Installation, Operation & Maintenance Manual

Installation, Betrieb und Wartungshandbuch

Manual de Instalación, Operación y Mantenimiento

安装、操作和维护手册
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</tbody>
</table>

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1 GENERAL

Product Description
The ST100 Series is a thermal dispersion, industrial process grade air/gas flow meter. It is suitable for all air and gas flow measurement applications in line sizes from 1” to 100” [25 to 2500 mm] and larger. The instrument provides direct mass flow measuring and measures flow rate, totalized flow and temperature, and the STP versions add pressure measurement.

The measurements are made available to the user by way of 4-20 mA analog output channels with HART or pre-selected digital bus protocols. The optional graphics display provides real-time process variable values along with flow range and process description information.

There are no moving parts to clean or maintain. A wide selection of process connections are offered to fit with any process piping. Versions are available for temperature service from -40 °F [-40 °C] to 850 °F [454 °C].

The ST100 Series electronics/transmitter can be integrally mounted with the flow sensor or remote mounted up to 1000’ [300m] from the sensor element. Additional patented and/or FCI exclusive features include VeriCal® in-situ calibration verification, SpectraCal™ user selectable gas mixes, dual sensor/single transmitter models, and a built-in data logger capable of storing more than 20M readings. All ST100s are precision calibrated in FCI’s world-class, NIST traceable calibration facility on one of our flow stands matched to your gas application and actual installation conditions.

Theory of Operation
The instrument is functionally based on the thermal dispersion operating principal. A low powered heater produces a temperature differential between two resistance temperature detectors (RTDs) by heating one of the RTDs above process temperature. As the process mass flow rate changes, the differential temperature between the RTDs changes. The differential temperature between the RTDs is proportional to the process mass flow. The flow transmitter converts the RTD differential temperature signal into a scaled flow output signal. The signal from the unheated RTD is used to provide the process temperature value.

Safety Instructions

Warning: Explosion Hazard. Do not disconnect equipment when flammable or combustible atmosphere is present.

- Field wiring shall be in accordance with NEC (ANSI-NFPA 70) or CEC (CSA C22.1) locations as applicable.
- The instrument must be installed, commissioned and maintained by qualified personnel trained in process automation and control instrumentation. The installation personnel must ensure the instrument has been wired correctly according to the applicable wiring diagram.
- All location specific installation and wiring requirements must be met and maintained. FCI recommends an input power circuit breaker be installed between the power source and the flow meter. This facilitates easy power disconnection during commissioning and maintenance procedures. A switch or circuit breaker is required if installation is in a hazardous area.
- The flow meter contains electrostatic discharge (ESD) sensitive devices. Use standard ESD precautions when handling the circuit board assemblies.
- Hazardous Areas: The instrument is designed for use in hazardous areas. The approved area classification is identified on the nameplate along with the temperature and pressure limitations. The USB port and the serial communication port do not support the hazardous area requirements and should only be used when the area is declassified. Remove any non-certified parts such as plastic protection caps from cable entry ports and replace by suitable wiring and cabling system certified by notified bodies for use in Hazardous areas.
- When mounting the flow element into the process pipe, it is important that a lubricant/sealant is applied to the mating threads. Use a lubricant/sealant that is compatible with the process media. Tighten all connections firmly. To avoid leaks do not overtighten or cross-thread connections.

Order Verification

- Verify the received hardware matches the purchased hardware and application requirements. Verify the model/part number on the instrument I.D. tag (i.e. ST100 – 10C0…) matches the purchased model/part number.
- Review the Calibration requirements as specified on the Engineering Data Sheet in the documentation package. Verify the flow, temperature and pressure limits meet the application requirements.

Hardware - Model Descriptions
ST100 – Single point insertion element with flow and temperature process output
ST100L – In Line element with flow and temperature process output
ST102 – Dual point insertion elements with flow and temperature process output
ST110 – Single point insertion element with flow and temperature process output, VeriCal option
ST112 – Dual point insertion elements with flow and temperature process output, VeriCal option
STP100 – Single point insertion element with flow, temperature and pressure process output
STP102 – Dual point insertion elements with flow, temperature and pressure process output
STP110 – Single point insertion element with flow and temperature process output, VeriCal option
STP112 – Dual point insertion elements with flow and temperature process output, VeriCal option

**Documentation and Accessories**

06EN003400  Installation, Operation, & Maintenance Manual
06EN003403  ST100 Configuration Software Manual

Calibration Certification Documentation

PC Configuration Software and USB Cable

**Supplemental Manuals, optional**

06EN003404  HART Operation Manual
06EN003405  Foundation™ Fieldbus Manual
06EN003406  Modbus Operation Manual
06EN003407  PROFIBUS PA Manual
06EN003408  VeriCal In-Situ Calibration Verification Operation Manual

**Supplemental Software, optional**

HART DD Files
 FOUNDATION Fieldbus
 PROFIBUS DD File
 PDM/DTMs
**Technical Specifications**

**Instrument**
- **Measuring Capability**
  - ST1XX Models: Flow rate, total flow and temperature
  - STP1XX Models: Flow rate, total flow, temperature and pressure

- **Basic Style**
  - ST100: Insertion, single-point
  - ST100L: In-line (spool piece), single-point
  - ST102: Insertion, dual-element system
  - ST110: Insertion, single-point with VeriCal™ capability
  - ST112: Insertion, dual-element system with VeriCal capability
  - STP100: Insertion, single-point with pressure measurement
  - STP102: Insertion, dual-element system with pressure measurement
  - STP110: Insertion, single-point with pressure measurement and VeriCal capability
  - STP112: Insertion, dual-element system with pressure measurement and VeriCal capability

- **Flow Measurement Range**
  - Insertion Style: 0.25 SFPS to 1000 SFPS [0,07 NMPS to 305 NMPS]
  - ST100L In-line: 0.0062 SCFM to 1850 SCFM [0.01 Nm3/h to 3,140 Nm3/h]
  - Air at standard conditions; 70 °F and 14.7 psia [21 °C and 1,013.25 bar (a)]

- **Temperature Measurement Range**
  - Up to 850 °F [454 °C] commensurate with element; see Operating Temperature in Flow Element specification

- **Pressure Measurement Range (STP Models)**
  - Available Ranges:
  - 0 psig to 50 psig [0 bar (g) to 3.4 bar (g)]
  - 0 psig to 160 psig [0 bar (g) to 11 bar (g)]
  - 0 psig to 500 psig [0 bar (g) to 34 bar (g)]
  - 0 psig to 1000 psig [0 bar (g) to 70 bar (g)]

- **Environmental Conditions**
  - Maximum Relative Humidity: 93%
  - Maximum Elevation: 6561’ [2000m]

- **Media**
  - All gases that are compatible with the flow element material

- **Accuracy**
  - Flow: Gas Specific Calibration: ± 0.75% reading, ± 0.5% full scale
  - SpectraCal Gas Equivalency: Typically ± 4% reading, ± 0.5% full scale; gas conditions specific to application will determine accuracy; utilize FCI’s online tool, AVA, to evaluate your application and provide expected accuracy
  - Temperature: ± 2 °F [± 1 °C] (display only, flow rate must be greater than 5 SFPS [1.5 m/sec])
  - Pressure (STP Models): ± 0.25% full scale pressure range

- **Temperature Coefficient**
  - With optional temperature compensation; valid from 10% to 100% of full scale calibration
  - Flow: Maximum ± 0.015% of reading / °F up to 850 °F [± 0.03% of reading / °C up to 454 °C]
  - Repeatability
    - Flow: ± 0.5% reading
    - Temperature: ± 1 °F [± 0.6 °C] (flow rate must be greater than 5 SFPS [1.5 NMPS])
  - Turndown Ratio
    - Normally factory set and field adjustable from 2:1 to 100:1 within calibrated flow range; up to 1000:1 possible with factory evaluation of application
  - Temperature Compensation
    - Standard: ± 30 °F [± 16 °C]
    - Optional: ± 100 °F [± 55 °C]
  - Agency Approvals
    - FM, FMc: Class I, Division 1, Division 2, Hazardous Locations; Groups B,C,D,E,F,G
    - ATEX and IECEx (see page 87)
    - CPA, NEPSI
  - Calibration
    - Performed on NIST traceable flow stands and equipment
  - Storage Temperature
    - -76 to 150°F [-60 to 65 °C]

**Flow Element**
- **Material of Construction**
  - All-welded 316L stainless steel; Hastelloy-C optional

**Operating Pressure**
- Metal ferrule: 1000 psig [69 bar (g)]
- Teflon ferrule: 150 psig [10 bar (g)] (200 °F [93 °C] maximum)
- Fixed Connection NPT: 1000 psig [69 bar (g)]
- Fixed Connection Flanged: per flange rating

**STP Models** See pressure sensor specifications. Same as ST type above or per pressure sensor specification, whichever is lower.

**Model ST100L In-line style**

<table>
<thead>
<tr>
<th>F Style Sensor</th>
<th>Tubing</th>
<th>Sch 40 Pipe</th>
<th>Sch 80 Pipe</th>
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<tr>
<td>1”</td>
<td>2400</td>
<td>165</td>
<td>2500</td>
</tr>
<tr>
<td>1 1/2”</td>
<td>1750</td>
<td>121</td>
<td>2500</td>
</tr>
<tr>
<td>2”</td>
<td>1500</td>
<td>103</td>
<td>2250</td>
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</table>

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<thead>
<tr>
<th>S Style Sensor</th>
<th>Tubing</th>
<th>Sch 40 Pipe</th>
<th>Sch 80 Pipe</th>
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<tr>
<td>1”</td>
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<tr>
<td>2”</td>
<td>1500</td>
<td>103</td>
<td>2250</td>
</tr>
</tbody>
</table>

* 1 1/2” and 2” Sch 80 available by special order only; contact FCI.
  3/4” pipe also available by special order.

**Operating Temperature (Process)**
- **ST100, ST102 Insertion Style**
  - All Flow Elements (– FPC, – FP and – S):
    - -40 °F to 350 °F [-40 °C to 177 °C]
    - -40 °F to 500 °F [-40 °C to 260 °C]
    - -40 °F to 850 °F [-40 °C to 454 °C]
  - **ST110, ST112 Insertion Style**
    - FP Style Flow Element:
      - -40 °F to 350 °F [-40 °C to 177 °C]
      - -40 °F to 500 °F [-40 °C to 260 °C]
  - **STP Series Insertion Style**
    - All Flow Elements (– FPC, – FP and – S):
      - -40 °F to 257 °F [-40 °C to 125 °C]
STP Models: Additional Specifications on Pressure Sensor

Remote Transmitter Configurations:

- Models ST100 and ST102 only
- 3/4” or 1” NPT, stainless steel with adjustable Teflon ferrule or metal ferrule; or flanged and threaded for 3/4” fitting, ANSI or DIN flanges
- Compression fittings not available with 850 °F [454 °C] temperature versions of ST100 or ST102

Retractable Packing Glands

- Low pressure 50 psig [3.5 bar (g)] or medium pressure 500 psig [34 bar (g)] with graphite or Teflon packing material; 1 1/4” male NPT or ANSI or DIN flange
- Teflon packing required when process media is ozone, chlorine or bromine

Fixed Fittings / All Welded

- 1” male NPT, ANSI or DIN flange

Insertion Length

- Field adjustable lengths:
  - 1” to 6” [25 mm to 152 mm]
  - 1” to 12” [25 mm to 305 mm]
  - 1” to 21” [25 mm to 533 mm]
  - 1” to 36” [25 mm to 914 mm]
  - 1” to 60” [25 mm to 1524 mm]
- Fixed lengths from 2.6” to 60” [66 mm to 1524 mm]

ST100L In-line Flow Tube

- Flow element is calibrated and supplied as a spool-piece; options include low flow injection tubes and built-in Vortab flow conditioners for optimum low flow rangeability and performance
- Size: 1” diameter tubing; 1”, 1 1/2” or 2” schedule 40 pipe
- Length: 9 nominal diameters
- Process Connections: Female NPT, male NPT, ANSI or DIN flanges, or butt weld prepared
- Option: Flanges sized for flow tube

Remote Transmitter Configurations: Transmitter may be mounted remotely from flow element using interconnecting cable (up to 1000’ [300 m])

STP Models: Additional Specifications on Pressure Sensor

Calibrated at nominal 70 °F [21 °C]
- Zero/Span Shift: 0.83% full scale/100 °F [1.5% full scale/100 °C]
- Zero Tolerance: ± 0.5% of full scale
- Span Tolerance: ± 0.5% of full scale
- Long Term Stability: ± 0.2% full scale per year

Maximum Over Pressure:
- 50 psi, 100 psi [3,4 bar, 7 bar] versions 3.0 x rated rate range
- 500 psi, 1000 psi [34 bar, 70 bar] versions 2.0 x rated rate range

Minimum Burst Pressure (all):
- 50 psi, 100 psi [3,4 bar, 7 bar] versions 40 x rated rate range
- 500 psi, 1000 psi [34 bar, 70 bar] versions 20 x rated rate range

Wetted Materials:
- 17-4 PH stainless steel diaphragm (not recommended for hydrogen service; contact FCI for Model STP for use in hydrogen)
- 304 stainless steel fittings

Flow Transmitter/Electronics

- Operating Temperature:
  - Single Point System: 0 °F to 140 °F [-18 ° to 60 °C]
  - Two Point System: 0 °F to 100 °F [-18 ° to 38 °C]

Input Power

- AC: 85 VAC to 265 VAC, 50 Hz to 60 Hz
- DC - Single Point System: 24 VDC ± 20%
- DC - Two-point System: 23.5 VDC - 28 VDC ± 20%

Power Consumption

- AC: 85 VAC to 265V = 10W, 1 Flow Element
- 13.1W, 2 Flow Element
- DC: 24V = 9.6W, 1 Flow Element
- 13.2W, 2 Flow Elements

Outputs

- Analog
  - Standard: Three (3) 4-20 mA*, 0-1kHz, or 0-10 kHz pulse/frequency
  - 4-20 mA outputs are user assignable to flow rate, temperature and/or if so equipped, pressure; outputs are user programmable to full flow range or subsets of full flow range; pulse/frequency output is user selectable as pulse for external counter/flow totalizer, or as 0-1 kHz or 0-10 kHz frequency representing flow rate
  - HART (comes standard with analog outputs, V7 compliant
  - * Outputs are isolated and have fault indication per NAMUR NE43 guidelines, user selectable for high (>21.0 mA) or low (<3.6 mA)

- Digital
  - Standard: USB, Ethernet - Service and Configuration Ports Only
  - Optional: FOUNDATION Fieldbus H1, PROFIBUS PA or Modbus RS-485

FF Physical Parameters

- Device Capacitance - Ci (in nF) = 0
- Device Inductance - Li (in mH) = 1.01
- Maximum Network Input Voltage - Ui (in V) = 32
- Maximum Network Input Current - li (in mA) = 13

Auxiliary Inputs

- One 4-20 mA input channel; used for FCI administered special configurations to allow ST100 Series to accept inputs from external devices such as gas analyzers, gas composition or pressure sensors

Enclosures

- Main Transmitter / Electronics:
  - NEMA 4X, IP67; polyester powder coated aluminum; 4 conduit ports threaded as 1/2” NPT or M20x1.5; 7.75” x 5.40” x 5.00” [196.6 mm x 137.2 mm x 127 mm]; stainless steel enclosure pending
  - Local Enclosure (Remote Configuration):
    - Model ST100L, Models ST100 and ST102 without packing gland option: NEMA 4X, IP67; polyester powder coated aluminum; 2 conduit ports threaded as 1/2” NPT or M20x1.5; 3.75” x 4.00” x 3.24” [95 mm x 102 mm x 82 mm]
  - Models ST100 and ST102 with medium pressure packing gland option: ST110, ST112 and all STP Models:
    - NEMA 4X, IP67; polyester powder coated aluminum; 1 conduit port threaded as 1” NPT or M20x1.5; 5.40” x 4.82” [137.2 mm x 122 mm]

Data Logger

- User programmable for readings per time increment to a maximum of 1 reading/second; removable, circuit board-mountable
- 2GB micro-SD (secure digital) memory card supplied; stores approximately 21M readings in ASCII comma-separated format.
Readout/Display and optical Touch buttons (optional):

- Large 2” x 2” [50 mm x 50 mm] LCD; digital plus bar graph and engineering units
- Digital displays of flow rate, total flow, temperature and pressure (with STP models); user selectable for engineering units
- Analog bar graph of flow rate
- Alarm status indication
- User programmable 17 alphanumeric character field associated with each calibration group
- Set-Up & Service mode displays text and service codes
- Four (4) optical touch buttons for user programming of instrument set-up and service interrogation
- Optical touch button activation through front window – no need to open enclosure to access or activate
- Display is electronically rotatable in 90° increments to optimize viewing angle

*Note:* If readout/display not ordered, all user set-up and service interrogation must be done via computer link to the USB or Ethernet port.
2 INSTRUMENT INSTALLATION

Specific Conditions of Use

1. Consult the manufacturer if dimensional information on the flameproof joints is necessary.
2. The painted surface of the ST100 Series Flow Meter may store electrostatic charge and become a source of ignition in applications with a low relative humidity < 30% relative humidity where the painted surface is relatively free of surface contamination such as dirt, dust, or oil. Cleaning of the painted surface should only be done with a damp cloth.
3. Do not replace internal battery when an explosive gas atmosphere is present.
4. The relationship between the temperature class, the maximum surface temperature, the ambient temperature and the process temperature is as follows:

   - Electronic enclosure: T6/T85°C for an ambient temperature range of -40°C to +40°C.
   - Electronic enclosure: T5/T100°C for a ambient temperature range of -40°C to +60°C.

For *Power Supply and Display* options A, B, C or D, corresponding to the models with the Standard probe configuration, the relationship between the temperature class and process temperature range is as follows:

   - Probe: T4/T135°C for a process temperature range of -40°C to +65°C
   - Probe: T3/T200°C for a process temperature range of -40°C to +115°C
   - Probe: T2/T300°C for a process temperature range of -40°C to +177°C
   - Probe: T1/T450°C for a process temperature range of -40°C to +365°C

For *Power Supply and Display* options E, F, G or H, corresponding to the models with the Adaptive Sensing Technology (AST) probe configuration, the relationship between the temperature class and process temperature range is as follows:

   - Probe: T4/T135°C for a process temperature range of -40°C to +89°C
   - Probe: T3/T200°C for a process temperature range of -40°C to +154°C
   - Probe: T2/T300°C for a process temperature range of -40°C to +254°C
   - Probe: T1/T450°C for a process temperature range of -40°C to +404°C

Instrument Identification and Outline Dimensions

Appendix A provides outline dimensions and mounting bracket dimensions for all integral and remote mounted electronic configurations. Verify all dimensions meet the application requirements before beginning the installation process.
Insertion Sensor Installation

The proper flow meter location in the process piping configuration is critical to the instruments ability to measure the process variables accurately. FCI recommends 20 nominal pipe diameters upstream and 10 pipe diameters downstream of the instrument installation point for most applications. These distances can be significantly reduced when the flow meter is combined with FCI’s flow conditioning technology (Vortab).

Insertion flow elements can be mounted into the process using several available customer selectable configurations; compression fitting mounted, threaded or flanged packing gland mounted, and threaded or flanged fixed “U” length mounted process connections. The specific sensor process connection is customer specified on the Order Information Sheet.

Mount the flow element to the process piping per the application piping requirements. Orient the instrument so that the flow arrow etched on the element matches the direction of the process flow with the reference flat parallel to flow within ±3° of rotation. Insert a flow element with variable insertion length ½” inch past the centerline of the process pipe or tube with the flow direction arrow correctly aligned and leveled. After the flow element has been located correctly and tightened into place, verify that the process seal does not leak by slowly applying pressure until the maximum operation pressure is applied. Check for leaks at the process connection boundary using standard leak detection methods.

Figure 1 shows a properly mounted compression fitting process connection instrument.
Compression Fitting Mounting

1. FCI single point insertion flow meters are calibrated at the centerline of the process pipe. The flow element is properly mounted when the tip of the flow element is located 0.50 inches (13 mm) past the pipe centerline.

\[
I = \text{Insertion depth} \\
\text{I.D.} = \text{Pipe inside diameter} \\
T = \text{Pipe wall thickness} \\
C = \text{Mounting coupling with and installed compression fitting length} \\
\text{Insertion Depth} = I = 0.50 \text{ inches} + (\text{I.D.} / 2) + T + C
\]

2. The scale etched on the side of the insertion pipe indicates the length to the tip of the flow element.

3. Calculate the Insertion depth using the equation in step 2 above.

\[
I = \text{__________}
\]

4. Mark the insertion pipe at the calculated insertion depth.

5. Apply proper thread sealant to the tapered pipe thread on the compression fitting and secure into pipe mounting coupling.

6. Insert the flow element to the insertion depth mark and hand tighten the compression nut. Align the orientation flat parallel to the flow direction.

7. Tighten the compression nut to the torque specified for the corresponding ferrule material. Compression fitting manufacture recommends 1-1/4 turns past hand tight.

<table>
<thead>
<tr>
<th>Ferrule Material</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teflon</td>
<td>6 FT-Lbs</td>
</tr>
<tr>
<td>316 SST</td>
<td>65 FT-Lbs</td>
</tr>
</tbody>
</table>

*Note: The metal ferrule configuration can only be tightened one time. Once tightened, the insertion length is no longer adjustable.*
**Flange Mount**

The flange mount flow element is shown in Figure 3. Attach the process mating flange with care. Correctly orient the flow element’s reference flat to ensure the instrument’s calibrated accuracy.

- Verify the process media flow matches the flow direction arrow on the flow element.
- Apply appropriate gasket and or sealant to flange mount as required.
- Mate flow element flange to process flange keeping flat oriented properly.
- Secure flanges with appropriate mounting hardware.

![Figure 3](image3.png)

**NPT Pipe Thread Mount**

The pipe thread configuration is shown in Figure 4. Apply sealant compatible with the process media to male threads. Carefully insert into process mounting coupling. Tighten the flow element until snug and continue until flat and flow direction arrow are aligned with process flow.

![Figure 4](image4.png)
Adjustable/Retractable Packing Gland Mounting

For applications involving the use of packing glands refer to drawings located in Appendix A for additional detail.

NPT and flange mounted gland are available. Isolation valves are typically used in packing gland applications.

- Follow the pipe thread or flange mount procedures as described in previous sections.
- Tighten the packing nut until the internal packing is tight enough to prevent excess process leakage but also allow the insertion pipe to be inserted into place. Orient the flat and flow arrow properly.
- Proceed to insert the flow element into process media pipe. For the medium pressure packing gland, use the adjusting nuts on the all-thread to pull the flow element into proper position. Tighten the opposing lock nuts.
- Tighten the packing nut another ½ to 1 turn until tight (approximately 65 – 85 ft-lbs)
- On low pressure packing glands, align the split ring collar with connecting strap on packing nut. Tighten the two ¼-28 cap screws on the split ring locking collar.

STP100 and STP102A Flow Element Installation

The Model STP100 and STP102A add an additional pressure transducer measurement as a third process variable output. The process connections available on the STP model include the standard connections available on the ST model except the compression fitting. The ST102 has two probe assemblies. Available process connections include:

- Retractable Packing Gland
- Fixed NPT
- Flanged

All flow element mounting and securing instructions for the selected process connections are identical to the ST100. These details are provided in the previous process connection mounting sections.

The pressure limitation for the STP model will be determined by the selection of the pressure transducer. The available options include 50, 160, 500 and 1000 psig (3.44, 11.03, 34.47 and 69.95 bar) maximum pressure ranges.

The pressure transducer is offered in two different temperature service ranges:

- Standard: 32 to 176 °F (0 to 80 °C)
- Explosion Proof (Ex): -22 to 212 °F (-300 to 100 °C)

The pressure transducer is located inside the rectangular shaped enclosure attached to the flow element. The pressure tap is located in the center of the two thermowells and extends through the center of the insertion pipe into the enclosure where the transducer is located. Because the pressure transducer is located several feet away from the process media, at the end of a dead head tube assembly, the pressure transducer will be exposed to the external ambient temperature of the flow element.

Flow Element Wiring

The STP100/102A can be configured with integral or remote electronics. Wiring diagrams for these configurations are located in Appendix B. Remote configurations require a 10-conductor shielded cable as specified in the Instrument Wiring Table 1.

STP100/102A Electronics Description

The electronic transmitter for the instrument provides flow, temperature and pressure output on the display and the customer selected output mode, analog or digital.

Analog 4-20mA output: factory default setup

- Output #1 – Flow or Two-point average Flow
- Output #2 – Temperature or Two-point average Temperature
- Output #3 – Pressure

HART output

- Command 9 – Slot 0, 2, 4: Flow or Two-point average Flow.
- Command 9 – Slot 5: Temperature or Two-point average Temperature
- Command 9 – Slot 6: Pressure
**Fieldbus output**
- Flow AI Block – Two-point average Flow
- Temperature AI Block – Two-point average Process Temperature
- Pressure AI Block - Pressure
- Process Transducer block — index 13, PRIMARY_VALUE (Average FLOW)
- Process Transducer block — index 15, SECONDARY_VALUE (Average TEMPERATURE)
- Process Transducer block – index 19, Quaternary_VALUE (Pressure)

**Modbus output**
- Command 3 – Two-point average Flow
- Command 3 – Two-point average Temperature
- Command 3 – Pressure, available on STP models
- Command 3 – Totalizer

**Troubleshooting**
The “Service Mode” for both HART and Foundation Fieldbus provide access to the individual sensor output values.

The 102A electronics transmitter can recognize a disconnected flow element. If this condition is detected, the instrument indicates a fault condition and displays process variable data from the sensor that remains connected to the transmitter. The fault self-corrects when the sensor is re-connected.

**ST102A and STP102A Flow Element Installation**
The Model ST/STP102A is a dual-element averaging system operating through a single transmitter. The ST/STP102A Flow Element offers the same process connections that are available on the basic ST100. The ST/STP102A will have two probe assemblies. Available process connections include:
- Compression Fitting
- Retractable Packing Gland
- Fixed NPT
- Flanged

All flow element mounting and securing instructions for the selected process connections are identical to the ST100. These details are provided in the previous process connection mounting sections. Each flow element is identified with the instrument serial number followed by a -1 or -2.

**For example:**
- Serial no: 409486-1 Description - flow element no. 1
- Serial no: 409486-2 Description - flow element no. 2

**Installed Point Locations**
The flow element point locations for a two-point averaging system are based from the US EPA – Method 1 Traverse Point recommendations. This method is applicable to gas streams flowing in ducts, stacks, and flues with inside diameters greater than 12 inches. The recommended point locations for a two-point averaging system are shown in the diagram below.

Locate and secure the flow elements into position using (0.146 x Pipe I.D. + 0.50 inches) as the location dimension from the pipe I.D. to the end of the flow element (Fig. 5).

**Flow Element Wiring**
The ST/STP102A can be configured with one integral and one remote flow element or with two separate flow elements and remote electronics. Wiring diagrams for these configurations are located in Appendix B. Each of the flow elements on the ST102A/STP102A are connected to the transmitter using an 8-conductor shielded cable as specified in "Table 1 – Instrument Wiring Recommended AWG" on page 18.
**ST/STP102A Electronics Description**

The electronic transmitter for the ST/STP102A type instruments provides a two-point averaged flow and temperature output on the display and the customer selected output mode, analog or digital.

*Analog 4-20 mA output: factory default setup*
- Output #1 – Two-point average Flow
- Output #2 – Two-point average Temperature
- Output #3 – Pressure, available on STP models

*HART output*
- Command 9 – Slot 0, 2, 4: Two-point average Flow.
- Command 9 – Slot 5: Two-point average Temperature
- Command 9 – Slot 6: Pressure

*Fieldbus output*
- Flow AI Block – Two-point average Flow
- Temperature AI Block – Two-point average Process Temperature
- Process Transducer block – index 13, PRIMARY_VALUE (Average FLOW)
- Process Transducer block – index 15, SECONDARY_VALUE (Average TEMPERATURE)

*Modbus output*
- Command 3 – Two-point average Flow
- Command 3 – Two-point average Temperature
- Command 3 – Pressure, available on STP models
- Command 3 – Totalizer

**Troubleshooting**

The “Service Mode” both HART and Foundation Fieldbus provide access to the individual sensor output values.

The ST/STP102A electronics transmitter can recognize a disconnected flow element. If this condition is detected, the instrument indicates a fault condition and displays process variable data from the sensor that remains connected to the transmitter. The fault self-corrects when the sensor is re-connected.
In-Line Sensor Installation

The sensor can be threaded, flanged or butt weld mounted to the process piping. See Figure 6. The specific sensor process connection is customer specified on the Order Information Sheet.

Mount the sensor to the process piping per the application piping requirements. Verify the flow direction arrow is pointed in the correct direction. After the sensor head has been located correctly and tightened into place, verify the process seal does not leak by slowly applying pressure until the normal operation pressure is applied. Check for leaks at the process connection boundary.

<table>
<thead>
<tr>
<th>OPTIONAL CUSTOMER PROCESS CONNECTIONS</th>
<th>BUTT WELD</th>
<th>FEMALE NPT</th>
<th>MALE NPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINE SIZE</td>
<td>“A” LENGTH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1”</td>
<td>9”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1/2”</td>
<td>13.5”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2”</td>
<td>18”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Flow Transmitter Electronics Installation

The instrument electronic transmitter can be an integral part of the flow element or it can be mounted remotely using a shielded cable between the flow element and the electronics.

Supply connection wiring must be rated to 90 °C.

ESD Precautions

Caution: FCI flow meters contain static-sensitive devices. To avoid damage to the instrument observe the ESD precautions listed below before opening the instrument for wiring.

- Use a wrist band or heel strap with a 1 MΩ resistor connected to ground.
- Use a static conductive mat on the work table or floor with a 1 MΩ resistor connected to the ground when working on the instrument in a shop setting.
- Connect the instrument to ground.
- Apply antistatic agents such as Static Free made by Chemtronics to hand tools used on the instrument.
- Keep high static-producing items away from the instrument.

The above precautions are minimum requirements. The complete use of ESD precautions can be found in the U.S. Department of Defense Handbook 263.
**Integral Electronics**

The integral electronics package is mounted during the flow element installation process. The integral electronics can be rotated ±180 degrees on the top of the flow element insertion pipe. This is done by loosening the lock nut at the base of the enclosure and rotating the enclosure to the preferred orientation. **Do not rotate the electronics enclosure more than ±180 degrees. Damage to internal wiring may result from over rotating the enclosure.**

Lock Nut Torque Specification: 30-35 ft-lbs (40-47 N·m)

Provide integral electronics with additional support/bracing in applications where excessive vibration is present. A mounting bracket is available from FCI to support the electronics when additional support is required.

**Remote Electronics**

A mounting bracket is supplied when the transmitter is ordered for remote mounting. The bracket mounting details are shown in Figure 8 below. Refer to the outline installation drawings in Appendix A for additional mounting details. The electronics can be easily wall or pipe mounted. The mount bracket is designed for .25 inch or M6 mounting hardware. Securely mount the electronics to cement or structural support columns or beams. Mounting to plaster is not recommended and does not meet system approval requirements.
Remote Pipe Mounting

Refer to the figures below for remote transmitter pipe mounting details.

Figure 9

1½" or 1" PIPE

2x ¼"-20 U BOLTS, SST

ALUMINUM BRACKET (FCI PROVIDED)

Figure 10

2" PIPE

2x ⅜"-16 U BOLTS, SST

4x ⅜" HEX NUT

ALUMINUM BRACKET (FCI PROVIDED)
Instrument Wiring

The flow transmitter can be powered by 85 – 265 VAC or 24 VDC as specified in the instrument specification. The electronics cannot be configured to switch between AC and DC power. **For 220/265 VAC installations, a neutral reference circuit must be used.**

All cable glands and conduit fittings must meet or exceed the area approval rating where the instrument is being installed.

The recommended instrument wiring routing is shown in Figure 12 and Figure 13.

DC powered instruments require a ferrite to be installed on the input power wires to meet the EMC directive 2004/108/EC. Refer to the ferrite installations instructions in Appendix C, 80 for details.
Table 1 – Instrument Wiring Recommended AWG

<table>
<thead>
<tr>
<th>Connection</th>
<th>10 FT</th>
<th>50 FT</th>
<th>100 FT</th>
<th>250 FT</th>
<th>500 FT</th>
<th>1000 FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power AC or DC</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>20</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>Flow Element (8 Conductor Shielded)</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>22</td>
<td>22</td>
<td>18</td>
</tr>
<tr>
<td>STP Flow Element (10 Conductor Shielded)</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>18</td>
</tr>
<tr>
<td>Analog Out (HART)</td>
<td>-30</td>
<td>-30</td>
<td>-30</td>
<td>-30</td>
<td>-30</td>
<td>-30</td>
</tr>
<tr>
<td>Digital Out</td>
<td></td>
<td></td>
<td>FF-844 H1 (14-30 AWG)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FOUNDATION Fieldbus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modbus</td>
<td></td>
<td></td>
<td>RS485 (14-30 AWG)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Analog output maximum load: 600 ohms


Instrument fuse rating and part no:

AC Input Power (85 - 265 VAC):

Mfgr – Littelfuse, 2A TR5 SLO-BLO series 383 (2 amp rating), part no. 38312000000; FCI part no. 022499-01.

DC Input Power (24 VDC):

Mfgr – Littelfuse, 2A TR5 SLO-BLO series 383 (2 amp rating), part no. 38312000000; FCI part no. 022499-01.

The input power fuse is located on the customer interface board. See Figure 13. **Turn instrument power OFF before replacing the fuse.** To replace the fuse, unscrew the clear fuse cover and pull the fuse straight out of the holder. Replace the fuse with the recommended fuse listed above by aligning the fuse pins with the receiving holes located in the fuse holder and pushing securely into place until the fuse bottoms in the holder. Replace the fuse cover.
Reference the following wiring diagrams in Appendix B for specific integral and remote mounted electronics.

- Figure B-1 – Integral: AC Input Power, Analog and HART Output
- Figure B-2 – Remote: AC Input Power, Analog and HART Output
- Figure B-3 – Integral: DC Input Power, Analog and HART Output
- Figure B-4 – Remote: DC Input Power, Analog and HART Output
- Figure B-5 – Integral: AC Input Power, FOUNDATION Fieldbus Output
- Figure B-6 – Remote: AC Input Power, FOUNDATION Fieldbus Output
- Figure B-7 – Integral: DC Input Power, FOUNDATION Fieldbus Output
- Figure B-8 – Remote: DC Input Power, FOUNDATION Fieldbus Output
- Figure B-9 – Integral: AC Input Power, Modbus Output
- Figure B-10 – Remote: AC Input Power, Modbus Output
- Figure B-11 – Integral: DC Input Power, Modbus Output
- Figure B-12 – Remote: DC Input Power, Modbus Output
- Figure B-13 – Remote: 8-Conductor Interconnection Cable
- Figure B-14 – Source, Pulse/Frequency Output
- Figure B-15 – Sink, Pulse/Frequency Output
- Figure B-16 – Flow Element Connection, Integral/Remote
- Figure B-17 – Flow Element Connection, Remote
- Figure B-18 – Remote: 10-Conductor Interconnection Cable
- Figure B-19 – Extended Operation Mode, External Input Flow Adjust (EIA)
- Figure B-20 – Extended Operation Mode, External ST100 Flow Input (EFI)

**Post Installation Check**

Verify all wiring connections are secure and correct to the appropriate wiring diagram. Verify the flow direction arrow on the flow element is pointing in the right direction. Verify the mechanical process connection is secure and meets the system pressure requirements.
3 OPERATION

Basic Commissioning and Start-Up

When all working and process connections have been verified, apply power to the instrument. LCD-equipped instruments briefly show a welcome screen indicating the HMI software version followed by the normal operation process screen. The normal process screen shows: percentage of flow bar, icons (if present), process flow rate, totalized flow (optional), temperature in customer units, pressure (optional) in customer units, calibration group and group name.

The instrument LCD display functions as a basic HMI (Human-machine Interface) setup tool. The four buttons (IR sensors) located at the 3, 6, 9, and 12 o’clock positions on the display provide access to basic setup parameters. The HMI setup menu can be accessed through the window without removing the electronics enclosure lids. Enter the HMI setup menu by touching the glass in front of the 12 o’clock sensor (Hot Key) for 3 seconds. The LCD acknowledges the button selection by flashing then inverting the display characters and background while the button is held.

HMI Display Menu Navigation

In the HMI setup mode use the four IR sensors to navigate the menu. Touch/tap the top/bottom sensor to scroll up/down through the menu selections. Tap the right sensor to select. Tap the left sensor to return to the previous menu. Some setup parameters are password protected—when prompted enter the HMI user password: E#C. To immediately exit HMI setup and return to the process display touch the bottom sensor for 2 seconds. Backing out of menus via repeated taps of the left button also exits setup. An overview of the HMI menu structure is shown in Appendix C, 77.
Verify Engineering Units

Verify that the engineering units are correct for flow rate, temperature (and pressure is equipped). Use the HMI to make any necessary changes. The basic functions accessible from the HMI menu are listed in the outline below. For expanded configuration options use the ST100 configuration software application.

System Faults, Alarms and Logging Indication

The ST100 HMI indicates System Faults, Alarms and Logging by displaying three different icons when these conditions are present. These icons appear directly above the flow rate indication on the main process data screen. FAULTS are displayed as a Caution Triangle icon, ALARMS as a Bell icon and LOGGING as a LOG icon.
ST100 Configuration Software Application (User Password: 2772)
The ST100 configuration software application (also used for the MT100 product line) provides an alternate and more extensive method for configuring the instrument. However, this requires opening the electronics enclosure and connecting to a PC via the USB port. The ST100 configuration software application is intuitive, easy to use and the preferred method for commissioning the instrument.

Note: An asterisk (*) shown on various menu locations on the HMI indicates that the instrument is connected to the ST100 configuration software application. Note that not all configuration software application menus are accessible via the HMI.

Use a passive, straight-through USB 2.0 cable with A-type male connectors on both ends (as supplied with the instrument). Connect one end of the USB cable to the computer’s USB port. Connect the other cable end to the ST100 USB port (remove blind lid to access USB connector on interface board). Launch the application via the PC’s desktop ST100 Configurator icon. An example ST100 configuration software Welcome screen is shown below.

![Welcome Screen](image1)

A local USB connection to the PC is the primary communication method—click **USB Connect** to activate this connection. Ethernet communication is an option for remotely connecting a PC using an Ethernet network hub or switch. An example Process Data screen is shown below.

![Process Data Screen](image2)
With the configuration software running on the attached PC the user has access to all the configurable features of the ST100 Series instrument. If parameter changes are required the User Level Password (2772) is required. For more detailed instructions on the configuration software, refer to the ST100 Series Configuration Software manual 06EN003403.

Real Time Clock

The ST100 system time is maintained by a battery-powered real time clock that is set to Pacific Time at the factory. Synchronize the ST100 system time with the user’s local time using the ST100 configuration software. The real time clock cannot be set using the HMI menu interface. If the real time clock is not set correctly, or becomes corrupted, the process data logging feature will not work properly.

Start the ST100 configuration software application. Click USB Connect on the welcome screen. Select the Advanced Setup branch from the menu tree on the window’s left side. Select the Date and Time tab.

![Date and Time Set Screen](image)

Click Get from Device. This displays the current date and the ST100 system time. If needed, set the correct date using the field’s calendar date picker and time using the field’s spinner buttons. Click Send to Device to save the changes to the instrument.

Totalizer Setup

The flow totalizer function accumulates the instrument total flow, much like the odometer on an automobile. The engineering flow units must be set in mass or volumetric units for the function to work. The totalized flow value is displayed directly below the indicated flow rate on the instrument HMI display. The totalizer is enabled and displayed by default. Use the ST100 configuration software to set up the totalizer. The totalizer cannot be programmed using the HMI menu interface.

![Total Flow Value](image)

Figure 17
Start the ST100 configuration software application. Click **USB Connect** on the home screen. Select the **Basic Setup** branch from the menu tree on the window’s left side. Select the **Totalizer** tab. Configure as desired (check/uncheck the check boxes). Click **Send to Device** to save the changes to the instrument (enter the user level password 2772 when prompted). Click **Get from Device** to verify any changes.

**Totalizer Setup Screen**

**Process Data Logging**

The ST100 has the ability to log process data (date and time, flow rate, temperature, pressure, totalized flow rate and the faults code — all in customer units). This information is stored on the microSD card in the comma separated value (.csv) format without any titles. Use the ST100 configuration software application to set up the process data logging feature. The process data logging feature is disabled by default. The HMI menu interface can only be used to insert or remove the microSD card.

**Accessing the microSD Memory Card**

The ST100 comes equipped with an 8 GB (max. size) microSD memory card. Access the microSD card by removing the instrument’s blind lid. Locate the microSD card by finding the dashed rectangle silkscreened on the interface board with the label “MICRO SD.” The card socket is behind this marking on the back side of the PWB assembly with the microSD card edge flush with the board. Push down on the microSD card to eject it from its socket.

**Log File Naming Convention**

Example log file name: LGCF0168.CSV (where LG is constant for log file followed by coding for Year (A = 2012, B = 2013, etc.) Month (A = January, B = February, etc.) Day (1 = 1, A =11, etc.) Hour (A = midnight, B = 1AM, etc.) Minutes (00 to 59).CSV.

**Log File Entry Example**

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Day</th>
<th>Time</th>
<th>Flow Rate</th>
<th>Temperature</th>
<th>Pressure</th>
<th>Totalizer</th>
<th>Faults Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>6</td>
<td>10</td>
<td>8:58:00</td>
<td>89.198631</td>
<td>0.028174</td>
<td>0</td>
<td>69269.365</td>
<td>0x00000000</td>
</tr>
<tr>
<td>2014</td>
<td>6</td>
<td>10</td>
<td>8:58:10</td>
<td>89.185516</td>
<td>0.027597</td>
<td>0</td>
<td>69269.613</td>
<td>0x00000000</td>
</tr>
<tr>
<td>2014</td>
<td>6</td>
<td>10</td>
<td>8:58:20</td>
<td>89.178818</td>
<td>0.029547</td>
<td>0</td>
<td>69269.861</td>
<td>0x00000000</td>
</tr>
<tr>
<td>2014</td>
<td>6</td>
<td>10</td>
<td>8:58:30</td>
<td>89.183357</td>
<td>0.027222</td>
<td>0</td>
<td>69270.109</td>
<td>0x00000000</td>
</tr>
</tbody>
</table>

**Upload Selected Log File(s) to a PC Using a USB Cable and the ST100 Configuration Application**

It is possible to upload selected log file(s) to a PC using a USB cable and the ST100 configuration software application without removing the memory card from the ST100 electronics.

Start the ST100 configuration application. Click **USB Connect** on the home screen. Select the **Basic Setup** branch from the menu tree on the window’s left side. Select the **SD Card Logging** tab. In the **SD Card Log Files** frame click **Show List of Log Files**. Select the desired file(s) from the list displayed. Click **Upload Selected Log File(s)**. A file dialog pops up showing the host computer file locations (like Windows Explorer). Select the desired location to store the file and click **OK**. The file is then copied to the specified host computer location.
Process Data Logging Configuration

Start the ST100 configuration application. Click **USB Connect** on the home screen. Select the **Basic Setup** branch from the menu tree on the window’s left side. Select the **SD Card Logging** tab.

Process data logging configuration is done in the window’s **Logging** section as follows.

- **Start Logging:** Specifies start time of the first log file. Can be either “Start Now” or “Date/Time."
- **Sample Period:** Specifies how often a log file is generated. Can range from once every 10 seconds to once every 24 hours.
- **Duration:** Specifies how long the logging feature remains activated. Can range from 1 minute to 90 days.
- **Cancel Logging:** Used to cancel ST100 logging-in-progress or pending log.
- **Show List of Log Files:** Shows the previously completed log files stored on the microSD card.
- **Upload Selected Log File(s):** Transfers log files from the microSD card to a PC connected to the ST100 USB interface.

![Basic Setup SD Card Logging](image)

Process Data Log File Handling

In addition to uploading selected microSD card log file(s) to a PC using a USB cable and the ST100 configuration application as described on the previous page, you can also remove the microSD card from the instrument and use a card reader to manually transfer files.

**Remove microSD Card from the Instrument and Manually Transfer Files with a Card Reader**

**Using the HMI** — Hold the “Hot Key” (top sensor) for three seconds. Select “LoggerSDcard.” Select “Remove.” This closes any open files on the microSD card allowing it to be removed safely.

**Using the ST100 Configuration Application** — Click **USB Connect** on the welcome screen. Select **Basic Setup** branch from the menu tree on the window’s left side. Select the **SD Card Logging** tab. In the **Secure Digital Card** field click **Remove Micro SD Card**. This closes any open files on the microSD card allowing it to be removed safely.

Open the ST100 enclosure and physically remove the microSD card from the electronics (see 25). Insert the card into an appropriate card reader. Use a PC to view and/or save the contents as desired. When finished, reinsert the microSD card using either the HMI menu or the ST100 configuration application as follows:

**Using the HMI** — Physically insert the microSD card into the electronics. Hold the “Hot Key” (top sensor) for three seconds. Select “LoggerSDcard.” Select “Inserted.” This signals the instrument that the microSD card is present and ready to use. Secure the electronics enclosure and return the ST100 to normal operation.

**Using the ST100 Configuration Application** — Click **USB Connect** on the welcome screen. Select the **Basic Setup** branch from the menu tree on the window’s left side. Select the **SD Card Logging** tab. In the **Secure Digital Card** field click **Insert Micro SD Card**. Physically insert the microSD card into the electronics. Click **OK** on the pop-up dialog box. This signals the instrument that the microSD card is present and ready to use. Secure the electronics enclosure and return the ST100 to normal operation.
Internal Delta-R Resistor (idR) Check

The Internal Delta-R Resistor (idR) Check is a routine designed to assess the ST100 internal normalization. The normalization process fine tunes the instrument’s ability to accurately measure resistance. Proper normalization also allows FCI electronics to be interchangeable for replacements, spares or repaired boards. If the unit’s normalization shifts, the accuracy of the meter may be compromised.

By passing the same sensor excitation current used to power the RTDs across three high precision idR resistors (60 Ω, 100 Ω, and 150 Ω) trendng patterns can be established. Periodically run the idR check to verify proper operation of the ST100 electronics package. Use the idR check as a troubleshooting tool to isolate a fault between the sensor and the electronics.

Running the idR Check

There are two ways to run the idR check:

Using the HMI

Hold the “Hot Key” (top sensor) for three seconds. Select Diagnostics and then Self Test. Select FE 1 IDR (or FE 2 IDR if present) and enter the User Level Password (E#C). After successful password entry the display shows the FE 1 IDR list again. Select (again) the desired FE. Observe that Test in Progress displays along with a timer counting down the seconds. See Appendix C, 78 for the idR test display sequence.

When the idR check completes the expected and measured values for each idR resistor are shown on the HMI display. The left part of the screen shows the expected (EXP’D) values. The right part of the screen shows the measured (MEAS’D) values. If all three pass (P shown at rightmost part of line) the display shows PASSED at display bottom. If any one of the three fail (F shown at rightmost part of line) the display shows FAILED at display bottom. Data from an HMI-initiated idR check is not saved; therefore, record the data by hand as required.

When a scheduled Internal Delta-R Check is running (see "Using the ST100 Configuration Software Application" below) the HMI shows the Fault icon (exclamation point inside a triangle) displayed above the flow rate.

Example idR Check Results Display

Using the ST100 Configuration Software Application

Click USB Connect on the home screen. Select the Diagnostics branch from the menu tree on the window’s left side. Select the idR Scheduled Tests tab. Select the “FE #” desired from the Selected FE drop-down list (only FE1 shows for a single-point system). Two settings that affect scheduled and on-demand idR tests are provided on this screen: FEx Internal Delta-R Pass Fail Criteria, Maximum Allowed Error (default = 0.5 ohms) and FEx Output Mode During Test, Mode (default = Freeze Flow During Test). Make changes to the default settings as required for your application.

In the FE1 Schedule Internal Resistor Check field, use the Mode drop-down list to select a schedule mode: Disabled (default), Day of Month (1-28), Day of Week (0=Sun), or Every(Day). Use the Day, #days, DOW spinner control to define the selected schedule mode. Use the Time spinner control to enter the desired start time of the scheduled check. Alternatively, click Run test now on FEx to run the idR check on demand.

After clicking Run test now on FEx the FEx idR Test Results field displays the expected and the measured resistance values. These instant checks are not logged to the FRAM and not displayed under the Test Logs tab as the Scheduled Tests files. Furthermore, they cannot be added to the SD card logs.

For ST100 models with FE2 (i.e., dual element) only: Each FE can have its own unique idR Scheduled Tests settings as revealed by the Selected FE drop-down list selection. To make all FEs use the same settings displayed on-screen, tick the Set All FEs to This Selection checkbox (this checkbox shown only for dual element models such as ST102, ST112, etc.).
Example Internal Delta R Scheduled Screen (After Clicking "Run test now...")

View idR files using the idRTest Logs tab. Add these files to the microSD card for further analysis by clicking Add to SD Card Logs. Manually remove the microSD card to transfer these idR log files to a PC. Use a card reader as described in “Remove microSD Card from the Instrument and Manually Transfer Files with a Card Reader” on page 26.

The idR log file is always named “DLTRLOG” and is amended every time a new scheduled test is initiated. Process data log files are always a new file with a unique file name as shown.

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Day</th>
<th>Time</th>
<th>FE</th>
<th>Act Ohms</th>
<th>Exp Ohms</th>
<th>Act Ohms</th>
<th>Exp Ohms</th>
<th>Act Ohms</th>
<th>Exp Ohms</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>5</td>
<td>6</td>
<td>10:21:24</td>
<td>0</td>
<td>59.96</td>
<td>60</td>
<td>99.76</td>
<td>100</td>
<td>149.78</td>
<td>150</td>
</tr>
<tr>
<td>2014</td>
<td>5</td>
<td>8</td>
<td>10:21:24</td>
<td>0</td>
<td>59.96</td>
<td>60</td>
<td>99.76</td>
<td>100</td>
<td>149.75</td>
<td>150</td>
</tr>
<tr>
<td>2014</td>
<td>5</td>
<td>12</td>
<td>10:21:24</td>
<td>0</td>
<td>59.94</td>
<td>60</td>
<td>99.75</td>
<td>100</td>
<td>149.75</td>
<td>150</td>
</tr>
<tr>
<td>2014</td>
<td>5</td>
<td>13</td>
<td>14:52:24</td>
<td>0</td>
<td>59.95</td>
<td>60</td>
<td>99.76</td>
<td>100</td>
<td>149.77</td>
<td>150</td>
</tr>
<tr>
<td>2014</td>
<td>6</td>
<td>11</td>
<td>10:41:24</td>
<td>0</td>
<td>59.95</td>
<td>60</td>
<td>99.75</td>
<td>100</td>
<td>149.76</td>
<td>150</td>
</tr>
<tr>
<td>2014</td>
<td>6</td>
<td>11</td>
<td>11:39:24</td>
<td>0</td>
<td>59.95</td>
<td>60</td>
<td>99.75</td>
<td>100</td>
<td>149.78</td>
<td>150</td>
</tr>
</tbody>
</table>

Internal Delta-R Log File Results Example (Data Formatted and Titles Added using Microsoft Excel)
Analog Output Response to idR Check

During the idR sequence the analog outputs respond as listed below. Readings are taken with a 250 Ω load across Analog Output 1, 2 or 3.

**NAMUR Enabled LOW**
- 2.325 Vdc = 23.16 sfps = baseline (example: actual flow output varies from 1-5 volts)
- 0.900 Vdc = idR In Progress
- 1.000 Vdc = momentary state
- 2.326 Vdc = after 3 seconds. idR values are displayed now.

**NAMUR Enabled HIGH**
- 2.325 Vdc = 23.16 sfps = baseline (example: actual flow output varies from 1-5 volts)
- 5.250 Vdc = idR In Progress
- 1.000 Vdc = momentary state
- 2.326 Vdc = after 3 seconds. idR values are displayed now.

**NAMUR Enabled Disabled**
- 2.325 Vdc = 23.16 sfps = baseline (example: actual flow output varies from 1-5 volts)
- 1.000 Vdc = idR In Progress
- 2.326 Vdc = after 3 seconds. idR values are displayed now.

### Extended Operation Modes

The measurement capabilities of the ST100 series instruments are expanded with the following extended operating modes:

- External Input Flow Adjust (EIA)
- External ST100 Flow Input (EFI)
- External Control Group Switching (EGS)

Use the ST100 configuration software application to set up an extended operating mode. The ST100 HMI menu cannot be used to program this feature.

**Basic**

This is the factory default mode of operation (no extended operating mode in effect).
External Input Flow Adjust (EIA)

This mode corrects the flow rate of an ST100 flow meter when an external 4-20 mA current is fed into the Auxiliary Input port. Four polynomial factors are used to determine the correction applied to the flow rate and corresponding 4-20 mA output. The equation that defines this correction is as follows:

\[
\text{Corrected Flow Rate} = (\text{Starting Flow Rate} \times \text{Factor1}) + (\text{Factor2} \times 4-20 \text{ mA Input}) + (\text{Factor3} \times (4-20 \text{ mA Input})^2) + (\text{Factor4} \times (4-20 \text{ mA Input})^3)
\]

Make the connections as shown in the wiring diagram "Figure B-19 – Extended Operation Mode, External Input Flow Adjust (EIA)" on page 69.

Start the application. Click **USB Connect** on the home screen. Select the **Configuration** branch from the menu tree on the window’s left side. Select the **Extended Op. Mode** tab. Click **Toggle System Mode**. Enter user level password 2772 at the prompt. Verify instrument is in the service state with **Setup** showing in **System Mode** field. Click **External Input Flow Adjust (EIA)** radio button. In the window’s **Ext. Input Flow Adjust Setup** field enter the four polynomial factors in the text box for **Factor1**, **Factor2**, **Factor3**, and **Factor4**.

At window bottom click **Set System Mode to ‘Running’ when Send** check box. Click **Send to Device** near check box to send the EIA programming to the instrument. Observe return to normal operation with **Running** showing in **System Mode** field.

The Process Data screen on the ST100 configuration application will now display “EXTENDED OP MODE EIA” in the upper left corner. The HMI display also shows **EIA** on the Group Number line after the HMI is refreshed. Refresh the HMI display by cycling the power to the unit or covering the Hot Key for 3 seconds.
External ST100 Flow Input (EFI)

This mode connects two separate ST100 flow meters for continuous flow averaging. This is done by sending 4-20 mA output current (relative to flow rate) from one ST100 (Slave) to the Auxiliary Input port of the other ST100 (Master). In this manner the Master displays the average flow rate and corresponding 4-20 mA output current.

Make the connections as shown in the wiring diagram "Figure B-20 – Extended Operation Mode, External ST100 Flow Input (EFI)" on page 69.

Start the application. Click **USB Connect** on the home screen. Select the **Configuration** branch from the menu tree on the window’s left side. Select the **Extended Op. Mode** tab. Click **Toggle System Mode**. Enter user level password 2772 at the prompt. Verify that instrument is in the service state with **Setup** showing in the **System Mode** field. Click **External ST100 Flow Input (EFI) radio button. In the window’s **Ext. ST100 Flow Input Setup** field, select the Slave ST100 flow units from the drop-down list. Enter the flow rate equal to 4 mA into the **(Ext. ST100) Flow Min (4mA)** text box. Enter the flow rate equal to 20 mA into the **(Ext. ST100) Flow Max (20mA)** text box.

At window bottom click **Set System Mode to ‘Running’ when Send** check box. Click **Send to Device** near check box to send the EFI programming to the instrument. Observe return to normal operation with **Running** showing in **System Mode** field.

The Process Data screen on the ST100 configuration application will now display “EXTENDED OP MODE EFI” in the upper left corner. The HMI display also shows **EFI** on the Group Number line after the HMI is refreshed. Refresh the HMI display by cycling the power to the unit or covering the Hot Key for 3 seconds.
External Control Group Switching (EGS)

This mode automatically changes the ST100 calibration group based on a 4-20 mA output current from another device fed into the ST100 Auxiliary Input port.

Start the application. Click USB Connect on the home screen. Select the Configuration branch from the menu tree on the window’s left side. Select the Extended Op. Mode tab. Click Toggle System Mode. Enter user level password 2772 at the prompt. Verify that instrument is in the service state with Setup showing in System Mode field. Click External Control Group Switching (EGS) radio button.

External Control Group Switching (EGS) Setup

Select the Group Switch Setup tab. In the window’s External Control Group Switching Setup field, assign a calibration group as desired to the min. (4 mA) and max. (20 mA) input values via the associated Group drop-down list. Similarly, define up to 4 points within the range by entering an input value in the text box and assigning it a calibration group via the associated Group drop-down list. These entries determine which calibration group is active as the auxiliary input current varies. The EGS setup field’s Reset button provides a quick way to clear out all programming entries (mA value/calibration group assignment).

Click Send to Device to send the EGS programming to the instrument. Return to normal operation by selecting the Extended Op. Mode tab and clicking the Toggle System Mode button (observe that System Mode field shows Running).

The Process Data screen on the ST100 configuration application will now display “EXTENDED OP MODE EGS” in the upper left corner. The HMI display also shows EGS on the Group Number line after the HMI is refreshed. Refresh the HMI display by cycling the power to the unit or covering the Hot Key for 3 seconds.
4 MAINTENANCE

**Warning:** To avoid hazards to personnel, ensure that all environmental isolation seals are properly maintained.

**Caution:** The electronics contains electrostatic discharge (ESD) sensitive devices. Use standard ESD precautions when handling the electronics. Refer to “ESD Precautions” on page 14.

The FCI instrument requires little maintenance. There are no moving parts or mechanical parts subject to wear in the instrument. The sensor assembly which is exposed to the process media is all stainless steel construction.

Without detailed knowledge of the environmental parameters of the application surroundings and process media, FCI cannot make specific recommendations for the periodic inspection, cleaning, or testing procedures. However, some suggested general guidelines for maintenance steps are offered below: Use operation experience to establish the frequency of each type of maintenance.

**Calibration**
Periodically verify the calibration of the output and recalibrate if necessary. See Section 4: Troubleshooting. FCI recommends every 18 months at a minimum.

**Electrical Connections**
Periodically inspect cable connection on terminal strips and terminal blocks. Verify that terminal connections are tight and physically sound with no signs of corrosion

**Remote Enclosure**
Verify that the moisture barriers and seal protection of the electronics, in the local and remote enclosures, are adequate and that no moisture is entering those enclosures.

**Electrical Wiring**
FCI recommends occasional inspection of the system's interconnecting cable, power wiring and flow element wiring on a "common sense" basis as appropriate to the application environment. Periodically inspect the conductors for corrosion and the cable insulation for signs of deterioration.

**Flow Element Connections**
Verify that all seals are performing properly and that there is no leakage of the process media. Check for deterioration of the gaskets and environmental seals used.

**Flow Element Assembly**
Periodically remove the flow element for inspection based on historical evidence of debris, foreign matter, or scale build-up and appropriate plant shutdown schedules and procedures. Check for corrosion, stress cracking, and/or build-up of oxides, salts, or foreign substances. The thermowells must be free of excessive contaminants and be physically intact. Any debris or residue build-up could cause inaccurate flow measurement. Clean the flow element, as necessary, with a soft brush and available solvents (compatible with stainless steel).
Intentionally Left Blank
5 TROUBLESHOOTING

**Warning:** Testing/troubleshooting of this instrument is limited to qualified personnel only. The operator assumes all responsibilities or safe practices while troubleshooting.

**Caution:** The electronics contains electrostatic discharge (ESD) sensitive devices. Use standard ESD precautions when handling the electronics. Refer to “ESD Precautions” on page 14.

In new or re-calibrated instruments, operating problems are most often caused by an improper installation. Review the information on instrument installation in Section 2, starting on 7. Verify the correct mechanical and electrical installation.

Troubleshooting is more effective if the operation of the equipment is understood before trying to solve the equipment problems. Be familiar with the way the instrument operates before troubleshooting an instrument that does not function properly.

Replacement parts must be of the same part type and number. Contact the FCI customer service department for the correct replacement parts.

Damage to equipment due to negligence or lack of technical skill is not covered by the warranty. When parts are replaced, the verification and calibration procedures must be performed by a qualified technician to ensure the accuracy and calibration of the instrument.

**Quick Check**

- Verify the serial numbers of the flow element and electronics match.
- Verify all cables are seated firmly.
- Verify all customer connections are correct.
- Verify the wiring is per the correct wiring diagram(s).
- Verify the installation is correct as shown in Installation section.
- Check customer fuses and power switches.
- Verify normal display on the HMI (flow rate, temperature, group number, group name, etc.)

- Confirm that the display indicates the correct calibration group name as stated on the dR sheet.
- Confirm the display’s fault status indication.
- If the Fault Alarm sign is continuously on it indicates an instrument fault. Troubleshoot the instrument as described in this section.
**General Function Check**

The ST100 series thermal mass flow meter is available in various configurations; this troubleshooting section covers ST100 Single point remote Analog (4-20mA/HART) ST100 Single point remote Digital bus output.

**Tools Needed**
- Digital Multimeter (DMM)
- ST100 Configuration Software Application
- USB Cable Type A to Type A, male-male (passive, straight-through type as supplied with instrument)
- Two Decade Resistance Boxes with resolution from 0.01 to 9999.99 ohms
- Allen Wrench 1/16 inch
- Small size flat blade screwdriver (for sensor wiring connection)

**Setup Verification**

Connect the flow meter via USB to a computer or laptop running the ST100 configuration software supplied with the instrument. See the ST100 configuration software manual for details.

Confirm the setup of the flow meter going through the setup windows in the configurator. Verify that the displayed information matches the parameters printed on the dR sheet parameter table. Contact your local representative or FCI for instructions if setup doesn’t match.

**NAMUR Fault Indication**

NAMUR NE43 is a German fault detection standard that lets the user know if there is a fault within the instrument by forcing the 4-20 mA output current outside the normal operating range of the instrument.

The NAMUR is turned on or off with the ST100 configuration software application only. The HMI cannot access NAMUR.

Launch the ST100 Configuration application and click **USB Connect** on the welcome screen. Select the **Configuration** branch from the menu tree on the window’s left side. Select the **4-20mA User** tab. Click on the **NAMUR Enabled** checkbox.
In the window’s NAMUR field, define the NAMUR output level by clicking either Set NAMUR @ 3.6 mA or Set NAMUR @ 21.0 mA. Click Send to Device to save the settings to the instrument. To discard changes, exit the screen without clicking Send to Device.

When NAMUR is enabled, and a Fatal Fault is detected, the 4-20 mA output is forced to the preselected NAMUR output level. Use the Click to Test NAMUR button (forces NAMUR output) as needed to verify the system setup and wiring.

### Fatal Faults that Trigger NAMUR

<table>
<thead>
<tr>
<th>FAULT BIT</th>
<th>FATAL FAULT ERROR OR STATUS DESCRIPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CORE: any of these errors: I2C error, UART error, Mutex error or Watchdog Reset.</td>
</tr>
<tr>
<td>4</td>
<td>CORE: unable to update process data (PD_NO_FE_DATA). Unable to obtain/use data from any active FEs.</td>
</tr>
<tr>
<td>6</td>
<td>CORE: detects FRAM/SPI error.</td>
</tr>
<tr>
<td>14</td>
<td>CORE: unable to communicate with one or more FEs (PD_COMM_ERROR).</td>
</tr>
<tr>
<td>16</td>
<td>CORE: averaged flow out of range of “Flow Min” or “Flow Max.”</td>
</tr>
<tr>
<td>20</td>
<td>CORE: averaged temperature above “Temperature Max.”</td>
</tr>
<tr>
<td>21</td>
<td>CORE: averaged temperature above “Temperature Min.”</td>
</tr>
<tr>
<td>22</td>
<td>(Any) FE reports SENSOR_HEATER_1_SHORTED_FAULT.</td>
</tr>
<tr>
<td>23</td>
<td>(Any) FE reports SENSOR_HEATER_2_SHORTED_FAULT.</td>
</tr>
<tr>
<td>24</td>
<td>(Any) FE reports SENSOR_HEATER_1_OPEN_FAULT.</td>
</tr>
<tr>
<td>25</td>
<td>(Any) FE reports SENSOR_HEATER_2_OPEN_FAULT.</td>
</tr>
<tr>
<td>33</td>
<td>(Any) FE reports AD5754_DAC_FAULT.</td>
</tr>
<tr>
<td>37</td>
<td>(Any) FE reports HTRS_FAULTS_ADC_FAULT.</td>
</tr>
</tbody>
</table>

### Application Verification

#### Equipment Needed
- ST100 Calibration certificate
- dR certificate supplied with the flow meter

#### Check Serial Numbers

Verify that the serial number of the flow element and the flow transmitter electronics are the same. The flow element and the flow transmitter are a matched set and cannot be operated independently of each other.

#### Check the Instrument Installation

Review the correct mechanical and electrical installation. Verify that the flow element is mounted at least 20 diameters downstream and 10 diameters upstream from any bends or interference in the process pipe or duct.

#### Check for Moisture

Check for moisture on the flow transmitter. Moisture on the flow transmitter may cause intermittent operation. Check for moisture on the flow element. If a component of the process media is near its saturation temperature it may condense on the flow element. Place the flow element where the process media is well above the saturation temperature of any of the process gases.

#### Check Application Design Requirements

Application design problems may occur with first time application instruments, although the design can also be checked on instruments that have been in operation for some time. If the application design does not match field conditions, errors occur.

Review the application design with plant operation personnel and plant engineers. Ensure that plant equipment such as pressure and temperature instruments conform to the actual conditions. Verify operating temperature, operating pressure, line size, and gas medium.
Verify Standard Versus Actual Process Conditions

The flow meter measures the mass flow rate. The mass flow rate is the mass of the gas flowing through a pipe per time. Other flow meters, such as an orifice plate or a pitot tube, measure the volumetric flow rate. The volumetric flow rate is the volume of gas per time. If the readings displayed do not agree with another instrument, some calculations may be necessary before comparing them. To calculate the mass flow rate, the volumetric flow rate, pressure, and temperature at the point of measurement must be known. Use the following equation to calculate the mass flow rate (Standard Volumetric Flow rate) for the other instrument:

\[ Q_s = Q_A \times \frac{P_A}{T_A} \times \frac{T_s}{P_s} \]

Where:
- \( Q_A \) = Volumetric Flow
- \( P_A \) = Actual Pressure
- \( P_s \) = Standard Pressure
- \( Q_s \) = Standard Volumetric Flow
- \( T_A \) = Actual Temperature
- \( T_s \) = Standard Temperature

PSIA and °R are used for pressure and temperature units. For Metric use bar(a) and °K are used for pressure and temperature.

Example:
- \( Q_A \) = Volumetric Flow = 1212.7 ACFM
- \( P_A \) = Actual Pressure = 19.7 PSIA
- \( P_s \) = Standard Pressure = 14.7 PSIA
- \( Q_s \) = Standard Volumetric Flow = 1485 SCFM
- \( T_A \) = Actual Temperature = 120°F (580°R)
- \( T_s \) = Standard Temperature = 70°F (530°R)

For Metric:
- \( P_s \) = Standard Pressure = 1.01325 bar(a)
- \( T_s \) = Standard Temperature = 21.1°C (294.1°K)

\[ \left( \frac{1212.7 \text{ ACFM}}{1} \right) \left( \frac{19.7 \text{ PSIA}}{580°R} \right) \left( \frac{580°R}{14.7 \text{ PSIA}} \right) = 1485 \text{ SCFM} \]

Check the Hardware

Equipment Required:
- Digital Multimeter (DMM)
- ST100 Configuration Software Application
- USB Cable Type A to Type A, male-male (passive, straight-through type as supplied with instrument)
- Two Decade Resistance Boxes with resolution from 0.01 to 9999.99 ohms
- Allen Wrench 1/16 inch
- Small size flat blade screwdriver (for sensor wiring connection)
Troubleshooting the Flow Element

Use the appropriate procedure depending on the instrument’s configuration, Integral or Remote.

**Integral Configuration** (Refer to Figure 18 below.)

1. Turn instrument power OFF.
2. Remove the two M4 socket head screws securing the electronics into the enclosure. A third M4 socket head screw is used to ground the electronics assembly, this screw can remain in place and will prevent the electronics from falling out of the enclosure.
3. Slide the electronics assembly out of the enclosure until the Flow Element connector TB1 is accessible.
4. Note the location of the positive locking tab on the connector. Carefully remove the plug from the connector.
5. Orient the pin 1 as shown in the figure below. Using an ohmmeter with pin type probes, measure and record the ohm values between the pins identified in the Integral Flow Element Resistance Table.
6. Reassemble the flow element plug into the connector TB1 making sure the tab on the plug is in alignment with the tab on the connector.
7. Carefully slide the electronics assembly back into place, inside the enclosure, and secure with the two M4 socket head screws.

**Figure 18**

*Note:* The resistance values listed below are based on an ambient temperature of 70 °F (20 °C). Since RTD resistance is dependent on the actual temperature at the sensor, it is normal for the resistance to differ from the table by several ohms. The flow element is OK if measured readings track the table values. Measured readings that are appreciably different from the table indicate an issue with the flow element.

**Integral Flow Element Resistance Table**

<table>
<thead>
<tr>
<th>Probe A</th>
<th>Probe B</th>
<th>Approximate Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 HTR EXC</td>
<td>3 HTR RTN</td>
<td>110-118 ohms</td>
</tr>
<tr>
<td>4 ACT EXC</td>
<td>5 ACT SEN</td>
<td>0 ohms</td>
</tr>
<tr>
<td>8 REF EXC</td>
<td>9 REF SEN</td>
<td>0 ohms</td>
</tr>
<tr>
<td>9 REF SEN</td>
<td>5 ACT SEN</td>
<td>2160 ohms</td>
</tr>
<tr>
<td>6 GND SEN</td>
<td>4 ACT EXC</td>
<td>1080 ohms</td>
</tr>
<tr>
<td>6 GND SEN</td>
<td>5 ACT SEN</td>
<td>1080 ohms</td>
</tr>
<tr>
<td>6 GND SEN</td>
<td>8 REF EXC</td>
<td>1080 ohms</td>
</tr>
<tr>
<td>6 GND SEN</td>
<td>9 REF SEN</td>
<td>1080 ohms</td>
</tr>
<tr>
<td>6 GND SEN</td>
<td>7 GND</td>
<td>0 ohms</td>
</tr>
</tbody>
</table>
Remote Configuration (Refer to Figure 19 below.)

1. Turn instrument power OFF.
2. Disconnect the flow element wires from local terminal block.
3. Using an ohmmeter, measure and record the ohm values between the pins identified in the Remote Flow Element Resistance Table.
4. Reassemble the flow element wires back onto the local terminal block as shown in the figure below.
5. A similar resistance check can be made at the electronics side of the interconnecting cable. The interconnecting cable wires will add ohmic values depending on the cable wire size and length. Use the table “Resistance Versus Wire Size (AWG)” on page 41 to correct flow element measured values through the interconnecting cable by subtracting the cable resistance from the measured value.

**Figure 19**

*Note:* The resistance values listed below are based on an ambient temperature of 70 °F (20 °C). Since RTD resistance is dependent on the actual temperature at the sensor, it is normal for the resistance to differ from the table by several ohms. The flow element is OK if measured readings track the table values. Measured readings that are appreciably different from the table indicate an issue with the flow element.

**Remote Flow Element Resistance Table**

<table>
<thead>
<tr>
<th>Probe A</th>
<th>Probe B</th>
<th>Approximate Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 GND</td>
<td>2 GND SEN</td>
<td>0 ohms</td>
</tr>
<tr>
<td>2 GND SEN</td>
<td>3 REF SEN</td>
<td>1080 ohms</td>
</tr>
<tr>
<td>2 GND SEN</td>
<td>5 REF EXC</td>
<td>1080 ohms</td>
</tr>
<tr>
<td>2 GND SEN</td>
<td>4 ACT SEN</td>
<td>1080 ohms</td>
</tr>
<tr>
<td>2 GND SEN</td>
<td>6 ACT EXC</td>
<td>1080 ohms</td>
</tr>
<tr>
<td>3 REF SEN</td>
<td>4 ACT SEN</td>
<td>2160 ohms</td>
</tr>
<tr>
<td>3 REF SEN</td>
<td>5 REF EXC</td>
<td>0 ohms</td>
</tr>
<tr>
<td>4 ACT SEN</td>
<td>6 ACT EXC</td>
<td>0 ohms</td>
</tr>
<tr>
<td>8 HTR RTN</td>
<td>7 HTR EXC</td>
<td>110-118 ohms</td>
</tr>
</tbody>
</table>
Resistance Versus Wire Size (AWG)

<table>
<thead>
<tr>
<th>AWG Size</th>
<th>Ohms Per 1000 Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>2.52</td>
</tr>
<tr>
<td>15</td>
<td>3.18</td>
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<tr>
<td>16</td>
<td>4.02</td>
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<tr>
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<td>16.2</td>
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<tr>
<td>23</td>
<td>20.3</td>
</tr>
<tr>
<td>24</td>
<td>25.7</td>
</tr>
</tbody>
</table>

Check the Flow Element Voltages

If resistance measurements fail to resolve the problem, or if power cannot be removed from the instrument, measure the following voltages. Using a DMM set to voltage, make the voltage measurements found in the table below at terminal strip P2A on the flow transmitter or on the sensor enclosure terminal block. Remote flow element cable resistance will affect the voltage readings at the electronics enclosure.

Approximate Flow Element Voltages at 70 °F

<table>
<thead>
<tr>
<th>Wire</th>
<th>Expected Voltage*</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTR EXC to HTR RTN</td>
<td>≈ 6.79 VDC</td>
</tr>
<tr>
<td>ACT SEN to ACT EXC</td>
<td>≈ 0.00 VDC</td>
</tr>
<tr>
<td>REF SEN to REF EXC</td>
<td>≈ 0.00 VDC</td>
</tr>
<tr>
<td>REF EXC to GND</td>
<td>≈ 2.20 VDC</td>
</tr>
<tr>
<td>ACT EXC to GND</td>
<td>≈ 2.21 to 2.82 VDC**</td>
</tr>
<tr>
<td>ACT SEN to REF SEN</td>
<td>≈ 0.24 VDC**</td>
</tr>
</tbody>
</table>

*Voltages vary with temperature, flow rate and the heater current.  
**Voltages vary with the process flow rate.
**Verification of the Electronics**

**Check the Flow Transmitter Power Supply Voltages**

Check the voltages shown in the table below with a DMM set to voltage. The readings are taken on the power supply board at connector P2.

<table>
<thead>
<tr>
<th>Instrument Power Supply Voltages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pin Number</strong></td>
</tr>
<tr>
<td>Digital 5 VDC: P1 to P2</td>
</tr>
<tr>
<td>Analog 24 VDC: P3 to P4</td>
</tr>
</tbody>
</table>

If the voltage checks correspond to the levels shown in the table, the power supply is functioning properly.

**Transmitter Circuit Calibration Check (Delta R Verification)**

*Equipment Needed*
- FES-200 Flow Element Simulator with proper cable for FCI transmitter model
- Digital Multimeter
- Delta R Calibration Data Sheet (serial number specific by instrument and group)
- Precision 250 Ω resistor (recommended)

*Alternate Tool for FES-200*
- 2 - Precision Decade Resistance Box, 0.1% (1 kΩ large step, 0.01 Ω small step)

*Note:* A change in flow meter parameters may result in inaccurate calibrations, or they may be a result of factory authorized changes. Consult a factory service representative if parameter changes don’t seem to correlate.

Each flow meter is provided with a Delta R data sheet which is a table listing the differential resistance values that correlate to the flow meter’s calibration. Resistance substitution instruments like the FES-200 can be used to check instrument calibration and verify correct operation of the flow transmitter using the Delta R data sheet.

To verify the transmitter is working properly, disconnect the sensor head and substitute a precision resistance (Delta R) using the FES-200 in place of the sensor. Determine if the transmitter is still within factory specification by measuring the transmitter output and observing the display.

**Safety Instructions**

*Warning:* Explosion Hazard. Do not disconnect equipment when flammable or combustible atmosphere is present. Operator assumes responsibility for all safety concerns relating to interrupting and reapplying power to their instrumentation.

**Delta R Check**

1. Verify the Delta R data sheet has the same serial number and group number as the flow meter calibration that is being verified.
2. Power off the transmitter.
3. Disconnect the instrument's sensor and connect the FES-200 input connector into the transmitter. See Figures 22 – 24 for integral or remote configuration diagrams. Precision decade boxes can be used in place of the FES-200. See “Figure 25 - ST100 Decade Box Wiring” on page 46 for decade box wiring.
4. Connect a DMM to the transmitter 4-20 mA output by either method A or B:
   a. To read 1 to 5 volts, disconnect both output loop wires and connect a precision 250 Ω resistor across the output terminal (Figure 20). Then connect the DMM, set to DC volts (V), across the resistor to read its voltage drop.
   b. To read 4 to 20 mA current, disconnect the output loop and connect the DMM, set to milliamperes (mA), in series with the output circuit (Figure 21) to read the current flow.
5. Turn power ON and allow the instrument 10 minutes to stabilize.

6. Verify the transmitter is in the calibration group matching the Delta R data sheet.

7. On the FES-200, dial in a Delta R value with the thumbwheel from the column marked Delta R (ohms) on the Delta R data sheet. Compare to the output value column (VDC Across 250 Ohms or mA Output) and/or the Indicated Display column. Verify that the meter reading is within the stated tolerance of the flow transmitter. See examples 1, 2 and 3 at the end of this section, as applicable.

8. Repeat for each point on the Delta R table, except for the step value and zero value.

9. Turn power OFF and disconnect the FES-200 and DMM. Reconnect the sensor element connector.

10. Close the enclosure, making sure none of the wires are strained. Ensure any seals and gaskets are properly installed.

11. Restore power to the meter.

If you are troubleshooting the flow meter and the readings are good, the flow transmitter is good and the problem may involve the flow element or interconnecting cable. If the readings are off, a flow element calibration may be required or the flow transmitter needs to be setup. Contact FCI Customer Service.

**Heater Current Check**

The heater current can be checked at TP1 on the FES-200. Set the DMM to measure VDC.

1. Connect the positive lead of the DMM to TP1 on the FES-200

2. Connect the negative lead of the DMM to the HTR EXC terminal of the flow transmitter.

The measured mV value of heater current will be 10x larger than the actual mA heater current. For example, 750 mV indicates 75 mA heater current. The measured value of heater current must be within ±0.15 mA of the factory set value. See table below.

<table>
<thead>
<tr>
<th>FCI Transmitter Model</th>
<th>Factory-set Heater Current</th>
<th>DMM Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST100</td>
<td>90 mA</td>
<td>900 mV</td>
</tr>
<tr>
<td>ST100</td>
<td>75 mA</td>
<td>750 mV</td>
</tr>
</tbody>
</table>
Allowable Limits

Example 1 - 4-20 mA output check using 1-5 VDC measurement.

Accuracy: ±(0.75% reading + 0.5% full scale) from GF90 Manual

Sample Delta R Table entry:

<table>
<thead>
<tr>
<th>Delta R (ohms)</th>
<th>VDC Across 250 ohms</th>
<th>mA Output</th>
<th>Unit dR</th>
<th>Indicated Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>71.08</td>
<td>2.995</td>
<td>11.98</td>
<td>71.197</td>
<td>154.8 SCFM</td>
</tr>
</tbody>
</table>

- Measure VDC with FES-200 thumbwheel set to 071.08 = 3.011 VDC measured on DMM
- Determine allowable VDC limits for the 2.995 VDC table value:
  
  *Note:* Since the 1-5 VDC range starts at 1 VDC, account for this offset by subtracting 1 VDC from both the “reading” of 2.995 VDC and the “full scale” of 5 VDC.

  Allowable VDC limits = 0.0075 x (2.995 – 1) + 0.005 x (5 – 1) = ±0.035 VDC

The measured value of 3.011 VDC is within the allowable limits of 2.995 ±0.035 VDC

Example 2 - 4-20 mA output check (using example 1 sample data)

- Measure mA with FES-200 thumbwheel set to 071.08 = 12.04 mA measured on DMM
- Determine allowable mA limits for the 11.98 mA table value:

  *Note:* Since the 4-20 mA range starts at 4 mA, account for this offset by subtracting 4 mA from both the “reading” of 11.98 mA and the “full scale” of 20 mA.

  Allowable mA limits = 0.0075 x (11.98 – 4) + 0.005 x (20 – 4) = ±0.139 mA

The measured value of 12.04 mA is within the allowable limits of 11.98 ±0.139 mA.

Example 3 - Indicated Display Check (using information from above examples)

- Record the indicated display value with FES-200 thumbwheel set to 071.08 = 156 SCFM indicated on display
- Determine allowable limits for the 154.8 SCFM table value:

  *Note:* The full scale display value is 310 SCFM in this example.

  Allowable Indicated flow limits = 0.0075 x 154.8 SCFM + 0.005 x 310 SCFM = ±2.71 SCFM

The indicated value of 156 SCFM is within the allowable limits of 154.8 ±2.71 SCFM.
Figure 22 - Integral Configuration

Figure 23 - Remote Configuration, FES-200 Connected at Flow Element
**Figure 24 - Remote Configuration, FES-200 Connected at Electronics**

**Figure 25 - ST100 Decade Box Wiring**
Output Verification using the ST100 Configuration Application

Another method for verifying the output current is by manually driving the output current via the ST100 configuration application. This allows the user to force the output to any given mA value between 4 and 20 mA.

Click **USB Connect** on the welcome screen. Select the **Configuration** branch from the menu tree on the window’s left side. Select the **4-20mA User** tab. In the 4-20mA #1 frame, enter the desired mA output level in the **Manual mA Output** text box. Click **Send to Device**. The output is now driven to the desired level.

If the measured output levels match the expected output levels this proves the output circuit is working properly.

If the measured output levels do not match the expected output levels there is a problem with the system.

Defective Parts

Before returning any equipment to FCI, obtain an RA number for authorization, tracking, and repair/replacement instructions. If a return is required, remove defective instrument, replace with spare, calibrate and then return the defective instrument to FCI freight prepaid for disposition. Refer to 93 for more information on customer service.
Intentionally Left Blank
APPENDIX A OUTLINE DIMENSIONAL DRAWINGS

The table below summarizes the drawings contained in this appendix.

<table>
<thead>
<tr>
<th>Drawing No.</th>
<th>Page No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>004871</td>
<td>50</td>
<td>Transmitter, ST100, Compression Fitting, Hazardous Location, Integral</td>
</tr>
<tr>
<td>004872</td>
<td>51</td>
<td>Transmitter, ST100 &amp; ST102A, Compression Fitting, Hazardous Location, Remote</td>
</tr>
<tr>
<td>004852</td>
<td>52</td>
<td>Transmitter, ST100 &amp; ST102A, 1 1/4-Inch NPT PGL, Hazardous Location, Remote</td>
</tr>
<tr>
<td>004877</td>
<td>53</td>
<td>Transmitter, ST100 &amp; ST102A, 1 1/4-Inch NPT PGM, Hazardous Location, Remote</td>
</tr>
<tr>
<td>004873</td>
<td>54</td>
<td>Transmitter, ST100L, Inline Pipe Spool, Explosion Proof, Local</td>
</tr>
<tr>
<td>004874</td>
<td>55</td>
<td>Transmitter, ST100L, Inline Pipe Spool, Explosion Proof, Remote</td>
</tr>
<tr>
<td>004875</td>
<td>56</td>
<td>Transmitter, ST110 &amp; ST110, 1 1/4-Inch NPT PGL, Hazardous Location, Integral</td>
</tr>
<tr>
<td>004876</td>
<td>57</td>
<td>Transmitter, ST110, ST112A, STP110, STP112A, 1 1/4-Inch NPT PGL, Hazardous Location, Remote</td>
</tr>
</tbody>
</table>
004871 - Transmitter, ST100, Compression Fitting, Hazardous Location, Integral
SPECIFICATIONS

Fluid Components International LLC
004872 - Transmitter, ST100 & ST102A, Compression Fitting, Hazardous Location, Remote
004852 - Transmitter, ST100 & ST102A, 1 1/4-Inch NPT PGL, Hazardous Location, Remote
004877 - Transmitter, ST100 & ST102A, 1 1/4-Inch NPT PGM, Hazardous Location, Remote
### Specifications

**Customer:**
- Purchase Order No: 
- Customer Order No: 
- Wetted Surface Material: 
- Max Element Operating Temp: 

**Line Type Connection:**
- Line Size: 
- "A" Length: 
- Serial No: 
- Tag No: 

**2X**
- .75 [19] 
- 2X 
- 1.75 [44] 
- 2X 
- 1.44 [37] 
- 2X 
- 4.25 [108] 
- 2X 
- 2.88 [73] 
- 4X 
- .31 [8] 
- 4X 
- .40 [10] 

**NOTES:**

1. DIMENSIONS IN BRACKET [ ] ARE IN MILLIMETERS. 
2. REMOTE ENCLOSURE MEETS EXPLOSION PROOF, WATER AND DUST TIGHT APPROVALS. 
3. FOR ELECTRICAL OPTIONS, CONNECTIONS AND TESTS, SEE APPLICABLE WIRING DIAGRAM. 
4. ALL ORIENTATIONS AND MOUNTING REFERENCES ARE INDICATED FROM TERMINAL ENCLOSURE END OF SENSING ELEMENT. 
5. SEE TABLE FOR AVAILABLE PIPE SIZES. 
7. FLANGE MOUNTING HOLES TO STRADDLE PIPE CENTERLINE. 
8. SEE TABLE FOR AVAILABLE CONNECTION TYPES. 
9. SEE TABLE FOR AVAILABLE PIPE SIZES. 
10. FLUID HANDLING HOSES TO SPECIFIED CAPS. 

---

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Fluid Components International LLC  
55004874 - Transmitter, ST100L, Inline Pipe Spool, Explosion Proof, Remote
ST100 Series Flow Meter

Fluid Components International LLC

**Specifications**

**Customer:**
**Purchase Order No:**
**Customer Order No:**
**Model Type:**
**Wetted Surface Material:**
**Packing Material:**
**Max Element Operating Temp:**
**Pressure (Model STP):**
**U Length:**
**Serial No:**
**Tag No:**

**Notes:**
- Unless otherwise specified.
- Max Element Operating Pressure: 50 PSIG (3.5 BAR (G)).
- Max Temperature: 850°F (454°C) for Graphite packing, 500°F (260°C) for Teflon packing.
- Maximum Dimension When Flow Element Is Installed To Customer Required "U" Length.
- Packing gland specifications:
  - Maximum operating temperature, Teflon packing: 500°F (260°C).
  - Maximum operating temperature, Graphite packing: 850°F (454°C).

**Notes on Drawing:**
- Dimensions are in inches, unless otherwise specified.
- Do not scale drawing.
- Decimal calculation: .XXX ± .010, .XX ± .03, .X ± .1.
- Finish: 125 RMS.
- Mach surface unless otherwise specified.
- Angular tolerances: ± 1/2°.
- Mach radial: .030 MFG QA.

**Approval Notes:**
- Engr.
- Check.
- Drawn.
- Title.
- Approvals.

**Date Description Rev:**
- 04/25/12
- 04/18/12
- 04/23/12
- 04/25/12
- 04/23/12
- N/A

**Notes:**
- Use on application material.
- ± 1/2° angular tolerance.
- ± 1/8° angular tolerance.

**Local Enclosure Meets Explosion Proof, Water and Dust Tight Approvals.**
(See manual for specific approval types.)

**Mounting Orientation of Flats to Be Parallel to Flow.**

**Locking Collar:**
- 4 X 1/2 INCH NPT OR M20 X 1.5

**Packaging Gland Style:**
- (Teflon or Graphite packing material)

**1/8 Inch Hose Plug, Washer, Jam Nut:**

**Optional Display:**
- M4 Ground Screw

**Next Assy:**

**Third Angle Projection:**

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**Notice of Proprietary Rights:**

8. ST100 & STP110: Single Point Insertion Flow Elements with Temperature, Flow and In-Situ Calibration Verification System. Pressure is an additional feature on the STP models.


6. Packing gland specifications:
   - Maximum operating temperature, Teflon packing: 500°F (260°C).
   - Maximum operating temperature, Graphite packing: 850°F (454°C).
   - Maximum operating pressure, 50 PSIG (3.5 BAR (G)).

5. See IO&M Manual for additional information and instruction.

4. All orientations and mounting references are indicated from terminal enclosure end of sensing element.

3. For electrical options, connections and tests, see applicable wiring diagram.

2. This drawing is reference document only.

1. Dimensions in brackets [ ] are in millimeters.
004876 - Transmitter, ST110, ST112A, STP110, STP112A, 1 1/4-Inch NPT PGL, Hazardous Location, Remote
APPENDIX B WIRING DIAGRAMS

Appendix B provides the following wiring diagrams:

- Integral: AC Input Power, Analog and HART Output
- Remote: AC Input Power, Analog and HART Output
- Integral: DC Input Power, Analog and HART Output
- Remote: DC Input Power, Analog and HART Output
- Integral: AC Input Power, Foundation Fieldbus Output
- Remote: AC Input Power, Foundation Fieldbus Output
- Integral: DC Input Power, Foundation Fieldbus Output
- Remote: DC Input Power, Foundation Fieldbus Output
- Integral: AC Input Power, Modbus Output
- Remote: AC Input Power, Modbus Output
- Integral: DC Input Power, Modbus Output
- Remote: DC Input Power, Modbus Output
- Remote: 8-Conductor Interconnection Cable
- Source: Pulse/Frequency Output
- Sink: Pulse/Frequency Output
- Flow Element Connection, Integral/Remote
- Flow Element Connection, Remote
- Remote: 10-Conductor Interconnection Cable
- Extended Operation Mode, External Input Flow Adjust (EIA)
- Extended Operation Mode, External ST100 Flow Input (EFI)

Generation 1 ST100 Series - Analog and HART Wiring, Units Shipped April 2012 through July 2013*

- *Integral - AC Input Power, Analog and HART Output
- *Remote - AC Input Power, Analog and HART Output
Figure B-1 – Integral: AC Input Power, Analog and HART Output

Figure B-2 – Remote: AC Input Power, Analog and HART Output
FIGURE B-3 – INTEGRAL: DC INPUT POWER, ANALOG AND HART OUTPUT

DC Input Power
24 VDC ± 20%
Customer Connection
16-22 Ga Wire

ANALOG OUTPUT (HART) ANALOG OUTPUT
1 (+)  
2 (-) (+)  
3 (+)  
4 (-)  
5 (+)  
6 (-)  

CUSTOMER CONNECTIONS

HART OUTPUT IS ALWAYS ON CH1

FIGURE B-4 – REMOTE: DC INPUT POWER, ANALOG AND HART OUTPUT

DC Input Power
24 VDC ± 20%
Customer Connection
16-22 Ga Wire

Remote Cable, Shielded
300-1000 ft
Remote Flow Transmitter
(Element)

ANALOG OUTPUT (HART) ANALOG OUTPUT
1 (+)  
2 (-) (+)  
3 (+)  
4 (-)  
5 (+)  
6 (-)  

CUSTOMER CONNECTIONS

HART OUTPUT IS ALWAYS ON CH1

C00999-1-3
C01116-1-1
Figure B-5 – Integral: AC Input Power, Foundation Fieldbus Output

Figure B-6 – Remote: AC Input Power, Foundation Fieldbus Output
Figure B-7 – Integral: DC Input Power, Foundation Fieldbus Output

Figure B-8 – Remote: DC Input Power, Foundation Fieldbus Output
**Figure B-9 – Integral: AC Input Power, Modbus Output**

AC Input Power 86-265 Vac
Customer Connection 16-22 Ga Wire

- **JUMPER A(+)**
- **JUMPER B(-)**
- **JUMPER, TERMINATION RESISTOR JP6***
- **JUMPER, TERMINATION RESISTOR JP7***

* Internal termination resistor. Only use if unit is at end of line and external termination resistor is not used.

**Figure B-10 – Remote: AC Input Power, Modbus Output**

AC Input Power 86-265 Vac
Customer Connection 16-22 Ga Wire

- **JUMPER A(+)**
- **JUMPER B(-)**
- **JUMPER, TERMINATION RESISTOR JP6***
- **JUMPER, TERMINATION RESISTOR JP7***

* Internal termination resistor. Only use if unit is at end of line and external termination resistor is not used.
Figure B-11 – Integral: DC Input Power, Modbus Output

Figure B-12 – Remote: DC Input Power, Modbus Output
Figure B-13 – Remote: 8-Conductor Interconnection Cable

Figure B-14 – Source: Pulse/Frequency Output
Figure B-15 – Sink: Pulse/Frequency Output

Figure B-16 – Flow Element Connection, Integral/Remote
Figure B-17 – Flow Element Connection, Remote

Figure B-18 – Remote: 10-Conductor Interconnection Cable
External 4-20 mA Current Source

ST100 Series Interface Board (Analog)

NOTE: ST102 AC power, dual remote interface board shown.

Figure B-19 – Extended Operation Mode, External Input Flow Adjust (EIA)

NOTE: ST102 AC power, dual remote interface board shown, 2 places.

ST100 Series SLAVE

ST100 Series MASTER

Figure B-20 – Extended Operation Mode, External ST100 Flow Input (EFI)
Generation 1 ST100 Series - Analog and HART Wiring, Units Shipped April 2012 through July 2013*

*Integral - AC Input Power, Analog and HART Output

*Remote - AC Input Power, Analog and HART Output
This appendix contains the following information:

- Delta R Sheet (Sample)
- Parameters Report from the ST100 Configuration Application (Sample)
- HMI Menu Outline (v2.99)
- Internal Delta-R Resistor Check (idR) HMI Display Sequence
- ST100 Configuration Software Menu Outline (v3.1.0.x)
- Instructions: Installing Ferrite Bead on ST100 Series DC Power Cable
- Instructions: Installing Sun Shield on ST100 Series Integral Enclosure
- Instructions: Installing Sun Shield on ST100 Series Remote Enclosure
## Delta R Sheet (Sample)

**ST100 Delta 'R**

**ST100-70D01202A0B1EBG0003**

**Fluid Components INTL**

1755 La Costa Meadows Drive, San Marcos, California 92076
(760) 744-9550  (800) 854-1993  FAX: (760) 736-5250
www.fluidcomponents.com

<table>
<thead>
<tr>
<th>C#</th>
<th>064202</th>
<th>Seriat</th>
<th>440103</th>
<th>Dec Box</th>
<th>Equip</th>
<th>Cal Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cust</td>
<td>EMERSON PROCESS MGMT</td>
<td>Date</td>
<td>May 23, 2013</td>
<td>(Act)</td>
<td>EL-710</td>
<td>11-Sep-13</td>
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<tr>
<td>Tag</td>
<td>BB18-FZIT-521012</td>
<td>Tag R1</td>
<td>N/A</td>
<td>Ref</td>
<td>EL-318</td>
<td>04-Dec-13</td>
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<td>TagL2</td>
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<td>Tag R2</td>
<td>N/A</td>
<td>DVM</td>
<td>EL-488</td>
<td>03-May-14</td>
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<td>TagL3</td>
<td>N/A</td>
<td>Tag R3</td>
<td>N/A</td>
<td>250 ohms</td>
<td>EL-210</td>
<td>25-Jan-14</td>
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**Nominal Sensor Resistance**: 1000 Ω

**Indicated Temperature at Nominal Resistance**: -0.01 C

**Notes**: ST100, calibration group 1.

### Delta R Sheet

<table>
<thead>
<tr>
<th>Delta 'R (ohms)</th>
<th>VDC 250 ohms</th>
<th>mA Output</th>
<th>Unit dR</th>
<th>Unit TCdR</th>
<th>Indicated NCMH</th>
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</thead>
<tbody>
<tr>
<td>271.80</td>
<td>1.00</td>
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<td>271.795</td>
<td>264.89</td>
<td>0.000</td>
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<td>271.55</td>
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<td>271.545</td>
<td>264.64</td>
<td>1005</td>
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<td>235.92</td>
<td>1.216</td>
<td>4.86</td>
<td>235.942</td>
<td>250.01</td>
<td>2048</td>
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<td>192.95</td>
<td>1.500</td>
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<td>4726</td>
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<tr>
<td>158.62</td>
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<tr>
<td>108.97</td>
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<td>98.82</td>
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<td>98.788</td>
<td>96.67</td>
<td>37700</td>
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</tbody>
</table>

**Core Vers.**

- 2.98
- 15 Apr. 13
- 0D508B

**FE Vers.**

- V 1.60
- 7EF9DD9

**HMI Vers.**

- 2.96

---

### Table Details

**Serial #: 440103**

<table>
<thead>
<tr>
<th>Analog Out 1</th>
<th>Flow (HART)</th>
<th>Curve Spline</th>
<th>Sp1</th>
<th>Spline</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 mA DAC1</td>
<td>0</td>
<td>8.8761585,265.3,0.00065999</td>
<td>dR Gm</td>
<td>0.99969</td>
<td>dR Off</td>
</tr>
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**Cal Param**: 4 mA DAC3

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**Delta R Sheet (Sample) continued...**

**Reference**: [Fluid Components International LLC](https://www.fluidcomponents.com)
### Parameters Report from the ST100 Configuration Application (Sample)

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HMI Menu Outline (v2.99)

- **Boot Screen**
- **Process Data Screen**
  - Percentage of Flow
  - Flowrate
  - Totalizer
  - Temperature
  - Pressure
  - Group
  - Group Name
- **Service**
  - Select Group
    - Password
      - 1. Air
      - 2. Gas
      - 3. Low Flow
      - 4. High Flow
      - 5. Upset
  - Alarm Ack
    - Blank
- **Diagnostics**
  - Show Faults
    - Blank
  - Self Test
    - FE 1 IDR
      - Password
    - FE2 IDR
      - Password
  - Raw Signal
    - Raw Signal FE1
      - F1 Raw Signal
      - RefR: 100.17
      - dR: 99.89
      - TCdR: 96.63
      - Temp: 32.0
      - Flow: 22.42
    - Raw Signal FE2
      - F2 Raw Signal (If Present)
        - Same as FE2
- **Set-up**
  - Instrument
    - Group 1
      - Flow: SFPS
      - Temp: Deg F
      - Pres: psi(a)
      - Name: Air
      - Restore
      - Pipe: Rect.
      - W: 1.0 in
      - H: 10.0 in
  - Display
    - Orientation
      - Select Display Orientation
    - Contrast
      - Select the HMI Display Contrast
  - Language
    - English
- **LoggerSDcard**
  - LoggerSCcard
    - Remove
    - Inserted
- **Device**
  - Serial No:
  - Sales Ord No:
  - Core: 1.06
  - HMI: 2.99
  - FE1: V1.60
  - FE2: V1.60
- **FE Control**
  - FE1: Online
    - Password
      - FE1 Control
        - Online
        - Offline
  - FE2: Offline
    - Password
      - FE2 Control
        - Online
        - Offline

*Note:* The HMI interface cannot access extended operation modes. Use the ST100 configuration software application to set up an extended operating mode. See "Extended Operation Modes" on page 29.
Internal Delta–R Resistor Check (idR) HMI Display Sequence

1. Normal Operation Display: Select and hold the hot key for 3 seconds.

2. Select Diagnostics.

3. Select Self Test.

4. Select FE 1 IDR for ST100 single point system.

5. Input Password E#C.

6. Select Password.

7. Select FE 1 IDR again.

8. idR Test is Running.

9. idR Test is Complete. Record values for comparison.
ST100 Configuration Software Menu Outline (v3.1.0.x)

Welcome to the ST100 Configuration Application

- **ST100**
  - **Process Data (in Customer Units)**
    - FLOW (display)
    - TEMPERATURE (display)
    - PRESSURE (display)
    - CALIBRATION GROUP (display)
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Instructions: Installing Ferrite Bead on ST100 Series DC Power Cable

**STEP 1**
Insert DC power supply cable through enclosure conduit port as shown. Measure 10 to 12 inches beyond interface board.

**STEP 2**
Slice open the jacket 10 to 12 inches and cut.

**STEP 3**
a. Loop wires around ferrite bead.
b. Keep .25 inches from ferrite bead to edge of cable jacket as shown.
c. Close ferrite bead.

**STEP 4**
Cut wires 2 inches from edge of ferrite bead and strip ends as shown.

**STEP 5**
Slide ferrite bead over power supply cover while pulling on the power supply cable. Position ferrite bead end face to coincide with edge of housing.

**STEP 6**
Insert and secure DC power supply wire leads to terminal connector as shown.
**Instructions: Installing Sun Shield on ST100 Series Integral Enclosure**

**STEP 1**
Remove top of sun shield assembly.

**STEP 2**
Remove existing tag screws.

**STEP 3**
Using provided screws & washers, attach enclosure to lower portion of sun shield.

**STEP 4**
Secure tag using provided hex standoffs.

**STEP 5**
Reinstall top portion of sun shield using provided pan head screws and washers.

**STEP 6**
Finished assembly, front and isometric views.
Instructions: Installing Sun Shield on ST100 Series Remote Enclosure

**STEP 1**
Remove top of sun shield assembly.

**STEP 2**
Remove existing tag screws.

**STEP 3**
Attach enclosure and lower portion of sun shield to the remote bracket, using provided screws & washers. (Remote bracket orientation adjustable depending on users desired orientation.)

**STEP 4**
Secure tag using provided hex standoffs.

**STEP 5**
Reinstall top portion of sun shield using provided pan head screws and washers.

**STEP 6**
Finished assembly, front and isometric views.
APPENDIX D  GLOSSARY

Abbreviations

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<tr>
<td>Delta-R (DR)</td>
<td>Differential Resistance</td>
</tr>
<tr>
<td>Delta-T (DT)</td>
<td>Differential Temperature</td>
</tr>
<tr>
<td>DMM</td>
<td>Digital Multimeter</td>
</tr>
<tr>
<td>DPDT</td>
<td>Double Pole Double Throw</td>
</tr>
<tr>
<td>FCI</td>
<td>Fluid Components Intl</td>
</tr>
<tr>
<td>HTR</td>
<td>Heater</td>
</tr>
<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
</tr>
<tr>
<td>POT</td>
<td>Potentiometer</td>
</tr>
<tr>
<td>RA</td>
<td>Return Authorization</td>
</tr>
<tr>
<td>RTD</td>
<td>Resistance Temperature Detector</td>
</tr>
<tr>
<td>SFPS</td>
<td>Standard Feet Per Second</td>
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<tr>
<td>SPDT</td>
<td>Single Pole Double Throw</td>
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Definitions

<table>
<thead>
<tr>
<th>Definition</th>
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<tbody>
<tr>
<td>Active RTD</td>
<td>The sensing element that is heated by the heater. The active RTD is cooled due to increases in the process fluid flow rate or density (level sensing).</td>
</tr>
<tr>
<td>Differential resistance</td>
<td>The difference in resistance between the active and reference RTDs.</td>
</tr>
<tr>
<td>Delta-R (DR)</td>
<td>The difference in resistance between the active and reference RTDs.</td>
</tr>
<tr>
<td>Differential temperature</td>
<td>The difference in temperature between the active and reference RTDs.</td>
</tr>
<tr>
<td>Delta-T (DT)</td>
<td>The difference in temperature between the active and reference RTDs.</td>
</tr>
<tr>
<td>Heater (HTR)</td>
<td>The part of the sensing element that heats the active RTD.</td>
</tr>
<tr>
<td>Local enclosure</td>
<td>The enclosure attached to the sensing element. (Usually contains the control circuit and mounting socket,)</td>
</tr>
<tr>
<td>Reference RTD</td>
<td>The part of the sensing element that senses the process media temperature.</td>
</tr>
<tr>
<td>Remote enclosure</td>
<td>An optional protective enclosure for the control circuit. Used when the control circuit must be located away from the sensing element.</td>
</tr>
<tr>
<td>Resistance Temperature Detector (RTD)</td>
<td>A sensor whose resistance changes proportionally to temperature changes.</td>
</tr>
<tr>
<td>Sensing element</td>
<td>The transducer portion of the instrument. The sensing element produces an electrical signal that is related to the flow rate, density (level sensing), and temperature of the process media.</td>
</tr>
<tr>
<td>Thermowell</td>
<td>The part of the sensing element that protects the heater and RTDs from the process fluid.</td>
</tr>
<tr>
<td>Turndown</td>
<td>The ratio of the upper to lower flow rate values.</td>
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APPENDIX E  APPROVALS

EU Information

EU DECLARATION OF CONFORMITY ST100 SERIES

We, Fluid Components International LLC, located at 1755 La Costa Meadows Drive, San Marcos, California 92078-5115 USA, declare under our sole responsibility that the ST100 Flowmeter Product Family, to which this declaration relates, is in conformity with the following directives and specifications.

Directive 2014/34/EU ATEX
IECEx Scheme

Certified by FM Approvals LLC, LTD, NB Code 2809: One George Quay Plaza D02 E440, Dublin, Ireland.

EU-Type Examination Certificates:


Hazardous Areas Approval FM12ATEX0016X / IECEx PMG 12 0003X for:
Il 2 G Ex db IIC T6...T1 Gb Ta = -40°C to +60°C
Il 2 D Ex tb IIIC T85°C...T450°C Db Ta = -40°C to +60°C; IP67

Directive 2014/30/EU Electromagnetic Compatibility EMC

Immunity specification: EN 61000-6-2: 2005

Directive 2014/35/EU Low Voltage


Directive 2014/68/EU Pressure Equipment (PED)

The ST100 (Insertion Style) models do not have a pressure bearing housing and are therefore not considered as pressure equipment by themselves according to article 2, paragraph 5.
The ST100L (In-line Style) models are in conformity with Sound Engineering Practices as defined in the Pressure Equipment Directive (PED) 2014/68/EU article 4, paragraph 3.

Directive 2011/65/EU (RoHS)


Issued at San Marcos, California USA
April, 2021

Eric Wilble, Director of Engineering

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Fluid Components International LLC
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Safety Instructions for the use of the ST100 Series flow meter in Hazardous Areas

Approval FM12ATEX0016X/IECEx FMG12.0003X for:

II 2 G for Gas protection Ex db IIC T6…T1
II 2 D for Dust protection Ex tb IIIC T85ºC…T450ºC; IP67

The ST100 Series consist of a sensing element and associated integral or remote mounted electronics mounted in a type “d” flameproof enclosure.

Relation between ambient temperature, process temperature and temperature class is as follows:

Electrical data: Power supply: 85 to 265 VAC, 50/60 Hz, 13.1 watts max.; 24 VDC, 13.2 watts max.

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DK Dansk - Sikkerhedsforskrifter

Disse sikkerhedsforskrifter gælder for Fluid Components, gennemstrømningsmåleren i ST100 Series for EF-typeafprøvningsattest-nr. FM12ATEX0016X/IECEx FMG12.0003X (attestens nummer på typeskiltet) til anvendelse i en potentiel eksplosiv atmosfære i kategori II 2 GD.

1) Ex-anlæg skal opstilles af specialiseret personale.
2) ST100 Series skal jordforbindes.
3) Klemmerne og elektronikken er monteret i et hus, som er beskyttet af en flammebestandig og tryktæt med følgende noter:
   • Gevindspalten mellem huset og låget er på en sådan måde, at ild ikke kan brede sig inden i det.
   • Ex-”d” tilslutningshuset er forsynet med et 1/2” NPT og/eller M20x1.5 kabelindføring til montering af en Ex-”d” kabelindføring, der er attestet iht. IEC/EN 60079-1.
   • Det er vigtigt at sørge for, at forsyningsledningen er uden spænding eller eksplosiv atmosfære ikke er til stede, før låget åbnes og når låget er åbent på ”d” huset (f.eks. ved tilslutning eller servicearbejde).
   • Låget på ”d” huset skal være skruet helt ind, når apparatet er i brug. Det skal sikres ved at dreje en af låseskruerne på låget ud.
4) Henvend dig til producenten, hvis du har brug for oplysninger om målene på de flammebestandige led.
5) Den malede overflade på gennemstrømningsmåleren i ST100 Series kan indeholde elektrostatisk udladning og blive en antændelseskilde ved anvendelser med en lav relativ fugtighed < 30 % relativ fugtighed, hvis den malede overflade er relativ fri for overladekontaminanter, som fx snavs, støv eller olie. Rengøring af den malede overflade må kun udføres med en fugtig klud.
6) Det interne batteri må ikke udsættes i en eksplosiv gasholdig atmosfære.
Deutsch - Sicherheitshinweise

Diese Sicherheitshinweise gelten für die Fluid Components, ST100 Series flow meter gemäß der EG-Baumusterprüfbescheinigung Nr. FM12ATEX0016X/IECEx FMG12.0003X (Bescheinigungsnummer auf dem Typschild) der Kategorie II 2 GD.

1) Die Errichtung von Ex-Anlagen muss grundsätzlich durch Fachpersonal vorgenommen werden.
2) Der ST100 Series muß geerdet werden.
3) Die Klemmen und Elektroniken sind in einem Gehäuse in der Zündschutzart druckfeste Kapselung („d“) eingebaut.
   • Der Gewindespalt zwischen dem Gehäuse und dem Deckel ist ein zünddurchschlagsicherer Spalt.
   • Das Ex-„d“ Anschlussgehäuse besitzt ein 1/2“ NPT und/oder M20x1.5 Gewinde für den Einbau einer nach IEC/EN 60079-1 bescheinigten Ex-„d“ Kabeleinführung.
   • Es ist sicherzustellen, dass vor dem Öffnen und bei geöffnetem Deckel des „d“ Gehäuses (z.B. bei Anschluss oder Service- Arbeiten) entweder die Versorgungsleitung spannungsfrei oder keine explosionsfähige Atmosphäre vorhanden ist.
   • Der Deckel des “d“ Gehäuses muss im Betrieb bis zum Anschlag hineingedreht sein. Er ist durch eine der Deckelarretierungsschrauben zu sichern.
4) Wenden Sie sich an den Hersteller, wenn die Dimensionsinformationen zu den flammbeständigen Spalten erforderlich sind.
6) Ersetzen Sie die interne Batterie nicht in einer explosionsfähigen Gasatmosphäre.

English - Safety instructions

These safety instructions are valid for the Fluid Components, ST100 Series flow meter to the EC type approval certificate no FM12ATEX0016X/IECEx FMG12.0003X (certificate number on the type label) for use in potentially explosive atmospheres in Category II 2 GD.

1) The installation of Ex-instruments must be made by trained personnel.
2) The ST100 Series must be grounded.
3) The terminals and electronics are installed in a flame proof and pressure-tight housing with following notes:
   • The gap between the housing and cover is an ignition-proof gap.
   • The Ex-"d" housing connection has a 1/2” NPT and/or M20x1.5 cable entry for mounting an Ex-d cable entry certified acc. to IEC/EN 60079-1.
   • Make sure that before opening the cover of the Ex"d" housing, the power supply is disconnected or there is no explosive atmosphere present (e.g. during connection or service work).
   • During normal operation: The cover of the "d" housing must be screwed in completely and locked by tightening one of the cover locking screws.
4) Consult the manufacturer if dimensional information on the flameproof joints is necessary.
5) The painted surface of the ST100 Series Flow Meter may store electrostatic charge and become a source of ignition in applications with a low relative humidity < 30% relative humidity where the painted surface is relatively free of surface contamination such as dirt, dust, or oil. Clean the painted surface using a damp cloth only.
6) Do not replace internal battery when an explosive gas atmosphere is present.
Ελληνικά - Υποδείξεις ασφαλείας

Αυτές οι οδηγίες ασφαλείας ισχύουν για τα ροόμετρα της Fluid Components τύπου ST100 Series που φέρουν Πιστοποιητικό Εγκρίσεως Ευρωπαϊκής Ένωσης, με αριθμό πιστοποίησης FM12ATEX0016X/IECEx FMG12.0003X (ο αριθμός πιστοποίησης βρίσκεται πάνω στην ετικέτα τύπου του οργάνου) για χρήση σε εκρηκτικές ατμόσφαιρες της κατηγορίας II 2 GD.

1) Η εγκατάσταση των οργάνων με αντιεκρηκτική προστασία πρέπει να γίνει από εξειδικευμένο προσωπικό.
2) Το όργανο τύπου ST100 Series πρέπει να είναι γειωμένο.
3) Τα τερματικά ηλεκτρικών συνδέσεων (κλέμες) και τα ηλεκτρονικά κυκλώματα είναι εγκατεστημένα σε περίβλημα αντιεκρηκτικό και αεροστεγές σύμφωνα με τις ακόλουθες παρατηρήσεις:
   - Το κενό ανάμεσα στο περίβλημα και στο κάλυμμα είναι τέτοιο που αποτρέπει την διάδοση σπινθήρα.
   - Το αντιεκρηκτικό περίβλημα "Ex-d" διαθέτει ανοίγματα εισόδου καλωδίων με διάμετρο ½" NPT και M 20 x1,5 , κατάλληλα για τοποθέτηση υποδοχής αντιεκρηκτικού καλωδίου πιστοποιημένου κατά IEC/EN 60079-1
   - Βεβαιωθείτε ότι πριν ανοίξετε το κάλυμμα του αντιεκρηκτικού περιβλήματος "Ex-d", η τάση τροφοδοσίας είναι αποσυνδεδεμένη ή ότι δεν υφίσταται στην περιοχή εκρηκτική κατοικίας όπου η βαμμένη επιφάνεια είναι σχετικά ελεύθερη από ρύπανση, όπως ακαθαρσίες, σκόνη ή λάδια. Ο καθαρισμός της βαμμένης επιφάνειας πρέπει να πραγματοποιείται μόνο με νοτισμένο πανί.
4) Εάν απαιτούνται πληροφορίες για τις διαστάσεις των αντιπυρικών συνδέσμων, απευθυνθείτε στον κατασκευαστή.
5) Στην βαμμένη επιφάνεια του ροόμετρου ST100 Series ενδέχεται να δημιουργείται ηλεκτροστατική φόρτιση και αυτό να αποτελεί πηγή ανάφλεξης κατά την εφαρμογή σε συνθήκες χαμηλής σχετικής υγρασίας (<30%) όπου η βαμμένη επιφάνεια είναι σχετικά ελεύθερη από ρύπανση, όπως ακαθαρσίες, σκόνη ή λάδια. Ο καθαρισμός της βαμμένης επιφάνειας πρέπει να πραγματοποιείται μόνο με νοτισμένο πανί.
6) Μην αντικαθιστάτε την εσωτερική μπαταρία σε ατμόσφαιρα με εκρηκτικά αέρια.
Consignes de sécurité

Ces consignes de sécurité sont valables pour le modèle série ST100 de la société Fluid Components (FCI) conforme au certificat d’épreuves de type FM12ATEX0016X/IECEx FMG12.0003X (numéro du certificat sur l’étiquette signalétique) conçu pour les applications dans lesquelles un matériau de la catégorie II2GD est nécessaire.

1) Seul un personnel spécialisé et qualifié est autorisé à installer le matériel Ex.

2) Les ST100 Series doivent être reliés à la terre.

3) Les bornes pour le branchement de la tension d’alimentation et l’électronique sont logées dans un boîtier à enveloppe antidéflagrante avec les notes suivantes :
   • Le volume entre le boîtier et le couvercle est protégé en cas d’amorçage.
   • Le boîtier de raccordement Ex-d dispose d’un filetage 1/2” NPT et/ou M20x1.5 pour le montage d’un presse-étoupe Ex-d certifié selon la IEC/EN 60079-1.
   • Avant d’ouvrir le couvercle du boîtier « d » et pendant toute la durée où il le restera ouvert (pour des travaux de raccordement, d’entretien ou de dépannage par exemple), il faut veiller à ce que la ligne d’alimentation soit hors tension ou à ce qu’il n’y ait pas d’atmosphère explosive.
   • Pendant le fonctionnement de l’appareil, le couvercle du boîtier « d » doit être vissé et serré jusqu’en butée. La bonne fixation du couvercle doit être assurée en serrant une des vis d’arrêt du couvercle.

4) Consulter le fabricant si les dimensions des joints ignifugés sont nécessaires.

5) La surface peinte du débitmètre série ST100 peut contenir une charge électrostatique et devenir une source d’inflammation pour les applications où l’humidité relative est faible (< 30 %) et où la surface peinte ne présente pas de souillures (poussière, saleté, huile). Les surfaces peintes ne doivent être nettoyées qu’à l’aide d’un chiffon humide.

6) Ne pas remplacer la batterie interne en cas de présence d’un gaz explosif.

Italiano - Normative di sicurezza

Questa normativa di sicurezza si riferisce ai misuratori di portata serie ST100 della Fluid Components. Secondo il certificato CE di prova di omologazione n° FM12ATEX0016X/IECEx FMG12.0003X (numero del certificato sulla targhetta d’identificazione), essi sono idonei all’impiego in atmosfere potenzialmente esplosive di categoria II 2 GD.

1) L’installazione di sistemi Ex deve essere eseguita esclusivamente da personale specializzato.

2) I misuratori serie ST100 devono essere collegati a terra.

3) I morsetti per il collegamento e l’elettronica sono incorporati in una custodia a prova di esplosione ("d") con le seguenti note:
   • L’interstizio tra la custodia e il coperchio è a prova di innesco.
   • La custodia di collegamento Ex-d è dotata di un NTP da 3,81 cm e/o un passacavo 20x1,5 per il montaggio di un passacavo omologato Ex-d secondo IEC/EN 60079-1.
   • Prima di aprire il coperchio della custodia "d" (per es. durante operazioni di collegamento o di manutenzione) accertarsi che l’apparecchio sia disinnescato o che non si trovino in presenza di atmosfere esplosive.
   • Durante le operazioni ordinarie, il coperchio della custodia "d" deve essere avvitato e chiuso avvittando una delle viti di chiusura fino all’arresto.

4) Consultare il produttore per ottenere informazioni sulle dimensioni dei giunti non infiammabili.

5) La superficie pitturata del misuratore di portata serie ST100 potrebbe trattenerne carica elettrostatica e diventare una fonte infiammabile in applicazioni con un’umidità relativa bassa < 30%, dove la superficie pitturata è relativamente libera da sostanze contaminanti come polvere, sporco o olio. La superficie pitturata deve essere pulita esclusivamente con un panno umido.

6) Non sostituire la batteria interna in caso di presenza di gas esplosivi nell’atmosfera.
Deze veiligheidsinstructies gelden voor de flow meter uit de ST100-serie van Fluid Components (FCI) overeenkomstig het EG-typegoedkeuringscertificaat met nummer FM12ATEX0016X/IECEx FMG12.0003X (nummer van het certificaat op het typeplaatje) voor gebruik in een explosieve atmosfeer volgens Categorie II 2GD.

1) De installatie van Ex-instrumenten dient altijd te geschieden door geschoold personeel.
2) De ST100-serie moet geaard worden.
3) De aansluitklemmen en de elektronica zijn ingebouwd in een drukvaste behuizing met de volgende opmerkingen:
   • De schroefdraadspleet tussen de behuizing en het deksel is een ontstekingsdoorslagveilige spleet.
   • De Ex-'d' aansluitbehuizing heeft een 1/2" of een M20x1.5 schroefdraad voor aansluiting van een volgens IEC/EN 60079-1 goedgekeurde Ex-'d' kabelinvoer.
   • De atmosfeer mag niet explosief zijn of de stroomtoevoer moet zijn uitgeschakeld, voordat het deksel van de Ex-'d' behuizing wordt geopend (bijvoorbeeld bij aansluit- of servicewerkzaamheden).
   • Het deksel van de 'd' behuizing moet bij normaal bedrijf zijn vastgeschroefd tot aan de aanslag. Het deksel moet zijn vergrendeld door een van de dekselborgschroeven aan te draaien.
4) Raadpleeg de fabrikant als u dimensionele informatie over de drukvaste verbindingen nodig hebt.
5) Er kan sprake zijn van een elektrostatische lading op het gelakte oppervlak van de flow meter uit de ST100-serie. Deze lading kan een onbeschermde bron vormen bij toepassingen met een lage relatieve vochtigheid (< 30% relatieve vochtigheid), wanneer het gelakte oppervlak relatief weinig is verontreinigd met bijvoorbeeld vuil, stof of olie. Het gelakte oppervlak mag alleen worden gereinigd met een vochtige doek.
6) Vervang de interne accu niet in een explosieve gasatmosfeer.

Estas instruções de segurança são válidas para o caudalímetro Fluid Components da série ST100, de acordo com o certificado de aprovação nº FM12ATEX0016X/IECEx FMG12.0003X (numero do certificado na etiqueta de tipo), para utilizar em atmosferas potencialmente explosivas da categoria II 2 GD.
1) A instalacao de equipamentos Ex deve ser realizada por pessoal qualificado.
2) A Série ST100 tem de ser ligada à terra.
3) Os terminais e a eletrónica são instalados num alojamento com proteção contra ignição e estanque em termos de pressão com as seguintes notas:
   • A folga entre o alojamento e a tampa é uma folga à prova de ignição.
   • A ligação do alojamento Ex-“d” tem uma entrada de cabo de 1/2” NPT e/ou M20x1,5 para a montagem de um cabo Ex-”d” certificado de acordo com a norma IEC/EN 60079-1.
   • Assegure, antes de abrir a tampa do alojamento Ex "d", que a fonte de alimentação está desligada ou que não está presente uma atmosfera explosiva (por exemplo, durante o trabalho de ligação ou assistência).
   • Durante o funcionamento normal: a tampa do alojamento "d" deve estar completamente aparafusada e bloqueada apertando um dos parafusos de bloqueio da tampa.
4) Consulte o fabricante se for necessária informação sobre as dimensões das junções à prova de chamas.
5) A superfície pintada do caudalímetro da série ST100 pode acumular cargas eletrostáticas e tornar-se numa fonte de ignição em aplicações com uma humidade relativa baixa < 30%, onde a superfície pintada está relativamente livre de contaminação da superfície com, por exemplo, sujidade, poeira ou óleo. A limpeza da superfície pintada deverá ser efetuada apenas com um pano humedecido.
6) Não substitua a bateria interna quando estiver presente uma atmosfera com fases explosivos.
Español - Instrucciones de seguridad

Estas instrucciones de seguridad son de aplicación para el modelo Serie ST100 de Fluid Components, según la certificación CE de Nº FM12ATEX0016X/IECEx FMG12.0003X para aplicaciones en atmósferas potencialmente explosivas según la categoría II 2 GD (el número decertificación se indica sobre la placa informativa del equipo).

1) La instalación de equipos Ex tiene que ser realizada por personal especializado.
2) Los Serie ST100 deben ser conectados a tierra.
3) Los bornes de conexión y la unidad electrónica están montados dentro de una caja con protección ignífuga y resistente a la presión, considerando los siguientes puntos:
   • La holgura entre la caja y su tapa es a prueba contra ignición.
   • La conexión eléctrica de la caja Ex-“d” posee una rosca NPT de 1/2” y/o una entrada de cable M20x1.5, dónde deberán conectar una entrada de cable Ex-“d” según lo establecido por las normas IEC/EN 60079-1.
   • Antes de la apertura de la tapa de la caja Ex-“d” (p. ej. durante los trabajos de conexión o de puesta en marcha), asegúrese de que el equipo se halle sin tensión o que no exista presencia de atmósfera explosiva.
   • Durante el funcionamiento normal: la tapa de la caja “d” tiene que estar cerrada, roscada hasta el tope, debiendo asegurar apretando los tornillos de bloqueo.
4) Consulte con el fabricante si es necesario incluir la información dimensional en las juntas ignífugas.
5) Es posible que la superficie pintada del medidor de flujo Serie ST100 almacene carga electrostática y se convierta en una fuente de ignición en aplicaciones con baja humedad relativa < 30% cuando la superficie pintada está relativamente libre de contaminación en superficie, como por ejemplo suciedad, polvo o aceite. La limpieza de la superficie pintada debe realizarse solo con un paño húmedo.
6) No reemplace la batería interna cuando se encuentre en una atmósfera con presencia de gas explosivo.

Svenska - säkerhetsanvisningar

Säkerhetsanvisningarna gäller för Fluid Components flowmätare, typ ST100 Series, enligt EG-typgodkännandeintyg nr FM12ATEX0016X/IECEx FMG12.0003X (intygsnumret återfinns på typskylten) för användning i explosiv gasblandning i kategori II 2 GD.

1) Installation av Ex-klassade instrument måste alltid utföras av fackpersonal.
2) ST100 Series måste jordas.
3) Anslutningsklämmorna och elektroniken är inbyggda i en explosions- och trycktät kapsling. Observera följande:
   • Spalten mellan kapslingen och lockets gänga är explosionstä.
   • Ex-d-kapslingen har en 1/2” NPT- och/eller M20x1,5-gänga för montering av en IEC/SS-EN 60079-1-typgodkänd Ex-d-kabelförskruvning
   • När Ex-d-kapslingens lock är öppet (t.ex. vid inkoppling - eller servicearbeten) ska man se till att enheten är spänningslös eller att ingen explosiv gasblandning förekommer.
   • Under drift måste Ex-d-kapslingens lock vara fastskruvat till anslaget. Skruva in en av lockets låskruvar för att låsa det.
   • Hör med tillverkaren om mätuppgifter om de brandsäkra fogarna behövs.
5) Den lackade ytan på ST100-flödesmätaren kan lagra elektrostatisk laddning och bli en antändningskälla vid tillämpningar i en låg relativ luftfuktighet (< 30 %) om den lackade ytan i stort sett är ren från ytkontaminering som smuts, damm eller olja. Den lackade ytan får endast rengöras med en fuktad trasa.
6) Byt inte ut det interna batteriet om en explosiv atmosfär föreligger.
APPENDIX F  CUSTOMER SERVICE

Customer Service/Technical Support

FCI provides full in-house technical support. Additional technical representation is also provided by FCI field representatives. Before contacting a field or in-house representative, perform the troubleshooting techniques outlined in this document.

By Mail

Fluid Components International LLC
1755 La Costa Meadows Dr.
San Marcos, CA 92078-5115 USA
Attn: Customer Service Department

By Phone

Contact the area FCI regional representative. If a field representative is unable to be contacted or if a situation is unable to be resolved, contact the FCI Customer Service Department toll free at 1 (800) 854-1993.

By Fax

To describe problems in a graphical or pictorial manner, send a fax including a phone or fax number to the regional representative. Again, FCI is available by facsimile if all possibilities have been exhausted with the authorized factory representative. Our fax number is 1 (760) 736-6250; it is available 7 days a week, 24 hours a day.

By Email

FCI Customer Service can be contacted by e-mail at: techsupport@fluidcomponents.com.

Describe the problem in detail making sure a telephone number and best time to be contacted is stated in the email.

International Support

For product information or product support outside the contiguous United States, Alaska, or Hawaii, contact your country's FCI International Representative or the one nearest to you.

After Hours Support

For product information visit FCI at www.fluidcomponents.com. For product support call 1 (800) 854-1993 and follow the prerecorded instructions.

Point of Contact

The point of contact for service, or return of equipment to FCI is your authorized FCI sales/service office. To locate the office nearest you, go to www.fluidcomponents.com.

Warranty Repairs or Returns

FCI prepays ground transportation charges for return of freight to the customer's door. FCI reserves the right to return equipment by the carrier of our choice.

International freight, handling charges, duty/entry fees for return of equipment are paid by the customer.

Non-Warranty Repairs or Returns

FCI returns repaired equipment to the customer either collect or prepaid and adds freight charges to the customer invoice.

Extended Warranty

An extended warranty is available. Contact the factory for information.

Return to Stock Equipment

The customer is responsible for all shipping and freight charges for equipment that is returned to FCI stock from the customer site. These items will not be credited to the customer's account until all freight charges are cleared, along with applicable return to stock charges, from the credit invoice. (Exceptions are made for duplicate shipments made by FCI.)

If any repair or return equipment is received at FCI, freight collect, without prior factory consent, FCI bills the sender for these charges.
Field Service Procedures

Contact an FCI field representative to request field service.

A field service technician is dispatched to the site from either the FCI factory or one of the FCI representative offices. After the work is complete, the technician completes a preliminary field service report at the customer site and leaves a copy with the customer.

Following the service call, the technician completes a formal, detailed service report. The formal report is mailed to the customer after the technician’s return to the factory or office.

Field Service Rates

All field service calls are billed at the prevailing rates as listed in the FCI Price Book unless previous arrangements have been made with the FCI Customer Service Manager.

Customers are charged for all travel expenses including airfare, auto rental, meals and lodging. In addition, the customer shall pay all costs of transporting parts, tools or goods to and from the job site. Invoicing travel time, field service work and other expenses will be performed by FCI’s Accounting Department.
Return Authorization Request

1. **Return Customer Information**
   
   Returning company’s name: ___________________________ Phone# ___________________________
   
   Return contact name: ___________________________ Fax# ___________________________
   
   Email address: ____________________________________________

2. **Return Address**
   
   Bill to: ____________________________________________ Ship to: ____________________________________________
   
   ____________________________________________
   
   ____________________________________________

3. **Mandatory End User Information**
   
   Contact: ___________________________ Company: ___________________________ Country: ___________________________

4. **Return Product Information**
   
   Model number: ___________________________ Serial number(s): ___________________________
   
   Failure symptoms (detailed description required): ____________________________________________
   
   What trouble-shooting was done via phone or field visit by FCI? ____________________________________________

   FCI factory technical service contact: ____________________________________________

5. **Reason For Return**
   
   ☐ Sensor Element   ☐ Electronics   ☐ As Found Testing   ☐ Credit
   
   ☐ Recalibrate (New Data) ☐ Recalibrate (Most Recent Data) ☐ Other

   **Note:** A new Application Data Sheet (ADS) must be submitted for all recalibrations and re-certifications.

5. **Payment Type**
   
   ☐ Visa   ☐ Mastercard   ☐ American Express

   **Note:** A priced quotation is provided for all Non-Warranty repairs after equipment has been evaluated. All Non-Warranty repairs are subject to a minimum evaluation fee. By submitting this RA request form, accepting the RA number, and returning the equipment to FCI, the customer agrees to terms of after three months from the date of the initial quote if there is no response from the customer. FCI will deem returned equipment abandoned and reserves the right to dispose of abandoned equipment.

   Factory return shipping address: Fluid Components International LLC
   1755 La Costa Meadows Drive
   San Marcos, CA 92078-5115
   Attn: Repair Department
The following Return Authorization Request form and Decontamination Statement MUST be completed, signed and emailed to techsupport@fluidcomponents.com before a Return Authorization Number will be issued. The signed Decontamination Statement and applicable MSDS Sheets must be included with the shipment. FCI will either fax, email or telephone you with the Return Authorization Number upon receipt of the signed forms.

Packing Procedures

1. **Electronics** should be wrapped in an anti-static or static-resistant bag, then wrapped in protective bubble wrap and surrounded with appropriate dunnage* in a box. Instruments weighing more than 50 lbs., or extending more than four feet, should be secured in wooden crates by bolting the assemblies in place.

2. The sensor head must be protected with pvc tubing, or retracted the full length of the probe, locked and secured into the Packaging Gland Assembly (cap screws tightened down).

3. FCI can supply crates for a nominal fee.

4. No more than four (4) small units packaged in each carton.

5. FCI will not be held liable for damage caused during shipping.

6. To ensure immediate processing mark the RA number on the outside of the box. Items without an RA number marked on the box or crate may be delayed.

7. Freight must be "PrePaid" to FCI receiving door.

* Appropriate dunnage as defined by UPS will protect package contents from a drop of three (3) feet.

*** Decontamination Statement *** This Section Must Be Completed ***

Exposure to hazardous materials is regulated by Federal, State, County and City laws and regulations. These laws provide FCI's employees with the "Right to Know" the hazardous or toxic materials or substances in which they may come in contact while handling returned products. Consequently, FCI's employees must have access to data regarding the hazardous or toxic materials or substances the equipment has been exposed to while in a customer's possession. Prior to returning the instrument for evaluation/repair, FCI requires thorough compliance with these instructions. The signer of the Certificate must be either a knowledgeable Engineer, Safety Manager, Industrial Hygienist or of similar knowledge or training and responsible for the safe handling of the material to which the unit has been exposed. Returns without a legitimate Certification of Decontamination, and/or MSDS when required, are unacceptable and shall be returned at the customer's expense and risk. Properly executed Certifications of Decontamination must be provided before a repair authorization (RA) number will be issued.

**Certification Of Decontamination**

I certify that the returned item(s) has(have) been thoroughly and completely cleaned. If the returned item(s) has(have) been exposed to hazardous or toxic materials or substances, even though it (they) has (have) been thoroughly cleaned and decontaminated, the undersigned attests that the attached Material Data Safety Sheet(s) (MSDS) covers said materials or substances completely. Furthermore, I understand that this Certificate, and providing the MSDS, shall not waive our responsibility to provide a neutralized, decontaminated, and clean product for evaluation/repair at FCI. Cleanliness of a returned item or acceptability of the MSDS shall be at the sole discretion of FCI. Any item returned which does not comply with this certification shall be returned to your location Freight Collect and at your risk.

This certification must be signed by knowledgeable personnel responsible for maintaining or managing the safety program at your facility.

Process flow media ________________________________

Product was or may have been exposed to the following substances:

_________________________________________________

Print name ________________________________ Date _______________________

Authorized signature ____________________________

Company title ________________________________

Visit FCI online: www.FluidComponents.com | techsupport@fluidcomponents.com

1755 La Costa Meadows Drive, San Marcos, California 92078-5115 USA | Phone: 760-744-5960 | 800-854-1993

European Sales Office: Persphonestraat 3-D, 5647 TT Tilburg, The Netherlands | 31-13-5159889
WARRANTIES

Goods furnished by the Seller are to be within the limits and of the sizes published by the Seller and subject to the Seller’s standard tolerances for variations. All items made by the Seller are inspected before shipment, and should any of said items prove defective due to faults in manufacture or performance under Seller approved applications, or fail to meet the written specifications accepted by the Seller, they will be replaced or repaired by Seller at no charge to Buyer provided return or notice of rejection of such material is made within a reasonable period but in no event longer than one (1) year for non-calibration defects and one (1) year for calibration defects from date of shipment to Buyer, and provided further, that an examination by Seller discloses to Seller’s reasonable satisfaction that the defect is covered by this warranty and that the Buyer has not returned the equipment in a damaged condition due to Buyer’s or Buyer’s employees’, agents’, or representatives’ negligence and Buyer has not tampered, modified, redesigned, misapplied, abused, or misused the goods as to cause the goods to fail. In addition, this warranty shall not cover damage caused by Buyer’s exposure of the goods to corrosive or abrasive environments. Moreover, Seller shall in no event be responsible for (1) the cost or repair of any work done by Buyer on material furnished hereunder (unless specifically authorized in writing in each instance by Seller), (2) the cost or repair of any modifications added by a Distributor or a third party, (3) any consequential or incidental damages, losses, or expenses in connection with or by reason of the use of or inability to use goods purchased for any purpose, and Seller’s liability shall be specifically limited to free replacement, or refund of the purchase price, at Seller’s option, provided return or rejection of the goods is made consistent with this paragraph, and the Seller shall in no event be liable for transportation, installation, adjustment, loss of good will or profits, or other expenses which may arise in connection with such returned goods, or (4) the design of products or their suitability for the purpose for which they are intended or used. Should the Buyer receive defective goods as defined by this paragraph, the Buyer shall notify the Seller immediately, stating full particulars in support of his claim, and should the Seller agree to a return of the goods, the Buyer shall follow Seller’s packaging and transportation directions explicitly. In no case are the goods to be returned without first obtaining a return authorization from the Seller. Any repair or replacement shall be at Seller’s factory, unless otherwise directed, and shall be returned to Seller transportation prepaid by Buyer. If the returned goods shall prove defective under this clause they will be replaced or repaired by Seller at no charge to Buyer provided the return or rejection of such material is made within a reasonable period, but in no event longer than (1) year from the date of shipment of the returned goods or the unexpired terms of the original warranty period whichever is later. If the goods prove to be defective under this paragraph, the Buyer shall remove the goods immediately from the process and prepare the goods for shipment to Seller. Continued use or operation of defective goods is not warranted by Seller and damage occurring due to continued use or operation shall be for Buyer’s account. Any description of the goods contained in this offer is for the sole purpose of identifying them, and any such description is not part of the basis of the bargain, and does not constitute a warranty that the goods will conform to that description. The use of any sample or model in connection with this offer is for illustrative purposes only, is not part of the basis of the bargain, and is not to be construed as a warranty that the goods will conform to the sample or model. No affirmation of that fact or promise made by the Seller, whether or not in this offer, will constitute a warranty that the goods will conform to the affirmation or promise. THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES WITH RESPECT TO THE GOODS OR THEIR INSTALLATION, USE, OPERATION, REPLACEMENT OR REPAIR, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS OF PURPOSE; AND THE GOODS ARE BEING PURCHASED BY BUYER “AS IS”. SELLER WILL NOT BE LIABLE BY VIRTUE OF THIS WARRANTY OR OTHERWISE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL LOSS OR DAMAGE RESULTING FROM THE USE OR LOSS OF USE OF THE GOODS.