.)
$\alpha > 45^{o}$	L ≥ 10 x D (min.)
$\alpha > 90^{o}$	L ≥ 20 x D (min.)

Steps

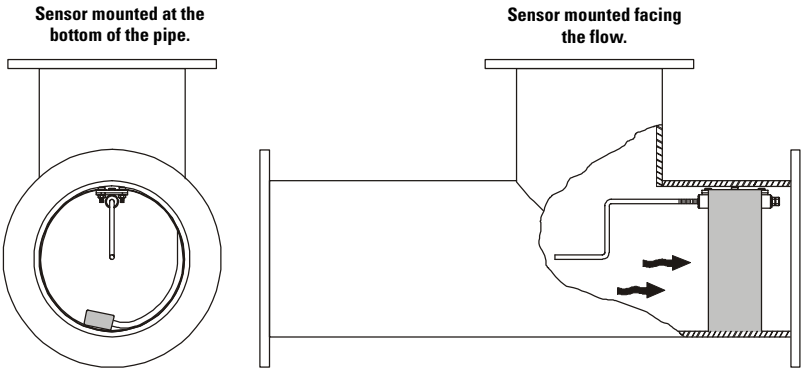
Pipe Profile	Adjustment
h ≤ 2.5% of D	L ≥ 3 x D (min.)
h > 2.5% of D	L ≥ distance to stabilize flow + 2 x D.



Sensor Mounting

Screw Jack Mounting Ring

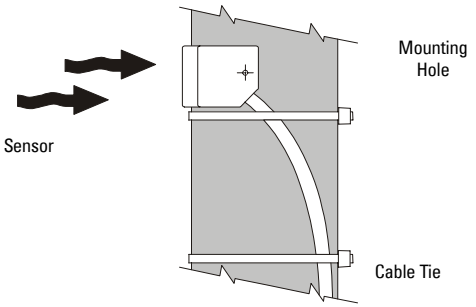
For use in round pipe less than 915mm (36") in diameter.



Installation

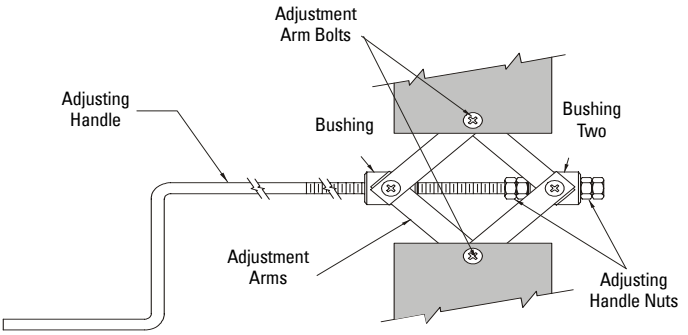
Sensor

1. Fasten the velocity sensor to the middle of the steel band using a 4-40 stainless steel screw in the mounting screw hole on the bottom of the sensor. To ensure a secure hold, also apply epoxy glue when fastening sensor to plate.
2. Fasten the connecting cable to the internal face of the steel band using cable ties.



Adjustment Arms

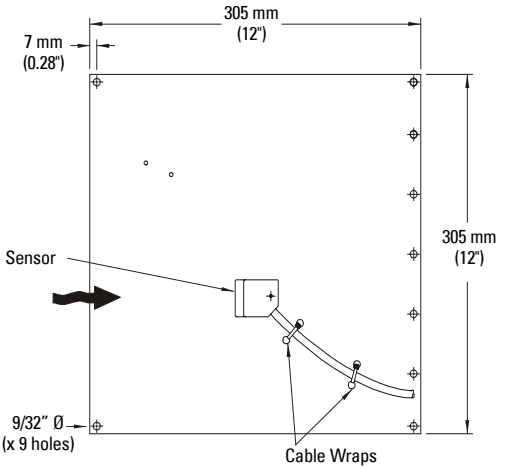
1. Connect each end of the steel band to the adjustment arms and bolt in place. The band should form a ring. Make sure the arms are inside the ring, not on top.
2. Thread the adjusting handle through Bushing One and slide through Bushing Two. Fasten using the double nuts as illustrated below.



3. Insert the ring into the pipe, with the sensor at the bottom of the stream flow.
4. Screw the adjusting handle in the appropriate direction to expand or contract the ring until it fits tightly in the pipe.

Flat Steel Mounting Plate

For use in a flat-bottom channel or stream.

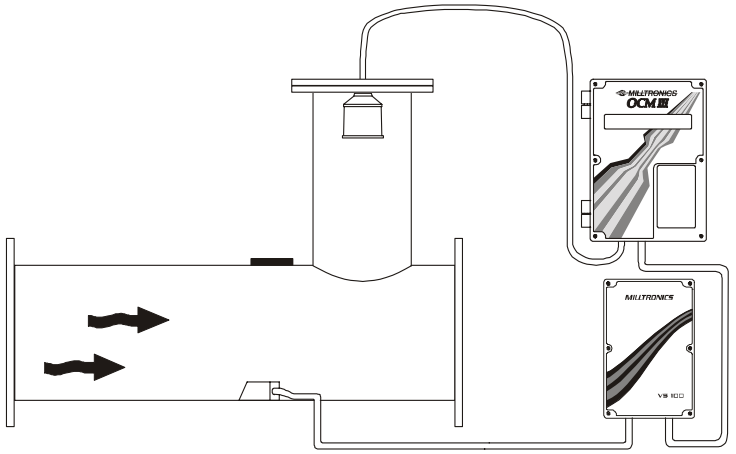


1. Fasten the sensor to a flat steel plate using a 4-40 stainless steel screw in the mounting screw hole on the bottom of the sensor. To ensure a secure hold, also apply epoxy glue when fastening sensor to plate.
2. Place the plate at the bottom of the channel and fasten it in place (location mounting screws provided by customer).

Mounting the Electronics

The VS 100 enclosure should be mounted in a clean, dry area that is within the temperature range and suitable for the specified enclosure. For convenience, it can be mounted in the same area as the open channel monitor (for example OCM III or EnviroRanger ERS 500) to allow for easy wiring access.

Position the VS 100 within the length capability of the sensor (7.5 m or 15 m). Do not extend the sensor cable length beyond that provided.



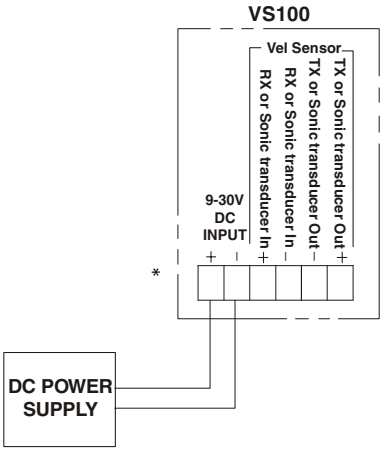
Wiring Diagrams

Connecting to the Power Source

The VS 100 transmitter is connected to a separate DC power supply.

Please note the following when you are connecting the VS 100 transmitter to the power source.

- Use the terminal block connections to connect to the VS 100 transmitter.
- Turn the small screw on top of the terminal block **CW** (clockwise) to tighten.
- After inserting wire into the terminal block, make sure the clamp is only on the wire and not on the insulator surrounding the wire.

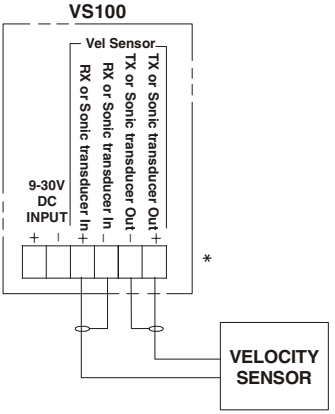


* labelling of terminal block connections depends on electronics version.

Connecting to the Sensor

The VS 100 sensor probe has two coaxial cables (RG174/U):

- one for the transmitter crystal
- one for the receiver crystal



* labelling of terminal block connections depends on electronics version.

Cable One

Select one of the two cables. The cable ends have been prepared and are ready to insert into the connector.

1. Connect the central, insulated copper wire to **TX or Sonic Transducer Out +** connector.
2. Connect the braided wire surrounding the copper wire to **TX or Sonic Transducer -** connector.

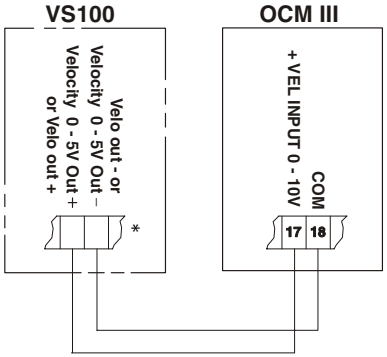
Cable Two

Select the other cable.

1. Using the remaining cable, connect the central insulated copper wire to **RX or Sonic Transducer In +** connector.
2. Connect the braided wire surrounding the copper wire to **RX or Sonic Transducer In -** connector.

Connecting to the Voltage Output

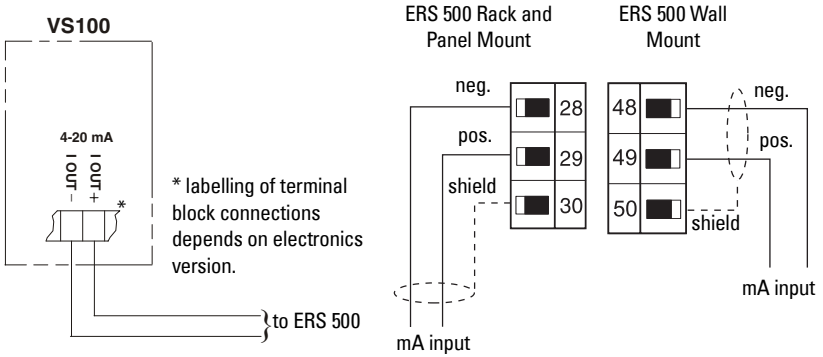
For example, use the voltage output from the VS 100 as a velocity input for the OCM III through the 0-10V input.



* labelling of terminal block connections depends on electronics version.

Connecting to the mA Output

For example, use the mA output from the VS 100 as a velocity input through the mA Input on the EnviroRanger ERS 500 for use in ERS 500 OCM applications.



Note: See EnviroRanger ERS 500 for mA input scaling and connection requirements.

Connecting to the Frequency Output

For example, the frequency output from the VS 100 can be monitored by the ERS 500 through discrete inputs 7 or 8. Frequency input to the ERS 500 cannot be used as an input for ERS 500 OCM applications, but can be used as a simple velocity input for triggers or logging.

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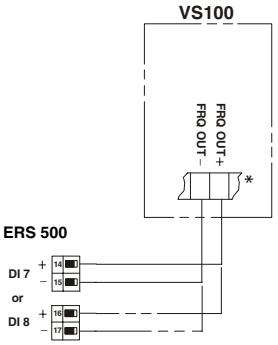
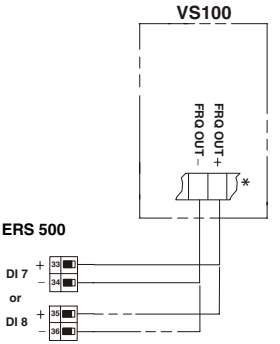
VS 100 to ERS 500 Wall Mount



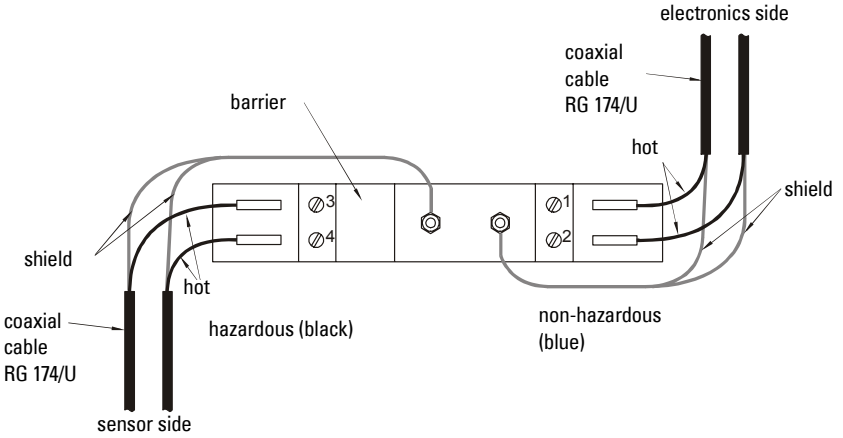
VS 100 to ERS 500 Rack and Panel Mount



* labelling of terminal block connections depends on electronics version.

Intrinsically Safe Barrier Connection

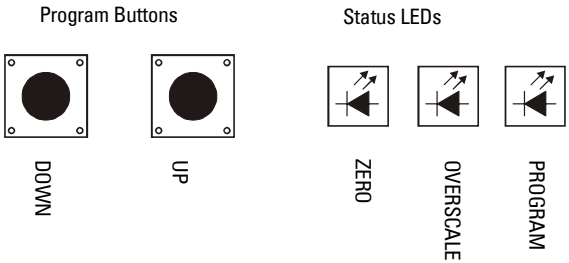
When installing the sensing probe in a hazardous area, an appropriate Zener barrier is required between the VS 100 electronics and the sensor. The sensor wiring must be put through a barrier to condition the signal to the sensor. A MTL766 or equivalent zener barrier will provide the required safety limits and performance. Install the barrier as shown below.



Note: For intrinsically safe applications, ensure the VS 100 sensor has an Entela approval label indicating it meets the approval requirements.

Gain Offset Adjustment

The VS 100 has programmable gain adjustment controls. In PROGRAM mode, the 0-5V, 4-20 mA, and frequency outputs are increased or decreased by increasing or decreasing the value of the offset coefficient.



To enter PROGRAM mode, hold both buttons for 6 seconds. When you release the buttons, the program LED will illuminate.

To adjust the output of the VS 100, press either the UP or DOWN button. To change the coefficient, you must pulse the button rather than holding it continuously. The overscale or zero LED will flash to indicate a change in coefficient.

To exit PROGRAM mode, hold the up and down buttons for 6 seconds. The Program LED will turn off.

Note: The output change cannot be viewed while in PROGRAM mode. Return to RUN mode to see the effect of the coefficient change on the output.

To reset the coefficients to factory default, hold the Up and Down buttons for 12 seconds. The LEDs will flash 3 times to indicate a reset. You do not need to enter or exit PROGRAM mode to reset the coefficients.

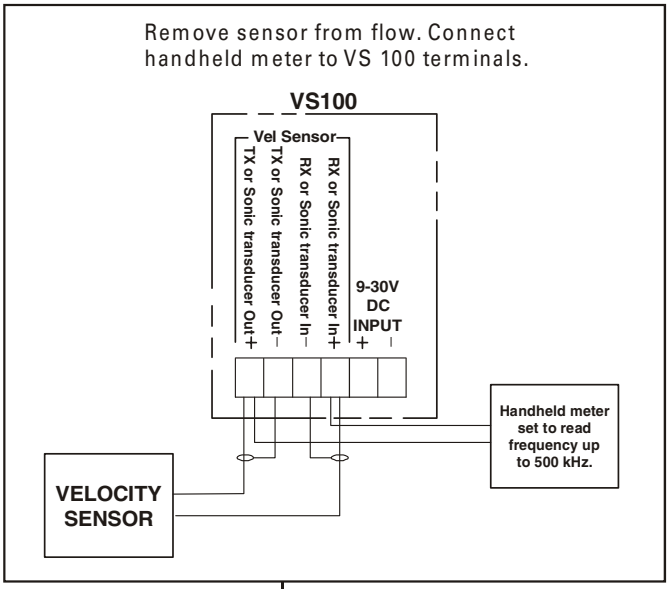
Maintenance

The VS 100 transmitter requires little maintenance. To ensure optimum operation, please perform the following every three months.

1. Wipe the sensor face with a soft cloth to remove any grease build-up or silt.
2. Check the cable for nicks and cuts.
3. Check mounting fasteners.
4. For Screw Jack installation, check band tension and installation fasteners.

Troubleshooting

If you are receiving no signal from your VS 100 system, check the operation of the sensor and electronics interface:



500 kHz reading?

Yes

Sensor is functioning. Check the transmitter wiring and flow monitor signal through-put.

No

Disconnect sensor from VS 100 terminals. Check handheld meter reading for 500 kHz signal.

500 kHz reading?

Yes

Check that the sensor is connected correctly. Check for:
- sensor polarity
- a damaged sensor
- damaged wiring
- a wiring short circuit

No

Contact your Siemens Milltronics representative regarding the electronics component.

www.siemens.com/processautomation

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