Installation and Operation Guide
20019058, Rev AB
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Micro Motion® Fuel Consumption Application for Transmitters

MICRO MOTION™

EMERSON™

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 EU declaration of conformity for directives that apply to this product. The EU declaration of conformity, with all applicable European directives, and the complete ATEX Installation Drawings and Instructions are available on the internet at *www.emerson.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.emerson.com*.

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.emerson.com*.

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.emerson.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*

Telephone:

North and South America		**Europe and Middle East**		**Asia Pacific**	
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
		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		

Contents

1 Before you begin

Topics covered in this chapter:

1.1 About this manual

This manual provides information to help you install, configure, commission, use, maintain, and troubleshoot the Micro Motion Fuel consumption application for the Model 2700 transmitters .

Important

This manual assumes that the following conditions apply:

- The transmitter has been installed correctly and completely according to the instructions in the transmitter installation manual
- The installation complies with all applicable safety requirements
- The user is trained in local and corporate safety standards

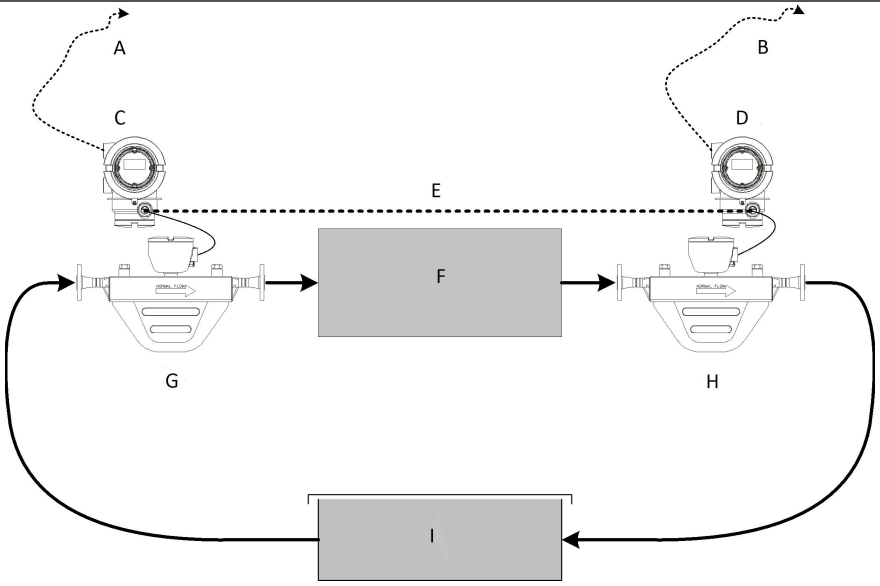
Note

The special update rate cannot be used with the Fuel consumption application.

1.2 Fuel consumption application architecture

The Fuel consumption application is designed to support fuel efficiency and fuel management projects and practices by providing accurate real-time fuel consumption data.

- Automatically calculates the fluid consumption between two Coriolis flow sensors, typically for recirculating fuel consumption loops
- Eliminates the need to program an external calculation system and minimizes common inaccuracies related to time lag, sampling issues and cumulative errors
- Uses a proprietary algorithm that adapts to the unique calibration of each pair of Coriolis flow sensors



A. Standard process variables
B. Standard and differential process variables
C. Supply transmitter
D. Return transmitter
E. HART cable
F. Engine
G. Supply sensor
H. Return sensor
I. Storage tank

1.3 Processing and reported process variables

The Fuel consumption application, residing on the return transmitter, polls the supply transmitter for status, mass flow rate, mass total, temperature, and density. After adjusting for time lag, the Fuel consumption application calculates and reports "differential" process variables.

- Mass flow rate → Differential mass flow rate
- Mass total → Differential mass total
- Mass inventory → Differential mass inventory

Table 1-1: Differential process variables

Differential process variable	Definition
Differential mass flow rate, or "fuel consumption rate"	Flow rate of supply meter minus flow rate of return meter
Differential mass total	Total fuel consumption since last totalizers reset, derived from the differential mass flow rate
Differential mass inventory	Total fuel consumption since last inventory reset, derived from the differential mass flow rate

Note

The totalizers and inventories of the supply meter are not linked to the totalizers and inventories of the return meter. If you reset the mass total or mass inventory on the return meter, the differential mass total and differential mass inventory values are reset automatically. If you plan to use differential data only, you do not need to reset totalizers or inventories on the supply meter.

1.4 Installation checklist

- ☐ Two F-Series sensors
  - ☐ Integral core processor (either standard or enhanced)
  - ☐ One sensor to be configured as the supply sensor
  - ☐ One sensor to be configured as the return sensor
- ☐ Two Model 2700 transmitters with analog outputs

Note

This feature is available on Model 2500 Transmitters, Model 2700 Transmitters with Configurable Inputs/Outputs, and Model 2700 Transmitters with Intrinsically Safe Outputs.

  - ☐ 4-wire remote mount
  - ☐ Two transmitters with the Fuel consumption application installed
    - ☐ 250– Ω resistor installed between Terminal 1 and Terminal 2 (by the sensor you configure as the supply sensor)

Note

Through a configuration option, you must select which is the supply meter and which is the return meter.

Basic meter verification is available on all transmitters. If the enhanced core processor is used, the Smart Meter Verification application can be purchased and used. It is compatible with the Fuel consumption application.

1.5 Special features

Differential flow and totals

The Model 2700 Fuel consumption application automatically calculates fuel consumed by an engine or boiler. The application compares the difference in flow rates between the Supply and Return sensors. A differential total is calculated based upon the differential flow rate.

Differential zero

Whenever the differential flow rate falls to zero, the Fuel consumption application automatically calculates a differential rolling zero for maximum accuracy. This differential zero is applied only to the differential mass flow rate. The differential zero eliminates the need for field zeros at either meter, and improves accuracy by minimizing the effect of any temperature differential.

Differential low flow cutoff

Differential low flow cutoff (DLFC) is used to eliminate “no-flow noise” from the Fuel consumption measurement. Even when the engine is off, the meters will register flow at slightly different rates. This noise causes the system to erroneously register fuel consumption. The DLFC is a limit below where the differential flow rate is not reported.

The DLFC varies according to sensor size, and is set at the factory. The default value is appropriate for most installations. Consult Emerson before changing the DLFC.

Differential damping

The differential damping parameter is used to reduce process noise during flow conditions. It operates like the standard flow damping parameter, but is applied to the differential mass flow rate rather than the actual mass flow rate.

The differential damping value is set at the factory. The default value is appropriate for most installations. Consult Emerson before changing the differential damping value, or the flow damping value on the Model 2700 transmitter.

1.5.1 Using the Fuel consumption application

When the Fuel consumption application is enabled, you can:

- Read the differential process variables using ProLink III, digital communications, or the meter display
- Map differential process variables to the mA or frequency outputs
- Configure the Modbus output to report the differential process variables

The fuel consumption data can then be used in external fuel efficiency and fuel management programs.

1.6 Best practices

Vibration

Vibration levels vary dramatically based on location and installation methods. The F-Series sensors meet IEC 68.2.6, which is a rigorous endurance sweep vibration test. The test certifies the sensors for 50 sweep cycles, from 5 to 2000 Hz at 1.0 g. Ensure that these limits are not exceeded. The following list is a basic set of installation guidelines designed to minimize vibration.

- Ensure that the sensors are installed in fuel lines that are not directly connected to the engine, or to any component that is mounted directly to the engine.
- Ensure that the fuel lines upstream and downstream from the sensors are rigidly and securely mounted to a vessel bulkhead or some other secure, non-vibrating structure.
- Install vibration isolators to prevent excess vibration from traveling down the fuel line. Vibration isolators are usually a flexible coupling between the rigid fuel line and the engine.
- Stabilize the fuel line immediately around the sensors by installing multiple rigid durable mounts.

Implement additional vibration-management methods as appropriate. Consult a vibration specialist if needed.

Bypass line

If the engine to be monitored is critical to vessel operation, Emerson recommends installing a bypass line around the sensors. This prevents engine stoppage in the case of any severe meter failure or sensor blockage.

Additionally, a bypass line is useful if meter maintenance is required. This allows the engine to continue operation during maintenance.

Fluid chiller

If your installation includes a fluid chiller, install the return sensor downstream from the fluid chiller. This minimizes the temperature differential between the sensors and improves measurement accuracy.

2 Install

Topics covered in this chapter:

2.1 Mount the sensors and transmitters

Use the appropriate documentation for mounting details.

1. Mount the sensors in the pipeline.
   - Install the supply sensor upstream from the engine, and install the return sensor downstream from the engine.
   - Ensure that the sensors are oriented so that the Flow Direction arrow matches the flow through the pipeline.
2. Mount the transmitters.

2.2 Wire the sensors and transmitters

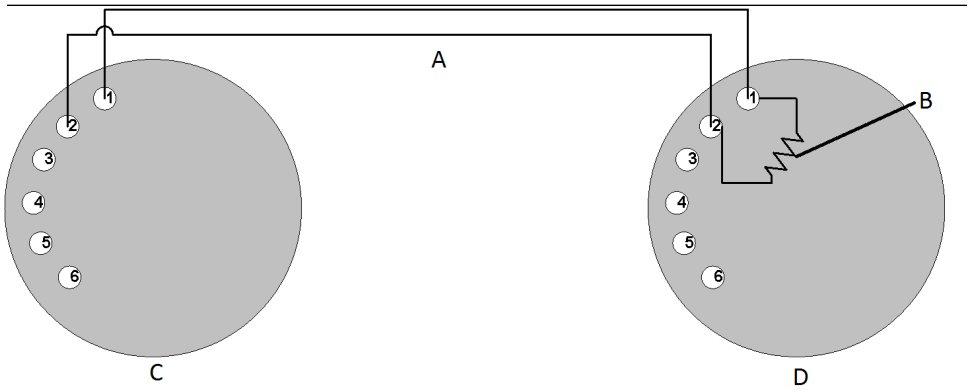
Use the appropriate documentation for wiring details.

1. Wire the transmitters to the sensors.
2. Wire transmitter outputs as desired.
3. Wire power to the transmitters.

2.3 Install the HART cable between the transmitters

Use the appropriate documentation for wiring details.

1. Obtain a standard shielded twisted-pair cable for the HART connection.
2. Remove the transmitter end-caps.
3. On the supply transmitter, pass the cable through the I/O conduit opening and connect it to Terminals 1 and 2. Refer to the image.
4. On the Return transmitter, pass the HART cable through the I/O conduit opening and connect it to Terminals 1 and 2, matching the colors at the Supply transmitter. For example, ensure that the red wire is used to connect Terminal 1 to Terminal 1, and the blue wire is used to connect Terminal 2 to terminal 2.



A. HART cable
B. 250-U resistor (factory-installed)
C. Supply transmitter
D. Return transmitter

5. Replace the transmitter end-caps.
6. Use standard methods to seal the I/O conduit openings.

3 Configure and commission

Topics covered in this chapter:

3.1 Basic configuration for the Fuel consumption application

Use the appropriate documentation to perform basic configuration on the Fuel consumption application when used with Model 2700 transmitters.

1. Apply power to both transmitters.
2. At the supply transmitter:
   a. Connect to the transmitter using ProLink III.
   b. Choose **ProLink** > **Configuration** > **Fuel Consumption**.
   c. Enter Supply Transmitter in the **Fuel Consumption Type** field and click **OK**.
   d. Enter SUPPLY in the **Tag** field and click **OK**.
   e. Disconnect.
3. At the return transmitter:
   a. Connect to the transmitter using ProLink III.
   b. Choose **ProLink** > **Configuration** > **Fuel Consumption**.
   c. Enter Return Transmitter in the **Fuel Consumption Type** field and click **Apply**.
   d. Enter RETURN in the **Tag** field and click **Apply**.
   e. From the **Fuel Consumption** page, open the **Polling** field and set the following values:
      a. **Source = Poll for external value**
      b. **Polling Slot = Slot 1**
      c. **Polling Control 1 = Poll as Primary**
      d. **External Device Tag 1 = Supply**
      e. Click **OK** and disconnect.

Note

The Fuel consumption application is pre-programmed to poll the Supply transmitter for status, mass flow rate, mass total, temperature, and density. Do not specify a process variable here.

4. From the **Fuel Consumption** page, select Differential Mass Flow (**DFlow**).

Note
You can also assign Differential Mass Inventory to the display.

5. Click **OK** and disconnect.

3.2 Configure and calibration limitations

Configuration limitations

Do not change the following parameters:

- Flow damping on the transmitters

  The value set at the factory (0.8) is optimized for the Fuel consumption application.
- Low flow cutoff at the transmitters
- Meter factor for mass flow

Calibration limitations

Do not perform any of the following calibrations:

- Zero calibration
- Density calibration
- Temperature calibration

Optional configuration

Configure other parameters as desired for either the supply transmitter or the return transmitter.

For example, you can:

- Set the mass flow measurement units as desired. Be sure to use the same unit of measure at both the supply and the return transmitter.
- Configure the transmitter outputs as desired.
- Configure additional display variables and display precision.
- Enable AutoScroll.
- Set up digital communications with a fuel management system, for example, data collection tools, or a flow computer.

For more information and advice about optional configuration, refer to *marinetechsupport@emerson.com* and *flow.support@emerson.com*.

4 Operation

Topics covered in this chapter:

- *Reading process data*
- *Differential process variables*

Whenever the Fuel consumption application is configured as the return meter, the transmitters will report differential values for the three process variables in *Table 4-1*. No additional steps are required.

4.1 Reading process data

Use ProLink III or a Modbus connection to read standard and differential process variables. The following table lists the relevant process variables by Modbus register.

Table 4-1: Process variables included in the Model 2700 transmitters Fuel consumption application

Read/write	Type	Address	Description
Read	Float	4438-4439	Differential mass flow rate
Read	Float	4440-4441	Differential mass total
Read	Float	4444-4445	Differential mass inventory

4.2 Differential process variables

If one of the process variables listed in *Section 4.1* is assigned to an output:

- When the Fuel consumption application is enabled, the output reports the differential process variable.
- When the Fuel consumption application is disabled, the output reports the standard process variable.

5 Troubleshoot

Topics covered in this chapter:

Use this section to troubleshoot issues specific to the Fuel consumption application.

Note

Basic meter verification is available on all meters and can be performed at any time. If the Smart Meter Verification application was ordered with your transmitter, all meter verification options are available. For more information , refer to your transmitter configuration manual.

Note

If you are having problems with output function, perform loop testing and mA output trimming procedures as needed.

5.1 Differential measurement is negative

Ensure that both sensors are mounted so that the Flow Direction arrow matches the actual flow direction. If not, using ProLink III, change the Flow Direction parameter from Forward Only to Negate Forward.

5.2 Status alarm A115

1. Ensure that the HART cable between the two transmitters is installed correctly, and that the cable is intact.
2. Ensure that polling is configured correctly on the Return transmitter. Polling Variable 1 must be enabled, and it must be polling the Supply transmitter.

5.3 Engine is on but no differential measurement

1. Ensure that the Fuel consumption application is enabled.
2. If the problem does not clear, the Differential Low Flow Cutoff (DLFC) may be too high. Contact Emerson.

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