Product Manual

Model 5300 Transmitter with FOUNDATION™ fieldbus

NOTICE

Read this manual before working with the product. For optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

⚠CAUTION

The products described in this document are NOT designed for nuclear-qualified applications.

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Fisher-Rosemount nuclear-qualified products, contact your local Fisher-Rosemount Sales Representative.

Micro Motion Model 5300 Transmitter with FOUNDATION fieldbus may be protected by one or more U.S. Patents Pending. Other foreign patents pending.

Model 5300 transmitters satisfy all obligations coming from legislation to harmonize product requirements in the European Union.

FOUNDATION

The Model 5300 transmitter has passed a series of tests conducted by the Fieldbus Foundation at its independent laboratory, and is interoperable with other registered instruments regardless of manufacturer.

PlantWeb

Model 5300 transmitters support PlantWeb field-based architecture, a scalable way to use open and interoperable devices and systems to build process solutions of the future.

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IMPORTANT

Procedures and instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). **Refer to the safety messages, listed throughout this manual, before performing an operation preceded by this symbol.**

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Section 1 Introduction

USING THIS MANUAL

This manual is intended to assist in installing, operating, and maintaining the Micro Motion® Model 5300 Transmitter with FOUNDATION™ fieldbus, for use with Micro Motion Coriolis flow sensors. For more information about the sensor, see the sensor instruction manual.

This manual does not explain how to use FOUNDATION fieldbus or any specific fieldbus host. Users should have at least a basic knowledge of FOUNDATION fieldbus before using this or any fieldbus product.

Section 2: Installation

provides mechanical, electrical, and environmental considerations and installation instructions (see page 2-1).

Section 3: Operation

summarizes basic operation, software functionality, and configuration (see page 3-1).

Section 4: Troubleshooting

provides troubleshooting instructions for diagnosing messages (see page 4-1).

Appendix A: Specifications

provides functional, performance, and physical specification data (see page A-1).

Appendix B: Transducer Block Data

provides transducer blocks data for the Model 5300 (see page B-1).

SAFETY MESSAGES

Procedures and instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to safety messages before performing an operation preceded by this symbol.

DEFINITIONS

The term *sensor* refers to a Micro Motion sensor only. The term *flowmeter* refers to the Model 5300 transmitter and the sensor installed as a flowmetering system.

GETTING ACQUAINTED WITH THE TRANSMITTER

Model 5300

The Model 5300 transmitter has passed a series of tests conducted by the Fieldbus Foundation at its independent laboratory. The Model 5300 is registered with the Fieldbus Foundation, and is interoperable with other registered instruments regardless of manufacturer.

The Model 5300 transmitter can be integrally mounted to a Micro Motion BASIS® sensor, or remotely mounted from an ELITE®, BASIS, D, DT, or DL sensor.

FOUNDATION fieldbus Technology

FOUNDATION fieldbus is an all digital, serial, two-way communication system that interconnects field equipment such as sensors, actuators, and controllers. Fieldbus is a Local Area Network (LAN) for instruments used in both process and manufacturing automation with built-in capability to distribute the control application across the network. The fieldbus environment is the base level group of digital networks in the hierarchy of plant networks.

The fieldbus retains the desirable features of the 4–20 mA analog system, including a standardized physical interface to the wire, bus powered devices on a single wire, and intrinsic safety options, and enables additional capabilities, such as:

- Increased capabilities due to full digital communications
- Reduced wiring and wire terminations due to multiple devices on one set of wires
- Increased selection of suppliers due to interoperability
- Reduced loading on control room equipment with the distribution of some control and input/output functions to field devices

Section 2 Installation

OVERVIEW

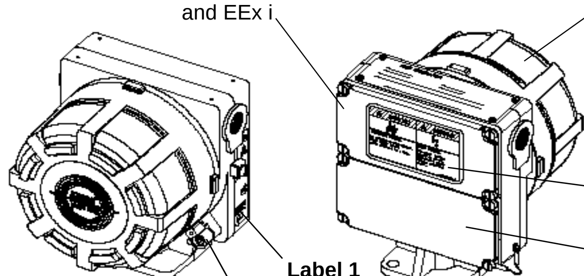
This section contains transmitter-specific installation information. For fieldbus-related installation information, refer to Fisher-Rosemount's **Site Planning Guide for Fieldbus PlantWeb™ Builder** if you are using the DeltaV™ Fieldbus Configuration Tool.

GENERAL CONSIDERATIONS

Before getting started, read the following general information regarding transmitter installation.

Safety, Reliability, and Accessibility

> ⚠ **WARNING**
>
> **Explosion hazard**
>
> **Improper installation in a hazardous area could cause an explosion.**
>
> Install the transmitter in an environment that is compatible with the hazardous area specified on the approvals label, "Label 2," below.
>
> Do not remove EEx e (field wiring) or EEx d (circuit board) compartment covers in an explosive atmosphere within 2 minutes after power is disconnected. Read labels that point to compartment covers before accessing wiring or circuit board compartments.



> - "Label 1" indicates the sensor wiring compartment is rated EEx i (intrinsically safe), and may be opened at any time.
> - "Label 2" indicates the field wiring compartment is rated EEx e (increased safety), and should remain closed when power is on.
> - The circuit board compartment is rated EEx d (flameproof), and should remain closed at all times after the transmitter has been installed. Normally, there is no reason for the user to access this compartment. If the transmitter is approved by CENELEC as flameproof, the compartment has a lockout device, shown above. The lockout device must be loosened and rotated before the compartment cover can be unscrewed.

Orientation and Mounting

Orient the Model 5300 so wiring compartments and conduit openings are easily accessible.

- If the Model 5300 will be integrally mounted to a BASIS sensor, see the sensor instruction manual for information about flowmeter mounting and location.
- If the Model 5300 will be remotely mounted, use the supplied bolt assemblies to attach the Model 5300 to the mounting bracket. Attach the bracket to a rigid, stable surface or instrument pole that will not transfer excessive vibration into the transmitter. See page 2-3 for more information about remote mounting.
- To rotate the Model 5300 on the sensor manifold or the mounting bracket, use the four supplied mounting bolt assemblies. Each bolt assembly includes one M8 bolt, one lock washer, and one flat washer. Remove the bolt assemblies, rotate the Model 5300, then reinstall the bolt assemblies to 12 ft-lb (16 Nm) of torque.

Temperature Limits

Install the Model 5300 in an area where ambient temperature will remain between –22 and 131°F (–30 and 55°C).

Visibility of Tags

To ensure personal and system safety, all tags attached to the Model 5300 housing must remain visible. Clean or replace them as often as necessary.

REMOTELY MOUNTING THE MODEL 5300

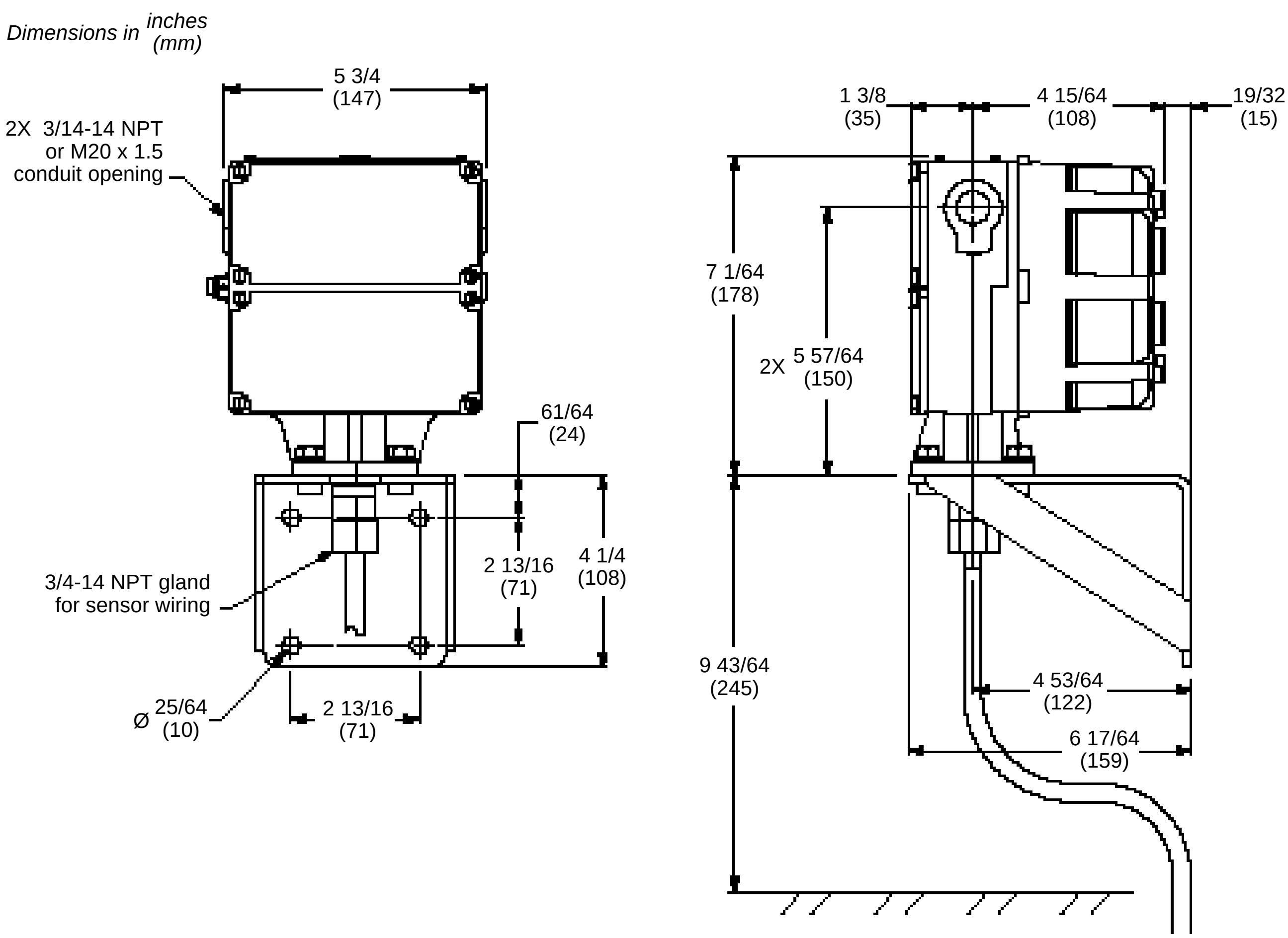
The instructions in this section apply only if the Model 5300 will be remotely mounted from the sensor. If the Model 5300 is integrally mounted to a BASIS sensor, proceed to page 2-10.

Mounting Procedure

To install the Model 5300 remotely from the sensor, follow these steps:

1. Choose the proper location. Install the Model 5300 according to the conditions stated in “General Considerations” on page 2-1.
   - For mounting dimensions, see Figure 2-1, below.
   - Total length of cable from sensor to Model 5300 must not exceed 1000 feet (300 meters).
   - For bend radii of cables, see Tables 2-1, 2-2, and 2-3, on pages 2-5 and 2-6.
2. If the Model 5300 was ordered for remote-mounting from the sensor, the transmitter is shipped with an L-shaped mounting bracket. Attach the bracket to a rigid, stable surface or instrument pole that will not transfer excessive vibration into the transmitter. Mount the Model 5300 to the bracket.
   - For flat-surface mounting, see Figure 2-2a on page 2-4.
   - For pole mounting, see Figure 2-2b on page 2-4.

FIGURE 2-1. Installation Dimensions for Remote Mounting.



For minimum bend radius of cable, see Tables 2-1, 2-2, and 2-3, pages 2-5 and 2-6

FIGURE 2-2a. Mounting the Model 5300 to a Wall or Other Surface.

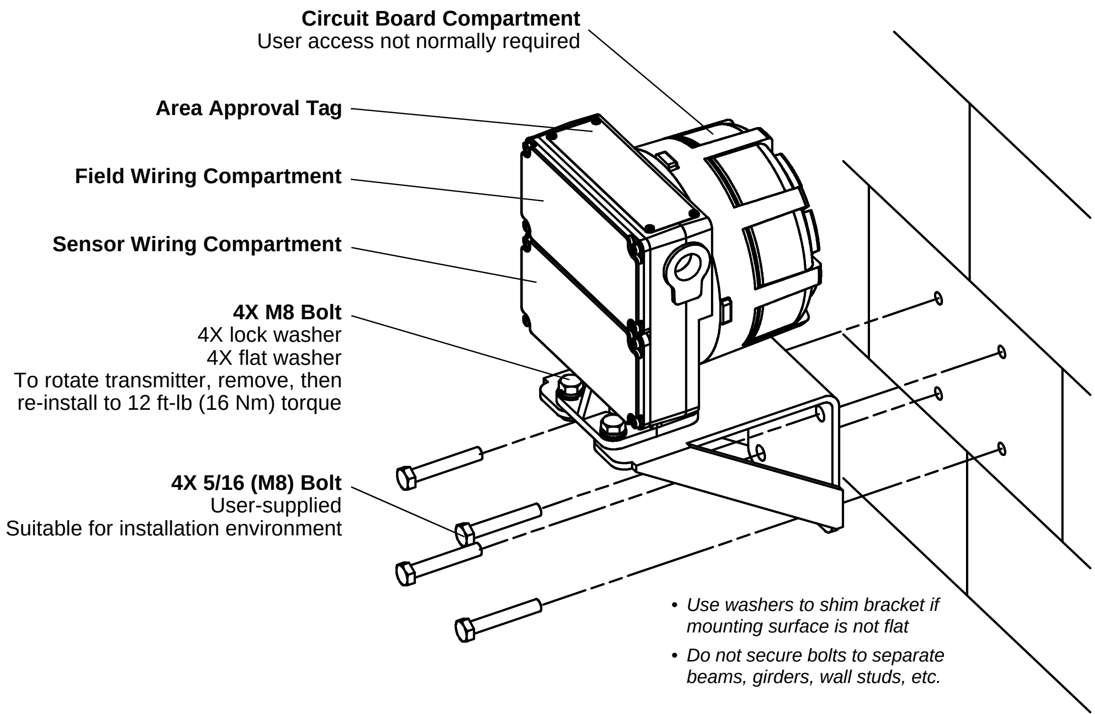


FIGURE 2-2b. Mounting the Model 5300 to an Instrument Pole.

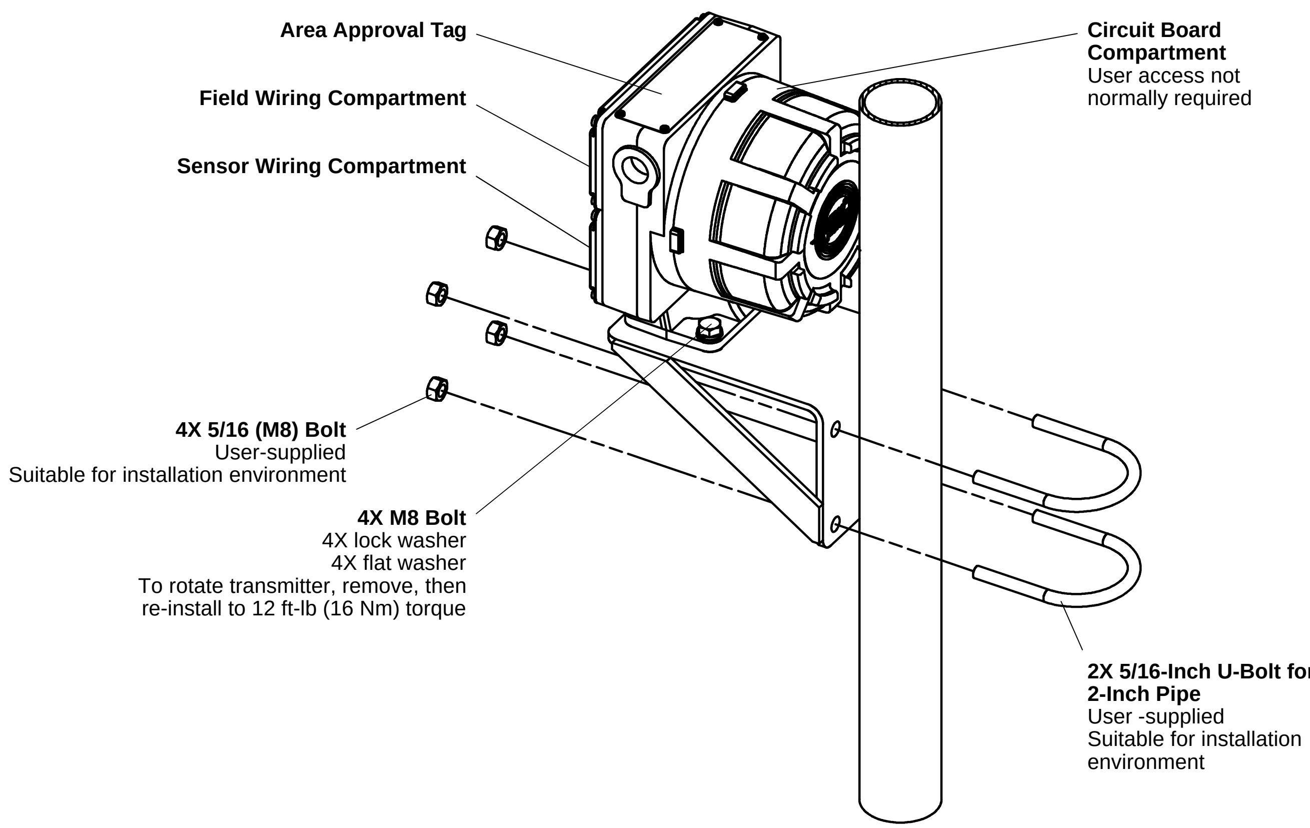


TABLE 2-1. Jacketed Cable.

Jacket Material	Outside Diameter	Minimum Bend Radii	
		Static (No Load) Condition	Under Dynamic Load
PVC	0.415 inch (10 mm)	3 1/8 inch (80 mm)	6 1/4 inch (159 mm)
Teflon® FEP	0.340 inch (9 mm)	2 5/8 inch (67 mm)	5 1/8 inch (131 mm)

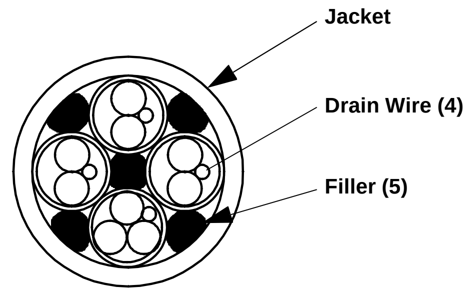


TABLE 2-2. Shielded Cable.

Jacket Material	Outside Diameter	Minimum Bend Radii	
		Static (No Load) Condition	Under Dynamic Load
PVC	0.560 inch (14 mm)	4 1/4 inch (108 mm)	8 1/2 inch (216 mm)
Teflon® FEP	0.425 inch (11 mm)	3 1/4 inch (83 mm)	6 3/8 inch (162 mm)

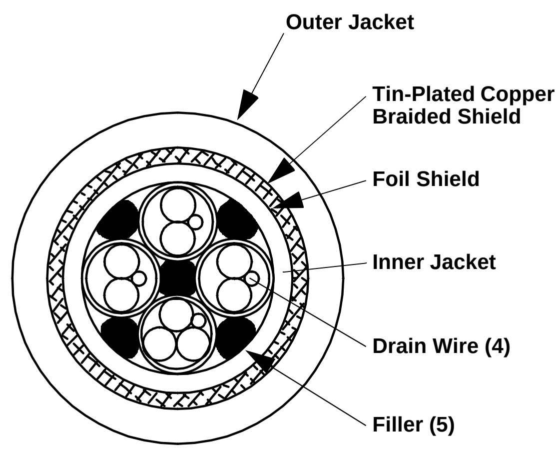


TABLE 2-3. Armored Cable.

Jacket Material	Outside Diameter	Minimum Bend Radii	
		Static (No Load) Condition	Under Dynamic Load
PVC	0.560 inch (14 mm)	4 1/4 inch (108 mm)	8 1/2 inch (216 mm)
Teflon® FEP	0.425 inch (11 mm)	3 1/4 inch (83 mm)	6 3/8 inch (162 mm)

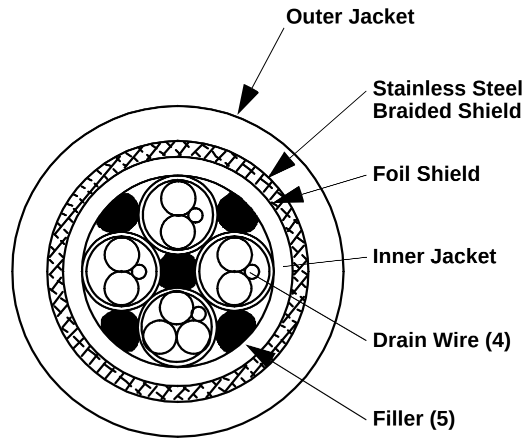


TABLE 2-4. Temperature Ranges for Jacket Material.

Cable Jacket Material	Low Operating Temperature Limit	High Operating Temperature Limit
PVC	–40°F (–40°C)	221°F (105°C)
Teflon® FEP	–76°F (–60°C)	302°F (150°C)

TABLE 2-5. Cable Installation Guidelines.

Installation Conditions	Jacketed Cable	Shielded Cable	Armored Cable
Conduit is used	✓		
Conduit is not used		✓	
Conduit is not used and mechanical protection is required			✓

Sensor Wiring

Connect the Model 5300 to the sensor using Micro Motion-supplied 9-wire jacketed, shielded, or armored cable. Refer to the instructions below and on page 2-8.

General Cable Information

- The remote-mount Model 5300 may be ordered with a length of cable attached to the transmitter by the factory, or with cable not yet attached.
- Jacketed cable is CE-compliant when it is installed inside user- supplied sealed metallic conduit that provides 360° termination shielding for the enclosed cable.
- Shielded and armored cable are CE-compliant when the cable is installed with the factory-supplied cable glands.
- Each cable type is available with a PVC or Teflon® FEP jacket. For temperature ranges of cable jacket materials, see Table 2-4 on page 2-6.
- All cable types are acceptable for cable tray installation.

Guidelines for Cable Glands

- Prepare cable ends and assemble the supplied cable gland according to the instructions that are enclosed with the cable preparation kit.
- Connect the ¾-inch NPT male cable gland to the ¾-inch NPT female conduit opening on the sensor junction box.

⚠CAUTION

Improper installation of cable, cable gland, or conduit could cause inaccurate measurements or flowmeter failure.

Ensure 360° termination shielding for flowmeter wiring. Install the factory-supplied cable gland or user-supplied sealed metallic conduit to the conduit opening on the sensor junction box.

Guidelines for Conduit

- If sealed metallic conduit is installed, it must provide 360° termination shielding for the enclosed flowmeter cable.
- Install a drip leg in conduit to prevent liquids from entering the junction box.
- Connect the sealed end of the conduit to the ¾-inch NPT female conduit opening on the sensor junction box.

Wiring Connections to Sensor

- Insert the ends of the individual wires into the terminals inside the sensor junction box. No bare wires should remain exposed.
- Match the wire colors of the cable with the wire colors at the sensor wiring terminal as described in Table 2-6, below, and Figure 2-3, page 2-9.
- If possible, position the junction box so the conduit entrance points downward to prevent moisture from entering.

⚠CAUTION

Failure to seal sensor junction box or transmitter housing could cause a short circuit, which would result in measurement error or flowmeter failure.

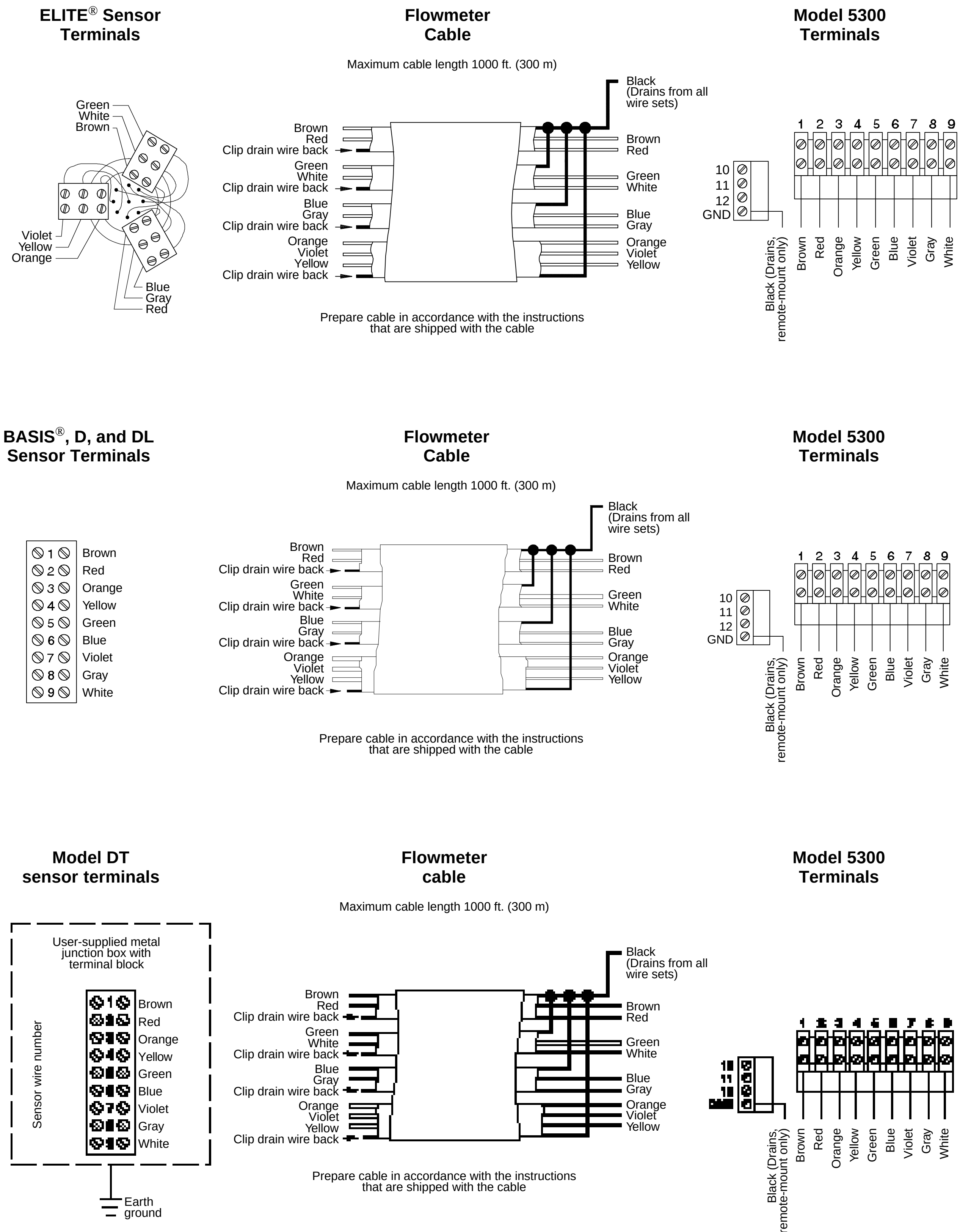
To avoid risk of condensation or excessive moisture entering the junction box or transmitter housing:

- Seal all conduit openings.
- Install drip legs in cable or conduit.
- Ensure integrity of gaskets and O-rings, and fully tighten sensor junction box and transmitter housing covers.

TABLE 2-6. Sensor Terminal Designations.

Terminal Number	Wire Color	Function
1	Brown	Drive +
2	Red	Drive –
3	Orange	Temperature –
4	Yellow	Temperature Lead Length Compensator
5	Green	Left Pickoff +
6	Blue	Right Pickoff +
7	Violet	Temperature +
8	Gray	Right Pickoff –
9	White	Left Pickoff –

FIGURE 2-3. Cable Connections to Sensor and Model 5300 Transmitter.



POWER-SUPPLY AND OUTPUT WIRING

The information in this section applies to power-supply and output wiring. For specific output wiring information — suitable types of wire, maximum lengths, and other concerns specific to the electrical specifications of a fieldbus loop — refer to the **Site Planning Guide for the Fieldbus PlantWeb™ Builder** if you are using the DeltaV™ Fieldbus Configuration Tool.

General Guidelines

The transmitter has a sensor wiring compartment for intrinsically safe sensor wiring, and a field wiring compartment for non-intrinsically safe power-supply wiring and intrinsically safe output wiring. See Figure 2-4.

- Access to the sensor wiring and circuit board compartments is not required during installation of power-supply and output wiring.
- To access power-supply and output wiring, loosen the four captive screws that secure the cover of the field wiring compartment.
- Install cable and wiring so they meet local code requirements.
- The transmitter has two separate ¾-inch NPT or M20 female conduit openings, which must remain sealed to keep the transmitter watertight. See Figure 2-4.

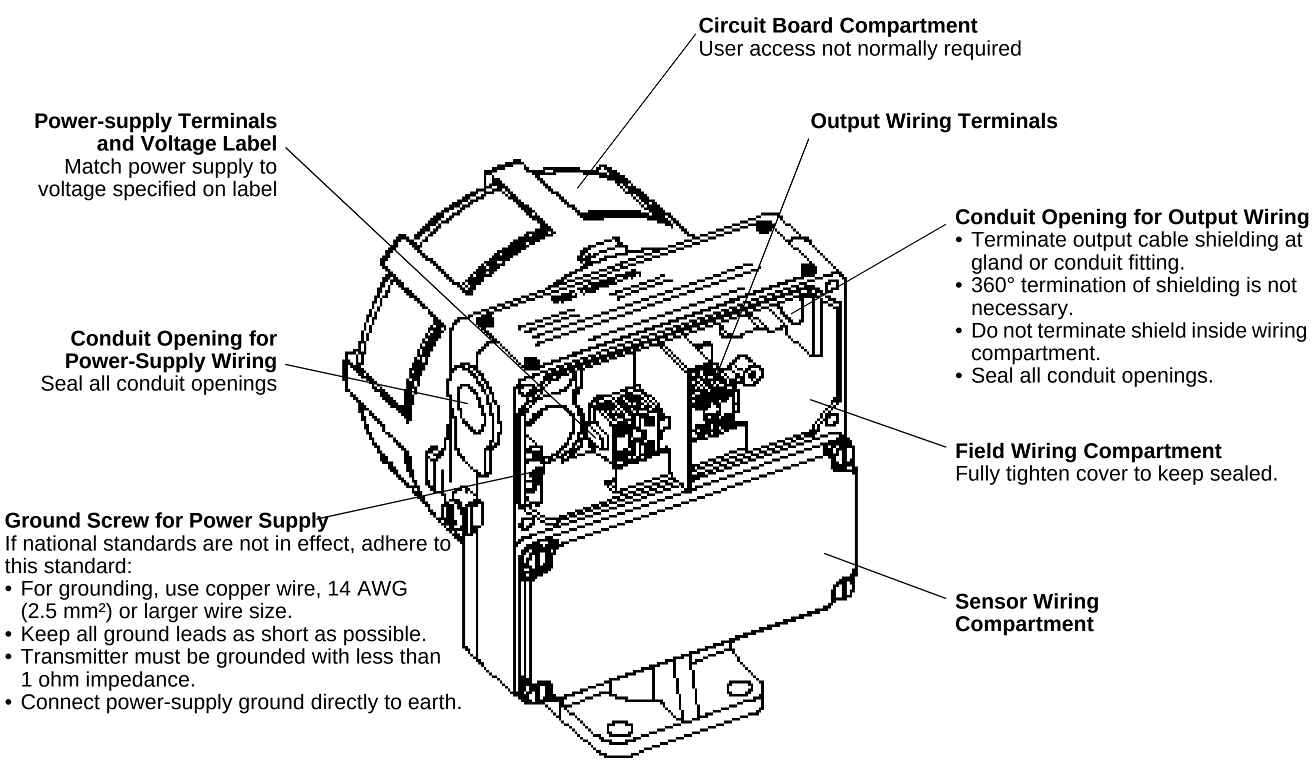
⚠CAUTION

Failure to seal transmitter housing could cause a short circuit, which would result in measurement error or flowmeter failure.

To avoid risk of condensation or excessive moisture entering the transmitter housing:

- Seal all conduit openings.
- Install drip legs in cable or conduit.
- Ensure integrity of gaskets, and fully tighten transmitter housing covers.

FIGURE 2-4. Power-Supply Wiring and Output Terminals.



Power-Supply Wiring

Connect power-supply wiring to the power-supply terminals, indicated in Figure 2-4.

- Wiring terminals accommodate 20 AWG (0.5 mm^2) to 16 AWG (1.5 mm^2) wire.
- If the transmitter has a DC power supply, maximum wire lengths are as follows:

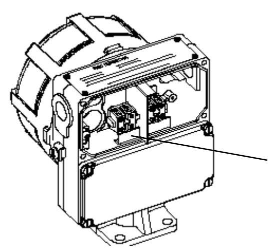
Power-Supply Wire Size	Maximum Length
16 AWG (1.5 mm^2)	1500 feet (450 meters)
18 AWG (0.75 mm^2)	1000 feet (300 meters)
20 AWG (0.5 mm^2)	600 feet (200 meters)

- A switch may be installed in the power-supply line. For compliance with low-voltage directive 73/23/EEC, a switch in close proximity to the transmitter is required.
- Do not install power cable in the same conduit or cable tray as flowmeter cable or output wiring.
- The transmitter must be grounded with a maximum impedance of 1 ohm. Either the internal ground screw or external case ground screw may be used as required by local policy or code.

⚠CAUTION

Incorrect voltage, or installation with power supply on, could cause transmitter damage or failure.

- Shut off power before installing transmitter.
- Match power supply voltage with voltage indicated on label in field wiring compartment.



Output Wiring

Connect output wiring to the Model 5300 output terminals, indicated in Figure 2-4. Wiring terminals accommodate 20 AWG (0.5 mm^2) to 16 AWG (1.5 mm^2) wire.

For information about suitable types of wire, maximum lengths, and other concerns specific to the electrical specifications of a Fieldbus loop, refer to the **Site Planning Guide for the Fieldbus PlantWeb™ Builder.**

Section **3**

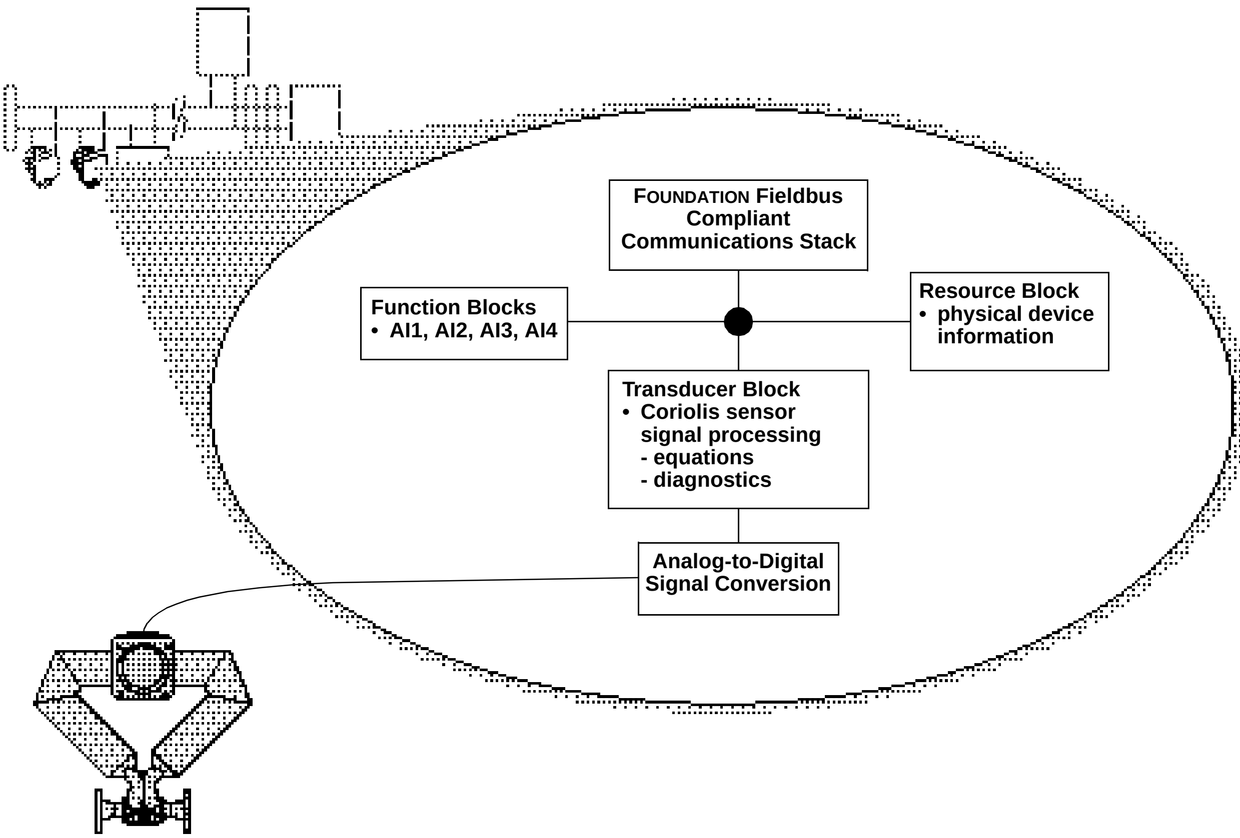
Operation

OVERVIEW

This section covers basic transmitter operation, software functionality, and configuration. The Model 5300 configuration and calibration instructions in this section are general, and are intended for use with any FOUNDATION fieldbus host.

Figure 3-1 illustrates how the Coriolis sensor signal is channelled through the Model 5300 to the control room and the FOUNDATION fieldbus configuration device.

FIGURE 3-1. Functional Block Diagram for the Model 5300 Transmitter with FOUNDATION fieldbus.



SOFTWARE FUNCTIONALITY

The Model 5300 software is designed to permit remote testing and configuration of the transmitter using the Fisher-Rosemount DeltaV™ Fieldbus Configuration Tool, or other FOUNDATION fieldbus compliant host.

Transducer Block

The transducer block contains the actual data from the Coriolis sensor. It includes information about the sensor type, sensor configuration, engineering units, calibration, damping, and diagnostics. Transducer block data are listed in the following sections:

- “Alarm Messages,” starting on page 4-1
- Appendix B – Transducer Blocks, starting on page B-1

Resource Block

The resource block contains physical device information, including available memory, manufacturer identification, type of device, and features.

FOUNDATION fieldbus Function Blocks

The Analog Input (AI) function block processes the measurement and makes it available to other function blocks. It also allows filtering, alarms, and changing engineering units. The four Model 5300 AI blocks process mass flow, volume flow, density, and temperature signals from the Coriolis sensor.

For details on the AI function block, and function blocks for other Fisher-Rosemount fieldbus devices, refer to the FOUNDATION™ Specification Function Block Application Process, Parts 1 and 2, documents FF-890 and FF-891.

Diagnostics and Service

The Model 5300 automatically performs continuous self diagnostics. Using the transducer block, the user can perform on-line testing of the transmitter and sensor. Diagnostics and troubleshooting information are provided in Section 4 – Troubleshooting, page 4-1.

Detailed Setup

Detailed setup is used during the initial setup of a transmitter. It allows the flowmeter to be configured and, if necessary, calibrated. Configuration and calibration are described starting on page 3-4.

FLOWMETER STARTUP

Before using the flowmeter for process measurement, and before calibrating the transmitter, the zeroing procedure must first be performed. Flowmeter zeroing establishes flowmeter response to zero flow and sets a baseline for flow measurement.

> ⚠**CAUTION**
>
> **Failure to zero the flowmeter at initial startup could cause the transmitter to produce inaccurate signals.**
>
> - Zero the flowmeter before putting the flowmeter in operation.
> - Before changing or writing parameters, ensure the transducer block has been placed in “Out of Service” mode.

Zeroing Procedure

1. Prepare the flowmeter for zeroing:
   a. Install the Coriolis sensor according to the sensor instruction manual.
   b. Apply power to the transmitter, then allow it to warm up for at least 30 minutes.
   c. Run the process fluid to be measured through the sensor until the sensor temperature approximates the normal process operating temperature.
2. Close the shutoff valve downstream from the sensor.
3. Fill the sensor **completely** with the process fluid under normal process conditions of temperature, density, pressure, etc., and ensure zero flow through the sensor.

> ⚠**CAUTION**
>
> **Flow through the sensor during flowmeter zeroing will result in an inaccurate zero setting.**
>
> Make sure fluid flow through the sensor is **completely** stopped during flowmeter zeroing.

4. Place the transducer block in “Out of Service” mode.
5. Make sure flow through the sensor is completely stopped, then select Zero Cal from CALMETHODS (see page 3-10) and write to the device.
6. Check the results of the calibration.

Diagnosing Zero Failure

If zeroing fails, a *Failed Cal* message is displayed by the fieldbus host in device description (DD) parameter CORE_STATUS. An error condition could indicate:

- Flow of fluid during flowmeter zeroing;
- Partially empty flow tubes; or
- An improperly mounted sensor.

To clear a zeroing error, use one of the following methods:

- Re-zero the flowmeter after correcting the problem;
- Abort the procedure by cycling power to the transmitter; or
- Use the fieldbus host or configurator to write PROCESSOR to the resource block parameter, RESTART.

CONFIGURING AND CALIBRATING THE MODEL 5300

Calibration accounts for performance variations in individual sensors, transmitters, and peripheral devices. When a transmitter and sensor are ordered together as a Coriolis flowmeter, they are factory calibrated.

NOTE
Certain parameters might require *configuration* even when *calibration* is not necessary.

The configuration and calibration instructions in this section are general, and are intended for use with any FOUNDATION fieldbus host.

- All steps use device description (DD) parameter names, and include the Object Dictionary “index values” for each parameter.
- Refer to the instructions provided with the Fieldbus host for specific information on how to install the Device description provided with this device.

Before changing or writing parameters, ensure the transducer block has been placed in “Out of Service” mode.

Configuration

Configuration parameters for the Model 5300 are contained in the transducer block. Configuration methods and parameters are described in the sections that follow.

Transmitter Tag

Using the fieldbus host or configurator, access TAG_DESC, which is parameter number 2, to establish the transmitter identification tag. Enter any value, up to 32 characters in length, then write to the device.

Coriolis Sensor Data

To enter data that describe the Coriolis sensor model, use the fieldbus host or configurator to access the parameter numbers listed in Table 3-1. Enter the appropriate values from the column titled Range of Values and write to the device.

TABLE 3-1. Sensor Data Parameters.

Variable	Definition	Range of Values	Parameter Number
SENSOR_MATERIAL	Material of the sensor wetted parts. Sensors referred to in product literature as “stainless steel” are 316L.	S_304_SS = 0 S_316L_SS = 1 S_HAST_ALLOY_C = 2 S_INCONEL = 3 S_TANTALUM = 4	27
SENSOR_LINER	Some Model D sensors are available lined with Tefzel® coating. If you are not sure whether your sensor is lined, choose None from the list at right.	None = 0 Tefzel = 1	28
SENSOR_END	Sensor process fittings. A listing of process fittings available for each sensor can be found in the sensor instruction manuals.	S_ANSI_150 = 0 S_ANSI_300 = 1 S_ANSI_600 = 2 S_ANSI_900 = 3 S_Union = 4 S_Sanitary = 5 S_PN_40 = 6 S_JIS_10_K = 7 S_JIS_20_K = 8 S_Special = 9 S_Other	29
SENSOR_MODEL_NUM	The sensor model number can be found on the serial number tag, affixed to the sensor housing.	(From sensor S/N tag)	30
SENSOR_SN	The sensor serial number can be found on the serial number tag, affixed to the sensor housing.	(From sensor S/N tag)	22

Configuring Channels and Units of Measure

The Model 5300 has four AI function blocks and four transducer block channels. Each transducer block channel represents a process variable: mass flow, volume flow, density, or temperature.

Before using the flowmeter for process measurement, each AI function block must be assigned to a transducer block channel. Then, units of measure and range values can be set.

To assign AI channels, configure measurement units, and set range values:

1. Change CHANNEL to a value, 1, 2, 3, or 4. Each value represents a process variable, as listed in Table 3-2.
2. Change L_TYPE to “Direct”.
3. Change XD_SCALE subindex UNITS to the desired units selection. Select the appropriate parameter number from Table 3-3 on page 3-6, based on the process variable assigned in step 1.

   For example, if Channel 3 (Density) was chosen in step 1, select a unit of measure from parameter number 48, DENSITY_UNITS.
4. If scaling is desired, access the subindex EU at 0%, then at 100%, and change the lower and upper range values for the selected engineering unit of measure (EU).

   For example, if the mass flow unit is grams per second (g/s), and the process flow rate stays between 10 and 40 g/s, it might be desirable to scale the output. In this example, enter 10 for EU at 0% and 40 for EU at 100%.

   This step can be performed for mass flow, volume flow, density, or temperature units of measure.
5. Repeat this procedure until all four AI channels have been assigned to an AI function block.

TABLE 3-2. Transducer Block Channels.

Transducer Block Channel Value	Process Variable
1	Mass Flow
2	Temperature
3	Density
4	Volume Flow

TABLE 3-3. Units of Measure for Mass, Volume, Density, and Temperature.

Variable	Definition	Range of Values		Parameter Number
PRIMARY_VALUE_RANGE	Units of measure for mass measurement	g/s = 1318 g/min = 1319 g/hr = 1320 kg/s = 1322 kg/min = 1323 kg/hr = 1324 kg/day = 1325 t/min = 1327 t/h = 1328	t/d = 1329 lb/s = 1330 lb/min = 1331 lb/hr = 1332 lb/day = 1333 Ston/min = 1335 Ston/hr = 1336 Ston/day = 1337 Lton/hr = 1340	15
VOLUME_FLOW_UNITS	Units of measure for volume measurement	m3/s = 1347 m3/min = 1348 m3/hr = 1349 m3/day = 1350 L/s = 1351 L/min = 1352 L/hr = 1353 ML/day = 1354 CFS = 1356 CFM = 1357 CFH = 1358 ft3/day = 1359	gal/s = 1362 GPM = 1363 gal/day = 1365 Mgal/day = 1366 ImpGal/s = 1367 ImpGal/min = 1368 ImpGal/hr = 1369 Impgal/day = 1370 bbl/s = 1371 bbl/min = 1372 bbl/hr = 1373 bbl/day = 1374	51
DENSITY_UNITS	Units of measure for density measurement	kg/m3 = 1097 g/cm3 = 1100 kg/L = 1103 g/ml = 1104 g/L = 1105	lb/in3 = 1106 lb/ft3 = 1107 lb/gal = 1108 Ston/yd3 = 1109	48
SECONDARY_VALUE_UNIT	Units of measure for temperature measurement	Deg K = 1000 Deg C = 1001	Deg F = 1002 Deg R = 1003	33

Flow Direction

The Model 5300 is shipped from the factory configured for “forward” flow. Configuration for forward or reverse flow determines how the output signal will react when fluid flows through the sensor.

- The flow direction arrow on the sensor is considered the “forward” flow direction (when the sensor is installed and wired properly). However, the sensor will measure fluid flow accurately in either direction.
- Table 3-4 lists how the output signal is affected by the flow direction that is selected.

To configure the Model 5300 for forward or reverse flow:

1. Use the fieldbus host or configurator to access FORWARD_FLOW, which is parameter number 39.
2. Enter zero (0) for forward flow, or one (1) for reverse flow, and write to the device.

TABLE 3-4. Effect of Flow Direction on Output.

Fluid Flow Direction	Configured Flow Direction	
	Forward	Reverse
Fluid flowing in *same direction* as flow arrow on sensor	Output increases as flow rate increases	Output decreases as flow rate increases
Fluid flowing in *opposite direction* as flow arrow on sensor	Output decreases as flow rate increases	Output increases as flow rate increases

Internal Damping

Internal damping filters out noise or the effects of rapid changes in the process variable without affecting measurement accuracy.

When a step change at the input occurs, such as a rapid change in flow rate at the Coriolis sensor, the output also changes. This change takes a certain amount of time, depending on many factors (including sensor model and density of the process fluid). The damping value is a filter coefficient, which approximates the time required for the output to achieve 63% of its new value.

To configure internal damping values for the transmitter:

1. Select an output from the fieldbus function block.
2. Use the fieldbus host or configurator to access the parameter numbers listed in Table 3-5.
3. Enter an appropriate value from the column titled Range of Values and write to the device.
4. Repeat this procedure for each output that is being used.

TABLE 3-5. Filter Coefficients for Internal Damping on Process Variables.

Variable	Definition	Range of Values		Parameter Number
MASS_FLOW_DAMPING	Damping coefficient for (mass and volume) flow measurement	0 sec = 0 0.1 sec = 1 0.3 sec = 2 0.8 sec = 3 1.7 sec = 4 3.5 sec = 5 7 sec = 6	15 sec = 7 30 sec = 8 60 sec = 9 120 sec = 10 240 sec = 11 480 sec = 12	62
DENSITY_DAMPING	Damping coefficient for density measurement	0.3 sec = 0 0.8 sec = 1 1.7 sec = 2 3.5 sec = 3 7 sec = 4 15 sec = 5	30 sec = 6 60 sec = 7 120 sec = 8 240 sec = 9 480 sec = 10	63
TEMP_DAMPING	Damping coefficient for temperature measurement	0 sec = 0 0.3 sec = 1 0.8 sec = 2 3.5 sec = 3 7 sec = 4	15 sec = 5 30 sec = 6 60 sec = 7 120 sec = 8	61

Slug Flow Limits and Duration

Slug flow limits enable the Model 5300 to indicate conditions such as gas slugs in a liquid flow stream or liquid in a gas/air flow stream. In some applications, slug flow typically occurs for short periods of time. If the slug flow condition ceases in less than 1 minute, the transmitter can continue holding the last accurately measured flow value until the process density stabilizes within the configured slug flow limits. The slug duration specifies the amount of time the Model 5300 indicates the last measured flow value before indicating zero flow.

To configure slug flow limits and slug duration for the transmitter:

1. Use the fieldbus host or configurator to access the parameter numbers listed in Table 3-6.
2. Enter an appropriate value from the column titled Range of Values and write to the device.

NOTE
Slug flow values must be entered in units of grams per cubic centimeter (g/cc).

3. Repeat this procedure for each parameter listed in Table 3-6.

TABLE 3-6. Slug Flow Parameters.

Variable	Definition	Range of Values	Parameter Number
SLUG_LOW_LIMIT	Low limit at which the transmitter indicates slug flow	–0.1 to 5.0 g/cc	37
SLUG_HIGH_LIMIT	High limit at which the transmitter indicates slug flow	–0.1 to 5.0 g/cc	38
SLUG_TIME	Length of time the transmitter indicates the last measured value before indicating flow or slug flow	0.1 to 60.0 seconds	36

Characterization and Calibration

Transmitters and sensors can be replaced separately, because each sensor is characterized for flow and density sensitivity at the factory, and labeled with the appropriate flow and density calibration factors. When a transmitter and sensor are ordered together as a Coriolis flowmeter, they are factory calibrated. If either the sensor or transmitter is replaced, field characterization or calibration is required.

If field calibration is necessary, the fieldbus host or configurator can be used for entering calibration factors for the attached sensor after the Model 5300 is installed. Calibration methods for the Model 5300 are contained in the transducer block.

The transducer block parameter for calibration is called CALMETHODS, which is parameter number 72. These calibration procedures can be performed using the CALMETHODS parameter:

- Zero Cal – Executes the Coriolis flowmeter zeroing procedure, required prior to using the meter for measurement. (See “Zeroing Procedure” on page 3-3.)
- Characterization – Allows entry of factors that describe sensor sensitivity to flow, density, and temperature.
- Low Density Cal – Executes the low-density calibration.
- High Density Cal – Executes the high-density calibration.
- Flowing Density Cal – Executes the third-point density calibration.
- Temp Cal Low – Executes the low-temperature calibration.
- Temp Cal Hi – Executes the high-temperature calibration.

Each calibration method can be performed by first selecting it from CALMETHODS, then writing it to the device. Methods are described in the sections that follow. The results of the calibration are contained in parameter CORE_STATUS, which is transducer block parameter 71.

- A successful calibration is displayed as *Successful Cal*.
- A calibration failure is displayed as *Failed Cal*.

Characterization Parameters

Calibration factors for flow, density, and temperature can be entered into the Model 5300 in lieu of performing field calibration procedures. Calibration factors can be found on the sensor serial number tag and on the calibration certificate that is shipped with the sensor. The process of entering these factors is called *characterization*.

To characterize the sensor:

1. Use the fieldbus host or configurator to access the parameter number.
2. Enter the appropriate value from the sensor serial number tag or the calibration certificate, and write to the device.
3. For an accurate characterization, repeat the procedure for each parameter listed in Table 3-7.

Calibration

Flow Cutoffs

Cutoffs filter out process noise by defining the level below which outputs will indicate zero flow. A flow cutoff is the lowest value at which the output indicates nonzero flow. If the output signal drops below the cutoff value, the output indicates zero flow.

To configure flow cutoff values:

1. Select an output from the fieldbus function block.
2. Use the fieldbus host or configurator to access the parameter numbers listed in Table 3-8.
3. Enter an appropriate value from the column titled Range of Values and write to the device.
4. Repeat this procedure for each output that is being used.

TABLE 3-7. Characterization Parameters.

Variable	Definition	Parameter Number
MASS_FLOW_GAIN	First 5 digits of the flow calibration factor	54
MASS_FLOW_T_COMP	Last 3 digits of the flow calibration factor	55
K1	K1 density calibration factor	64
K2	K2 density calibration factor	65
FD	FD density calibration factor	66
D1	D1 density calibration factor	67
D2	D2 density calibration factor	68
T_COEFF	The TC value from the serial number tag or calibration certificate, or the last three digits (and decimal point) from the 13-digit density calibration factor	57

TABLE 3-8. Flow Cutoff Parameters.

Variable	Definition	Range of Values	Parameter Number
MASS_LOW_CUT	Flow cutoff value for mass flow measurement	0.0 to 999.999999	60
VOLUME_FLOW_LOW_CUTOFF	Flow cutoff value for volume flow measurement	0.0 to 999.999999	50

Density Calibration

Density calibration adjusts the factors that are used by the Model 5300 to calculate density. The procedure is performed in two parts, called a two-point density calibration, under zero-flow or no-flow conditions as described below. A third-point density calibration is also possible.

The density calibration procedure replaces values entered during characterization. (See “Characterization Parameters” on page 3-11.)

1. Calibrate the flowmeter for the low-density process fluid (typically air):
   a. Enter the low density of the process fluid into DD parameter DENS1, which is transducer block parameter number 75.
   b. Make sure flow through the sensor is **completely** stopped, then select Low Density Cal from CALMETHODS and write to the device.
   c. Check the results of the calibration.
2. Calibrate the flowmeter for the high-density process fluid (typically water):
   a. Enter the density of the process fluid into DD parameter DENS2, which is transducer block parameter number 76.
   b. Make sure flow through the sensor is **completely** stopped, then select High Density Cal from CALMETHODS and write to the device.
   c. Check the results of the calibration.
3. If the sensor serial number tag or calibration certificate lists an FD calibration factor, enter the value into DD parameter DENS3, which is transducer block parameter number 77.

   Alternatively, perform the third-point density calibration, if desired. The third-point density calibration is desirable, however, only if the process exceeds or often approaches the flow rates listed in Table 3-9. If the process remains below these rates, or an FD value is available, calibrating a third density point is unnecessary.

   To perform a third-point density calibration:
   a. Use the same process fluid as the fluid that was used Step 2, above.
   b. Pump fluid through the sensor at highest possible flow rate.
   c. Enter the density of the process fluid into DD parameter DENS3, which is transducer block parameter number 77.
   d. Select Flowing Density Cal from CALMETHODS and write to the device.
   e. Check the results of the calibration. If an FD value is listed on the sensor serial number tag or calibration certificate, compare the results of the calibration to the listed FD value. The calibration value should be within ±50% of the listed FD value.

TABLE 3-9. Minimum Flow Rate for Third-Point Density Calibration.

Sensor Model		Minimum Flow Rate	
		lb/min	kg/h
ELITE®	CMF010	2.4	65.5
	CMF025	40	1090
	CMF050	125	3400
	CMF100	500	13,600
	CMF200	1600	43,550
	CMF300	5000	136,080
	CMF400	25,610	696,960
BASIS®	All F sensors	Third-point cal not necessary	
Model D (standard pressure)	D6	1	27.5
	D12	4.5	121.5
	D25	22.5	612
	D40 stainless steel	40.5	1102.5
	D40 Hastelloy® C-22	Third-point cal not necessary	
	D65	150	4080
	D100	400	10,890
	D150	1400	38,100
	D300	3500	95,250
	D600	12,500	340,200
Model D (high-pressure)	DH6	1.8	49.5
	All other DH sensors	Third-point cal not necessary	
Model DT	DT65	150	4080
	DT100	400	10,890
	DT150	700	19,050
Model DL	DL65	125	3400
	DL100	400	10,890
	DL200	1750	47,625

Temperature Calibration

Temperature calibration adjusts the factors that are used by the Model 5300 to calculate temperature. The procedure is performed in two parts, called a two-point temperature calibration, as described below. Both parts of the procedure must be performed, without interruption, for an accurate temperature calibration.

The temperature calibration procedure replaces values entered during characterization. (See “Characterization Parameters” on page 3-11.)

1. Perform the low-temperature calibration:
   a. Enter the process fluid low temperature into DD parameter LOW_TEMP, which is transducer block parameter number 73.
   b. Select Temp Cal Low from CALMETHODS and write to the device.
2. Perform the high-temperature calibration:
   a. Enter the process fluid low temperature into DD parameter HIGH_TEMP, which is transducer block parameter number 74.
   b. Select Temp Cal Hi from CALMETHODS and write to the device.
3. Check the results of the calibration.

PROCESS MEASUREMENT

After flowmeter zeroing has been completed as described in the procedure on page 3-3, the Model 5300 is ready for process measurement.

⚠ WARNING

Operating transmitter without compartment covers in place exposes electrical hazards that can cause property damage, injury, or death.

Ensure integrity of gaskets and O-rings, and make sure covers for field-wiring and circuit-board compartments are securely in place before operating the transmitter.

Viewing Process Variables

There are two ways to view process variables from the Model 5300:

- Using the fieldbus host or configurator to access the parameter numbers listed in Table 3-10, or
- Using the AI function block (for example, if an AI function block is defined as Channel 1, Mass Flow, then the OUT parameter will display the mass flow variable).

TABLE 3-10. Process Variable Parameters in Transducer Block.

Variable	Description	Parameter Number
PRIMARY_VALUE	Mass flow rate	14
VOLUME_FLOW	Volume flow rate	49
DENSITY	Density of fluid flowing through the sensor	47
SECONDARY_VALUE	Temperature of sensor flow tube	32

Section 4 Troubleshooting

GENERAL GUIDELINES FOR TROUBLESHOOTING

Follow these general guidelines while troubleshooting a Micro Motion flowmeter:

- Before beginning the diagnostic process, become familiar with **all applicable** instruction manuals.
- While troubleshooting a problem, leave the Coriolis sensor in place, if possible. Problems may result from the specific environment in which the sensor operates.
- Check all signals under both flow and no-flow conditions. This procedure will minimize the possibility of overlooking some causes or symptoms.

CUSTOMER SERVICE

For assistance, phone the Micro Motion Customer Service Department:

- In the U.S.A., phone **1-800-522-MASS** (1-800-522-6277), 24 hours
- Outside the U.S.A., phone 303-530-8400, 24 hours
- In Europe, phone +31 (0) 318 549 443
- In Asia, phone 65-770-8155

ALARM MESSAGES

Alarm and status messages are listed in the following tables:

- Transducer block alarms and status are listed in Table 4-1, below.
- Transducer block diagnostic variables are listed in Table 4-2 on page 4-2.
- Resource block alarms and status are listed in Table 4-3 on page 4-2.

TABLE 4-1. Transducer Block Alarms and Status.

Message	Description
Aborted Cal	User-initiated calibration aborted
Cal in Progress	User-initiated calibration in progress
Cal Var Out of Range	A device calibration parameter is out of range
Checksum Error	Internal device communications error
Comm Timeout	Internal device communications error
Core Failure	Transmitter hardware failure
Density Error	• Inappropriate density factors • Density reading is less than 0.1 g/cc • Density reading is greater than 5.0 g/cc.
Drive Out of Range	• Flow rate outside sensor limit • Open or short drive coil in sensor • Faulty cable between sensor and transmitter
EEPROM Write Error	Error writing EEPROM
Failed Cal	User-initiated calibration failed
Lost Sync 1	Internal device communications error
Lost Sync 2	Internal device communications error
Packet Error	Internal device communications error
Packet ID Error	Internal device communications error
Raw Electronic Zero Data	Internal device fault

TABLE 4-1. (continued).

Message	Description
Sensor Failure	• Faulty cable between sensor and transmitter • Faulty pickoff circuit in sensor • Two-phase flow or meter not full of process fluid • Sensor flow tube is damaged
Slug Flow	• Gas in liquid stream causing process density to go below low slug limit • Solids in liquid or gas stream causing process density to go above high slug limit
Raw Flow Data Overflow	Internal device fault
Realtime Interrupt Error	Internal device fault
RTD Failure	Temperature sensor failed
Slug Timeout	Slug condition lasted longer than time-out value
Successful Cal	User-initiated calibration successful
Sync Timeout	Internal device communications error
Temperature Failure	• Temperature outside sensor limit • RTD failure
UART Break	Internal device communications error
UART Frame	Internal device communications error
UART Overrun	Internal device communications error
UART Parity	Internal device communications error
Unexpected Event	Internal device communications error
Warming Up	Device startup in progress

TABLE 4-2. Transducer Block Diagnostic Variables.

Message	Description
Tube Period	Natural frequency of vibrating sensor flow tubes
Drive Gain	Voltage of sensor drive gain circuitry

TABLE 4-3. Resource Block Alarms and Status.

Message	Description
Block Configuration	Block configuration parameters are incorrect
Device Fault State	Indicates if device is on-line or in a failure mode
Lost NV Data	Data in nonvolatile memory is lost
Lost Static Data	A master reset was performed, or a hardware fault occurred
Maintenance Needed	The device requires repair or maintenance
Memory Failure	A fault was detected in device memory
Out of Service	The block mode is out of service
Power Up	Power to device has been cycled off and on
Simulation Active	Device is in simulation mode

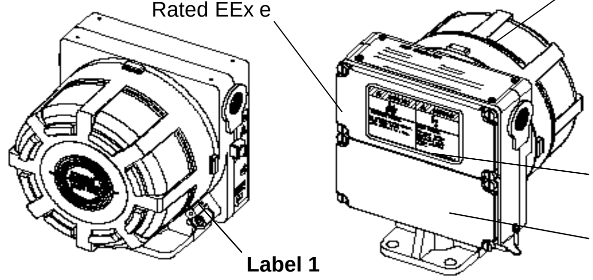
TROUBLESHOOTING PROCEDURES

If you suspect a malfunction, follow the procedures described here to verify the Model 5300 is in good working order.

⚠WARNING

Explosion Hazard

Do not remove EEx e (field wiring) or EEx d (circuit board) compartment covers in an explosive atmosphere within 2 minutes after power is disconnected. Read labels that point to compartment covers before accessing wiring or circuit board compartments.



- ”Label 1” indicates the sensor wiring compartment is rated EEx i (intrinsically safe), and may be opened at any time.
- ”Label 2” indicates the field wiring compartment is rated EEx e (increased safety), and should remain closed when power is on.

⚠CAUTION

During troubleshooting, the transmitter could produce inaccurate flow signals.

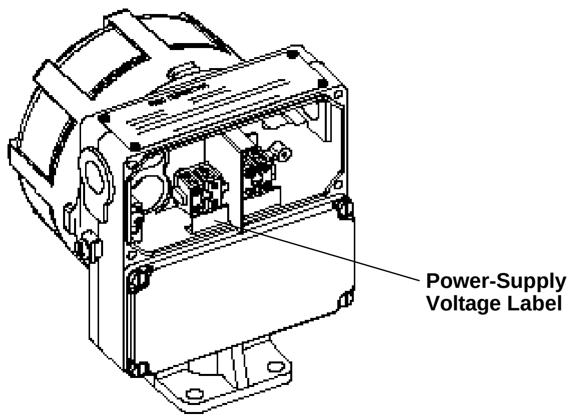
Before troubleshooting the flowmeter, ensure the transducer block has been placed in “Out of Service” mode.

Power Supply

Check for specified power at the Model 5300 terminals. The power-supply voltage must match the voltage specified on the label in the Model 5300 field wiring compartment. See Figure 4-1.

The Model 5300 does not have replaceable fuses for the power supply.

FIGURE 4-1. Power-Supply Voltage Label.



Wiring

Wiring problems are often incorrectly diagnosed as a faulty sensor. At initial startup of the transmitter, always check the following:

- Proper cable, and use of shielded pairs.
- Proper wire termination.
- Wires on correct terminals.
- Wires making good connections with the terminal strip.
- Wires making good connections at the sensor terminals. Table 4-4 lists terminal designations for Micro Motion sensors.

See Section 2 – Installation, starting on page 2-1, for detailed wiring instructions.

TABLE 4-4. Sensor Terminal Designations.

Terminal Number	Wire Color	Function
1	Brown	Drive +
2	Red	Drive –
3	Orange	Temperature –
4	Yellow	Temperature Lead Length Compensator
5	Green	Left Pickoff +
6	Blue	Right Pickoff +
7	Violet	Temperature +
8	Gray	Right Pickoff –
9	White	Left Pickoff –

Error Messages Displayed By the fieldbus Host or Controller

Over Range and Sensor Failure Conditions

If the fieldbus host or controller displays an *over range* error or *sensor failure* condition, follow these steps, if necessary, to troubleshoot the problem:

1. Disconnect the transmitter's power supply.
2. Disconnect sensor wiring from the transmitter's intrinsically safe terminals in the sensor wiring compartment. See Figure 4-2.
3. Use a digital multimeter (DMM) or similar device to measure voltage across the red and brown wires. This value is the *drive gain* from the sensor. If drive gain exceeds 8 volts, see Table 4-5 to troubleshoot the problem. Otherwise, go to step 4.

FIGURE 4-2. Sensor Wiring Compartment.

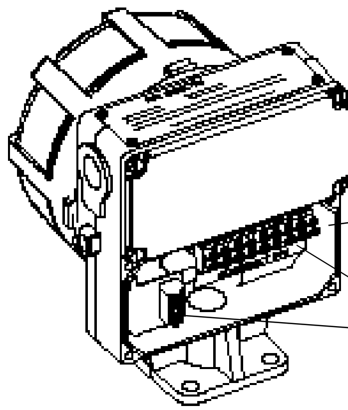


TABLE 4-5. Troubleshooting Excessive Drive Gain.

Potential Cause of Drive Gain Over 8V	Corrective Action
Erratic process density (slug flow) has caused flow tubes to vibrate erratically or stop vibrating	• Monitor density • Change sensor orientation (see sensor manual for orientation instructions)
Plugged flow tube	Purge flow tubes
Cavitation or flashing of process fluid	• If possible, increase inlet pressure and/or back pressure • If pump is mounted upstream from sensor, increase distance between pump and sensor
• Drive circuit or transmitter has failed • Cracked sensor flow tube • Sensor flow tube imbalance	Phone the Micro Motion Customer Service Department: • In the U.S.A., phone 1-800-522-MASS (1-800-522-6277), 24 hours • Outside the U.S.A, phone 303-530-8400, 24 hours • In Europe, phone +31 (0) 318 549 443 • In Asia, phone 65-770-8155

4. Use a DMM to measure resistance between wire pairs, as indicated in Table 4-6.
   - If open or short circuits are found, or if measured resistance values are outside the ranges listed in Table 4-6, the flowmeter cable (between the sensor and transmitter) could be faulty. See Table 4-7 to troubleshoot the problem.
   - If faulty flowmeter cable is not indicated, go to step 5.
5. If the Model 5300 is remotely mounted from the sensor, repeat the measurements at the terminal block in the sensor junction box before reconnecting wiring at the Model 5300 terminals. This will distinguish cable failure from sensor failure.
   - If all measured resistance values are within the ranges listed in Table 4-6, either the process is outside acceptable limits, or the flowmeter calibration needs to be changed. See Table 4-8 to troubleshoot the problem.
   - If open or short circuits are found, either the sensor junction box contains moisture, or the sensor is damaged. See Table 4-8 to troubleshoot the problem.
6. If troubleshooting fails to reveal why over range and/or sensor failure messages have appeared, phone Micro Motion Customer Service:
   - In the U.S.A., phone **1-800-522-MASS** (1-800-522-6277), 24 hours
   - Outside the U.S.A., phone 303-530-8400, 24 hours
   - In Europe, phone +31 (0) 318 549 443
   - In Asia, phone 65-770-8155

TABLE 4-6. Normal Resistance and Voltage Ranges for Flowmeter Circuits.

Notes

- Temperature sensor value increases 0.38675 ohms per °C increase in temperature.
- Nominal resistance values will vary 40% per 100°C. However, confirming an open coil or shorted coil is more important than any slight deviation from the resistance values presented below.
- Resistance across terminals 6 and 8 (right pickoff) should be within 10% of resistance across terminals 5 and 9 (left pickoff).
- Resistance values depend on the sensor model and date of manufacture.

Circuit	Wire Colors	Sensor Terminals	Nominal Resistance Range
Drive Coil	Red to Brown	1 to 2	8 to 2650Ω
Left Pickoff	Green to White	5 to 9	15.9 to 300Ω
Right Pickoff	Blue to Gray	6 to 8	15.9 to 300Ω
Temperature Sensor	Orange to Violet	3 to 7	100Ω at 0°C + 0.38675Ω per °C
Lead Length Compensator	Yellow to Violet	4 to 7	100Ω at 0°C + 0.38675Ω per °C

TABLE 4-7. Troubleshooting Faulty Sensor Cable.

Digital Multimeter (DMM)	Cause(s)	Corrective Action(s)
• Open or short from green to white at transmitter • Open or short from red to brown at transmitter • Open or short from violet to yellow at transmitter • Open or short from violet to orange at transmitter	Faulty cable	Repair or replace flowmeter cable
Resistance of any wire pair is outside range listed in Table 4-6	• Incorrect or faulty cable connection • Sensor failure	• Reconnect sensor cable according to installation instructions • See step 5 on page 4-6

TABLE 4-8. Troubleshooting Over Range and Sensor Failure Conditions

Digital Multimeter (DMM)	Cause(s)	Corrective Action(s)
• Open or short from red to brown at transmitter • Open or short from red to brown at sensor	• Flow rate outside sensor limit • Faulty cable • Faulty drive coil in sensor • Moisture in sensor case	• Bring flow rate within sensor limit • Monitor flow rate • If open or short at transmitter terminals, check cable • If open or short at sensor j-box, return sensor to factory • Replace conduit and/or conduit seals • Repair cable
• Open or short from green to white at transmitter • Open or short from green to white at sensor	• Flow rate outside sensor limit • Faulty cable • Faulty left pickoff in sensor • Moisture in sensor case	
• Open or short from blue to gray at transmitter • Open or short from blue to gray at sensor	• Faulty cable • Faulty right pickoff in sensor • Moisture in sensor case	• If open or short at transmitter terminals, check cable • If open or short at sensor j-box, return sensor to factory • Replace conduit and/or conduit seals • Repair cable
• No open circuits • No short circuits	• Transmitter cannot calculate offset of flow signal	• Eliminate noise, then re-zero • Completely shut off flow, then re-zero
	• Transmitter cannot calculate flow rate	• Eliminate pipe stress, vibration, or mechanical noise
	• Inappropriate density factor • Density reading less than 0.1 g/cc • Density reading greater than 5.0 g/cc • Erratic process density has caused flow tubes to stop vibrating • Plugged flow tube • Transmitter cannot calculate density	• Recalibrate for density • Characterize density values for sensor • Monitor density • Bring density within sensor limit • Purge flow tubes • Eliminate pipe stress, vibration, or mechanical noise
• Open or short from yellow to orange at transmitter • Open or short from yellow to orange at sensor	• Temperature outside sensor limit • Faulty cable • Faulty lead length compensator	• Bring temperature within sensor limit • Monitor temperature • If open or short at transmitter terminals, check cable • If open or short at sensor j-box, return sensor to factory
• Open or short from violet to yellow at transmitter • Open or short from violet to yellow at sensor	• Faulty cable • Faulty RTD in sensor	

Slug Flow Condition

The fieldbus host or controller displays a *slug flow* message when significant quantities (slugs) of gas in a liquid flow stream, or slugs of liquid in a gas flow stream, pass through the sensor. Such conditions adversely affect sensor performance by causing erratic vibration of the sensor flow tubes, which in turn causes the transmitter to produce inaccurate flow signals.

Slug flow limits, programmed by the user, minimize inaccurate measurement caused by slug flow. The flowmeter resumes normal operation when density stabilizes within the programmed slug flow limits. To program slug flow limits, see page 3-9.

Transmitter Failure Condition

If the fieldbus host or controller displays a *transmitter failure* or *electronics failure* message, a transmitter failure might have occurred. If a transmitter failure is indicated, phone the Micro Motion Customer Service Department:

- In the U.S.A., phone **1-800-522-MASS** (1-800-522-6277), 24 hours
- Outside the U.S.A., phone 303-530-8400, 24 hours
- In Europe, phone +31 (0) 318 549 443
- In Asia, phone 65-770-8155

Appendix A Specifications

FUNCTIONAL SPECIFICATIONS

Input

One intrinsically safe 9-wire Coriolis sensor signal input with ground.

Input frequency from sensor

Mass flow	20 Hz
Volume flow	20 Hz
Density	10 Hz
Temperature	1 Hz

Analog Input Function Blocks

Cycle time	host dependent
Update rate	50 milliseconds
Refresh rate	host dependent

Output

Manchester-encoded digital signal conforms to IEC 1158-2. Can be configured to indicate mass flow, volume flow, density, and temperature.

Communication

Registered with Fieldbus Foundation. Conforms to FOUNDATION fieldbus H1 protocol specification. FOUNDATION fieldbus wiring is intrinsically safe.

Low-Flow Cutoff

Flow rate below cutoff causes outputs to default to the level that indicates zero flow.

Slug-Flow Inhibit

When the transmitter senses density outside user-selected limits, outputs default to levels indicating zero flow.

Damping

User-selected time constant from pre-programmed values. Can be applied to flow, density, temperature, or any combination.

Power Supply Options

Micro Motion flowmeters require external power to operate the Coriolis sensor. The transmitter fieldbus circuit is passive, and draws its power from the fieldbus segment.

85–250 VAC

47 to 64 Hz; 10 watts typical, 15 watts maximum. Fused at 250 V/630 mA. Meets low-voltage directive 73/23/EEC

20–30 VDC

6 watts normal, 14 watts maximum. Protected at 60 V/0.9 amp. Minimum startup voltage is 16 V at transmitter terminals. Maximum total resistance for wiring is 13 ohms. At startup, transmitter power source must provide a minimum of 0.7 amp of short-term current

HAZARDOUS AREA APPROVALS

For approvals that apply to an individual transmitter, see the hazardous area approvals tag attached to the transmitter.

UL and CSA

Class I, Division 2, Groups A, B, C, and D
Class II, Division 2, Groups F and G
Approvals pending

UL Non-Incendive Parameters

V_{max}	30 V
I_{max}	300 mA
C	3.3 pF
L	10 µH

CENELEC

EEx de [ib] IIB/C T6 for Hazardous Locations
[EEx ib] IIB/C for Safe Locations
Approval pending

ENVIRONMENTAL SPECIFICATIONS

Ambient Temperature Limits

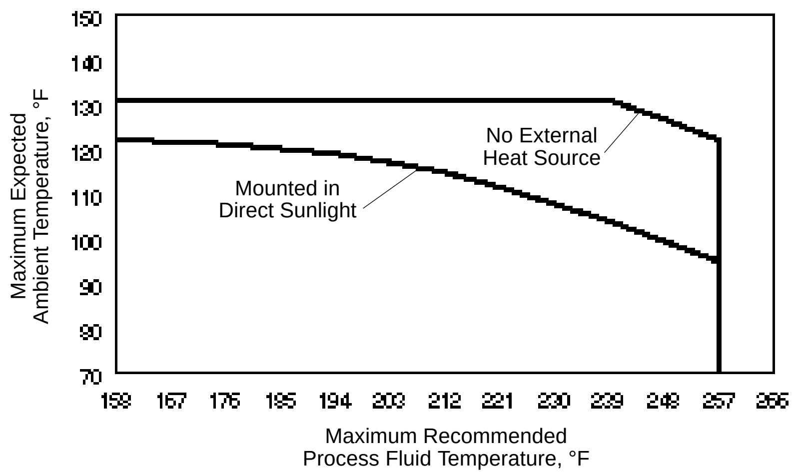
Operating	–22 to 131°F (–30 to 55°C)
Storage	–40 to 185°F (–40 to 85°C)

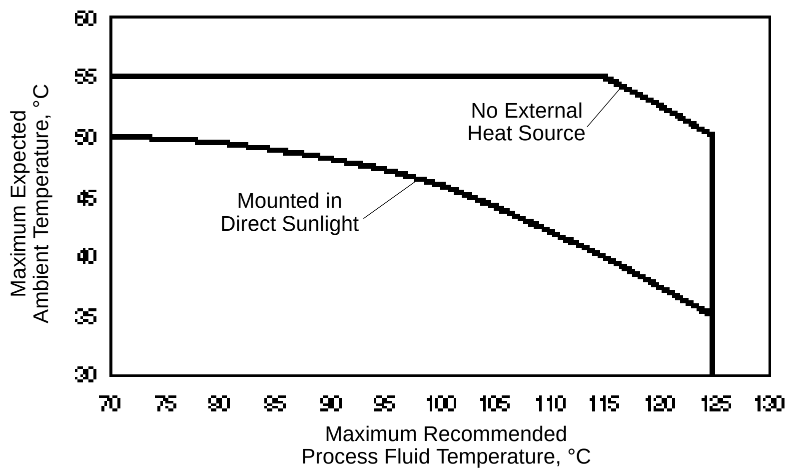
Process Fluid Temperature Limits

Integrally mounted transmitter*	–40 to 257°F (–40 to 125°C) See graphs, below, for ambient limits
Remotely mounted transmitter	Refer to temperature limits for sensor

**Integral-mount available only with BASIS sensors.*

Recommended Process Temperature Limits for Integrally Mounted Model 5300 Transmitters





Humidity Limits

5 to 95% non-condensing

Vibration Limits

Meets IEC 68.2.6, endurance sweep, 10 to 2000 Hz, 50 sweep cycles

Environmental Effects

Model 5300 transmitters meet the requirements of the EMC directive 89/336/EEC per EN 50081-2 (January 1992) and EN 50082-2 (March 1995) when operated at nominal rated flow measurement range.

The requirements of NAMUR NE-21 (prepared by AK 4.6 EMC, May 1993) are met at the standard level(s). For specific EMC effects within the EC, the Technical EMC file may be reviewed at Micro Motion Veenendaal.

Model 5300 transmitters meet the recommendations of ANSI/IEEE C62.41 (1991) for surge and EFT.

To meet the above specifications, the transmitter must be installed with an approved Micro Motion sensor, and the sensor cable must be doubly shielded with full-contact glands, or installed in continuous, fully bonded metallic conduit. The transmitter and sensor must be directly connected to a low-impedance (less than 1 ohm) earth ground. Transmitter outputs must be standard twisted-pair, shielded instrument wire.

PHYSICAL SPECIFICATIONS

Mounting

Transmitters are available integrally mounted to BASIS sensors. Remote installation – up to 1000 feet (300 meters) – is required for use with all other sensor models.

Conduit Connections

Two 3/4-14 NPT or M20 x 1.5 female conduit ports for power and output signal wiring. Remotely mounted transmitter has one additional 3/4-14 NPT female conduit for sensor cable.

Housing

NEMA 4X (IP65) epoxy polyester painted cast aluminum.

Electrical connections

Fixed screw terminals for all wiring connections. Screw terminal on housing for chassis ground.

Shipping Weight

12.5 lb (5.7 kg)

PERFORMANCE SPECIFICATIONS

Sensor model	Process Fluid	Mass flow accuracy[1]	Mass flow repeatability
ELITE[2]	liquid gas	±0.10% ± [(zero stability / flow rate) x 100]% of rate ±0.50% ± [(zero stability / flow rate) x 100]% of rate	±0.05% ± [½(zero stability / flow rate) x 100]% of rate ±0.25% ± [(zero stability / flow rate) x 100]% of rate
BASIS	liquid gas	±0.20% ± [(zero stability / flow rate) x 100]% of rate ±0.70% ± [(zero stability / flow rate) x 100]% of rate	±0.10% ± [½(zero stability / flow rate) x 100]% of rate ±0.35% ± [(zero stability / flow rate) x 100]% of rate
D (except DH38), DT, and DL	liquid gas	±0.15% ± [(zero stability / flow rate) x 100]% of rate ±0.65% ± [(zero stability / flow rate) x 100]% of rate	±0.05% ± [½(zero stability / flow rate) x 100]% of rate ±0.30% ± [(zero stability / flow rate) x 100]% of rate
DH38	liquid gas	±0.15% ± [(zero stability / flow rate) x 100]% of rate ±0.50% ± [(zero stability / flow rate) x 100]% of rate	±0.05% ± [½(zero stability / flow rate) x 100]% of rate ±0.25% ± [(zero stability / flow rate) x 100]% of rate

Sensor model		Density accuracy	Density repeatability
ELITE (except high-pressure CMF010P)	liquid gas	±0.0005 g/cc ±0.002 g/cc	±0.0002 g/cc ±0.001 g/cc
ELITE high-pressure CMF010P	liquid gas	±0.002 g/cc ±0.008 g/cc	±0.001 g/cc ±0.004 g/cc
BASIS	liquid only	±0.002 g/cc	±0.001 g/cc
D6, D12, D25, D40, DH100, DH150	liquid only	±0.002 g/cc	±0.001 g/cc
DH6, DH12, DH25, DH38	liquid only	±0.004 g/cc	±0.002 g/cc
D65, DL65, DT65, D100, DT100, D150, DT150, DH300	liquid only	±0.001 g/cc	±0.0005 g/cc
DL100, DL200, D300, D600	liquid only	±0.0005 g/cc	±0.0002 g/cc

Sensor model	Temperature accuracy	Temperature repeatability
All sensors	±1°C ± 0.5% of reading in °C	±0.02°C

(1) Flow accuracy includes the combined effects of repeatability, linearity, and hysteresis. All specifications for liquids are based on reference conditions of water at 68 to 77°F (20 to 25°C) and 15 to 30 psig (1 to 2 bar), unless otherwise noted.

(2) For ELITE sensors with Model 5300 transmitters, specified accuracy applies to nominal flow range only.

Appendix B Transducer Blocks

TRANSDUCER BLOCKS

Transducer blocks connect function blocks to local input/output functions. This permits the transducer block to execute as frequently as necessary to obtain good data from sensors and ensure proper writes without burdening the function blocks that use the data. The transducer block also isolates the function block from the vendor specific characteristics of the physical I/O.

Alerts

When an alert occurs, execution control sends an event notification and waits a specified period of time for an acknowledgment to be received. This occurs even if the condition that caused the alert no longer exists. If the acknowledgment is not received within the pre-specified time-out period, the event notification is retransmitted. This assures that alert messages are not lost.

Two types of alerts are defined for the block: events and alarms. Events are used to report a status change when a block leaves a particular state, such as when a parameter crosses a threshold. Alarms not only report a status change when a block leaves a particular state, but also report when it returns back to that state.

Transducer Block Data

The tables below and on the following pages provide detailed information about the transducer block data specific to the Model 5300 transmitter.

TABLE B-1. Transducer Block Data Definitions

Variable	Definition	Message Type	Size	Rate (Hz)	Store	Default Value	Access	Range of Values
Zeroing Parameters								
ZERO_CYCLES	Length of zero operation	VARIABLE	4	—	S	2	R/W	1 to 5
MECHANICAL_ZERO		VARIABLE	4	—	S	0	R/W	—
TEMP_SLOPE	Temperature slope	VARIABLE	4	—	S	1.0	R/W	0.8 to 1.2
TEMP_OFFSET	Temperature offset	VARIABLE	4	—	S	0.0	R/W	–5.0 to 5.0
ZERO_OFFSET	Meter zero offset	VARIABLE	5	1	D		R	N/A
Characterization Parameters								
MASS_FLOW_GAIN	Mass flow gain	VARIABLE	4	—	S	1.00	R/W	0.0001 to 9999.0
MASS_FLOW_T_COMP	Temperature coefficient for flow	VARIABLE	4	—	S	5.13	R/W	0.0 to 10.0
K1	K1 density factor	VARIABLE	4	—	S	5000.00	R/W	500.0 – 599999.0
K2	K2 density factor	VARIABLE	4	—	S	50000.00	R/W	500.0 – 999999.0
FD	FD density factor	VARIABLE	4	—	S	0.0	R/W	0.0 – 999.0
D1	D1 density factor	VARIABLE	4	—	S	0.0000	R/W	0.0 – 7.999999
D2	D2 density factor	VARIABLE	4	—	S	1.0000	R/W	0.0 – 7.999999
T_COEFF	Temperature coefficient for density	VARIABLE	4	—	S	4.44	R/W	0.0 to 9.0
Flow Direction								
FORWARD_FLOW	Flow direction	ENUM	1	—	S	0	R/W	Forward = 0 Reverse = 1

TABLE B-1. (continued) Transducer Block Data Definitions

Variable	Definition	Message Type	Size	Rate (Hz)	Store	Default Value	Access	Range of Values
Cutoff and Slug Flow Values								
MASS_LOW_CUT	Mass flow low cutoff	VARIABLE	4	—	S	0.0	R/W	0.0 to 999.999999
VOLUME_FLOW_LOW_CUTOFF	Volume flow low cutoff	VARIABLE	4	—	S	0.0	R/W	0.0 to 1.0
SLUG_TIME	Slug time	VARIABLE	4	—	S	1.0	R/W	0.1 to 60.0
SLUG_LOW_LIMIT	Slug low limit	VARIABLE	4	—	S	0.0	R/W	–0.1 to 5.0
SLUG_HIGH_LIMIT	Slug high limit	VARIABLE	4	—	S	5.0	R/W	–0.1 to 5.0
Units of Measure								
PRIMARY_VALUE_RANGE	Mass flow unit of measure	ENUM	4	—	S	g/s	R/W	g/s = 1318 g/min = 1319 g/hr = 1320 kg/s = 1322 kg/min = 1323 kg/hr = 1324 kg/day = 1325 t/min = 1327 t/h = 1328 t/d = 1329 lb/s = 1330 lb/min = 1331 lb/hr = 1332 lb/day = 1333 Ston/min = 1335 Ston/hr = 1336 Ston/day = 1337 Lton/hr = 1340
VOLUME_FLOW_UNITS	Volume flow unit of measure	ENUM	4	—	S	l/s	R/W	m3/s = 1347 m3/min = 1348 m3/hr = 1349 m3/day = 1350 L/s = 1351 L/min = 1352 L/hr = 1353 ML/day = 1354 CFS = 1356 CFM = 1357 CFH = 1358 ft3/day = 1359 gal/s = 1362 GPM = 1363 gal/day = 1365 Mgal/day = 1366 ImpGal/s = 1367 ImpGal/min = 1368 ImpGal/hr = 1369 Impgal/day = 1370 bbl/s = 1371 bbl/min = 1372 bbl/hr = 1373 bbl/day = 1374

TABLE B-1. (continued) Transducer Block Data Definitions

Variable	Definition	Message Type	Size	Rate (Hz)	Store	Default Value	Access	Range of Values
Units of Measure (continued)								
DENSITY_UNITS	Density unit of measure	ENUM	4	—	S	g/cm^3	R/W	kg/m3 = 1097 g/cm3 = 1100 kg/L = 1103 g/ml = 1104 g/L = 1105 lb/in3 = 1106 lb/ft3 = 1107 lb/gal = 1108 Ston/yd3 = 1109
SECONDARY_VALUE_UNIT	Temperature unit of measure	ENUM	4	—	S	Deg C	R/W	Deg K = 1000 Deg C = 1001 Deg F = 1002 Deg R = 1003
Damping Values								
MASS_FLOW_DAMPING	Mass flow tau	ENUM	2	—	S	2	R/W	0 sec = 0 0.1 sec = 1 0.3 sec = 2 0.8 sec = 3 1.7 sec = 4 3.5 sec = 5 7 sec = 6 15 sec = 7 30 sec = 8 60 sec = 9 120 sec = 10 240 sec = 11 480 sec = 12
DENSITY_DAMPING	Density tau	ENUM	2	—	S	2	R/W	0.3 sec = 0 0.8 sec = 1 1.7 sec = 2 3.5 sec = 3 7 sec = 4 15 sec = 5 30 sec = 6 60 sec = 7 120 sec = 8 240 sec = 9 480 sec = 10
TEMP_DAMPING	Temperature tau	ENUM	2	—	S	3	R/W	0 sec = 0 0.3 sec = 1 0.8 sec = 2 3.5 sec = 3 7 sec = 4 15 sec = 5 30 sec = 6 60 sec = 7 120 sec = 8

TABLE B-1. (continued) Transducer Block Data Definitions

Variable	Definition	Message Type	Size	Rate (Hz)	Store	Default Value	Access	Range of Values
Sensor Data								
SENSOR_MATERIAL	Sensor material	ENUM	1	—	S	0	R/W	S_304_SS = 0 S_316L_SS = 1 S_HAST_ALLOY_C = 2 S_INCONEL = 3 S_TANTALUM = 4
SENSOR_LINER	Sensor liner material	ENUM	1	—	S	0	R/W	None = 0 Tefzel = 1
SENSOR_END	Sensor process fittings	ENUM	2	—	S	0	R/W	S_ANSI_150 = 0 S_ANSI_300 = 1 S_ANSI_600 = 2 S_ANSI_900 = 3 S_Union = 4 S_Sanitary = 5 S_PN_40 = 6 S_JIS_10_K = 7 S_JIS_20_K = 8 S_Special = 9 S_Other
SENSOR_MODEL_NUM	Sensor model number	STRING	32	—	S	“None”	R/W	
SENSOR_SERIAL_NUM	Sensor serial number	STRING	32	—	S	“000000”	R/W	
Fieldbus Transmitter Tag								
TAG_NAME	Tag name	STRING	32	—	S	“None”	R/W	
On-Line Process Variables								
MASS_FLOW	Coriolis mass flow variable	VARIABLE	5	20	D		R	N/A
VOLUME_FLOW	Coriolis volume flow variable	VARIABLE	5	20	D		R	N/A
DENSITY	Coriolis density variable	VARIABLE	5	10	D		R	N/A
TEMPERATURE	Coriolis temperature variable	VARIABLE	5	1	D		R	N/A
On-Line Flowmeter Status								
START_MECH_ZERO	Calibration value	METHOD	—	—	—		R/W	N/A
START_LOW_DENSITY	Calibration value	METHOD	—	—	—		R/W	N/A
START_HIGH_DENSITY	Calibration value	METHOD	—	—	—		R/W	N/A
START_FLOW_DENSITY	Calibration value	METHOD	—	—	—		R/W	N/A
START_LOW_TEMP	Calibration value	METHOD	—	—	—		R/W	N/A
START_HIGH_TEMP	Calibration value	METHOD	—	—	—		R/W	N/A
Troubleshooting Variables								
Coriolis_Status	Status of Coriolis computations	ENUM	4	—	D		R	
DRIVE_GAIN	Drive gain	VARIABLE	4	1	D		R	N/A
TUBE_FREQUENCY	Sensor tube frequency	VARIABLE	4	1	D		R	N/A

TABLE B-2. Transducer Block Data Views

Parameter	Relative Index	VIEW 1	VIEW 2	VIEW 3	VIEW 4
ALARM2_STATUS	70			5	
ALARM_STATUS	69			5	
ALERT_KEY	4				1
BLOCK_ALM	8				
BLOCK_ERR	6	2		2	
CAL_MIN_SPAN	18				4
CAL_POINT_HI	16		4		
CAL_POINT_LOW	17		4		
CAL_UNIT	19				2
CALMETHODS	72			5	
COLLECTION_DIRECTORY	12				
CORE_STATUS	71			5	
D1	67				
D2	68				
DENS1	75	5			
DENS2	76	5			
DENS3	77	5			
DENS_M_FACTOR	58				
DENSITY	47				4
DENSITY_DAMPING	63				
DENSITY_UNITS	48				4
DRIVE_GAIN	40				
FORWARD_FLOW	39				
HIGH_TEMP	74	5			
K1	64				
K2	65				
FD	66				
LEFT_PICKUP_VOLTAGE	43				
LIN_TYPE	31				1
LOW_TEMP	73			5	
MASS_FLOW_DAMPING	62				
MASS_FLOW_GAIN	54				
MASS_FLOW_M_FACTOR	56				
MASS_FLOW_T_COMP	55				
MASS_FLOW_UNITS	46				4
MASS_LOW_CUT	60				
MECHANICAL_ZERO	35				
MODE_BLK	5	4		4	
PRIMARY_VALUE	14	5		5	
PRIMARY_VALUE_RANGE	15				11
PRIMARY_VALUE_TYPE	13		2		
RIGHT_PICKUP_VOLTAGE	44				4
SECONDARY_VALUE	32			5	
SECONDARY_VALUE_UNIT	33				2
SENSOR_CAL_DATE	25				7
SENSOR_CAL_LOC	24				
SENSOR_CAL_METHOD	23				2

TABLE B-2. (continued) Transducer Block Data Views

Parameter	Relative Index	VIEW 1	VIEW 2	VIEW 3	VIEW 4
SENSOR_CAL_WHO	26				32
SENSOR_END	29				
SENSOR_LINER	28				
SENSOR_MATERIAL	27				
SENSOR_MODEL_NUMBER	30				
SENSOR_RANGE	21				11
SENSOR_SN	22				4
SENSOR_TYPE	20				2
SLUG_HIGH_LIMIT	38				
SLUG_LOW_LIMIT	37				
SLUG_TIME	36				
ST_REV	1	2	2	2	2
STRATEGY	3				2
T_COEFF	57				1
TAG_DESC	2				
TEMP_DAMPING	61				
TEMP_OFFSET	53				
TEMP_SLOPE	52				
TOTALIZER	45				4
TRANSDUCER_DIRECTORY	9				
TRANSDUCER_TYPE	10	2	2	2	2
TUBE_FREQUENCY	41				
UPDATE_EVT	7				
V_METER_FACTOR	59				
VOLTOTALIZER	78		4		
VOLUME_FLOW	49				4
VOLUME_FLOW_LOW_CUTOFF	50				4
VOLUME_FLOW_UNITS	51				4
XD_ERROR	11	1		1	
ZERO_CYCLES	34				
ZERO_OFFSET	42				

TABLE B-3. Transducer Block Channels

Channel	Coriolis Variable
Channel 1	Mass Flow
Channel 2	Temperature
Channel 3	Density
Channel 4	Volume Flow

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P/N 3100869, Rev. A (1/99)

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