Installation Manual
MMI-20031634, Rev AA
December 2016

Micro Motion® 2-Wire Time Period Signal (TPS) Gas Density Meter (GDM)

2-Wire TPS GDM Installation Supplement

MICRO MOTION™

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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.

For information about the Pressure Equipment Directive, go to *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 configuration manual. Product data sheets and manuals are available from the Micro Motion web site at *www.micromotion.com/documentation*.

Return policy

Follow Micro Motion procedures when returning equipment. These procedures ensure legal compliance with government transportation agencies and help provide a safe working environment for Micro Motion employees. Micro Motion will not accept your returned equipment if you fail to follow Micro Motion procedures.

Return procedures and forms are available on our web support site at *www.micromotion.com*, or by phoning the Micro Motion Customer Service department.

Emerson Flow customer service

Email:

- Worldwide: *flow.support@emerson.com*
- Asia-Pacific: *APflow.support@emerson.com*

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United States	800-522-6277	U.K.	0870 240 1978	Australia	800 158 727
Canada	+1 303-527-5200	The Netherlands	+31 (0) 704 136 666	New Zealand	099 128 804
Mexico	+41 (0) 41 7686 111	France	0800 917 901	India	800 440 1468
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		
		Saudi Arabia	800 844 9564		
		UAE	800 0444 0684		

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Appendices and reference

1 Planning

Topics covered in this chapter:

1.1 2-wire installations

The 2-wire Time Period Signal (TPS) is a configuration option available on the Gas Density Meter (GDM).

This option provides:

- A TPS output superimposed on the same pair of wires used to power the meter
- An optional 4-wire connection to the internal RTD

Restriction

The 2-wire TPS device does not support:

- Internal calculations of density
- Integral health diagnostics, alarm and alert statuses, or internal calculation of other measurement variables derived from gas density
- The display option

1.2 Installation checklist

☐ Verify the contents of the product shipment to confirm that you have all parts and information necessary for the installation.

Part	Quantity
Micro Motion® Gas Density Meter (GDM)	1

Part	Quantity
Accessories kit: - M20 to 1/2-inch NPT adapter (if applicable) - 1/2-inch NPT blanking plug - 2.5 mm hex key	1
Aluminum sleeve	1
Silicon fluid	1
Thermo-well pocket kit (if applicable)	1
Calibration certificate	1
Safety instructions booklets	2
Micro Motion Product Documentation DVD	1

- ☐ Make sure that all electrical safety requirements are met for the environment in which the meter will be installed.
- ☐ Make sure that the local ambient and process temperatures and process pressure are within the limits of the meter.
- ☐ Make sure that the hazardous area specified on the approval tag is suitable for the environment in which the meter will be installed.
- ☐ If installing the meter in a hazardous area, confirm that you have the required safety barriers or galvanic isolators for your installation.
- ☐ Make sure that you will have adequate access to the meter for verification and maintenance.
- ☐ Make sure that the process gas meets the recommended characteristics regarding composition, temperature, and pressure for your installation.
- ☐ Verify that you have all equipment necessary for your installation. Depending on your application, you may be required to install additional parts for optimal performance of the meter.
- ☐ Follow recommended best practices for installing the GDM to account for the effects of density, temperature, and pressure equilibrium.

1.3 Best practices

The following information can help you get the most from your meter.

- Handle the meter with care. Follow local practices for lifting or moving the meter.
- Ensure that the process gas is clean and dry.
- Do not use gases incompatible with the materials of construction. To prevent corrosion of the sensing element, the process gas should be compatible with Ni-Span-C.
- Do not expose the meter to excessive vibration (greater than 0.5 g continuously). Vibration levels in excess of 0.5 g can affect the meter accuracy.

- Installing the meter in a bypass configuration allows you to remove the meter for servicing or calibration without affecting the main pipeline.
- Install the meter in a thermo-well pocket to ensure the temperature of the sample gas is equal to that of the pipeline gas. Micro Motion thermo-well pocket kits are available for purchase.
- Minimize the length and volume of the input sample pipe to ensure an optimal meter response time. Use 6 mm (1/4 in) instrument tubing and low-volume inlet filters.
- Control gas flow with a needle valve mounted before or after the meter, depending on the installation.
- Install an external coalescing filter in the sample gas inlet pipework to minimize condensate and dust contamination.
- Verify that the filters in your system are not causing any excessive flow restrictions.
- Verify that the pressure of the process gas is approximately equal to the pipeline pressure.
- Ensure that the meter and associated pipework are pressure-tested to 1½ times the maximum operating pressure after installation.
- Install thermal insulation to the meter and the inlet and bypass-loop pipeline to maintain temperature equilibrium between the sample and pipeline gases. Do not insulate the transmitter (electronics) and maintain a nominal 1-in clearance between the insulation and the transmitter housing.

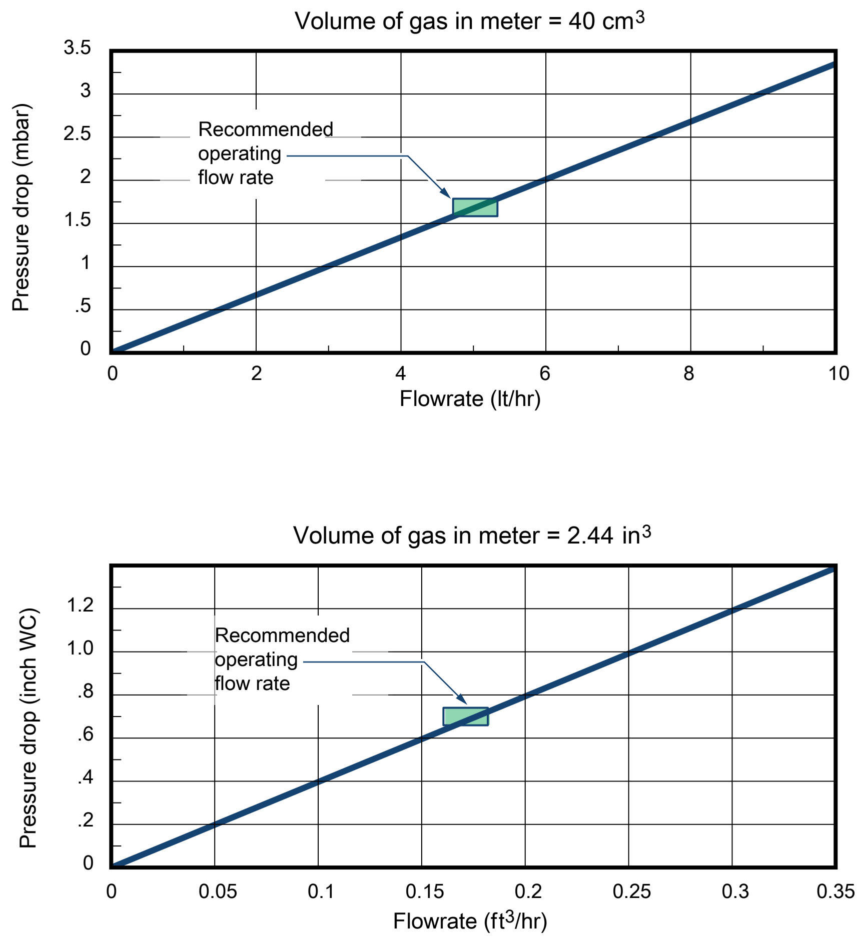
1.4 Recommended sample flow rate

Use the smallest acceptable flow rate for the process gas passing through the meter. This ensures a sample gas flow rate that is representative of the main flow with regard to the proportions of different gas constituents.

Micro Motion recommends a gas flow rate of 5 ±1 l/hr (0.176 ±0.35 ft^3/hr), although a flow rate between 1 to 10 l/hr (0.035 to 0.35 ft^3/hr) is acceptable.

At flow rates greater than 10 l/hr (0.35 ft^3/hr), the density reading can become slightly unstable and may introduce a small density error. For natural gas with a typical application density of approximately 0.06 g/cm^3 (60 kg/m^3), a pressure differential of approximately 1.66 mbar (0.67 in WC) is required to maintain a flow rate of 5 l/hr (0.176 ft^3/hr) .

Figure 1-1: Pressure drop through the meter



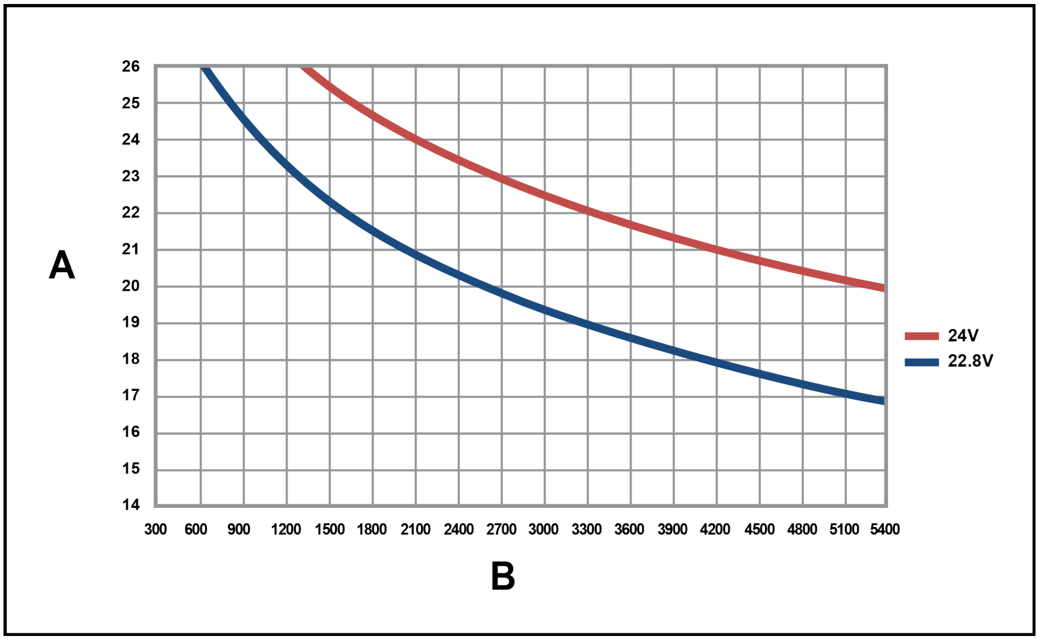
1.5 Power requirements

The following DC power requirements are needed to operate the meter:

- 24 VDC, 0.25 W typical with 300 Ω barrier, 0.3 W maximum with 300 Ω barrier
- Minimum recommended voltage: 22.8 VDC with 1000 ft of 22 AWG (300 m of 0.25 mm^2) power-supply cable with 300 Ω barrier

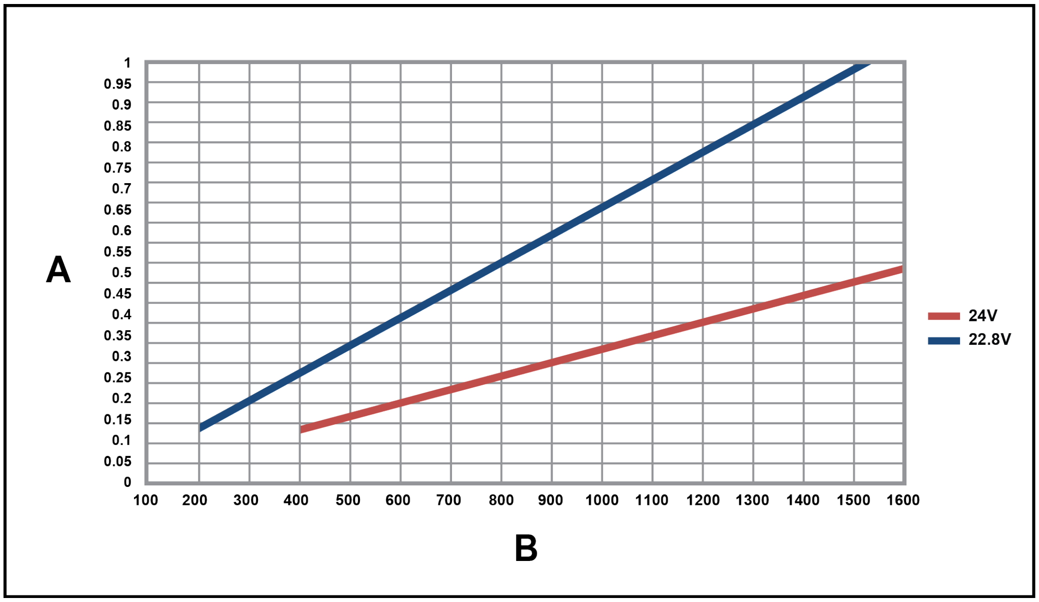
Power cable recommendations for intrinsically-safe meters

Figure 1-2: Minimum wire gauge with 300 Ω barrier



A. AWG
B. Distance of installation in feet

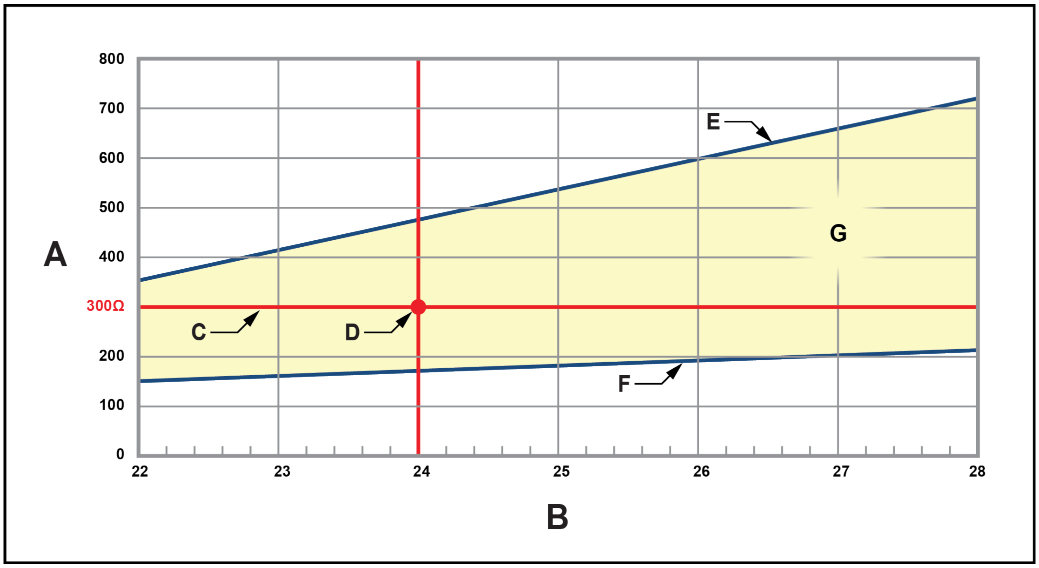
Figure 1-3: Minimum wire area with 300 Ω barrier



A. Minimum wire area (mm^2)

B. Distance of installation in meters

Figure 1-4: Limits of series resistance versus supply voltage



A. *Series resistance (Ω)*
B. *Supply voltage (V)*
C. *300 Ω barrier resistance*
D. *Normal operating point*
E. *Maximum resistance for correct operation*
F. *Minimum resistance for 5 volt TPS*
G. *The 2-wire GDM fully operates anywhere in the shaded area*

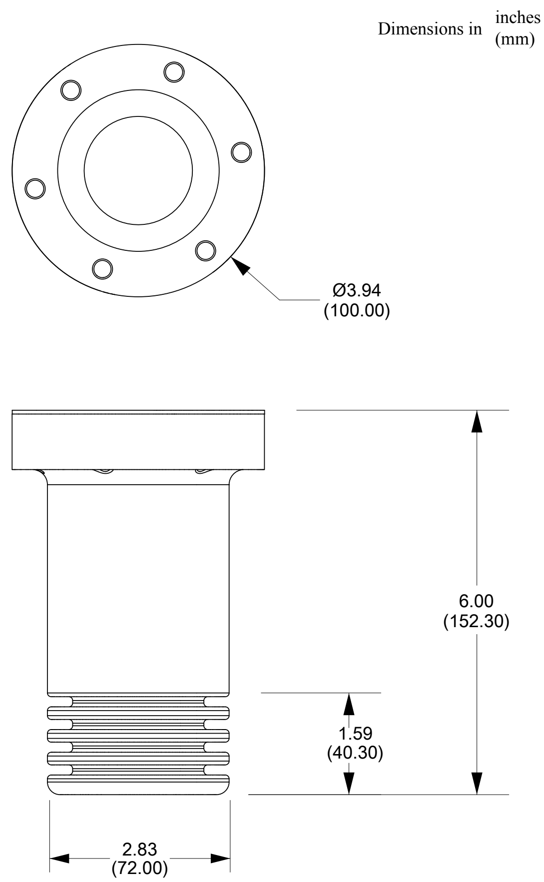
1.6 Installation requirements for the thermo-well pocket

Installation of the GDM in a thermo-well pocket helps maintain temperature equilibrium between the sample gas and pipeline gas. Micro Motion provides thermo-well pocket installation kits for purchase. Contact your local sales representative or Micro Motion Customer Support at *flow.support@emerson.com* for more information.

A thermo-well pocket installation requires the following, before you can mount and connect the GDM:

1. Create an aperture in the pipeline to receive the pocket (see *Figure 1-5* for the pocket dimensions).
2. Install and weld the pocket in place. Be sure to follow local practices and guidelines for welding in hazardous areas, if applicable.

Figure 1-5: Micro Motion thermo-well pocket dimensions



1.7 Recommended installations for gas density applications

Micro Motion recommends specific installations for the GDM depending on the gas density application – as defined by international standards, ISO 5167 and AGA 3. This information is provided for your reference only.

1.7.1 Installation in an orifice plate metering system

The orifice plate metering system is a widely used method for accurate flow measurement of natural gas. The orifice meter is a differential pressure device in which the orifice plate causes a pressure drop between the upstream and downstream sides. The flow rate is determined from the dimensions of the system (as defined by international standards ISO 5167 and AGA 3), and from measurements of differential pressure and fluid density.

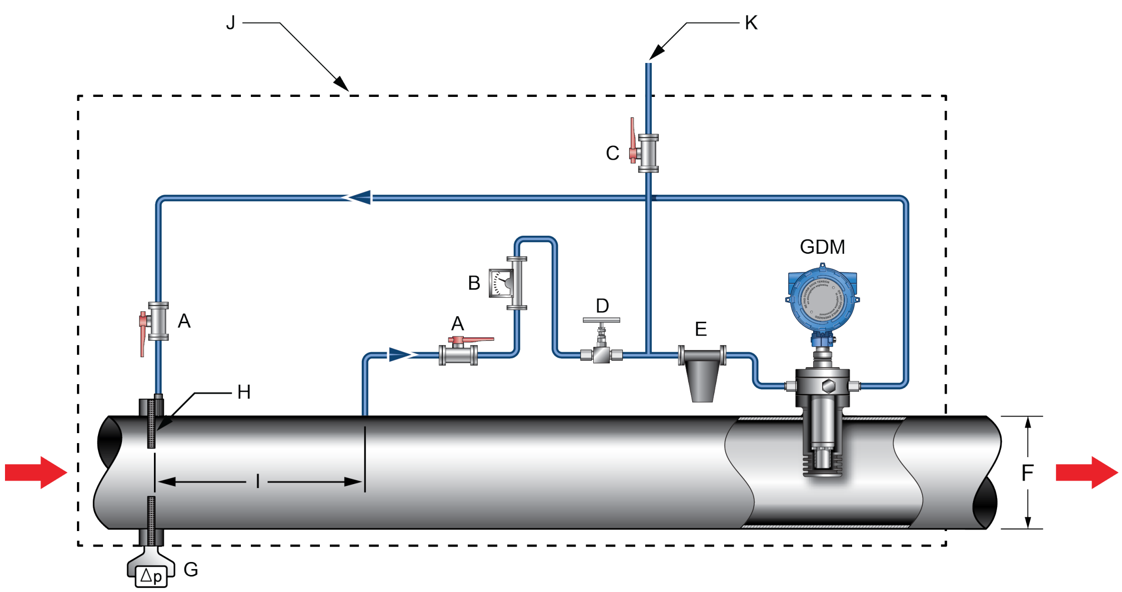
Meter installation in a pressure recovery application

The most common location for a density device in an orifice plate metering system is downstream from the orifice plate. This installation is commonly referred to as the pressure recovery method. The pressure recovery method allows an optimal gas flow rate, and provides easy access for checking filters and verifying the meter calibration.

Tip

Use 6-mm (1/4-in) instrument tubing for the gas input pipework. Use 12-mm (1/2-in) insertion tubing for the gas return pipework.

Figure 1-6: Meter installation in pressure recovery application



A. Meter isolation valves
B. Flowmeter
C. Venting valve
D. Flow control needle valve
E. Filter
F. Pipeline diameter
G. Differential pressure transmitter
H. Density point
I. Distance is eight times the pipeline diameter
J. Thermal insulation
K. Vent/vacuum test point

Note

Do not insulate the transmitter (electronics) and maintain a nominal 1-in clearance between the insulation and the transmitter housing.

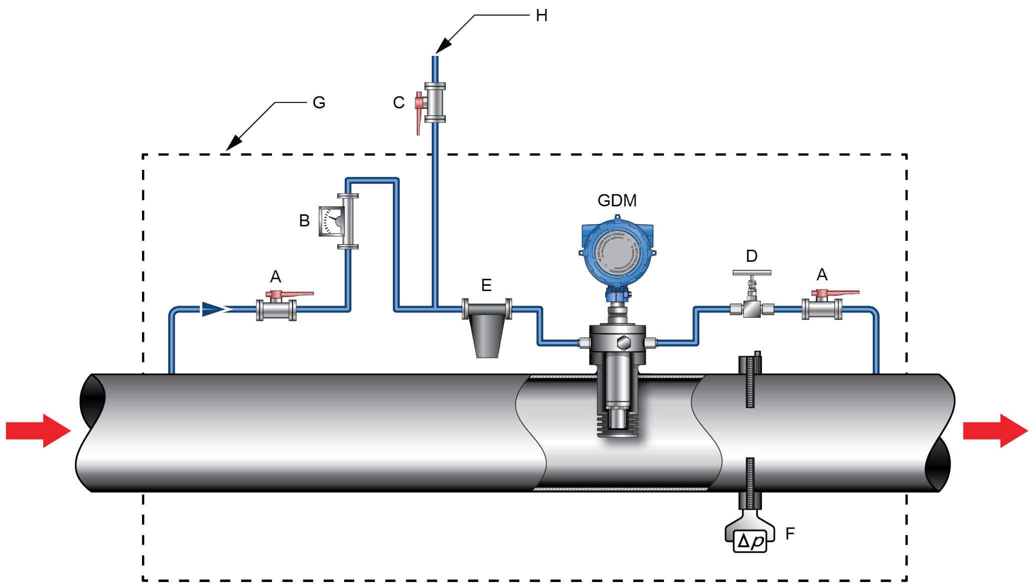
With the pressure recovery installation method:

- No bypass of the orifice plate is necessary.
- Density is measured at the downstream tapping of the orifice plate, which reduces the significance of pressure build-up across the fine-gauge filters.
- Flow is achieved because the pressure after the orifice plate is lower than that further downstream.
- Pressure drops through the valves and filters do not affect the reading. The pressure inside the meter and at the gas outlet is equal to the pressure at the orifice downstream point.
- The correct expansion factor for the downstream point is used in the orifice flow calculations.
- The measured density at the density point is used in the mass flow calculation, as defined by ISO 5167 and AGA 3.

Meter installation in differential pressure application

An alternative to the downstream installation method is the upstream installation method, as defined by AGA 3. This method is also known as the differential pressure method, which is optimal for orifice plate metering. A disadvantage of this installation is that the sample gas flow is not measured because it bypasses the orifice plate.

Figure 1-7: Meter installation in differential pressure application



A. Meter isolation valves
B. Flowmeter
C. Venting valve
D. Flow control needle valve
E. Filter
F. Differential pressure transmitter
G. Thermal insulation
H. Vent/vacuum test point

Note

Do not insulate the transmitter (electronics) and maintain a nominal 1-in clearance between the insulation and the transmitter housing.

With the differential pressure installation method:

- The process gas flow bypasses the meter, but should be low enough [for example, 5 lt/hrs (0.176 ft^3/hr)] to not be of significance.
- The measured density is the upstream density.
- The control valve and the flowmeter can be mounted on either side of the meter to suit the installation and dependent on where the density point is.

Tip

To avoid excessive pressure drops in your sample pipeline, be sure to monitor the condition of the filters. Do this by varying the sample flow rate and monitoring the magnitude of the resultant density changes. Pressure drops through the filters can cause density errors if they become too large.

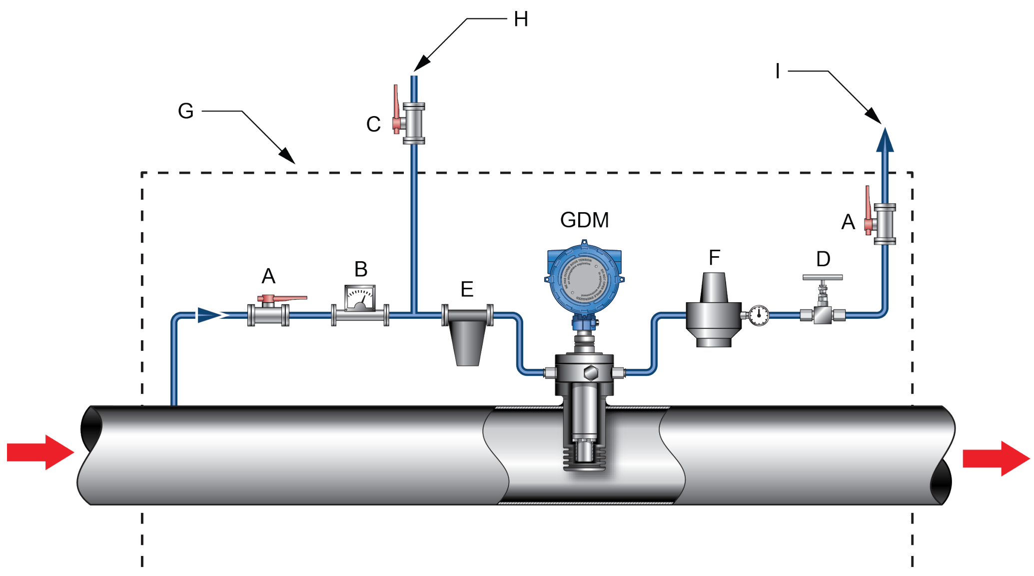
1.7.2 Meter installation in a vented gas application

The vented gas method allows the gas to be vented to flare or, in some cases, to atmosphere. With this method, the full-pipe pressure is available as a pressure drop. For high-pressure applications, a two-stage letdown system may be required to prevent icing.

CAUTION!

Because the full-pipe pressure is available as a pressure drop, ensure that the flow is adequately controlled by the control valve.

Figure 1-8: Meter installation in a vented gas application



A. *Meter isolation valves*
B. *Flowmeter*
C. *Venting valve*
D. *Flow control needle valve*
E. *Filter*
F. *Pressure regulator*
G. *Thermal insulation*
H. *Vent/vacuum test point*
I. *Low-pressure vent system connection point*

Note

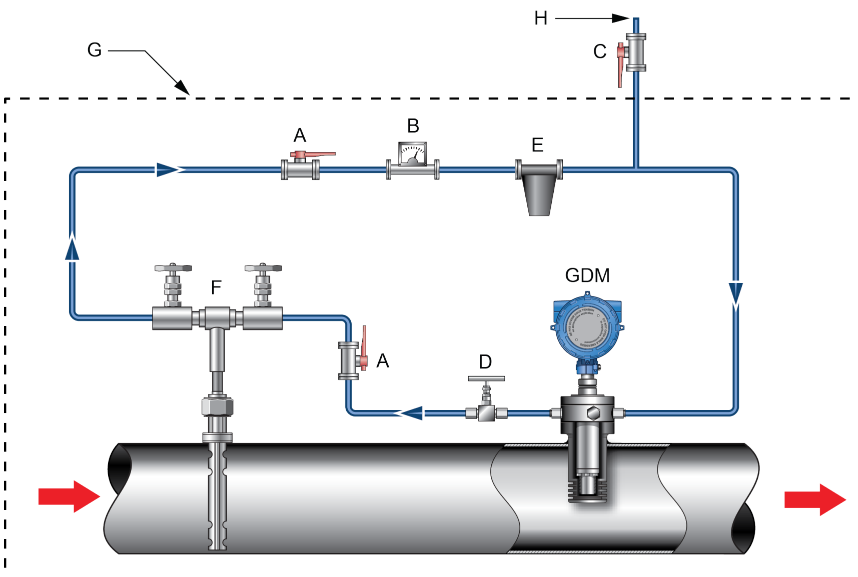
Do not insulate the transmitter (electronics) and maintain a nominal 1-in clearance between the insulation and the transmitter housing.

1.7.3 Meter installation in an ultrasonic meter application

To use the GDM with a full-bore ultrasonic meter, Micro Motion recommends that you install an insertion probe downstream from the ultrasonic meter as a means to provide differential pressure.

The following diagram shows an insertion probe installed to provide differential pressure for the measurement system. This type of installation method does not require sample gas to be vented to atmosphere. The insertion probe and GDM must be installed a specific distance downstream from the ultrasonic meter in your pipeline. Refer to all manufacturer guidelines for best practices or recommendations for installing the meters in your system.

Figure 1-9: Meter installation in an ultrasonic meter application



- *A. Meter isolation valves*
- *B. Flowmeter*
- *C. Venting valve*
- *D. Flow control needle valve*
- *E. Filter*
- *F. Insertion probe*
- *G. Thermal insulation*
- *H. Vent/vacuum test point*

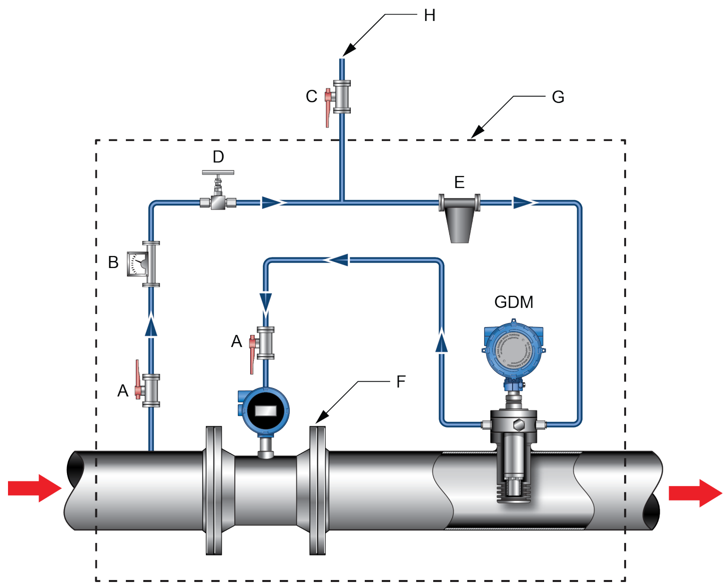
Note

Do not insulate the transmitter (electronics) and maintain a nominal 1-in clearance between the insulation and the transmitter housing.

1.7.4 Meter installation with a turbine flow meter

The following diagram shows a meter measurement system with a gas turbine flowmeter installation. Refer to manufacturer guidelines for best practices or recommendations for installing the meter in your system.

Figure 1-10: Meter installation with a turbine flow meter



A. Meter isolation valves
B. Flowmeter
C. Venting valve
D. Flow control needle valve
E. Filter
F. Turbine flowmeter
G. Thermal insulation
H. Vent/vacuum test point

Note
Do not insulate the transmitter (electronics) and maintain a nominal 1-in clearance between the insulation and the transmitter housing.

1.8 Perform a pre-installation meter check

1. Remove the meter from the box.

⚠ **CAUTION!**

Handle the meter with care. Follow all corporate, local, and national safety regulations for lifting and moving the meter.

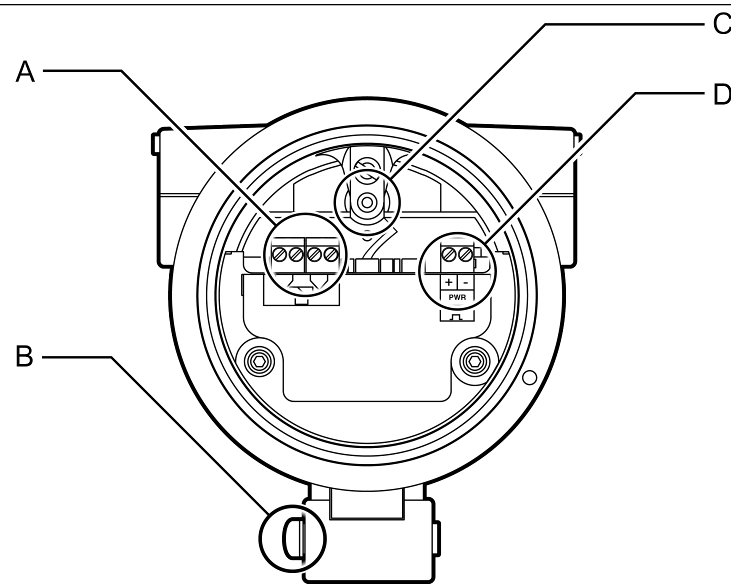
2. Visually inspect the meter for any physical damage.

   If you notice any physical damage to the meter, immediately contact Micro Motion Customer Support at *flow.support@emerson.com*.

3. Position and secure the meter in a vertical position with the flow arrow pointing upward.

4. Connect the power wiring, and power up the meter.

   Remove the back transmitter housing cover to access the PWR terminals.



A. RTD connector block
B. Chassis ground (external)
C. Chassis ground (internal)
D. Power/TPS connector block

5. Perform a verification check.

Related information

Verify the meter

2 Mounting

Topics covered in this chapter:

- *Mount the meter in the pipeline*
- *Connect the gas bypass lines*
- *Rotate the electronics on the meter (optional)*
- *Post-installation check*

2.1 Mount the meter in the pipeline

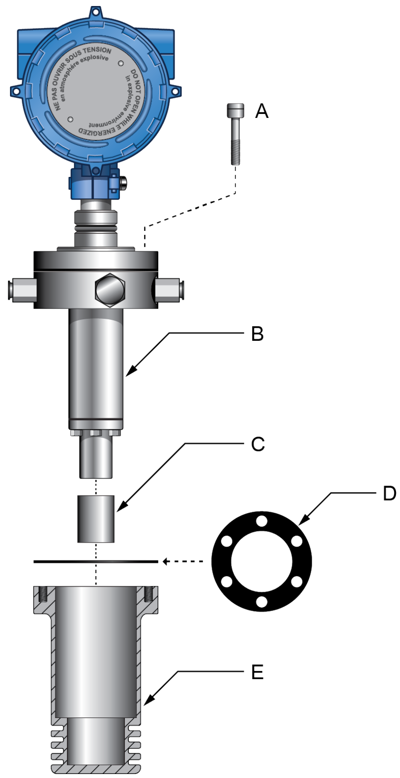
Prerequisites

Important
Micro Motion recommends that you install the meter in a thermo-well pocket to maintain temperature equilibrium between the sample gas and the pipeline gas. For ease of maintenance, you can insert and remove the meter from the pocket as needed. See *Section 1.6* for more information on the pocket installation.

The following parts are recommended for installation in a pipeline.

- Micro Motion ® Gas Density Meter (GDM)
- Thermo-well pocket kit, which includes:
  - Thermo-well pocket
  - Anti-vibration gaskets
  - Aluminum sleeve
  - Silicone fluid
  - Mounting screws

Figure 2-1: Meter installation pieces



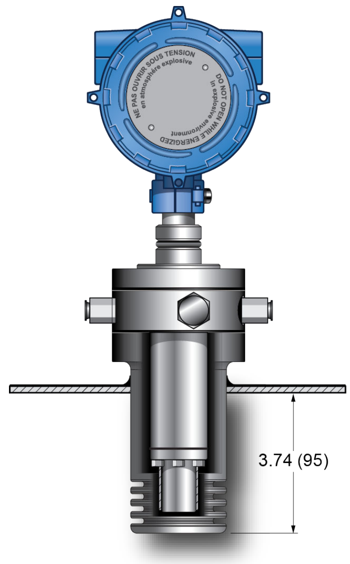
A. *M8 socket-head cap screw (for mounting)*
B. *Meter housing*
C. *Aluminum sleeve (cylinder)*
D. *Anti-vibration gasket*
E. *Thermo-well pocket*

Procedure

1. (Recommended) Install the thermo-well pocket in the aperture created in the pipeline and weld it into place.
2. Pour the supplied silicon fluid (an amount of 20 cm^3) into the interior of the pocket.
3. Place one 5-mm anti-vibration gasket on top of the pocket.

   Align the anti-vibration gasket holes with the bolt holes on the pocket.
4. Place the aluminum sleeve over the end of the meter housing.
5. Insert the meter housing into the pocket.
6. Secure the meter into place, using the supplied mounting screws.

Figure 2-2: Typical installation in pipeline (with thermo-well pocket)



Dimensions are in inches.

2.2 Connect the gas bypass lines

Once you have mounted the meter in the pipeline, you are ready to connect the gas bypass lines.

Adjacent to the gas connection ports, the meter provides two filters to ensure optimal performance of the meter sensing element.

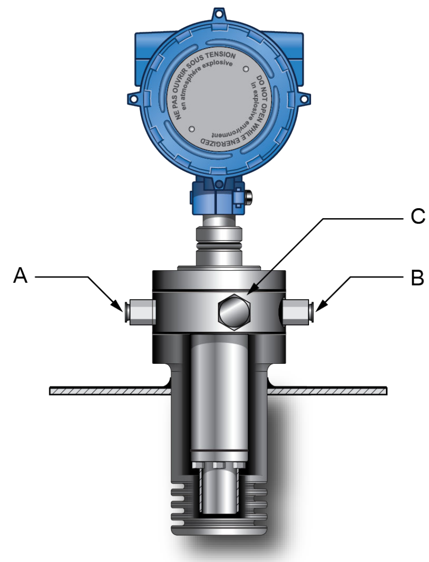
- 2 micron filter for the inlet connection
- 90 micron filter for the outlet connection

The outlet filter provides additional protection if reverse gas flow occurs. This filter arrangement is best suited for density measurement at the process gas return point.

Procedure

Connect the process gas bypass lines to the gas inlet/outlet ports.

Figure 2-3: Gas inlet/outlet connectors



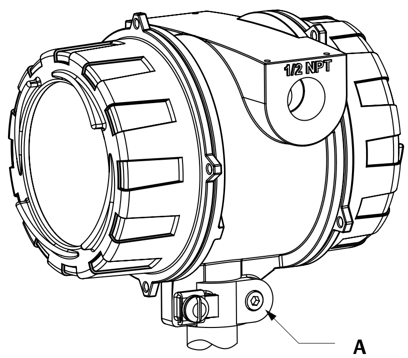
A. Process gas outlet
B. Process gas inlet
C. Filter

2.3 Rotate the electronics on the meter (optional)

You can rotate the transmitter on the meter up to 90°.

1. Using a 4 mm hex key, loosen the cap screw that holds the transmitter in place.

Figure 2-4: Component to secure transmitter in place



A. M5 socket-head cap screw

2. Rotate the transmitter clockwise to the desired orientation up to 90°.
3. Secure the cap screw in place and tighten to 60 lb·in (6.8 N·m).

2.4 Post-installation check

After you complete the installation of the meter, pressure test the meter and associated pipework to 1½ times the maximum operating pressure.

3 Wiring

Topics covered in this chapter:

3.1 Terminals and wiring requirements

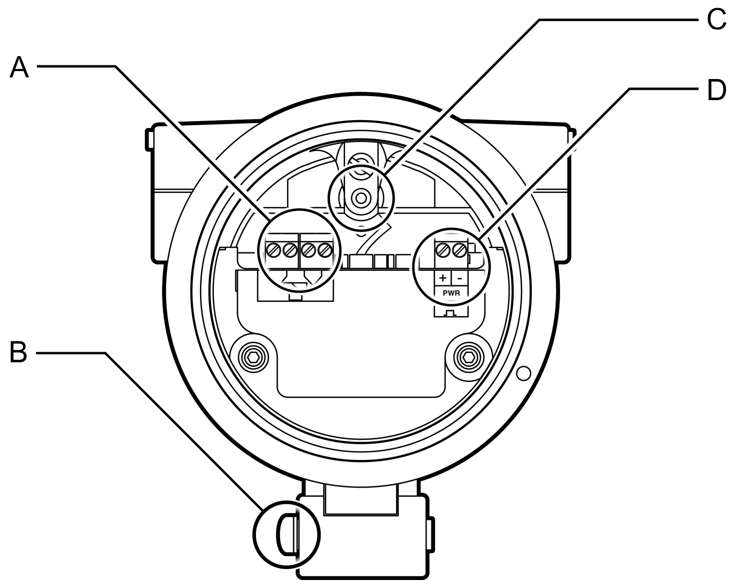
Three pairs of wiring terminals are available for transmitter outputs. One terminal is designated for the 24 VDC Power and Time Period Signal (TPS). The other two terminals are for the internal RTD connection.

The screw connectors for each output terminal accept a maximum wire size of 14 AWG (2.5 mm^2).

Important

Output wiring requirements depend on whether the meter will be installed in a safe area or a hazardous area. It is your responsibility to verify that this installation meets all corporate, local, and national safety requirements and electrical codes.

Figure 3-1: Output wiring terminals



A. RTD connector block
B. Chassis ground (external)
C. Chassis ground (internal)
D. Power/TPS connector block

3.2 Hazardous area output wiring

Micro Motion provides safety barrier installation kits for wiring the meter in a hazardous environment. These kits provide the appropriate barriers depending on the outputs available and approvals required.

Information provided about wiring the safety barriers is intended as an overview. You should wire the meter according to the standards that are applicable at your site.

CAUTION!

- **Meter installation and wiring should be performed by suitably trained personnel only in accordance with the applicable code of practice.**
- **Refer to the hazardous area approvals documentation shipped with your meter. Safety instructions are available on the Micro Motion Product Documentation DVD and accessible on the Micro Motion website at *www.micromotion.com*.**

3.2.1 Hazardous area entity parameters

⚠ **DANGER!**

- **Hazardous voltage can cause severe injury or death. To reduce the risk of hazardous voltage, shut off power before wiring the meter.**
- **Improper wiring in a hazardous environment can cause an explosion. Install the meter only in an area that complies with the hazardous classification tag on the meter.**

Input entity parameters

Table 3-1: Power in/signal output terminals 1, 2

Parameter		
Maximum input voltage	Ui	28 V
Maximum input current	Ii	93 mA
Maximum input power	Pi	0.65 W
Maximum internal capacitance	Ci	0 nF
Maximum internal inductance	Li	0 mH

Table 3-2: RTD terminals 5, 6, 7 and 8

Parameter		
Maximum input voltage	Ui	12 V
Maximum input current	Ii	36 mA
Maximum input power	Pi	0.432 W
Maximum internal capacitance	Ci	0 nF
Maximum internal inductance	Li	0 mH

The voltage, current, and power values are the total available to all four RTD connections.

The total inductance (La) and capacitance (Ca) allowable for the electronics plus the cable connecting it to the Zener barriers must be equal or less than the specified values for the hazardous are classification. Refer to the hazardous area approvals documentation shipped with the meter.

Hazardous area capacitance The capacitance (Ci) of the meter is 0.0 µF. There is no extra capacitance when calculating the maximum capacitance allowable for the connecting cable. Therefore, the cable capacitance may be less or equal to the maximum permitted capacitance (Ca) specified by the safety barrier: `(Ccable ≤ Ca)`

Hazardous area inductance	The inductance (Li) of the meter is 0.0 μH. There is no extra inductance when calculating the maximum inductance allowable for the connecting cable. Therefore, the cable inductance may be less or equal to the maximum permitted inductance (La) specified by the safety barrier: `(Lcable ≤ La)`

3.2.2 Wire all intrinsically-safe installations using Zener safety barriers

Micro Motion provides safety barriers for wiring the meter in a hazardous area. Contact your local sales representative or Micro Motion Customer Support at *flow.support@emerson.com* for more information on ordering the appropriate barriers.

⚠ CAUTION!

- **Install the meter installation and wiring only if you are suitably trained in accordance with the applicable code of practice.**
- **Refer to the hazardous area approvals documentation shipped with your meter. Safety instructions are available on the Micro Motion Product Documentation DVD and accessible on the Micro Motion website at *www.micromotion.com*.**
- **Wire the i.s. barrier earth directly to its own earth bar as described in the safety instructions. If you do not have a good i.s. earth — for example, if you are installing the meter in a dry area, then use galvanic isolators instead of Zener safety barriers. Order galvanic isolators from an external supplier since Micro Motion does not sell them.**

The barriers are used for connecting all of the available meter outputs. Use the following barriers with the designated output.

Output(s)	Barrier	Model code for ordering
Power and TPS	MTL 7787+	BARRIER7787
RTD	MTL 7764+ (two)	BARRIER7764

Procedure

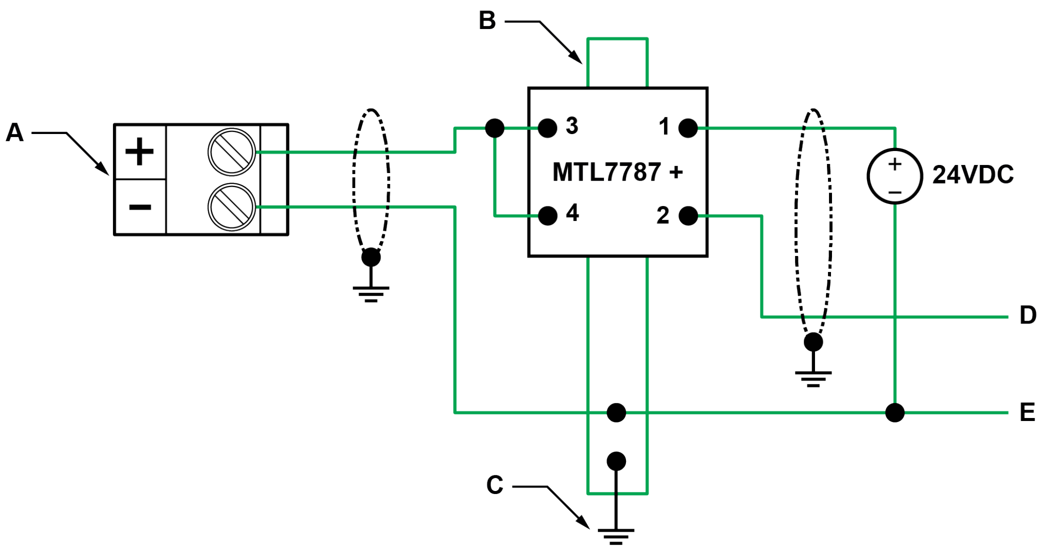
Using the 2-wire wiring diagrams, wire the barriers to the appropriate output terminal and pins.

2-wire wiring diagrams

⚠ CAUTION!

- **To meet the EC Directive for Electromagnetic Compatibility (EMC), use a suitable instrumentation cable to connect the meter. The instrumentation cable should have individual screens, foil or braid over each twisted pair, and an overall screen to cover all cores. Where permissible, connect the overall screen to earth at both ends (360° bonded at both ends). Connect the inner individual screens at only the controller end.**
- **Use metal cable glands where the cables enter the meter amplifier box. Fit unused cable ports with metal blanking plugs.**

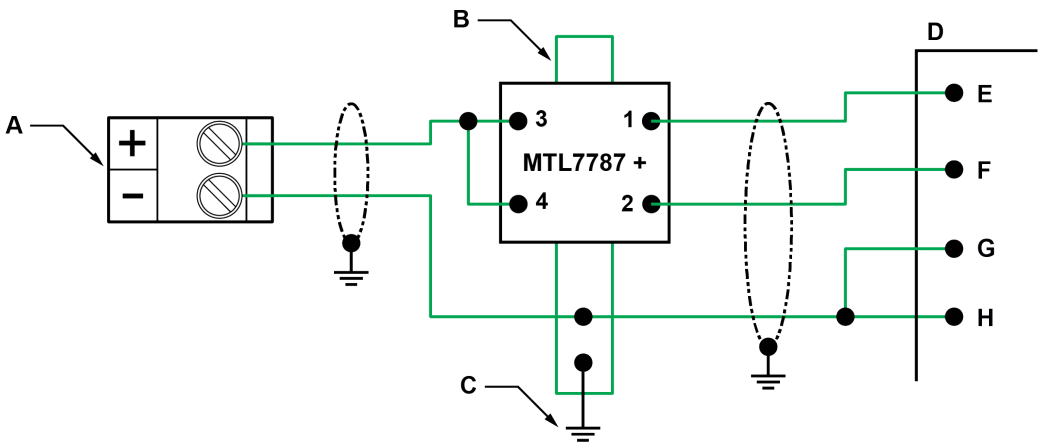
Figure 3-2: Minimum 2-wire barrier connection



A. Power / TPS out
B. IS barrier earth bar
C. IS ground
D. TPS signal +
E. TPS signal –

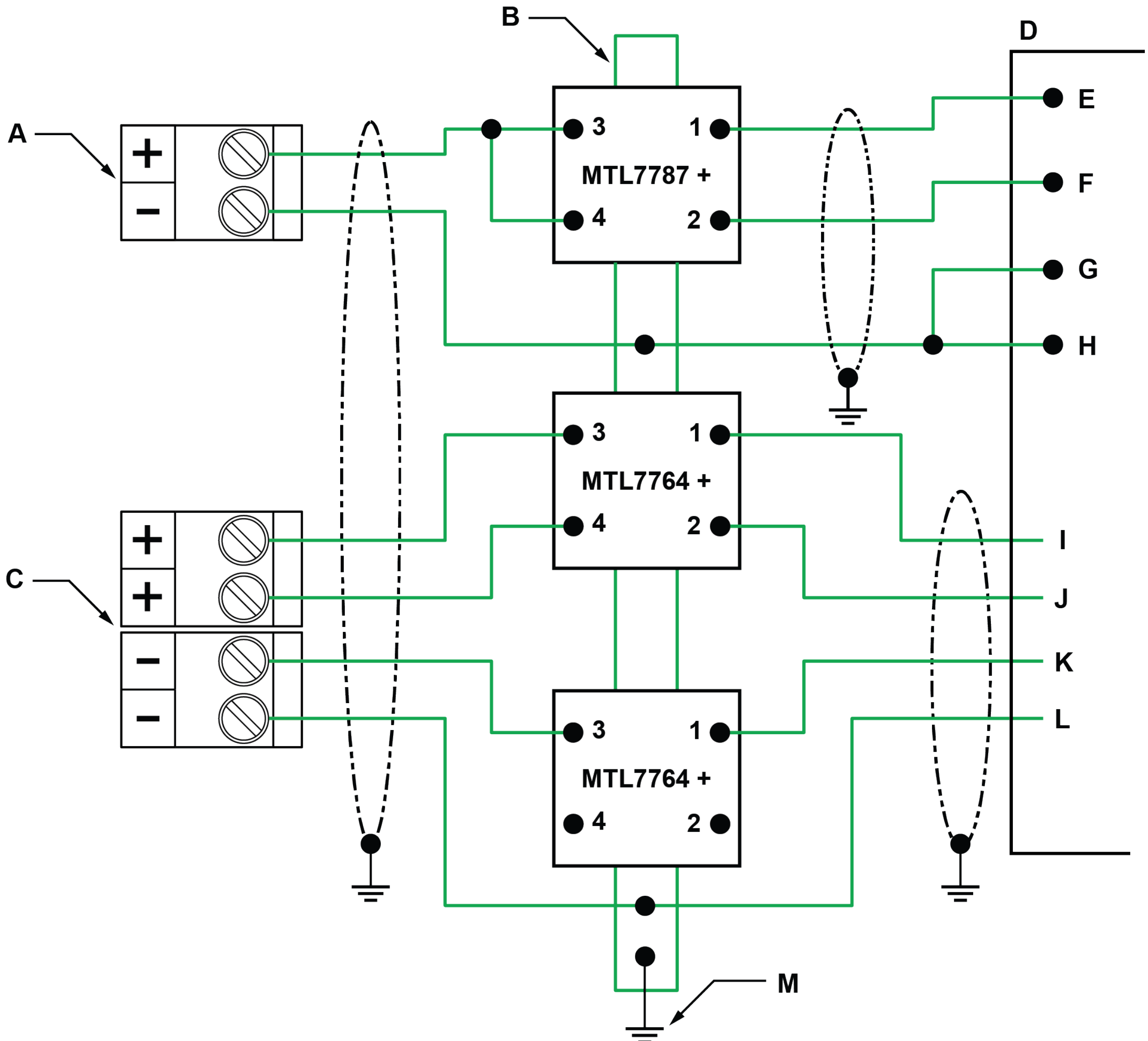
Figure 3-3: 2-wire barrier connection with flow computer / signal converter

The following figure describes a 2-wire barrier connection that is powered through a flow computer / signal converter.



A. Power / TPS out
B. IS barrier earth bar
C. IS ground
D. Flow computer / signal converter
E. Power +
F. TPS signal +
G. Power –
H. TPS signal –

Figure 3-4: 2-wire barrier connection plus RTD barrier connection



A. *Power / TPS out*
B. *IS barrier earth bar*
C. *RTD*
D. *Flow computer / signal converter*
E. *Power +*
F. *TPS signal +*
G. *Power –*
H. *TPS signal –*
I. *RTD supply +*
J. *RTD signal +*
K. *RTD signal –*
L. *RTD supply –*

M. IS ground

Note

If required, use two separate screened cables via two separate cable glands, one for the power and one for the RTD. However, Micro Motion recommends that you use a single cable to facilitate a good seal through a single cable entry gland.

3.3 Wire to galvanic isolators

In hazardous area installations where there is no proper I.S. ground available, such as dry locations, Micro Motion recommends that you use galvanic isolators instead of Zener barriers. Galvanic isolators convert the signal differently from Zenier barriers when passing the signal across an isolation gap.

Prerequisites

- Galvanic isolators (MTL5532 and MTL5575)

  Note

  Micro Motion does not sell galvanic isolators. Obtain the isolators from an external supplier.

- A Zener diode

  The MTL5532 pulse isolator has a trigger level connected to the power + pin that is not connected to the power – pin. Therefore, a Zener diode ensures a reliable switching point.
- A pull-up resistor

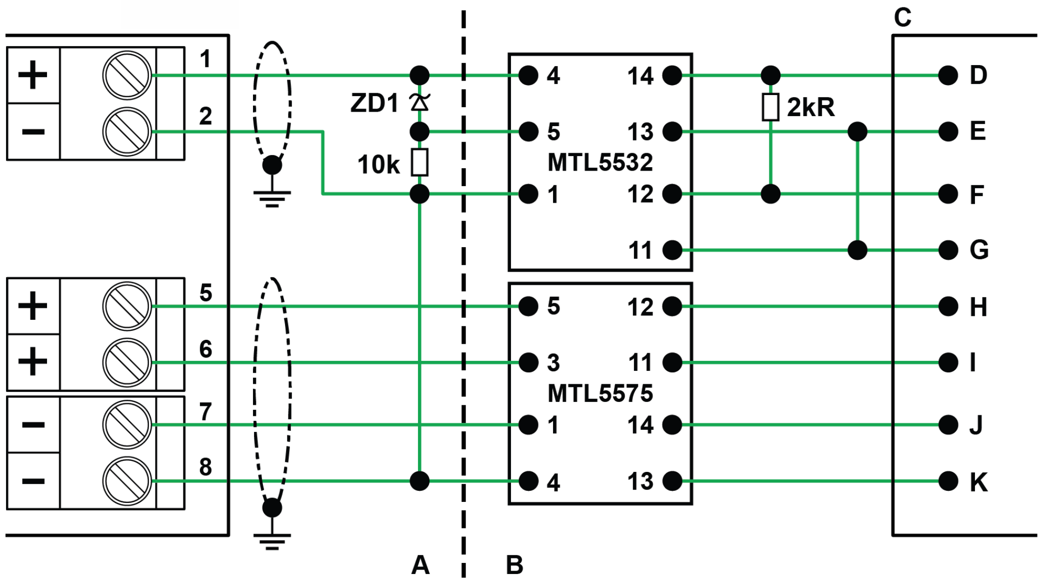
  The resistor is required because the output is passive.
- A 20 V to 35 V supply on the safe area side.

The MTL5575 is used specifically for the 4-wire RTD, and converts the RTD voltage and current into a 4-20mA loop signal on the safe area side. The isolator requires 20 V to 35 V DC energization from the safe area side that also supplies the active output of the 4-20 mA loop.

Procedure

Using the 2-wire galvanic isolator wiring diagram, wire the isolators to the appropriate output terminal and pins.

Figure 3-5: 2-wire galvanic isolator connections



A. *Hazardous area*
B. *Safe area*
C. *Flow computer / signal converter*
D. *Power +*
E. *Power –*
F. *TPS signal +*
G. *TPS signal –*
H. *Analog i/p +*
I. *Analog i/p –*
J. *Analog pwr +*
K. *Analog pwr –*

Note

Connect the screens to the chassis if no better earth is available.

Isolator trip level switch setting	*Zener voltage*
12 V	*6.2 V*
6 V	*13 V*
3 V	*16 V*

4 Grounding

The meter must be grounded according to the standards that are applicable at the site. The customer is responsible for knowing and complying with all applicable standards.

Prerequisites

Micro Motion suggests the following guides for grounding practices:

- In Europe, EN 60079-14 is applicable to most installations, in particular Sections 12.2.2.3 and 12.2.2.4.
- In the U.S.A. and Canada, ISA 12.06.01 Part 1 provides examples with associated applications and requirements.
- For IECEx installations, IEC 60079-14 is applicable.

If no external standards are applicable, follow these guidelines to ground the meter:

- Use copper wire, 18 AWG (0.75 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.

⚠ CAUTION!

Ground the meter to earth, or follow ground network requirements for the facility. Improper grounding can cause measurement error.

Procedure

Check the joints in the pipeline.

- If the joints in the pipeline are ground-bonded, the sensor is automatically grounded and no further action is necessary (unless required by local code).
- If the joints in the pipeline are not grounded, connect a ground wire to the grounding screw located on the sensor electronics.

5 Verifying

Topics covered in this chapter:

- *Verify the meter*
- *Meter health tests*

5.1 Verify the meter

Use the following procedure after installation to verify that your meter is working correctly.

1. Check for a series resistance of approximately 300 Ω either as a load resistor or the Zener barrier.
2. Measure the current consumption and the supply voltage at the meter terminals.
3. Verify that the measured values match the values in the following table.

Power supply voltage (safe area)	GDM terminal voltage (hazardous area)	Supply current
22.8 VDC	18.4 ± 0.5 VDC	13.6 mA ± 0.7 mA
24.0 VDC	20.0 ± 0.5 VDC	12.4 mA ± 0.7 mA
28.0 VDC	24.9 ± 0.5 VDC	9.8 mA ± 0.7 mA

5.2 Meter health tests

To verify the health of the GDM, perform one or more of the following tests. Use your local corporate procedures to perform these tests.

Ambient air test

To validate the health of the GDM under ambient conditions, compare the values in the calibration certificate against the time period output signal that corresponds to the density of the ambient air.

The accuracy of this test depends on the density span of the GDM, and known conditions of the ambient air. The following table shows the typical change in air density with ambient conditions.

Table 5-1: Air density changes

Air pressure (mm Hg)	Density at 10 °C (kg/m^3	Density at 20 °C (kg/m^3
790	1.294	1.247
760	1.224	1.199
730	1.195	1.152

Atmospheric pressure test

An atmospheric pressure test measures the density of the gas inside the GDM at atmospheric conditions. This test can be used to compare against a known reference density value. You can isolate the GDM from the gas pipeline by closing the shut off valves. Slowly vent the gas in the GDM to atmosphere. If the initial gas pressure is high, vent slowly in order to prevent cooling due to gas expansion.

Vacuum test point

A vacuum test point checks the zero density point.

This is the most accurate of the three tests, and is run by isolating the GDM from the gas pipeline and then evacuating the sensing chamber using a conventional vacuum pump (less than 1 mmHg). The advantage of using this test is that the GDM temperature and the gas composition are of little significance.

Note

The zero density test result will not give a zero indication when using the calibration factors from the GDM. Run the test against the “Verification Time Period (Vacuum) @ 20 °C” listed on the calibration certificate.

The vacuum test does not check instrument sensitivity. It is not possible to change the instrument sensitivity without also changing its zero point unless the spoolbody has aged badly or been replaced.

An agreement of ±0.015µs, (equivalent to 0.007 kg/m^3) taking into account a temperature effect of 0.02µs per °C, should be considered a “pass” result, and indicates the GDM is in good health. If the GDM does not meet this criteria during a vacuum test, please contact your local Emerson or Micro Motion Sales and Technical Support team for further guidance. The sound velocity of the gas will also change the instrument sensitivity, but this is accounted for when generating an instrument calibration certification and will only become apparent when changing from one gas type to another.

Appendix A
Sample calibration certificate

Your meter was shipped with a calibration certificate. The calibration certificate describes the calibrations and configurations that were performed or applied at the factory.

Figure A-1: Sample calibration certificate: 2-wire TPS GDM

Micro Motion

CALIBRATION CERTIFICATE

GDM GAS DENSITY METER
MODEL CODE : GDM2AAAF3Z0EZZZ

SERIAL NO	:	15009640
CAL DATE	:	21-Oct-2016
PRESSURE TEST	:	375 Bar
AMPLIFIER NO	:	25816002
CYLINDER NO	:	8543
SPOOLBODY NO	:	15009640

DENSITY CALIBRATION COEFFICIENTS @ 20°C :

K0 = -1.110381E+02
K1 = -8.735985E-03
K2 = 4.571798E-04

DENSITY, D = K0 + K1*TP + K2*TP²

CALIBRATED RANGE = 9 - 90 kg/m³

TEMPERATURE COMPENSATION DATA :
Coefficients between 20°C and 70°C
K18 = -1.400589E-05
K19 = 7.973284E-04

Dt = D(1 + K18(t-20)) + K19(t-20)

VELOCITY OF SOUND COMPENSATION DATA :

K3 = 3.493814E+02
K4 = 5.662276E+01

Dvos = Dt(1 + (K3/(Dt + K4)) x (0.00236 - (G/(t + 273))))

DENSITY CALIBRATION DATA :

DENSITY (kg/m³)	TIME PERIOD, TP (µs)	% Error
0.00	502.346	Reference Point
8.00	519.912	0.01
15.00	534.704	0.02
20.00	545.015	0.01
30.00	565.051	0.01
40.00	584.411	0.00
50.00	603.137	0.01
60.00	621.265	0.01
70.00	638.896	0.01
80.00	656.041	0.00
90.00	672.771	0.02

KNOWN DENSITY VERIFICATION DATA :

VERIFICATION TIME PERIOD (VACUUM) @ 20°C = 502.3459 µs

where
D = Density (uncompensated)
Dt = Density (temperature compensated)
Dvos = Density (temp and velocity of sound compensated)
TP = Time period (µs)
t = Temperature (°C)
G = Gas Specific Gravity / Ratio of Specific Heats

FINAL TEST & INSPECTION
Passed

Reference V3.0.7.0 / C1.0.5.0

All equipment used for this calibration is calibrated at routine intervals against standards that are traceable to National Standards of Measurement.

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