Installation Manual
20001685, Rev DB
May 2015

Micro Motion® Model 1500 and Model 2500

Installation Manual

Micro Motion®

EMERSON™
Process Management

Safety messages

Safety messages are provided throughout this manual to protect personnel and equipment. Read each safety message carefully before proceeding to the next step.

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Contents

1 Planning

Topics covered in this chapter:

- *Meter components*
- *Installation types*
- *Maximum cable lengths between sensor and transmitter*
- *Output options*
- *Environmental limits*
- *Hazardous area classifications*
- *Power requirements*

1.1 Meter components

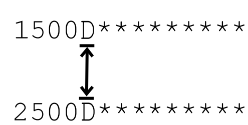
The transmitter is one component of a Micro Motion device. The other major component is the sensor.

A third component, called the core processor, provides additional memory and processing functions.

1.2 Installation types

The transmitter was ordered and shipped for one of three installation types. The fifth character of the transmitter model number indicates the installation type.

Figure 1-1: Installation type indication for Model 1500 and Model 2500 transmitters



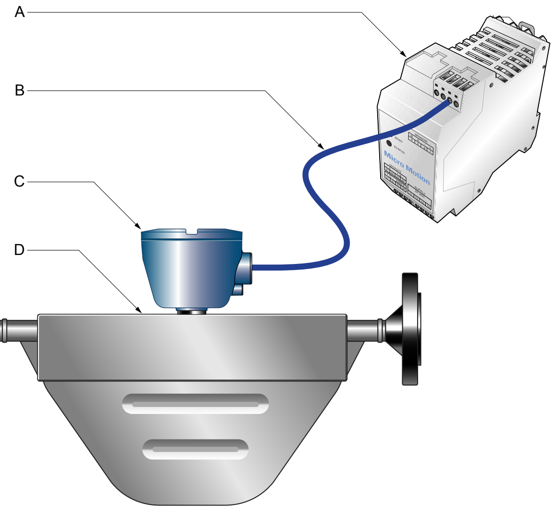
The model number is located on the device tag on the side of the transmitter.

Table 1-1: Installation types for Model 1500 and Model 2500 transmitters

Model code	Description
D	4-wire remote 35 mm DIN rail
E	4-wire remote 35 mm DIN rail transmitter with 9-wire remote enhanced core processor
B	4-wire remote 35 mm DIN rail with 9-wire remote core processor

Figure 1-2: 4-wire remote installation (model code D)

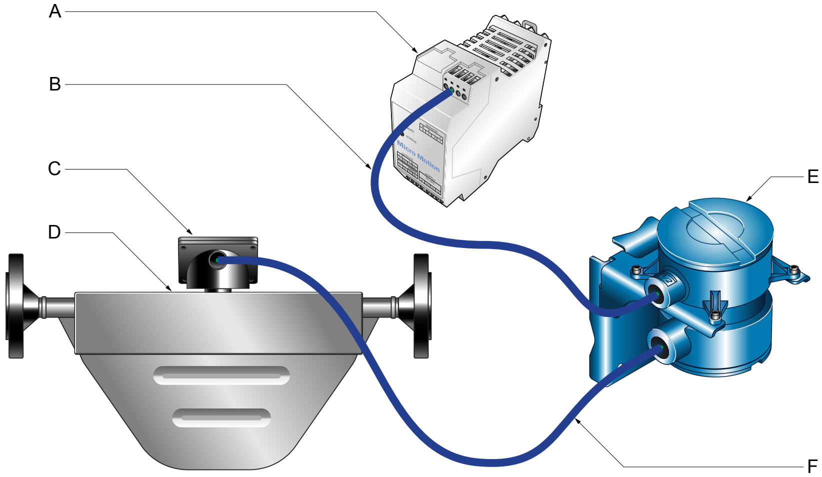
The transmitter is installed remotely from the sensor. The 4-wire connection between the sensor and transmitter must be field wired. Power supply and I/O must be field wired to the transmitter.



A. Transmitter
B. Field-wired 4-wire connection
C. Core processor
D. Sensor

Figure 1-3: Remote core processor with remote sensor installation (model code B or E)

The transmitter, core processor, and sensor are all mounted separately. The 4-wire connection between the transmitter and core processor must be field wired. The 9-wire connection between the core processor and the sensor must be field wired. Power supply and I/O must be field wired to the transmitter. This configuration is sometimes called double-hop.



A. Transmitter
B. Field-wired 4-wire connection
C. Junction box
D. Sensor
E. Core processor
F. Field-wired 9-wire connection

1.3 Maximum cable lengths between sensor and transmitter

The maximum cable length between the sensor and transmitter that are separately installed is determined by cable type.

Table 1-2: Maximum cable lengths between sensor and transmitter

Cable type	Wire gauge	Maximum length
Micro Motion 4-wire	Not applicable	• 1000 ft (300 m) without Ex-approval • 500 ft (150 m) with IIC rated sensors • 1000 ft (300 m) with IIB rated sensors
Micro Motion 9-wire	Not applicable	60 ft (20 m)
User-supplied 4-wire	VDC 22 AWG (0.35 mm^2)	300 ft (90 m)

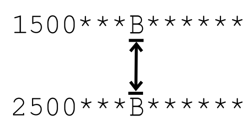
Table 1-2: Maximum cable lengths between sensor and transmitter *(continued)*

Cable type	Wire gauge	Maximum length
	VDC 20 AWG (0.5 mm^2)	500 ft (150 m)
	VDC 18 AWG (0.8 mm^2)	1000 ft (300 m)
	RS-485 22 AWG (0.35 mm^2) or larger	1000 ft (300 m)

1.4 Output options

The transmitter was ordered and shipped for one of up to three output options. You must know your transmitter output option to correctly install the transmitter. The eighth character of the transmitter model number indicates the output option.

Figure 1-4: Output option model code indication for Model 1500 and Model 2500 transmitters



The model number is located on the device tag on the side of the transmitter.

Table 1-3: Output options for Model 1500 transmitters

Model code	Description
A	One mA, one frequency, RS-485
C(1)	One mA, two DO, RS-485

(1) Output code C on the Model 1500 transmitter is used only with the filling and dosing application.

Table 1-4: Output options for Model 2500 transmitters

Model code	Description
B	One mA, two configurable I/O channels, RS-485 – default configuration of two mA, one FO
C	One mA, two configurable I/O channels, RS-485 – custom configuration

1.5 Environmental limits

Table 1-5: Environmental specifications

Type	Value
Ambient temperature limits (Operating)	–40 to +131 °F (–40 to +55 °C)
Ambient temperature limits (Storage)	–40 to +185 °F (–40 to +85 °C)
Humidity limits	5 to 95% relative humidity, non-condensing at 140 °F (60 °C)
Vibration limits	Meets IEC 60068-2-6, endurance sweep, 5 to 2000 Hz, 50 sweep cycles at 1.0 g
EMI effects	Complies with EMC Directive 2004/108/EC per EN 61326 Industrial Complies with NAMUR NE-21 (22.08.2007)
Ambient temperature effect (analog output option)	On mA output: ±0.005% of span per °C

1.6 Hazardous area classifications

If you plan to mount the transmitter in a hazardous area:

- Verify that the transmitter has the appropriate hazardous area approval. Each transmitter has a hazardous area approval tag attached to the transmitter housing.
- Ensure that any cable used between the transmitter and the sensor meets the hazardous area requirements.

1.7 Power requirements

The transmitter must be connected to a DC voltage source.

- Minimum 19.2 to 28.8 VDC
- 6.3 watts
- Meets Installation (Overvoltage) Category II, Pollution Degree 2 requirements

Figure 1-5: Cable sizing formula

$$M = 19.2\text{V} + (R \times L \times 0.33\text{A})$$

A. M: minimum supply voltage
B. R: cable resistance
C. L: cable length

Table 1-6: Typical power cable resistance at 68 °F (20 °C)

Wire gauge	Resistance
14 AWG	0.0050 Ω/ft
16 AWG	0.0080 Ω/ft
18 AWG	0.0128 Ω/ft
20 AWG	0.0204 Ω/ft
2.5 mm^2	0.0136 Ω/m
1.5 mm^2	0.0228 Ω/m
1.0 mm^2	0.0340 Ω/m
0.75 mm^2	0.0460 Ω/m
0.50 mm^2	0.0680 Ω/m

2 Mounting and sensor wiring for 4-wire remote installations

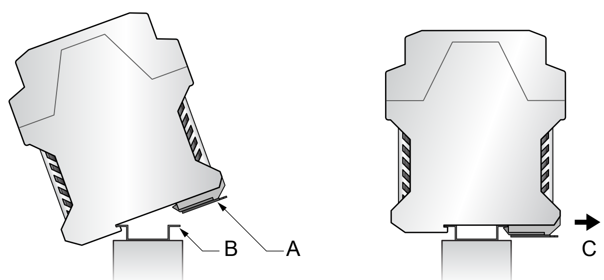
Topics covered in this chapter:

- *Mounting the transmitter to a DIN rail*
- *Prepare the 4-wire cable*
- *Wire the transmitter to the sensor*
- *Ground the flowmeter components*

2.1 Mounting the transmitter to a DIN rail

The transmitter is designed to be mounted on a 35 mm DIN rail. The DIN rail must be grounded.

Figure 2-1: Mounting the transmitter

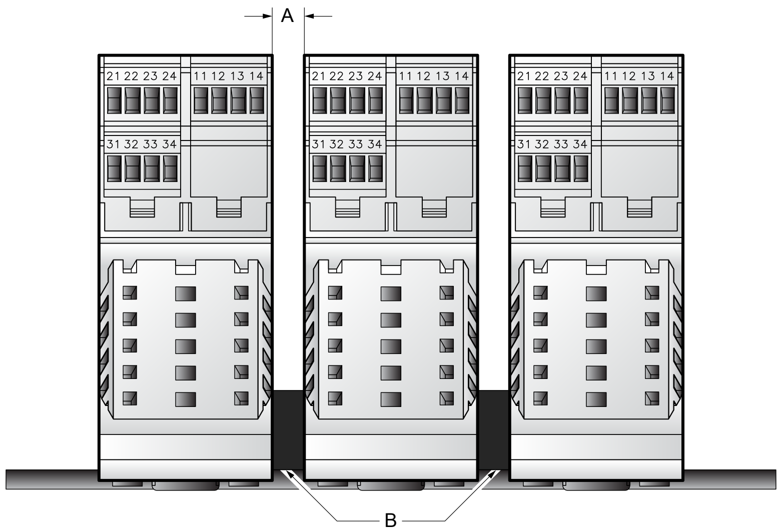


A. *Spring clamp*
B. *DIN rail*
C. *Spring clamp release loop*

2.1.1 Mounting multiple transmitters

If the ambient temperature is above 113 °F (45 °C) and you are mounting multiple transmitters, mount the transmitters so they are at least 0.39 in (10 mm) apart.

Figure 2-2: Mounting multiple transmitters



A. *0.39 in or greater (10 mm or greater)*
B. *End bracket or end stop; 0.33 in (8.5 mm) minimum spacing*

2.2 Prepare the 4-wire cable

Important

For user-supplied cable glands, the gland must be capable of terminating the drain wires.

Note

If you are installing unshielded cable in continuous metallic conduit with 360º termination shielding, you only need to prepare the cable – you do not need to perform the shielding procedure.

Figure 2-3: 4-wire cable preparation

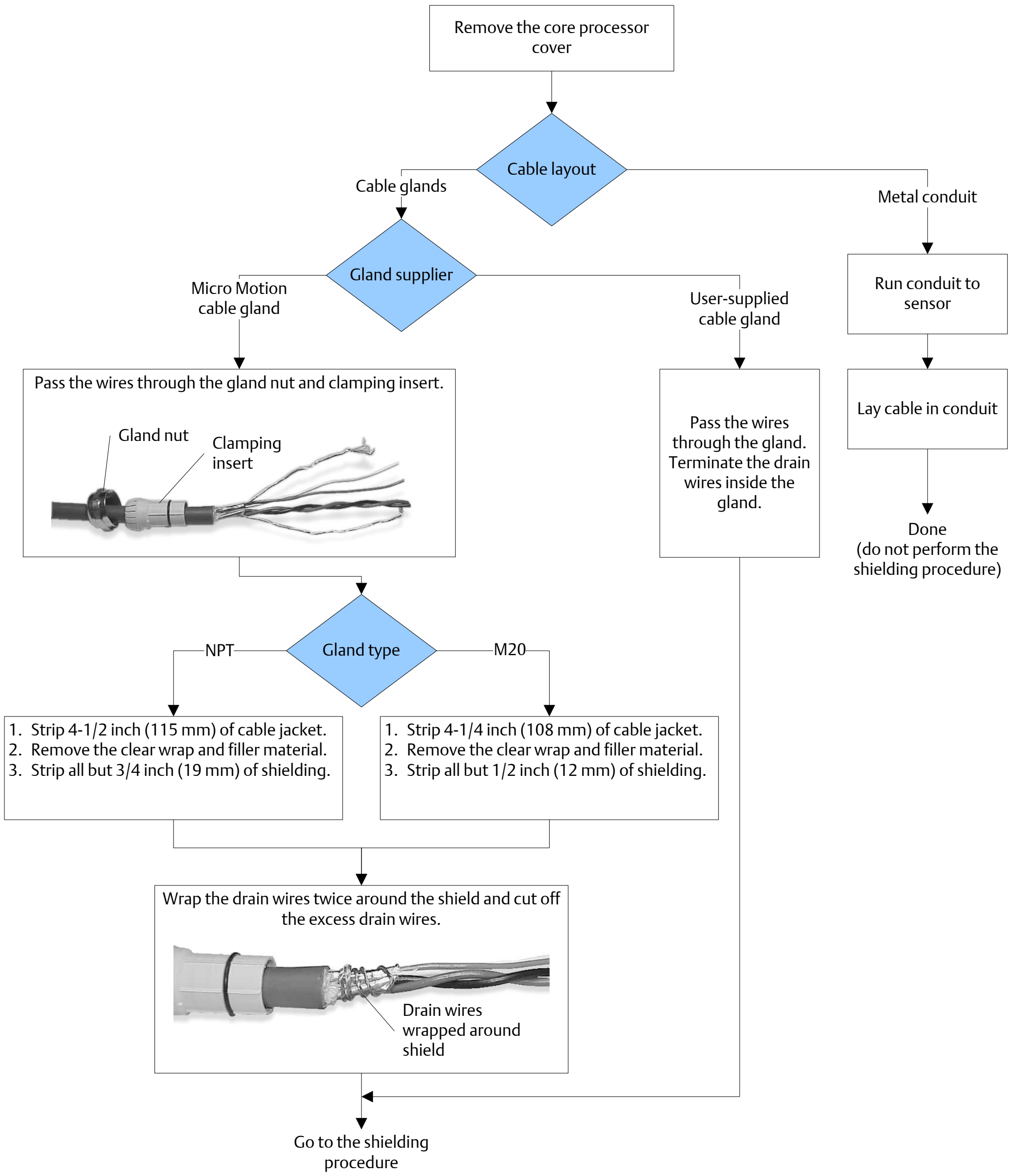
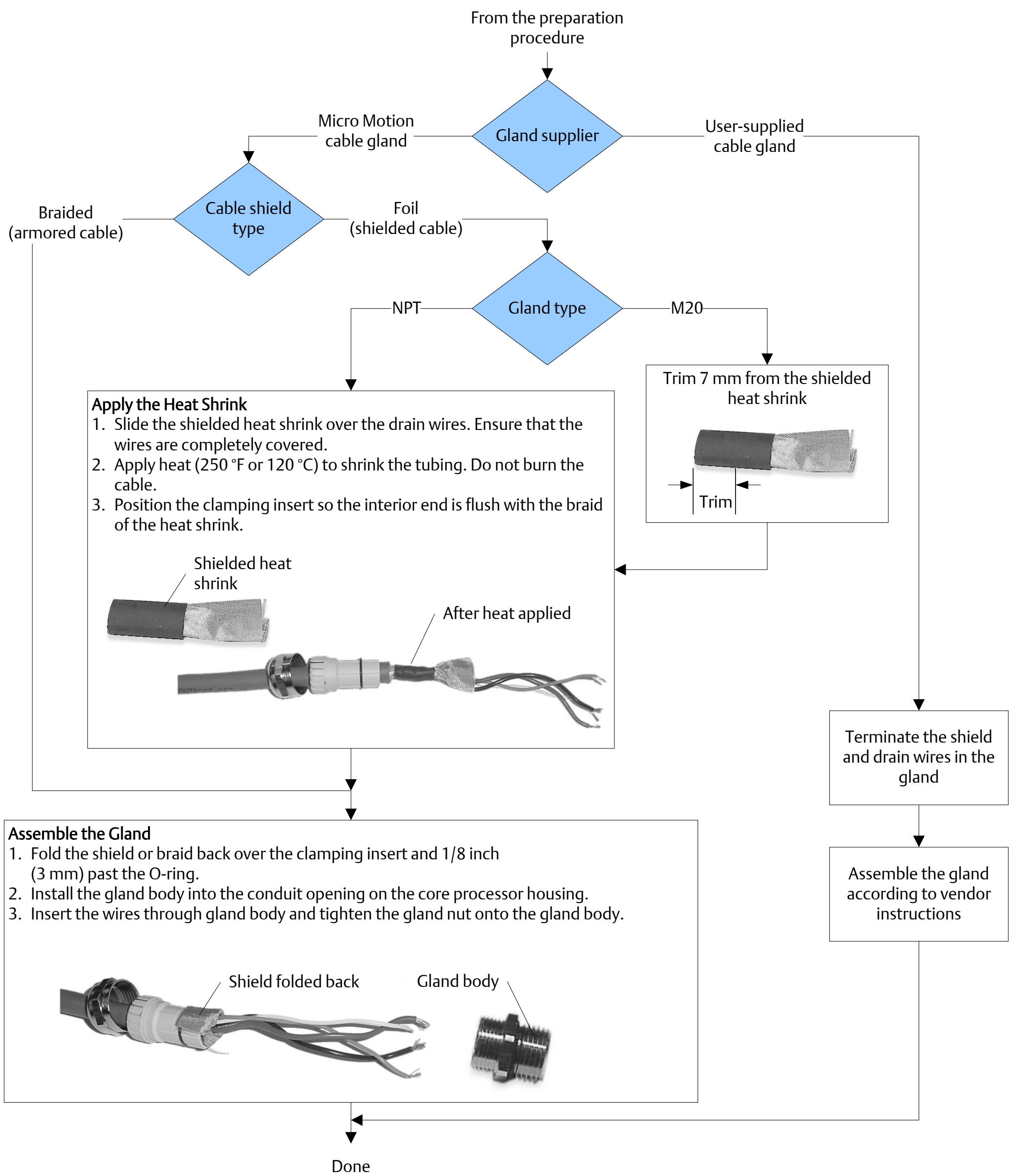


Figure 2-4: 4-wire cable shielding



2.2.1 4-wire cable types and usage

Micro Motion offers two types of 4-wire cable: shielded and armored. Both types contain shield drain wires.

The 4-wire cable supplied by Micro Motion consists of one pair of red and black 18 AWG (0.75 mm^2) wires for the VDC connection, and one pair of white and green 22 AWG (0.35 mm^2) wires for the RS-485 connection.

User-supplied 4-wire cable must meet the following requirements:

- Twisted pair construction.
- Applicable hazardous area requirements, if the core processor is installed in a hazardous area.
- Wire gauge appropriate for the cable length between the core processor and the transmitter.

Table 2-1: Wire gauge

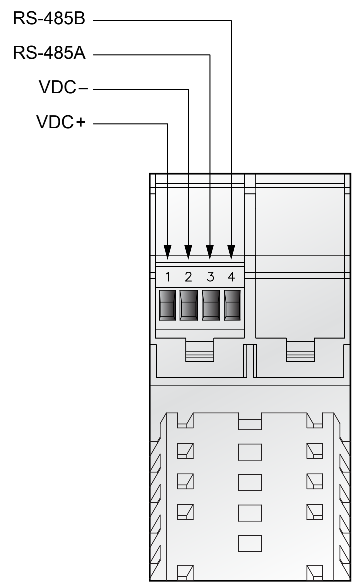
Wire gauge	Maximum cable length
VDC 22 AWG (0.35 mm^2)	300 ft (90 m)
VDC 20 AWG (0.5 mm^2)	500 ft (150 m)
VDC 18 AWG (0.8 mm^2)	1000 ft (300 m)
RS-485 22 AWG (0.35 mm^2) or larger	1000 ft (300 m)

2.3 Wire the transmitter to the sensor

1. Connect the cable to the sensor-mounted core processor as described in the sensor documentation.
2. Connect the four wires from the core processor to terminals 1–4 on the transmitter.

Important
Do not ground the shield, braid, or drain wires at the transmitter.

Figure 2-5: Terminal connections for 4-wire cable



2.4 Ground the flowmeter components

In 4-wire remote installations, the transmitter and sensor are grounded separately.

Prerequisites

CAUTION!

Improper grounding could cause inaccurate measurements or meter failure.

Note
For hazardous area installations in Europe, refer to standard EN 60079-14 or national standards.

If national standards are not in effect, adhere to the following guidelines for grounding:

- Use copper wire, 14 AWG (2.5 mm^2) or larger wire size.
- Keep all ground leads as short as possible, less than 1 Ω impedance.
- Connect ground leads directly to earth, or follow plant standards.

Procedure

1. Ground the sensor according to the instructions in the sensor documentation.
2. Ground the DIN rail.

   The rail clip in the base of the transmitter housing grounds the transmitter to the DIN rail.

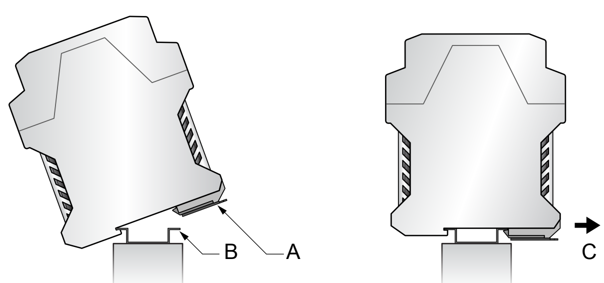
3 Mounting and sensor wiring for remote core processor with remote sensor installations

Topics covered in this chapter:

3.1 Mounting the transmitter to a DIN rail

The transmitter is designed to be mounted on a 35 mm DIN rail. The DIN rail must be grounded.

Figure 3-1: Mounting the transmitter

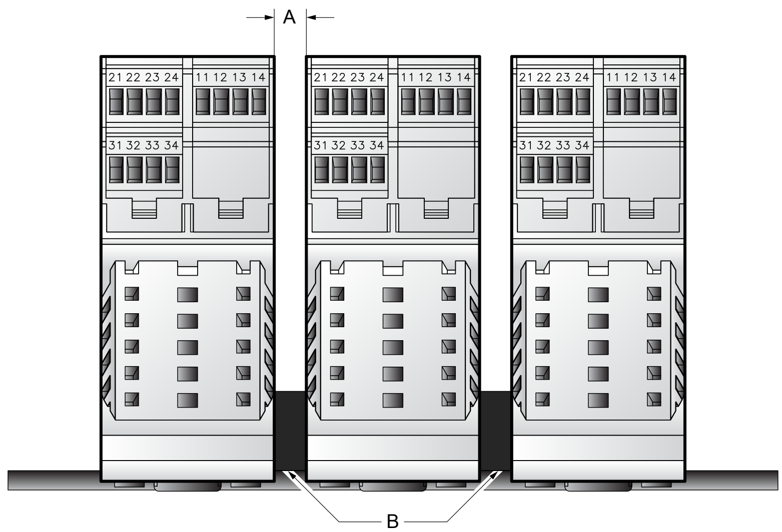


A. *Spring clamp*
B. *DIN rail*
C. *Spring clamp release loop*

3.1.1 Mounting multiple transmitters

If the ambient temperature is above 113 °F (45 °C) and you are mounting multiple transmitters, mount the transmitters so they are at least 0.39 in (10 mm) apart.

Figure 3-2: Mounting multiple transmitters



A. 0.39 in or greater (10 mm or greater)
B. End bracket or end stop; 0.33 in (8.5 mm) minimum spacing

3.2 Mount the remote core processor

This procedure is required only for remote core processor with remote transmitter installations.

Prerequisites

For mounting the remote core processor to a wall:

- Micro Motion recommends the use of 5/16-18 (8 mm–1.25) fasteners that can withstand the process environment. Micro Motion does not supply bolts or nuts as part of the standard offering (general purpose bolts and nuts are available as an option).
- Ensure that the surface is flat and rigid, does not vibrate, or move excessively.
- Confirm that you have the necessary tools, and the mounting kit shipped with the transmitter.

For mounting the remote core processor to an instrument pole:

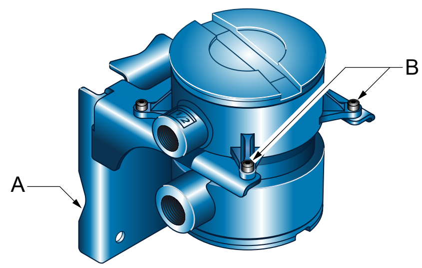
- Use two 5/16-inch U-bolts for 2-inch pipe, and four matching nuts, that can withstand the process environment. Micro Motion does not supply U-bolts or nuts.

- Ensure the instrument pole extends at least 12 inches (305 mm) from a rigid base, and is no more than 2 inches (50.8 mm) in diameter.

Procedure

1. 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).

Figure 3-3: Components of a remote core processor



A. Mounting bracket
B. Cap screws

2. Attach the mounting bracket to an instrument pole or wall.

3.3 Prepare the 4-wire cable

Important
For user-supplied cable glands, the gland must be capable of terminating the drain wires.

Note
If you are installing unshielded cable in continuous metallic conduit with 360º termination shielding, you only need to prepare the cable – you do not need to perform the shielding procedure.

Figure 3-4: 4-wire cable preparation

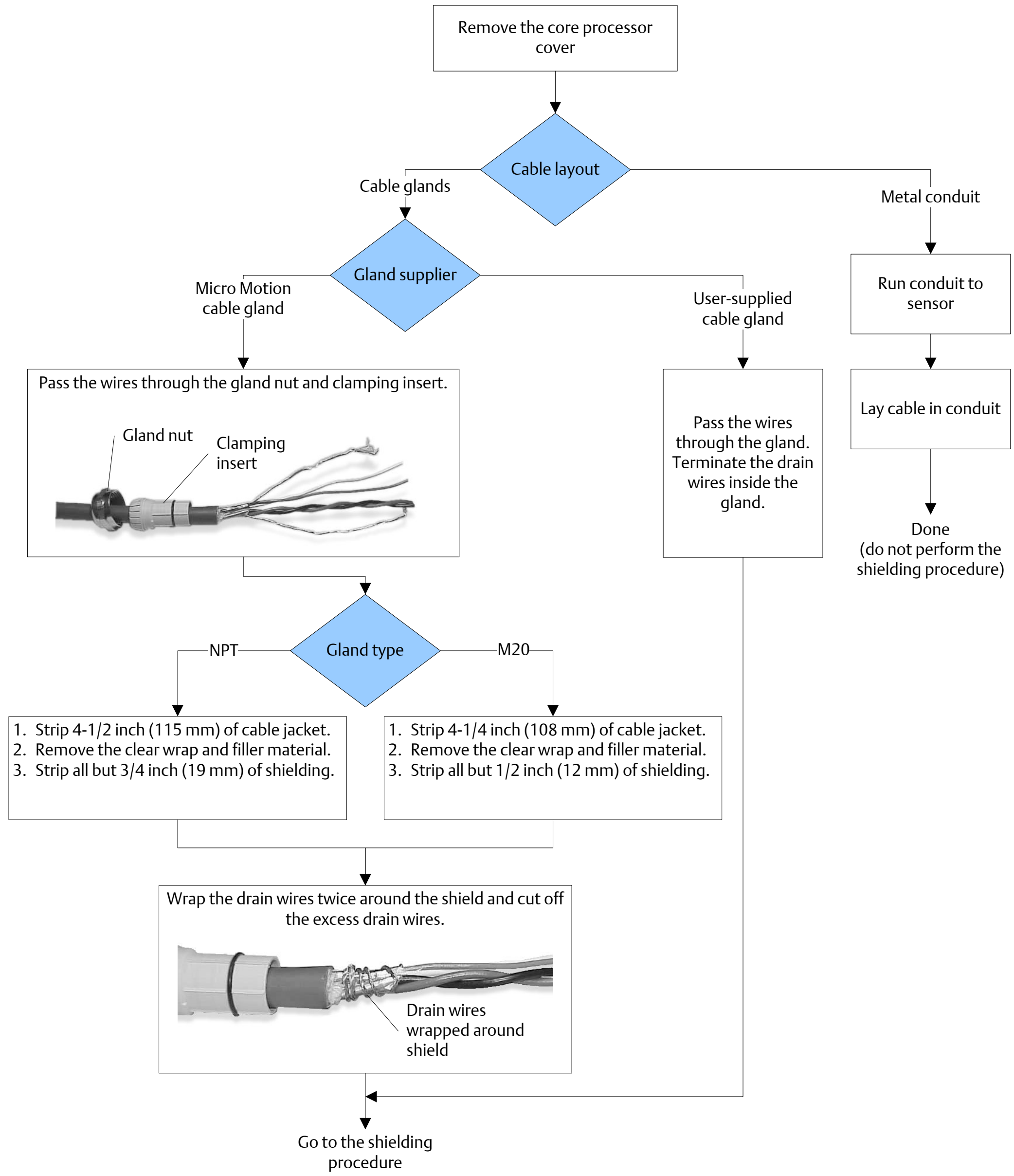
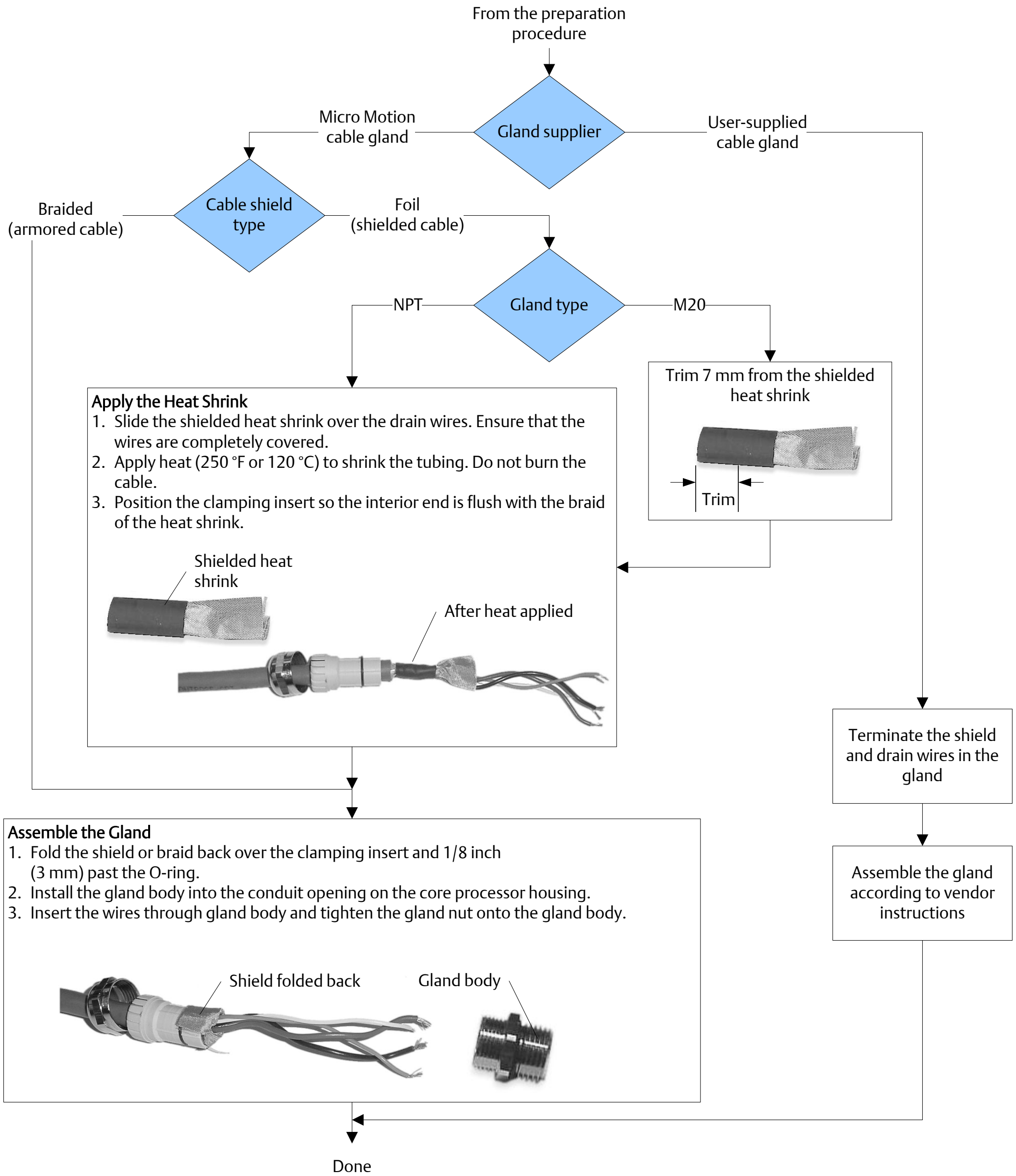


Figure 3-5: 4-wire cable shielding



3.3.1 4-wire cable types and usage

Micro Motion offers two types of 4-wire cable: shielded and armored. Both types contain shield drain wires.

The 4-wire cable supplied by Micro Motion consists of one pair of red and black 18 AWG (0.75 mm^2) wires for the VDC connection, and one pair of white and green 22 AWG (0.35 mm^2) wires for the RS-485 connection.

User-supplied 4-wire cable must meet the following requirements:

- Twisted pair construction.
- Applicable hazardous area requirements, if the core processor is installed in a hazardous area.
- Wire gauge appropriate for the cable length between the core processor and the transmitter.

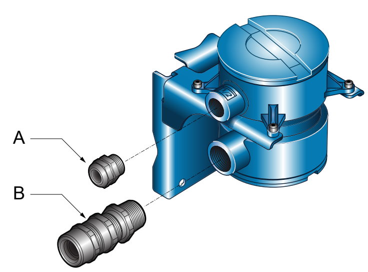
Table 3-1: Wire gauge

Wire gauge	Maximum cable length
VDC 22 AWG (0.35 mm^2)	300 ft (90 m)
VDC 20 AWG (0.5 mm^2)	500 ft (150 m)
VDC 18 AWG (0.8 mm^2)	1000 ft (300 m)
RS-485 22 AWG (0.35 mm^2) or larger	1000 ft (300 m)

3.4 Wire the transmitter to the remote core processor

1. If you are installing a Micro Motion-supplied cable gland at the core processor housing, identify the cable gland to use for the 4-wire cable conduit opening.

Figure 3-6: Cable gland identification

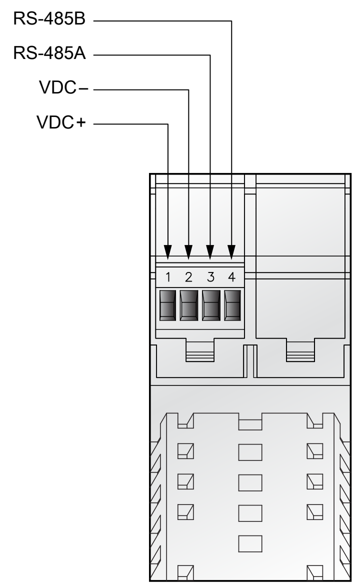


A. Cable gland used with 4-wire conduit opening
B. 3/4"–14 NPT cable gland used with 9-wire conduit opening

2. Connect the cable to the core processor as described in the sensor documentation.
3. Connect the four wires from the core processor to terminals 1–4 on the transmitter.

Important
Do not ground the shield, braid, or drain wires at the transmitter.

Figure 3-7: Terminal connections for 4-wire cable



3.5 Prepare the 9-wire cable

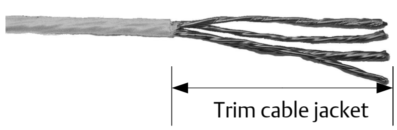
Micro Motion supplies three types of 9-wire cable: jacketed, shielded, and armored. The type of cable you are using determines how you will prepare the cable.

Perform the cable preparation procedure appropriate for your cable type.

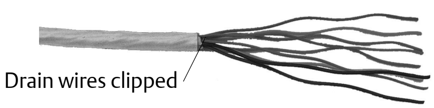
Figure 3-8: Preparing jacketed cable

Prepare jacketed cable at the sensor end

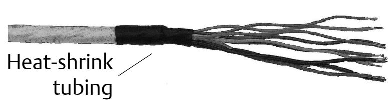
1. Trim 4 ½ inches (115 mm) of cable jacket.
2. Remove the clear wrap and filler material.
3. Remove the foil that is around the insulated wires and separate them.



4. Identify the drain wires in the cable. Clip off each drain wire as close as possible to the cable jacket.



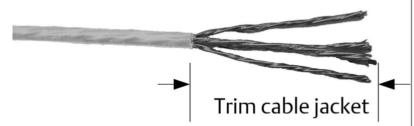
5. Slide the 1 ½ inch (40 mm) heat-shrink tubing over the wires and cable jacket. The tubing should completely cover the clipped ends of the drain wires.



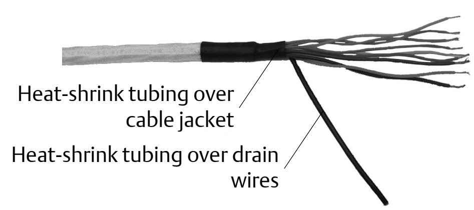
6. Without burning the cable, apply heat to shrink all tubing. Recommended temperature is 250 °F (121 °C).
7. Allow the cable to cool, then strip ¼ inch (5 mm) of insulation from each wire.

Prepare jacketed cable at the transmitter end

1. Trim 4 inches (100 mm) of cable jacket.
2. Remove the clear wrap and filler material.
3. Remove the foil that is around the insulated wires and separate them.



4. Identify the drain wires in the cable and bring them together. Fan the other wires to the outside of the cable. Twist the drain wires together.
5. Slide the 3-inch (75 mm) heat-shrink tubing over the drain wires. Push the tubing as close as possible to the cable jacket.
6. Slide the 1 ½ inch (40 mm) long heat-shrink tubing over the cable jacket. The tubing should completely cover all portions of the drain wires that remain exposed next to the cable jacket.

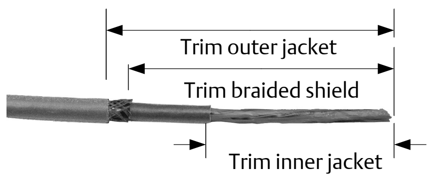


7. Without burning the cable, apply heat to shrink all tubing. Recommended temperature is 250 °F (121 °C).
8. Allow the cable to cool, then strip ¼ inch (5 mm) of insulation from each wire.

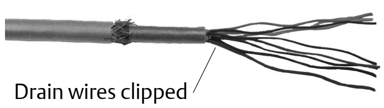
Figure 3-9: Preparing shielded or armored cable

Prepare shielded or armored cable at the sensor end

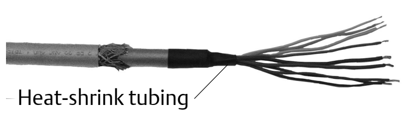
1. Without cutting the shield, strip 7 inches (175 mm) of outer jacket.
2. Strip 6 ½ inches (165 mm) of braided shield, so ½ inch (10 mm) of shield remains exposed.
3. Remove the foil shield that is between the braided shield and inner jacket.
4. Strip 4 ½ inches (115 mm) of inner jacket.



5. Remove the clear wrap and filler material.
6. Remove the foil that is around the insulated wires and separate them.
7. Identify the drain wires in the cable. Clip each drain wire as close as possible to the cable jacket.



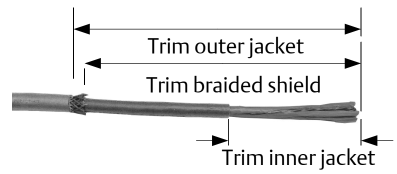
8. Slide the 1 ½ inch (40 mm) long heat-shrink tubing over the cable jacket. The tubing should completely cover the clipped ends of the drain wires.



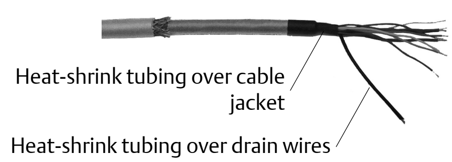
9. Without burning the cable, apply heat to shrink all tubing. Recommended temperature is 250 °F (121 °C).
10. Allow the cable to cool, then strip ¼ inch (5 mm) of insulation from each wire.

Prepare shielded or armored cable at the transmitter end

1. Without cutting the shield, strip 9 inches (225 mm) of cable jacket.
2. Strip 8 ½ inches (215 mm) of braided shield, so ½ inch (10 mm) of shield remains exposed.
3. Remove the foil shield that is between the braided shield and inner jacket.
4. Strip 4 inches (100 mm) of inner jacket.



5. Remove the clear wrap and filler material.
6. Remove the foil that is around the insulated wires and separate them.
7. Identify the drain wires in the cable and bring them together. Fan the other wires to the outside of the cable. Twist the drain wires together.
8. Slide the 3-inch (75 mm) long heat-shrink tubing over the drain wires. Push the tubing as close as possible to the inner jacket.
9. Slide the 1 ½ inch (40 mm) long heat-shrink tubing over the cable jacket. The tubing should completely cover all portions of the drain wires that remain exposed next to the cable jacket.



10. Without burning the cable, apply heat to shrink all tubing. Recommended temperature is 250 °F (121 °C).
11. Allow the cable to cool, then strip ¼ inch (5 mm) of insulation from each wire.

3.5.1 9-wire cable types and usage

Cable types

Micro Motion supplies three types of 9-wire cable: jacketed, shielded, and armored. Note the following differences between the cable types:

- Armored cable provides mechanical protection for the cable wires.
- Jacketed cable has a smaller bend radius than shielded or armored cable.
- If ATEX compliance is required, the different cable types have different installation requirements.

Cable jacket types

All cable types can be ordered with a PVC jacket or Teflon® FEP jacket. Teflon FEP is required for the following installation types:

- All installations that include a T-series sensor.
- All installations with a cable length of 250 ft (75 m) or greater, a nominal flow less than 20 percent, and ambient temperature changes greater than +68 °F (+20 °C).

Table 3-2: Cable jacket material and temperature ranges

	Handling temperature		Operating temperature	
Cable jacket material	**Low limit**	**High limit**	**Low limit**	**High limit**
PVC	–4 °F (–20 °C)	+194 °F (+90 °C)	–40 °F (–40 °C)	+221 °F (+105 °C)
Teflon FEP	–40 °F (–40 °C)	+194 °F (+90 °C)	–76 °F (–60 °C)	+302 °F (+150 °C)

Cable bend radii

Table 3-3: Bend radii of jacketed cable

Jacket material	Outside diameter	Minimum bend radii	
		Static (no load) condition	**Under dynamic load**
PVC	0.415 inches (10 mm)	3–1/8 inches (80 mm)	6–1/4 inches (159 mm)
Teflon FEP	0.340 inches (9 mm)	2–5/8 inches (67 mm)	5–1/8 inches (131 mm)

Table 3-4: Bend radii of shielded cable

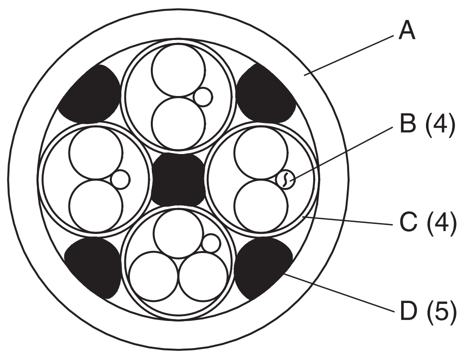
Jacket material	Outside diameter	Minimum bend radii	
		Static (no load) condition	**Under dynamic load**
PVC	0.2 inches (14 mm)	4–1/4 inches (108 mm)	8–1/2 inches (216 mm)
Teflon FEP	0.425 inches (11 mm)	3–1/4 inches (83 mm)	6–3/8 inches (162 mm)

Table 3-5: Bend radii of armored cable

Jacket material	Outside diameter	Minimum bend radii	
		Static (no load) condition	Under dynamic load
PVC	0.525 inches (14 mm)	4–1/4 inches (108 mm)	8–1/2 inches (216 mm)
Teflon FEP	0.340 inches (9 mm)	3–1/4 inches (83 mm)	6–3/8 inches (162 mm)

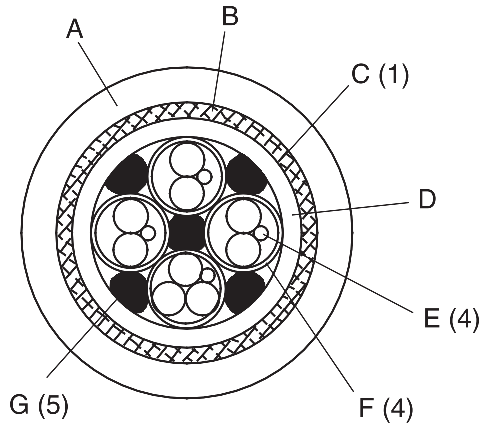
Cable illustrations

Figure 3-10: Cross-section view of jacketed cable



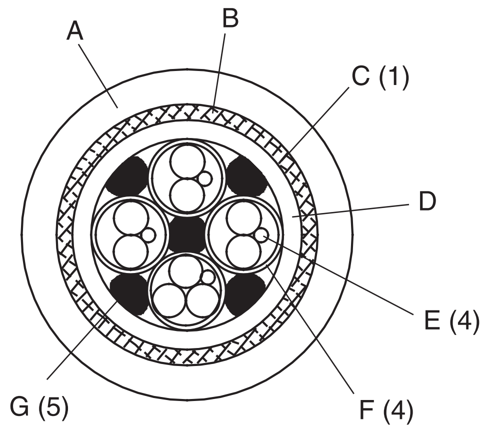
A. Outer jacket
B. Drain wire (4 total)
C. Foil shield (4 total)
D. Filler (5 total)

Figure 3-11: Cross-section view of shielded cable



A. *Outer jacket*
B. *Tin-plated copper braided shield*
C. *Foil shield (1 total)*
D. *Inner jacket*
E. *Drain wire (4 total)*
F. *Foil shield (4 total)*
G. *Filler (5 total)*

Figure 3-12: Cross-section view of armored cable



A. *Outer jacket*
B. *Stainless steel braided shield*
C. *Foil shield (1 total)*
D. *Inner jacket*
E. *Drain wire (4 total)*
F. *Foil shield (4 total)*
G. *Filler (5 total)*

3.6 Wire the remote core processor to the sensor using jacketed cable

Prerequisites

For ATEX installations, the jacketed cable must be installed inside a user-supplied sealed metallic conduit that provides 360° termination shielding for the enclosed cable.

⚠ CAUTION!

Sensor wiring is intrinsically safe. To keep sensor wiring intrinsically safe, keep the sensor wiring separated from power supply wiring and output wiring.

⚠ CAUTION!

Keep cable away from devices such as transformers, motors, and power lines, which produce large magnetic fields. Improper installation of cable, cable gland, or conduit could cause inaccurate measurements or flow meter failure.

⚠ CAUTION!

Improperly sealed housings can expose electronics to moisture, which can cause measurement error or flowmeter failure. Install drip legs in conduit and cable, if necessary. Inspect and grease all gaskets and O-rings. Fully close and tighten all housing covers and conduit openings.

Procedure

1. Run the cable through the conduit. Do not install 9-wire cable and power cable in the same conduit.
2. To prevent conduit connectors from seizing in the threads of the conduit openings, apply a conductive anti-galling compound to the threads, or wrap threads with PTFE tape two to three layers deep.

   Wrap the tape in the opposite direction that the male threads will turn when inserted into the female conduit opening.
3. Remove the junction box cover and core processor end-cap.
4. At both the sensor and transmitter, do the following:
   a. Connect a male conduit connector and waterproof seal to the conduit opening for 9-wire.
   b. Pass the cable through the conduit opening for the 9-wire cable.
   c. Insert the stripped end of each wire into the corresponding terminal at the sensor and transmitter ends, matching by color. No bare wires should remain exposed.

Table 3-6: Sensor and remote core processor terminal designations

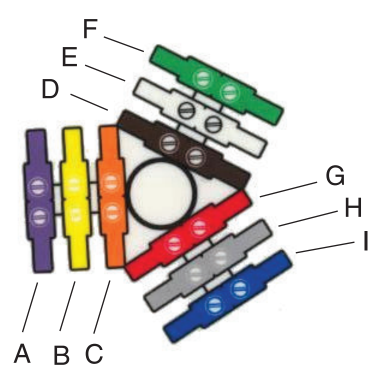
Wire color	Sensor terminal	Remote core processor terminal	Function
Black	No connection	Ground screw (see note)	Drain wires
Brown	1	1	Drive +
Red	2	2	Drive –
Orange	3	3	Temperature –
Yellow	4	4	Temperature return
Green	5	5	Left pickoff +
Blue	6	6	Right pickoff +
Violet	7	7	Temperature +
Gray	8	8	Right pickoff –
White	9	9	Left pickoff –

d. Tighten the screws to hold the wire in place.

e. Ensure integrity of gaskets, grease all O-rings, then replace the junction-box and transmitter housing covers and tighten all screws, as required.

3.6.1 Sensor and remote core processor terminals

Figure 3-13: All ELITE, H-Series, and T-Series sensor, and 2005 or newer F-Series sensor terminals



A. Violet
B. Yellow
C. Orange
D. Brown
E. White
F. Green
G. Red
H. Gray
I. Blue

Figure 3-14: All Model D and Model DL, and pre-2005 F-Series sensor terminals

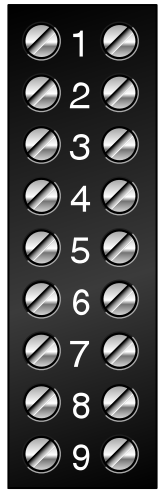
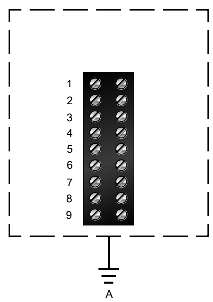
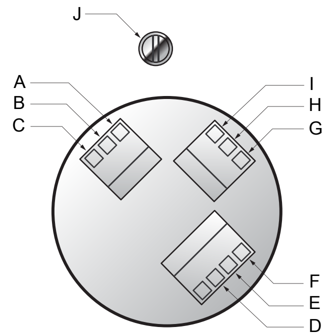


Figure 3-15: Model DT sensor terminals (user-supplied metal junction box with terminal block)



A. Earth ground

Figure 3-16: Remote core processor terminals



- *A. Brown*
- *B. Violet*
- *C. Yellow*
- *D. Orange*
- *E. Gray*
- *F. Blue*
- *G. White*
- *H. Green*
- *I. Red*
- *J. Ground screw (black)*

3.7 Wire the remote core processor to the sensor using shielded or armored cable

Prerequisites

For ATEX installations, shielded or armored cable must be installed with cable glands, at both the sensor and remote core processor ends. Cable glands that meet ATEX requirements can be purchased from Micro Motion. Cable glands from other vendors can be used.

⚠ CAUTION!

Keep cable away from devices such as transformers, motors, and power lines, which produce large magnetic fields. Improper installation of cable, cable gland, or conduit could cause inaccurate measurements or flow meter failure.

⚠ CAUTION!

Install cable glands in the 9-wire conduit opening in the transmitter housing and the sensor junction box. Ensure that the cable drain wires and shields do not make contact with the junction box or the transmitter housing. Improper installation of cable or cable glands could cause inaccurate measurements or flow meter failure.

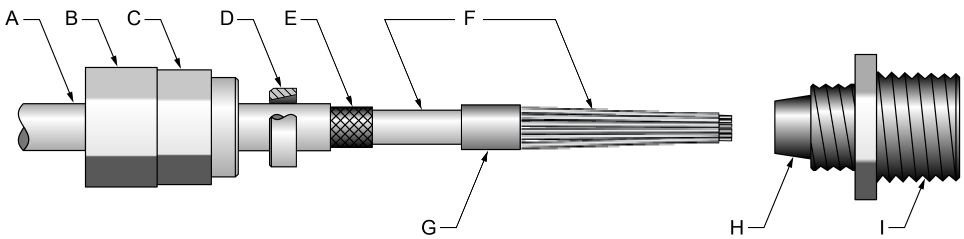
⚠ CAUTION!

Improperly sealed housings can expose electronics to moisture, which can cause measurement error or flowmeter failure. Install drip legs in conduit and cable, if necessary. Inspect and grease all gaskets and O-rings. Fully close and tighten all housing covers and conduit openings.

Procedure

1. Identify the components of the cable gland and cable.

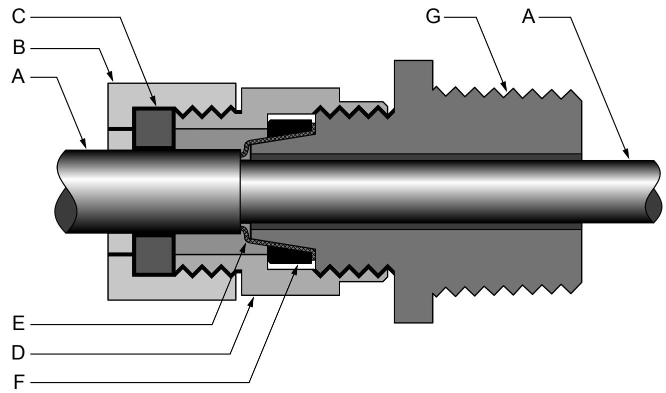
Figure 3-17: Cable gland and cable (exploded view)



A. Cable
B. Sealing nut
C. Compression nut
D. Brass compression ring
E. Braided shield
F. Cable
G. Tape or heat-shrink tubing
H. Clamp seat (shown as integral to nipple)
I. Nipple

2. Unscrew the nipple from the compression nut.
3. Screw the nipple into the conduit opening for the 9-wire cable. Tighten it to one turn past hand-tight.
4. Slide the compression ring, compression nut, and sealing nut onto the cable. Make sure the compression ring is oriented so the taper will mate properly with the tapered end of the nipple.
5. Pass the cable end through the nipple so the braided shield slides over the tapered end of the nipple.
6. Slide the compression ring over the braided shield.
7. Screw the compression nut onto the nipple. Tighten the sealing nut and compression nut by hand to ensure that the compression ring traps the braided shield.
8. Use a 25-mm (1-inch) wrench to tighten the sealing nut and compression nut to 20–25 foot-pounds (27–34 N-m) of torque.

Figure 3-18: Cross-section of assembled cable gland with cable



A. Cable
B. Sealing nut
C. Seal
D. Compression nut
E. Braided shield
F. Brass compression ring
G. Nipple

9. Remove the junction box cover and remote core processor end-cap.
10. At both the sensor and remote core processor, connect the cable according to the following procedure:

   a. Insert the stripped end of each wire into the corresponding terminal at the sensor and remote core processor ends, matching by color. No bare wires should remain exposed.

Table 3-7: Sensor and remote core processor terminal designations

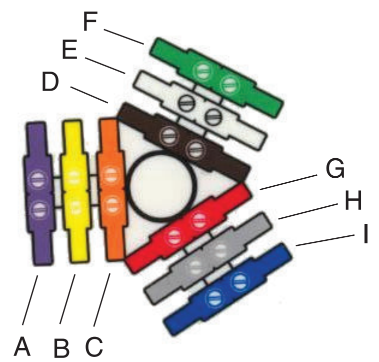
Wire color	Sensor terminal	Remote core processor terminal	Function
Black	No connection	Ground screw (see notes)	Drain wires
Brown	1	1	Drive +
Red	2	2	Drive –
Orange	3	3	Temperature –
Yellow	4	4	Temperature return
Green	5	5	Left pickoff +
Blue	6	6	Right pickoff +
Violet	7	7	Temperature +
Gray	8	8	Right pickoff –
White	9	9	Left pickoff –

   b. Tighten the screws to hold the wires in place.

c. Ensure integrity of gaskets, grease all O-rings, then replace the junction box cover and remote core processor end-cap and tighten all screws, as required.

3.7.1 Sensor and remote core processor terminals

Figure 3-19: All ELITE, H-Series, and T-Series sensor, and 2005 or newer F-Series sensor terminals



A. *Violet*
B. *Yellow*
C. *Orange*
D. *Brown*
E. *White*
F. *Green*
G. *Red*
H. *Gray*
I. *Blue*

Figure 3-20: All Model D and Model DL, and pre-2005 F-Series sensor terminals

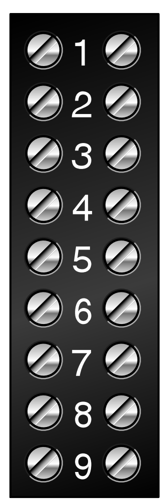
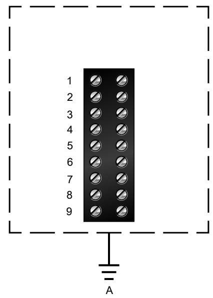
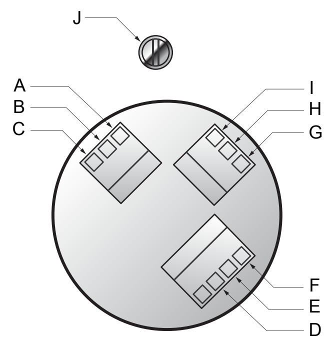


Figure 3-21: Model DT sensor terminals (user-supplied metal junction box with terminal block)



A. Earth ground

Figure 3-22: Remote core processor terminals



A. Brown
B. Violet
C. Yellow
D. Orange
E. Gray
F. Blue
G. White
H. Green
I. Red
J. Ground screw (black)

3.8 Ground the meter components

In a remote core processor with remote sensor installation, the transmitter, remote core processor, and sensor are all grounded separately.

Prerequisites

⚠ **CAUTION!**

Improper grounding could cause inaccurate measurements or meter failure.

Note

For hazardous area installations in Europe, refer to standard EN 60079-14 or national standards.

If national standards are not in effect, adhere to the following guidelines for grounding:

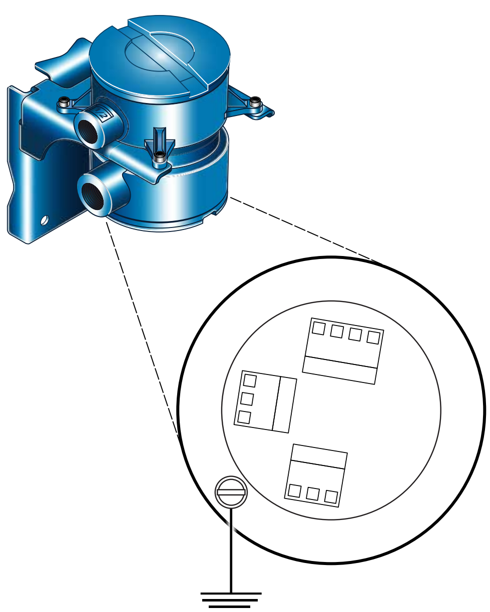
- Use copper wire, 14 AWG (2.5 mm^2) or larger wire size.
- Keep all ground leads as short as possible, less than 1 Ω impedance.
- Connect ground leads directly to earth, or follow plant standards.

Procedure

1. Ground the sensor according to the instructions in the sensor documentation.
2. Ground the DIN rail.

   The rail clip in the base of the transmitter housing grounds the transmitter to the DIN rail.
3. Ground the remote core processor according to applicable local standards, using the remote core processor's internal ground screw.

Figure 3-23: Remote core processor internal ground screw

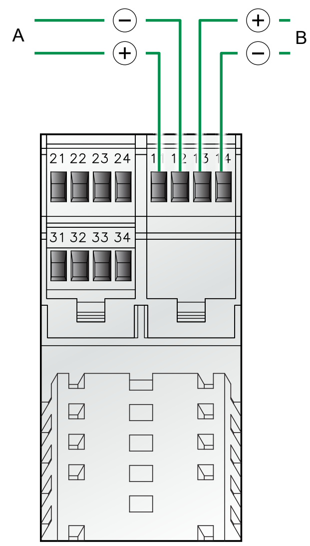


4 Wiring the power supply

4.1 Wire the power supply

Connect the power supply to terminals 11 and 12. Terminals 13 and 14 are used to jumper power to another Model 1500 or Model 2500 transmitter. A maximum of five transmitters can be jumpered together.

Figure 4-1: Power terminals



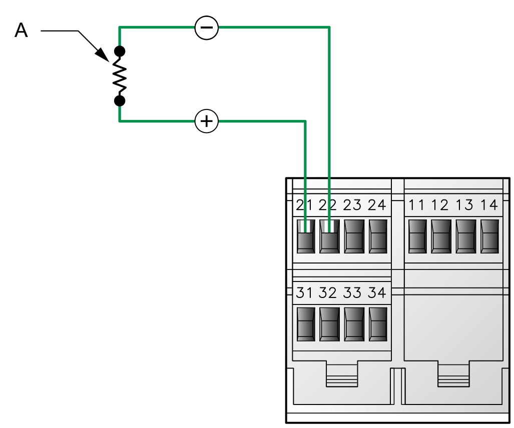
A. Primary power supply (VDC)
B. Power supply jumper to 1–4 additional Model 1500 or Model 2500 transmitters

5 I/O wiring for Model 1500 transmitters

Topics covered in this chapter:

5.1 Basic analog wiring

Figure 5-1: Model 1500 basic analog wiring



A. *Terminals 21 and 22 to mA receiving device; 820 Ω maximum loop resistance*

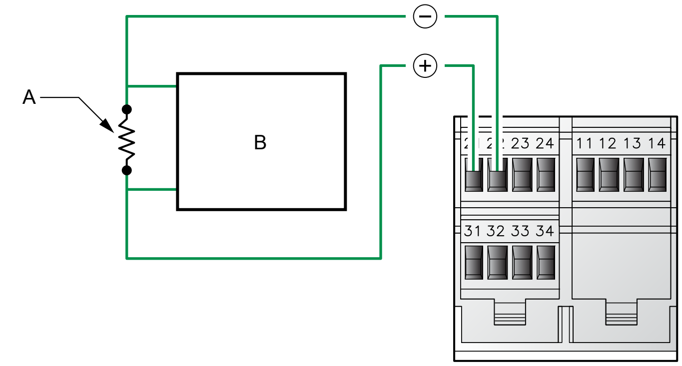
5.2 HART/analog single loop wiring

Note

For HART communications:

- 600 Ω maximum loop resistance
- 250 Ω minimum loop resistance

Figure 5-2: HART/analog single loop wiring



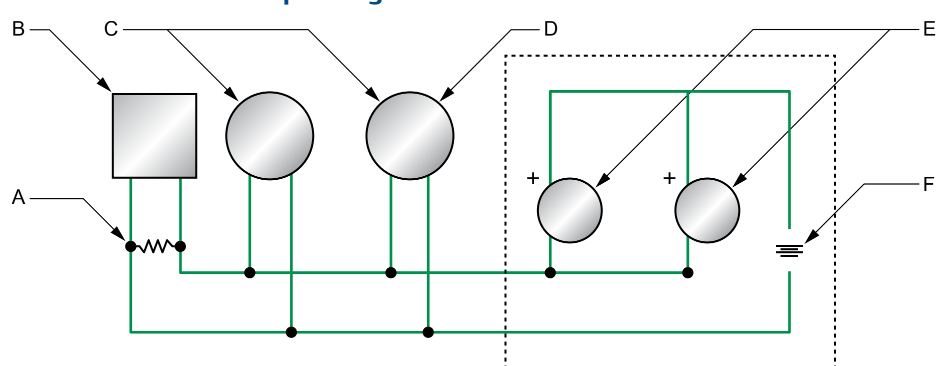
A. 820 Ω maximum loop resistance
B. HART-compatible host or controller

5.3 HART multidrop wiring

Tip

For optimum HART communication, single-point ground the output loop to an instrument-grade ground.

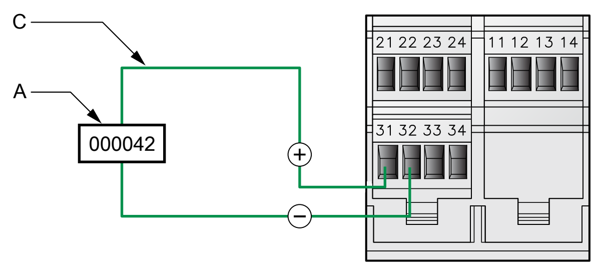
Figure 5-3: HART multidrop wiring



A. 250–600 Ω resistance
B. HART-compatible host or controller
C. HART-compatible transmitters
D. Model 1500 or Model 2500 transmitter
E. SMART FAMILY™ transmitters
F. 24 VDC loop power supply required for passive transmitters

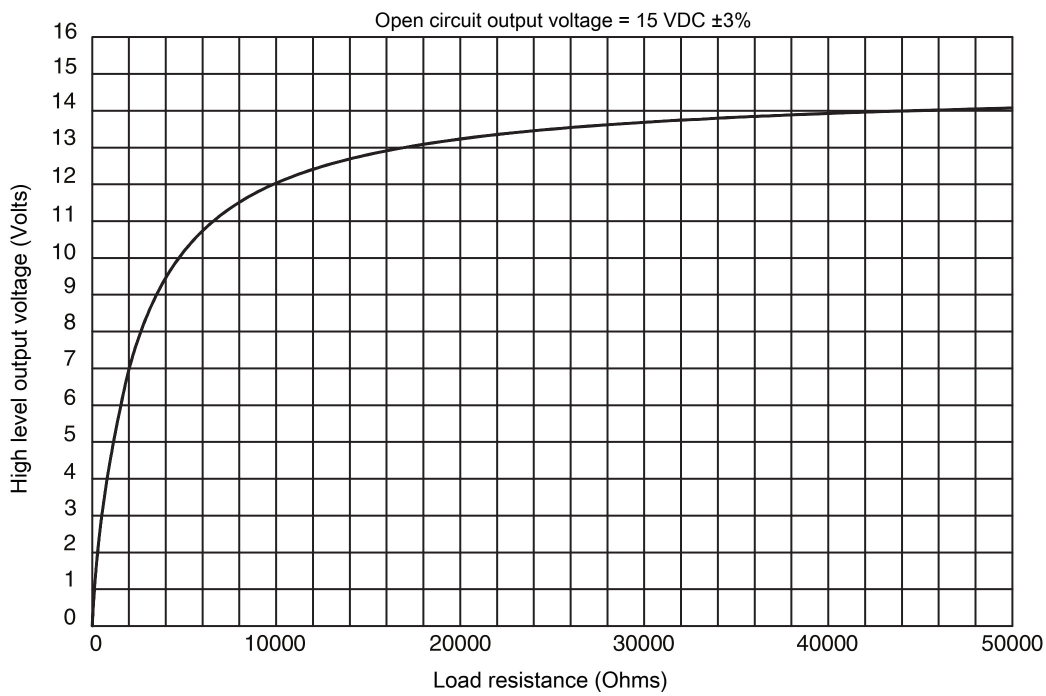
5.4 Internally powered frequency output wiring

Figure 5-4: Internally powered frequency output wiring



A. Counter
B. Channel C – Terminals 31 and 32

Figure 5-5: Output voltage versus load resistance (Channel C)



6 I/O wiring for Model 2500 transmitters

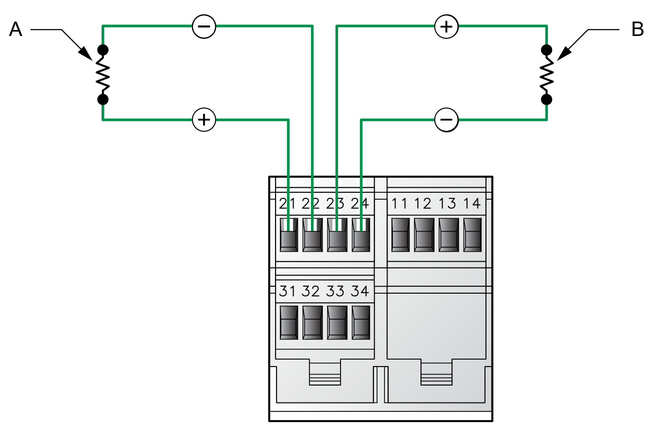
Topics covered in this chapter:

- *mA/HART wiring*
- *Frequency output wiring*
- *Discrete output wiring*
- *Discrete input wiring*

6.1 mA/HART wiring

6.1.1 Basic analog wiring

Figure 6-1: Model 2500 basic analog wiring



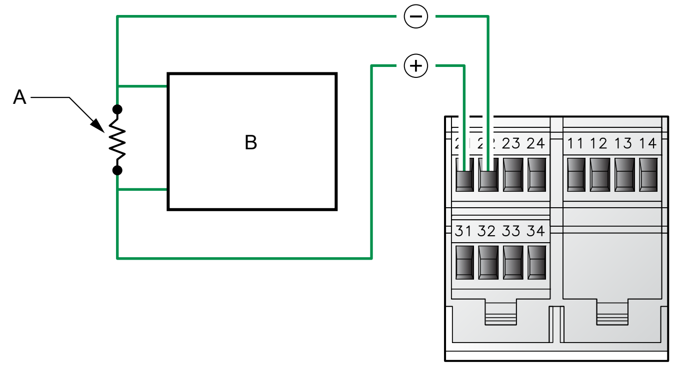
A. Channel A – Terminals 21 and 22 to mA receiving device; 820 Ω maximum loop resistance
B. Channel B – Terminals 23 and 24 to mA receiving device; 420 Ω maximum loop resistance

6.1.2 HART/analog single loop wiring

Note
For HART communications:

- 600 Ω maximum loop resistance
- 250 Ω minimum loop resistance

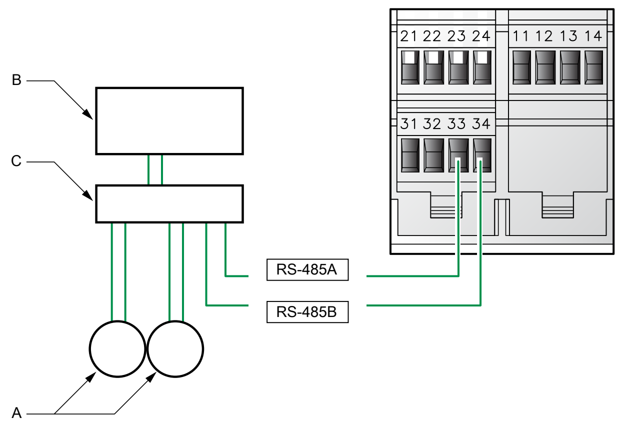
Figure 6-2: HART/analog single loop wiring



A. 820 Ω maximum loop resistance
B. HART-compatible host or controller

6.1.3 RS-485 point-to-point wiring

Figure 6-3: RS-485 point-to-point wiring



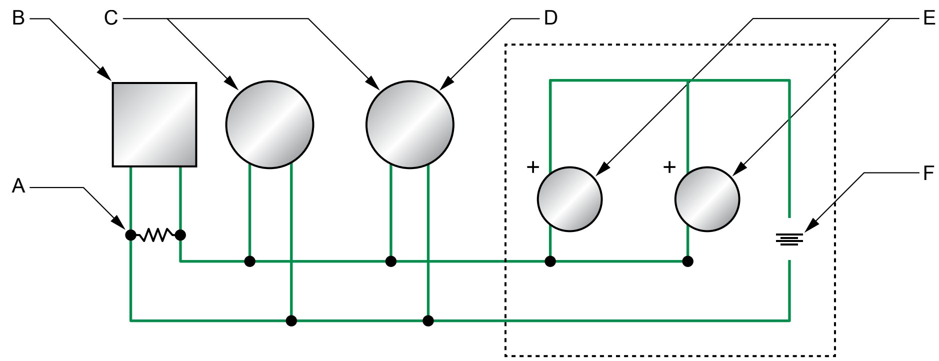
A. Other devices
B. Primary controller
C. Multiplexer

6.1.4 HART multidrop wiring

Tip

For optimum HART communication, single-point ground the output loop to an instrument-grade ground.

Figure 6-4: HART multidrop wiring

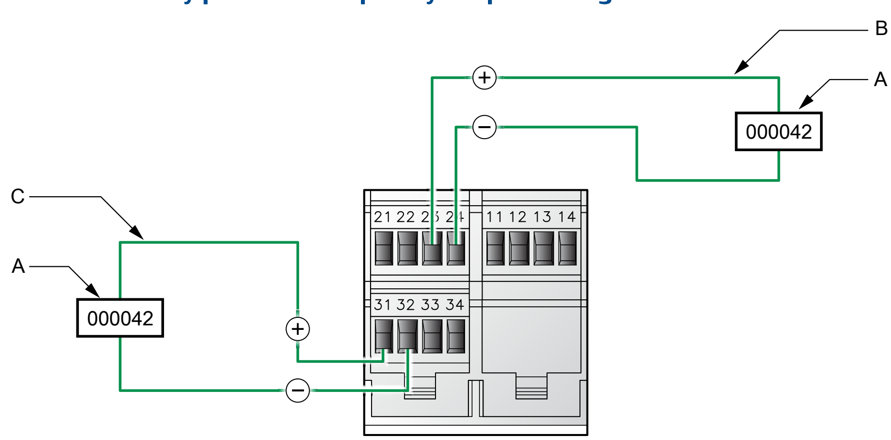


A. 250–600 Ω resistance
B. HART-compatible host or controller
C. HART-compatible transmitters
D. Model 1500 or Model 2500 transmitter
E. SMART FAMILY™ transmitters
F. 24 VDC loop power supply required for passive transmitters

6.2 Frequency output wiring

6.2.1 Internally powered frequency output wiring

Figure 6-5: Internally powered frequency output wiring



A. Counter
B. Channel B – Terminals 23 and 24
C. Channel C – Terminals 31 and 32

Figure 6-6: Output voltage versus load resistance (Channel B)

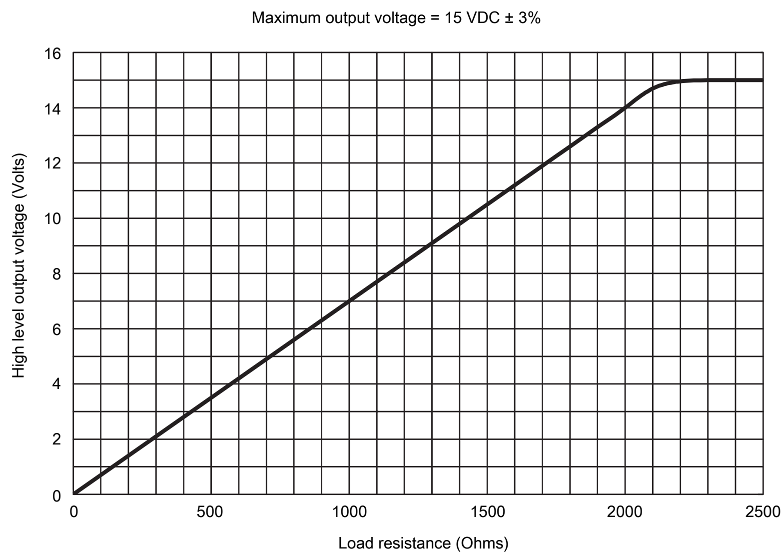
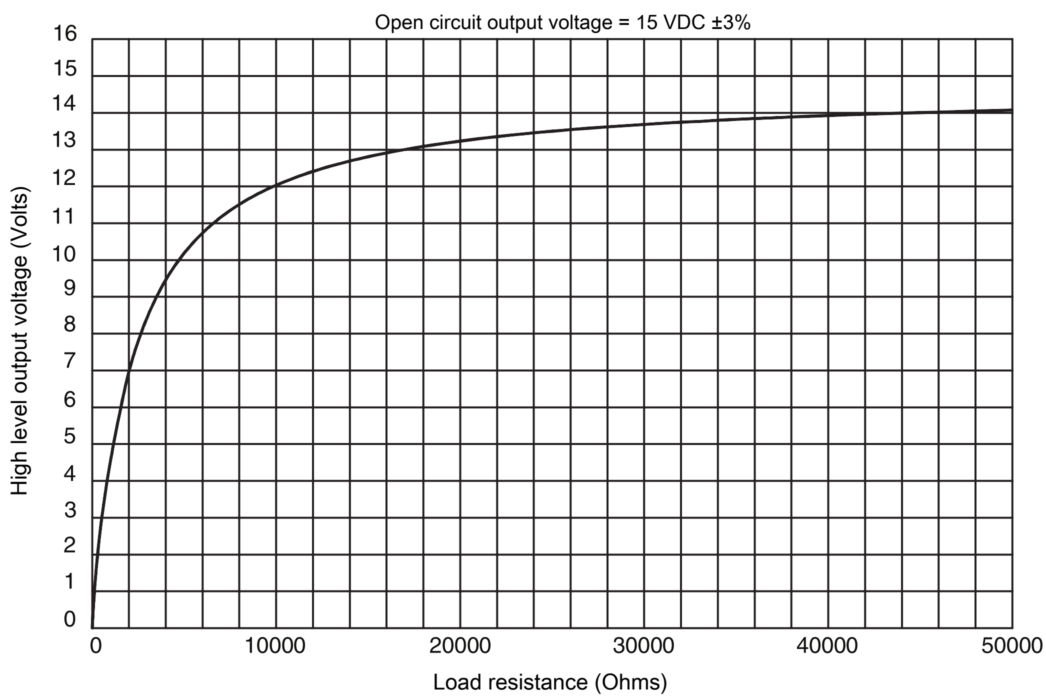
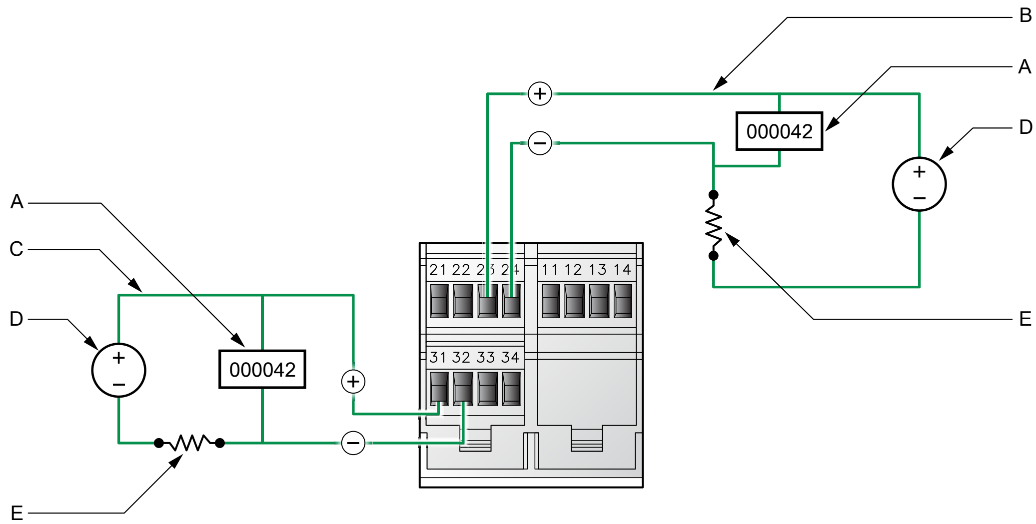


Figure 6-7: Output voltage versus load resistance (Channel C)



6.2.2 Externally powered frequency output wiring

Figure 6-8: Externally powered frequency output wiring

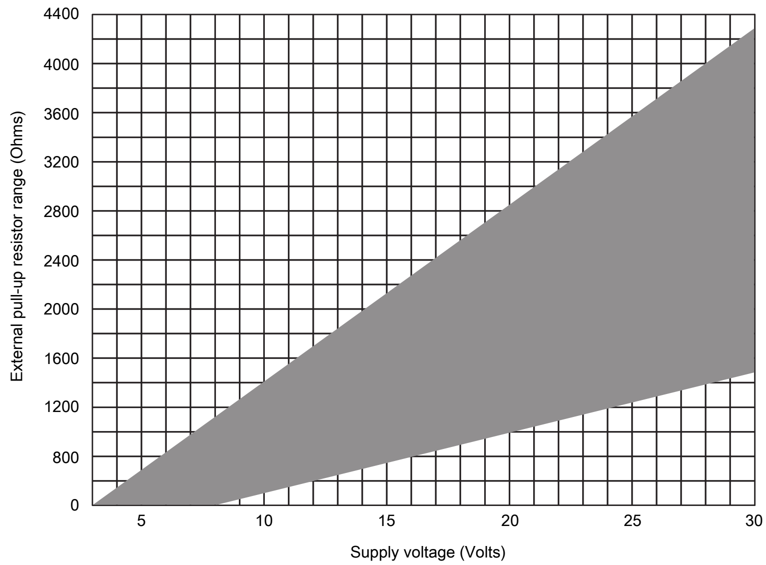


A. *Counter*
B. *Channel B – Terminals 23 and 24*
C. *Channel C – Terminals 31 and 32*
D. *External DC Power Supply (3–30 VDC)*
E. *Pull-up reisistor*

⚠ CAUTION!

Exceeding 30 VDC can damage the transmitter. Terminal current must be less than 500 mA.

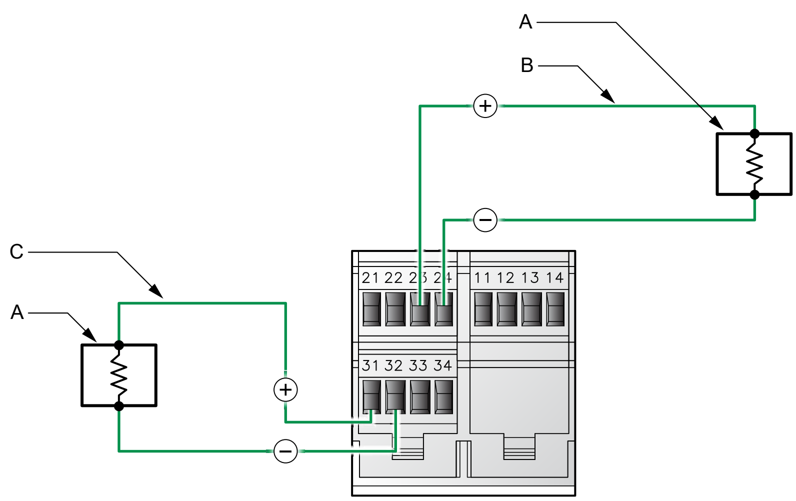
Figure 6-9: Recommended pull-up resistor versus supply voltage



6.3 Discrete output wiring

6.3.1 Internally powered discrete output wiring

Figure 6-10: Internally powered discrete output wiring



A. *Discrete output receiving device*
B. *Channel B (DO1) – Terminals 23 and 24*
C. *Channel C (DO2) – Terminals 31 and 32*

Figure 6-11: Output voltage versus load resistance (Channel B)

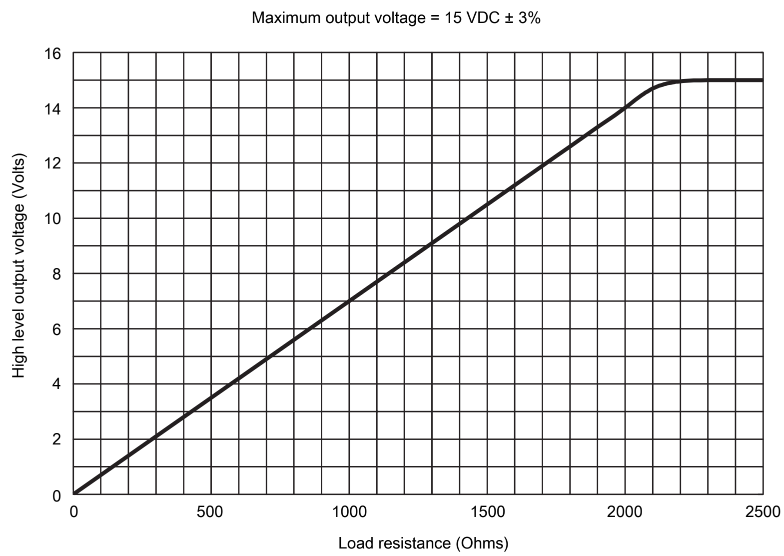
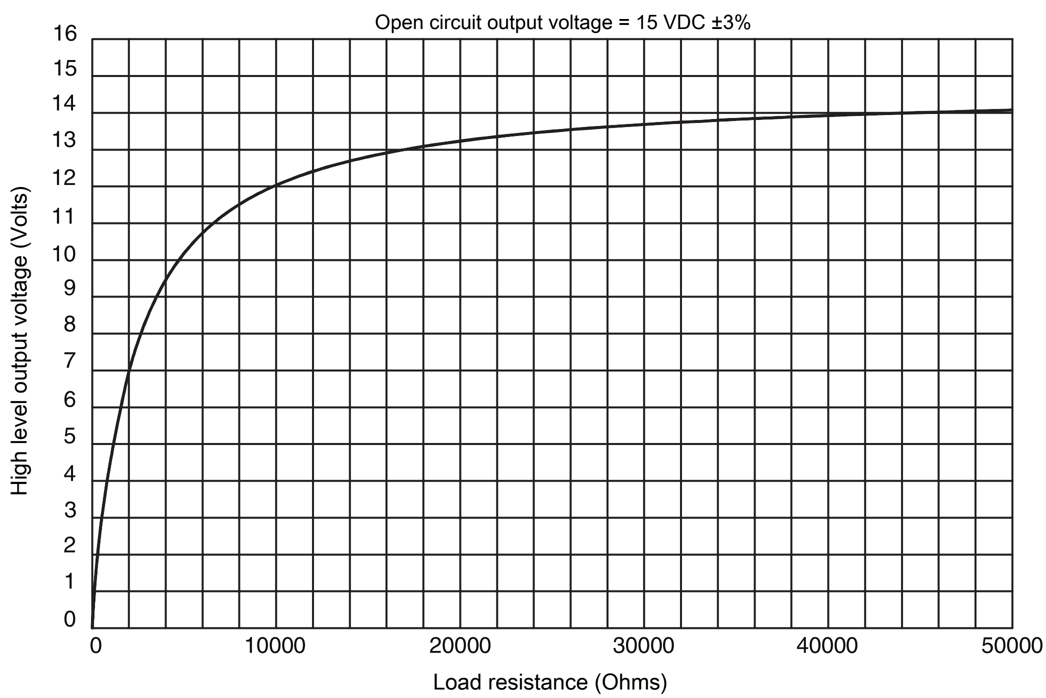
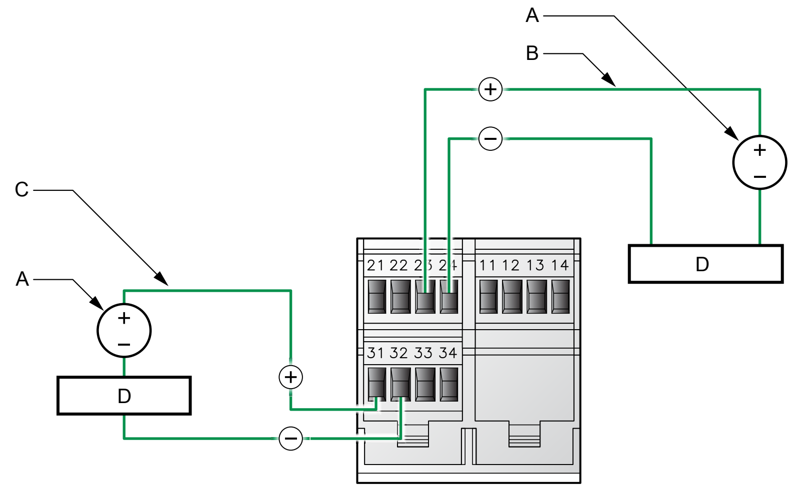


Figure 6-12: Output voltage versus load resistance (Channel C)



6.3.2 Externally powered discrete output wiring

Figure 6-13: Externally powered discrete output wiring

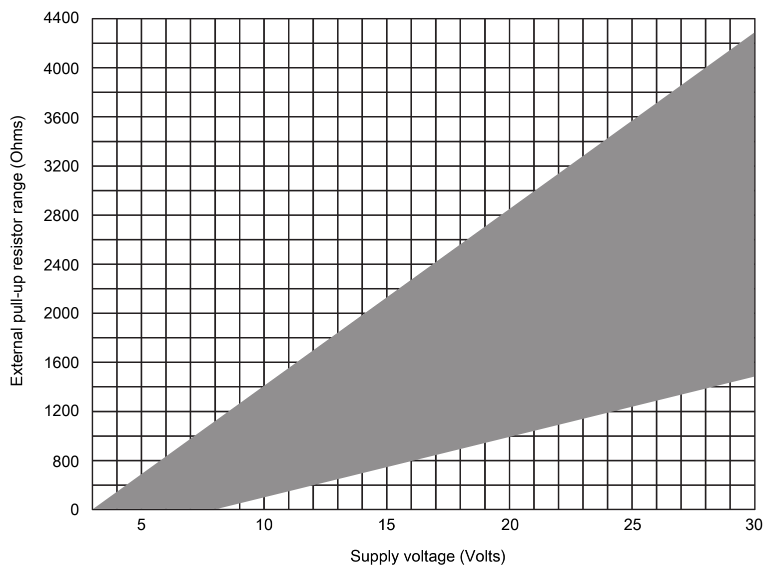


A. *External DC Power Supply (3–30 VDC)*
B. *Channel B (DO1) – Terminals 23 and 24*
C. *Channel C (DO2) – Terminals 21 and 32*
D. *Pull-up register or DC relay*

⚠ CAUTION!

Exceeding 30 VDC can damage the transmitter. Terminal current must be less than 500 mA.

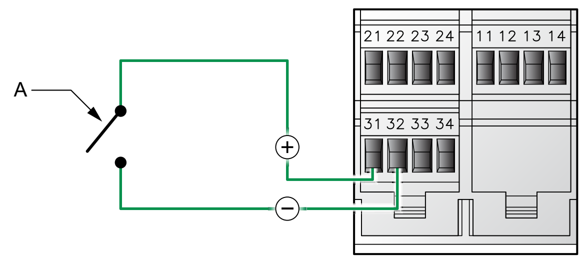
Figure 6-14: Recommended pull-up resistor versus supply voltage



6.4 Discrete input wiring

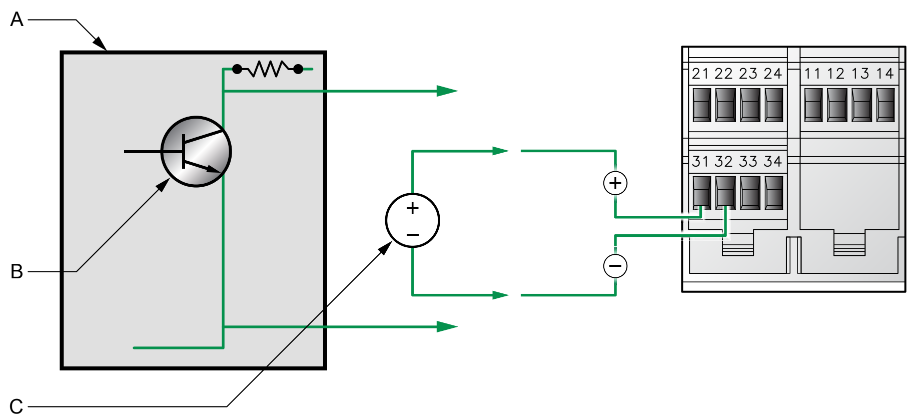
6.4.1 Internally powered discrete input wiring

Figure 6-15: Internally powered discrete input wiring



6.4.2 Externally powered discrete input wiring

Figure 6-16: Externally powered discrete input wiring



A. *PLC or other device*
B. *External DC Power Supply (VDC)*
C. *Direct DC input*

Power is supplied by either a PLC/other device or by direct DC input.

Table 6-1: Input voltage ranges for external power

VDC	Range
3–30	High level
0–0.8	Low level
0.8–3	Undefined

7 Specifications

Topics covered in this chapter:

7.1 Electrical connections

Table 7-1: Electrical connections

Type	Descriptions
Input/output connections	Three pairs of wiring terminals for transmitter outputs. Screw terminals accept stranded or solid conductors, 24 to 12 AWG (0.40 to 3.5 mm^2).
Power connections	The transmitter has two pairs of terminals for the power connection: • Either pair accepts DC power • The remaining pair is used for making a jumper connection to a second transmitter Plug terminals accept solid or stranded conductors, 24 to 12 AWG (0.40 to 3.5 mm^2).
Digital communications maintenance connections	Two clips for temporary connection to the service port. One pair of terminals supports Modbus/RS-485 signal or service port mode. On device power-up, user has 10 seconds to connect in service port mode. After 10 seconds, the terminals default to Modbus/RS-485 mode.
Core processor connection	The transmitter has two pairs of terminals for the 4-wire connection to the core processor: • One pair is used for the RS-485 connection to the core processor • One pair is used to supply power to the core processor Plug terminals accept solid or stranded conductors, 24 to 12 AWG (0.40 to 3.5 mm^2).

7.2 Input/output signals

Table 7-2: I/O and digital communication for Model 1500 transmitters

Description
One active 4–20 mA output, not intrinsically safe: • Isolated to ±50 VDC from all other outputs and Earth ground • Maximum load limit: 820 ohms • Can report mass flow or volume flow • Output is linear with process from 3.8 to 20.5 mA, per NAMUR NE43 Version 03.02.2003
One active frequency/pulse output, not intrinsically safe: • Can report mass flow or volume flow, which can be used to indicate flow rate or total • Reports the same flow variable as the mA output • Scalable to 10,000 Hz • Voltage is +15 VDC ±3% with 2.2 kohm internal pull-up resistor • Linear with flow rate to 12,500 Hz • Configurable polarity: active high or active low • Can be configured as a discrete output to report five discrete events, flow direction, flow switch, calibration in progress, or fault

Service port, Modbus/RS-485 (terminals 33-34)
• After device power up, terminals 33 and 34 are available in service port mode for 10 seconds:
  - Modbus RTU protocol
  - 38,400 baud
  - No parity
  - One stop bit
  - Address = 111
• After 10 seconds, terminals 33 and 34 default to Modbus/RS-485:
  - Modbus RTU or Modbus ASCII protocol (default: Modbus RTU)
  - 1200 to 38,400 baud rate (default: 9600)
  - Stop bit configurable (default: one stop bit)
  - Parity configurable (default: odd parity)

HART/Bell 202: • HART Bell 202 signal is superimposed on the primary milliamp output, and is available for host system interface. Frequency 1.2 and 2.2 kHz, Amplitude: to 1.0 mA, 1200 baud, Requires 250 to 600 ohms load resistance • HART revision 5 as default, selectable to HART revision 7
One zero button that can be used to start the flowmeter zeroing procedure

Table 7-3: I/O and digital communication for Model 1500 transmitters with filling and dosing application

Description
One active 4–20 mA output, not intrinsically safe: • Isolated to ±50 VDC from all other outputs and Earth ground • Maximum load limit: 600 ohms • Can report mass flow or volume flow, or can control a two-position discrete valve or three-position analog valve • Output is linear with process from 3.8 to 20.5 mA, per NAMUR NE43 Version 03.02.2003

One or two discrete outputs:
• Can report fill in progress or fault, or can control discrete valve
• Maximum sink capability is 500 mA
• Configurable for internal or external power
  - Internally powered to 15 VDC ±3%, internal 2.2 kΩ pull-up, or
  - Externally powered 3-30 VDC max., sinking up to 500 mA at 30 VDC maximum

One discrete input (can be configured instead of one of the discrete outputs): • Configurable for internal or external power • Can be used to begin fill, end fill, pause fill, resume fill, reset fill total, reset mass total, reset volume total, or reset all totals (includes fill total)

Service port, Modbus/RS-485 (terminals 33-34):
• After device power up, terminals 33 and 34 are available in service port mode for 10 seconds:
  - Modbus RTU protocol
  - 38,400 baud
  - No parity
  - One stop bit
  - Address = 111
• After 10 seconds, terminals 33 and 34 default to Modbus/RS-485:
  - Modbus RTU or Modbus ASCII protocol (default: Modbus RTU)
  - 1200 to 38,400 baud rate (default: 9600)
  - Stop bit configurable (default: one stop bit)
  - Parity configurable (default: odd parity)

One zero button that can be used to start the flowmeter zeroing procedure

Table 7-4: I/O and digital communication details for Model 2500 transmitters

Description
Three input/output channels (A, B, and C) that can be configured from the following choices:(1) • One or two active 4–20 mA outputs (Channels A and B): - Not intrinsically safe - Isolated to ±50 VDC from all other outputs and earth ground - Maximum load limits of mA1: 820 ohms; of mA2: 420 ohms - Can report mass flow, volume flow, density, temperature, or drive gain - Output is linear with process from 3.8 to 20.5 mA, per NAMUR NE43 Version 03.02.2003 • One or two active or passive frequency/pulse outputs (Channels B and C): - Not intrinsically safe - Can report mass flow or volume flow, which can be used to indicate flow rate or total - If configured as a dual pulse output, the channels are electrically isolated but not independent(2) - Scalable to 10,000 Hz - If active, output voltages is +15 VDC ±3% with a 2.2 kohm internal pull-up resistor - If passive, output voltage is 30 VDC maximum, 24 VDC typical, sinking up to 500 mA at 30 VDC - Output is linear with flow rate to 12,500 Hz • One or two active or passive discrete outputs (Channels B and C): - Not intrinsically safe - Can report five discrete events, flow switch, forward/reverse flow, calibration in progress, or fault - If active, output voltage is +15 VDC ±3% with a 2.2 kohm internal pull-up resistor - If passive, output voltage is 30 VDC maximum, 24 VDC typical, sinking up to 500 mA at 30 VDC • One discrete input (Channel C)
Service port, Modbus/RS-485 (terminals 33-34): • After device power up, terminals 33 and 34 are available in service port mode for 10 seconds: - Modbus RTU protocol - 38,400 baud - No parity - One stop bit - Address = 111 • After 10 seconds, terminals 33 and 34 default to Modbus/RS-485: - Modbus RTU or Modbus ASCII protocol (default: Modbus RTU) - 1200 to 38,400 baud rate (default: 9600) - Stop bit configurable (default: one stop bit) - Parity configurable (default: odd parity)
HART/Bell 202: • HART Bell 202 signal is superimposed on the primary milliamp output, and is available for host system interface. Frequency 1.2 and 2.2 kHz, Amplitude: to 1.0 mA, 1200 baud, Requires 250 to 600 ohms load resistance • HART revision 5 as default, selectable to HART revision 7

(1) When output option B is ordered, the channels are configured at the factory for two mA and one frequency output; When output option C is selected, the channels are custom configured at the factory.

(2) *For custody transfer using double-pulse frequency output, the transmitter can be configured for two frequency outputs. The second output can be phase shifted –90, 0, 90, or 180 degrees from the first output, or the dual-pulse output can be set to quadrature mode*

7.3 Environmental limits

Table 7-5: Environmental specifications

Type	Value
Ambient temperature limits (Operating)	–40 to +131 °F (–40 to +55 °C)
Ambient temperature limits (Storage)	–40 to +185 °F (–40 to +85 °C)
Humidity limits	5 to 95% relative humidity, non-condensing at 140 °F (60 °C)
Vibration limits	Meets IEC 60068-2-6, endurance sweep, 5 to 2000 Hz, 50 sweep cycles at 1.0 g
EMI effects	Complies with EMC Directive 2004/108/EC per EN 61326 Industrial Complies with NAMUR NE-21 (22.08.2007)
Ambient temperature effect (analog output option)	On mA output: ±0.005% of span per °C

7.4 Physical specifications

Figure 7-1: Transmitter dimensions

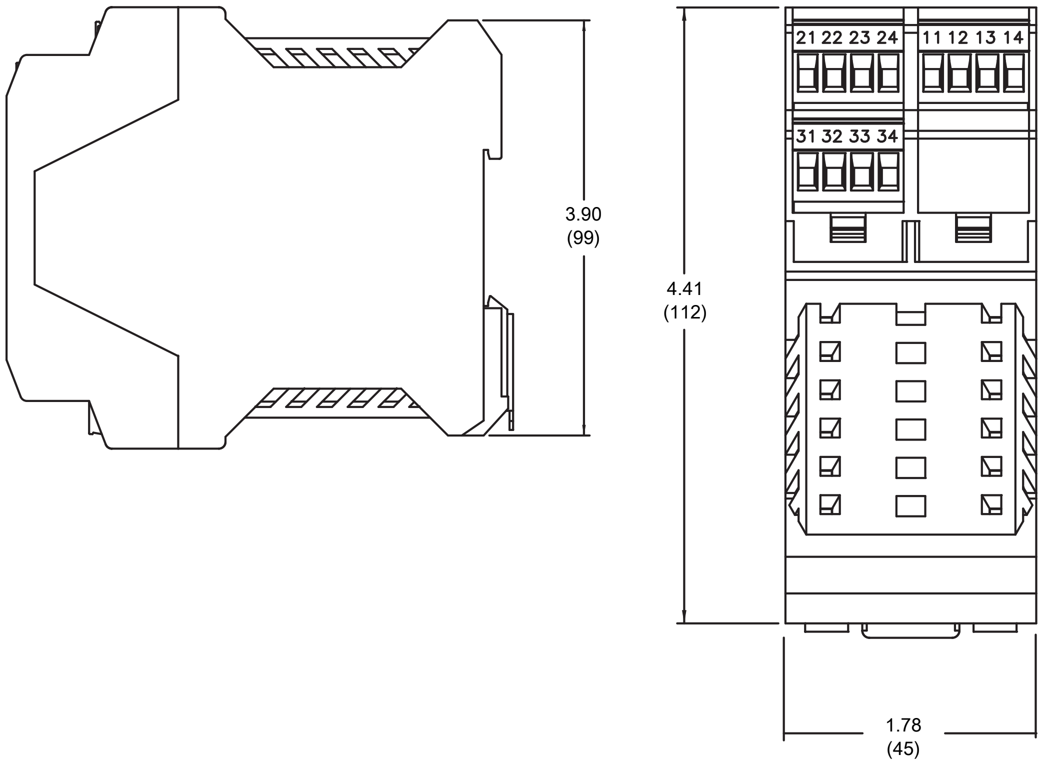


Figure 7-2: Remote core processor dimensions

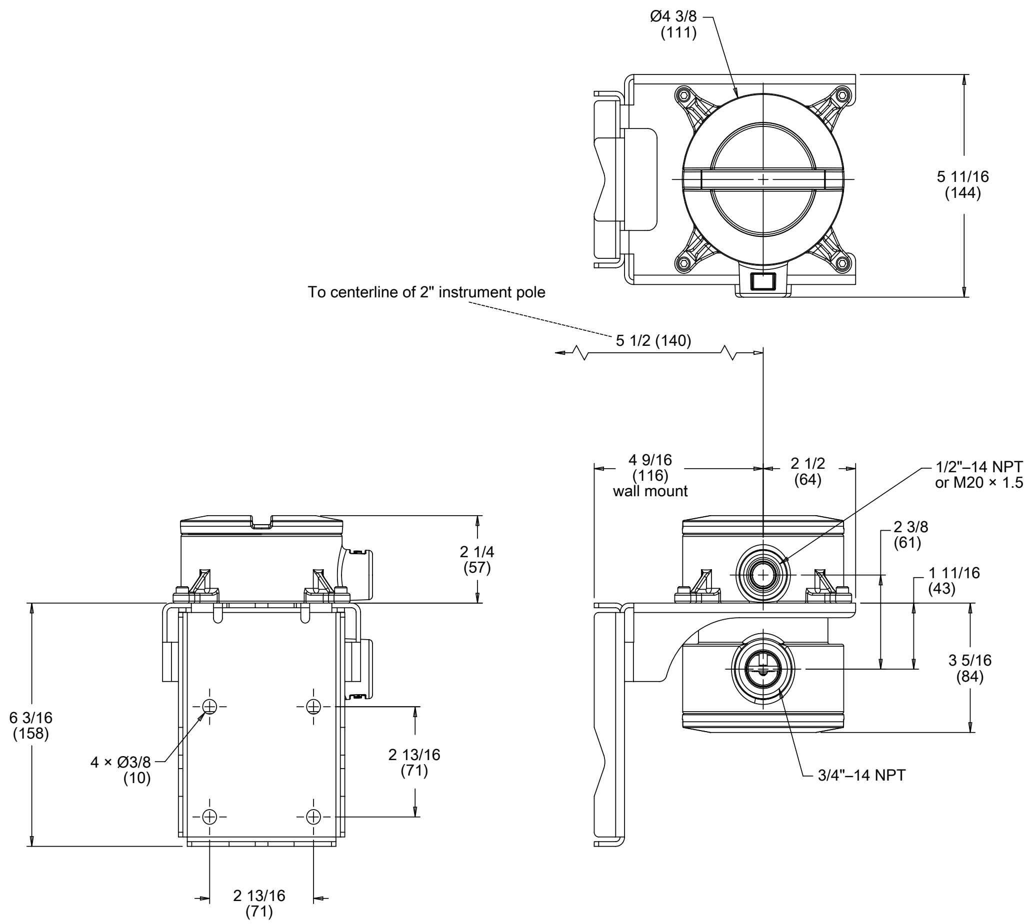
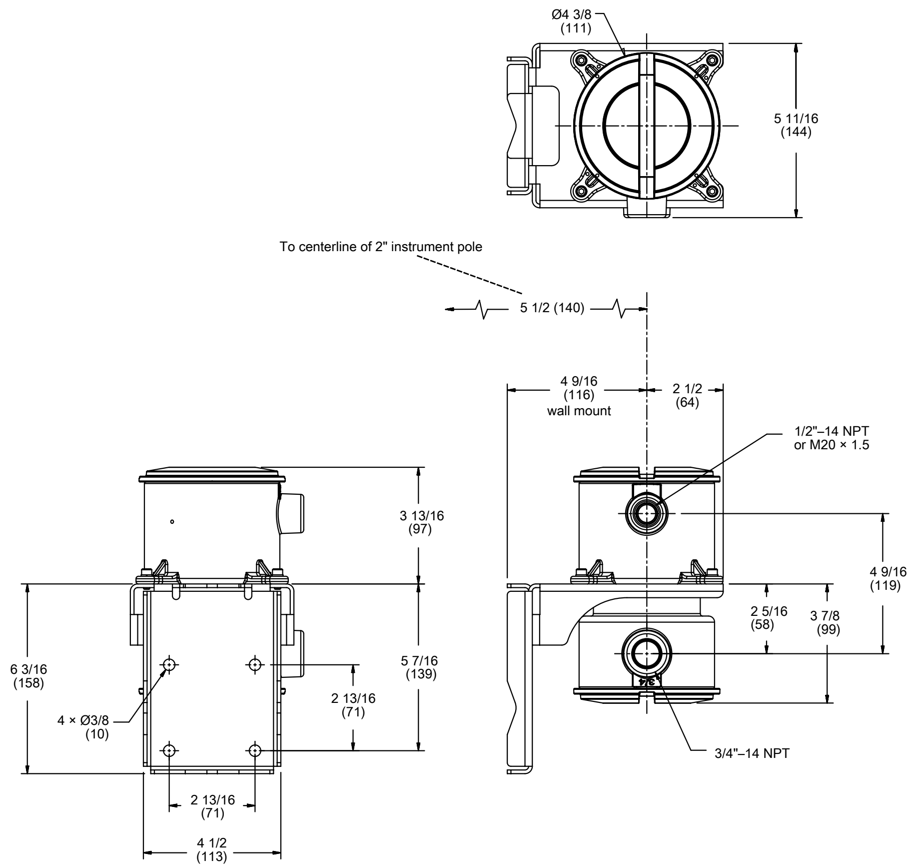


Figure 7-3: Remote enhanced core processor dimensions



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Rev DB
2015

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