

Coriolis Flow Meter with Micro Motion™ 4200 2-Wire Transmitters

Safety Manual for Safety Instrumented Systems (SIS)



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.

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 following are available: the EU Declaration of Conformity, with all applicable European directives, and the complete ATEX installation drawings and instructions. In addition, the IECEx installation instructions for installations outside of the European Union and the CSA installation instructions for installations in North America are available at Emerson.com or through your local Micro Motion support center.

Other information

Troubleshooting information can be found in the appropriate Configuration and Use Manual. Product data sheets and manuals are available from the Micro Motion website at Emerson.com.

Return policy

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

Return procedures and forms are available on our web support site at Emerson.com, or by calling the Micro Motion Customer Service department.

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1 Before you begin

1.1 About this document

This document provides information about how to install, commission, and proof test a 4200 transmitter to comply with Safety Instrumented Systems (SIS) requirements.

Important

This manual assumes that:

- The transmitter has been installed correctly and completely according to the instructions in the transmitter installation manual.
 - Users understand basic transmitter and sensor installation, configuration, and maintenance concepts and procedures.
-

1.2 Hazard messages

This document uses the following criteria for hazard messages based on ANSI standards Z535.6-2011 (R2017).



DANGER

Serious injury or death will occur if a hazardous situation is not avoided.



WARNING

Serious injury or death could occur if a hazardous situation is not avoided.



CAUTION

Minor or moderate injury will or could occur if a hazardous situation is not avoided.

NOTICE

Data loss, property damage, hardware damage, or software damage can occur if a situation is not avoided. There is no credible risk of physical injury.

Physical access



WARNING

Unauthorized personnel can potentially cause significant damage and/or misconfiguration of end users' equipment. Protect against all intentional or unintentional unauthorized use.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access to protect users' assets. This is true for all systems used within the facility.

1.3 Related documentation

See the approval documentation shipped with the transmitter, or download the appropriate documentation from [Emerson.com](https://www.emerson.com):

- [Micro Motion 4200 2-Wire Transmitter Installation Manual](#)
- [Micro Motion 4200 Transmitters Configuration and Use Manual](#)
- [Micro Motion 4200 2-Wire Transmitter Product Data Sheet](#)
- [ProLink III with ProcessViz Software User Manual](#)
- Sensor installation manual, which is shipped with the sensor
- FMEDA report for Coriolis Flow Meter with 4200 Transmitter, prepared for Emerson by exida.com LLC

2 Installation and commissioning

Use this section to install and commission a Coriolis flow meter with a 4200 transmitter with SIS features.

IEC 61508 relevant requirements

The 4200 is certified per the relevant requirements of IEC 61508.

Systematic capability	Safety Integrity Level (SIL) 3 capable
Random capability	<ul style="list-style-type: none"> Type B element SIL 2 capable @ HFT=0 (single meter) SIL 3 capable @ HFT=1 (multiple meters)

Failure rates according to IEC 61508 in FIT⁽¹⁾

Device	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}
4200 integral mount transmitter and 4200C 9-wire remote mount transmitter	0	152	2130	76

SIS-certified versions

Emerson maintains an SIS-compliant modification process. Changes made after initial release do not affect overall SIS certification.

Version information is available from the display at **About** → **Versions**.

Table 2-1: SIS-certified versions for a 4200

Device	Display tag	Version
4200 firmware	Core Processor	1.0 and later
4200 hardware	Transmitter hardware	0 and later

On SIS applications for a 4200 with intrinsically safe outputs, the Channel A mA Output is used for the safety critical variable (mass flow, volume flow, or density). The SIS features are enabled through licensing. While other output channels can be licensed, they are outside the scope of SIS usage.

Safety precautions

Prior to making any changes to the 4200, such as changing the configuration, upgrading the firmware, replacing the transmitter hardware or sensor:

- Take appropriate action to avoid a false trip by electronically bypassing the safety Programmable Logic Controller (PLC).

Important

Ensure alternate means are in place to maintain the process in a safe state.

- Prior to placing the meter online and removing the bypass from the safety PLC, verify the transmitter configuration and all safety parameters.

(1) FIT = 1 failure / 10⁹ hours

2.1 Set up the 4200

Use this section to make sure the 4200 is installed and configured for SIS applications.

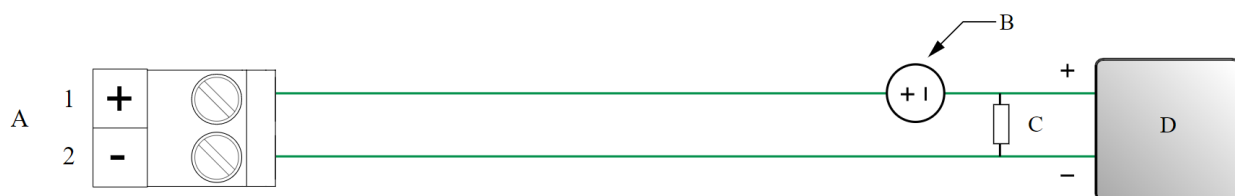
You can use ProLink™ III, the display, or a field communicator to verify, or if needed, configure these settings. For more information, see the [Micro Motion 4200 Transmitters Configuration and Use Manual](#).

The sensor does not require special installation in addition to the standard installation procedures in the sensor installation manual.

Procedure

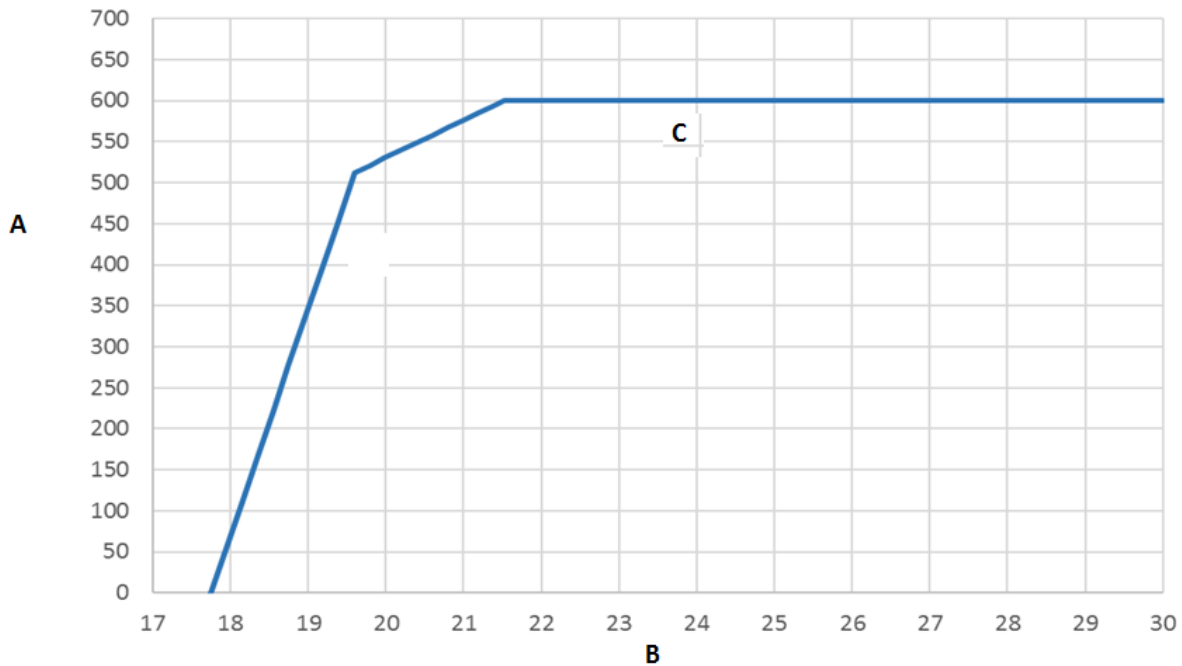
1. Use the [Micro Motion 4200 Transmitters Configuration and Use Manual](#) to mount the transmitter and install the sensor wiring.
2. Wire the Channel A passive (external) power to the appropriate output terminal and pins.

Figure 2-1: Channel A mA/HART® output wiring (externally powered)



- A. mA HART output
- B. Supply Voltage (see the following figure.)
- C. Loop Resistance (see the following figure for maximum loop resistance.)
- D. Input device

Figure 2-2: Channel A output supply voltage and loop resistance



- A. Loop resistance (Ohms)
- B. Supply voltage (Vs)
- C. Maximum Loop Resistance (Ohms)

3. Verify that the following features are licensed: SIL and ChA.

Note

If SIL is not licensed, see [Install the SIL license key](#).

4. Verify all safety parameters:

- a) Verify that all appropriate flow and density calibration parameters are set (FCF, K1, K2, D1, D2, and DT).
- b) Verify that the Lower Range Value (LRV) and the Upper Range Value (URV) for Channel A mA Output 1 is configured.
- c) Verify that the appropriate measurement units are configured (mass flow, volume flow, density, and temperature).
- d) Verify that the HART Primary Variable (PV) is assigned to Channel A mA Output.
- e) Verify that the appropriate low flow cutoff parameter is configured.
- f) Verify that the appropriate damping values are configured - such as flow, density, temperature, and added damping.
- g) Verify that the mA Output Fault Action is set to Upscale or Downscale.

2.2 Diagnostics for a 4200

The SIL license enables a mA Output to internal mA Readback comparison diagnostic.

If the difference between the programmed mA Output and the actual internal mA Readback exceeds 0.2 mA, an `Electronics Failed` alert becomes active and all analog outputs will be turned off (outputs all to 3.6 mA fault state) within 5 minutes. The alert shows up as:

On the display as:	Verification of mA01 Failed
On ProLink™ III as:	mA0 Verification Failed

After 5 minutes, the outputs are turned back on, and the mA Output to internal mA Readback comparison check is performed again. If the alert was due to a transient condition, since cleared, the transmitter will resume normal operations. If the alert was due to a component failure, the alert will remain active and the outputs will turn off again.

Note

The mA Output to mA Readback comparison diagnostic is disabled for the first 5 minutes after the transmitter is powered up. This allows time to verify correct wiring and operation of the ChA mA Output with internal mA Readback.

2.2.1 Enable or disable software write protection

When enabled, write protection prevents changes to the transmitter configuration. You can perform all other functions, and you can view the transmitter configuration parameters.

Write protection is enabled by toggling the physical write protect (dip) switch (identified by a lock icon) located behind the display module.

Figure 2-3: Write protect (dip) switch behind the display module

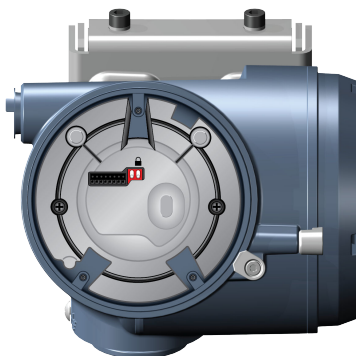


Figure 2-4: Write protect on the display (upper right corner)



You cannot change write protection from any host configuration tool.

Note

Write protecting the transmitter primarily prevents accidental changes to configuration, not intentional changes. Any user who can change the switch can disable write protection.

2.3 Update the firmware

If you need to update the firmware, contact customer service.

2.4 Replace equipment

If you need to replace hardware, purchase all spare parts from Emerson.

You cannot use user-supplied components on any Emerson printed circuit assemblies.

Procedure

1. Replace the hardware.
2. Verify the transmitter configuration and all safety parameters.
3. Enable write protection.

2.5 Install the SIL license key

Use this procedure if the license key was purchased after shipment.

Important

If you added a SIL license key to a meter that was originally installed for a different function, note that the expected meter lifetime starts at the time of the original installation and commissioning. Meter lifetime and all SIS calculations should include total meter operational time. Always perform [Proof tests](#) before placing the meter online.

Note

Smart Meter Verification is the only add on option that is compatible with the SIL license.

Prerequisites

Obtain the SIL license key from your local service office by requesting the model code: LICKEY4200SI.

Note

After you obtain the license key, manually enter the license key using the display, ProLink™ III, or a field communicator.

Procedure

1. To install a license using the display:
 - a) Choose **Menu** → **Service Tools** → **License Manager**.
Depending on the type of license key provided, choose either **Enter Permanent License** or **Enter Trial License**.
 - b) Use the arrow keys to enter the license key.
2. To install a license using ProLink III:
 - a) Open the license file.
 - b) Choose **Device Tools** → **Configuration** → **Feature License**.
 - c) Copy the license from the file to the appropriate **License Key** field.
 - d) Select **Apply**.
3. To install a license using a field communicator:
 - a) Choose **Overview** → **Device Information** → **Licenses** → **Upload License**.
 - b) Select the license feature to upload, Permanent Feature or Temporary Feature.
 - c) Write the license key.
4. Use the following menu structures to verify that the license has been installed.

Display	Menu → Service Tools → License Manager
ProLink III	Device Tools → Configuration → Feature License
Field communicator	Overview → Device Information → Licenses

The features supported by the new license are displayed.

3 Proof tests

Proof tests detect transmitter failures that are not detected by transmitter diagnostics — mainly undetected failures that prevent the Safety Instrumented Function from performing correctly.

The frequency of proof testing, or the proof test interval, is determined by reliability calculations for your transmitter model's Safety Instrumented Functions.

The proof tests must be performed at least as frequently as specified in the calculation to maintain the required Safety Instrumented Function integrity.

3.1 Proof test options

The Coriolis flow meter with a 4200 transmitter has two proof tests you can use to detect failures.

Proof tests can be performed using the display, ProLink™ III, or a field communicator.

Table 3-1: Proof test options

Proof test	Description	DU failure detection
1	<ul style="list-style-type: none"> • mA Output min-to-max test • Checking for alarms • Checking configuration • Smart Meter Verification (SMV) • Verification of onboard temperature measurement • Test for soft errors in RAM 	46%
1 and 2	<ul style="list-style-type: none"> • mA Output min-to-max test • Checking for alarms • Checking configuration • SMV • Verification of onboard temperature measurement • Test for soft errors in RAM • Calibration against primary standard 	99%

3.2 Proof test 1

Proof test 1 is recommended for a SIL-approved 4200 with either the integrated core processor or the enhanced core processor.

Prerequisites

This procedure assumes that you are familiar with plant procedures.

Procedure

1. Take appropriate action to avoid a false trip by electronically bypassing the safety Programmable Logic Controller (PLC).

Important

Ensure alternate means are in place to maintain the process in a safe state.

Example

Use Management of Change procedures to override the safety PLC function.

2. Disable write-protection.
3. Using an external device such as a fluke meter, test the mA Output by setting each mA Output to the Fault Level specified for Upscale. Verify that the mA current reaches that value, or use the default value (22mA).
This step tests for compliance voltage problems, such as low voltage on the loop power supply, or increased wiring resistance.
4. Using an external device such as a fluke meter, test the mA Output by setting each mA Output to the Fault Level specified for Downscale – 3.6 mA. Verify that the mA current reaches that value, or use the default value: 4-20mA.
This step tests for possible failures related to quiescent current.
5. Read the sensor temperature value. Compare it to the process temperature, and verify that this is a reasonable reading.
6. Power cycle the transmitter. Wait approximately 30 seconds for the flow meter to return to normal operation.
7. Run an SMV test by using the [Micro Motion 4200 Transmitters Configuration and Use Manual](#).
8. Verify that the transmitter does not display alarms or warnings.
9. Verify all safety-critical configuration parameters.
10. Restore the loop to full operation.
11. Enable write-protection.
12. Remove the bypass from the safety PLC, or otherwise restore normal operation.
13. Document the results of this proof test as part of your plant safety management procedures.

3.3 Proof test 2

Proof test 2 is recommended for all SIL-approved 4200s.

Procedure

Perform a full calibration against a primary standard.

Note

The meter verification procedure and the onboard temperature verification tests are incorporated into a full calibration.

4 Operating constraints

4.1 Reliability data

The 4200 transmitter:

- Has a specified safety deviation of 2%. Internal component failures are listed in the device failure rate if they will cause an error of 2% or greater.
- Reports an internal failure within 5 minutes of fault occurrence – worst case scenario.
- Generates a valid signal within 30 seconds of a power-on startup.

FMEDA report

The Failure Mode, Effects, and Diagnostics Analysis (FMEDA) report is used to calculate the failure rate. A FMEDA report for a 4200 transmitter contains:

- All failure rates and failure modes
- Common cause factors for applications with redundant devices that should be included in reliability calculations
- The expected lifetime of your flow meter and transmitter, as the reliability calculations are valid only for the lifetime of the equipment; useful flow meter lifetime is 10 years — see the FMEDA report for details

Obtain a FMEDA report from [Emerson.com](https://www.emerson.com).

Environmental and application limits

See the [Micro Motion 4200 2-Wire Transmitter Product Data Sheet](#) for environmental and application limits.

Using the 4200 transmitter outside environmental or application limits invalidates the reliability data in the FMEDA report.

4.2 Report failures

If you have detected any failures that compromise safety, contact our Customer Service team either through e-mail (flowsupport@emerson.com) or by phone: 1-800-522-6277. Customer service is available 24 hours a day, seven days a week.



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