Model RFT9709 Transmitter

Instruction Manual

March 1999

Micro Motion

FISHER-ROSEMOUNT™ Managing The Process Better.™

Model RFT9709 Transmitter

Instruction Manual

For technical assistance, phone the Micro Motion Customer Service Department:

- In the U.S.A., phone 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

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Before You Begin

About this manual

This instruction manual explains how to install the Micro Motion® Model RFT9709 transmitter for use with Micro Motion Coriolis flow sensors. For more information about the sensor, see the appropriate sensor instruction manual.

⚠ CAUTION

Improper installation could cause measurement error or transmitter failure.

For personal and system safety, follow all instructions to ensure transmitter will operate correctly.

About the transmitter

The Model RFT9709 transmitter is a microprocessor-based transmitter for fluid process measurement. The transmitter works with Micro Motion sensors to measure mass or volume flow, density, and temperature.

Components of the transmitter are illustrated on the following page.

Configuration and calibration

An RFT9709 transmitter and a sensor are ordered together as a Coriolis flowmeter. The factory can provide any of three standard configuration options:

- Gross volume, API table 5A
- Gross standard volume, API table 5A
- Not configured

For specific configuration details, see the calibration certificate that is shipped with the sensor. To meet API requirements, the user must supply an external RTD that is accurate to ±0.1°F. The external RTD calibration must be configured in the transmitter. The factory can configure the transmitter if the RTD calibration is provided.

Changes to the configuration are possible with a custom version of Micro Motion's ProLink® software program, designed specifically for the RFT9709.

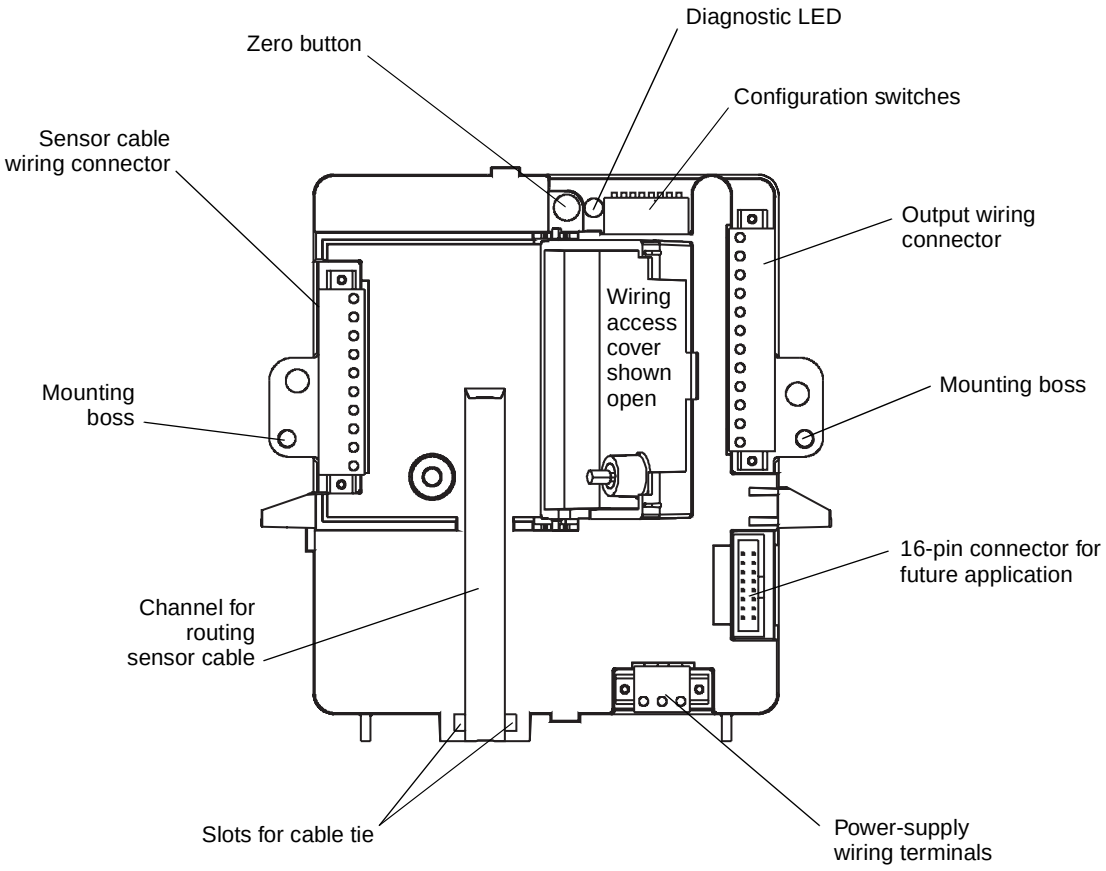
- The standard ProLink software cannot be used with the RFT9709. Contact the factory for additional ProLink information.
- The Rosemount® hand-held HART® Communicator cannot be used with the RFT9709.

Proving the Coriolis flowmeter

Proving Micro Motion flowmeters can be accomplished using conventional proving methods. Micro Motion publishes a comprehensive applications manual, which describes in detail how to prove Coriolis meters. For additional information, contact the Micro Motion Customer Service Department:

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

RFT9709 components



Mounting

1.1 Location requirements

- Mount the RFT9709 in a user-supplied or factory-supplied NEMA-4 (IP65) enclosure.
- Locate the RFT9709 where it is accessible for service.
- Locate the RFT9709 where the ambient temperature remains between –40 and 122°F (–40 and 50°C).
- Locate the RFT9709 where humidity is less than 90%.
- Total length of cable from the sensor to the RFT9709 must not exceed 1000 feet (300 meters).
- In hazardous areas, install the RFT9709 as described below.

Hazardous area installations

Read the RFT9709 approvals tag before installing the transmitter. The approvals tag is attached to the RFT9709 housing. See Figure 1-1.

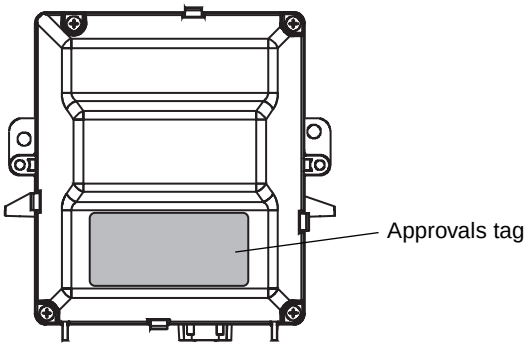
⚠ WARNING

Failure to comply with requirements for intrinsic safety in a hazardous area could result in an explosion.

- Install the RFT9709 in an environment that is compatible with the hazardous area specified on the approvals tag.
- For installations that require intrinsic safety, use this document with Micro Motion UL installation instructions.

- For a complete list of approvals, see *Hazardous area approvals*, page 43.
- For an intrinsically safe or hazardous area installation, use this manual with Micro Motion UL-D-IS Installation Instructions.

Figure 1-1. RFT9709 approvals tag



1.2 Mounting options

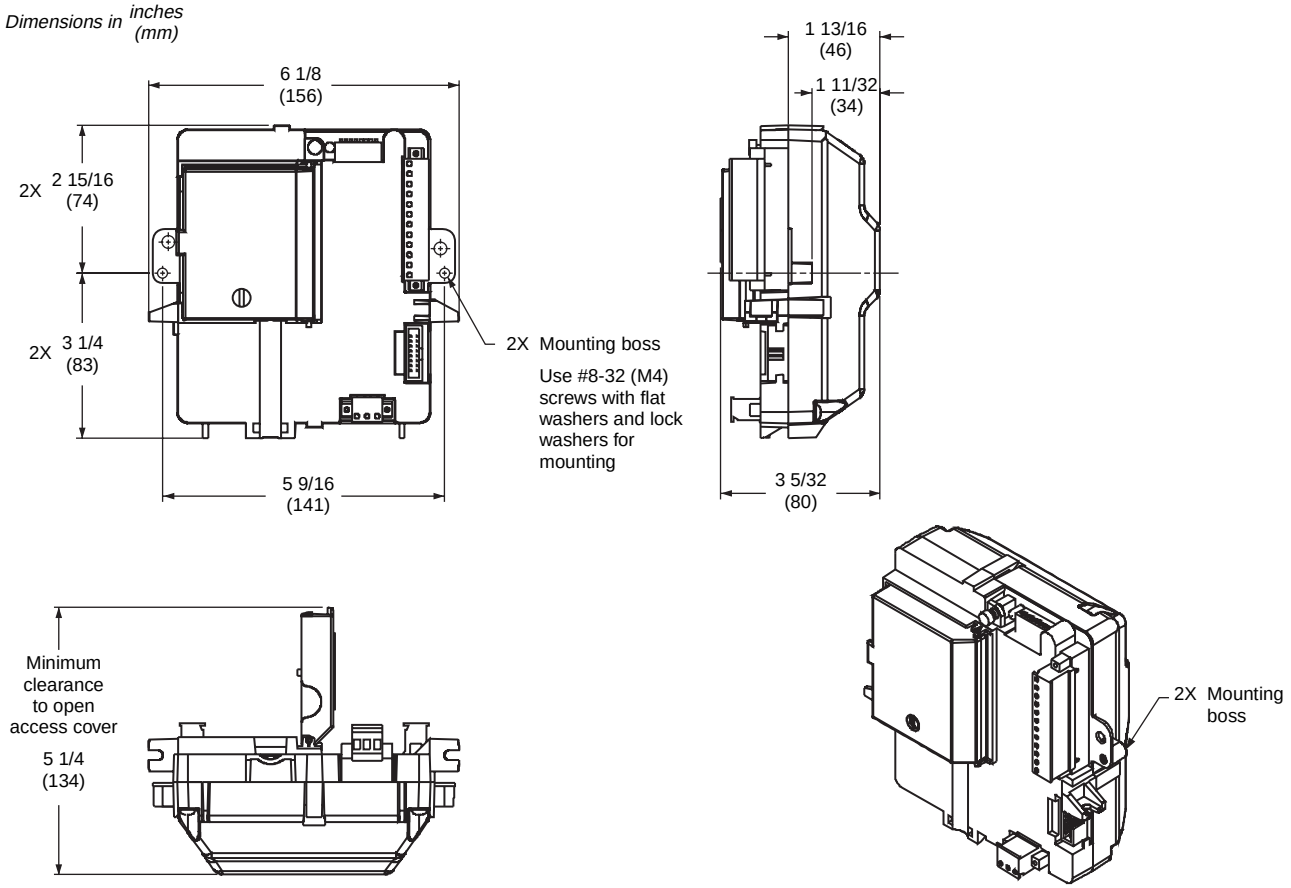
The RFT9709 has these installation options for mounting on any flat surface:

- For mounting in a user-supplied NEMA-4 (IP65) enclosure
- Pre-installed by the factory in an optional NEMA-4 (IP65) enclosure

1.3 Installation in user-supplied enclosure

- Install the RFT9709 with two screws to a flat mounting surface. Micro Motion does not supply mounting screws.
- Install with wiring terminals facing away from the mounting surface.
- RFT9709 dimensions are provided in Figure 1-2.

Figure 1-2. RFT9709 dimensions



1.4 Optional NEMA-housing installation

An optional NEMA-4 (IP65) housing is available from the factory, or the enclosure may be user-supplied.

Factory-supplied housing

If the RFT9709 is ordered with the factory-supplied NEMA-4 (IP65) housing, Micro Motion installs the transmitter in the enclosure.

- Install the NEMA enclosure with four bolts. Micro Motion does not supply mounting bolts.
- Mount to any flat, stable surface.
- NEMA housing dimensions are provided in Figure 1-3, page 6.

User-supplied housing

Any user-supplied NEMA-4 (IP65) enclosure of an appropriate size may be used to house the RFT9709. Dimensions of the RFT9709 are provided in Figure 1-2, page 4.

Conduit openings

Whether the optional NEMA housing is supplied by the user or the factory, the user must add three conduit openings for power-supply wiring, input wiring, and output wiring.

- Locate the housing so these openings are accessible for installation of wiring and so the housing cover can be fully opened for access to the RFT9709 inside.
- To help prevent moisture from entering the housing, install the housing so conduit openings are pointed downward, if possible. To maintain the enclosure's NEMA rating, all conduit openings must be fully sealed after wiring is installed.
- Recommended size for conduit openings is 3/4-inch (20 mm).

⚠ CAUTION

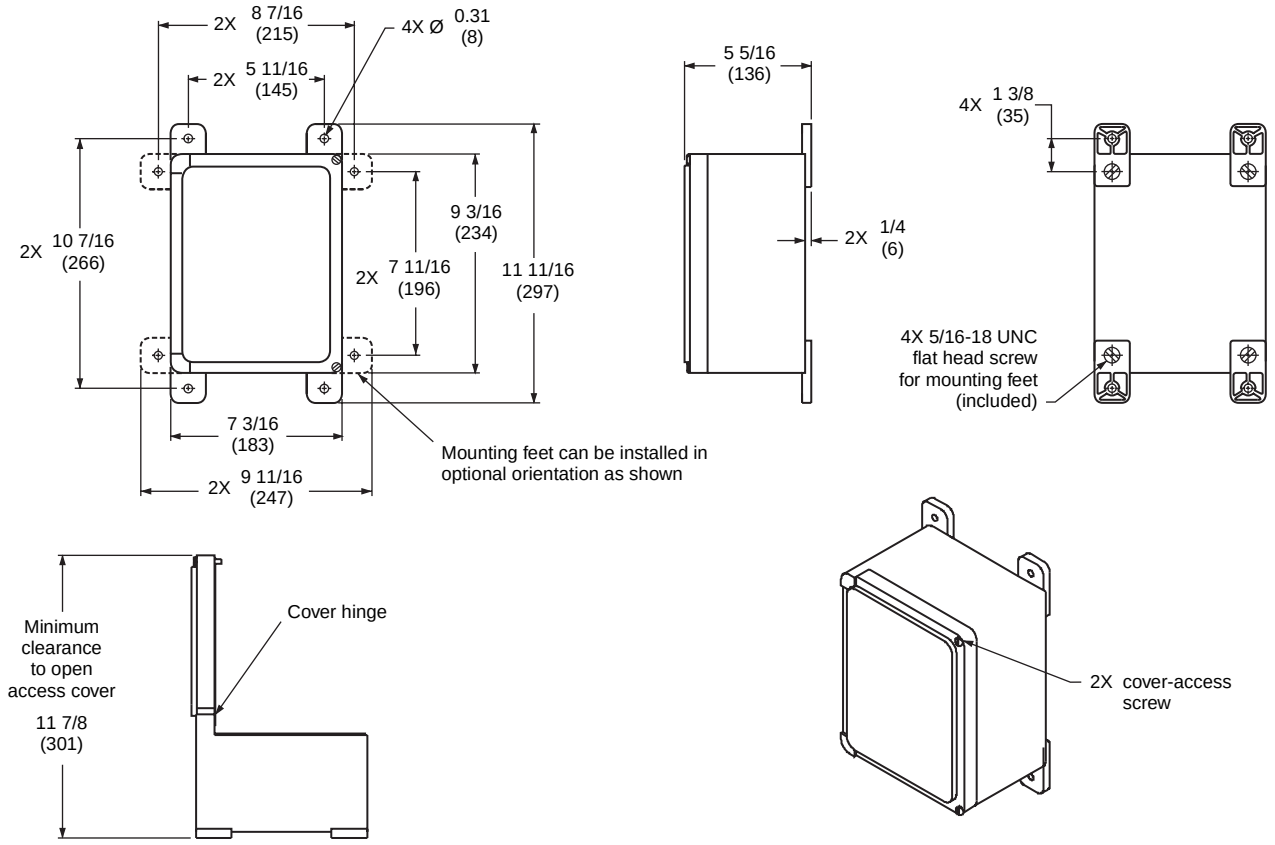
Failure to protect the RFT9709 from moisture could cause a short circuit, which would result in measurement error or flowmeter failure.

To avoid risk of condensation of excessive moisture in the NEMA housing:

- Seal all conduit openings.
- Install drip legs in cable or conduit.
- Close and fully tighten all NEMA-housing covers.

Figure 1-3. Factory-supplied NEMA-housing dimensions

Dimensions in inches (mm)



Housing requires installation of three conduit openings for power-supply wiring, input wiring, and output wiring. Recommended opening size: 3/4-inch (20 mm).

Wiring

2.1 General guidelines

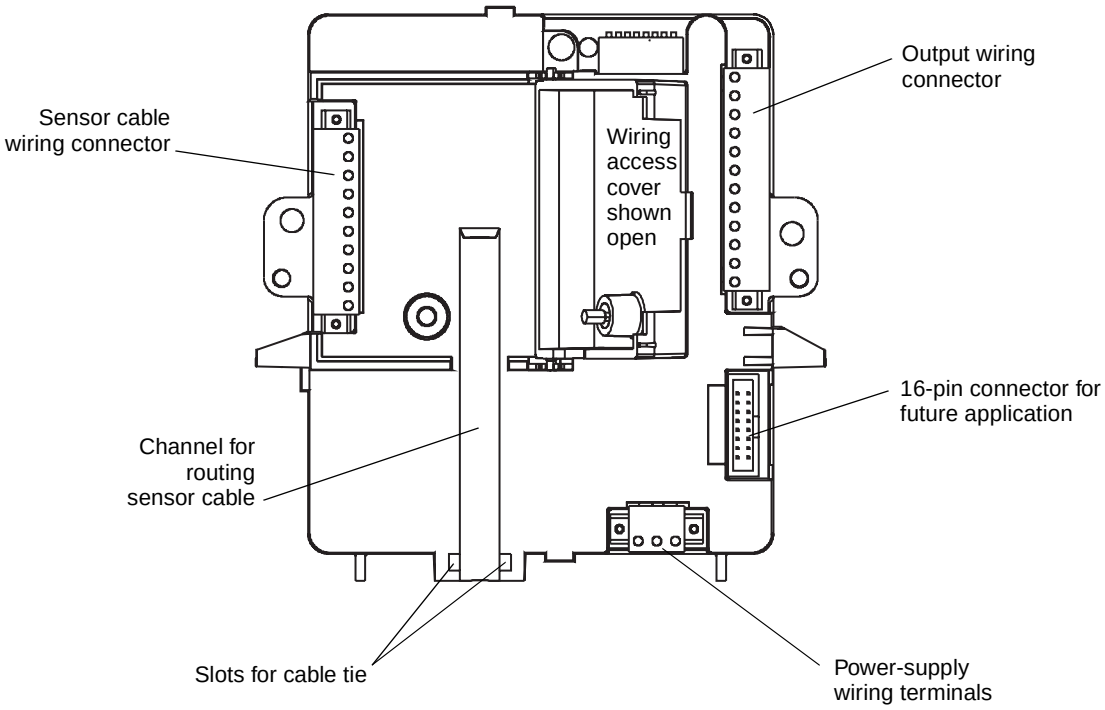
Figure 2-1 illustrates the locations of the terminals for power-supply wiring, wiring to the sensor, and output wiring.

- Terminal blocks may be unplugged from the RFT9709 (after removing two screws) for easier installation of wiring. Always tighten screws after re-installing terminal blocks.
- Install all conduit, cable and wiring to meet local code requirements.

For an RFT9709 installed in a NEMA enclosure:

- The RFT9709 may be installed in a user-supplied or factory-supplied NEMA-4 (IP65) enclosure, as described in Section 1.4, page 5. The enclosure requires three separate conduit openings for power-supply wiring, sensor wiring, and output wiring.
- Conduit openings must remain sealed to maintain the NEMA-4 (IP65) rating. Use conduit seals or cable glands that provide a complete seal with the conduit openings.

Figure 2-1. RFT9709 wiring terminals



2.2 Power supply wiring and grounding

For power-supply wiring and grounding, follow these guidelines:

- The RFT9709 requires an 11 to 30 VDC power supply.
- Do not install unfiltered DC power cable in the same conduit or cable tray as sensor cable or output wiring.
- If the sensor installation must comply with UL standards, refer to Micro Motion UL-D-IS Installation Instructions.
- Refer to the wiring diagram presented in Figure 2-2.

⚠ WARNING

Failure to comply with requirements for intrinsic safety in a hazardous area could result in an explosion.

Power-supply wiring is not intrinsically safe.

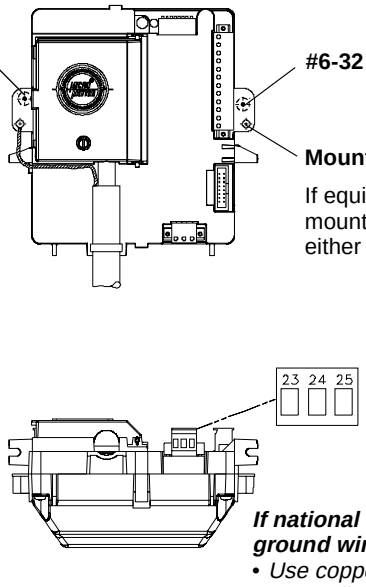
- Keep power-supply wiring separated from intrinsically safe sensor wiring and output wiring.
- For intrinsically safe sensor installations, use this document with Micro Motion UL installation instructions.

⚠ CAUTION

Installation with power supply on could cause transmitter damage or failure.

Turn off power before connecting power supply wiring.

Figure 2-2. Power-supply wiring and grounding connections



11–30 VDC power supply	
Terminal	Function
23	DC–
24	DC+
25	⏚

If national standards are not in effect, adhere to these standards for ground wiring:

- *Use copper wire, 14 AWG (2.5 mm²) or larger wire size for grounding.*
- *Keep all ground leads as short as possible, less than 1 ohm impedance.*
- *Connect power-supply ground lead directly to earth ground, or follow plant standards if a separate high-integrity intrinsically safe ground scheme is used.*

2.3 Sensor wiring

The instructions in this section explain how to connect a fully prepared Micro Motion flowmeter cable to the RFT9709 and a sensor. The sensor can be a Model D, DL, DT, ELITE®, or BASIS® sensor.

- The procedure for preparing Micro Motion flowmeter cable and cable glands is described in the instructions that are shipped with the cable.
- Install cable and wiring to meet local code requirements.
- Use Micro Motion color-coded cable.
- Total length of cable from the sensor to the RFT9709 must not exceed 1000 feet (300 meters).

⚠ WARNING

Failure to comply with requirements for intrinsic safety in a hazardous area could result in an explosion.

Sensor wiring is intrinsically safe.

- Keep intrinsically safe sensor wiring separated from power-supply wiring and output wiring.
- For intrinsically safe sensor installations, use this document with Micro Motion UL installation instructions.

⚠ CAUTION

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

Keep sensor cable away from devices such as transformers, motors, and power lines, which produce large magnetic fields.

Cable types

Micro Motion supplies 9-wire jacketed, shielded, or armored cable, as illustrated in Figure 2-3.

- All cable types are acceptable for cable tray installation.
- All cable types must have the jacket extend under the wiring terminals access cover, as illustrated in Figure 2-4.
- Shielded and armored cable must have the braided shield terminated as illustrated in Figure 2-4.

Figure 2-3. Cable types

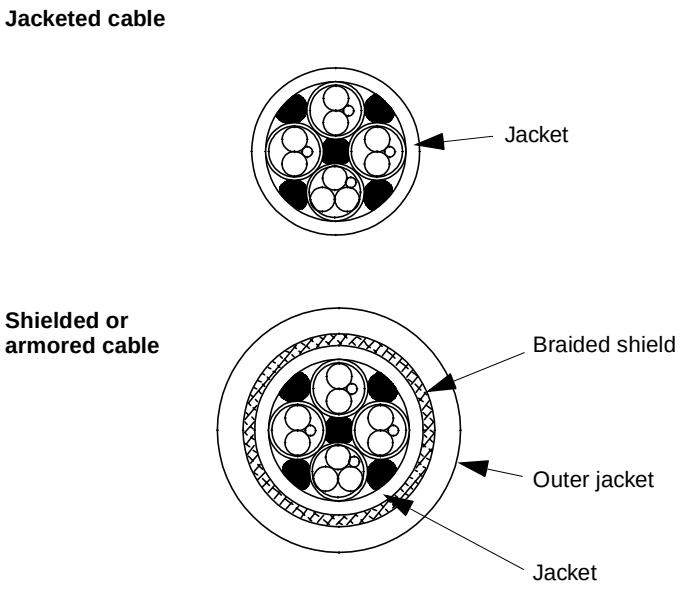
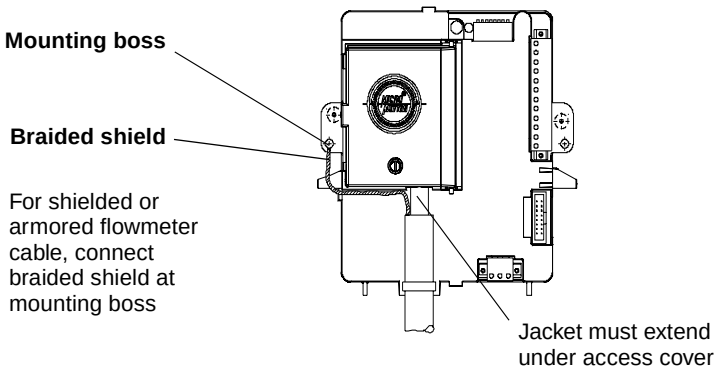


Figure 2-4. Terminating flowmeter cable



Remotely-installed temperature detector

A temperature signal is transmitted to the RFT9709 from a temperature detector (RTD) on the flow tube inside the sensor case. This signal is carried by three wires of the flowmeter cable: the yellow, orange and violet wires (see Table 2-1, page 13).

To meet API requirements, a user-supplied external temperature detector can be installed remotely by the user. This external temperature detector, instead of the RTD inside the sensor, is wired to the RFT9709.
- The external RTD must be accurate to ±0.1°F (±0.05°C).
- RTD calibration information must be configured in the RFT9709.

Requirements for installing a user-supplied external temperature detector:
- Locate the external temperature detector as close to the sensor as possible.
- Use an individually shielded 3-wire cable of 22 AWG (0.3 mm²) or larger wires to connect the external temperature detector to the flowmeter.
- Wiring diagrams are provided in Figure 2-6, Figure 2-7, and Figure 2-8 on pages 14 through16.

Procedure for installing the user-supplied external temperature detector:
1. At the sensor junction box, before connecting the flowmeter cable, identify the yellow, orange and violet wires that come from inside the sensor.
2. Disconnect these wires from the terminal block, and tie all three together with a wire nut to protect exposed wire ends.
3. Connect three wires from the external temperature detector to the terminals, as illustrated in Figure 2-6, Figure 2-7, or Figure 2-8. If the temperature detector has a fourth wire, it remains unconnected.
4. Make flowmeter cable connections as illustrated in Figure 2-6, Figure 2-7, or Figure 2-8.

Cable connections to sensor and RFT9709

Wiring connections from the sensor to the RFT9709 are made at the RFT9709 terminals indicated in Figure 2-5. Instructions for wiring the sensor and transmitter are provided below and on the following pages.

The wiring procedure is the same for the sensor and RFT9709. Refer to the wiring diagrams on pages 14 through 16, and follow these steps:

1. Insert the stripped ends of the individual wires into the terminal blocks. No bare wires should remain exposed.
   - At the sensor, connect wiring inside the sensor junction box.
   - At the RFT9709, connect wiring to the intrinsically safe terminals for sensor wiring, indicated in Figure 2-5. The flowmeter cable outer jacket must extend under the RFT9709 wiring terminals access cover.
   - For easier connection of wiring, terminal blocks can be unplugged from the RFT9709. Two captive screws hold each terminal block in place.

2. Locate the wires by color as indicated in Table 2-1.

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

4. Tightly close all housing covers.
   - Tighten the sensor junction-box cover. Tighten all four cover screws.
   - Close the RFT9709 sensor-wiring access cover and tighten the screw that holds it in place.
   - If the RFT9709 is installed in a NEMA enclosure, tightly close all NEMA housing covers.

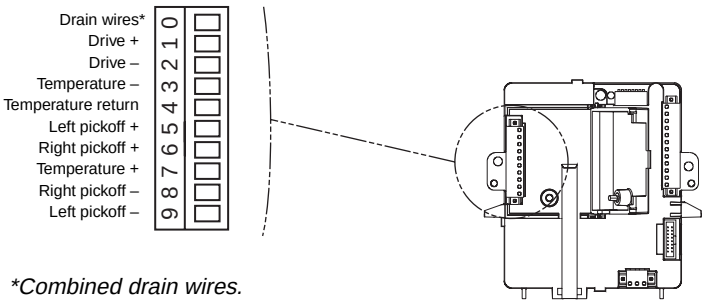
⚠ CAUTION

Exposing the RFT9709 to moisture, or failure to seal the sensor junction box, could cause a short circuit.

A short circuit would result in measurement error or flowmeter failure.

To avoid risk of condensation or excessive moisture:
- Seal all conduit openings.
- Install drip legs in cable or conduit.
- Fully tighten sensor junction box cover.
- Close and tighten all NEMA housing covers.

Figure 2-5. RFT9709 terminals for sensor wiring



**Combined drain wires.*

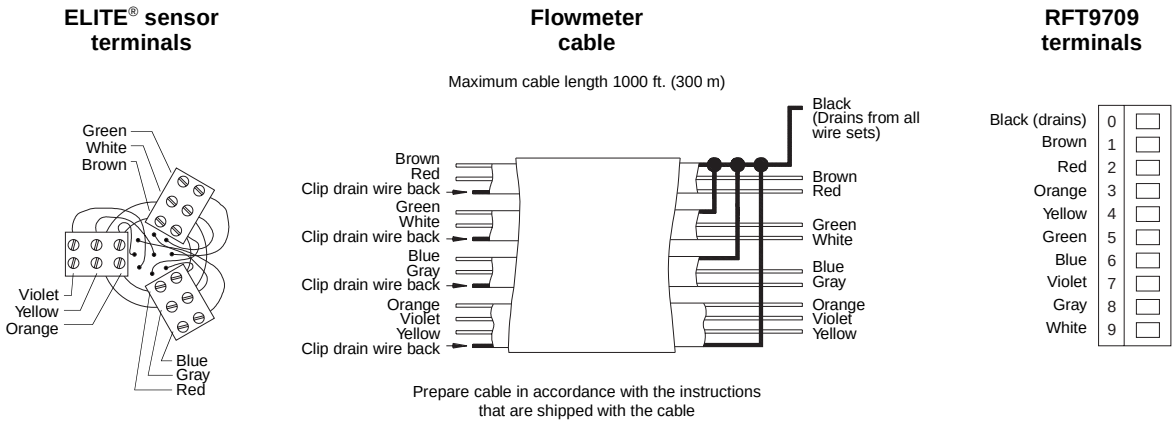
Table 2-1. Sensor-wiring terminal designations

Wire color	Sensor terminal	RFT9709 terminal	Function
Black*	No connection**	0	Drain wires*
Brown	1	1	Drive +
Red	2	2	Drive –
Orange	3	3	Temperature –
Yellow	4	4	Temperature return
Green	5	5	Left pickoff +
Blue	6	6	Right pickoff +
Violet	7	7	Temperature +
Gray	8	8	Right pickoff –
White	9	9	Left pickoff –

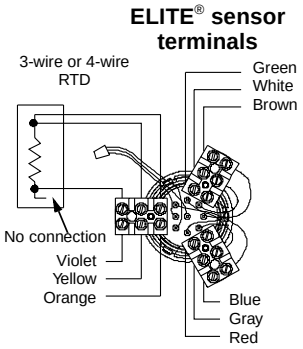
**Combined drain wires from brown/red, green/white, and gray/blue pairs, and yellow/orange/violet triplet.*

***Cut off drain wires and protect from shorting to any metal or terminals.*

Figure 2-6. Wiring to ELITE® CMF sensors

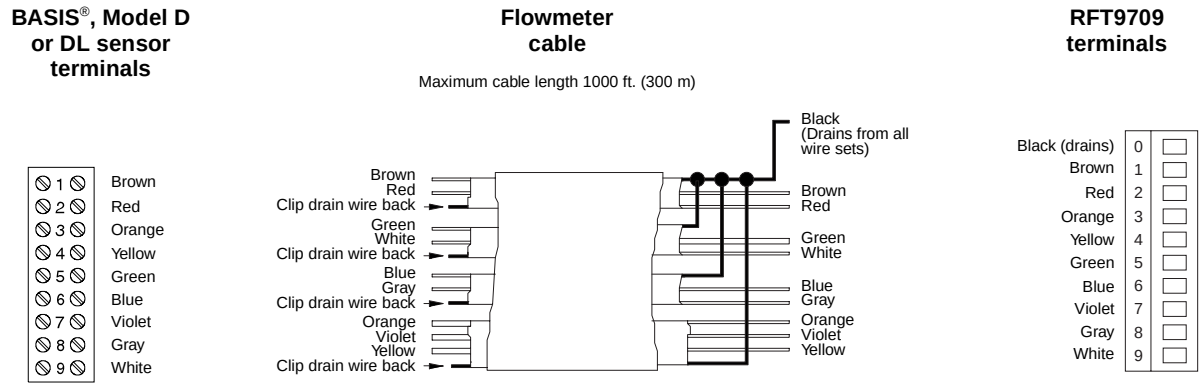


Optional remote temperature detector (RTD) wiring (required for API)

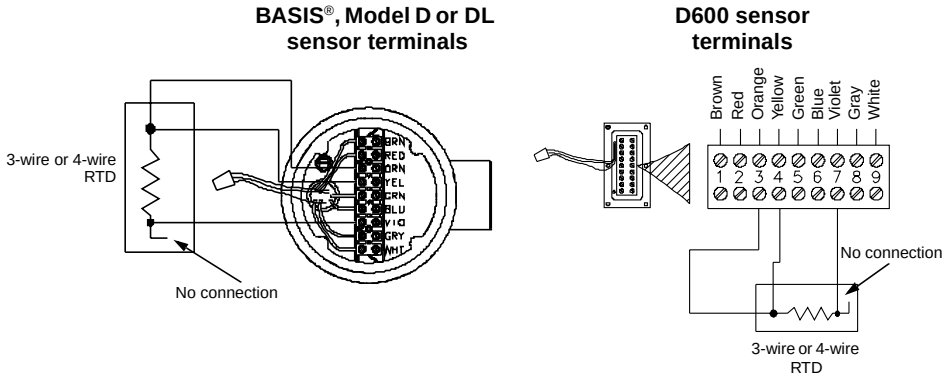


1. In the sensor junction box, identify the violet, yellow, and orange wires that come from the sensor.
2. Disconnect these wires from the terminal block, then tie all three together with a wire nut to protect exposed wire ends.
3. Connect three wires from the external RTD to the terminals from Step 2, as illustrated at left. If the RTD has a fourth wire, it remains unconnected.

Figure 2-7. Wiring to BASIS® F, Model D, and DL sensors

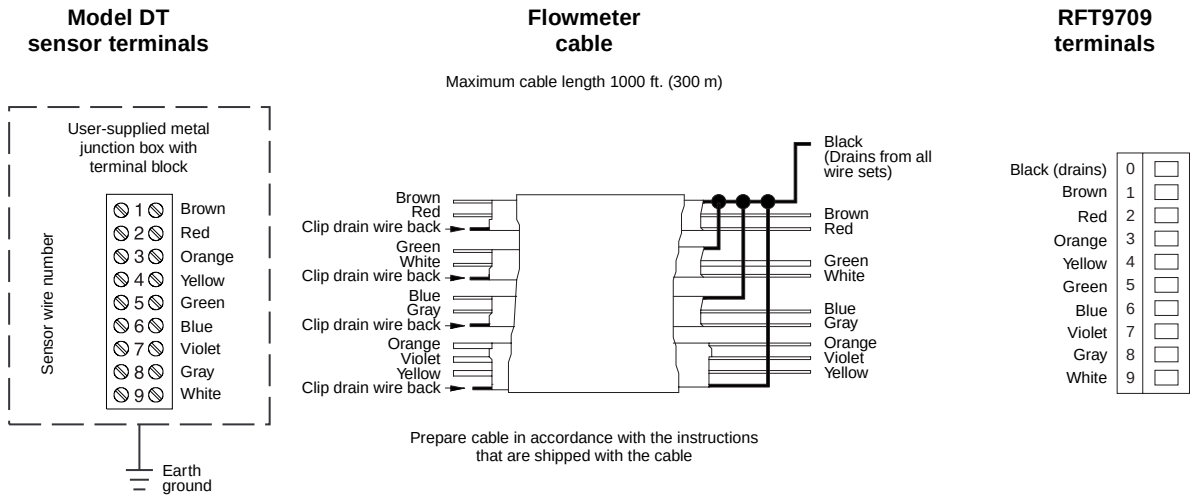


Optional remote temperature detector (RTD) wiring (required for API)

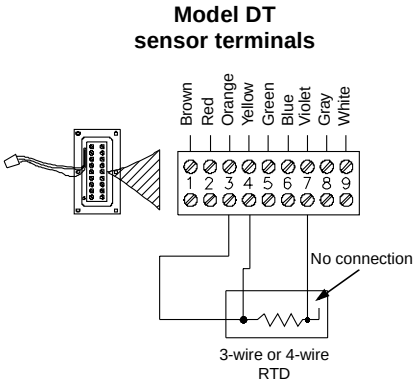


1. In the sensor junction box, identify the violet, yellow, and orange wires that come from inside the sensor.
2. Disconnect these wires from the terminal block, then tie all three together with a wire nut to protect exposed wire ends.
3. Connect three wires from the external RTD to the terminals from Step 2, as illustrated above. If the RTD has a fourth wire, it remains unconnected.

Figure 2-8. Wiring to Model DT sensors



Optional remote temperature detector (RTD) wiring (required for API)



1. In the sensor junction box, identify the violet, yellow, and orange wires that come from the sensor.
2. Disconnect these wires from the terminal block, then tie all three together with a wire nut to protect exposed wire ends.
3. Connect three wires from the external RTD to the terminals from Step 2, as illustrated at left. If the RTD has a fourth wire, it remains unconnected.

2.4 Output wiring

Output wiring terminal designations are described in Table 2-2. Output functions and wiring are described in detail through page 25. Follow these general guidelines for output wiring:

- Use individually shielded pairs of 22 AWG (0.3 mm²) or larger wires for connections between the RFT9709 and any peripheral device.
- Maximum wire length between the RFT9709 and any peripheral device is 500 feet for 22 AWG wire (150 meters for 0.3 mm² wire), 50 feet for 28 AWG wire (15 meters for 0.1 mm² wire).
- Shields and/or drain wires must be terminated at the RFT9709 (see Figure 2-9) or at the peripheral device.

⚠ WARNING

Failure to comply with requirements for intrinsic safety in a hazardous area could result in an explosion.

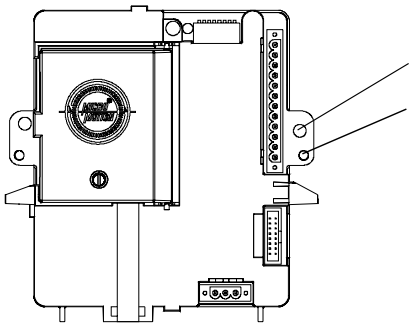
Output wiring is not intrinsically safe.

- Keep output wiring separated from power-supply wiring and intrinsically safe sensor wiring.
- Follow all output wiring instructions to ensure the RFT9709 and any connected devices will operate correctly.

Table 2-2. Output-wiring terminal designations

Terminals	Function
11 and 12	Primary variable (PV) mA output
13 and 14	Secondary variable (SV) mA output
15 and 16	RS-485 I/O
17 and 18	Frequency/pulse output
19 and 18	Control output
20 and 18	Remote zero input
21 and 22	Pressure transmitter (or DP cell)

Figure 2-9. Terminating output-wiring shields and drains



#6-32 ground nut

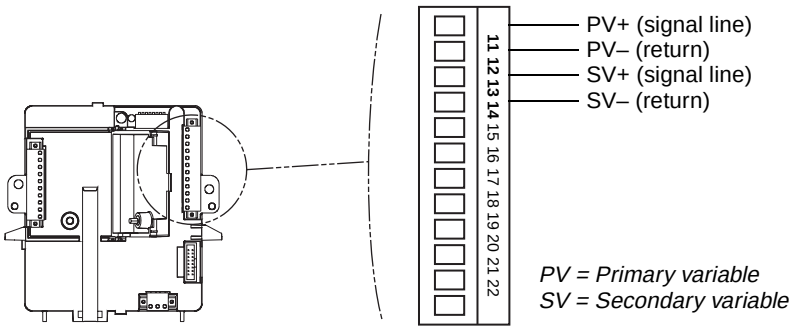
Mounting boss

Terminate shields and/or drain wires at mounting boss or ground nut, or terminate them at peripheral device.

Primary and secondary mA outputs

Primary and secondary output signals can be independently configured, and can represent mass flow rate, gross volume flow rate, gross standard volume flow rate, density, or temperature. With a pressure or differential pressure transmitter, the primary and secondary output signals can also represent pressure, differential pressure, or viscosity.

Figure 2-10. mA output terminals



Output performance and requirements

- The mA outputs produce a 4-20 mA current, and can supply power for loop-powered process indicators such as the Micro Motion PI 4-20 Process Indicator.
- Primary and secondary mA output loops are isolated and floating. Additional grounding will result in optimum performance, and optimum HART communication on the primary mA output. Ensure that mA output loops are grounded at the external device.
- The maximum allowable length for mA signal wiring is determined by measuring resistance over the signal wires and through the receiver device. Total loop resistance must not exceed 1000 ohms.

Output fault setting

The mA outputs can be set to produce downscale or upscale fault levels.

- If set to downscale (switch 7 off), a fault drives the outputs to 0-2 mA
- If set to upscale (switch 7 on), a fault drives the outputs to 22-24 mA

Low-flow cutoffs

If an mA output is configured to represent a flow rate, flow values below the user-defined low-flow cutoff cause the output to default to the level that represents zero flow.

Slug-flow inhibit

The RFT9709 senses density outside user-selected limits. An mA output configured to represent a flow rate holds at the last measured flow rate before a slug-flow condition occurred, for a programmed time of 0-60 seconds, then defaults to the output level that represents zero flow.

Damping

A wide range of filter constants is available for damping on flow, density, or temperature. Additional damping may be applied to mA outputs.

HART multidrop network wiring

The Bell 202 physical layer is used for digital communication with the HART protocol. Devices in a HART multidrop network communicate by sending and receiving signals to and from one another.

Up to 15 transmitters can be connected using the Bell 202 standard. Other Rosemount® SMART FAMILY® transmitters can also participate in a HART network.

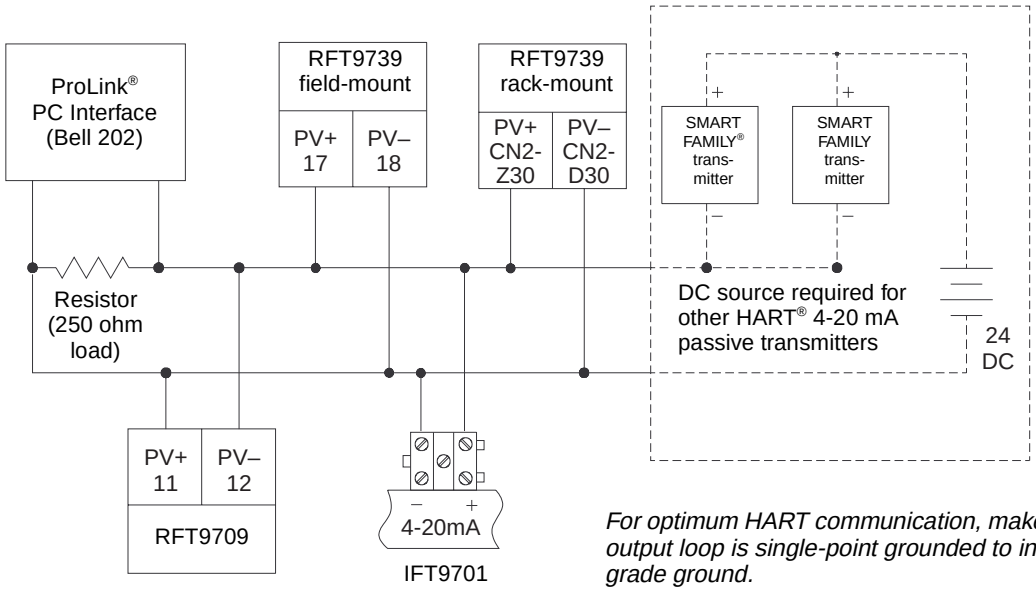
- Using multiple transmitters in a HART network requires assigning a unique address from 1 to 15 to each transmitter. Assigning an address of 1 to 15 to the RFT9709 causes the primary mA output to remain at a constant 4 mA level.
- A HART-compatible control system can communicate with any device in a HART network over the same 2-wire pair.

Configuration switches on the RFT9709 allow the choice of Bell 202 or RS-485 physical layers for HART or Modbus® communications. Make sure switches are set as instructed in Section C.2, page 47, before attempting to use the RFT9709 in a HART multidrop network.

Figure 2-11 shows how to connect multiple transmitters to a host controller for Bell 202 HART digital communication.

- The Bell 202 standard requires twisted-pair wire.
- SMART FAMILY devices require a minimum loop resistance of 250 ohms. Loop resistance must not exceed 1000 ohms.
- Connect the mA outputs from each transmitter together so they terminate at a common load resistor, with at least 250 ohms impedance, installed in series.

Figure 2-11. Typical HART® network wiring



For optimum HART communication, make sure the output loop is single-point grounded to instrument grade ground.

RS-485 output

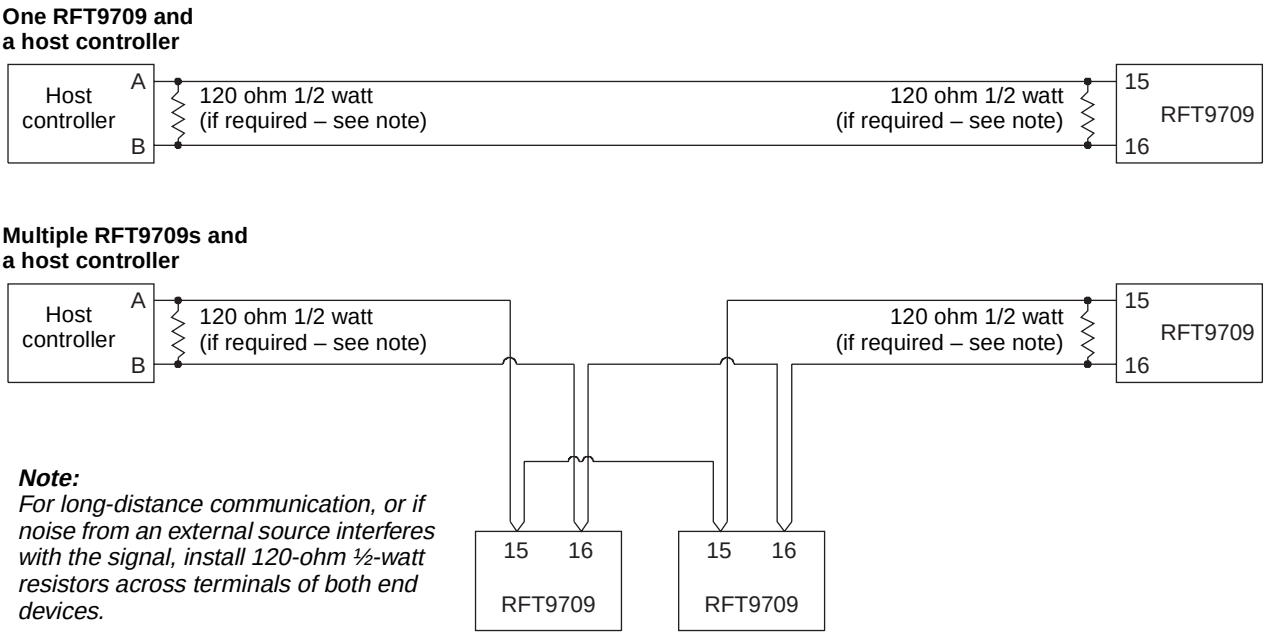
The RS-485 physical layer is used for serial communication with the HART or Modbus protocol. Multiple transmitters can participate in an RS-485 multidrop network.

- Under HART protocol, up to 32 transmitters can participate in the network. Each transmitter must have a unique tag name. If polling addresses are used, up to 16 transmitters can have unique polling addresses from 0 to 15.
- Under Modbus protocol, up to 15 transmitters can participate in the network. Each transmitter must have a unique polling address from 1 to 15.
- Configuration switches on the RFT9709 allow the choice of Bell 202 or RS-485 physical layers for HART or Modbus communications. Make sure switches are set as instructed in Section C.2, page 47, before attempting to use the RFT9709 in an RS-485 multidrop network.

Figure 2-12 shows how to connect one transmitter or multiple transmitters to a host controller for RS-485 serial communication.

- Install twisted-pair, shielded cable, consisting of 24 AWG (0.25 mm²) or larger wire, between the RFT9709 and an RS-485 communication device. Maximum cable length is 4000 feet (1200 meters).
- Some installations require a 120-ohm, ½-watt resistor at both ends of the network cable to reduce electrical reflections.

Figure 2-12. RS-485 wiring

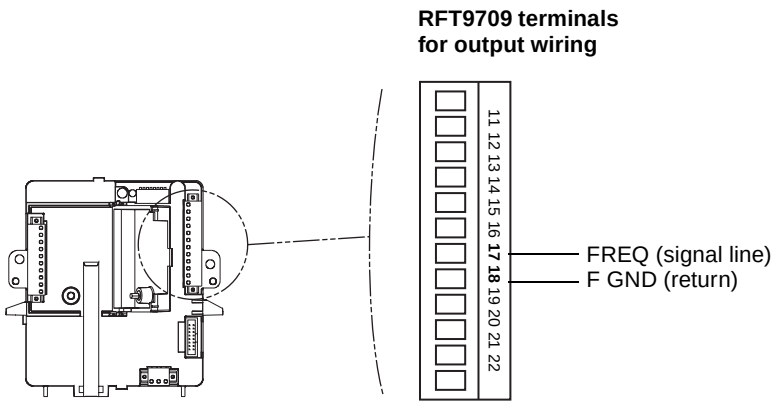


Note:
For long-distance communication, or if noise from an external source interferes with the signal, install 120-ohm ½-watt resistors across terminals of both end devices.

Frequency/pulse output

The frequency/pulse output represents mass, mass flow rate, gross volume, gross volume flow rate, gross standard volume, or gross standard volume flow rate, independent of the mA outputs.

Figure 2-13. Frequency/pulse output terminals



Terminal 18 is a common return for the frequency/pulse output, the control output, and the external zero input.

Output performance and requirements

- The frequency/pulse output can be used with any Micro Motion peripheral device except the DMS Density Monitoring System and the PI 4-20 Process Indicator, which do not have frequency inputs.
- For use with receivers other than Micro Motion peripheral devices, check the instruction manual for the receiver to make sure its input-voltage and electrical-current ratings match the output-voltage and electrical-current ratings of the RFT9709.
- RFT9709 output is a nominal +23 V square wave, unloaded. Any load will decrease the peak voltage level.
- Output impedance is 3.3 kohm.
- The frequency/pulse output loop is isolated and floating. Additional grounding will result in optimum performance. Ensure that the frequency/pulse output loop is grounded at the external device.
- If necessary, the frequency output can be configured for open collector mode. For instructions, see Appendix D, page 53. When used in the open collector mode, the output circuit is rated to 30 VDC, with 0.1 ampere maximum sinking capability.

Output fault setting

The frequency/pulse output can be set to produce downscale or upscale fault levels.

- If set to downscale (switch 7 off), a fault drives the output to 0 Hz
- If set to upscale (switch 7 on), a fault drives the outputs to 15-19 kHz

Low-flow cutoff

Flow values below the user-defined low-flow cutoff cause the output to default to the level that represents zero flow.

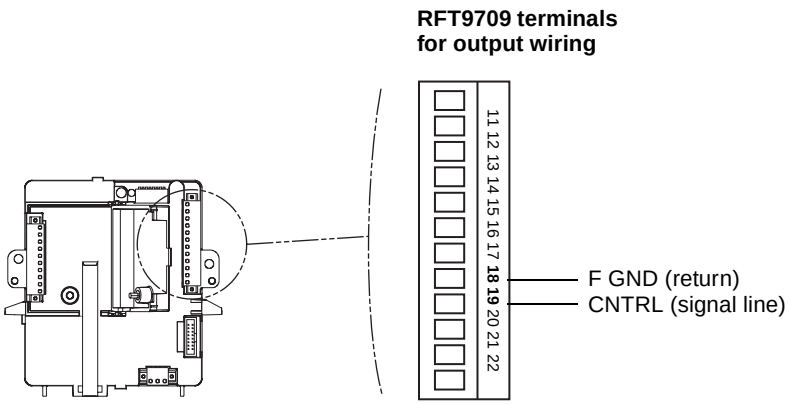
Slug-flow inhibit
The RFT9709 senses density outside user-selected limits. The output holds at the last measured flow rate before a slug-flow condition occurred, for a programmed time of 0-60 seconds, then defaults to 0 Hz.

Damping
A wide range of filter constants is available for damping on flow.

Control output

The control output can indicate flow direction, RFT9709 zeroing in progress, fault alarm, event 1, or event 2.

Figure 2-14. Control output terminals



Terminal 18 is a common return for the frequency/pulse output, the control output, and the external zero input.

Output performance
- When configured to indicate flow direction, the output is high (+23 V) when indicating forward flow, and low (0 V) when indicating reverse flow.
- When configured to indicate RFT9709 zeroing in progress, the output is low (0 V) when zeroing is in progress and high (+23 V) at all other times.
- When configured to indicate faults, the output is low (0 V) when a fault condition exists and high (+23 V) during normal operation.
- When configured to indicate event 1 or event 2, the output switches ON (0 V) or OFF (+23 V) when the flow rate, flow total, density, temperature, pressure, or viscosity of the process fluid achieves a programmed setpoint.
- RFT9709 output is nominal 0 or +23 V, unloaded.
- Output impedance is 3.3 kohm.
- If necessary, the control output can be configured for open collector mode. For instructions, see Appendix D, page 53. When used in the open collector mode, the output circuit is rated to 30 VDC, with 0.1 ampere maximum sinking capability.

External zero switch wiring

The RFT9709 can be configured to allow flowmeter zeroing from an external switch.

- The switch must be a momentary-type contact, normally open, and must carry 1 mA of current in the closed position. The open circuit voltage is 23 VDC.
- The flowmeter zeroing procedure is described in Section 3.2, page 27.

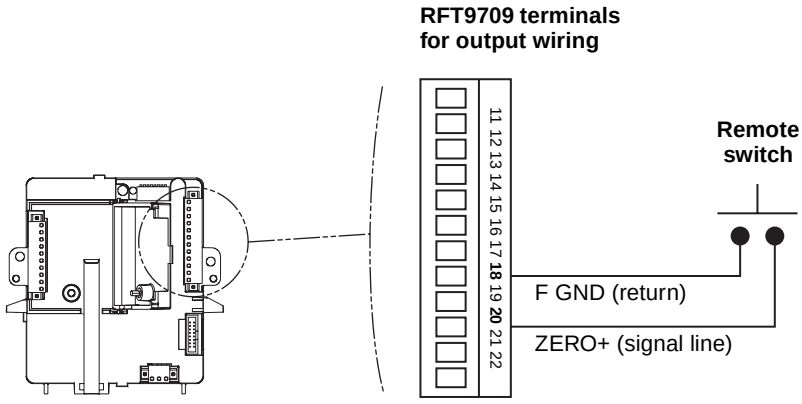
⚠ WARNING

Failure to comply with requirements for intrinsic safety in a hazardous area could result in an explosion.

External zero switch wiring is not intrinsically safe.

Keep external zero switch wiring separated from power-supply wiring, intrinsically safe sensor wiring, and any other intrinsically safe wiring.

Figure 2-15. Remote-zero switch wiring



Terminal 18 is a common return for the frequency/pulse output, the control output, and the external zero input.

Viscosity measurement or pressure compensation

The RFT9709 accepts pressure input signals from a pressure transmitter for viscosity measurement, pressure indication, or pressure compensation.

RFT9709 performance

- Using input from a differential pressure transmitter (DP cell), the RFT9709 can calculate viscosity.
- If a pressure transmitter connected to a host controller measures gauge pressure at the sensor input, the RFT9709 can compensate for the pressure effect on the sensor. Pressure compensation is required only for the sensor models listed in Table 2-3, page 24.
- With a pressure transmitter or DP cell, the RFT9709 primary variable (PV) and secondary variable (SV) outputs can represent pressure.
- When using the pressure transmitter as part of a HART multidrop network, the RFT9709 PV output remains fixed at 4 mA.

Pressure transmitter requirements

- The pressure transmitter must be a HART SMART FAMILY device.
- The pressure transmitter can be powered from the RFT9709, or externally powered as part of a HART multidrop network. See *HART multidrop network wiring*, page 19.

Multidrop network requirements

- The pressure transmitter must be assigned a unique multidrop address from 1 to 15.
- The RFT9709 must be assigned a unique multidrop address from 0 to 15. Assigning an address other than 0 fixes the RFT9709 primary variable (PV) output at 4 mA.

Configuration options

- The pressure transmitter can be configured with a Rosemount Model 275 HART Communicator, attached either to the RFT9709 HART loops or directly to the pressure transmitter.
- To configure the RFT9709 for pressure compensation or viscosity measurement, a special version of the ProLink program is required. The HART Communicator cannot be used for RFT9709 configuration. (Contact the factory for additional ProLink information.)

Table 2-3. Sensors affected by pressure

ELITE®	BASIS®	Model D
CMF100	F050	D300
CMF200	F100	D600
CMF300	F200	DL100
CMF400		DL200

Wiring instructions

Instructions for wiring the RFT9709 to a pressure transmitter are provided below.

- Use Figure 2-16a for an internally powered configuration.
- Use Figure 2-16b for an externally powered (multidrop) configuration.

⚠ WARNING

Failure to comply with requirements for intrinsic safety in a hazardous area could result in an explosion.

Pressure transmitter wiring is not intrinsically safe.

Keep pressure transmitter wiring separated from power-supply wiring, intrinsically safe sensor wiring, and any other intrinsically safe wiring.

Figure 2-16a. Pressure transmitter wiring, internally powered

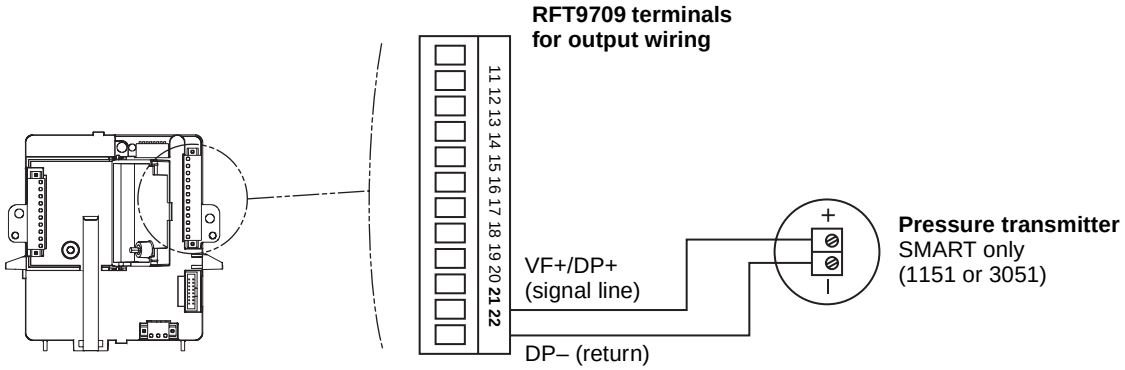
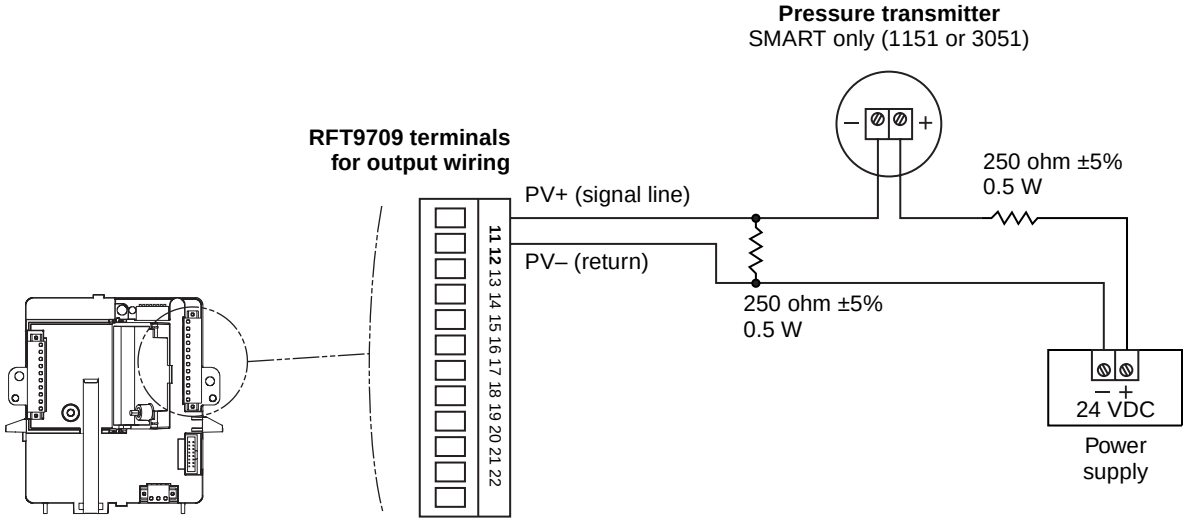


Figure 2-16b. Pressure transmitter wiring, externally powered (multidrop network)



Startup

3.1 Initialization

After wiring has been connected, power can be applied. During initialization, the RFT9709 diagnostic LED (see Figure 3-1) remains on continuously, while the RFT9709 performs a self-diagnostic test. After initialization is completed, the LED blinks ON once per second to indicate proper RFT9709 operation.

At startup, the power source must provide a minimum of 2 amperes of inrush current at a minimum of 11 volts and a maximum of 7 watts at the RFT9709 power input terminals.

3.2 Flowmeter zeroing

Flowmeter zeroing establishes flowmeter response to zero flow and sets a baseline for flow measurement.

- Zeroing is necessary when the flowmeter is first put into operation, and if either the transmitter or sensor is replaced or reinstalled.
- Zeroing is not necessary every time power is applied to the transmitter, or when a new process fluid is run through the sensor.
- Zeroing is accomplished with the RFT9709 zero button (see Figure 3-1) or a special version of the ProLink program. The HART Communicator cannot be used for zeroing the flowmeter. (Contact the factory for additional ProLink information.)
- The zeroing procedure is described on page 28.

⚠ 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.

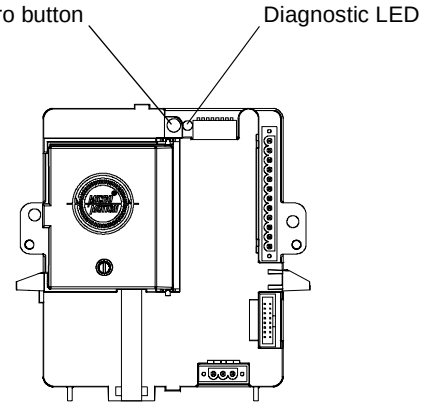


Figure 3-1. Diagnostic LED and zero button

Zeroing procedure

1. Prepare the flowmeter for zeroing:
   a. Install the sensor according to the sensor instruction manual.
   b. Apply power to the RFT9709, then allow it to warm up for at least 30 minutes.
   c. Ensure the RFT9709 is in a security mode that allows flowmeter zeroing (see *Security modes*, page 49).
   d. Run the process fluid to be measured through the sensor until the sensor temperature reading approximates the normal process operating temperature.

2. Close the shutoff valve downstream from the sensor.

3. Make sure the sensor is completely filled 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. Zero the flowmeter in any of three ways:
   • Press and hold the zero button for at least five seconds. Figure 3-1, page 27, shows the location of the button.
   • An external contact closure can be used for zeroing. Close the contact for at least 5 seconds. (Refer to *External zero switch wiring*, page 23, for wiring instructions.)
   • Issue an auto zero command using a special version of the ProLink program. The HART Communicator cannot be used for zeroing the flowmeter. (Contact the factory for additional ProLink information.)

During zeroing, the diagnostic LED remains on continuously. The default zero time will range from 20 to 90 seconds, depending on the sensor.

After the zeroing procedure has been completed, the LED again blinks ON once per second to indicate normal operation.

Diagnosing zero failure

If zeroing fails, the LED blinks ON four times per second to indicate an error condition. An error condition could indicate:
• Flow of fluid during zeroing
• Partially empty flow tubes
• An improperly mounted sensor

To clear a zeroing error, re-zero the flowmeter after correcting the problem, or abort the procedure by cycling power to the RFT9709.

3.3 Event registers

Event registers are provided for security requirements for custody transfer applications. When the RFT9709 is configured for security mode 8 (see *Security modes*, page 49), the RFT9709 meets security requirements for custody transfer described in National Institute of Standards and Technology (NIST) Handbook 44.

Event registers record one change for each change "session." A change session begins when the transmitter is taken out of security mode 8, and ends when security mode 8 is reentered. After a change session is ended, security event registers will increase by one (1) if any of the parameters listed in Table 3-1 have been changed. Each register counts up to 999, then rolls over to zero. Event registers cannot be reset.

Event registers can be read using a special version of the ProLink program. The HART Communicator cannot be used for viewing these registers. (Contact the factory for additional ProLink information.)

Table 3-1. Parameters that affect event registers

Configuration register	
Mass flow cutoff	Primary mA output trim
Flow damping	Secondary mA output trim
Volume flow cutoff	Primary mA output assignment
Flow direction	Secondary mA output assignment
Primary mA scaling factors	Control output assignment
Secondary mA scaling factors	Master reset
Calibration register	
Mass flow units	Density calibration factors • Density A and Density B • K1, K2, and FD • Density temperature coefficient
Volume flow units	
Auto zero calibration	
Density calibration	
Flow calibration factor	Pressure compensation factors • Flow factor • Density factor • Flow calibration pressure
Meter factors	
Frequency output scaling factors • Frequency • Rate	

3.4 Totalizer reset

Mass and volume totalizers cannot be reset independently. When one totalizer is reset, the other is also reset.

A special version of the ProLink program is required for totalizer control. The HART Communicator cannot be used for totalizer control. (Contact the factory for additional ProLink information.)

⚠ WARNING

When the totalizers are stopped, the frequency/pulse output is disabled.

If the frequency/pulse output is used for process control, failure to set control devices for manual operation could affect process control.

- Before stopping the totalizers, set process control devices for manual operation.
- To enable the frequency/pulse output, restart the totalizers.

3.5 Process measurement

After flowmeter zeroing has been completed as described in Section 3.2, page 27, the flowmeter is ready for process measurement.

Troubleshooting

4.1 General guidelines

Troubleshooting a Micro Motion flowmeter is performed in two parts:
1. Tests of wiring integrity
2. Observation of the transmitter's diagnostic tools, which include the diagnostic LED and fault output levels

⚠ CAUTION

During troubleshooting, the transmitter could produce inaccurate flow signals.

For personal and system safety:
- Set control devices for manual operation while troubleshooting the flowmeter.
- If terminal blocks are unplugged from the transmitter, cycle power to the transmitter after reconnecting terminal blocks.

Follow these general guidelines when troubleshooting a Micro Motion flowmeter:
- Before beginning the diagnostic process, become familiar with this instruction manual and with the instruction manual for the sensor.
- While troubleshooting a problem, leave the sensor in place, if possible. Problems often 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.

4.2 Transmitter diagnostic tools

In some situations, troubleshooting requires use of the transmitter's diagnostic tools, which include the diagnostic LED and fault output levels.

Diagnostic LED

- Transmitter operating conditions indicated by the diagnostic LED are listed in Table 4-1.
- The diagnostic LED is illustrated in Figure 4-1.

Fault outputs

The RFT9709 has downscale and upscale fault levels. To set fault levels, see *Switch Settings*, Appendix C.

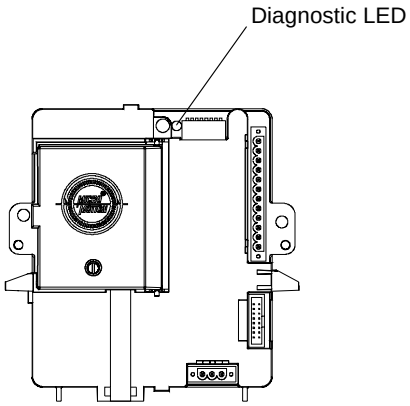
Downscale
Under fault conditions:
- mA outputs go to 0-2 mA
- frequency/pulse output goes to 0 Hz

Upscale
Under fault conditions:
- mA outputs go to 22-24 mA
- frequency/pulse output goes to 15-19 kHz

Table 4-1. Conditions indicated by diagnostic LED

Diagnostic LED does this:	Condition
Blinks ON once per second (25% ON, 75% OFF)	Normal operation
Remains ON continuously	Startup and initialization, zero in progress
Blinks ON three times, then OFF for 1 second	Communication configuration mode (configuration switch 8 in ON position)
Blinks OFF once per second (75% ON, 25% OFF)	Slug flow (density below or above user-defined limits)
Blinks ON 4 times per second	Fault condition

Figure 4-1. Diagnostic LED



4.3 Interrogation with the ProLink® program

The transmitter provides diagnostic messages, which can be viewed using a special version of the ProLink program. (The HART Communicator cannot be used for troubleshooting.) Contact the Micro Motion Customer Service Department for the special ProLink software version:

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

Figure 4-2 (next page) explains how to connect the ProLink PC Interface adaptor to the RFT9709.

Fault detection indicates an interruption in the functional integrity of the sensor and the electronics, including the sensor pickoff coils, drive coil, and RTD. Faults, such as a short or an open circuit, are detected by the ProLink program.

The RFT9709 runs continuous self-diagnostic tests. If these tests reveal a failure, the ProLink program displays an error message. Self-testing allows the RFT9709 to check its own circuitry.

Output test and trim

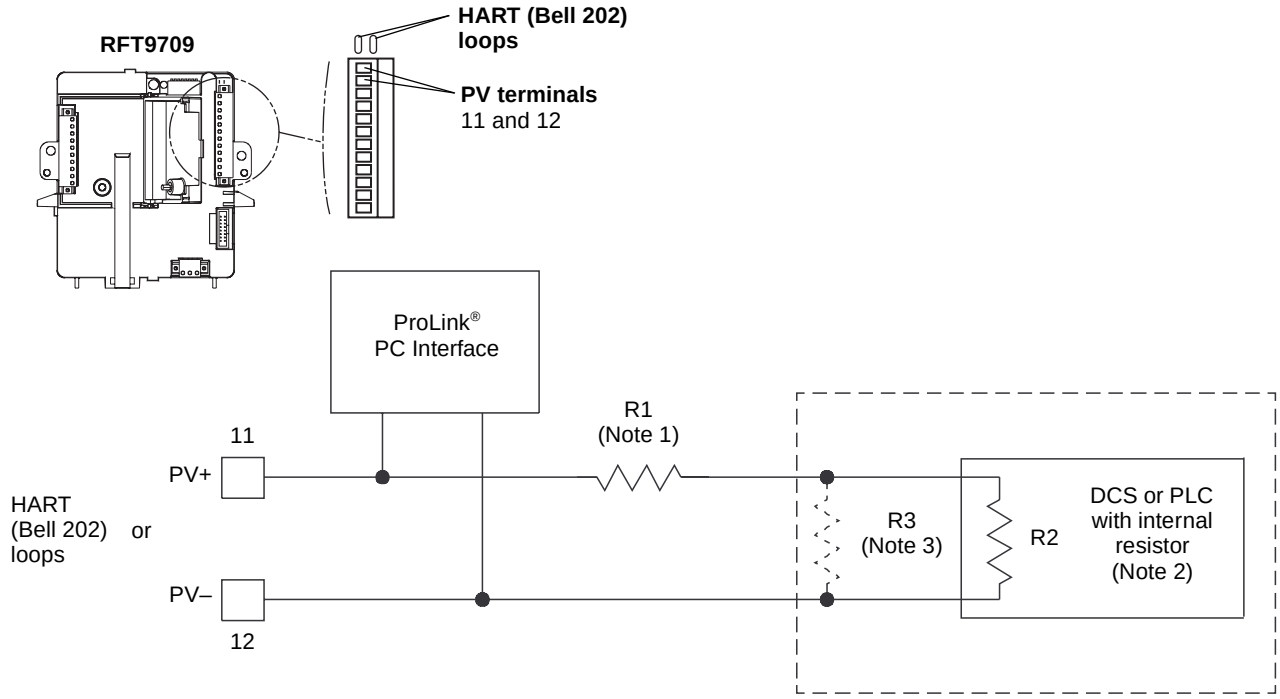
The RFT9709 works with a Micro Motion flow sensor to provide flow information. Therefore, many of the troubleshooting checks pertain only to the sensor. However, the ProLink program enables the user to perform other tests:

- Performing an mA output test forces the transmitter to produce a user-specified current output of 2 to 22 mA.
- Performing a frequency/pulse output test forces the transmitter to produce a user-specified frequency output between 0.1 and 15,000 Hz.
- Performing an mA output trim allows adjustment of the primary and secondary mA outputs against a highly accurate external standard such as a digital multimeter (DMM) or receiving device.

If the transmitter is in security mode 8, mA output test, mA output trim, and frequency/pulse output test cannot be performed.

- Perform mA trim and/or test procedures, if necessary, with the ProLink program.
- For more information, see *Security mode 8*, page 50.

Figure 4-2. ProLink® PC-Interface connections



1. If necessary, add resistance in the loop by installing resistor R1. SMART FAMILY devices require a minimum loop resistance of 250 ohms. Loop resistance must not exceed 1000 ohms, regardless of the communication setup.

⚠ CAUTION

If the primary variable (PV) analog output is being used for flow control, connecting the PC Interface to the output loop could cause the transmitter 4-20 mA output to change, which would affect flow control devices.

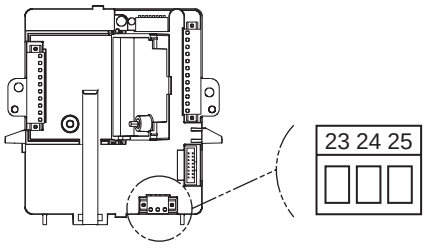
For personal and system safety, set control devices for manual operation before connecting the PC Interface to the RFT9709 primary variable milliamp output loop.

2. The DCS or PLC must be configured for an active milliamp signal.
3. Resistor R3 is required if the DCS or PLC does not have an internal resistor.

4.4 Power supply

Check to be certain the power-supply is 11-30 VDC. Ensure all wires are properly terminated. The RFT9709 power-supply and ground terminals are labeled as illustrated in Figure 4-3.

Figure 4-3. Power-supply wiring and grounding terminals



11–30 VDC power supply	
Terminal	Function
23	DC–
24	DC+
25	⏚

4.5 Wiring

For transmitter wiring instructions, refer to *Installation Step 2*, page 7.

Wiring problems are often incorrectly diagnosed as a faulty sensor. At initial startup of the RFT9709, always check the following:

1. Proper sensor cable, and use of shielded pairs
   a. Proper wire termination
   b. Wires on correct terminals
   c. Wires making good connections at RFT9709 terminals
   d. Wires making good connections at the sensor terminals
2. Wires properly connected at any intermediate terminal junction, such as the user-supplied junction box between a Model DT sensor and RFT9709.

If a fault condition is indicated, follow these instructions:

1. Shut off power supply to the RFT9709.
2. Unscrew the two screws that hold the terminal blocks to the RFT9709, and unplug the terminal blocks from the connectors.
3. Use a digital multimeter (DMM) to measure resistance between wire pairs at the RFT9709 terminals:
   • Drive coil, check terminals 1 and 2
   • Left pickoff coil, check terminals 5 and 9
   • Right pickoff coil, check terminals 6 and 8
   • RTD, check RFT9709 terminals 3 and 7
4. If the measured resistance is outside the range listed in Table 4-2, page 36, repeat the measurements at the sensor terminals.
5. Reinsert the terminal blocks and restore power to the RFT9709.
6. Use the DMM and the guidelines listed in Table 4-3, page 36, to troubleshoot the flowmeter.

Table 4-2. Normal resistance 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	Brown to Red	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	35 to 175Ω depending on process fluid
Lead Length Compensator	Yellow to Violet	4 to 7	35 to 175Ω depending on process fluid

Table 4-3. Input and output ratings

Transmitter terminal number	Input or output	Approximate value
1 to 2	Drive signal output to sensor	1.2 to 14 V peak-to-peak at flow tube natural frequency
3 to 4	Lead length compensator input	10 mVDC maximum
5 to 9	Left pickoff input	3.4 mV/Hz peak-to-peak sine wave
6 to 8	Right pickoff input	3.4 mV/Hz peak-to-peak sine wave
7 to 4	Temperature input	30 mV at 0°C, +0.14 mVDC per °C
Power terminals (+ to –)	Line voltage input	11 to 30 VDC
11 to 12	Primary mA output	4-20 mA
13 to 14	Secondary mA output	4-20 mA
15 to 16	RS-485 I/O	±5 V square wave
17 to 18*	Frequency/pulse output	23 VDC peak-to-peak square wave (+23 VDC at zero flow)
19 to 18*	Zero in progress	23 VDC when not in progress, 0 VDC when in progress
19 to 18*	Flow direction output	23 VDC with forward, 0 VDC with reverse
19 to 18*	Alarm output	23 VDC normal, 0 VDC with fault
20 to 18*	Remote zero input	23 VDC
21 to 22*	Pressure transmitter input	0.3 to 11 VDC

**Optional configuration*

4.6 Master reset

Use the RFT9709 configuration switches to perform a master reset. A master reset causes user-configured communication options to default to the setup used by HART communication devices, causes all other configuration options to return to their default values, and **requires complete characterization and reconfiguration of the transmitter.**

Table 4-4 lists master reset defaults for characterization and configuration variables.

To perform a master reset:
1. Note the position of switch 5.
2. Shut off power to the RFT9709.
3. Set switches 1, 2, and 3 to the OFF position.
4. Set switches 4, 5, 6, and 8 to the ON position.
5. Restore power. Wait until the diagnostic LED blinks ON three times followed by a 1-second pause.
6. Set switches 4, 5, 6, and 8 to the OFF position.
7. Shut off power to the RFT9709. Wait 30 seconds, then restore power.
8. If switch 5 was originally in the ON or USR position configure communications as described in *Communication settings*, page 47.
9. Reconfigure the transmitter. (A special version of the ProLink software program is required for field configuration. Contact the factory for ProLink information.)

To avoid an unintentional master reset, set switches 4, 6, and 8 to the OFF position after performing a master reset. If switches are left in the ON position, another master reset will occur the next time power to the RFT9709 is shut off and then restored.

After the user performs a master reset, and switch 8 is returned to the OFF position, the diagnostic LED blinks ON four times per second until the user characterizes the sensor. Use a special version of the ProLink program to characterize the sensor. The HART Communicator cannot be used for characterization. (Contact the factory for additional ProLink information.) After characterization is completed, the LED blinks ON once per second to indicate normal RFT9709 operation.

4.7 Customer service

For technical assistance, phone the Micro Motion Customer Service Department:
- In the U.S.A., phone 1-800-522-6277, 24 hours
- From 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 4-4. Default values after a master reset

Characterization variables

	Default		Default
Flow calibration factor	1.00005.13	Pressure	
Density		Pressure polling	No
Density A	0.0000 g/cc	Field device tag	DP CELL!
K1 density constant	5000.00	Pressure input at 4 mA	0.00 psi
Density B	1.0000 g/cc	Pressure input at 20 mA	1000.00 psi
K2 density constant	50000.00	Pressure correction for flow	0.00% per psi
Density temperature coefficient	4.44% per 100°C	Pressure correction for density	0.00 g/cc per psi
FD density constant	0.000	Flow calibration pressure	0.00 psi
Mass flow factor	1.0	RTD parameters	
Volume flow factor	1.0	0°C =	100.0 Ω
Density factor	1.0	100° =	138.5 Ω
Viscosity calibration factor	1.000000.00000	API table	Disabled

Measurement units

	Default		Default
Mass flow unit	g/sec	Temperature unit	°C
Volume flow unit	l/sec	Viscosity unit	centipoise
Density unit	g/cc	Pressure unit	psi

Field device variables

	Default		Default
Mass flow cutoff	0.00 g/sec	Low slug flow limit	0.0000 g/cc
Volume flow cutoff	0.0000 l/sec	High slug flow limit	5.0000 g/cc
Flow direction	Forward only	Internal damping on density	2.00 sec
Internal damping on flow	0.80 sec	Internal damping on temperature	4.00 sec

Transmitter output variables

	Default		Default
Primary mA output variable	Mass flow	Frequency/pulse output variable	Mass flow
Upper range value	160.00 g/sec	Frequency	10000.00 Hz
Lower range value	–160.00 g/sec	Rate	15000.00 g/sec
Added damping	0.00 sec	Maximum pulse width	0.50 sec
Secondary mA output variable	Temperature	Control output	Flow direction
Upper range value	450.00°C	Slug duration	1.00 sec
Lower range value	–240.00°C	Polling address	0
Added damping	0.00 sec	Burst mode	Off
		Burst command	2

Device information

	Default		Default
Transmitter tag name	M. RESET	Sensor model	Unknown
Description	CONFIGURE XMTR	Sensor flow tube material	Unknown
Message	MASTER RESET - ALL DATA DESTROYED	Sensor flange type	Unknown
		Sensor flow tube liner material	None
Date	01/JAN/95		

Communication settings (standard communication)*

	Default		Default
Baud rate	9600 baud	Protocol and physical layer	Modbus RTU mode (8 bits) on RS-485, and HART (Bell 202) on PV
Stop bits and parity	1 stop bit, odd parity		

**Switch 5 set to the USER-DEFINED position. See Appendix C, page 47, for information on setting switches.*

Appendix
A

RFT9709 Specifications

Performance specifications

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

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

Sensor model		Density accuracy	Density repeatability
ELITE (except high-pressure CMF010P)	liquid	±0.0005 g/cc	±0.0002 g/cc
	gas	±0.002 g/cc	±0.001 g/cc
ELITE high-pressure CMF010P	liquid	±0.002 g/cc	±0.001 g/cc
	gas	±0.008 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, 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
D300, D600, DL100, DL200	liquid only	±0.0005 g/cc	±0.0002 g/cc

Sensor model	Temperature accuracy	Temperature repeatability
All sensors, Micro Motion sensor RTD	±1°C ± 0.5% of reading in °C	±0.02°C
All sensors, user-supplied sensor RTD[2]	±0.5°F	±0.04°F

[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. For values of zero stability, refer to product specifications for each sensor.

[2] The user can install an external temperature detector, for the sensor, that is accurate to within ±0.1°F. Temperature accuracy within ±0.5°F is required for API.

Functional specifications

Outputs

Analog

Two independently configured analog outputs, designated as primary and secondary, can represent mass flow rate, gross volume flow rate, gross standard volume flow rate, density, or temperature. With a pressure transmitter, can also provide indication for pressure or viscosity. Internally powered 4-20 mA current outputs. Galvanically isolated to ±50 VDC, 1000 ohm load limit. Out-of-range capability: 2-22 mA.

Milliamp (mA) output rangeability

- Flow
  - Maximum span determined by sensor specifications.
  - Range limit determined by sensor maximum rate.
  - Minimum recommended span (% of nominal flow range):

ELITE CMF sensors	2.5%
BASIS F sensors	10%
D, DT, and DL sensors	10%
D300, D600 sensors	5%
High-pressure (DH) sensors	20% typical

- Density — 0.0 to 5.0 g/cc range limit; 0.1 g/cc minimum span
- Temperature — –400 to 842°F (–240 to 450°C) range limit; 36°F (20°C) minimum span

Frequency/pulse

One frequency/pulse output can be configured to indicate mass, mass flow rate, gross volume flow rate, gross standard volume flow rate, or gross standard volume, independent of analog outputs. Internally powered, 0-23 V square wave, unloaded; 3.3 kohm impedance at 23 V, galvanically isolated to ±50 VDC. In open collector configuration: sinking capability, 0.1 amps in "on" condition (0 volt level), 30 VDC compliance in "off" condition. Signal can be scaled up to 10,000 Hz. Out-of-range capability to 15,000 Hz. Programmable pulse width for low frequencies. Downscale or upscale fault indication: downscale (switch 7 off), output goes to 0 Hz; upscale (switch 7 on), output goes to 15-19 kHz.

Control

One control output can represent flow direction, fault alarm, zero in progress. Internally powered, digital level, 0 or 23 V, 3.3 kohm pull-up, galvanically isolated to ±50 VDC. In open collector configuration: sinking capability, 0.1 amps in "on" condition (0 volt level), 30 VDC compliance in "off" condition.

Communication

Switches on the RFT9709 allows selection of the Bell 202 standard for HART digital communication, and/or the RS-485 serial standard for HART or Modbus communication.

- Bell 202 signal is superimposed on primary variable mA, and available for host system interface. Frequency 1.2 and 2.2 kHz, amplitude 0.8 V peak-to-peak, baud rate 1200 baud. Requires 250 to 1000 ohms load resistance.
- RS-485 signal is a ± 5 V square wave referenced to transmitter ground. Baud rates from 1200 baud to 38.4 kilobaud can be selected.

API-2540 standard tables

The RFT9709 calculates both reference and on-line density, and standard and gross standard volume, based on API equation 2540 for Generalized Petroleum Products and Generalized Crude Oils. Totalizers and inventories for gross volume are independent of totalizers and inventories for gross standard volume.

Compensation accomplished by the following **user-specified** API-2540 standard tables:

- 5 A/B/D
- 6 A/B/C/D
- 23 A/B/D
- 24 A/B/C/D
- 53 A/B/D
- 54 A/B/C/D

These additional specifications are **required**:

- For "C" tables (6C, 24C, and 54C), also specify the thermal expansion coefficient.
- For even-numbered tables (6 A/B/C/D, 24 A/B/C/D, and 54 A/B/C/D), also specify the reference density.

For tables 53 and 54 (53 A/B/D and 54 A/B/C/D), a reference temperature of 15°C is used per the API-2540 standard table. The reference temperature can be changed using the special version of ProLink software.

Input for pressure transmitter

The RFT9709 can communicate with a HART SMART FAMILY pressure transmitter using the Bell 202 physical layer and HART communications protocol. The pressure transmitter can be externally powered as part of a HART multidrop network, or powered internally from the RFT9709.

When using the pressure transmitter as part of a HART multidrop network, the RFT9709 primary variable (PV) output remains fixed at 4 mA.

The pressure transmitter may be configured by a Rosemount Model 275 HART Communicator attached to the RFT9709 HART loops. To configure the RFT9709 for pressure compensation or viscosity measurement, a special version of the ProLink program is required. The HART Communicator cannot be used for RFT9709 configuration. (Contact the factory for additional ProLink information.)

Low-flow cutoff	Flow values below the user-defined low-flow cutoff cause digital, mA, and frequency outputs to default to zero flow levels.
Slug-flow inhibit	RFT9709 senses density outside user-selected limits. Flow output holds at last measured value prior to slug condition, for a programmed time of 1-60 seconds, before defaulting to the level that represents zero flow.
Damping	Wide range of programmed filter time constants for damping on flow, density, and temperature. Additional damping may be applied to mA outputs.
Fault indication	Faults can be indicated by user-selected downscale (0-2 mA, 0 Hz) or upscale (22-24 mA, 15-19 kHz) output levels. The control output can also be configured to indicate a fault condition at 0 V.
Output testing	**Current source** RFT9709 can produce a user-specified current between 2 and 22 mA on a 4-20 mA output. **Frequency source** RFT9709 can produce a user-specified frequency between 0.1 and 15,000 Hz.
Power supply options	11 to 30 VDC, 7 watts typical, 14 watts maximum, fused with IEC 127-3 1.6A/125V, time-lag, subminiature. At startup, transmitter power source must provide a minimum of 1.6 ampere of short-term current at a minimum of 12 volts at the RFT9709 power input terminals.
Environmental limits	**Ambient temperature limits** Operating: –40 to 122°F (–40 to 50°C) Storage: –40 to 176°F (–40 to 80°C) **Humidity limits** Meets SAMA PMC 31.1-1980 **Vibration limits** Meets SAMA PMC 31.1-1980, Condition 2
Environmental effects	**Ambient temperature effect on transmitter** On mA outputs: ±0.005% of span/°C On mA input: ±0.01% of span/°C

Hazardous area approvals

When properly installed with an approved sensor, the RFT9709 transmitter can be installed in the following areas:

UL

Class I, Div. 2, Groups A, B, C, and D. Provides nonincendive sensor outputs for use in Class I, Div. 2, Groups A, B, C, and D; or intrinsically safe sensor outputs for use in Class I, Groups C and D, and Class II, Groups E, F, and G.

UL Division 2 nonincendive parameters

Parameter	Analog output (Terminals 11-12, 13-14)	Frequency/pulse output (Terminals 17-18)
V_{OC}	36.5 V	16 V
I_{SC}	22 mA	51 mA
C_a	0.135 µf	1.5 µf
L_a	100 mH	37 mH

CSA

Approval pending

Weight

Standard housing	1.5 lb (0.68 kg)
Housed in factory-supplied NEMA-4 (IP65) enclosure	6.5 lb (2.9 kg)

Appendix
B

Ordering Information

RFT9709 model number matrix

Code	Transmitter model
RFT9709	RFT9709 transmitter

Code	Housing options
S	Standard
N	Optional factory-supplied NEMA-4 (IP65) enclosure

Code	Power supply
1	11 to 30 VDC

Code	Connector options
C	Terminal block connections — all connectors included

Code	Approval
M	Micro Motion standard — no approvals
U	UL intrinsically safe — U.S.A. approvals agency

Micro Motion instruction manuals

To obtain any of the Micro Motion instruction manuals listed below, contact the Micro Motion Customer Service Department:

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

Sensors

- ELITE® Sensor Instruction Manual
- R-Series Flowmeter Instruction Manual
- R-Series Flowmeter with FOUNDATION™ fieldbus
- BASIS® Sensor Instruction Manual
- Model D and DT Sensors Instruction Manual
- Model DL Sensor Instruction Manual

Transmitters

- ELITE® Model RFT9739 Field-Mount Transmitter Instruction Manual
- ELITE® Model RFT9739 Rack-Mount Transmitter Instruction Manual
- BASIS® Model IFT9701 Transmitter Instruction Manual
- Model RFT9709 Transmitter Instruction Manual
- Model RFT9712 Remote Flow Transmitter Instruction Manual
- Model 5300 Transmitter with FOUNDATION™ fieldbus

ALTUS™ platform

- ALTUS™ Installation Manual
- ALTUS™ Detailed Setup Manual
- ALTUS™ Discrete Batch Control Applications Manual
- ALTUS™ HFCS/Brix Applications Manual
- ALTUS™ Net Oil Computer Applications Manual
- Installing Relays for the ALTUS™ Applications Platform
- Printer Setup for the ALTUS™ Applications Platform

Communications

- Using ProLink® Software with Micro Motion® Transmitters
- Using the HART® Communicator with Micro Motion® Transmitters
- Using Modbus® Protocol with the Micro Motion® ELITE® Model RFT9739 Transmitter
- RFT9739 Transmitter-Specific Command Specification
- RFT9709 Transmitter-Specific Command Specification
- RFT9712 Transmitter-Specific Command Specification

Peripheral products

- DMS Density Monitoring System Instruction Manual
- DRT Digital Rate Totalizer LCD Instruction Manual
- DRT Digital Rate Totalizer LED Instruction Manual
- FMS-3 Flow Monitoring System LCD Instruction Manual
- FMS-3 Flow Monitoring System LED Instruction Manual
- NFC Net Flow Computer Instruction Manual
- NOC Net Oil Computer Instruction Manual
- PI 4-20 Process Indicator

Wiring instructions

- 9-Wire Flowmeter Cable Preparation and Installation
- Cable Gland Assembly Instructions
- UL-D-IS Installation Instructions
- CSA-D-IS Installation Instructions
- SAA-D-IS Installation Instructions
- Power-Supply Wiring for the D600 Sensor
- Input Signal Wiring for Peripheral Devices

Appendix
C

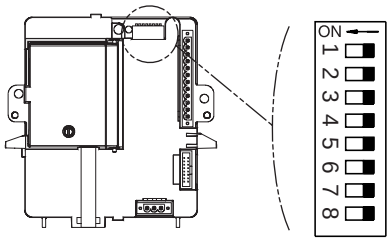
Switch Settings

C.1 Configuration switches

Switches on the RFT9709 (see Figure C-1) control the following transmitter functions:

- Communications settings
- mA output settings
- Zeroing method
- Security

Figure C-1. Switches



Switch number	Switch position	
	OFF	ON
1	OFF	SEC1
2	OFF	SEC2
3	OFF	SEC3
4		
5	STD	USR
6		
7	DOWN	UP
8	OP	CONFIG

Switches at left shown in OFF position.

C.2 Communication settings

Switch 5 enables the user to choose the standard communication configuration, or user-defined parameters. With switch 8 in the ON (CNFG) position, switches 1 through 6 can be used for setting user-defined communication parameters.

Standard communication setting

To use the standard communication configuration, set switch 5 to the STD position. Setting the switch in this position establishes the following communication parameters:

- HART protocol, at 1200 baud, on the primary-variable (PV) mA output
- Modbus protocol, in RTU mode (8 bit), at 9600 baud, on the RS-485 output
- 1 stop bit, odd parity

User-defined communication settings

To establish user-defined settings, set switches as instructed in Table C-1, page 48. In the user-defined setting, until they are changed or after a master reset, communication parameters match those listed above.

Table C-1. Communications configuration

Instructions

Before beginning, make note of the positions of switches 1, 2, and 3. Then, for each setting:

1. Begin with switch 8 in the CNFG position, and switches 1 through 6 in the OFF position. The diagnostic LED flashes ON 3 times and pauses, which indicates the transmitter is in the communication configuration mode.
2. Set designated switches to the ON position as indicated below.
3. Press and hold the zero button for five seconds, until the diagnostic LED remains ON for 3 seconds, which indicates the setting has been accepted by the RFT9709.

When done:

1. Reset switches 1, 2, and 3 to the appropriate positions.
2. Set switch 5 to the USER position.
3. Set switches 4 and 6 to the OFF position.
4. Set switch 8 to the OPR position.

Note

If switches 4, 5, 6, and 8 are left in the ON position after configuration, a master reset will occur the next time power to the RFT9709 is shut off and then restored. To avoid an unexpected master reset, make sure switches 4, 6, and 8 are left in the OFF position after configuration.

Baud rate	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6
1200 baud		ON				ON
2400 baud		ON	ON			ON
4800 baud			ON			ON
9600 baud	ON		ON			ON
19,200 baud	ON	ON				ON
38,400 baud	ON					ON

Stop bits and parity	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6
1 stop bit, no parity					ON	
1 stop bit, odd parity		ON			ON	
1 stop bit, even parity	ON	ON			ON	
2 stop bits, no parity			ON		ON	
2 stop bits, odd parity		ON	ON		ON	
2 stop bits, even parity	ON				ON	

Data bits, protocol, physical layer	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6
HART (Bell 202) on primary mA	ON		ON		ON	ON
HART on RS-485			ON		ON	ON
Modbus RTU mode (8 bits) on RS-485					ON	ON
Modbus ASCII mode (7 bits) on RS-485		ON			ON	ON
Modbus RTU mode (8 bits) on RS-485 and HART on primary mA	ON				ON	ON
Modbus ASCII mode (7 bits) on RS-485 and HART on primary mA	ON	ON			ON	ON

C.3 Fault output settings

Fault outputs can be set for downscale or upscale levels.

Downscale
If switch 7 is set to the DWN position:
- mA outputs go to 0-2 mA
- frequency/pulse output goes to 0 Hz

Upscale
If switch 7 is set to the UP position
- mA outputs go to 22-24 mA
- frequency/pulse output goes to 15-19 kHz

C.4 Security modes

Switches 1, 2, and 3 are security switches, which enable the user to disable flowmeter zeroing, disable resetting of totalizers, and write-protect all configuration and calibration parameters. Switch settings enable any of eight possible security modes. See Table C-2.
- Security modes 1 through 7 are entered immediately when switches 1 through 3 are set.
- For information about security mode 8, see pages 50 and 51.

Table C-2. Security modes

Switch settings	**Mode 1**	**Mode 2**	**Mode 3**	**Mode 4**	**Mode 5**	**Mode 6**	**Mode 7**	**Mode 8***
Switch 1	OFF	OFF	OFF	OFF	ON	ON	ON	ON
Switch 2	OFF	OFF	ON	ON	OFF	OFF	ON	ON
Switch 3	OFF	ON	OFF	ON	OFF	ON	OFF	ON

Function/ parameter	**Mode 1**	**Mode 2**	**Mode 3**	**Mode 4**	**Mode 5**	**Mode 6**	**Mode 7**	**Mode 8**
Zeroing with zero button		Disabled	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled
Zeroing with digital communication			Disabled	Disabled	Disabled			Disabled
Totalizer reset, no flow			Disabled		Disabled	Disabled		
Totalizer reset, with flow			Disabled	Disabled	Disabled	Disabled	Disabled	Disabled
Configuration and calibration parameters			Write-protected	Write-protected	Write-protected	Write-protected	Write-protected	Write-protected

**Security mode 8 is not entered when switches are set. For more information about security mode 8, see pages 50 through 51.*

Security mode 8

When security is set for mode 8, the RFT9709 meets security requirements for custody transfer described in National Institute of Standards and Technology (NIST) Handbook 44.

Once the RFT9709 is configured for security mode 8, the security mode cannot be changed unless a master reset is performed. A master reset causes all configuration parameters to return to their default values, and **requires complete characterization and reconfiguration of the transmitter**. See Section 4.6, page 37.

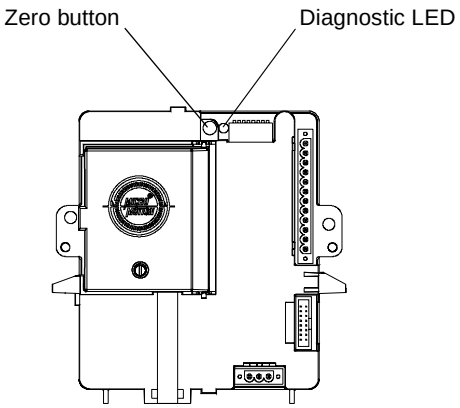
If the user attempts to enter a new security mode or change the RFT9709 configuration after entering security mode 8:
- Internal totalizers stop counting
- The frequency/pulse output goes to 0 Hz
- mA outputs go to 4 mA
- Event registers record changes made to defined configuration and calibration parameters. See Section 3.3, page 29.

The security breach continues, and totalizers and outputs remain inactive, until the RFT9709 is reconfigured for security mode 8, or until a master reset has been performed. Custody transfer event registers are not affected by a master reset.

Before entering security mode 8, perform milliamp trim and/or test procedures, if necessary. Milliamp output trim, milliamp output test, and frequency/pulse output test cannot be performed after security mode 8 is entered. A special version of the ProLink program is required to perform these procedures. A HART Communicator cannot be used. (Contact the factory for additional ProLink information.) See *Output test and trim*, page 33.

To enter security mode 8:
1. Note the position of switch 5.
2. Set switch 8 to the ON position. The diagnostic LED flashes ON three times and pauses, which indicates the RFT9709 is in the configuration mode.
3. Set switches 1, 2, and 3 to the ON position.
4. Set switches 4, 5, and 6 to the OFF position.
5. Press and hold the zero button for 5 seconds. The diagnostic LED will remain on for 2 to 3 seconds to indicate security mode 8 has been entered. Figure C-2 illustrates the location of the zero button and diagnostic LED.
6. Reset switch 5 to the desired position (as noted in Step 1).
7. Reset switch 8 to the OFF (OPERATE) position. The diagnostic LED flashes on once per second (25% on, 75% off), which indicates the RFT9709 is in the normal operating mode.

Figure C-2. Diagnostic LED and zero button



To verify the transmitter is in security mode 8:

1. Configure the security mode, as described above.
2. Wait until the diagnostic LED blinks ON once per second.
3. Move switch 1, 2, or 3 to the OFF position.
4. If the diagnostic LED blinks ON 4 times per second, the RFT9709 is in security mode 8.

To make changes to configuration or calibration parameters once security mode 8 is entered:

1. Set switches 1, 2, and 3 to the OFF position.
2. Make changes using the switches (see *Communication settings*, page 47) or with a special version of the ProLink program. The HART Communicator cannot be used. (Contact the factory for additional ProLink information.) Event registers record changes made to defined configuration and calibration parameters (see Section 3.3, page 29).
3. Set switches 1, 2, and 3 to the ON position.

To reenter security mode 8:

If security mode 8 has been established previously, and the security mode has been temporarily changed, it is not necessary to use the zero button to reenter security mode 8. In such a case, resetting switches 1, 2, and 3 to the ON position will reenter security mode 8 immediately.

If a master reset has been performed (see Section 4.6, page 37), it is necessary to use the zero button method to reenter security mode 8. See the procedure on the previous page.

To change from security mode 8 to another security mode:

1. Perform a master reset (see Section 4.6, page 37).
2. Perform characterization and reconfiguration procedures using a special version of the ProLink program. The HART Communicator cannot be used. (Contact the factory for additional ProLink information.)
3. Set switches 1, 2, and 3 to the desired positions, See Table C-2, page 49.

Appendix
D

Open Collector Configuration

If desired, the RFT9709 frequency/pulse and control outputs can be configured for open collector mode.

- When used in the open collector mode, the output circuit is rated to 30 VDC, with 0.1 ampere maximum sinking capability.
- To wire the RFT9709 outputs, see *Installation Step 2*, starting on page 7.

⚠ CAUTION

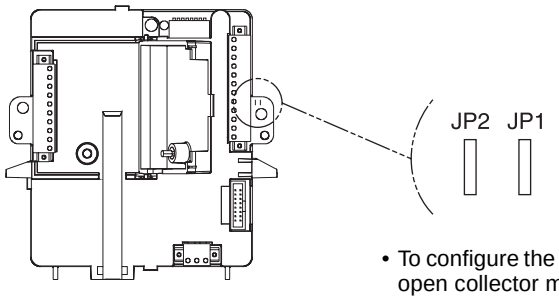
The open collector configuration procedure cannot be reversed.

Configuring the frequency/pulse or control outputs for open collector mode requires jumpers on the RFT9709 to be cut. Once cut, the jumpers cannot be reconnected.

Do not cut jumpers unless you are certain your process requires outputs in open collector mode.

To configure outputs for open collector mode, jumpers on the RFT9709 must be cut. Refer to Figure D-1.

Figure D-1. Configuring open collector mode



- To configure the **frequency/pulse** output for open collector mode, cut jumper **JP2**.
- To configure the **control** output for open collector mode, cut jumper **JP1**.

Appendix
E

Decontamination and Return Goods Policy – USA

A Return Material Authorization Number (RMA) must be obtained prior to returning any equipment to Micro Motion for any reason. The RMA number can be obtained by calling the Customer Service Department at 1-800-522-6277 between 6:00 AM and 5:30 PM (Mountain Time), Monday through Friday, except holidays.

To help ensure that both you and Micro Motion are providing a safe working environment for our employees and conforming with OSHA regulations, the following equipment return requirements must be followed. Failure to follow these requirements may result in additional charges for cleaning and decontamination.

To comply with Department of Transportation (DOT) regulations, the equipment you return must be thoroughly cleaned and decontaminated of all foreign substances (e.g., process fluid) prior to shipment to Micro Motion. This decontamination requirement applies to the sensor tubes, sensor case exterior, sensor case interior, and electronics. If you suspect that the sensor case interior may be contaminated, the case must be drained by drilling a hole or removing the purge plug(s), and then flushed to remove contaminants from the case interior. To avoid risk of explosion, do not drill the case if a combustible gas may be present. The flow tubes must be cleaned and decontaminated of all foreign substances. Shipping equipment that has not been decontaminated may violate DOT regulations. The requirements for packaging and labeling hazardous substances are listed in DOT regulations (49 CFR 172,178, and 179).

A DECONTAMINATION/ CLEANING STATEMENT form must be completed. If the statement is not completed, the customer may be charged for decontamination and cleaning. If the equipment has been exposed to a known hazardous substance with any characteristic that can be identified in the Code of Federal Regulations, 40 CFR 261.20 through 261.24, then the chemical abstracts number and hazardous waste number/hazard code must be stated in the space provided on the form.

Material Safety Data Sheets (MSDS) for all substances that came in contact with the equipment must be supplied. This includes substances used for decontamination and cleaning. If the equipment has been exposed only to food-grade substances or potable water, or substances for which an MSDS is not available, a Decontamination/Cleaning Statement form is acceptable.

Please ship one piece of equipment per package and include two copies of the Decontamination/Cleaning Statement and MSDS. The package should be shipped to the address on the Decontamination/Cleaning Statement form.

Decontamination/Cleaning Statement

RMA number:_____

Equipment to be returned:_____

	Substance 1	Substance 2
Common name of substance exposed to equipment		
Chemical abstract number see 40 CFR 261* (if applicable)		
Hazardous waste number/ hazard code see 40 CFR 261* (if applicable)		
Describe decontamination process, list substances used for decontamination and cleaning		

I hereby certify that the above listed equipment being returned is clean and has been decontaminated of any hazardous substances, and poses no health or safety risks. Furthermore, it is my understanding that the equipment being returned complies with OSHA and DOT regulations.

By:_____ _____
(Signature) (Please print)

Job title:_____ Date: _____

Company name:_____ FAX number: _____

Phone number:_____

IMPORTANT:

- *RMA number must be noted on the shipping package.*
- *Two copies of this DECONTAMINATION/CLEANING STATEMENT and Material Safety Data Sheet (MSDS), if required, must be included — one attached to the outside of the box and one inside of the shipping package.*

Ship equipment to: Micro Motion, Inc.
6930 Winchester Circle, Dock #6
Attn: RMA #_____
Boulder, CO 80301

*Refer to Micro Motion Equipment Return Requirements (page 55).

Appendix
F

Decontamination and Return Goods Policy – Europe

To conform with Dutch ARBO regulations and to provide a safe working environment for our employees, Micro Motion has instituted the following Return/Repair conditions. Strict adherence to these conditions is required.

Returned equipment that does not conform to the requirements listed below will NOT be processed. If Micro Motion finds evidence of contamination, we may, at our option, have the sensor cleaned or returned AT YOUR EXPENSE, after notifying you of the contamination.

1. The equipment must be COMPLETELY cleaned and decontaminated prior to shipment to Rosemount. This decontamination procedure applies to the sensor tubes, sensor case exterior, and the transmitter.

2. A Repair and/or Warranty Request Sheet (RWRS) is REQUIRED for all process fluids that have been in contact with the equipment. This includes fluids used to clean the equipment.

3. If the equipment being returned has been used on a food-grade process fluid, for which no RWRS is available, a statement listing all process fluids and certifying decontamination is acceptable. Please fill out the accompanying Decontamination Statement PRIOR to returning the equipment.

4. The RWRS document must be included in the shipping package.

Repair and/or Warranty Request Sheet

Please do not fill in the shaded areas

Company:		Contact:	
Address:			
Tel No:		Fax No:	
Reference / Order numbers		**Installation data**	
Customer reference		Delivery date	
Purchase order No		Date of installation	
MMI No		Date of failure	
Type of order			
☐ Repair ☐ Calibration ☐ Exchange ☐ Return (after exchange) ☐ Replacement ☐ Investigation/Quote ☐ Report needed ☐ Other:			☐ No warranty ☐ Warranty ☐ Extended warranty
Sensor information		**Transmitter information**	
Model		Model	
Serial No		Serial No	
Tag No		Tag No	
Flange type		Power supply	
Sensor condition		**Process conditions**	
Tubes empty	☐ yes / ☐ no	Medium	
Case empty	☐ yes / ☐ no	Chemical formula	
Decontamination statement	☐ yes / ☐ no	Maximum temperature	
Type of cleaning material used		Operating pressure	
Warning! For the health and safety of our goods handling/inspection department, a Decontamination Statement MUST be filled in with this form. Please be specific with the information provided.			
Calibration data			
Maximum process flow			
Primary output	Units =	4mA =	20mA =
Secondary output	Units =	4mA =	20mA =
Frequency output	1 pulse =	Freq. =	Rate =
Description of failure			
Remarks/Instructions			
Return (shipping) instructions			
Ship to address:			
Shipped by:		Ship date:	
Remarks			

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Page numbers in **bold** indicate illustrations.

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Micro Motion

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