Installation Manual
20002273, Rev. AA
July 2014

Micro Motion® MVD™ Direct Connect™ Meters

Micro Motion®

EMERSON™
Process Management

Safety and approval information

This Micro Motion product complies with all applicable European directives when properly installed in accordance with the instructions in this manual. Refer to the EC declaration of conformity for directives that apply to this product. The EC declaration of conformity, with all applicable European directives, and the complete ATEX Installation Drawings and Instructions are available on the internet at *www.micromotion.com* or through your local Micro Motion support center.

Information affixed to equipment that complies with the Pressure Equipment Directive can be found on the internet at *www.micromotion.com/documentation*.

For hazardous installations in Europe, refer to standard EN 60079-14 if national standards do not apply.

Other information

Full product specifications can be found in the product data sheet. Troubleshooting information can be found in the transmitter configuration manual. Product data sheets and manuals are available from the Micro Motion web site at *www.micromotion.com/documentation*.

Return policy

Micro Motion procedures must be followed when returning equipment. These procedures ensure legal compliance with government transportation agencies and help provide a safe working environment for Micro Motion employees. Failure to follow Micro Motion procedures will result in your equipment being refused delivery.

Information on return procedures and forms is available on our web support system at *www.micromotion.com*, or by phoning the Micro Motion Customer Service department.

Micro Motion customer service

Email:

- Worldwide: *flow.support@emerson.com*
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Canada	+1 303-527-5200	The Netherlands	+31 (0) 318 495 555	New Zealand	099 128 804
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Argentina	+54 11 4837 7000	Germany	0800 182 5347	Pakistan	888 550 2682
Brazil	+55 15 3413 8000	Italy	8008 77334	China	+86 21 2892 9000
Venezuela	+58 26 1731 3446	Central & Eastern	+41 (0) 41 7686 111	Japan	+81 3 5769 6803
		Russia/CIS	+7 495 981 9811	South Korea	+82 2 3438 4600
		Egypt	0800 000 0015	Singapore	+65 6 777 8211
		Oman	800 70101	Thailand	001 800 441 6426
		Qatar	431 0044	Malaysia	800 814 008
		Kuwait	663 299 01		
		South Africa	800 991 390		
		Saudia Arabia	800 844 9564		
		UAE	800 0444 0684		

Contents

1 Before you begin

This manual provides installation information for Micro Motion® MVD™ Direct Connect meters. MVD Direct Connect meters may or may not include the MVD Direct Connect I.S. barrier. Both installation types are discussed here.

Additionally, this manual provides basic information for establishing communication between the MVD Direct Connect meter and the remote host system.

1.1 Safety

For information on I.S. applications, refer to Micro Motion ATEX, UL, or CSA installation instructions.

⚠ WARNING!

Improper installation in a hazardous area can cause an explosion. For information about hazardous applications, refer to the appropriate Micro Motion approval documentation, shipped with the meter or available from the Micro Motion web site.

⚠ CAUTION!

Excess voltage can damage the core processor. To avoid damaging the core processor, use only low-voltage DC power.

2 Product overview and architecture

MVD Direct Connect meters are used to supply Micro Motion sensor data directly to a remote Modbus-capable host, rather than to a Micro Motion transmitter. Because there is no transmitter component, MVD Direct Connect systems are not intrinsically safe unless the MVD Direct Connect I.S. barrier is included in the installation.

⚠ WARNING!

MVD Direct Connect systems without the MVD Direct Connect I.S. barrier are not intrinsically safe.

2.1 Installation options

All MVD Direct Connect systems include a sensor and a core processor. Either the standard core processor or the enhanced core processor may be installed. The core processor (standard or enhanced) can be mounted integrally with the sensor or remotely.

If the MVD Direct Connect I.S. barrier is installed, a separate barrier is required for each core processor.

See *Figure 2-1* and *Figure 2-2* for illustrations of MVD Direct Connect installations without the MVD Direct Connect I.S. barrier. See *Figure 2-3* and *Figure 2-4* for illustrations of MVD Direct Connect installations with the MVD Direct Connect I.S. barrier.

Figure 2-1 MVD Direct Connect installations – Integral core processor, no I.S. barrier

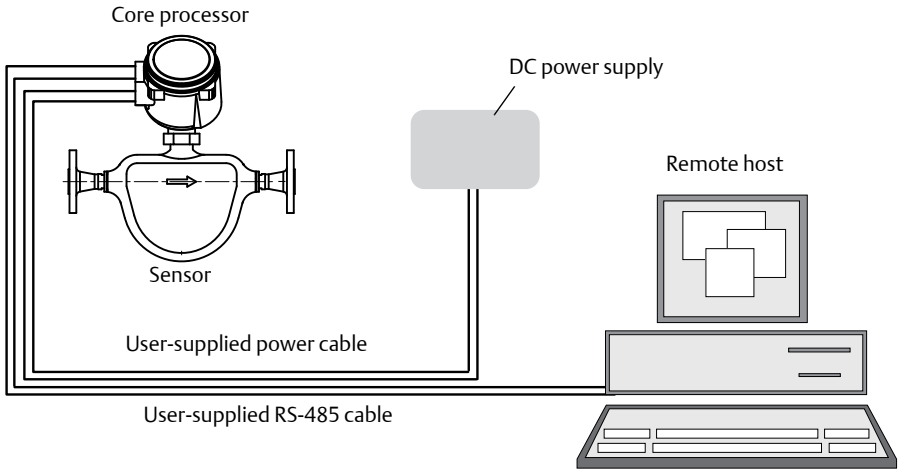


Figure 2-2 MVD Direct Connect installations – Remote core processor, no I.S. barrier

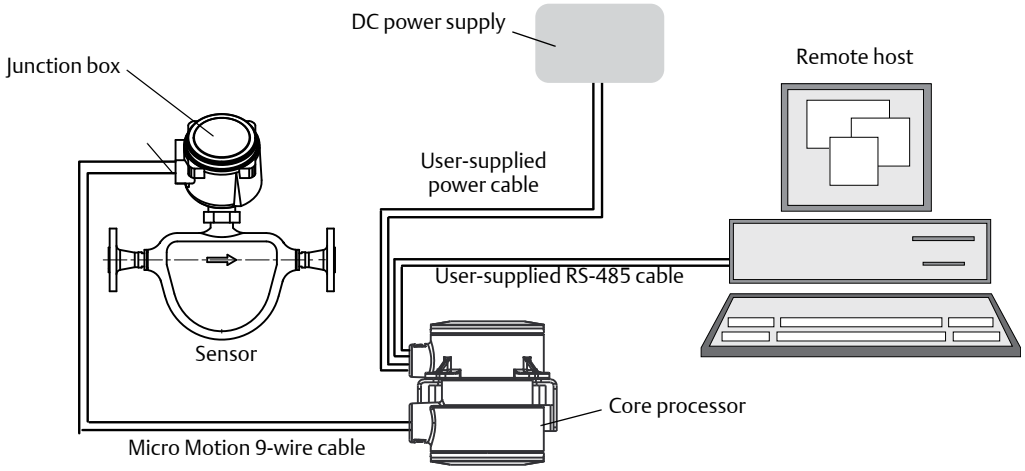


Figure 2-3 MVD Direct Connect installations – Integral core processor, I.S. barrier

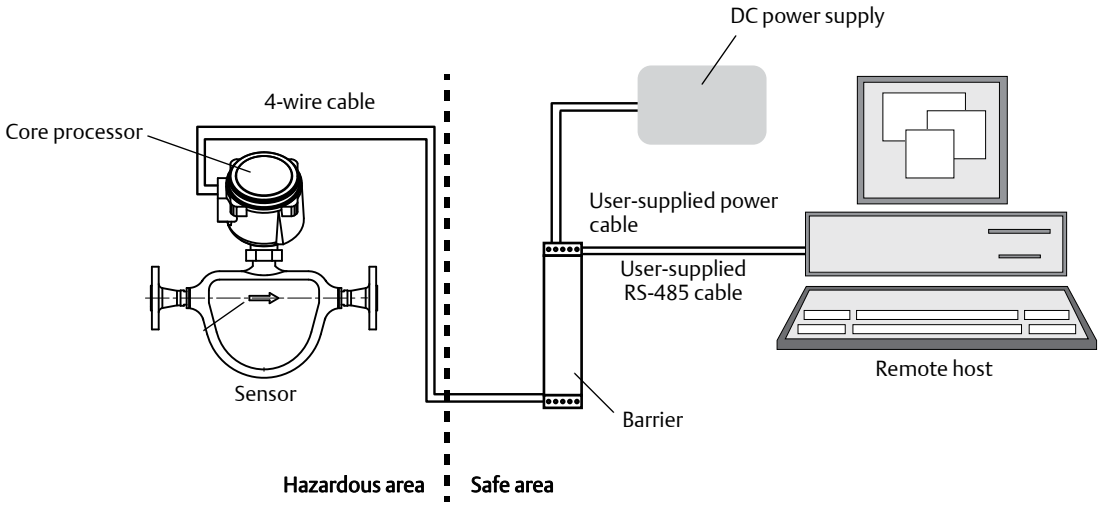
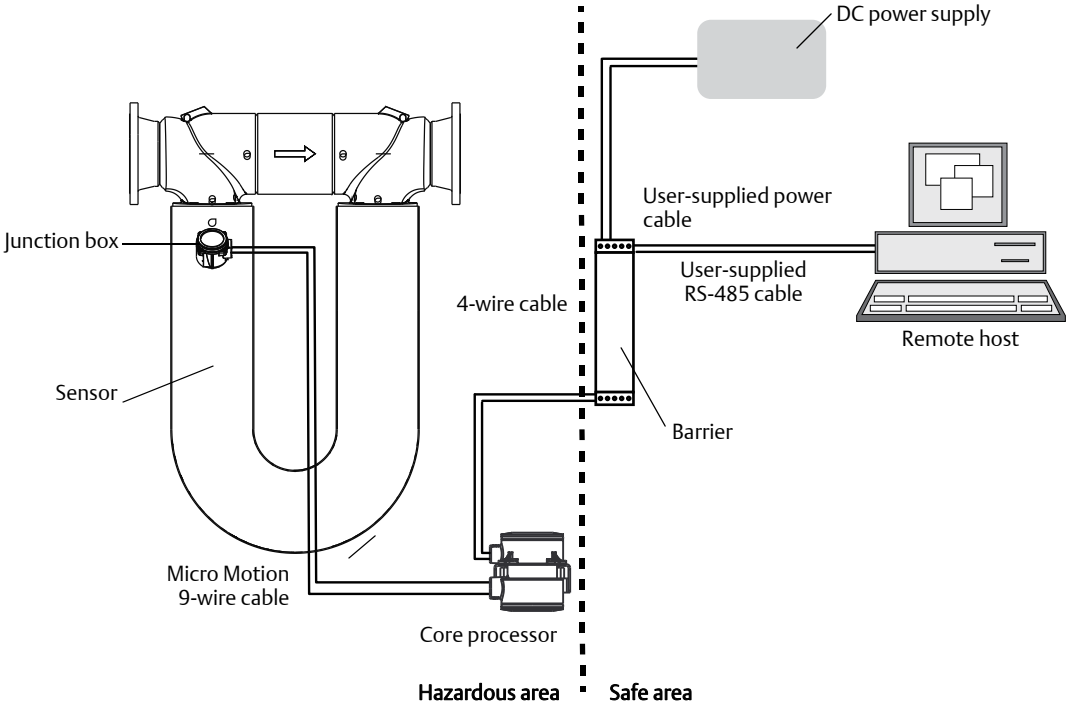


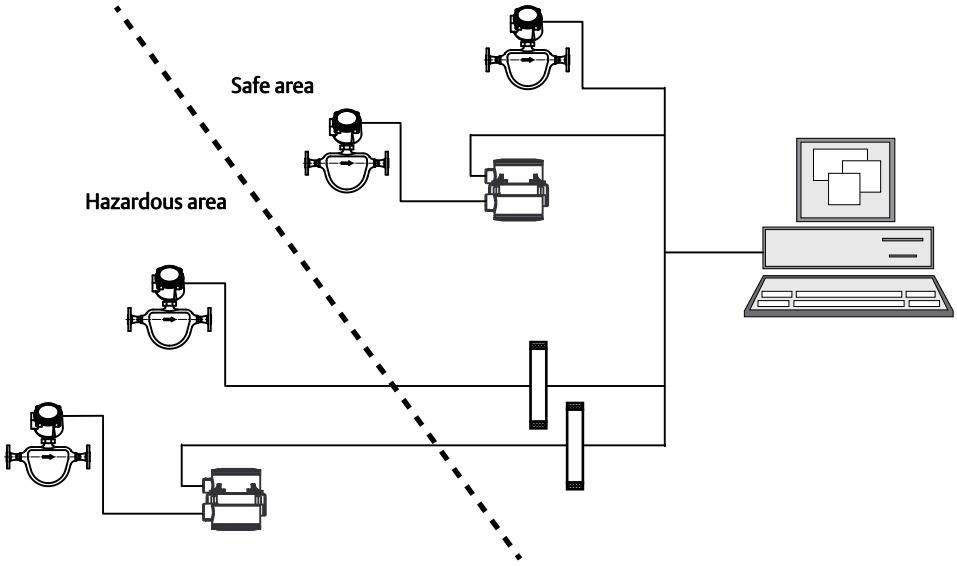
Figure 2-4 MVD Direct Connect installations – Remote core processor, I.S. barrier



2.2 Multidrop installation

Up to fifteen MVD Direct Connect installations can be networked to a single remote host. If I.S. barriers are used, one barrier is required for each core processor. *Figure 2-5* shows the four options for a multidrop installation.

Figure 2-5 Multidrop installation options



3 Installation

3.1 Supplying power

Power supply requirements depend on your installation type:

- MVD Direct Connect without the MVD Direct Connect I.S. barrier (see *Figure 2-1* and *Figure 2-2*)
- MVD Direct Connect with the MVD Direct Connect I.S. barrier (see *Figure 2-3* and *Figure 2-4*)

3.1.1 MVD Direct Connect installations without the MVD Direct Connect I.S. barrier

In MVD Direct Connect installations without the I.S. barrier, power is supplied directly to the core processor. The core processor supplies power to the sensor. The power supply must meet the following requirements:

- Power must be supplied from a common floating regulated power supply with the correct voltage.
- The voltage requirement for a single core processor is 15–26 VDC. The maximum power consumption of a single core processor is approximately 3 W.
- The power supply may be used to power any number of core processors, but must not be used to power other devices.
- Use shielded wiring.
- The power supply must not allow power surges or conducted radio frequency interference (RFI) to propagate through to its output.
- The power supply must not be grounded.

⚠ CAUTION!

Grounding the power supply to the core processor can cause damage to the core processor or the remote host. To avoid damaging the core processor or the remote host, ensure that the power supply to the core processor is not grounded.

- In EU countries, the power supply must meet the requirements of the EMC directive.
- The power supply cable must comply with the size and length requirements listed in *Table 3-2*. A minimum DC input of 15 V is required for each core processor. At startup, the power source must provide a minimum of 0.2 A of short-term current per core processor. The maximum steady state current is 0.15 A. For assistance in sizing the power supply cable, refer to *Table 3-1* and use the equation below:

$$\text{MinimumSupplyVoltage} = 15\text{V} + (\text{CableResistance} \times \text{CableLength} \times 0.15\text{A})$$

Example

The core processor is mounted 350 feet from a DC power supply. If you want to use 18 AWG cable, calculate the required voltage at the DC power supply as follows:

$$\text{MinimumSupplyVoltage} = 15\text{V} + (\text{CableResistance} \times \text{CableLength} \times 0.15\text{A})$$

$$\text{MinimumSupplyVoltage} = 15\text{V} + (0.0128\ \text{ohms/ft} \times 350\ \text{ft} \times 0.15\text{A})$$

$$\text{MinimumSupplyVoltage} = 15.7\text{V}$$

Table 3-1 Typical power cable resistances at 68 °F (20 °C)

Gauge	Resistance
14 AWG	0.0050 Ω/foot
16 AWG	0.0080 Ω/foot
18 AWG	0.0128 Ω/foot
20 AWG	0.0204 Ω/foot
22 AWG	0.0328 Ω/foot
2,5 mm^2	0,0136 Ω/meter
1,5 mm^2	0,0228 Ω/meter
1 mm^2	0,0340 Ω/meter
0,75 mm^2	0,0460 Ω/meter
0,5 mm^2	0,0680 Ω/meter

Note

These values include the resistance of both high and low conductors in a cable.

3.1.2 MVD Direct Connect installations with the MVD Direct Connect I.S. barrier

In MVD Direct Connect installations with the I.S. barrier, power is supplied to the barrier. The barrier supplies power to the core processor, and the core processor supplies power to the sensor. The power supply must meet the following requirements:

- The power supply can be either floating or grounded.
- The voltage requirement for a single barrier is 24 VDC ±20%. The maximum power consumption of a single barrier plus core processor is approximately 3.5 W.
- The power supply cable must comply with the size and length requirements listed in *Table 3-3*. A minimum DC input of 19.2 V is required at the barrier terminals. At startup, the power source must provide a minimum of 0.2 A of short-term current per core processor. The maximum steady state current is 0.15 A. For assistance in sizing the power supply cable, refer to *Table 3-1* and use the equation below:

$$\text{MinimumSupplyVoltage} = 19.2\text{V} + (\text{CableResistance} \times \text{CableLength} \times 0.15\text{A})$$

Example

A single MVD Direct Connect I.S. barrier is mounted 350 feet from a DC power supply. If you want to use 18 AWG cable, calculate the required voltage at the DC power supply as follows:

$$\text{MinimumSupplyVoltage} = 19.2\text{V} + (\text{CableResistance} \times \text{CableLength} \times 0.15\text{A})$$

$$\text{MinimumSupplyVoltage} = 19.2\text{V} + (0.0128\ \text{ohms/ft} \times 350\ \text{ft} \times 0.15\text{A})$$

$$\text{MinimumSupplyVoltage} = 19.9\text{V}$$

3.2 Locating the components

See the sensor installation manual for information on locating the sensor or the sensor/core processor assembly. If the core processor is installed remotely from the sensor, see the sensor installation manual for information on the maximum distance between these two components.

Maximum distance between the core processor, the power supply, the remote host, and the I.S. barrier (if your installation includes the barrier) depends on the wire size and type. Ensure that your installation complies with these requirements.

- *Table 3-2* lists the wire size and length requirements for MVD Direct Connect installations without the I.S. barrier.
- *Table 3-3* lists the wire size and length requirements for MVD Direct Connect installations with the I.S. barrier.

Table 3-2 Wire sizes and lengths – MVD Direct Connect installations without I.S. barrier

Span	Cable type	Wire size	Max length
Core processor to remote host	RS-485	22 AWG (0,35 mm^2) or larger	500 feet (150 meters)
Core processor to power supply	Power	22 AWG (0,35 mm^2)	300 feet (90 meters)
		20 AWG (0,5 mm^2)	500 feet (150 meters)
		18 AWG (0,8 mm^2)	500 feet (150 meters)

Note

Power wires must be sized to provide a minimum of 15 V at the core processor. See the discussion in the preceding section.

Table 3-3 Wire sizes and lengths – MVD Direct Connect installations with I.S. barrier

Span	Cable type	Wire size	Max length
Core processor to barrier	RS-485	22 AWG (0,35 mm^2) or larger	500 feet (150 meters)
	Power	22 AWG (0,35 mm^2)	300 feet (90 meters)
		20 AWG (0,5 mm^2)	500 feet (150 meters)
		18 AWG (0,8 mm^2)	500 feet (150 meters)
Barrier to host	RS-485	22 – 18 AWG (0,35 – 0,8 mm^2)	1000 ft (300 meters)
Barrier to power supply	Power	22 AWG (0,35 mm^2)	300 feet (90 meters)
		20 AWG (0,5 mm^2)	500 feet (150 meters)
		18 AWG (0,8 mm^2)	500 feet (150 meters)

Notes

- Core processor to barrier wire must be sized to provide a minimum of 15 V at the core processor. See the discussion in the preceding section.
- Barrier to power supply wiring must be sized to provide a minimum of 19.2 V at the barrier. See the discussion in the preceding section

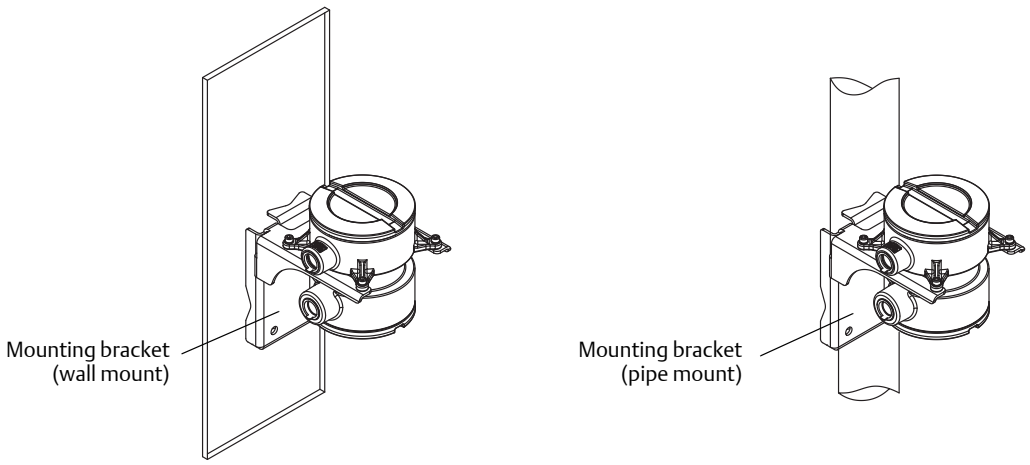
3.3 Installing the core processor

Note

This step is required only if the core processor is mounted separately from the sensor. Refer to *Figure 2-2* and *Figure 2-4*.

See *Figure 3-1* for a diagram of the mounting bracket supplied with the core processor. Both pipe mounting and wall mounting are shown.

Figure 3-1 Remote core processor – Wall mount or pipe mount



To mount the core processor:

1. Identify the components shown in *Figure 3-2*. For dimensions, see *Figure 3-3*.
2. If desired, reorient the core processor housing on the bracket.
   a. Loosen each of the four cap screws (4 mm).
   b. Rotate the bracket so that the core processor is oriented as desired.
   c. Tighten the cap screws, torquing to 30 to 38 in-lbs (3 to 4 N-m).
3. Attach the mounting bracket to an instrument pole or wall. For pipe mount, two user-supplied U-bolts are required. Contact Micro Motion to obtain a pipe-mount installation kit if required.

Figure 3-2 Remote core processor components

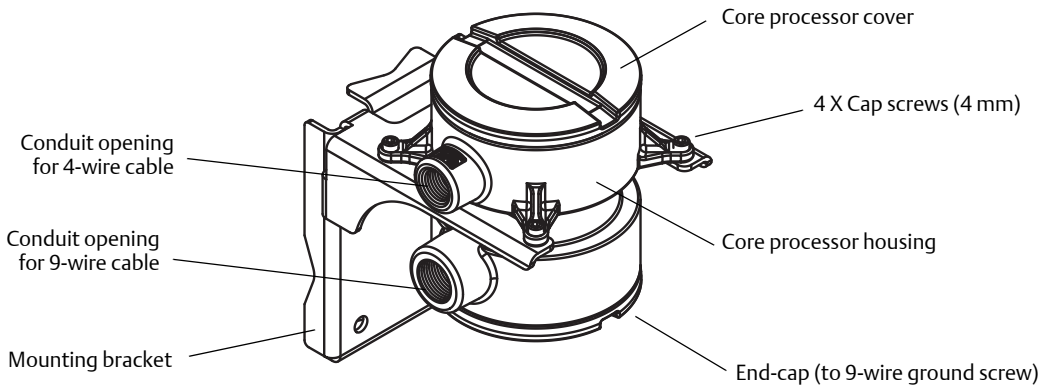


Figure 3-3 Dimensions – Remote core processor

Dimensions in inches (mm)

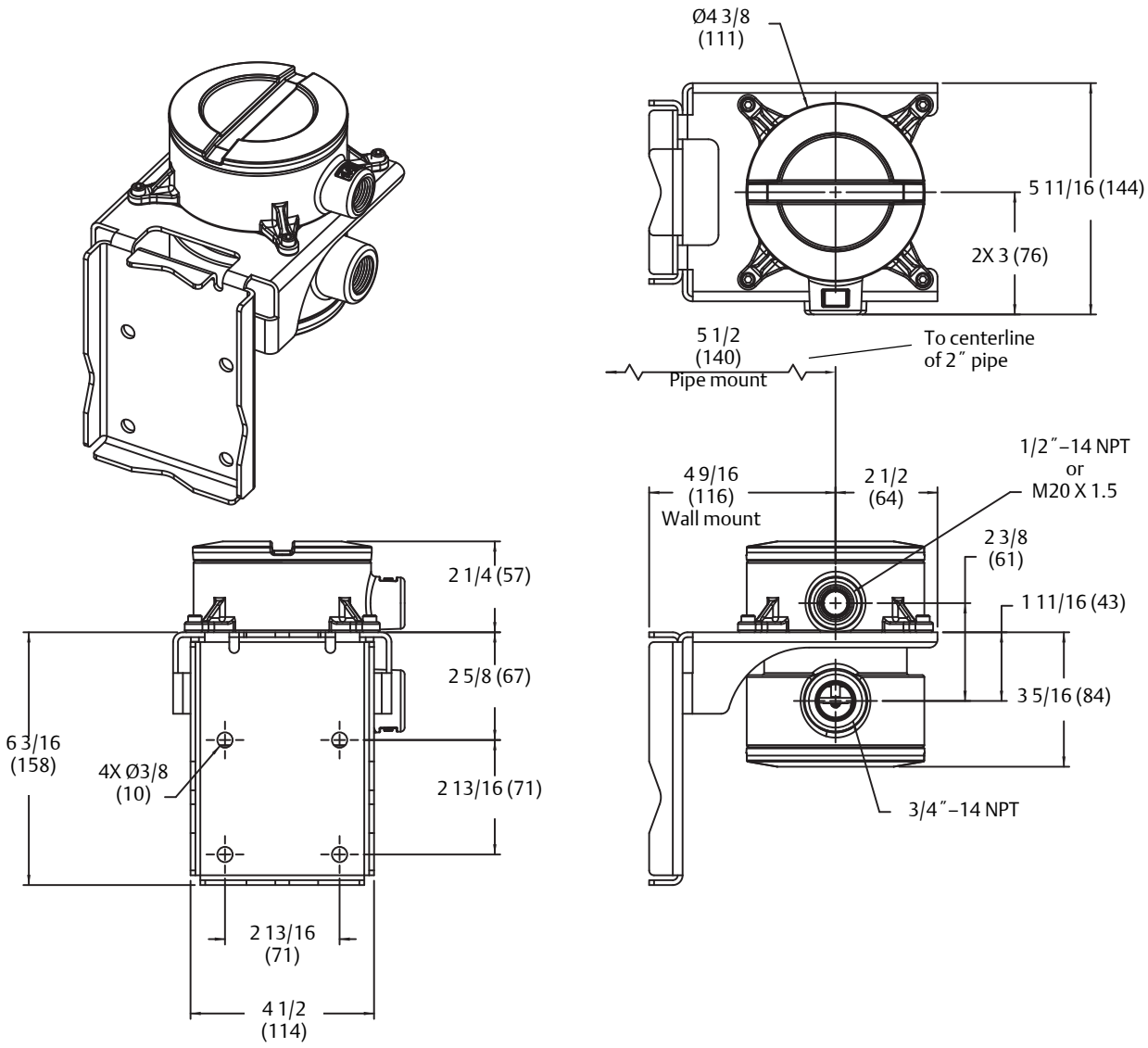
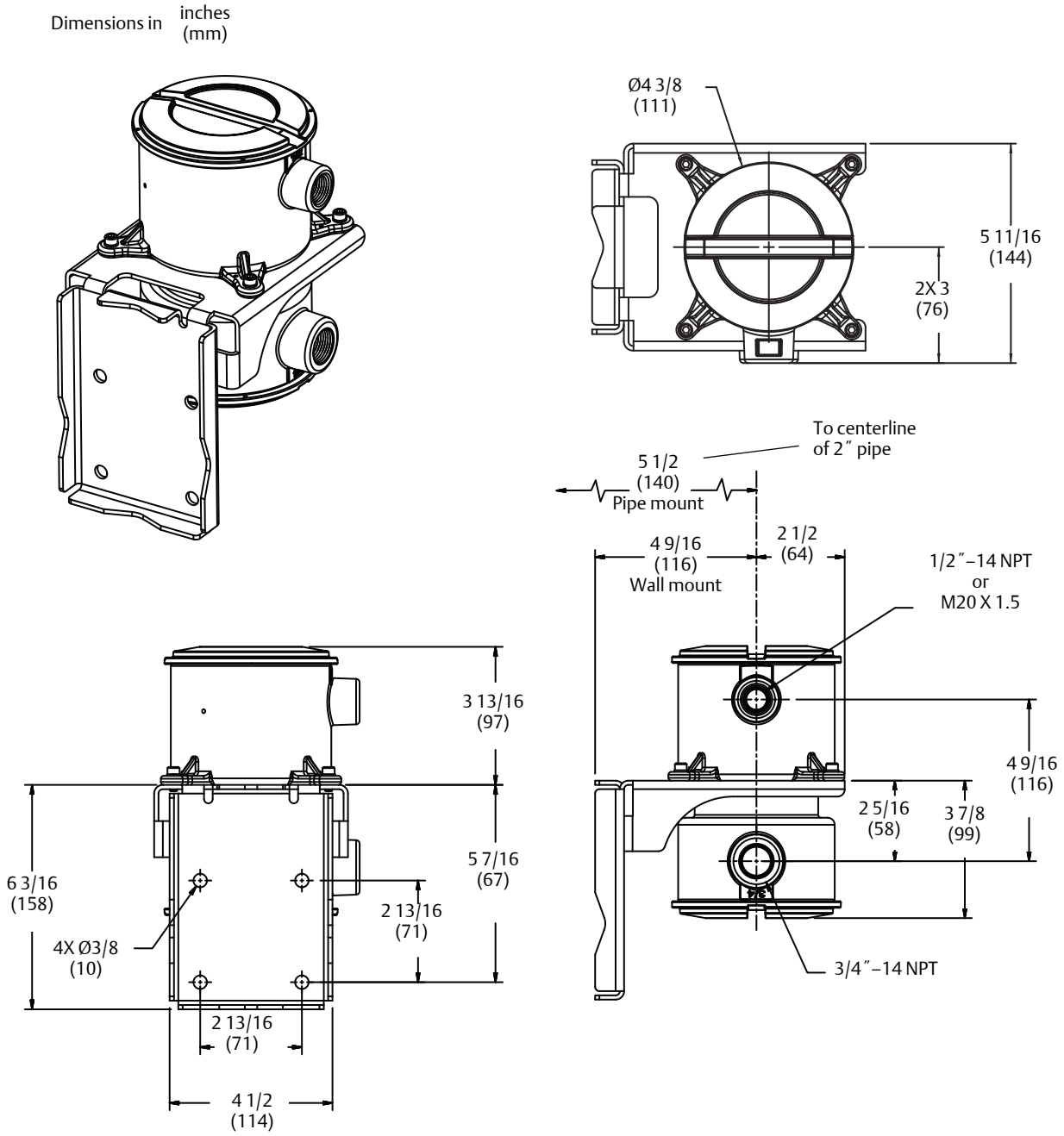


Figure 3-4 Dimensions – Remote enhanced core processor



3.4 Wiring the core processor to the sensor

Note
This step is required only if the core processor is mounted separately from the sensor. Refer to *Figure 2-2* and *Figure 2-4*.

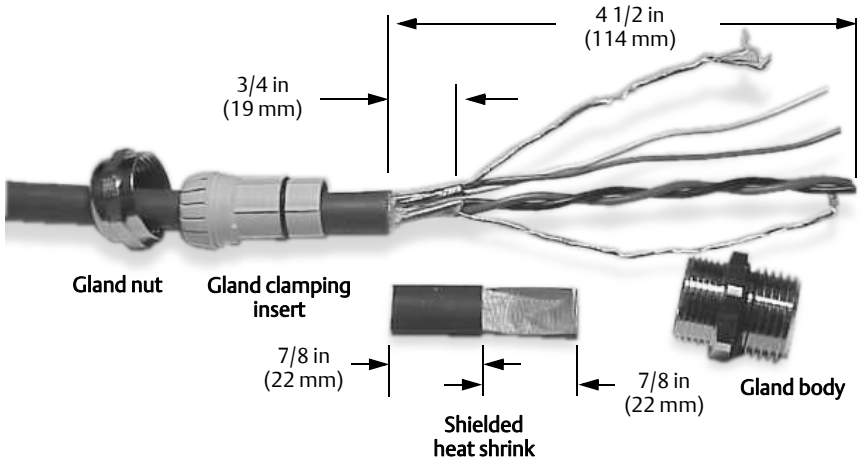
Wire the core processor to the sensor using a Micro Motion 9-wire cable. See the sensor installation manual for instructions.

3.5 4-wire cable preparation and core processor wiring

Note
This step is required for all MVD Direct Connect installations

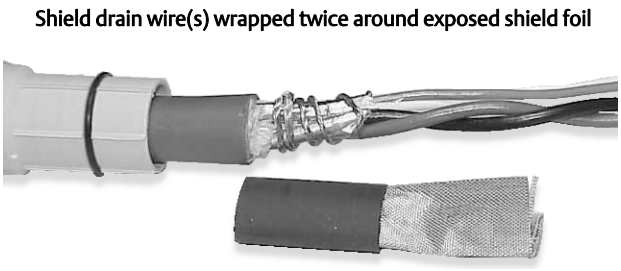
1. Ensure that the cables meet the following requirements:
   - Twisted-pair construction
   - The size and length requirements described in the preceding sections
2. Use one of the following methods to shield the wiring from the core processor:
   - If you are installing unshielded cable, the cable must be installed in continuous metallic conduit that provides 360° termination shielding for the enclosed wiring. Go to Step 7.
   - If you are installing shielded or armored cable with a user-supplied cable gland, terminate the shield or braid and drain wires in the cable gland. Never connect the drain wires to the internal ground screw of the core processor. Go to Step 7.
   - If you are installing shielded or armored cable with a Micro Motion-supplied cable gland:
     • With shielded cable (where the shield consists of foil), prepare the cable and apply shielded heat shrink as described in Steps 3 through 6. The shielded heat shrink provides a shield termination suitable for use in the gland.
     • With armored cable (where the shield consists of braid), prepare the cable as described as described in Steps 3 through 6. Do not apply heat shrink (omit Steps 5d through 5g).
3. Remove the cover from the core processor.
4. Slide the gland nut and the clamping insert over the cable.

Figure 3-5 Micro Motion cable gland and heat shrink



5. For connection at the core processor housing, prepare cable as follows (for armored cable, omit Steps 5d through 5g):
   a. Strip 4 1/2 inches (114 mm) of cable jacket.
   b. Remove the clear wrap that is inside the cable jacket, and remove the filler material between the wires.
   c. Remove the foil shield that is around the insulated wires, leaving 3/4 inch (19 mm) of foil or braid and drain wires exposed, and separate the wires.
   d. Wrap the shield drain wire(s) around the exposed foil twice. Cut off the excess wire.

Figure 3-6 Wrapping the shield drain wires



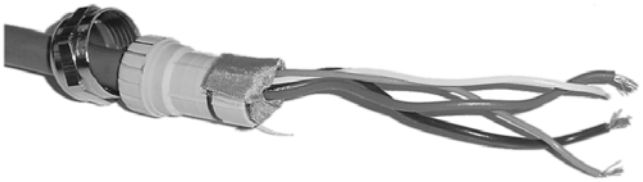
   e. Place the shielded heat shrink over the exposed shield drain wire(s). The tubing should completely cover the drain wires.
   f. Without burning the cable, apply heat (250 °F or 120 °C) to shrink the tubing.

Figure 3-7 Applying the heat shrink

g. Position gland clamping insert so the interior end is flush with the heat shrink.

h. Fold the cloth shield or braid and drain wires over the clamping insert and approximately 1/8 inch (3 mm) past the O-ring.

Figure 3-8 Folding the cloth shield

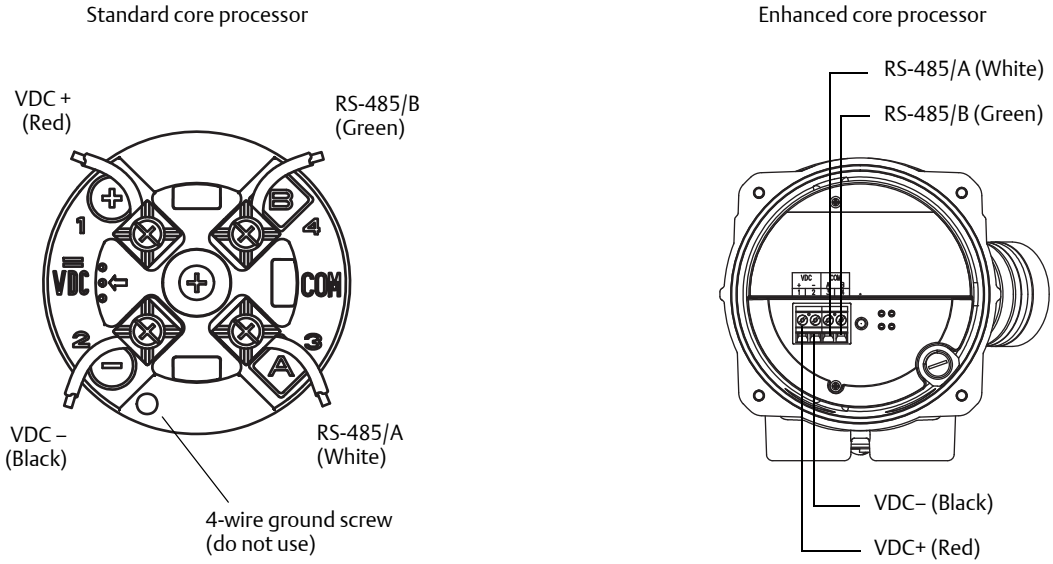


i. Install the gland body into the core processor housing conduit opening.

Figure 3-9 Gland body and core processor housing

6. Insert the wires through the gland body and assemble the gland by tightening the gland nut.
7. Connect signal wires to the RS-485 terminals on the core processor (see *Figure 3-10*). If you are using Micro Motion 4-wire cable, use the green and white wires.

Figure 3-10 Connecting the wires at the core processor



8. Connect power supply wires to the VDC terminals on the core processor (see *Figure 3-10*). If you are using Micro Motion 4-wire cable, use the red and black wires.
9. Reattach the core processor cover.

⚠ CAUTION!

If the core processor is mounted integrally with the sensor, twisting the core processor will damage the sensor. To avoid damaging the sensor, do not twist the core processor.

⚠ CAUTION!

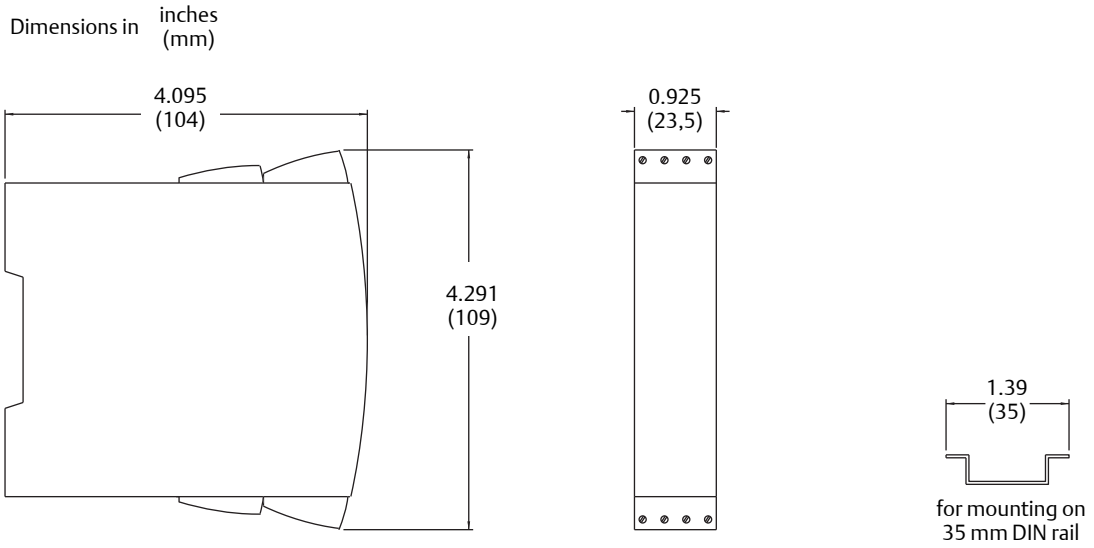
Damaging the RS-485 wires can cause measurement error or meter failure. Damaging the power supply wires can cause meter failure. When replacing the core processor cover, make sure that the wires are not caught or pinched.

3.6 Installing the MVD Direct Connect I.S. barrier

Note
This step is required only for installations that include the MVD Direct Connect I.S. barrier. Refer to *Figure 2-3* and *Figure 2-4*.

The barrier is designed to snap onto a 35 mm DIN rail. Dimensions are shown in *Figure 3-11*. To remove the barrier from the rail, lift the bottom lock.

Figure 3-11 Barrier dimensions



3.7 Wiring at the MVD Direct Connect I.S. barrier

Note
This step applies only to installations that include the MVD Direct Connect I.S. barrier. Refer to *Figure 2-3* and *Figure 2-4*.

1. Connect the core processor to the barrier:
   a. Connect the RS-485 wires from the core processor to the I.S. RS-485 terminals at the barrier (terminals 43 and 44), matching A and B. See *Table 3-4* and *Figure 3-12*. If you are using Micro Motion 4-wire cable, you can identify the wires by color.
   b. Connect the power supply wires from the core processor to the I.S. VDC terminals at the barrier (terminals 42 and 41), matching positive and negative (+ and –). See *Table 3-4* and *Figure 3-12*. Do not terminate the shields at the barrier.

Table 3-4 Core processor terminals and barrier I.S. terminals

Function	Wire color (Micro Motion 4-wire cable)	Core processor terminals	Barrier I.S. terminals
RS-485 A	White	3	43
RS-485 B	Green	4	44
VDC +	Red	1	42
VDC –	Black	2	41

2. Connect RS-485 wires to the non-I.S. RS-485 terminals at the barrier (terminals 13 and 14). See *Figure 3-12*. These wires will be used in the next step to connect the barrier to the remote host. Do not terminate the shields at the barrier.
3. Connect power supply wires to the non-I.S. VDC terminals at the barrier (terminals 11 and 12). See *Figure 3-12*. These wires will be used in the next step to connect the barrier to the power supply.

Figure 3-12 Barrier terminals

3.8 Wiring to the remote host

Note
This step is required for all MVD Direct Connect installations.

1. At the remote host, open the wiring compartment and identify the RS-485 terminals. Refer to the vendor documentation if required.
2. If you are connecting the RS-485 wires directly from the core processor (see Figures 2-1 and 2-2):
   a. Connect the RS-485 wires from the core processor (see *Figure 3-10*) to the RS-485 terminals at the remote host.
   b. Do not terminate the shield, braid, or drain wire(s) at the remote host.
   c. Do not terminate the RS-485 lines using the standard 60-ohm termination resistor. If possible, do not terminate the RS-485 lines at all. If the RS-485 cable is 1000 feet (300 meters) long or longer, and termination is required, the total termination must be 175 ohm or above.
3. If you are connecting the RS-485 wires from the I.S. barrier (see Figures 2-3 and 2-4):
   a. Connect the RS-485 wires from the barrier (see *Figure 3-12*) to the RS-485 terminals at the remote host.
   b. Terminate the shields at the remote host.
   c. The barrier contains internal pull-up/pull-down and termination resistors. Do not add external resistors.
4. Close the wiring compartment.

3.9 Wiring to the power supply

Note
This step is required for all MVD Direct Connect installations.

1. You may connect multiple MVD Direct Connect installations to a single power supply, as long as each installation receives sufficient power.
2. If you are connecting the power supply wires directly from the core processor (see Figures 2-1 and 2-2):
   a. Do not connect any other equipment to the power supply used for MVD Direct Connect installations.
   b. Connect the power supply wires from the core processor (see *Figure 3-10*), matching positive and negative (+ and –).

   If you are connecting the power supply wires from the I.S. barrier (see *Figure 2-3* and *Figure 2-4*):
   a. The power supply may be used to power other equipment.
   b. Connect the power supply wires from the barrier (see *Figure 3-12*), matching positive and negative (+ and –).

3.10 Grounding

Note
This step is required for all MVD Direct Connect installations.

⚠ CAUTION!

Improper grounding could cause measurement error. To reduce the risk of measurement error:

- **Ground the meter to earth, or follow ground network requirements for the facility.**
- **For installation in an area that requires intrinsic safety, refer to the appropriate Micro Motion approval documentation.**
- **For hazardous area installations in Europe, refer to standard EN 60079-14 if national standards do not apply.**

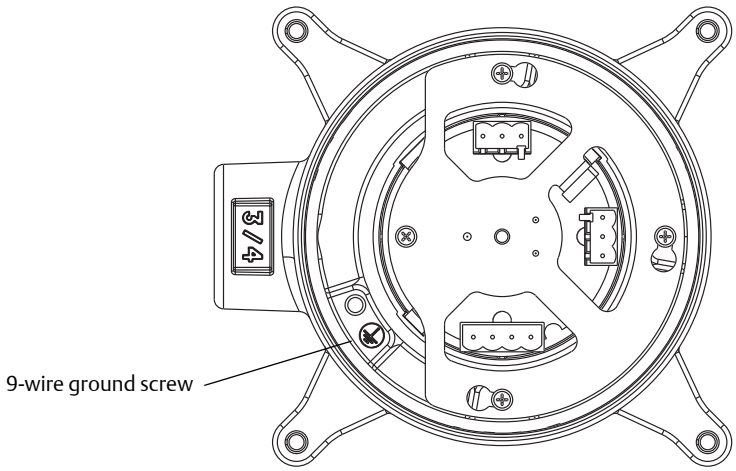
The sensor/core processor assembly (see *Figure 2-1* and *Figure 2-3*) or the sensor alone (see *Figure 2-2* and *Figure 2-4*) must be grounded. To ground these components, see the sensor installation manual.

If your installation includes a remote core processor (see *Figure 2-2* and *Figure 2-4*), it must be grounded. To ground the remote core processor:

- The core processor has two internal ground screws: one 4-wire ground screw and one 9-wire ground screw. Do not use the 4-wire ground screw. The 9-wire ground screw may be used (see *Figure 3-13*). To access the 9-wire ground screw, remove the core processor end-cap (see *Figure 3-2*).
- Use copper wire, 14 AWG (2,0 mm^2) or larger, for grounding.
- Keep all ground leads as short as possible, less than 1 ohm impedance.
- Connect ground leads directly to earth, or follow plant standards.

If your installation includes the MVD Direct Connect I.S. barrier (see *Figure 2-3* and *Figure 2-4*), the barrier is not grounded. Do not ground the barrier.

Figure 3-13 Core processor 9-wire ground screw



4 MVD Direct Connect communications

For communication with the remote host, the core processor uses an industry-standard RS-485 half-duplex communication line driver. Supported communication settings are described in *Table 4-1*. The remote host can use any supported setting and the core processor will automatically detect and switch.

Table 4-1 Supported communication settings

Parameter	Option
Protocol	Modbus RTU (8-bit) Modbus ASCII (7-bit)
Baud rate	Standard rates between 1200 and 38,400
Parity	Even, odd, none
Stop bits	1, 2

4.1 Addresses

When addressing specific registers in the core processor, certain remote hosts require the program to subtract 1 from the address. For more information, see the manual entitled *Modbus Mapping Assignments for Micro Motion Transmitters*.

4.2 Response time

The core processor's default response time to a valid query is 1.2 milliseconds. If required, a delay may be programmed into the core processor (see the manual entitled *Modbus Mapping Assignments for Micro Motion Transmitters*).

The core processor may be queried as often as once every 10 milliseconds. If you are sending queries at this rate at 38,400 baud, a maximum of three floating-point values can be returned per query.

Core processors may be multidropped, with a maximum of 15 per segment. Communication throughput is improved with fewer units per segment.

4.3 Byte order in floating-point values

Four bytes are used to transmit floating-point values. When the core processor leaves the Micro Motion factory, its default byte order is either 1–2–3–4 (typical) or 3–4–1–2. For contents of bytes, see *Table 4-2*.

Table 4-2 Byte contents in Modbus commands and responses

Byte	Bits	Definitions
1	S E E E E E E E	S = Sign E = Exponent
2	E M M M M M M M	E = Exponent M = Mantissa
3	M M M M M M M M	M = Mantissa
4	M M M M M M M M	M = Mantissa

If the core processor is attached to a transmitter for any reason (for example, for field testing), the byte order is automatically set to 1–2–3–4. It may be necessary to reset the byte order before resuming MVD Direct Connect operation. Byte order is controlled by the value in register 521. The byte order codes and associated byte orders are listed in *Table 4-3*.

Table 4-3 Byte order codes and byte orders

Byte order code	Byte order
0	1–2–3–4
1	3–4–1–2
2	2–1–4–3
3	4–3–2–1

4.4 Additional information

For more information on programming a remote host for use with MVD Direct Connect systems, see the manual entitled *Modbus Mapping Assignments for Micro Motion Transmitters*.

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