FLUID COMPONENTS INTERNATIONAL LLC

# Installation & Operation Guide

## Models FS10A, FS10i
### Analyzer Flow Switch / Monitor

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# 1. GENERAL

The FS10 Series is a universal flow monitor and switch specifically designed for gas and liquid process analyzer sampling systems, and general flow and level applications. The FS10A installs easily into a standard tube tee fitting or SP76 (NeSSI) modular manifold and uses a fast responding, highly repeatable sensor. The FS10i is an insertion type instrument with ¼-inch or ½-inch NPT fitting (fixed 2- or 4-inch length) or ½-inch NPT compression fitting (6-inch length, Teflon or stainless steel ferrule).

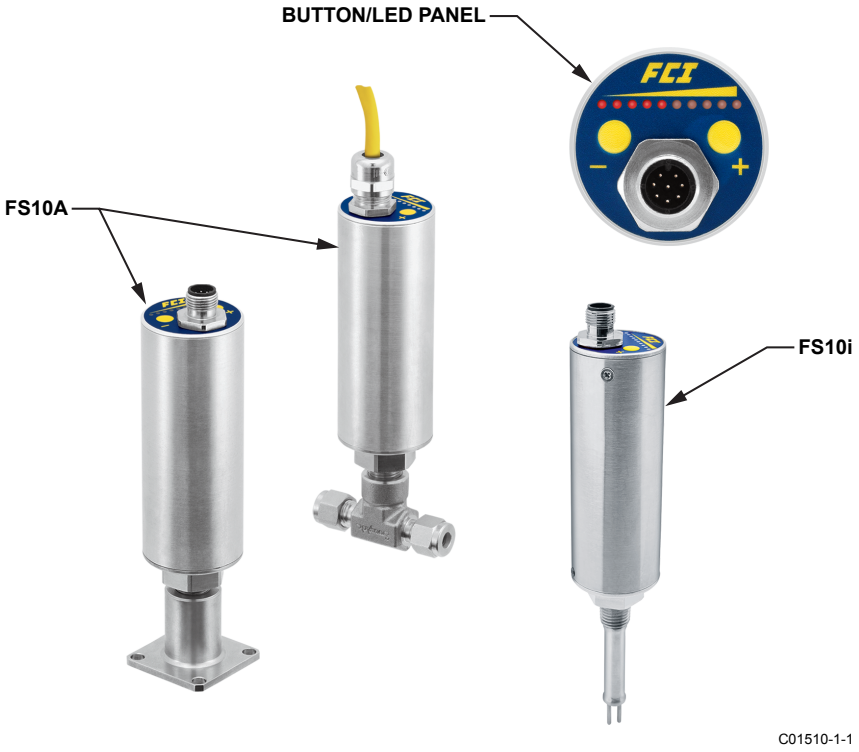



**Figure 1 – Models FS10A, FS10i Analyzer Flow Switch/Monitor**

## Technical Specifications

### Instrument

- **Media Compatibility**
  All gases and liquids compatible with 316L stainless steel and Hastelloy C22.
- **Process Connection**
  FS10A: ¼" NPT; compatible with ¼", 3/8" and ½" tube tee,
  ¼" tube tee with 1/8" injection tube adapters and SP76 adapter (FCI part number 019897-01)
  FS10i: ½" male NPT compression fitting with 316 SST or Teflon ferrule
  ¼" male NPT 316 SST (2-inch [50 mm] fixed length)
- **Flow Sensitivity/Range**
  Air: 0.25 to 400 SFPS [0,076 to 0,15 MPS]
  Water: 0.01 to 0.5 FPS [0,003 to 0,15 MPS]

| | Air/Gas | | | | Liquids | | | |
|---|---|---|---|---|---|---|---|---|
| | CC/Min | | SCFH | | CC/Min | | GPH | |
| | Min | Max | Min | Max | Min | Max | Min | Max |
| 1/8" tube adapter with 0.0625" ID injection tube | 10 | 2,000 | 0.02 | 5 | 0.70 | 18.00 | 0.01 | 0.30 |
| 1/8" tube adapter with 0.0940" ID injection tube | 25 | 5,000 | 0.05 | 10 | 1.50 | 40.00 | 0.03 | 0.60 |
| 1/4" tube tee | 50 | 20,000 | 0.10 | 40 | 4.00 | 100.00 | 0.07 | 1.70 |
| SP76 adapter | 50 | 20,000 | 0.10 | 40 | 4.00 | 100.00 | 0.07 | 1.70 |
| 3/8" tube tee | 180 | 50,000 | 0.40 | 100 | 14.00 | 350.00 | 0.20 | 5.50 |
| 1/2" tube tee | 375 | 100,000 | 0.80 | 200 | 30.00 | 750.00 | 0.50 | 12.00 |

- **Repeatability**
  ± 0.5% of reading
- **Temperature Coefficient**
  For temperatures > ±30 °F [±16 °C]
  Gas: Maximum ±0.025% of reading/°F up to 500 °F [±0.05% of reading/°C up to 260 °C]
  Liquid: Maximum ±0.2% of reading/°F up to 250 °F [±0.367% of reading/°C up to 121 °C]
  Turndown Ratio: 5:1 to 100:1

### Agency Approvals

Integral Electronics

FM, FMc: Nonincendive, Class I Division 2 Groups A, B, C, D;
Class II/III, Division 2 Groups E, F, G;
T4@Ta=71°C Type 4X

ATEX, IEC: Nonincendive for gas and dust,
II 3 G Ex ec IIC T4 Gc, -40 °C ≤ Ta ≤ +71 °C
II 3 D Ex tc IIIC T 81°C Dc, -40 °C ≤ Ta ≤ +71 °C
IP64

Ingress Protection: IP65, IP66, IP67 in non-hazardous locations.

CE Marking, CRN, complies with Canadian Electrical code requirements of ANSI/ISA 12.27.01-2011 as a single seal device.

IEC 61508 (SIL): SIL 2 compliant; Safe Failure Fraction (SFF) 90%

Remote Flow Element

FM, FMc: Class I, Division 1, Groups A, B, C, D; T2...T6
Ta = -40 °C TO +65 °C (Electronics)
Class II/III, Division 1 Groups E, F, G; T2...T6
Ta = -40 °C TO +65 °C (Electronics); Type 4x, IP67
Tp = -40 °C TO 260 °C (T1...T6) Includes Div1/Zone1 ambient temperature zone.

ATEX: II 2 G Ex d IIC Gb T2....T6; Ta = 40 °C TO +65 °C
II 2 D Ex tb IIIC Db T300 °C...T85 °C; IP67

IEC: Ex d IIC Gb T2....T6; Ta = 40 °C TO +65 °C
Ex tb IIIC Db T300 °C...T85 °C; IP67

Refer to Probe Installation Operation manual [06EN003428] for Zone 1/Division 1 installation.
Remote flow element; IP67

### Flow Element

Materials of Construction (wetted parts) 316L stainless steel with Hastelloy C22 thermowells; optional, all Hastelloy C22 probe assembly

Operating Temperature
Standard: -40 °F to 250 °F [-40 °C to 121 °C]
FS10i, Teflon ferrule: -40 °F to 200 °F [-40 °C to 93 °C]
Electronics limited to 160 °F [71 °C]
Remote probe with polyurethane cable limited to 194 °F [90 °C]
Medium Temp: -40 °F to 500 °F [-40 °C to 260 °C]; remote configuration only – probe and Teflon jacketed cable.

Operating Pressure
Tube tee and insertion: 2000 psig [138 bar(g)]
FS10i, Teflon ferrule: 150 psig [10 bar(g)]
SP76 adapter: Per SP76 manifold specifications up to 500 psig [34 bar(g)] maximum

### Transmitter/Electronics

- **Enclosure**
  NEMA 4X [IP64], CE rated (Div 2, Zone 2 areas)
  IP64, IP65, IP66, IP67 in non-hazardous locations
- **Operating Temperature**
  -40 °F to 160 °F [-40 °C to 71 °C]
- **Output Signals**
  Standard:
  (1) Relay (SPDT, 1A @ 24 VDC); [1A @ 24 VDC/120 VAC, FM and FMc only] or (1) Open Collector N-Channel MOSFET (100 mA);
  (1) 4-20 mA* (500 Ω max. load). User scalable, general purpose, uncalibrated output proportional to flow rate for trend monitoring.
  (1) RS232C Serial I/O

  (*For linearized, calibrated analog outputs see FCI thermal mass flow meter products*)
  ** Fault indication per NAMUR NE43 guidelines, user selectable high (> 21.0 mA) or low (< 3.6 mA)*
- **Display**
  10 LED array, red; sequential lighting proportional to flow trend and flashes at setpoint
- **User Interface**
  Two top-mounted push buttons to program switch point, zero and span setting, relay hysteresis and time delay; button operation may be user disabled to prevent unwanted changes; all set-up functions also programmable via RS232C port
- **Input Power**
  24 VDC (21.5 VDC to 30 VDC); maximum 2.5 watts
- **Remote Configuration**
  Transmitter/electronics may be remote-mounted from flow element using interconnecting cable; remote flow element available with potted cable in 6', 15' or 30' [2 m, 5 m or 10 m] length and M12 connection plug at electronics; optional extended temperature service to 500 °F [260 °C] with selection of PTFE jacketed cable.

# 2. INSTALLATION

The FS10 is marked with a flow direction arrow FLOW or "A" etched onto the sensor element. It is located on the flattened area of the sensor body close to the housing or on the assembled tee. For 1/4 and 3/8 inch tube tees, mount the instrument with the "A" upstream of the flow to maximize sensitivity at low flow rates (flow into the "A"). Larger line sizes should follow the flow arrow direction. Refer to Figure 1. Where the flow tube is not included with the sensor assembly, the orientation mark must be parallel to flow (±3°). For liquid **vertical flows** in particular, **FCI recommends the sensor element be installed where flow is in the up direction. In vertical low flow gas applications, flow in the down direction is recommended**.

As a level device, the orientation mark can be perpendicular or parallel to the liquid level. The sensor element may be installed top mount 90° to the liquid surface. The sensor element can be at any angle as long as the flow direction follows the flow arrow. For liquid applications where the flow element is positioned other than horizontally, FCI recommends the flow go in the up direction.

***Caution***: To minimize the possibility of damage, leave the protective covers over the sensing area in place until the time of installation. Take extra precaution with the sensing elements and surface when installing.

**For NPT process connections**: Apply the appropriate sealant compatible with the process media to the male threads. Tighten until the orientation mark is positioned correctly. Check for leaks.

***Note***: ATEX/IEC labeled units are supplied with a UV filter disc located inside the silicone boot. The disc can be removed if the display is not subjected to UV light (e.g., sunlight, mercury-vapor lighting, etc.). See "Figure 16 – Installation Outline, FS10 Silicone Boot and UV Filter" on page 16 for UV filter disc removal details.

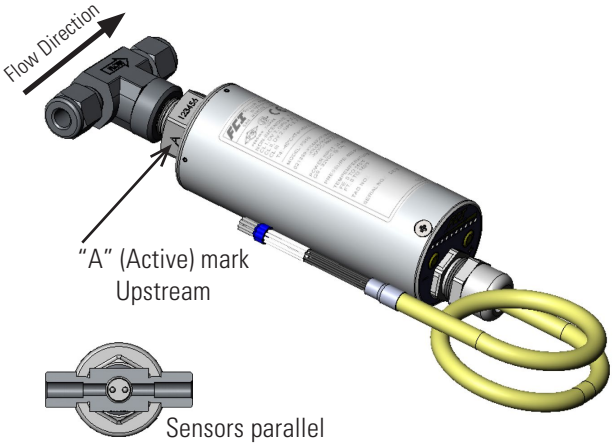
## Special Conditions for Safe Use

1. Provisions shall be made to prevent the rated voltage being exceeded by transient disturbances of more than 40%.
2. For applications in explosive atmospheres caused by air/dust mixtures, cable and conduit entries used shall provide a degree of ingress protection of at least IP 54 according to EN 60529.
3. When the temperature under rated conditions exceeds 158 °F [70 °C] at the cable or conduit entry point, or 176 °F [80 °C] at the branching point of the conductors, the temperature specification of the selected cable shall be in compliance with the actual measured temperature.
4. Cable gland assemblies are factory tightened – do not adjust; M12 connectors assembled finger-tight. Mencom MDC-8MR-PG9 or equal M12 connector is used on FS10.
5. Parts of the enclosure are non-conducting and exceed the maximum permissible resistance according to IEC 60079-0. Therefore, to avoid electrostatic charge build-up, do not rub with a dry cloth or clean with solvents when the instrument is installed/used within a potentially explosive atmosphere.

## Remote Flow Element Installation Into Zone 1, Division 1 Areas

Refer to Probe Installation, Operation & Maintenance manual (06EN003428) for Zone 1/Division 1 installation.

## Mounting Orientation

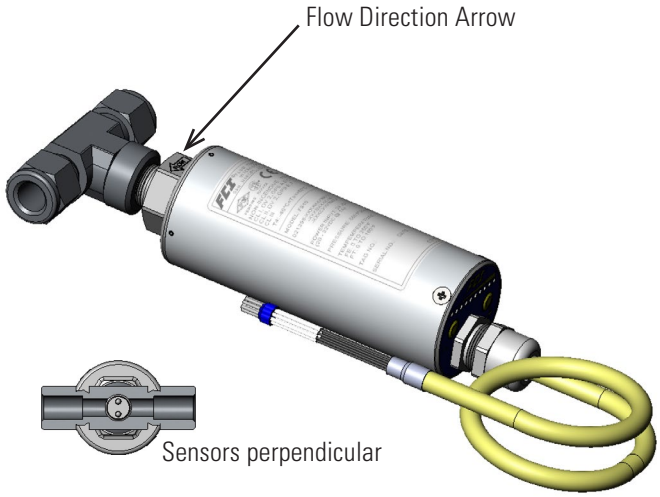



**Left to Right Flow Example in 1/4 or 3/8 inch tube tees**

For optimum sensitivity in low flow applications, install probes with the "A" (Active) sensor positioned upstream.

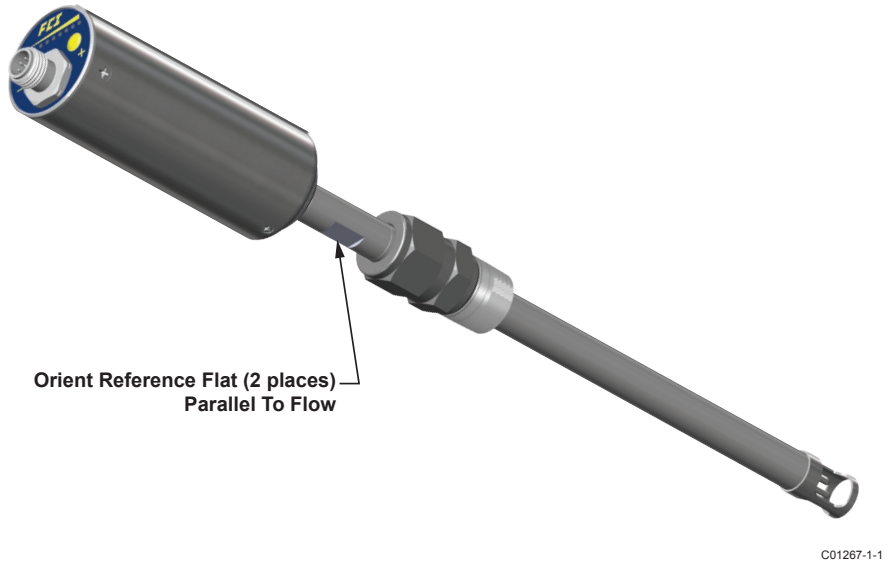
Horizontal lines: gas or liquid.

Vertical lines: gas - flow must be down
liquid - flow must be up




**Right to Left Flow Example in 1/2 inch or greater tube or pipe tee**

Probes mounted into 1/2 inch or greater tees are installed with the sensors positioned perpendicular to the flow path in the tee. Orient with the "A" (Active) facing up in side mount horizontal configurations. These sensors may also be marked with a flow direction arrow.




**FS10i**

Install probe with reference flats parallel to flow and arrow on top in horizontal installations.

**Figure 2 – Mounting Orientation**

## Instrument Wiring

Only qualified personnel are to wire or test this instrument. The operator assumes all responsibilities for safe practices while wiring or troubleshooting. One of the following wiring instruction and diagrams illustrate the requirements for power input, alarm and analog outputs and safety instructions for the unit being installed.

***Caution:*** The instrument contains electrostatic discharge (ESD) sensitive devices. Use standard ESD precautions when handling the instrument.

### Recommended Minimum Wire Gauge

The following wire gauge chart specifies the correct wire for the distance to the power source or loads. For best results from the open collector output, use shielded cable (50 ft. max.) and route it separately from the power source or relay load.

**Table 1 – I/O Wiring Gauge vs. Distance**

| Connection | Maximum Diameter (Gauge) | | | | | |
|---|---|---|---|---|---|---|
| | 10′ (3 m) | 50′ (15 m) | 100′ (30 m) | 250′ (76 m) | 500′ (152 m) | 1000′ (305 m) |
| Input Power (24 VDC nominal) | 24 | 24 | 22 | 22 | 20 | 18 |
| Relay Output (1 amp contacts) | 18 | 16 | 14 | 12 | 10 | X |
| Open Collector Output | 24 | 22 | X | X | X | X |
| 4-20 mA Output | 24 | 24 | 22 | 22 | 20 | 18 |

### Grounding

Properly connect the switch to earth ground for safety and operational reasons.

The circuit board is tied to the enclosure case internally and both are tied to the probe assembly. If the installation pipe or vessel is not properly grounded, connection to earth ground may be connected at the output connector, i.e. M12 or cable pigtail. Use the recommended wire gauge specified for the input power and distance listed in the chart above. **Do not connect the earth ground to DC ground (terminals are marked "GND", "RTN", "COM" or "–").**

### Input Power, 24 VDC

FCI recommends installing an input power disconnect and a fuse near the instrument to interrupt power during installation, maintenance, calibration, alarm selection and troubleshooting procedures. Install conduit according to the local electrical codes or hazardous location requirements.

Attach the power leads according to the Input/Output connection schematic on the following page. If the unit has an M12 interface, verify that the mating connector pin numbers match the designations of the wiring diagram. If the unit is supplied with a cable pigtail, connect the flying leads via an approved terminal block or connector in an electrically safe and approved conduit box.

Attach the wires to the relay and other functions as needed. The relay contact conditions are shown in the alarm state (de-energized). The relay's maximum rating is 1 A @ 24 VDC/120 VAC (FM only), 24 VDC (ATEX), resistive loads.

Refer to "3. OPERATION" on page 23 for details on setpoint and alarm state settings.

### I/O Wiring Hookup Diagrams

***Caution***: Instrument power is provided to Pin 1 of the I/O connector/cable (white wire). To avoid equipment damage always be sure that power is connected to Pin 1 (white wire) when making external I/O cable connections. Do NOT apply power to Pin 8 (red wire) or any other pin other than Pin 1.

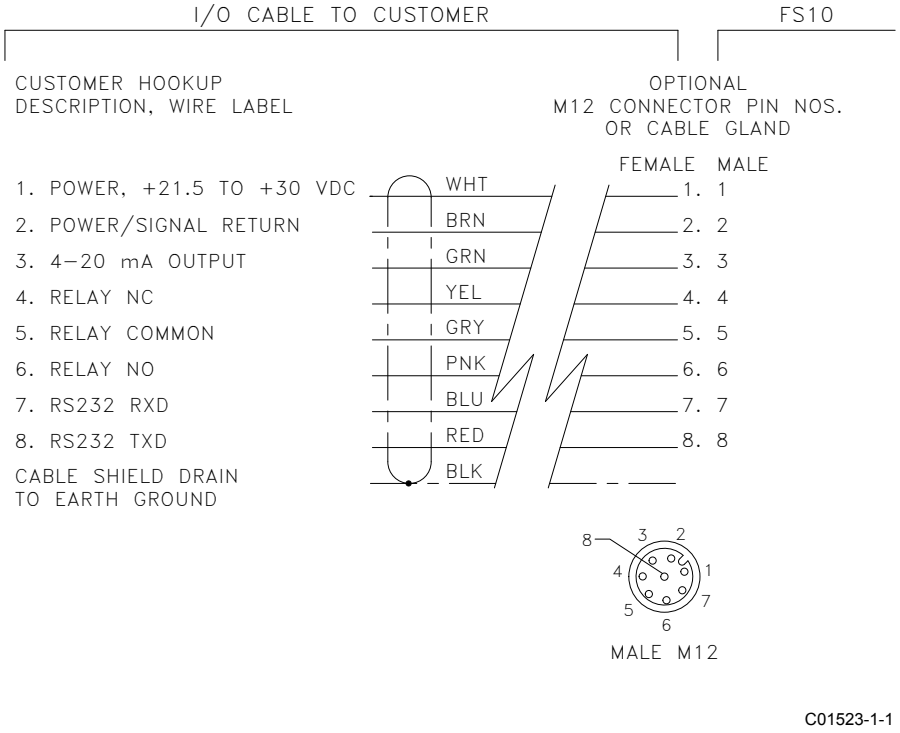



**Figure 3 – FS10 Integral & Remote (8-Wire Cable Gland or M12), Output Wiring: Relay, 4-20 mA, RS-232**

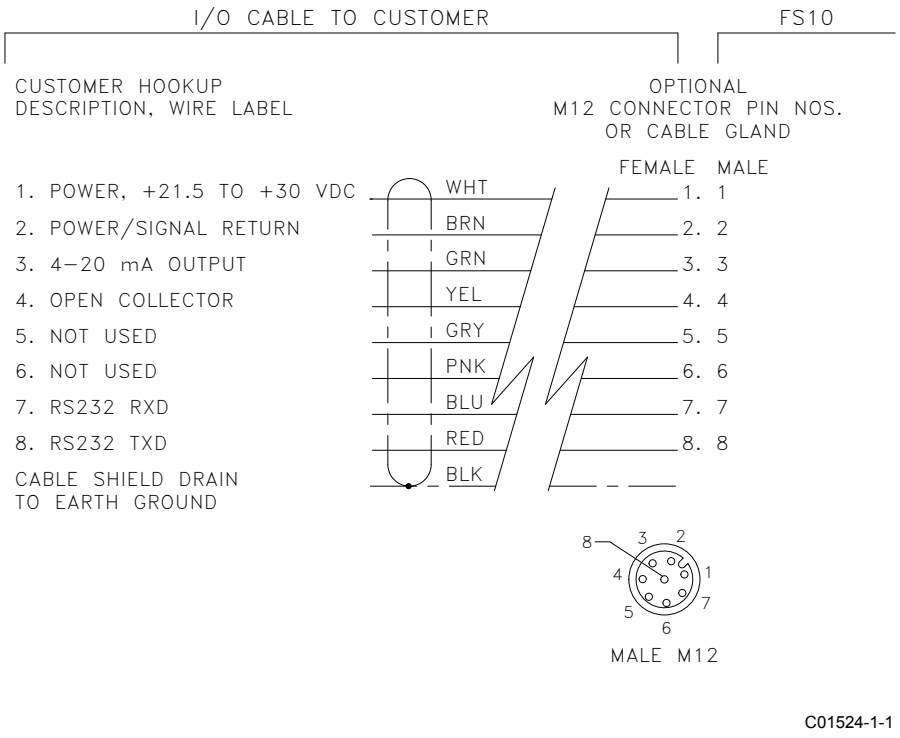



**Figure 4 – FS10 Integral & Remote (8-Wire Cable Gland or M12), Output Wiring: Open Collector, 4-20 mA, RS-232**

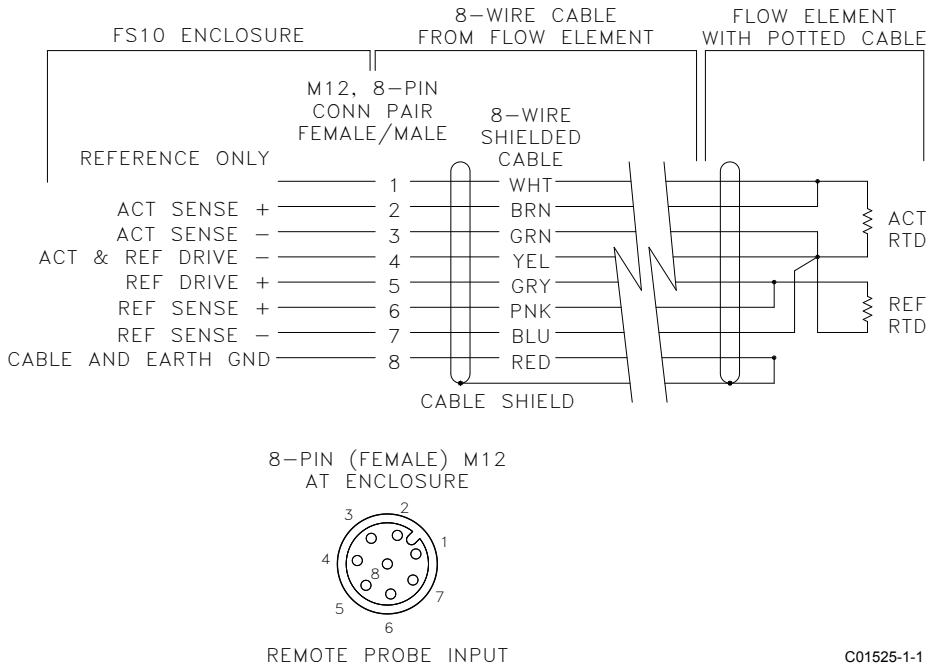



**Figure 5 – Flow Element Wiring Diagram, Remote 8-Wire Cable (P/N 021549-01) to 8-Pin Female M12 Connector on FS10 Enclosure**

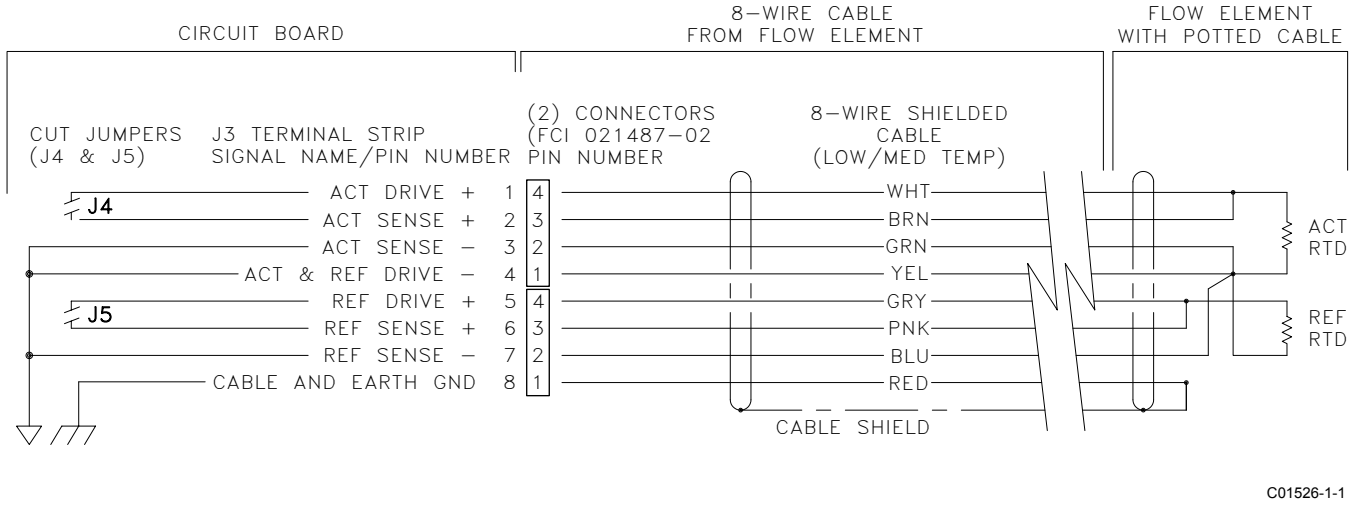



**Figure 6 – Flow Element Wiring Diagram, Remote 8-Wire Cable (P/N 021548-00) With Board Connectors Only (OEM)**

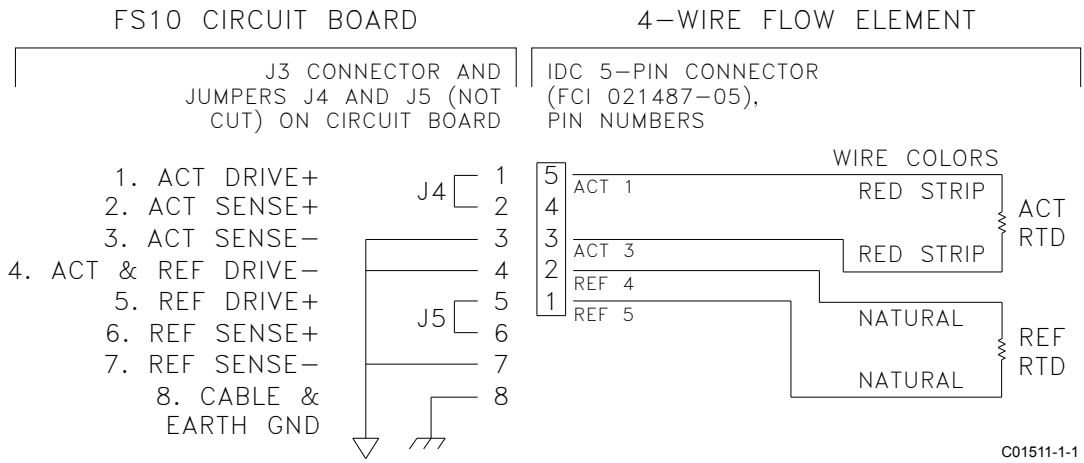



**Figure 7 – Flow Element Schematic, Integral Assembly, 4-Wire Hookup with Short Pigtails (OEM: Board Only, No Enclosure)**

## FS10 Output Modes

A schematic view of the FS10 output modes and corresponding jumper settings are shown below.

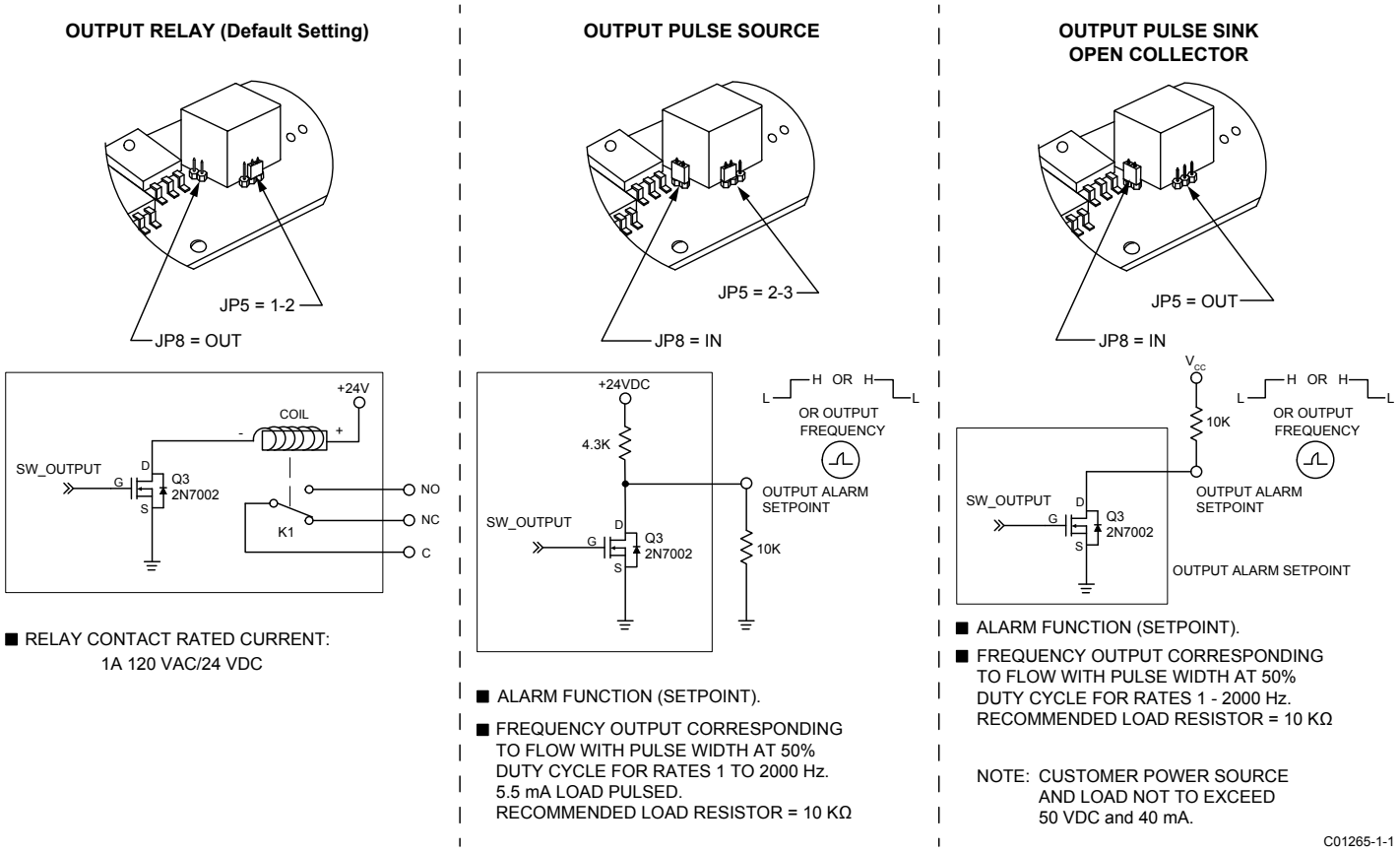



**Figure 8 – Output Modes and Jumper Settings**

## Switching Inductive Loads

If the FS10A/FS10i relay contacts are to be used to energize or de-energize an external relay, diode suppression must be used across the external relay coil. Use the guidelines in the following example to select the proper diode.

A Tyco Electronics relay K10P-11D15-24 is used as a slave relay. The DC coil voltage is specified at 24 VDC and the specification indicates a coil resistance of 650 Ω. The DC coil current is calculated by dividing the rated coil power by the rated voltage VDC or dividing the rated voltage VDC by the coil resistance. In this case the current through the coil will be around 37 mA (24 ÷ 650). Refer to the K10P-11D15-24 data sheet.

It is recommended the diode reverse voltage (Vr) rating be twice or greater the voltage across the relay and the diode forward current (IF) rating be greater than the relay current. Diodes 1N914 or 1N4148 meet these limits for this case.

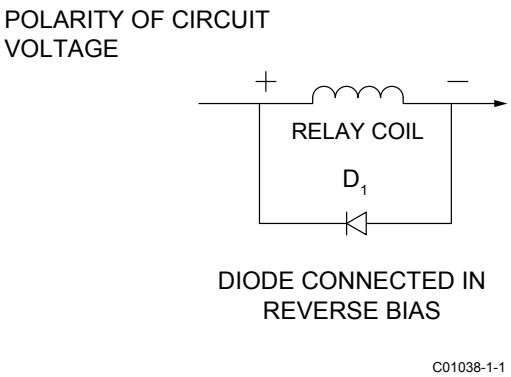



**Figure 9 – Relay Coil Suppression Diode**

## Installation Drawings

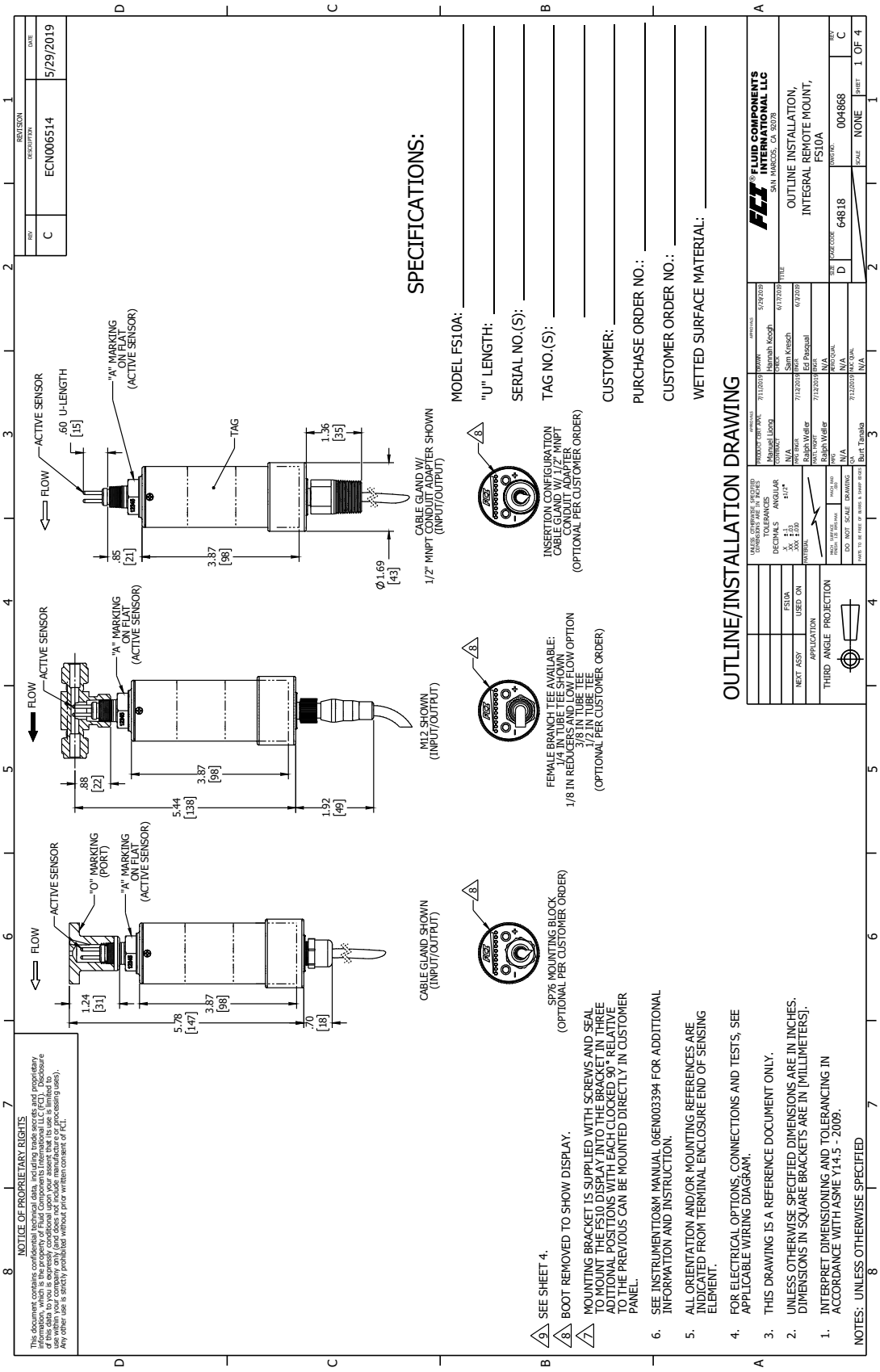
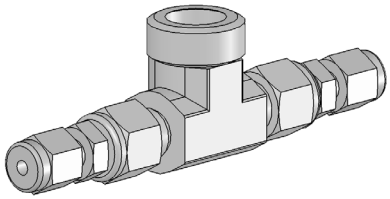
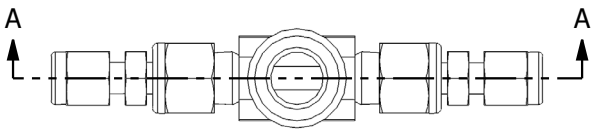
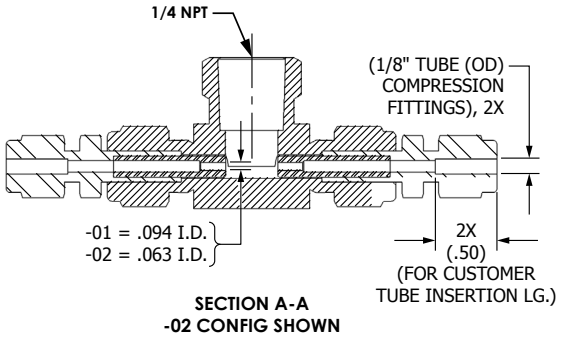


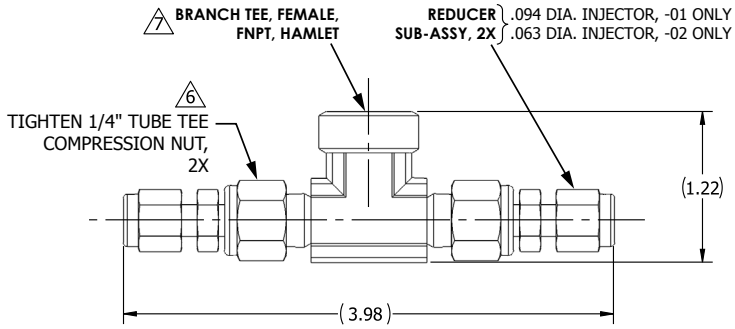

**Figure 10 – Outline Installation Drawing**



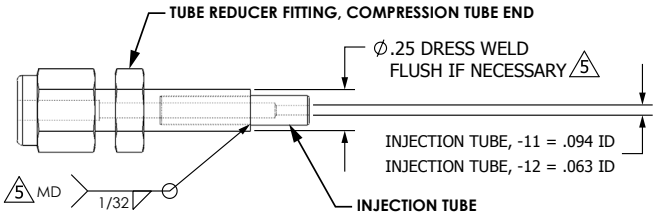



SECTION A-A
-02 CONFIG SHOWN




-01, -02 CONFIG




REDUCER SUB-ASSY
-11, -12 CONFIG

**CONFIGURATION:**

021865-XX — INJECTION TUBE ID

- 01 = COMPLETE TEE ASSY, .094 I.D.
- 02 = COMPLETE TEE ASSY, .063 I.D.
- 11 = REDUCER SUB-ASSY ONLY, .094 I.D.
- 12 = REDUCER SUB-ASSY ONLY, .063 I.D.
- 94 = PAIR (2) OF REDUCER SUB-ASSY .094 I.D.
- 63 = PAIR (2) OF REDUCER SUB-ASSY .063 I.D.

4. PRESSURE RATING, PER MAX. ALLOWED FS10A.
3. MATERIAL: ALL MATERIALS 316 OR 316L STAINLESS STEEL.
2. UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. DIMENSIONS IN SQUARE BRACKETS ARE IN [MILLIMETERS].
1. INTERPRET DIMENSIONING AND TOLERANCING IN ACCORDANCE WITH ASME Y14.5 - 2009.

NOTES: UNLESS OTHERWISE SPECIFIED.

7 OPTIONAL TEE REPLACEMENT FOR HAMLET TEE AVAILABLE ON REQUEST.

6 TIGHTEN BOTH REDUCER ASSEMBLIES INTO TEE HAND TIGHT, PLUS 3/4 TURN.

5 INSERT INJECTION TUBE INTO TUBE REDUCER TO BOTTOM. WELD AND DRESS AS NEEDED TO MAINTAIN .25 DIAMETER.

C01438-1-1

**Figure 11 – FS10 1/4-Inch Tube Tee Assy With 1/8" Tube Adapters And Injection Tubes**

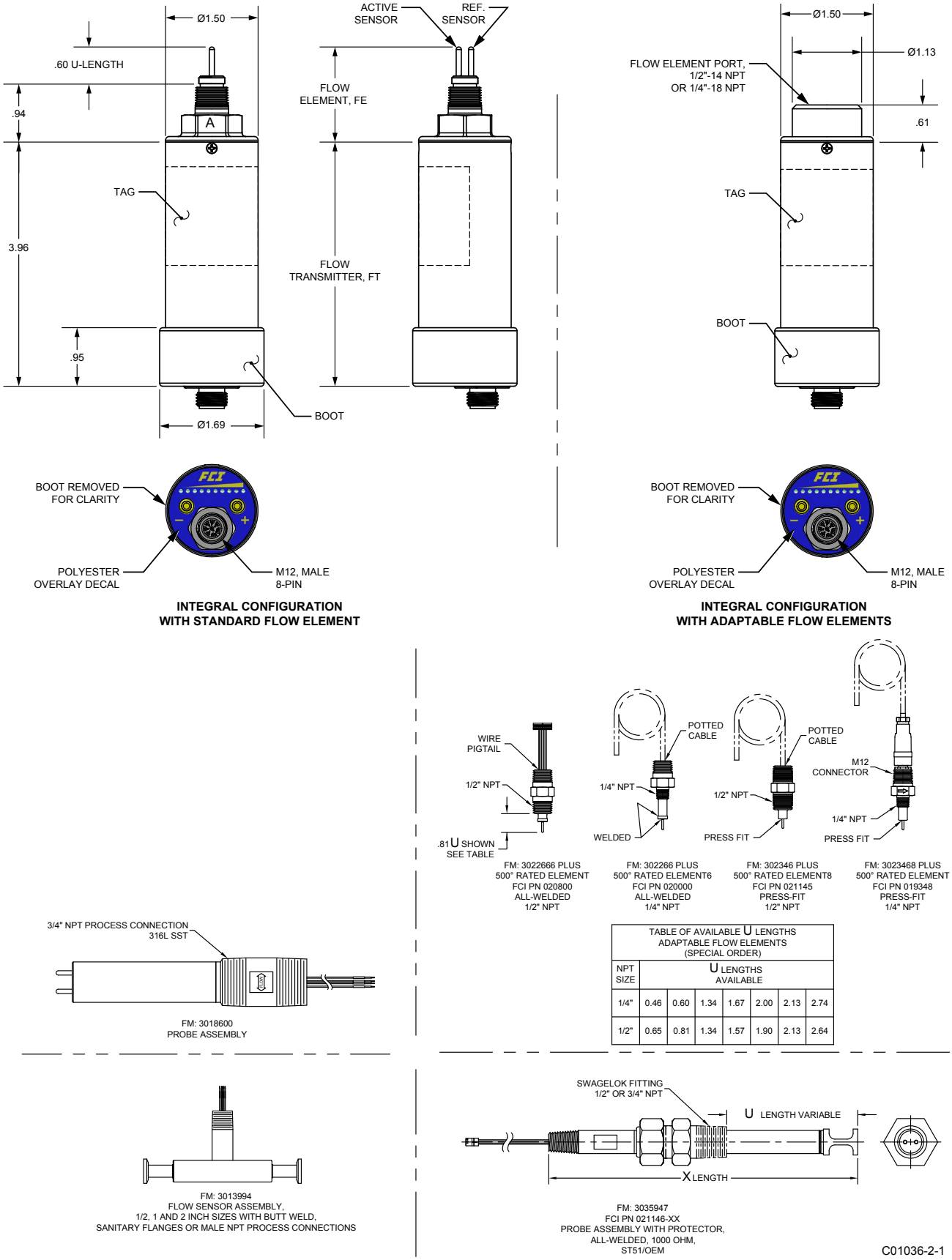



**Figure 12 – FS10 Flow Element Options**

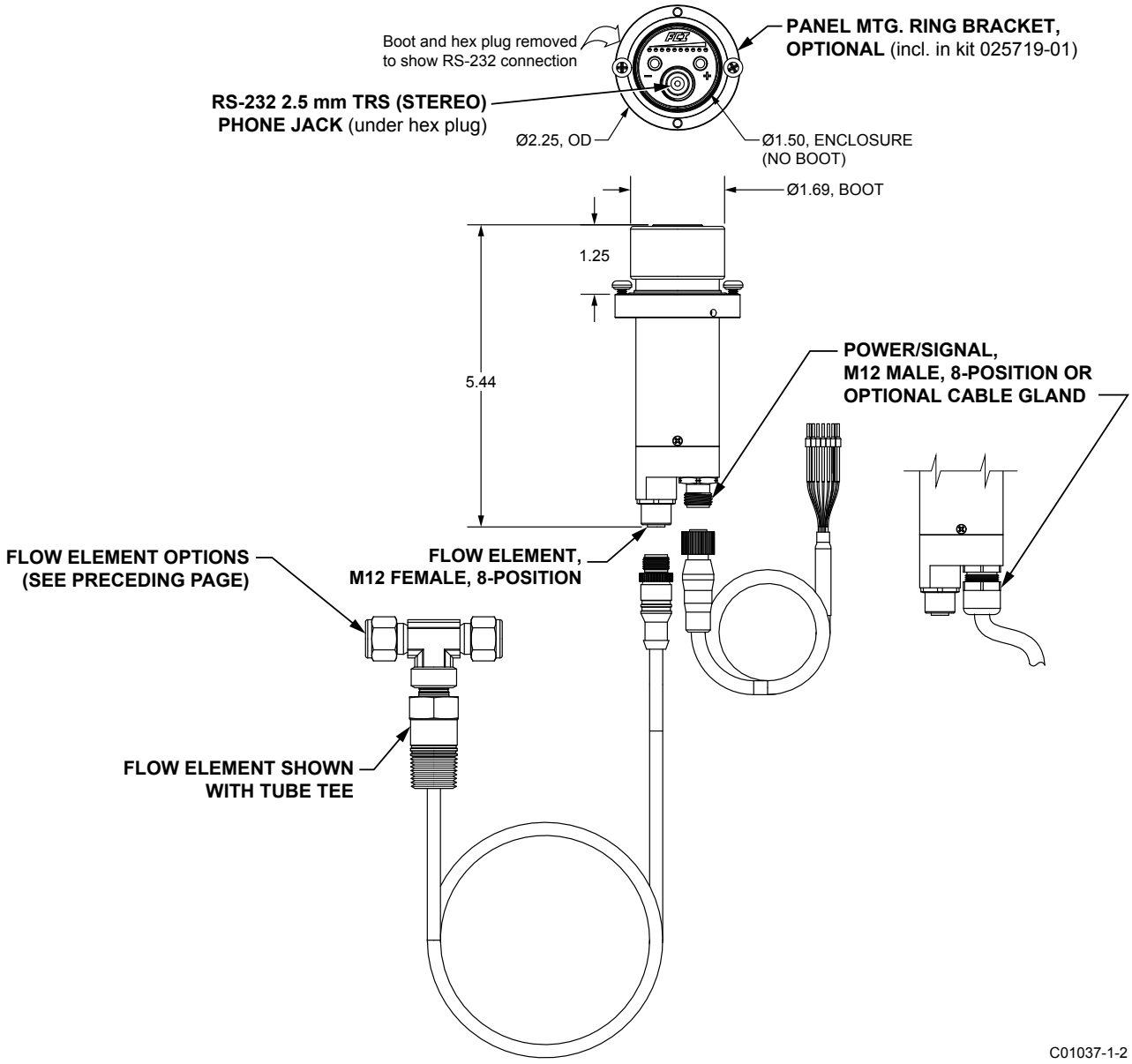



**Figure 13 – FS10 Remote Enclosure and Connection Options**

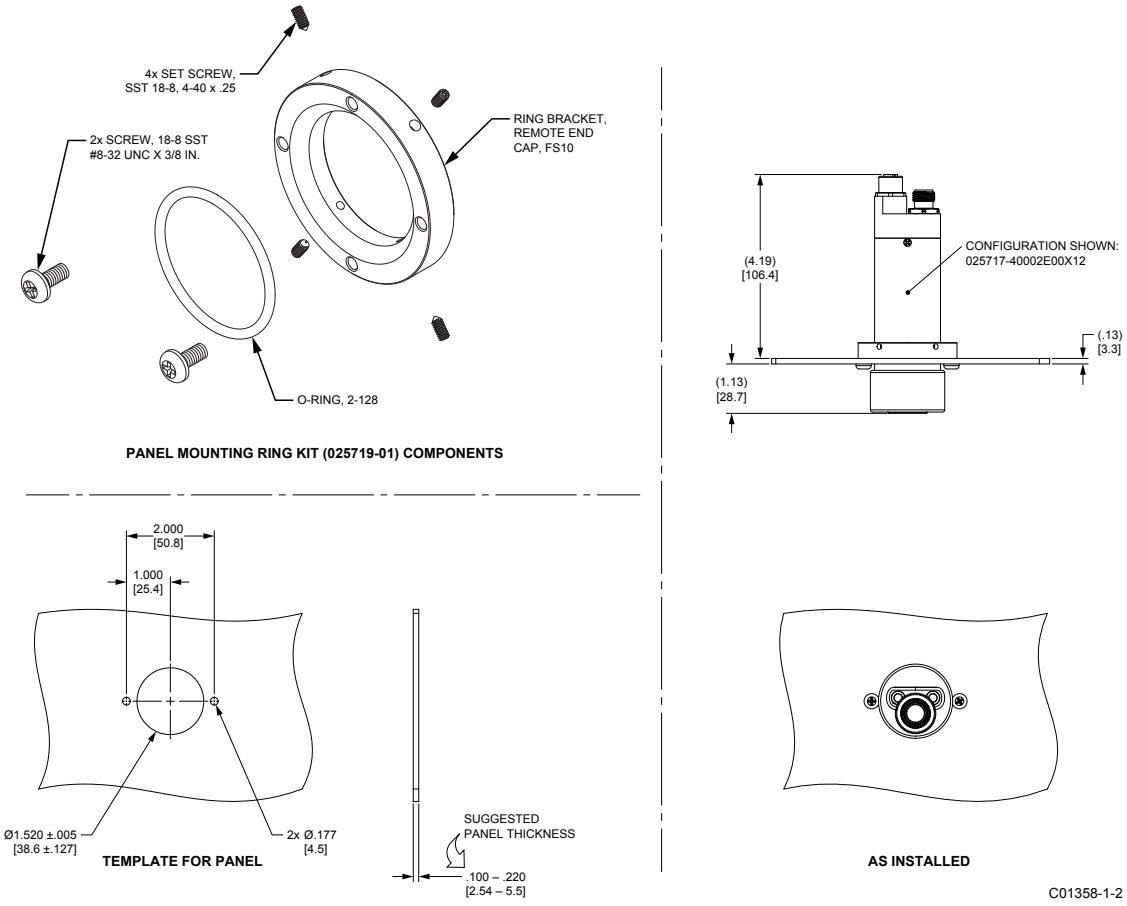



**Figure 14 – Installation Dimensions, FS10 Remote Panel Mounting Ring Kit (025719-01)**

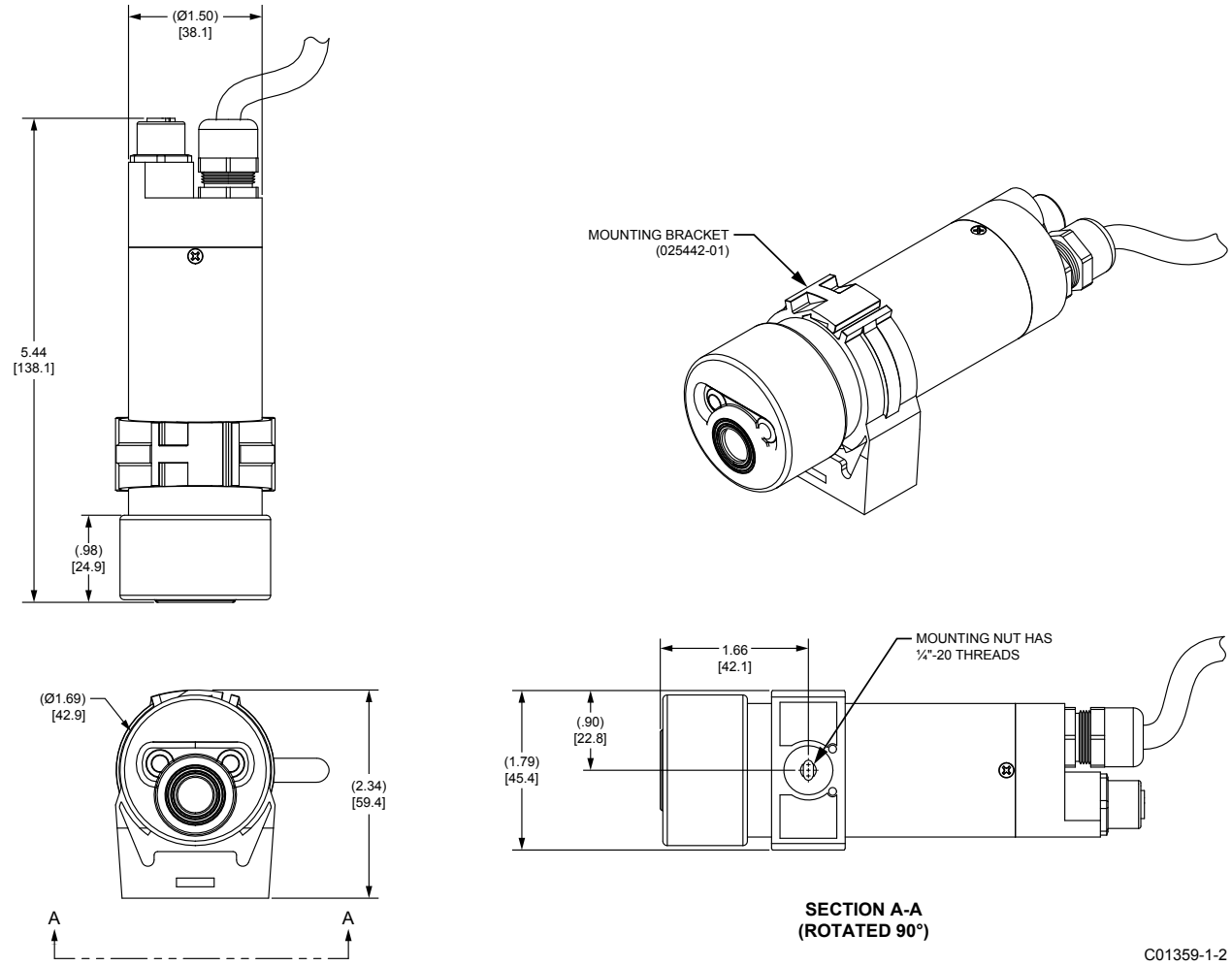



**Figure 15 – Installation Dimensions, FS10 Remote Mounting Bracket (025442-01)**

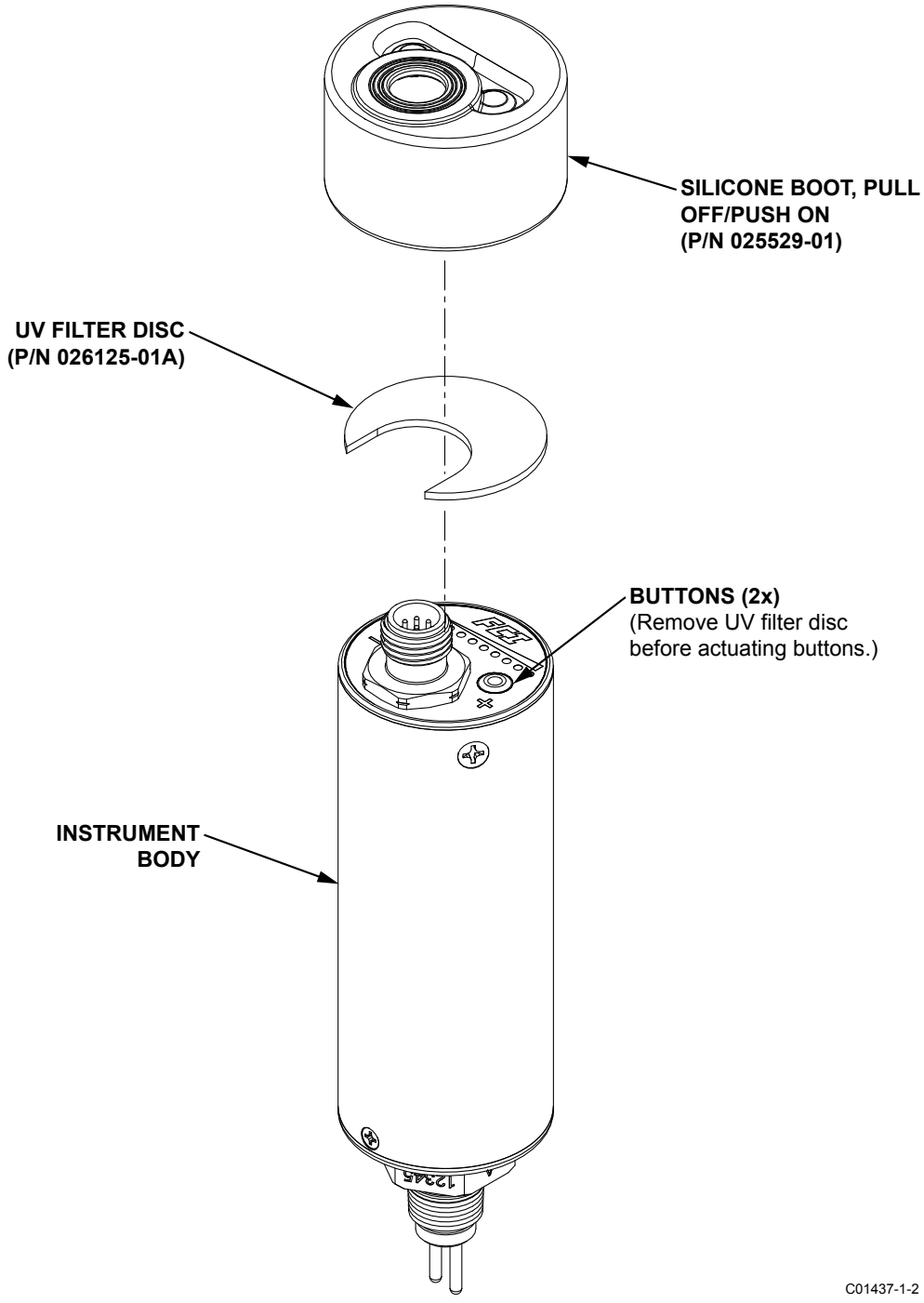



**Figure 16 – Installation Outline, FS10 Silicone Boot and UV Filter**

## FS10i Drawings

***Note***: An FS10i housing is secured with removable screws. The original FS10A housing was secured with fixed pins that were not removable in the field. Later versions of the FS10A are supplied with removable housing screws. The disassembly instructions below apply to any FS10 unit with removable housing screws.

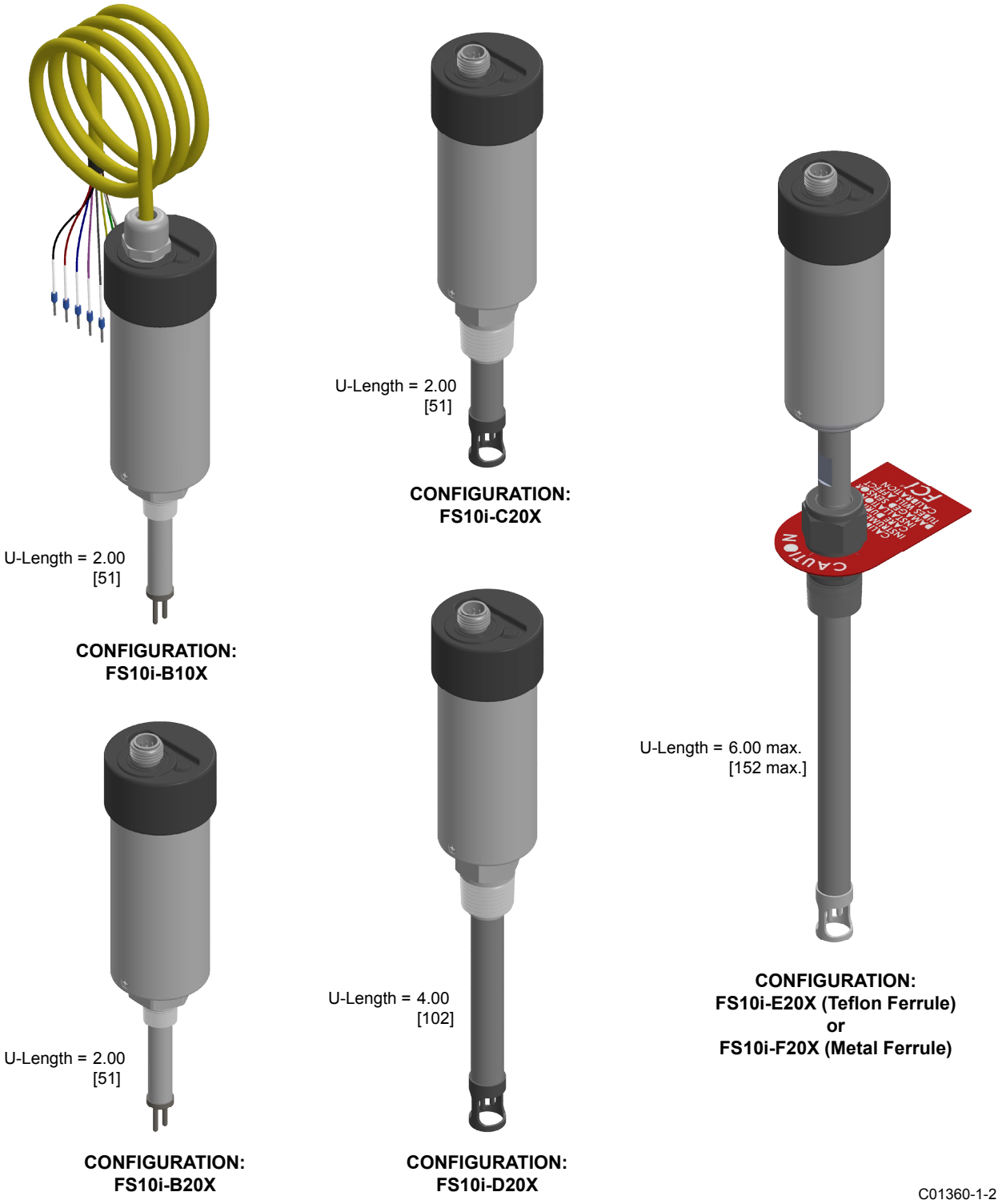



**Figure 17 – FS10i Configuration Overview**

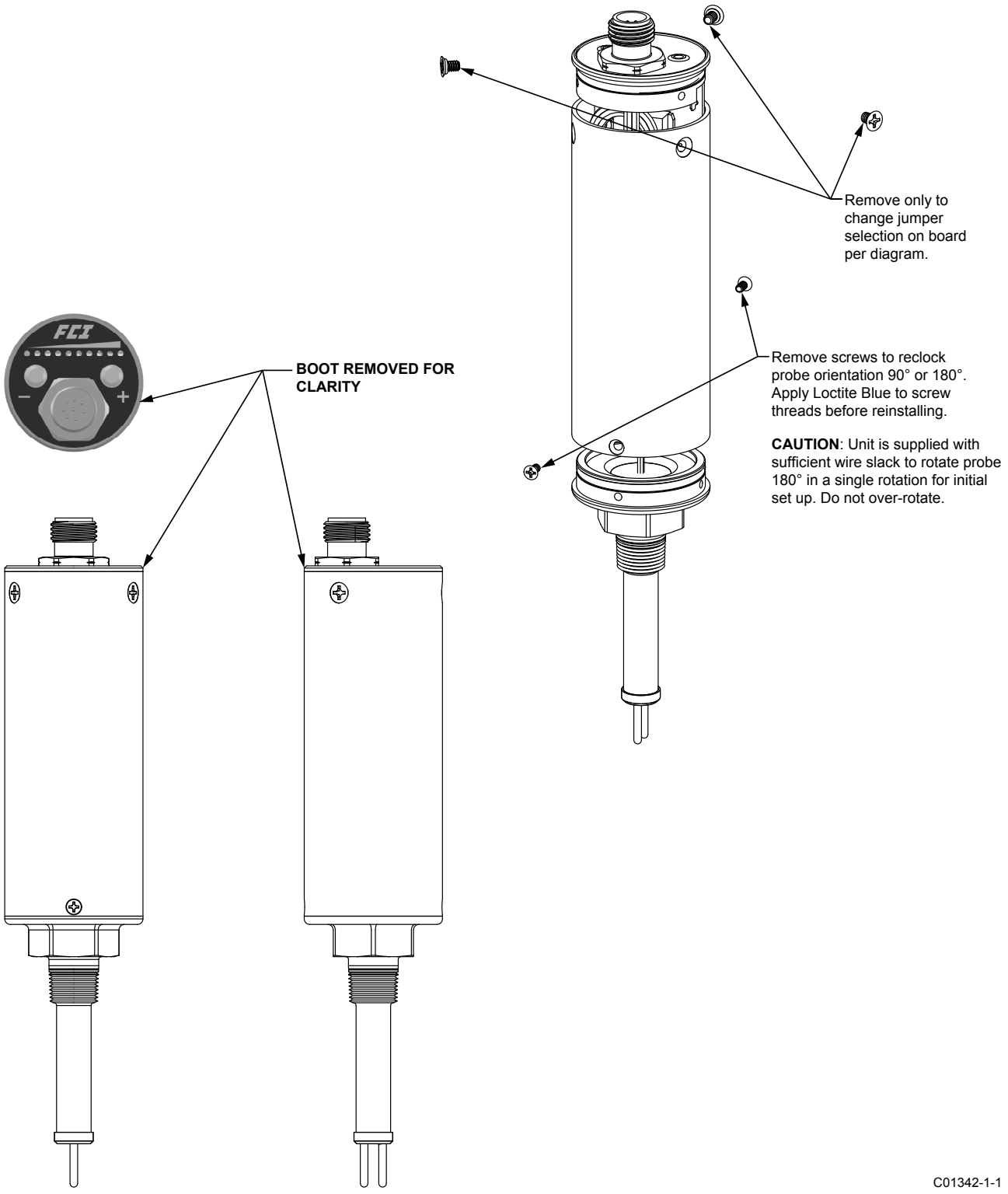



**Figure 18 – FS10i Sensor Subassembly**

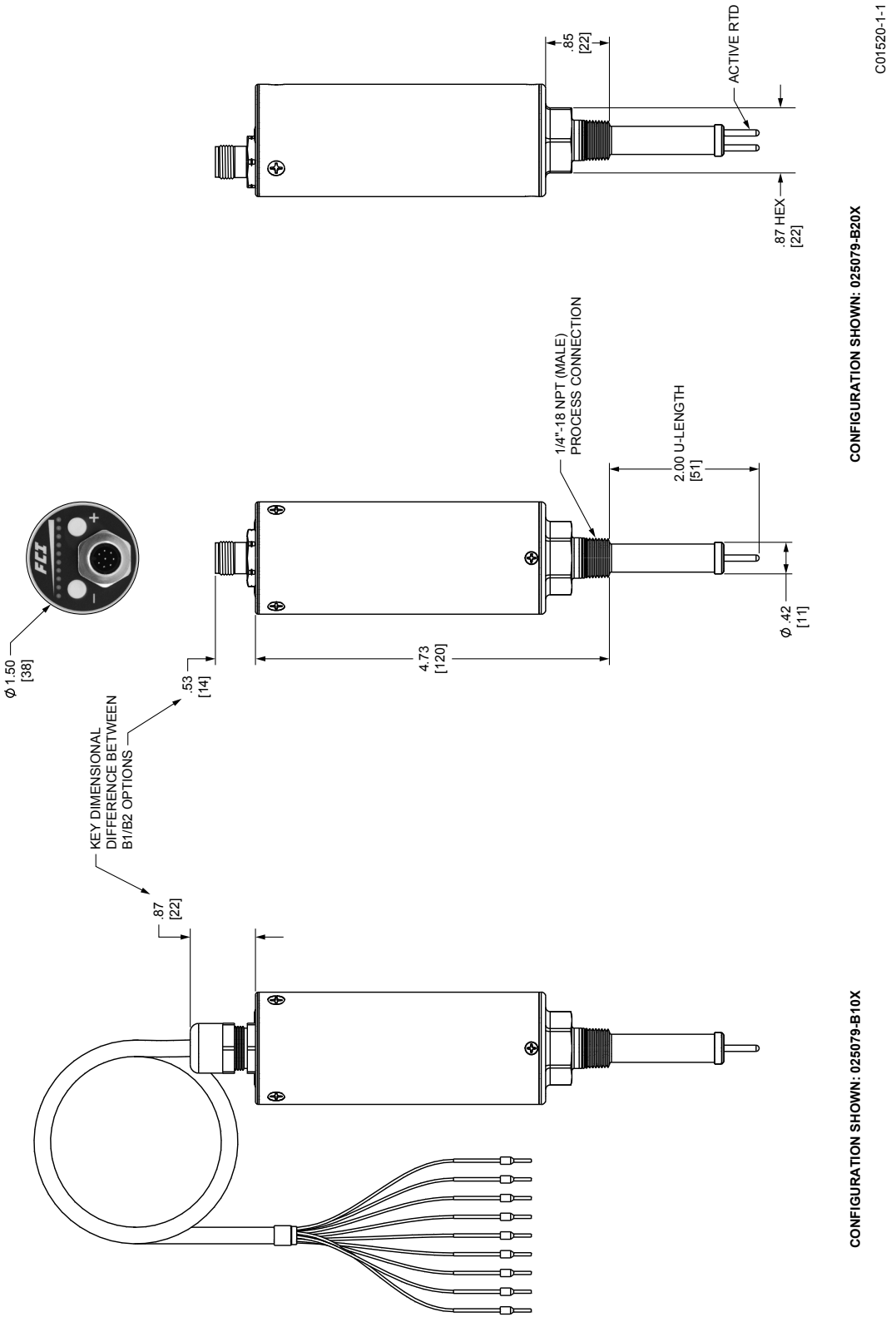



**Figure 19 – FS10i Dimensional Outlines, Configurations 025079-B10X and 025079-B20X**

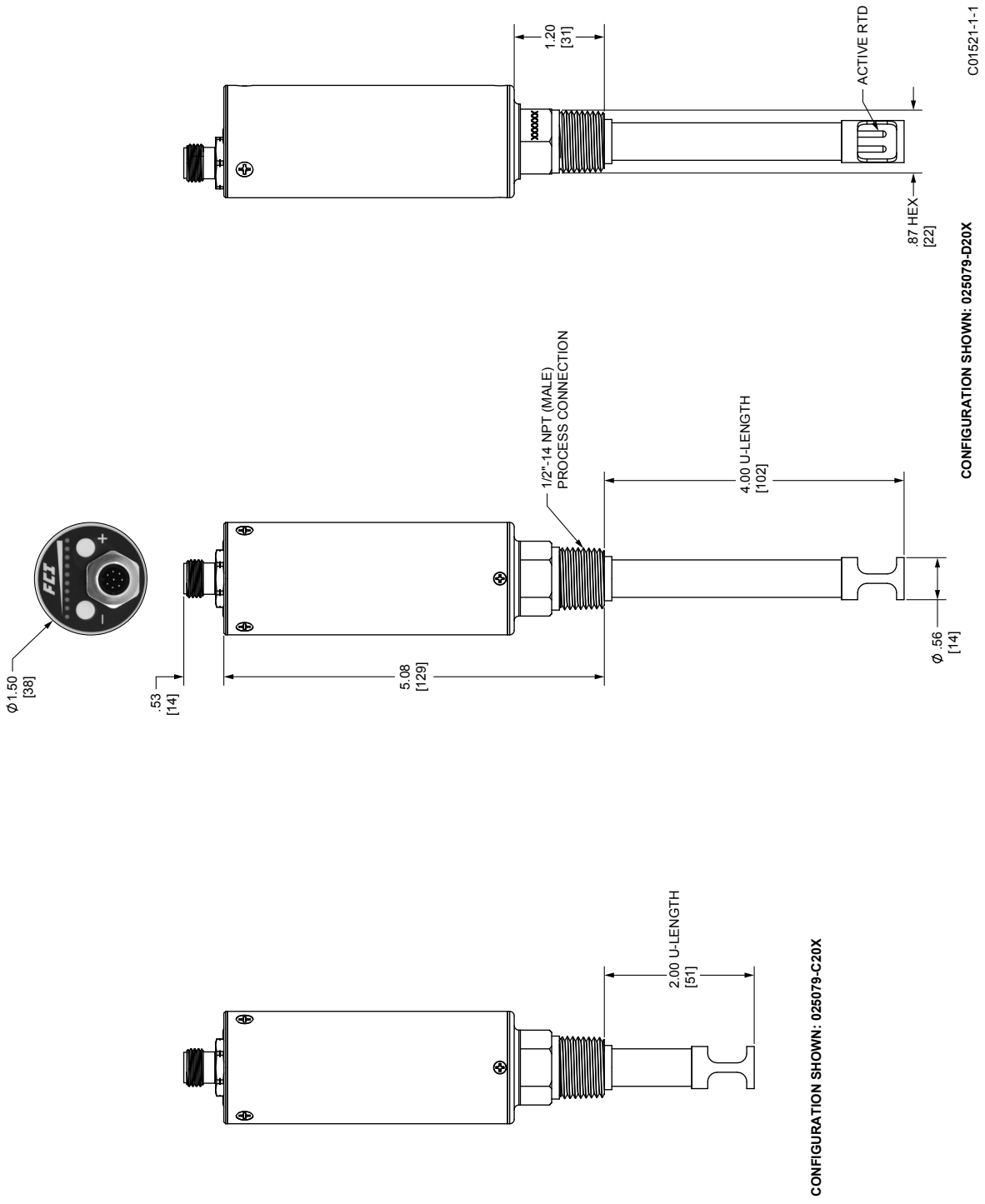
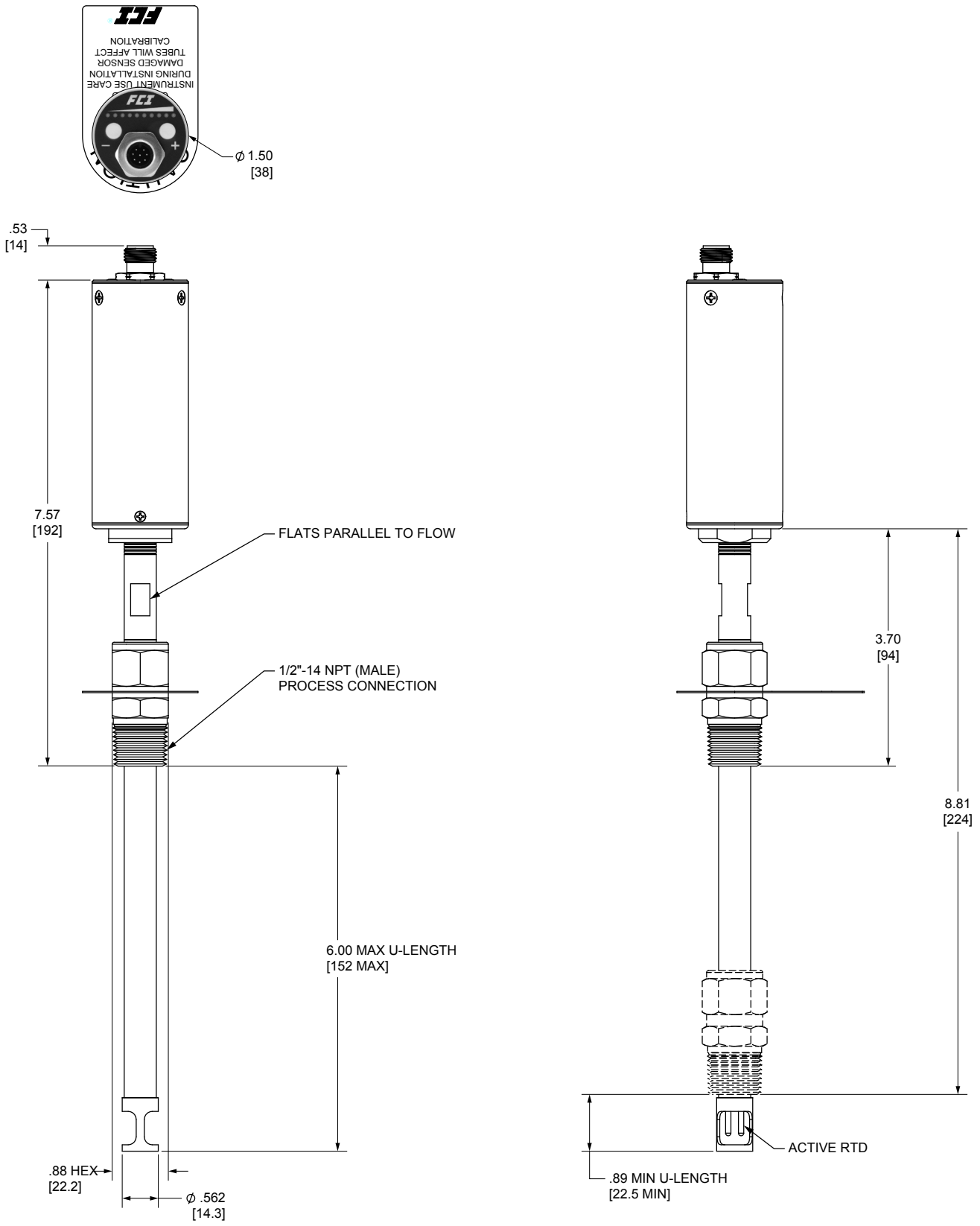



**Figure 20 – FS10i Dimensional Outlines, Configurations 025079-C20X and 025079-D20X**




**CONFIGURATION SHOWN: 025079-E20X OR 025079-F20X**

C01522-1-1

**Figure 21 – FS10i Dimensional Outlines, Configurations 025079-E20X or 025079-F20X**

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# 3. OPERATION

## General

Before applying power to the instrument, it is recommended that a third party inspect the installation workmanship. Make sure wires are not pinched or frayed. Check for matching serial numbers on the sensing element and the control circuit. Verify that the power and alarm circuits are properly connected. Review the instrument configuration and its application.

Units supplied with LEDs will have at least one LED on or slowly blinking to indicate power on. Apply power and look for the power indicator light. After power is established let the instrument warm up for 5 minutes. Refer to the set-up information in the sections below. Properly connect the switch to earth ground to ensure safe and problem-free operation.

### FS10 Function Overview

The FS10 flow monitor comes configured for use as a flow or temperature meter. The output of the switch configuration is an SPDT relay contact or open collector to ground [N-channel MOSFET] output (sync). A 4-20 mA output signal is also active as a signal reference. In the transmitter configuration, either flow or temperature is assigned to the 4-20 mA output. The table below shows the possible output configurations, including the status of the LED bar display.

**Table 2 – Output Configuration [Field Selectable with PC Interface Kit]**

| Configuration | 4-20 mA Output | Relay On/Off Output | LEDs |
|---|---|---|---|
| 1 (default) | Corresponds to flow measurement | Controls relay switch on/off from flow | Reflects flow. Flashing LED indicates Relay Limit. |
| 2[1] | Corresponds to flow measurement | Frequency corresponds to flow | Reflects flow. No Relay Limit indication. |
| 3[1] | Corresponds to flow measurement | Frequency corresponds to temperature | Reflects flow. No Relay Limit indication. |
| 4 | Corresponds to temp measurement | Controls relay switch on/off from flow | Reflects temperature. No Relay Limit indication. |
| 5 | Corresponds to temp measurement | Controls relay switch on/off from flow | Reflects flow. Flashing LED indicates Relay Limit. |
| 6[1] | Corresponds to temp measurement | Frequency corresponds to flow | Reflects temperature. No Relay Limit indication. |

Note: 1. **Caution**: Frequency output function must only be used with solid state output. Relay must NOT be engaged. Select proper jumper setting for MOSFET solid state output (see Section 3, Instrument Wiring).

- Flow measurement is mapped using CUST_FLOW_MIN and CUST_FLOW_MAX in the 4-20 mA output configuration.
- Temperature measurement is mapped using CUST_TEMP_MIN and CUST_TEMP_MAX in the output configuration and reflected in the 4-20 mA output when configuration 4 or 5 is selected. The default temperature range mapped to the 4-20 mA output is 0 °F to 250 °F [-17.8 °C to 121 °C]. Use the FS10 Windows PC interface program to rescale the temperature output as required.

The output configuration setting is normally factory set but it can be changed in the field if required. Use caution when making any configuration changes, as the monitor may not have been properly calibrated to accommodate the new setting. Use the Windows PC interface or the RS232 interface to make a change in output configuration.

***Note:*** ATEX-approved units are supplied with a polycarbonate UV filter under the silicone boot. Remove the boot and filter to use button setup (see next section).

## FS10 Field Quick Setup Procedure

Select desired setup option A or B below by pressing the (-) or (+) button continuously for the designated time period. In either case, the ability to set up the device in actual flow conditions is required, i.e., actual switch point flow rate, or flow close to intended value (Mode A) or actual zero flow and full scale flow (Mode B). In both cases, setting of the fail-safe is also established and the final switch (alarm) point can be adjusted in 5% of span increments before exiting to normal operation.

- Enter into Mode A to capture actual switch point and assume default settings for the flow range
  OR
- Enter into Mode B to set actual range (Zero and Full Scale) and a default switch point

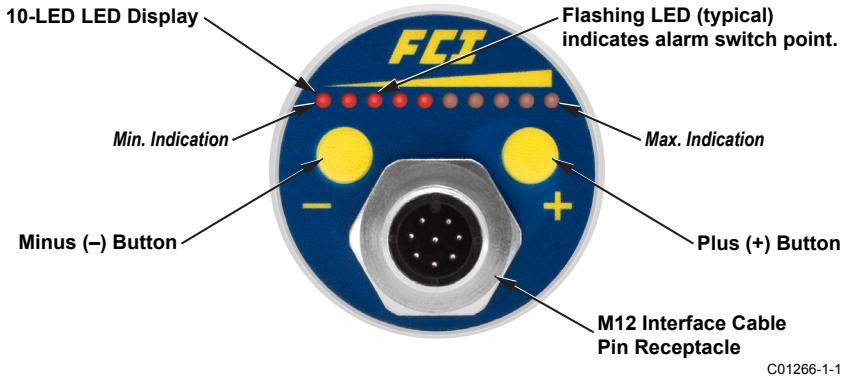



**Figure 22 – FS10 Button/LED Panel**

**Table 3 – Mode Operation Summary**

| MODE A – SWITCH POINT CAPTURE: Captures Switch Point and Sets Default Range | | | | | |
|---|---|---|---|---|---|
| **Button** | **Press & Hold** | **LED Pattern[1]** | **Setup** | **Press Momentarily To Capture And Exit[2]** | **After Release, 5 sec. to:** |
| (–) minus **For gas, low flow liquids.** | 6 to 9 seconds | Blinking | Throttle flow to desired switch point setting. | (–) Captures switch point, exits fail-safe Low<br>(+) Captures switch point, exits fail-safe High | Press (–) or (+) button momentarily to step captured switch point down or up in 5% increments |
| (+) plus **For liquids, high flow gases.** | 6 to 9 seconds | Blinking | Throttle flow to desired switch point setting. | (–) Captures switch point, exits fail-safe Low<br>(+) Captures switch point, exits fail-safe High | Press (–) or (+) button momentarily to step captured switch point down or up in 5% increments |
| **MODE B – SPAN SETTING: Captures Zero & Full Scale and Sets Default Switch Point** | | | | | |
| **Button** | **Press & Hold** | **LED Pattern** | **Setup** | **Press Momentarily to Save and Exit[2]** | **After Release, 5 secs. to:** |
| (–) minus **For gas, low flow liquids.** | Greater than 10 seconds | LEDs sequence down from 3 to 1 and LEDs 8 to 10 sequence up | Throttle flow over operating range to capture zero and full scale setting. | (–) Sets the flow range and exits fail-safe Low<br>(+) Sets the flow range and exits fail-safe High | Press (–) or (+) button momentarily to step switch point down or up in 5% increments from the default setting of 30% of span [exiting (–) button; fail-safe Low] or 70% of span [exiting (+) button; fail-safe High]. |
| (+) plus **For liquids, high flow gases.** | Greater than 10 seconds | LEDs sequence down from 3 to 1 and LEDs 8 to 10 sequence up | Throttle flow over operating range to capture zero and full scale setting. | (–) Sets the flow range and exits fail-safe Low<br>(+) Sets the flow range and exits fail-safe High | Press (–) or (+) button momentarily to step switch point down or up in 5% increments from the default setting of 30% of span [exiting (–) button; fail-safe Low] or 70% of span [exiting (+) button; fail-safe High]. |

1. LEDs blink when entering these modes. Blink rate increases when button is released, indicating mode is active and flow is ready for capture by momentary press of (–) or (+) button.
2. Refer to fail-safe default settings and span default settings below for complete description of exit parameter settings.

**Table 4 – Quick Setup Mode Defaults**

| | | Parameter | Default Button Selection (–)[3] | Default Button Selection (+)[3] |
|---|---|---|---|---|
| **Initial Button Press: Enter QSM, A or B➔** | | Bank Selection[1,2] | 1 | 3 |
| | | **Parameter** | **Default Button Selection (–)[3]** | **Default Button Selection (+)[3]** |
| **2nd Button Press: Exit QSM/Set Fail-Safe ➔** | **Common to Mode A & Mode B ➔** | Fail-safe | Low | High |
| | | Hysteresis Relative to Switch Point | Above | Below |
| | | NAMUR | Low | High |
| | | Relay Trip Adjust - Step Value | 5% | 5% |
| | **Mode A Only ➔** | Flow Min Factor Around Switch Point[4] | 0.5 | 0.1 |
| | | Flow Max Factor Around Switch Point[4] | 2 | 1.5 |
| | **Mode B Only ➔** | Switch Point | 30% | 70% |

Notes: 1. Bank 2 defaults to the low heater setting, Bank 4 defaults to the high heater setting (same as banks 1 and 3 respectively).

2. (–) and (+) buttons can be set to represent Bank 2 or 4 with additional set parameters in place.

3. Additional defaults may be applied using PC interface; e.g., time delays, hysteresis setting, filter value; and then saving to Bank 2 or 4.

4. $\% \, Switch \, Point = \left( \frac{1 - Flow \, Min \, Factor}{Flow \, Max \, Factor - Flow \, Min \, Factor} \right) \times 100$

## Quick Setup Mode

Single button operation is used in both Mode A (switch point capture mode) and Mode B (range capture mode).

Use either mode to set the default fail-safe and fine tune the switch point.

For either mode, first select the power mode as appropriate to the process media:

- The minus (–) button represents Bank 1 (low heater setting) for gas and low velocity liquids (Low Power)
- The plus (+) button represents Bank 3 (50% greater heater setting) for liquids and high velocity gas (High Power)

The length of time the selected button is pressed puts the unit in Quick Setup Mode (QSM) Mode A or Mode B as described below.

**Mode A: Capture Switch Point + Set Default Zero & Full Scale**

1. After pressing the (+) or (–) button for 6+ seconds, every other LED blinks indicating that the unit is ready to capture the switch point. Release the button at this point to enter Mode A.
2. Throttle flow rate to where desired switch point is to be set. Wait at least 30 seconds to ensure the unit has a stable signal.
3. With the flow rate at the desired switch point, momentarily press the (–) button or (+) button to choose an alarm fail-safe and exit the Mode A switch point capture mode:
   - Fail-safe Low (–/minus): Span is set at 2 times switch point value; Zero is set at 1/2 switch point value.
   - Fail-safe High (+/plus): Span is set at 1.5 times switch point value; Zero is set at 1/10 switch point value.
4. After exiting the switch point capture mode, the LED representing the captured switch point blinks rapidly for 5 seconds.
   - It is during this **5-second window** that adjustments to the switch point setting can be made if needed.

   Press the (+) or (–) button to increment or decrement the switch point setting in 5% intervals of the newly established span (observe that the blinking LED moves in response to button presses). After 5 seconds of button inactivity, the unit flashes the end LEDs 5 times in alternate fashion to indicate that the setting was accepted. The unit then returns to regular operation as the switch point LED blinks normally (and in its new switch point location if moved).

***Note***: Switch point LED blink rate, normal operation: Slow = Not In Alarm; Fast = In Alarm (trip point exceeded).

**Mode B: Capture Zero and Full Scale + Set Default Switch Point**

1. After pressing the (+) or (–) button for 10+ seconds, the 3 outside LEDs sequentially flash in opposite directions. Release the button at this point to enter Mode B. The FS10 is now cued to remember the lowest and highest flow signal it sees while in this mode.
2. Adjust high flow to represent span setting and low flow (or no flow) to represent the zero as described below:

   **For Gas**: It is recommended that the flow be at the desired full-scale value **before** entering this mode. After entering the mode, slowly reduce the flow until the zero flow is reached. Setting the low flow to around 10% yields more linear results over the entire range as this zero offset removes a steep portion of the curve.

   **For Liquid**: It is recommended that the line be full with no flow **before** entering this mode. After entering the mode, slowly throttle the valve to full-scale.
3. After giving the instrument zero and full-scale flow, momentarily press the (+) button or (–) button to choose an alarm fail-safe and exit the Mode B range capture mode:

   ***Note***: Unit remains in learning mode indefinitely until either the (+) or (–) button is momentarily pressed.

   - Fail-safe Low (–/minus): Default switch point is set to 30% of span.
   - Fail-safe High (+/plus): Default switch point is set to 70% of span.
4. After exiting the range capture mode, the LED representing the default switch point blinks rapidly for 5 seconds.
   - It is during this **5-second window** that adjustments to the switch point setting can be made if needed.

   Press the the (+) or (–) buttons increment or decrement the switch point setting in 5% intervals of the newly established span (observe that the blinking LED moves in response to button presses). After 5 seconds of button inactivity, the unit flashes the end LEDs 5 times in alternate fashion to indicate that the setting was accepted. The unit then returns to regular operation as the switch point LED blinks normally (and in its new switch point location if moved).

   ***Note***: Switch point LED blink rate, normal operation: Slow = Not In Alarm; Fast = In Alarm (trip point exceeded).

A minimum span setting of 2% in gas (–) button or 0.05% in liquid (+) button is required to save new parameters. If minimum span is not reached, the first two, middle two and last two LEDs flash for 3 seconds to indicate an error. The unit then resumes the last operation with no change in parameters.

Definition of fail-safe parameters upon exiting:

**(–) Minus Button Exit = Low Flow Alarm = Fail-Safe Low**

Relay polarity = 1 (Relay energized above the switch point)

Hysteresis position = 1 (Reset above the switch point)

NAMUR fault = 1 (Fault low; Analog Output drives to <3.6mA), relay drives to fail-safe position

**(+) Plus Button Exit = High Flow Alarm = Fail-Safe High**

Relay polarity = 0 (Relay energized below the switch point)

Hysteresis position = 0 (Reset below the switch point)

NAMUR fault = 2 (Fault high; Analog Output drives to >21mA), relay drives to fail-safe position

These default parameters can be changed through the PC interface program or factory setup by completing the Application Data Sheet (ADS) at time of order.

**Quick Setup Mode Recommendations**

*Mode A: Switch Point Capture With Default Zero & Full Scale*

If only a zero flow can be simulated, set flow to zero flow (if liquid, make sure line is full). Then enter into Mode A to capture switch point at no flow. Immediately after exiting, momentarily press the (+) button to increment the switch point in 5% steps to set the actual trip above the actual no flow reading.

If throttling the flow is not possible and the switch can only be set under normal flow conditions, set the switch point at this normal flow, then just after exiting, momentarily press the (–) button a number of times decrementing to an alarm point well below the normal flow. Each press of the (–) button lowers the switch point approximately 5%. After 5 seconds the FS10 returns to normal operating mode with new settings in place.

*Mode B: Range Capture With Default Switch Point*

**Gas Applications** – The high flow limit or span setting is normally the most difficult to stabilize in a gas application. Therefore, simulating the desired high flow rate at normal process conditions and allowing it to stabilize before entering into the QSM is recommended. Using in-line valves or other means of throttling establish the desired full scale flow rate and allow the system to stabilize. Now enter into QSM 2 (capture/exit)—the FS10 immediately captures this high flow signal. Then slowly throttle the flow down until the zero flow setting is reached (i.e. valve closed, no flow). Allow to stabilize, then momentarily press appropriate fail-safe button to save parameters and return to normal operating mode with the new scaled operating range established.

***Note***: If using the 4-20 mA output, create a zero offset to significantly improve the linearization of that output; i.e., instead of scaling between 0 and 10 SCFH (0 to 5000 cc/min), establish the zero and span from 1 to 10 SCFH (500 to 5000 cc/min). This method yields a more accurate representation of the switch point, set at 30% (or 70%) of the span by default.

**Liquid Applications** – To optimize the performance of the FS10 in liquids, it is critical to establish a stable zero setting under a packed line condition. It is recommended that the FS10 be operating and allowed to come to equilibrium with a downstream valve closed and the line completely filled with the process fluid and no flow. At this point, enter into QSM 2 (capture/exit)—the FS10 immediately captures this low flow signal. Then slowly open the downstream valve to allow flow up to the maximum span desired. Momentarily press the appropriate fail-safe button to save parameters and return to normal operating mode with the newly scaled operating range established.

In some cases the high liquid flow signal will saturate before reaching the high flow that is simulated. The FS10 will save the highest value it is capable of sensing in that application and use it as the high end limit.

**Switch Point** – By factory default, the switch point is set to 30% (fail-safe low) or 70% (fail-safe high) of the established span when exiting the Quick Setup Mode. This may be adjusted in 5% increments in the field within 5 seconds of exiting per above instructions. Alternatively, the QSM factory switch point default of 30% (or 70%) of span can be changed using the PC interface program before entering into the QSM. Selecting the factory setup option at time of order by completing the Application Data Sheet (ADS) also sets up a custom default value at the factory. Note that this value is always a percentage of the established span and alters any previous switch point that may have been attained on a previous setup.

The 4-20 mA output and relay trip continues to operate at the previously set range while in the Quick Setup Mode.

## Output and Display Parameters

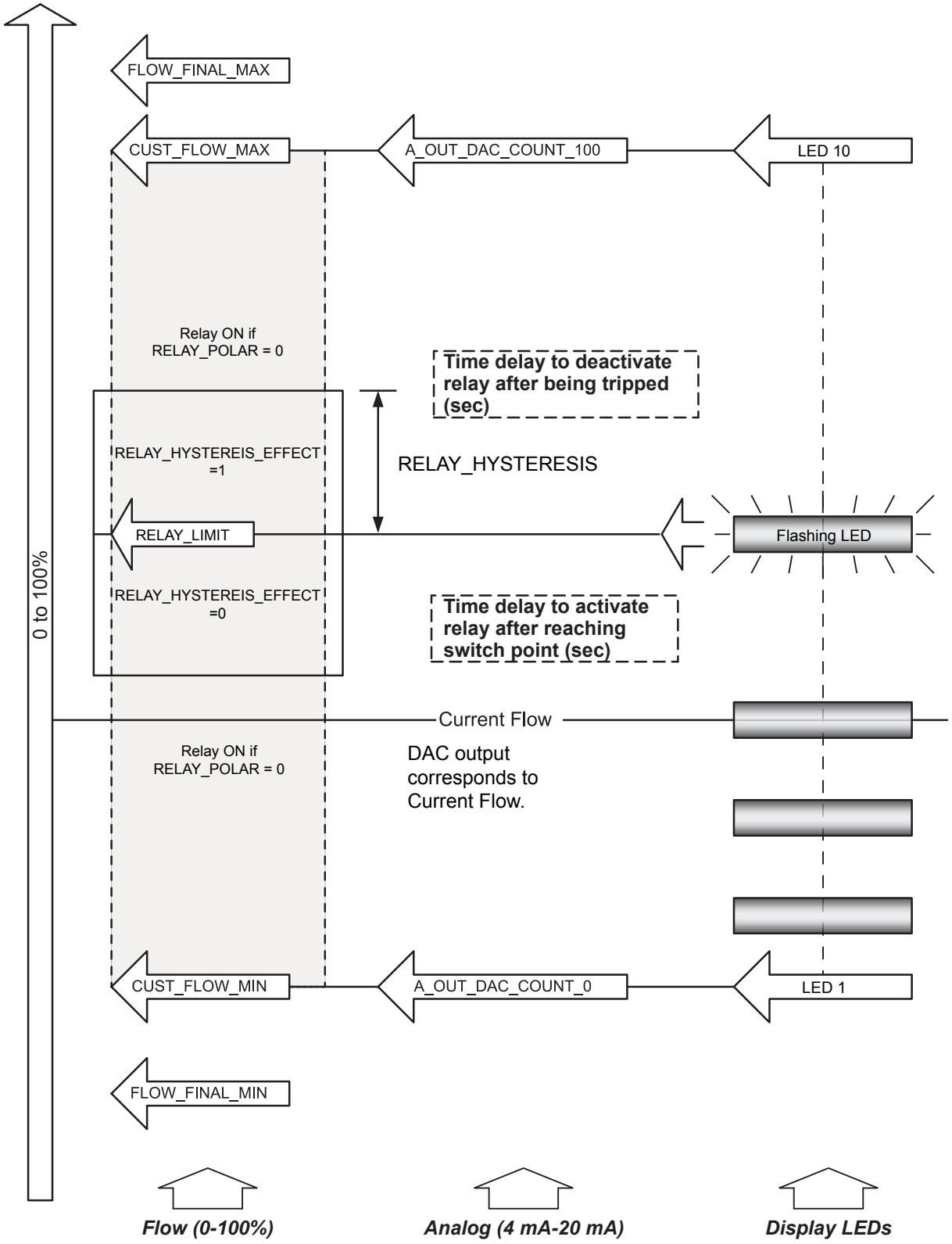



**Figure 23 – Flow Percentages vs. Output Indications**

## FS10 Button Controls, Alternate Setup Method

A variety of FS10 control functions can be accessed using the (–) and (+) buttons. This section describes how to configure and use the instrument using the button interface. It is recommended the unit be powered-up for 10-15 minutes before making changes to any of the flow settings. The following paragraphs explain the button control sequence.

1. **Enter the Function Selection Mode** – Press and hold both (–) and (+) buttons for 3 seconds and release. Observe that all LEDs momentarily light up, followed by LED #1 (leftmost) blinking slowly by itself (Function #1 automatically selected).
2. **Select the Function** – Press the (–) or (+) button for two seconds to decrement/increment, respectively, the current selection. Observe that all LEDs momentarily light up, followed by one more LED blinking slowly (increment), or one less LED blinking slowly (decrement), with the other LEDs previously shown. For example, with LED #1 blinking slowly by itself (function #1 selected), incrementing the selection results in two LEDs, #1 and #2, blinking slowly, which indicates that the function #2 is selected.

   Refer to "Table 7 – Button Controls" on page 30 for the list of functions that are accessible with the button controls.
3. **Adjust the Function** – Press either the (–) or (+) button for three seconds. Observe that the LEDs flash at a faster rate. The LED pattern reflects either the current value of the parameter being adjusted, or the *ready to capture* pattern for parameters to be captured (see specific function descriptions in "Table 7 – Button Controls" on page 30 for details). The buttons, therefore, will either increment or decrement the function parameter, or capture a value for the corresponding parameter.
4. **Exit to Normal Operation** – Exiting to normal operating mode is a 2-step operation, (a) exit **Function Adjust**, and (b) exit **Function Selection**. To exit **Function Adjust**, press and hold either (–) or (+) button for 3 seconds. The LEDs then indicate the **Function Selection** mode by flashing all LEDs once and then showing the next LED in the sequence (slow blink). Press and hold both (–) and (+) buttons for 3 seconds to return to normal operation.

**Table 5 – Button Operation Summary**

| Seq. | Action | Description |
|---|---|---|
| 1 | Enter the **Function Selection** mode. | Press and hold both (–) and (+) buttons for 3 seconds. |
| 2 | Select the desired function to adjust. | Press (+) or (–) for 2 seconds to increment/decrement the function (LED pattern indicates function number.) |
| 3 | Adjust the function control. | Press and hold either (–) or (+) button for 3 seconds. |
| 4 | Exit to normal operation. | (a) Press and hold either (–) or (+) button for 3 seconds. Unit now in **Function Selection** mode. |
| | | (b) Press and hold both (–) and (+) buttons simultaneously for 3 seconds. Unit now back in normal operation. |

**Table 6 – Bank Default Values**

| Bank No. | Bank Properties | Range Setting |
|---|---|---|
| 0 | FS10 Current Active Parameters. | — |
| 1 | Universal Default Setting A – Low flow sensitivity (Low Power mode). | Uncalibrated output – low sensor excitation power setting. Full range gas or liquid. |
| 2 | Reserved for customer saved setting (user defined and stored). | Low sensor excitation power setting |
| 3 | Universal Setting B – High flow gas, liquids (High Power mode). | Uncalibrated output – 1.5X sensor excitation power setting. Full range gas or liquid. |
| 4 | Reserved for customer saved settings (user defined and stored). | High sensor excitation power setting. |
| 5 | Reserved for custom factory calibration. | — |
| 6 | Reserved for custom factory calibration. | — |

**Table 7 – Button Controls**

| Function # | Function Name | LED Pattern<br>0 = LED OFF<br>1 = LED ON | Parameter | LED Pattern for Parameter | Description |
|---|---|---|---|---|---|
| 1 | Switch Point Adjust | 1000000000<br>- + | RELAY_LIMIT | 1 – indicates current value relative to full scale | Button controls adjust relay switch point in 10% increments. |
| 2 | Switch Point Capture | 1100000000<br>- + | RELAY_LIMIT | 1 – indicates current value relative to full scale | When entering this function the ready-to-capture LED pattern is presented (0101010101). Pressing either button precisely captures the current flow value as the new relay switch point. |
| 3 | Fail-safe | 1110000000<br>- + | RELAY_POLAR | 0000011111 = ON above (default)<br><br>1111100000 = ON below | Selects whether the relay is ON (energized) if the flow value is above the relay switch point, or if the relay is ON (energized) when the flow value is below the relay switch point. Pressing the buttons toggles between the two options (default = ON above switch point – typical for low flow alarm). |
| 6 | Minimum Flow Capture | 1111110000<br>- + | CUST_FLOW_MIN | 1 – indicates current value relative to full scale | When entering this function the ready-to-capture LED pattern is presented (0101010101). Pressing either button captures the current flow value as the new display *zero* point. |
| 7 | Maximum Flow Capture | 1111111000<br>- + | CUST_FLOW_MAX | 1 – indicates current value relative to full scale | When entering this function the ready-to-capture LED pattern is presented (0101010101). Pressing either button captures the current flow value as the new display *maximum flow* point. *Note:* This mode is only valid if the DISPLAY_ RANGE_MODE (5) is "static." |
| 8 | Hysteresis Applied Above or Below Switch Point | 1111111100<br>- + | RELAY_HYSTERESIS_ EFFECT | 0000011111 = apply above<br>1111100000= apply below | Selects whether the hysteresis is to be applied above (default) or below the relay switch point. Pressing the buttons toggles between the two options. |
| 9 | Maximum Hysteresis Value | 1111111110<br>- + | RELAY_HYSTERESIS | 1 – indicates current value relative to maximum 10% hysteresis (MAX_ HYSTERESIS) | Buttons adjust the value of the dead band effect. Increments in 1 percent of switch point value. Default setting is 2% of span. Button range 0-10%. Wider range available through RS232 interface. |
| 10 | Time Delay to Activate Relay or Binary Pulse | 1111111111<br>- + | RELAY_TURN_ON_DELAY | 1 – indicates current value relative to maximum delay (MAX_DELAY) | Time delay from when flow measurement is greater/less than relay switch point, to turn on relay. Increments and decrements in 1 second steps [max. default setting 10 seconds when using buttons].* |
| 11 | Time Delay to Deactivate Relay or Binary Pulse | 1000000001<br>- + | RELAY_TURN_OFF_DELAY | 1 – indicates current value relative to maximum delay (MAX_DELAY) | Time delay from when flow measurement is greater/less than relay switch point, to turn off relay. Increments and decrements in 1 second steps [max. default setting 10 seconds when using buttons].* |

**Table 7 – Button Controls (continued)**

| Function # | Function Name | LED Pattern<br>0 = LED OFF<br>1 = LED ON | Parameter | LED Pattern for Parameter | Description |
|---|---|---|---|---|---|
| 12 | Alarm Simulation | 1100000001<br>- + | | 0000011111= output "max"<br>1111100000= output "min" | Alarm simulation mode. Pressing (+) button forces maximum (corresponds to A_OUT_DAC_COUNT_100) 4-20 mA output. Pressing (–) button forces minimum (corresponds to A_OUT_DAC_COUNT_0) 4-20 mA output.<br>Relay output follows the RELAY_POLAR setting. |
| 14 | Filter Setting | 1111000001<br>- + | INPUT_FILTER_COUNT | LED 1 on = setting 3<br>LEDs 1-3 on = 18<br>LEDs 1-5 on = 30<br>LEDs 1-7 on = 50<br>LEDs 1-10 on = 100 | Input filtering count: Default = 18.<br>(–) decreases filter, min. = 3.<br>(+) increases filter, max. = 100.<br>Filter value 18 reduces response time <2 sec |

* Maximum time delay is up to 65,000 seconds when using RS232 command line or PC interface.

## Normal Set-Up and Operation Using the Button Interface

Refer to "Table 7 – Button Controls" on page 30 for details on the functions listed in the descriptions below.

### Flow Switch Scaling

Units supplied without factory switch point setting should be scaled in situ before setting the switch point. Default Universal Setting A from Bank 1 is recommended for most low flow sampling gas or liquid service. Universal Setting B from Bank 3 is recommended for gas or liquid service applications where higher flow rate detection is required.

Scaling is performed in the following order:

**Minimum Flow Setting (Function 6)** – Select Function 6 to capture the minimum flow rate. In liquids, optimum performance is achieved by setting the Minimum Flow using a full line with no flow. If possible, with liquids, slightly pressurize the pipe and block the flow using valves to assure a full and static condition. Capturing the no-flow value in Function 6 sets the zero point.

**Maximum Flow Setting (Function 7)** – Run the process at maximum flow and use this function to capture the maximum flow in gas or liquid. Since liquids transfer heat very efficiently, depending on the sensor assembly and fluid, maximum signal level will likely be achieved at flow rates under 2 feet per second, though the actual flow in the tube may be higher. Capturing the maximum flow effectively establishes the span in the installation.

***Note***: Be sure to pause at least 30 seconds before capturing zero and span to ensure a stable signal.

### Switch Point Adjust (Function 1 or 2)

There are two ways to set the switch point using the buttons.

**Function 1** uses the LEDs as indicators to set the switch point in 10% increments within the established span.

**Function 2** is used to more precisely set the switch point by "capturing" the process flow rate representing the alarm condition. In liquids, make certain the desired switch point is within the set operating range. That is, when capturing at the switch point, the LEDs should be showing no greater than 90% flow. Note: The switch point setting is saved in feet/sec; therefore, changing the span later may alter the relative position of the flashing LED indicating the switch point value.

Low flow alarm applications with relay energized above the switch point (default setting): In an alarm condition, the switch point LED flashes quickly when the flow drops below the switch point. In a non-alarm condition, the LED flashes at a slower rate when the flow is at or above the switch point.

**Fail-safe Position (Function 3)**

This function establishes the state of the relay during normal operation and alarm condition. It is common to set the fail-safe so that the relay is "energized" or activated under normal operating conditions. An alarm condition (switch point activated) results in the de-energized state. That assures an alarm state if power is lost to the device as well.

If the relay is bypassed in favor of a solid-state binary output, set up the system so that a no-power condition results in an alarm state. Under normal operating conditions, the transistor should be ON, resulting in an approximate 5 VDC signal to ground. Power loss or an alarm condition results in 0 VDC to ground.

**Hysteresis (Function 8 and 9)**

In the case of the flow switch, hysteresis is defined as the difference in signal level between turning on the relay and turning it off. If the hysteresis is set to zero, that point is the same and can result in chattering, rapidly turning the relay on and off, in slow moving processes. A hysteresis level is applied to minimize the possibility of chattering around the switch point. It is set as a percent of the established span.

The hysteresis is applied either above the switch point or below the switch point. For example, if hysteresis is set above the switch point in an application requiring low flow detection, the relay changes state as the signal falls below the switch point. The relay, however, will not reset until it reaches the switch point value plus the added hysteresis value. The default setting is hysteresis above the switch point and set at 2% of the span value. If changes are required to the default, see how the hysteresis is applied in Function 8 and set the value in Function 9. Any value hysteresis may be applied through the Windows PC interface (recommended) or the RS232 command line interface. The button functions are limited to settings between 0% and 10% in 1% increments.

**Time Delay (Function 10 or 11)**

A time delay can be applied to the switch point in one of two ways, (a) The time delay is applied to activate (Function 10) the relay after the switch point has been reached, or (b) The time delay is applied to de-activate (Function 11) the relay after the switch point has been reached. The time starts as the switch point is reached and counts down as long as the switch point value is retained. The relay then changes state. If the switch point was reached, but not maintained during this period, the time delay resets and the relay does not change state. The default value is zero seconds and can be increased in 1-second increments up to 10 seconds with the buttons (time delays considerably higher are achievable through the RS232 interface (>65,000 sec. with PC interface).

Function 10 operation (relay change of state is delayed this amount [sec.] after signal reaches switch point) is normally used in applications where false trips may occur due to turbulent or cyclic flow action or in wet dry applications where splashing during vessel filling, for example, may cause premature actuation. Proper setting of the time delay in this mode can be very effective in preventing problematic nuisance trips.

Function 11 operation (relay change of state is delayed this amount [sec] after signal leaves switch point) may also be used in cyclic flow conditions. Another possible use may be to fill a vessel after a low level is reached. For example, the level reaches the low level switch point; the relay immediately changes state and is set to actuate a solenoid valve that begins the filling action. A time delay may be set that corresponds to the time needed to fill the vessel.

***Note***: The time delay function is dependent on the Failsafe Position (Function 3). Therefore, select the proper mode of delay based on relay being activated in normal operation and de-activated in the alarm condition. These selections are likely to be different when alarm settings are for low flow (or dry) verses high flow (or wet) applications.

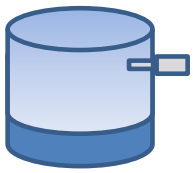
**Alarm Simulation (Function 12)**

This function is used to force the output to the highest or lowest value, resulting in a change of relay state as well. Alarm simulation may be useful in testing the system in which the FS10 is installed.

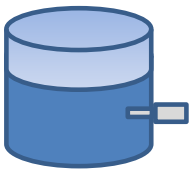
**Filter Setting (Function 14)**

A filter is applied to the raw input signal (delta R). It is used to smooth the output against fluctuating or turbulent flow conditions. The range of the filter setting is 3-100. The default setting is 18 and reduces the time response by < 2 seconds. A setting of 100 provides the maximum dampening of the signal and decreases the response time approximately 10 seconds. Settings from 3 to 100 can be applied using the Windows PC interface or the RS232 command line interface. The buttons permit changes of values 3, 18, 30, 50 and 100 only.

## FS10 Recommended Point Level Interface Setup Procedure



**Probe**
Normal = **Dry**
Alarm = **Wet**
(Relay + max. out. 20 mA ↑)



**Probe**
Normal = **Wet**
Alarm = **Dry**
(Relay + min. out. 4 mA ↓)

**Special Conditions**:
Splashing during filling, agitation and wave action due to mixing and other conditions can cause a momentary alarm condition that should not be interpreted as a true alarm. Tune out these transient actions by applying a time delay in seconds to activate or deactivate the relay using the PC interface program. It is also possible to apply up to 10 seconds using the button controls functions. Refer to "FS10 Button Controls, Alternate Setup Method" on page 29 for complete instructions. Deadband (hysteresis) around the relay trip point can also be changed using the PC interface program.

**Preferred Method: Level Can Be Adjusted During Setup**

| **Case 1 - Normal Dry, Alarm on Wet**<br>Probe Dry, Fail-Safe High (FSH) | **Case 2 – Normal Wet, Alarm on Dry**<br>Probe Wet, Fail-Safe Low (FSL) |
|---|---|
| a) Press and hold "–" >10 secs (Using Mode B, Span Setting). | a) Press and hold "–" >10 secs (Using Mode B, Span Setting). |
| Observe LED pattern: LEDs 1-3 sequence down; LEDs 8-10 sequence up. | |
| b) Adjust level from dry to wet. | b) Adjust level from wet to dry. |
| Allow 2-15 seconds to stabilize after the level transition (affects response time; the longer the wait, the longer the response time). | |
| c) Momentarily press "+" to exit FSH.<br>Within 5 secs repeatedly press "–" until 5th LED blinks (50%). | c) Momentarily press "–" to exit FSL.<br>Within 5 secs repeatedly press "+" until 5th LED blinks (50%). |
| Unit resumes normal operation after 5 seconds. | |

**Probe Normally Wet, Level Cannot Be Adjusted During Setup**

| **Case 3 - Normal Wet, Alarm on Dry**<br>Probe Wet, Fail-Safe Low (FSL) | **Case 3a – Normal Wet, Alarm on Dry (Setup while in Dry only)**<br>Probe Dry, Fail-Safe Low (FSL) [See ***Note*** below.] |
|---|---|
| a) Press and hold "–" 6-9 secs (Using Mode A, Sw. Pt. Capture). | a) Press and hold "–" 6-9 secs (Using Mode A, Sw. Pt. Capture). |
| Observe LED pattern: Every other LED blinks. Allow to stabilize 2-15 secs. | |
| b) Momentarily press "–" to exit FSL.<br>Within 5 secs of exiting press "–" four times (-20%). | b) Momentarily press "–" to exit FSL.<br>Within 5 secs of exiting press "+" six times (+30%). |
| Unit resumes normal operation after 5 seconds. | |

**Probe Normally Dry, Level Cannot Be Adjusted During Setup**

| **Case 4 - Normal Dry, Alarm on Wet**<br>Probe Dry, Fail-Safe High (FSH) | **Case 4a – Normal Dry, Alarm on Wet (Setup while in Wet only)**<br>Probe Wet, Fail-Safe High (FSH) |
|---|---|
| a) Press and hold "–" 6-9 secs (Using Mode A, Sw. Pt. Capture). | a) Press and hold "–" 6-9 secs (Using Mode A, Sw. Pt. Capture). |
| Observe LED pattern: Every other LED blinks. Allow to stabilize 2-15 secs. | |
| b) Momentarily press "+" to exit FSH.<br>Within 5 secs of exiting press "+" four times (+20%). | b) Momentarily press "+" to exit FSH.<br>Within 5 secs of exiting press "–" four times (-20%). |
| Unit resumes normal operation after 5 seconds. | |

***Note***: Although the response from dry to wet is near instantaneous, this setup may result in very slow reset (many minutes in some cases) when unit transitions back from wet to dry. These reset and response delays can be improved significantly by changing the **Flow min factor** and **Flow max factor** defaults. Change the defaults as necessary using the PC interface program (Quick Setup Mode window).

Case 3a: Under Button "-" change "Flow min factor" from 0.5 to 0.99, "Flow max factor" from 2 to 10.0.
Case 4: Under Button "+" change "Flow min factor" from 0.10 to 0.99, "Flow max factor" from 1.5 to 10.0.

Move trip point up to 70-80% during setup after making these changes. (These changes will render setup as described in Case 3 and Case 4a unachievable. Reinstalling default values returns unit to normal operation.)

## PC Interface and Command Line Interface Configurations

### FS10 Communication Options

In addition to the button interface, the FS10 may be addressed directly through the RS232 interface. This type of communication offers convenient access to all user available parameters. There are two methods for interfacing through the RS232 connections:

1. A **Windows PC Interface** program is available that allows reading and writing to all user available functions and parameters.
2. A **Command Line Interface** through a terminal program will access all functions and parameters. See "FS10 Serial Interface (Command Line, Alternate Communication Interface)" on page 43 for details.

In both cases the parameters are accessed directly through the RS232 terminals. Depending on the hardware configuration selected, the RS232 signals are available through any of the following:

- M12 pins – for units supplied with M12 power and output (I/O) connector
- 8-wire cable units – for units supplied with cable pigtail, terminate to 3 wires
- 2.5 mm TRS jack connector – available on remote mount units only

***Note***: RS232 RxD, RS232 TxD **and** SIGNAL RETURN (3-connections) must be used to for effective communication.

An RS232 to 9-pin serial (DB9) to USB interface cable is available from FCI to connect directly to a PC or PLC. An RS232 interface from either of the 3 configurations above is available. See "PC Interface Kits" on page 60 for details.

***Note***: The USB interface cable is supplied with a device driver disk. Depending on the computer operating system, installation may be necessary for communication. Entry of the USB port # will be requested. It is normally the highest value listed.

### Flow Rate Indication on PC Interface

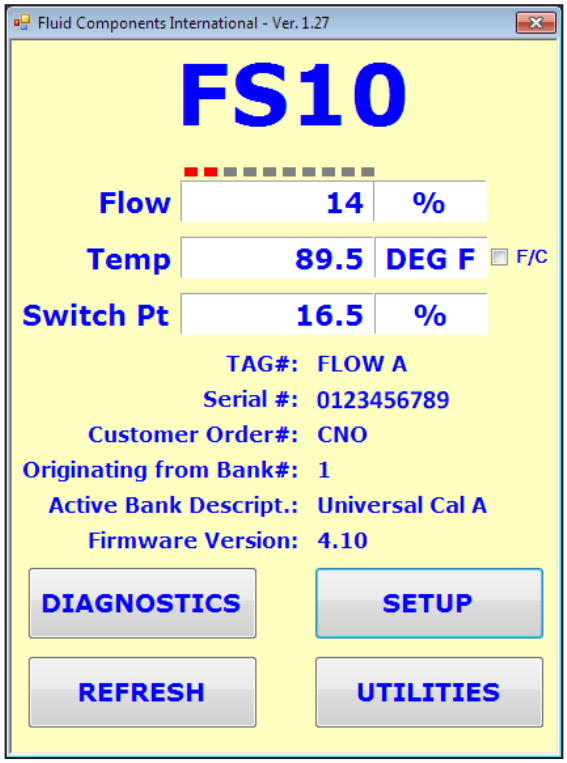
The PC interface provides a convenient means of capturing zero, span and switch point settings in lieu of using the buttons. Flow units are shown in percent, trend with flow and are repeatable.

### Power Supply Interface Kit

FCI offers an interface kit, part number 022083-02, that makes it easy to connect to a notebook computer in the field. See "Figure 28 – FS10 Power Supply/Interface Box and Kit" on page 61 for details. The power supply interface can be used to simply power up the unit using an AC connection or provide monitoring of the relay function and/or 4-20 mA output.

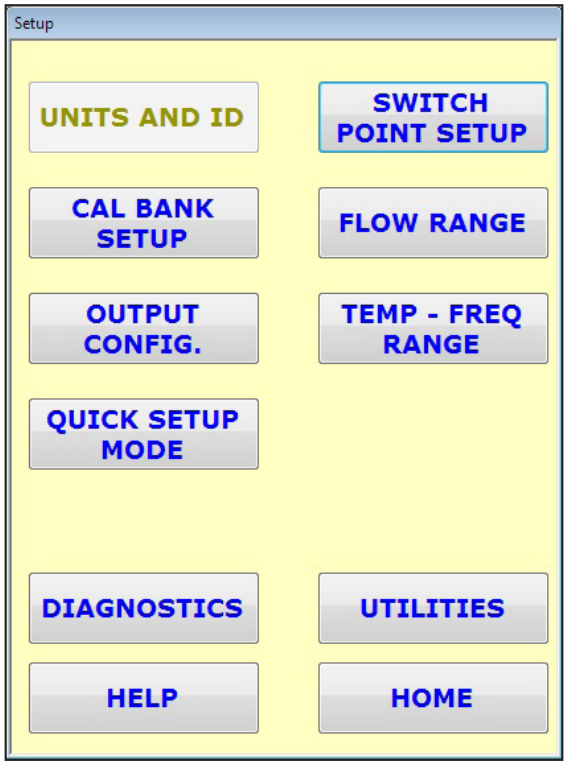
## Windows PC Interface Software

Below are typical screen shots of the FS10 Windows-based PC interface application. A brief description is given for each window (screen).



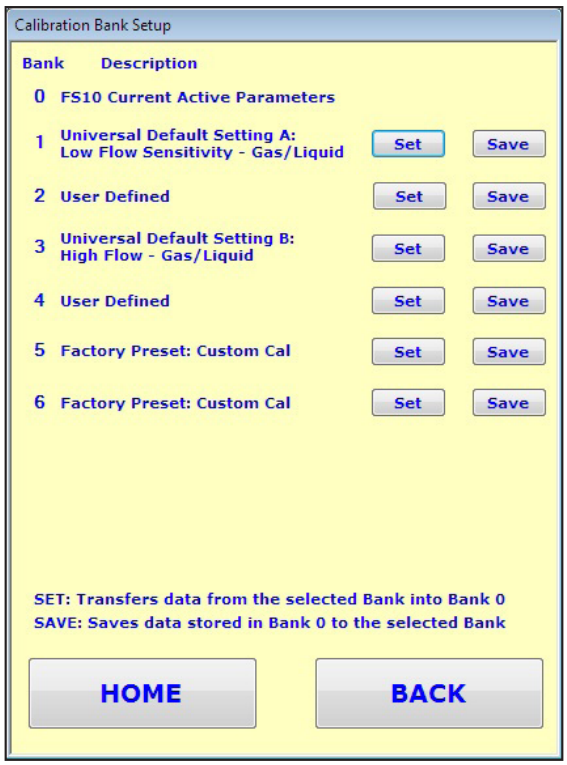

**Display Window**

The FS10 PC interface Home screen. The Home screen shows the flow, temperature, and setpoint values. Basic device info is also shown. The Home screen is the hub from which other features are accessed.



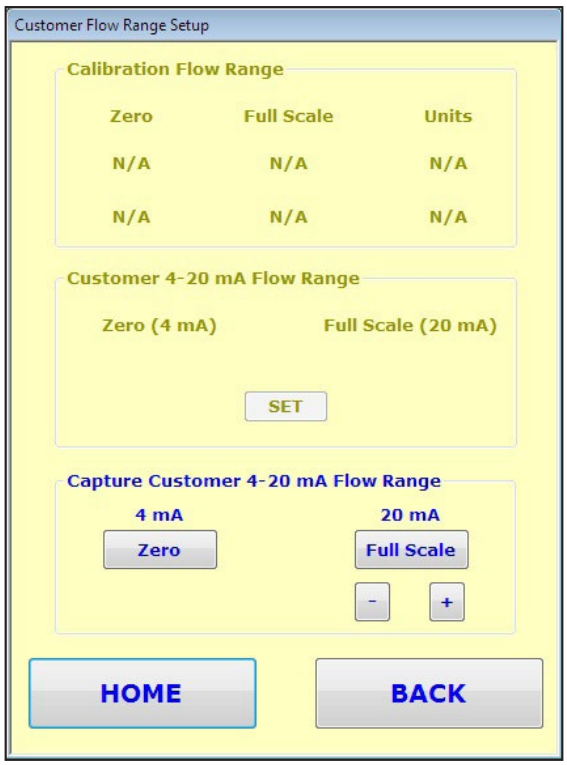

**Setup Window**

Use the Setup window to access various setup options.



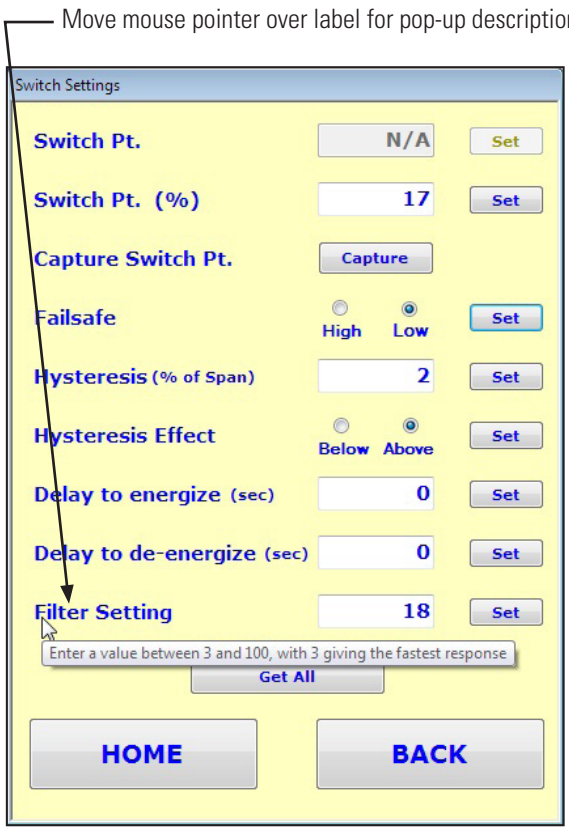

**Setup/Calibration Bank Setup Window**

Saves/retrieves instrument calibrations to and from banks.



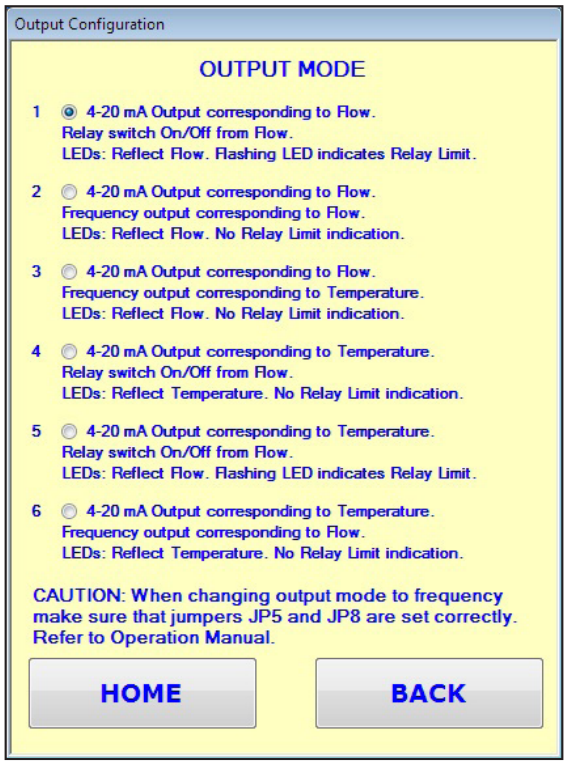

**Setup/Customer Flow Range Setup Window**

Use this window to capture customer's zero and full scale flow.



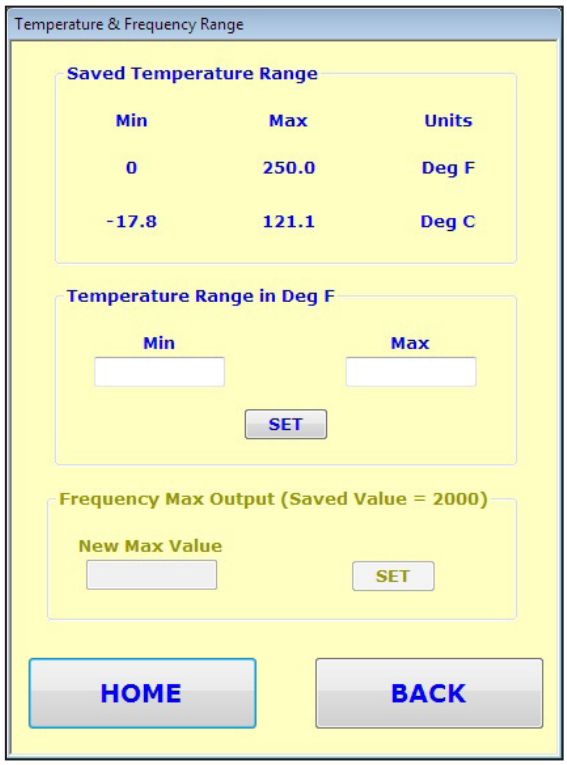

**Setup/Switch Point Setup Window**

Sets switch point with Capture button or by entering % of span. Additional switch point parameters can also be defined on this screen.



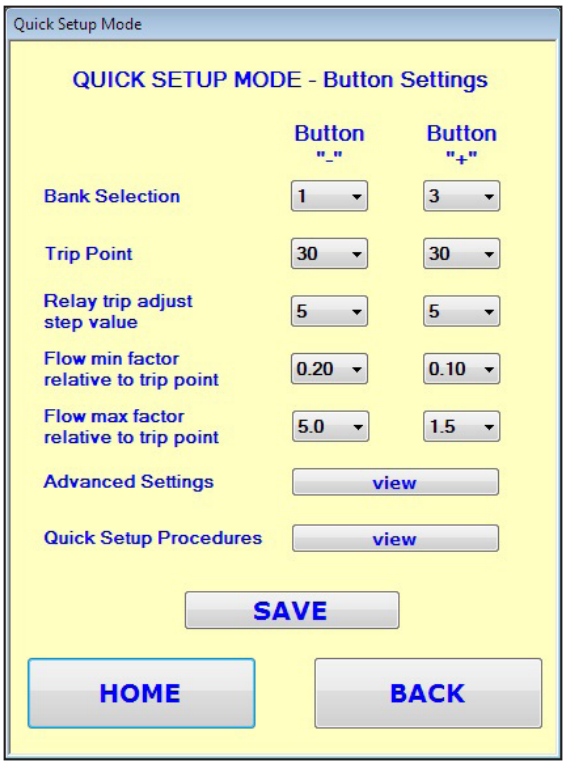

**Setup/Output Configuration Window**

Selects 4-20 mA and LED mapping (flow or temperature).



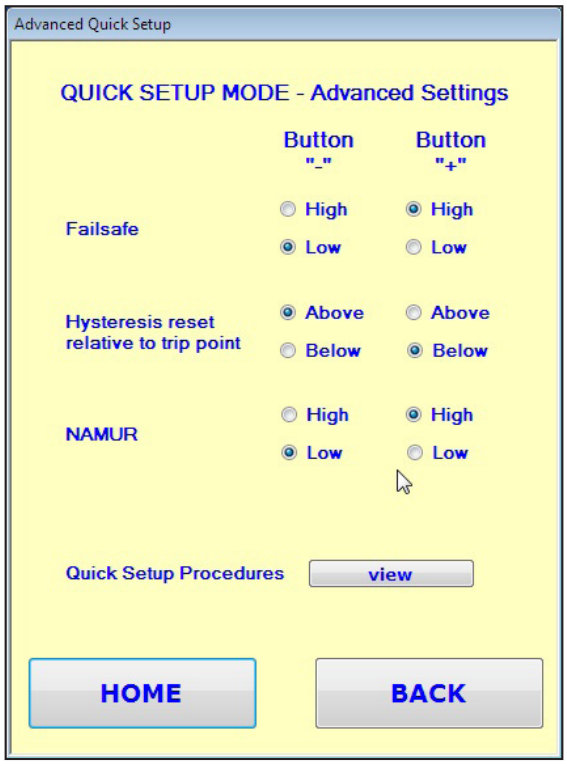

**Setup/Temperature & Frequency Range Window**

Sets temperature output range if using 4-20 mA out as temperature indication, and max. frequency output.



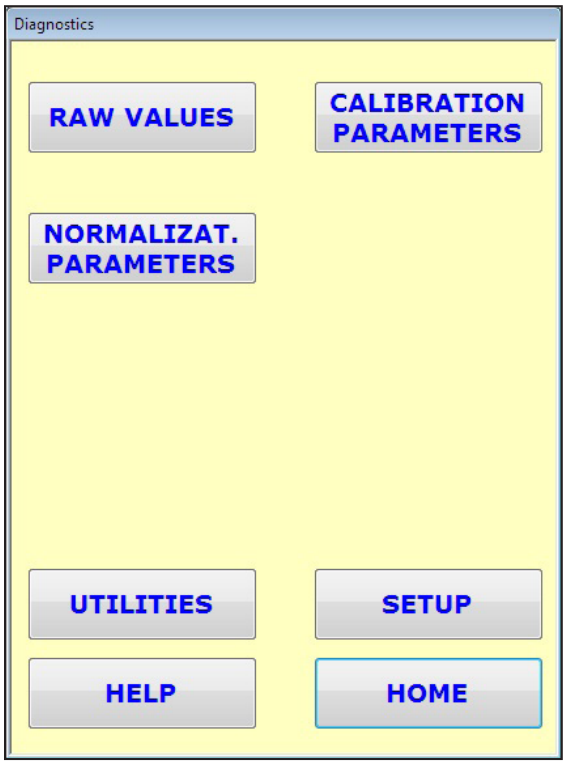

**Setup/Quick Setup Mode Window**

Sets (+) & (–) button parameters for quick setup, including button assignments for advanced settings.



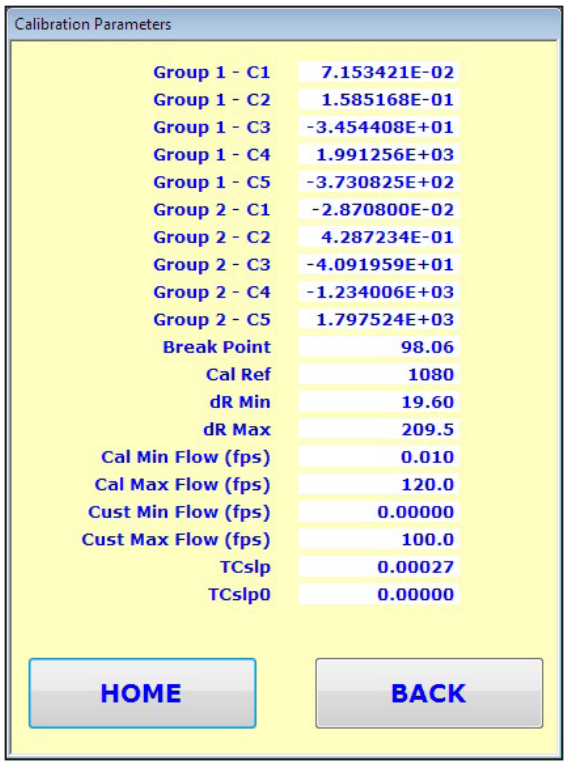

**Setup/Advanced Quick Setup Window**

Sets (+) and (–) buttons for fail-safe, hysteresis and NAMUR modes.



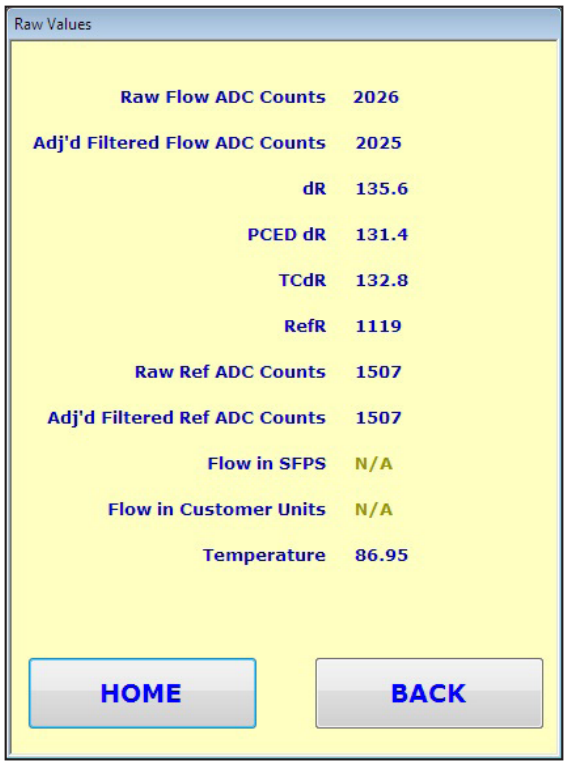

**Diagnostics Window**

Use the Diagnostics window to access various diagnostic options.



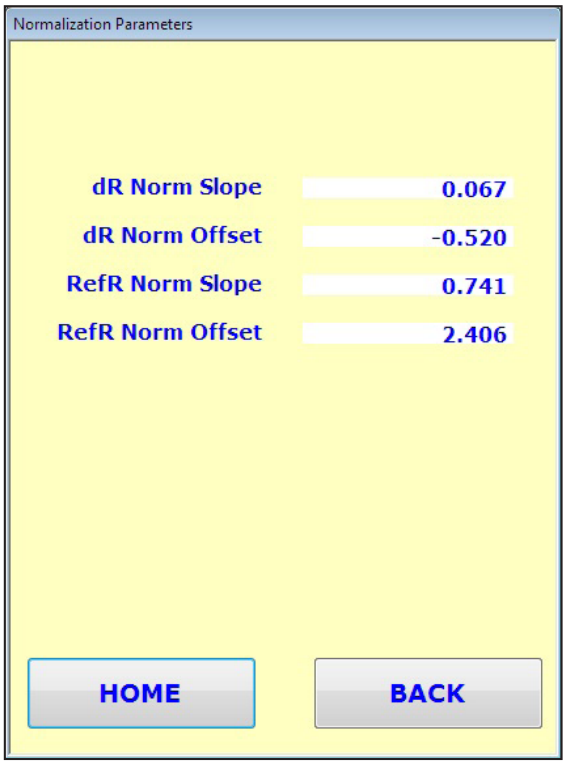

**Diagnostics/Calibration Parameters Window**

Access this window to display the instrument's calibration values.



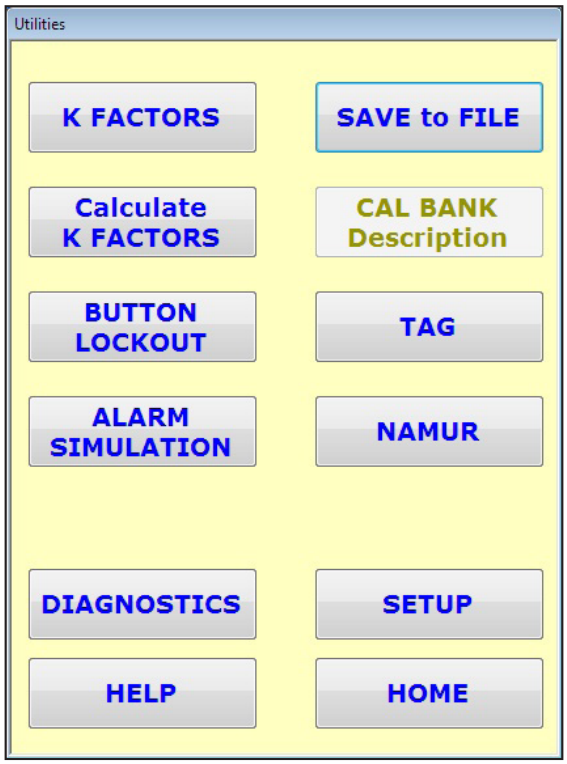

**Diagnostics/Raw Values Window**

Access this window to display the instrument's raw measurement data.



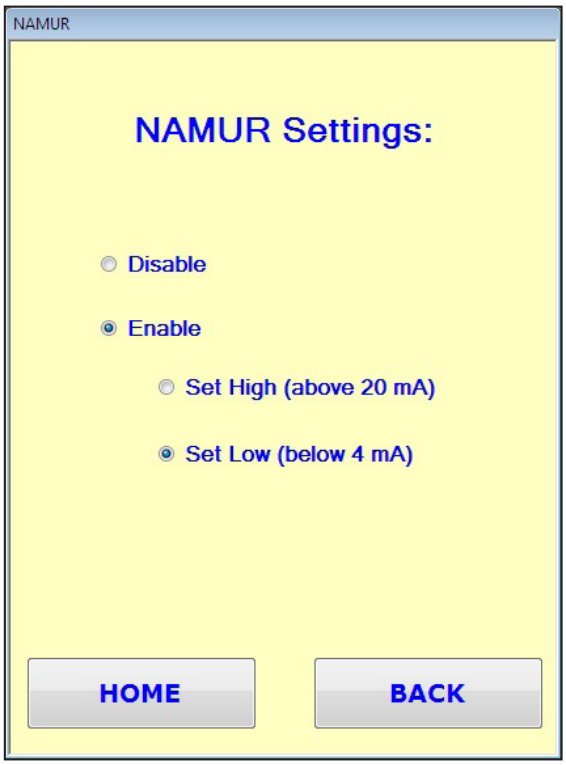

**Diagnostics/Normalization Parameters Window**

Access this window to display the instrument's normalization parameters.



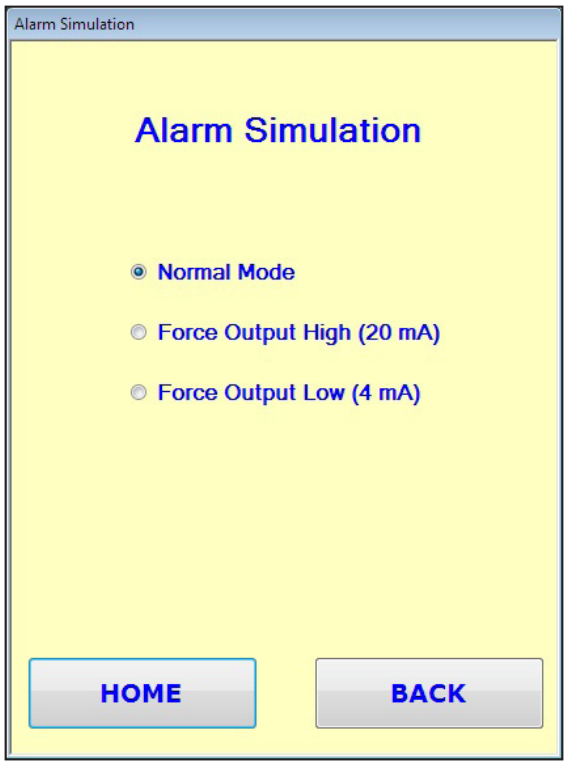

**Utilities Window**

Use the Utilities window to access various utility options.



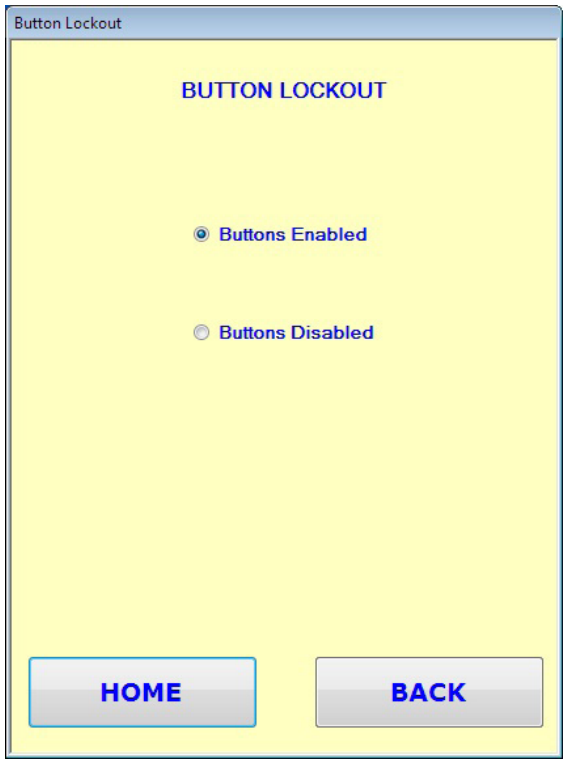

**Utilities/NAMUR Window**

Click the appropriate radio button to disable or enable NAMUR (set as *High* or *Low*).



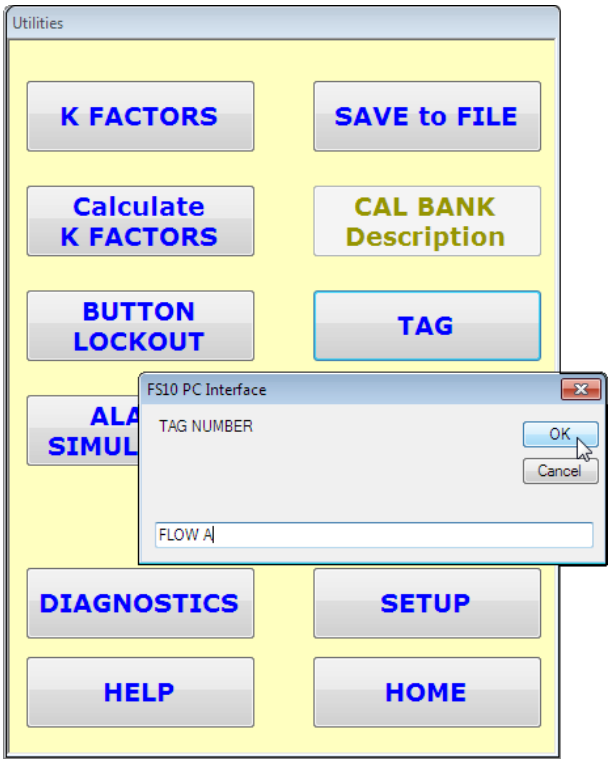

**Utilities/Alarm Simulation Window**

Click the appropriate radio button to force a high or low alarm condition for testing.



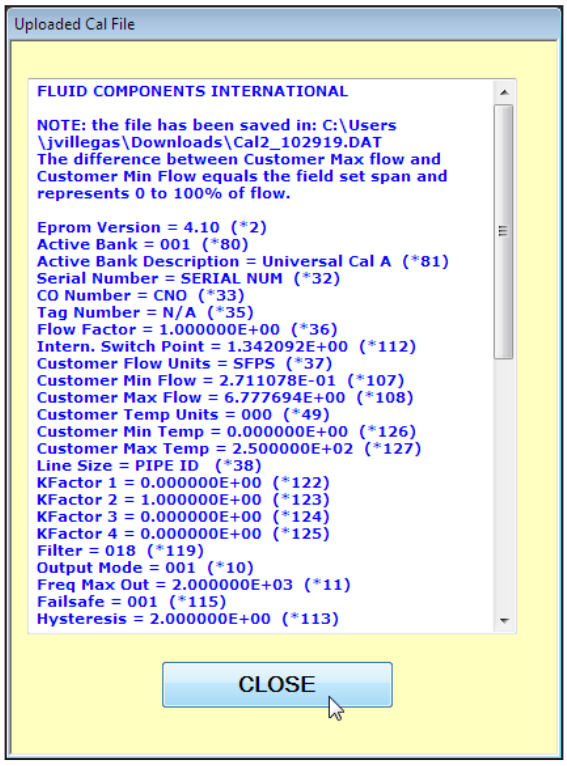

**Utilities/Button Lockout Window**

Click the appropriate radio button to enable or disable the front panel buttons.




**Utilities/Tag Dialog**

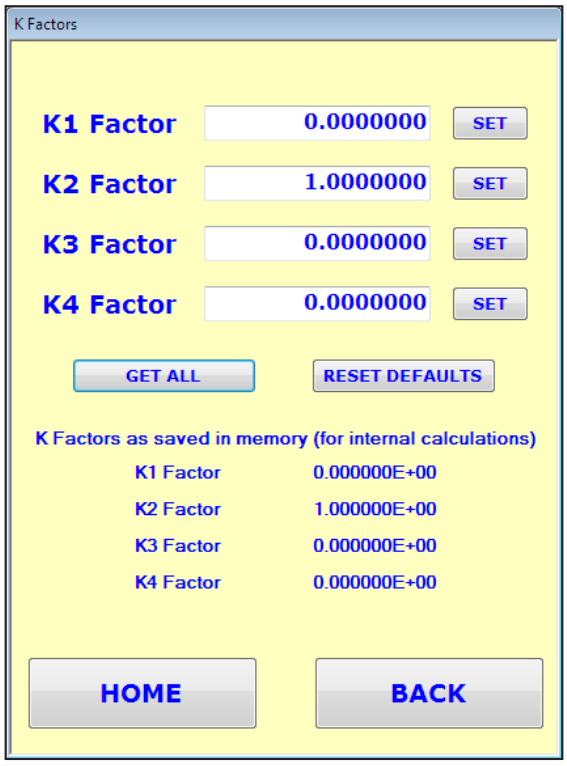
Click **TAG** to enter the tag or number that identifies the instrument on the FS10 PC Interface's HOME screen. Enter the desired tag in the *TAG NUMBER* dialog. Note that there is a 13-character limit and that any lower case letters entered in the dialog are shown as uppercase in the HOME screen's Tag field. Click **OK** when done and **Yes** to the confirmation (or **No** to start over again). Note that entering tag data (**OK** clicked) overwrites the existing tag, even when attempting to cancel by clicking **NO** in the confirmation dialog.




**Utilities/SAVE to FILE**

Click **SAVE to FILE** to save instrument parameters in a quote delimited .dat text file. In the *Save As* dialog, specify a filename and location for the file on your local drive.

After clicking **Save**, observe the progress bar showing uploading status. When the *UPLOAD COMPLETE* dialog shows, click **OK**. A preview of the .dat file is shown in a scrollable window, as shown in the example above. Click **CLOSE** to dismiss.




**Utilities/K Factors Window**

Displays instrument's flow rate K Factor values. The K Factors window allows direct entry of K Factor values by a trained technician.

Click **GET ALL** to display the instrument's stored K Factors on the lower half of the window.

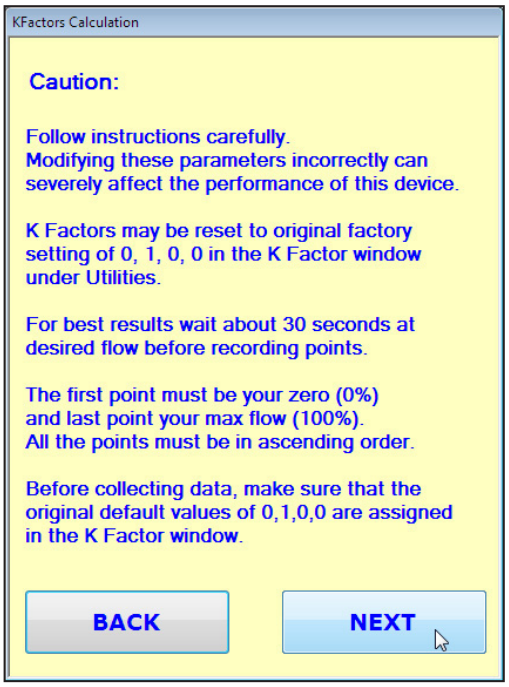
To change a K Factor, enter the desired value in the appropriate data field, then click **SET**. Click **GET ALL** to verify the instrument's new K Factor value(s).

To reset K Factors to the factory defaults, click **RESET DEFAULTS**. Click **GET ALL** to verify the reset K Factor values.

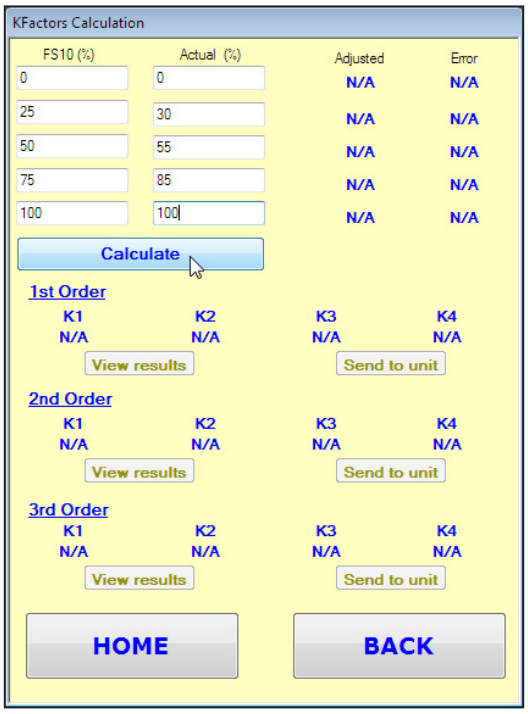
### Using the K Factors Calculation Window

The K Factors Calculation window provides the means to automatically linearize the FS10's output signal by entering a reference meter normalized readings corresponding to the same flow rate as the FS10. The interface software computes three sets (1st, 2nd and 3rd order) of K Factors (linearization coefficients). Choose the set that provides the smallest error and send it to the instrument. This provides the most ideal FS10 output signal linearization for optimum flow measurement accuracy.


1. After establishing a zero and span using the Customer Flow Range Setup window, click Calculate K FACTORS.




2. Heed the cautions in the next screen. Click **NEXT** when ready.



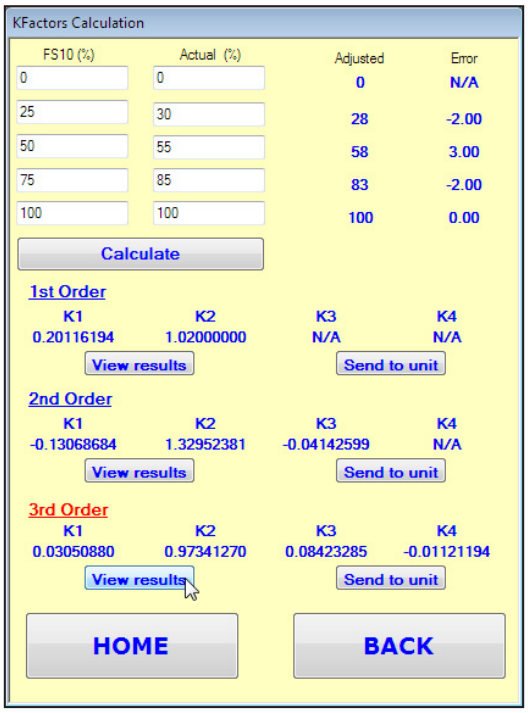

3. Enter normalized data in order. Enter 0 and 100% into 1st and 5th blocks respectively. Values are always in percent of flow.

- **FS10 (%)** data are recorded values from HOME window.
- **Actual (%)** data are entered values from reference meter at same flow rate.

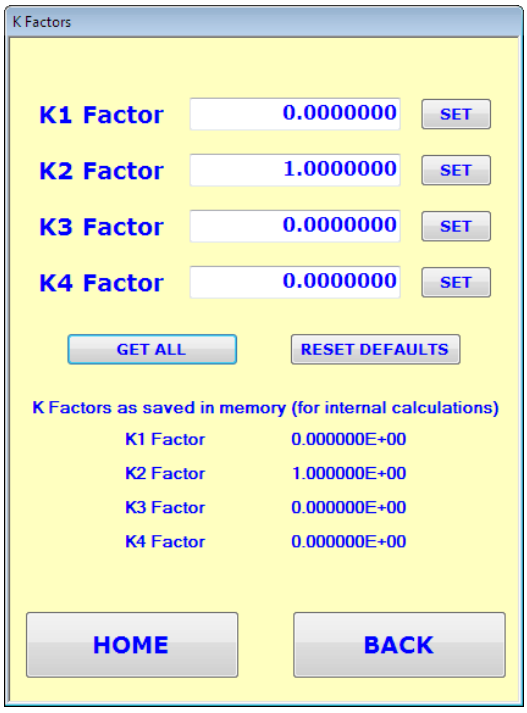
Click **Calculate** after all percentage data is entered.

***Note:*** The FS10 must have the default K Factors loaded before K Factor calculation can be carried out successfully. An error dialog will display (*K Factors are not set to their default values.*) when a calculation is attempted with existing calculated K Factors in place. After dismissing the error dialog (twice) the program asks, *Do you want to set the Kfactors to their default values now?* Click **Yes** to set the defaults. Alternatively, go to the K Factors screen (Utilities) and click **RESET DEFAULTS**.

***Tip:*** Creating a zero offset during initial setup (Customer Flow Range Setup window or through use of buttons) can significantly improve the linearization of the output range. For example, instead of scaling between 0 and 10 SCFH (0 to 5000 cc/min), set the zero at 1 or 1.5 SCFH (500 or 750 cc/min). This removes the steepest portion of the output curve, which improves linearization over the usable range.




4. Click **Calculate** to produce 1st, 2nd and 3rd order K Factor coefficients. Click **View results** for each to see the associated error in the window's Error column. Look for results that give the smallest error. Typically, the 3rd order results yield the smallest error. Click **Send to unit** to transfer the new linearization coefficients to the unit.




5. Go to the K Factors window (Utilities) and verify that the new coefficients are in place. See "Utilities/K Factors Window" on page 40 for details on how to use this window, including how to revert the K Factors to factory settings (if needed).

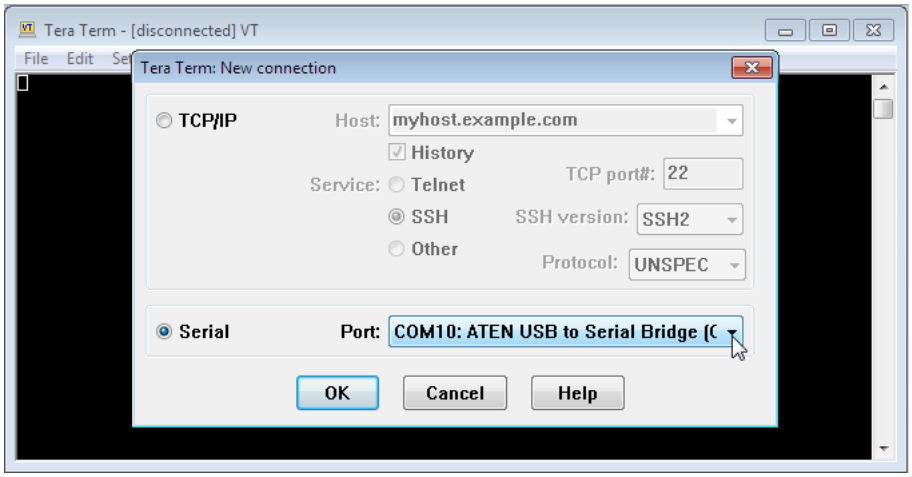
## FS10 Serial Interface (Command Line, Alternate Communication Interface)

A PC terminal program can be used as a serial console to control the FS10 over its serial interface. The instructions below use Tera Term, a free open source terminal program that's maintained on the Open Source Development Network (OSDN) website. Follow the steps in Tera Term's installer program to install this app onto your computer. Then follow the below steps to set up Tera Term to communicate with the FS10 (assumes the FS10 is already powered up and connected to one of the PC's USB ports via a serial-to-USB adapter). Adapt these instructions if an alternate terminal program is used such as HyperTerminal that came with older versions of Microsoft Windows (XP and earlier).

1. Launch the Tera Term program: With a newly installed program, the *New connection* dialog pops up as shown at right. Click the **Serial** radio button. Select the COM port assigned to the PC's USB port to which the FS10 is connected using the *Port* drop-down list. Click **OK** when done. See #2 below.

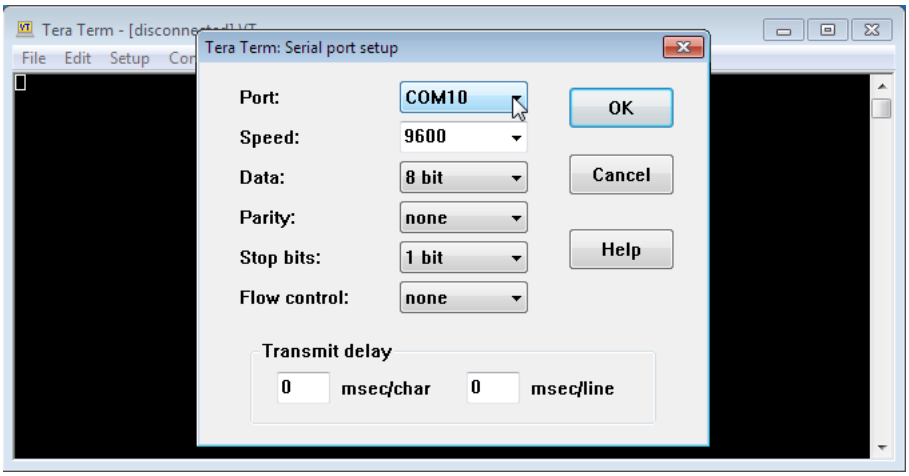
   If the PC's Tera Term program was used with the FS10 before and the setup was saved, the terminal window shows without the *New connection* dialog. See #2 below.

   If the PC's Tera Term program was used previously for another purpose, launching the program may show the Error dialog, "Cannot open COMx. Not found." where "x" is some port number that the system cannot find. If this is the case, click **OK** to dismiss the Error dialog. See #2 below.




2. Under Tera Term's **Setup** menu, accept the defaults for *Terminal...* (VT100, Terminal size = 80 x 24) and *Window...* Verify that the *Serial port...* setup dialog has the parameters as shown at right. Other than the port number, these are default values. Adjust the parameters as necessary to match the defaults. Click **OK** when done. See #3 below.

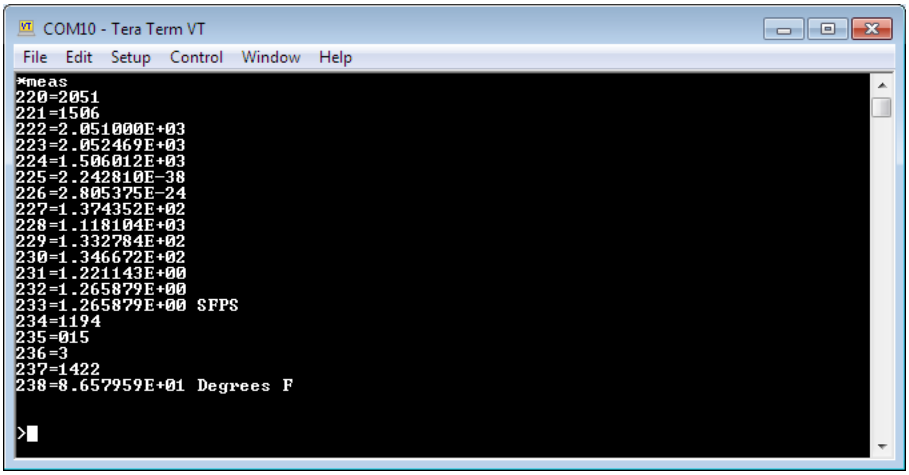
   If Tera Term showed the Error dialog "Cannot open COMx. Not found." when launched, use the *Serial port setup* dialog to select the appropriate COM port (FS10's serial to USB adapter connection) using the *Port* drop-down list. Click **OK** when done. See #3 below.



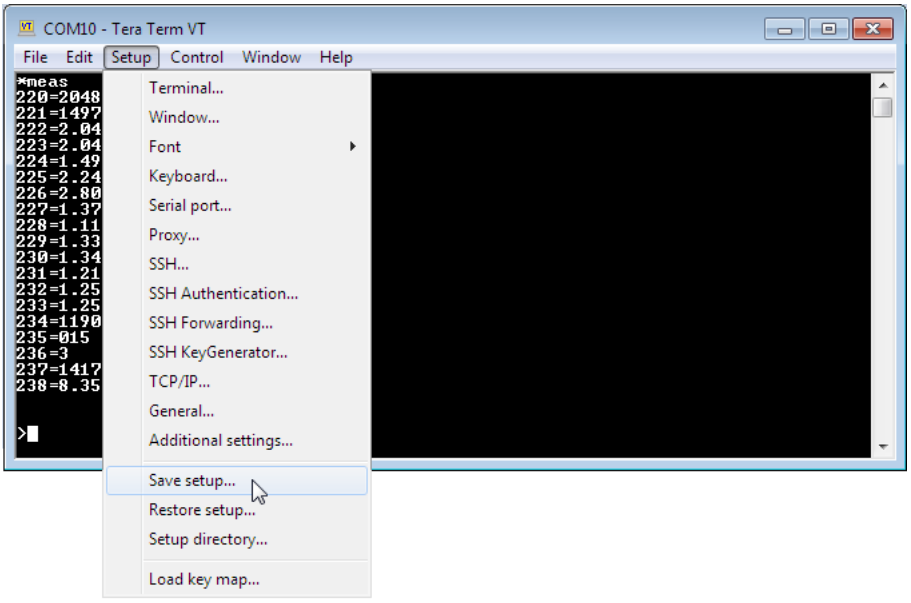
3. With the Tera Term window properly configured and awaiting input, the serial console is now ready to communicate with the FS10.

   Type: *meas

   Observe that the system responds to the CLI ***meas** command by showing parameter data #220 through #238 as shown in the example screen at right. Refer to "Table 8 – CLI Command Set" on page 45 for a summary of the CLI commands.




4. Under Tera Term's **Setup** menu, run the *Save setup...* command to save the FS10 terminal configuration for future use. This brings up the *Save setup* dialog. The default is to overwrite the TERATERM.INI file, which the program automatically uses when launched. You have the option to instead save Tera Term's .ini file under a different name. Click **SAVE** when done. Use Tera Term's *Restore setup...* command to have Tera Term use the alternately named .ini file. ***Note***: Even after restoring the FS10 .ini file setup, run the *Serial port...* command again if the previous Tera Term configuration used different serial port settings. This forces Tera Term to use the FS10-specific serial port settings.



### Password Protection

Factory settings are protected with a level 1 factory password. End user settings are protected with a level 2 password. The following password allows changes to any level 2 parameter: **19113**

Refer to "Table 9 – Serial Interface CLI Parameter Reference Table" on page 46 for the CLI parameter reference. Access to all level 2 (user configurable) parameters are available through the FC10 Windows PC interface software.

### Command Line Interface (CLI) Commands

The table below summarizes the FS10 command line interface (CLI) command set.To be recognized by the system, each command must start with an asterisk followed by the command mnemonic plus any applicable argument as specified in the table. The CLI commands can be entered either as upper or lower case letters (it doesn't matter which). Commands typically respond with parameter value(s) each identified by an item number (for example #220–#238 shown in example screen at left for ***meas** command). All possible parameters are listed in "Table 9 – Serial Interface CLI Parameter Reference Table" on page 46.

**Table 8 – CLI Command Set**

| Command Mnemonic | Description |
|---|---|
| *INFO | Read version information (Hardware, Firmware, Date code, other info). The parameter values for items #1–#66 are listed. |
| *MEAS | Read most recent flow measurement values. The parameter values for items #220 –#238 are listed. |
| *RCFG B | Read configuration parameters from bank B (0–9). The parameter values for items #80–#133 are listed for the specified bank number.<br>Example: *RCFG 7 (to read bank 7 parameters) |
| *SAVE B | Save currently active parameters to bank B (0–9) (Level 2 – Field password required).<br>Example: *SAVE 7 |
| *RCL B | Recall parameters from bank B as the active parameters. (Level 2 – Field password required).<br>Example: *RCL 7 |
| *PASSWD NNNN | To enter the password for either Level 1 (Factory) or Level 2 (Field).<br>Example: *PASSWD 19113 |
| *EXIT | To exit the current password level (undo having entered a password). The current parameters will automatically be saved to Bank 0 upon exit. |
| *NNN=<VALUE> | Update item #NNN (#1–#238) in the "active" (RAM) parameters with value. Value may be either integer or floating point (scientific notation).<br>Example 1: *228=1.100119E+03 enters value 1.100119E+03 into item #228<br>Example 2: *1=002 enters 002 into item #1<br>Example 3: *110=800 enters 800 into item #110 |
| *B:NNN | For Bank B (0–9) read item #NNN (#1–#238). For items #1–#45, and items #220–#238 the Bank is ignored. If no bank is specified, the currently active (RAM) parameters will be accessed.<br>Example 1: *7:85 returns item 85 from bank 7 in this form: 7:85>5.053665E-02<br>Example 2: *8:119 returns item 119 from bank 8 in this form: 8:119=030] |

**Table 9 – Serial Interface CLI Parameter Reference Table**

| Bank | Item # | Item Name | Description | R/W | Type | Size | Default | Password Level |
|---|---|---|---|---|---|---|---|---|
| | 1 | HW_REV | Hardware Version | R | int | 1 | | N/A |
| | 2 | FW_REV | Firmware Revision | R | int | 1 | | N/A |
| | 3 | YY | Date Code, Year | R | int | 1 | | N/A |
| | 4 | MM | Date Code, Month | R | int | 1 | | N/A |
| | 5 | DD | Date Code, Date | R | int | 1 | | N/A |
| | 6 | S_N | Sequence Number | R | int | 2 | | N/A |
| | 7 | RESERVED1 | Reserved 1 | | int | 1 | | |
| | 11 | FREQ_MAX_OUT | For output modes 2, 3, 6, & 7 sets the maximum frequency output | R/W | float | 4 | 2000.0 | Lev 2 |
| | 12 | UI_ENABLE | User Interface enable:<br>0 = "normal" buttons and LEDs active<br>1 = "LEDs only"<br>2 = "power indicator LED only"<br>3 = "all LEDs on" (test mode)<br>4 = "none" neither buttons nor LEDs active | R/W | int | 1 | 0 | Lev 2 |
| | 14 | BTN_ENTER_TIMEOUT | Keypad lockout time period (sec) | R/W | int | 2 | 3 | Lev 2 |
| | 35 | TAG | Customer Tag Number | R/W | char. | 20 | | Lev 2 |
| | 36 | UNITS_K | Conversion factor applied to flow_final_out to compute flow_final_units | R/W | float | 4 | 1.0 | Lev 2 |
| | 37 | UNITS_ID | Units identifier associated with UNITS_K conversion factor | R/W | char. | 10 | SFPS | Lev 2 |
| | 38 | PIPE_ID | User Field: Pipe identification | R/W | char. | 20 | | Lev 2 |
| | 39 | USER_ID2 | User identification field | R/W | char. | 20 | | Lev 2 |
| | 40 | USER_ID3 | User identification field | R/W | char. | 20 | | Lev 2 |
| | 41 | USER_ID4 | User identification field | R/W | char. | 20 | | Lev 2 |
| | 45 | RTD_TYPE | Reference sensor RTD type:<br>1 = 1000 Ω, 2 = 500 Ω, 3 = 100 Ω | R/W | int | 1 | 1 | Lev 2 |
| | 46 | NAMUR_ENABLE | Enables/Disables NAMUR_Level<br>0 = disabled; 1 = enabled low, <3.6 mA;<br>2 = enabled high, >21 mA) | R/W | int | 1 | 0 | Lev 2 |
| | 49 | TEMP_UNITS | Temperature units for parameter #238:<br>0 = °F, 1 = °C. | R/W | int | 1 | 0 | Lev 2 |
| | 50 | QSM1_BANK | Quick setup mode bank for button 1 | R/W | int | 1 | .05 | Lev 2 |
| | 52 | QSM1_PERCENT_SPAN | Default switch point level as percent of established span | R/W | float | 4 | 30 | Lev 2 |
| | 53 | QSM2_BANK | Quick setup mode bank for button 2 | R/W | int | 1 | .05 | Lev 2 |
| | 55 | QSM2_PERCENT_SPAN | Default switch point level as percent of established span | R/W | float | 4 | 30 | Lev 2 |
| | 81 | BANK_ID | Bank Identification | R/W | char. | 20 | Bank ID | Lev 2 |
| 0..9 | 107 | CUST_FLOW_MIN | Customer Flow_Final Limit Min. in SFPS | R/W | float | 4 | 1.224 | Lev 2 |

**Table 9 – Serial Interface CLI Parameter Reference Table (continued)**

| Bank | Item # | Item Name | Description | R/W | Type | Size | Default | Password Level |
|---|---|---|---|---|---|---|---|---|
| 0..9 | 108 | CUST_FLOW_MAX | Customer Flow_Final Limit Max in SFPS | R/W | float | 4 | 120.0 | Lev 2 |
| 0..9 | 112 | RELAY_LIMIT | Relay Limit (FPS) | R/W | float | 4 | 65.0 | Lev 2 |
| 0..9 | 113 | RELAY_HYSTERESIS | Relay Hysteresis = % of span (#108 [CUST_FLOW_MAX] – #107 [CUST_FLOW_MIN]) | R/W | float | 4 | 2.0 | Lev 2 |
| 0..9 | 114 | RELAY_HYSTERESIS_ EFFECT | Hysteresis either above or below set point | R/W | int | 1 | 1 = above | Lev 2 |
| 0..9 | 115 | RELAY_POLAR | Relay Polarity (1 = Active High, 0 = Active Low) | R/W | int | 1 | 1 | Lev 2 |
| 0..9 | 116 | RELAY_TURN_ON_DE-LAY | Relay Turn-on Delay (secs) 65K secs max. Restricted by #121 value when using buttons | R/W | int | 1 | 0 | Lev 2 |
| 0..9 | 117 | RELAY_TURN_OFF_DE-LAY | Relay Turn-off Delay (secs) 65K secs max. Restricted by #121 value when using buttons | R/W | int | 1 | 0 | Lev 2 |
| 0..9 | 118 | DISPLAY_RANGE_ MODE | Display range either static (0): based on zero flow and max flow. Or dynamic (1): based on zero flow, with auto-adjust (peak hold) for max flow | R/W | int | 1 | 0 = static | Lev 2 |
| 0..9 | 119 | INPUT_FILTER_PERIOD | Time constant for input filtering (secs) | R/W | int | 1 | 3 | Lev 2 |
| 0..9 | 120 | MAX_HYSTERESIS | Maximum hysteresis value for buttons as % of #112 (switch point) | R/W | float | 4 | 10.0 | Lev 2 |
| 0..9 | 121 | MAX_DELAY | Maximum delay for turn on/turn off delays (sec); affects button operation only | R/W | int | 2 | 10 | Lev 2 |
| 0..9 | 122 | FLOW_K1 | "K1" factor applied | R/W | float | 4 | 0.0 | Lev 2 |
| 0..9 | 123 | FLOW_K2 | "K2" factor applied | R/W | float | 4 | 1.0 | Lev 2 |
| 0..9 | 124 | FLOW_K3 | "K3" factor applied | R/W | float | 4 | 0.0 | Lev 2 |
| 0..9 | 125 | FLOW_K4 | "K4" factor applied | R/W | float | 4 | 0.0 | Lev 2 |
| 0..9 | 126 | CUST_TEMP_MIN | Customer Temperature final Min. limit | R/W | float | 4 | 0.0 | Lev 2 |
| 0..9 | 127 | CUST_TEMP_MAX | Customer Temperature final Max. limit | R/W | float | 4 | 0.0 | Lev 2 |
| | 220 | FLOW_COUNT_RAW | Raw ADC Counts for Flow Sampling | R | int | 2 | N/A | N/A |
| | 221 | REF_COUNT_RAW | Raw ADC Counts for Reference Sampling | R | int | 2 | N/A | N/A |
| | 222 | FLOW_COUNT_ADJ | Temp. Compensated Flow ADC Counts | R | float | 4 | N/A | N/A |
| | 223 | FLOW_COUNT_FILT | Adjusted, filtered Flow ADC Counts | R | float | 4 | N/A | N/A |
| | 224 | REF_COUNT_FILT | Adjusted, filtered Ref ADC Counts | R | float | 4 | N/A | N/A |
| | 225 | dR_OHM | Delta R in milliohm | R | float | 4 | N/A | N/A |
| | 226 | REF_OHM | Reference R in milliohm | R | float | 4 | N/A | N/A |
| | 227 | dR_OHM_NORM | Normalized dR milliohm | R | float | 4 | N/A | N/A |

**Table 9 – Serial Interface CLI Parameter Reference Table (continued)**

| Bank | Item # | Item Name | Description | R/W | Type | Size | Default | Password Level |
|---|---|---|---|---|---|---|---|---|
| | 228 | refR_OHM_NORM | Normalized refR milliohm | R | float | 4 | N/A | N/A |
| | 229 | dR_OHM_PCED | Power Corrected dR in milliohm | R | float | 4 | N/A | N/A |
| | 230 | dR_OHM_TCED | Temp Compensated dR in milliohm | R | float | 4 | N/A | N/A |
| | 231 | FLOW_FINAL | Temp Compensated and N-L Corrected Flow [FPS] | R | float | 4 | N/A | N/A |
| | 232 | FLOW_FINAL_OUT | FLOW_FINAL used for analog output (adjusted for customer limits) | R | float | 4 | N/A | N/A |
| | 233 | FLOW_FINAL_UNITS | FLOW_FINAL_OUT adjusted by UNITS_K | R | float | 4 | N/A | N/A |
| | 234 | A_OUT_DAC_COUNT | Analog Output DAC Count | R | int | 2 | N/A | N/A |
| | 235 | DISPLAY_COUNT | COUNT to be displayed on LED bar graph | R | int | 1 | N/A | N/A |
| | 236 | DIO_BIT_PATTERN | LED/Button Bit Pattern | R | int | 2 | N/A | N/A |
| | 237 | BOARD_TEMP_COUNT | Raw ADC Counts for On-Board Temp Sensor Sampling | R | int | 2 | N/A | N/A |
| | 238 | REF_TEMP | Computed Temperature [°F; refer to #49 to change units.] | R | float | 4 | N/A | N/A |

## Safety Instrumented Systems Requirements (SIS)

The safety-critical output of the FS10 is provided through the 4-20 mA signal representing flow and the SPDT relay or solid state output.

### Compliance through FMEDA (Failure Modes, Effects and Diagnostic Analysis)

SIL (Safety Integrity Level): 2 – as a single device

HFT (Hardware Fault Tolerance): 0

Subsystem Type: B

### FS10 Safety Identification

Firmware version 4.02 or greater

To identify firmware version, use Fluid Components Intl FS10 PC Interface program

### Installation in SIS Applications

Installations are to be performed by qualified personnel. No special installation is required in addition to the standard installation practices outlined in this document. Environmental and operational limits are defined in "Technical Specifications" on page 2.

The supplied power should be designed so the terminal voltage does not drop below 21.5 VDC. With the relay output option, current must be limited to 60% of the relay rating (600 mA) and provide transient voltage protection (see "Switching Inductive Loads" on page 9).

Use the PC Interface tool to communicate with and verify configuration of the FS10. Use the keypad lockout function within the PC interface application to prevent accidental or deliberate change of configuration data during normal operation. *Note*: Firmware version 4.08 or greater faults if either button inadvertently locks in to closed (active) position for greater than 30 seconds.

***Note***: Transmitter output is not safety-rated during configuration changes. Alternative means should be used to ensure process safety during transmitter configuration and maintenance activities.

*Alarm Levels*

Namur: <3.6mA = Fault or >21mA = Fault

*Proof Test*

The suggested proof test described below detects 95% of possible DU failures in the FS10 Flow Switch. The suggested proof test in combination with automatic diagnostics detects 99% of possible DU failures in the FS10 Flow Swtich.

The suggested proof test consists of setting the output to the min and max, and a calibration check.

*Suggested Proof Test*

| Step | Action |
|---|---|
| 1 | Bypass the safety function and take appropriate action to avoid a false trip. |
| 2 | Send a command through PC interface or function buttons to the FS10 to de-energize the relay or transistor or go to the high alarm current output. Verify that the relay or transistor changes state or that the analog current reaches that value. |
| 3 | If the current output is used as the safety critical output, send a command through PC interface or function buttons to the FS10A to go to the low alarm current output and verify that the analog current reaches that value. |
| 4 | Perform a two-point calibration of the transmitter over the full working range. |
| 5 | Remove the bypass and otherwise restore normal operation. |

### Product Repair

The FS10 is repairable by major component replacement. All product repair and part replacement is limited to qualified personnel only.

### FS10 SIS Reference

The FS10 must be operated in accordance to the functional and performance specifications listed in "Technical Specifications" on page 2.

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# 4. MAINTENANCE & TROUBLESHOOTING

## Maintenance

Perform preventive maintenance on the sensing element as required. If the process media sticks to the process pipes (or tank) clean the sensing element in the same manner and frequency as the process pipe (or tank). Use solvent compatible with 316L stainless steel and Hastelloy C22 (be careful not to bend or damage the thermowells). Occasionally check for moisture in the control circuit housing and wiring connections. Check for proper system functionality and response time.

## Troubleshooting

If the instrument is not operating, go through the installation and adjustment procedures and verify proper installation. If the instrument fails after some time in service and it has been checked, or if it fails to operate at start up and the installation has been verified, contact your authorized FCI service representative.

If FCI representative cannot be reached, contact FCI Technical Service. If the instrument is to be returned, obtain a Return Authorization. The form contains a declaration of decontamination cleaning information that the instrument must comply with before it is shipped to FCI. The telephone number in the US is 1-800-854-1993 or 1-760-744-6950 or email: techsupport@fluidcomponents.com. See x for complete customer service information.

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# APPENDIX A APPROVALS

## Safety Instructions

**Safety Instructions for the use of the FS10 flow meter in Hazardous Areas Approval LC 16ATEX14269X / IECEx LC 16.0006X for:**

**Category II 3 G for Gas protection Ex ec IIC T4 Gc**

**Category II 3 D for Dust protection Ex tc IIIC T81°C Dc, IP64**

The FS10 series consist of a sensing element and associated integral or remote mounted electronics.

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

1) Ambient temperature range (Ta): -40 °C – +71 °C

2) Maximum process temperature (Tp): 121 °C (integral version)
260 °C (remote version)

Electrical data: Power supply: 21.5 to 30 VDC, 2.5 watts max.

| | | | |
|---|---|---|---|
| Dansk | Sikkerhedsforskrifter | Italiano | Normative di sicurezza |
| Deutsch | Sicherheitshinweise | Nederlands | Veiligheidsinstructies |
| English | Safety instructions | Português | Normas de segurança |
| Ελληνικά | Υποδείξεις ασφαλείας | Español | Instrucciones de seguridad |
| Suomi | Turvallisuusohjeet | Svenska | Säkerhetsanvisningar |
| Français | Consignes de sécurité | | |

## DK Dansk – Sikkerhedsforskrifter

Disse sikkerhedsforskrifter gælder for Fluid Components, FS10 EF-typeafprøvningsattest-nr. LC 16ATEX14269X / IECEx LC 16.0006X (attestens nummer på typeskiltet) er egnet til at blive benyttet i eksplosiv atmosfære kategori II 3 GD.

1) Ex-anlæg skal principielt opstilles af specialiseret personale.
2) FS10 skal jordforbindes.

## D A Deutsch – Sicherheitshinweise

Diese Sicherheitshinweise gelten für die Fluid Components, FS10 flow meter gemäß der EG-Baumusterprüfbescheinigung Nr. LC 16ATEX14269X / IECEx LC 16.0006X (Bescheinigungsnummer auf dem Typschild) der Kategorie II 3 GD.

1) Die Errichtung von Ex-Anlagen muss grundsätzlich durch Fachpersonal vorgenommen werden.
2) Der FS10 muß geerdet werden.

## GB IRL English – Safety instructions

These safety instructions are valid for the Fluid Components, FS10 flow meter to the EC type approval certificate no LC 16ATEX14269X / IECEx LC 16.0006X (certificate number on the type label) for use in potentially explosive atmospheres in Category II 3 GD.

1) The installation of Ex-instruments must be made by trained personnel.
2) The FS10 must be grounded.

## GR Ελληνικά – Υποδείξεις ασφαλείας

Αυτές οι οδηγίες ασφαλείας ισχύουν για τα Ροόμετρα της Fluid Components τύπου FS10 που φέρουν Πιστοποιητικό Εγκρίσεως Ευρωπαϊκής Ένωσης, με αριθμό πιστοποίησης LC 16ATEX14269X / IECEx LC 16.0006X (ο αριθμός πιστοποίησης βρίσκεται πάνω στην ετικέτα τύπου του οργάνου) για χρήση σε εκρηκτικές ατμόσφαιρες της κατηγορίας II 3 GD.

1) Η εγκατάσταση των οργάνων με αντιεκρηκτική προστασία πρέπει να γίνει από εξειδικευμένο προσωπικό.
2) Το όργανο τύπου FS10 πρέπει να είναι γειωμένο.

## FIN Suomi – Turvallisuusohjeet

Nämä turvallisuusohjeet koskevat Flud Components, FS10 EY-tyyppitarkastustodistuksen nro. LC 16ATEX14269X / IECEx LC 16.0006X (todistuksen numero näkyy tyyppikilvestä) käytettäessä räjähdysvaarallisissa tiloissa luokassa II 3 GD.

1) Ex-laitteet on aina asennettava ammattihenkilökunnan toimesta.
2) FS10 on maadoitettava.

## F B L Français – Consignes de sécurité

Ces consignes de sécurité sont valables pour le modèle FS10 de la société Fluid Components (FCI) conforme au certificat d'épreuves de type LC 16ATEX14269X / IECEx LC 16.0006X (numéro du certificat sur l'étiquette signalétique) conçu pour les applications dans lesquelles un materiel de la catégorie II3GD est nécessaire.

1) Seul un personnel spécialisé et qualifié est autorisé à installer le matériel Ex.
2) Les FS10 doivent être reliés à la terre.

## I Italiano – Normative di sicurezza

Queste normative di sicurezza si riferiscono ai Fluid Components, FS10 secondo il certificato CE di prova di omologazione n° LC 16ATEX14269X / IECEx LC 16.0006X (numero del certificato sulla targhetta d'identificazione) sono idonei all'impiego in atmosfere esplosive applicazioni che richiedono apparecchiature elettriche della Categoria II 3 GD.

1) L'installazione di sistemi Ex deve essere eseguita esclusivamente da personale specializzato.
2) I FS10 devono essere collegati a terra.

## NL B Nederlands – Veiligheidsinstructies

Deze veiligheidsinstructies gelden voor de Fluid Components, FS10 overeenkomstig de EG-typeverklaring nr. LC 16ATEX14269X / IECEx LC 16.0006X (nummer van de verklaring op het typeplaatje) voor gebruik in een explosieve atmosfeer volgens Categorie II 3GD.

1) Installatie van Ex-instrumenten dient altijd te geschieden door geschoold personeel.
2) De FS10 moet geaard worden.

## P Português – Normas de segurança

Estas normas de segurança são válidas para os Fluid Components, FS10 conforme o certificado de teste de modelo N.º LC 16ATEX14269X / IECEx LC 16.0006X (número do certificado na plaqueta com os dados do equipamento) são apropriados para utilização em atmosferas explosivas categoria II 3 GD.

1) A instalação de equipamentos em zonas sujeitas a explosão deve, por princípio, ser executada por técnicos qualificados.
2) Os FS10 Flexmasster precisam ser ligados à terra.

## E Español – Instrucciones de seguridad

Estas indicaciones de seguridad son de aplicación para el modelo FS10 de Fluid Components, según la certificación CE de modelo Nº LC 16ATEX14269X / IECEx LC 16.0006X para aplicaciones en atmósferas potencialmente explosivas según la categoría II 3 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 FS10 tienen que ser conectados a tierra.

## S Svenska – Säkerhetsanvisningar

Säkerhetsanvisningarna gäller för Fluid Components, Flödesmätare typ FS10 enligt EG-typkontrollintyg nr LC 16ATEX14269X / IECEx LC 16.0006X (intygsnumret återfinns på typskylten) är lämpad för användning i explosiv gasblandning i kategori II 3 GD.

1) Installation av Ex- klassade instrument måste alltid utföras av fackpersonal.
2) FS10 måste jordas.

## Republic of Korea: Type Approval for 22-KA4BO-0579X, 22-KA4BO-0580X

As given by KC certificates 22-KA4BO-0579X and 22-KA4BO-0580X, the following applies to the FS10 flow switch/monitor:

Type of protection:

Ex ec IIC T4 Gc -40°C≤Ta≤+71°C

Ex tc III C T81°C Dc, -40°C ≤ Ta ≤ +71°C

Applicable standards:

- Protection Device Safety Certification Notice No. 2021-22
- EN 60079-0:2012
- EN 60079-15:2010
- EN 60079-31:2014

The installation of explosion-proof equipment must comply with KS C IEC 60079-14.

In relation to maintenance and repair, there is a limit of responsibility of the user and the manufacturer, such as the method and subject.

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# APPENDIX B AUXILIARY DRAWINGS

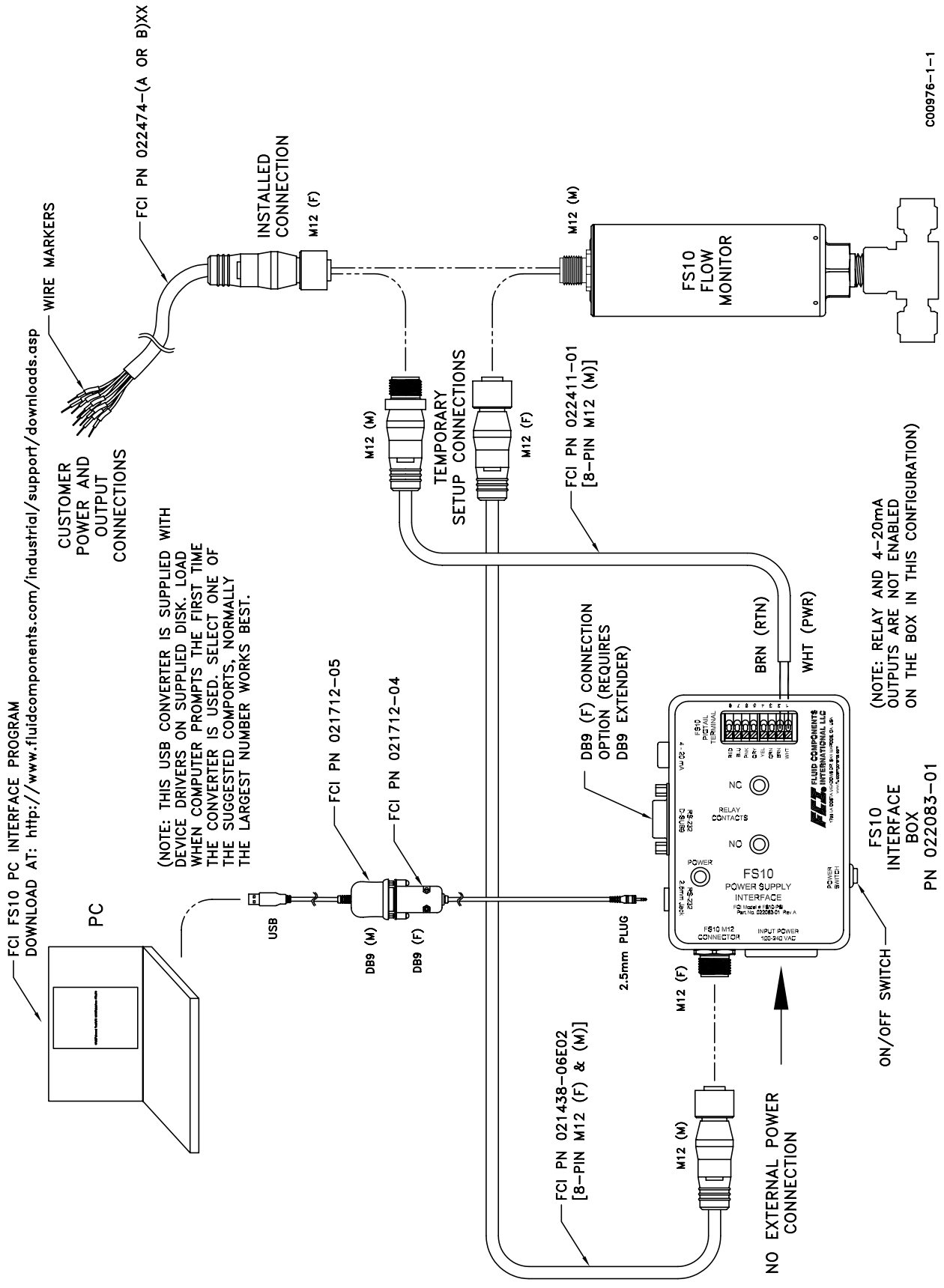



**Figure 24 – RS232 Interface Box Hookup - Using Installed DC Power to FS10A**

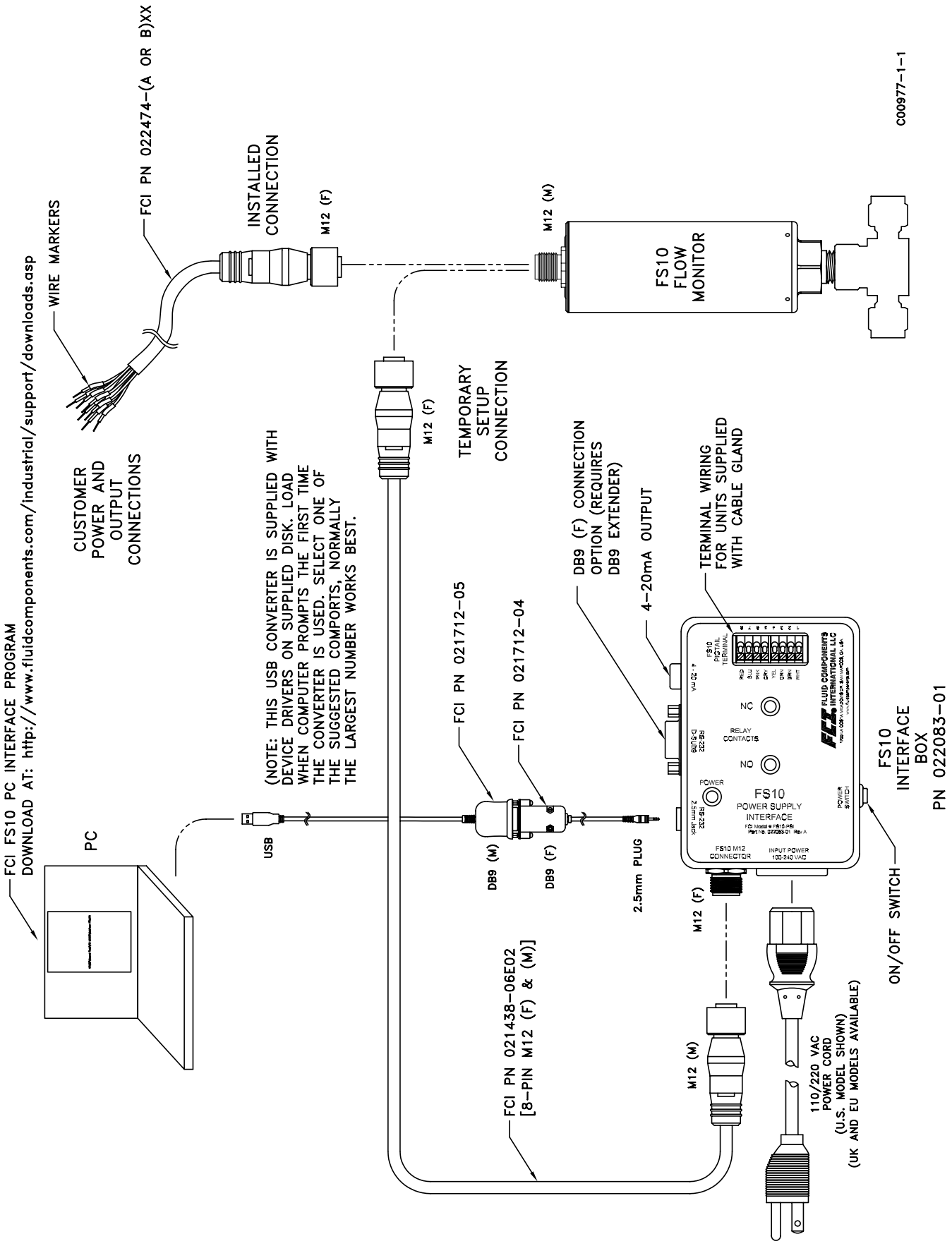



**Figure 25 – RS232 Interface Box Hookup - External AC Power Available**

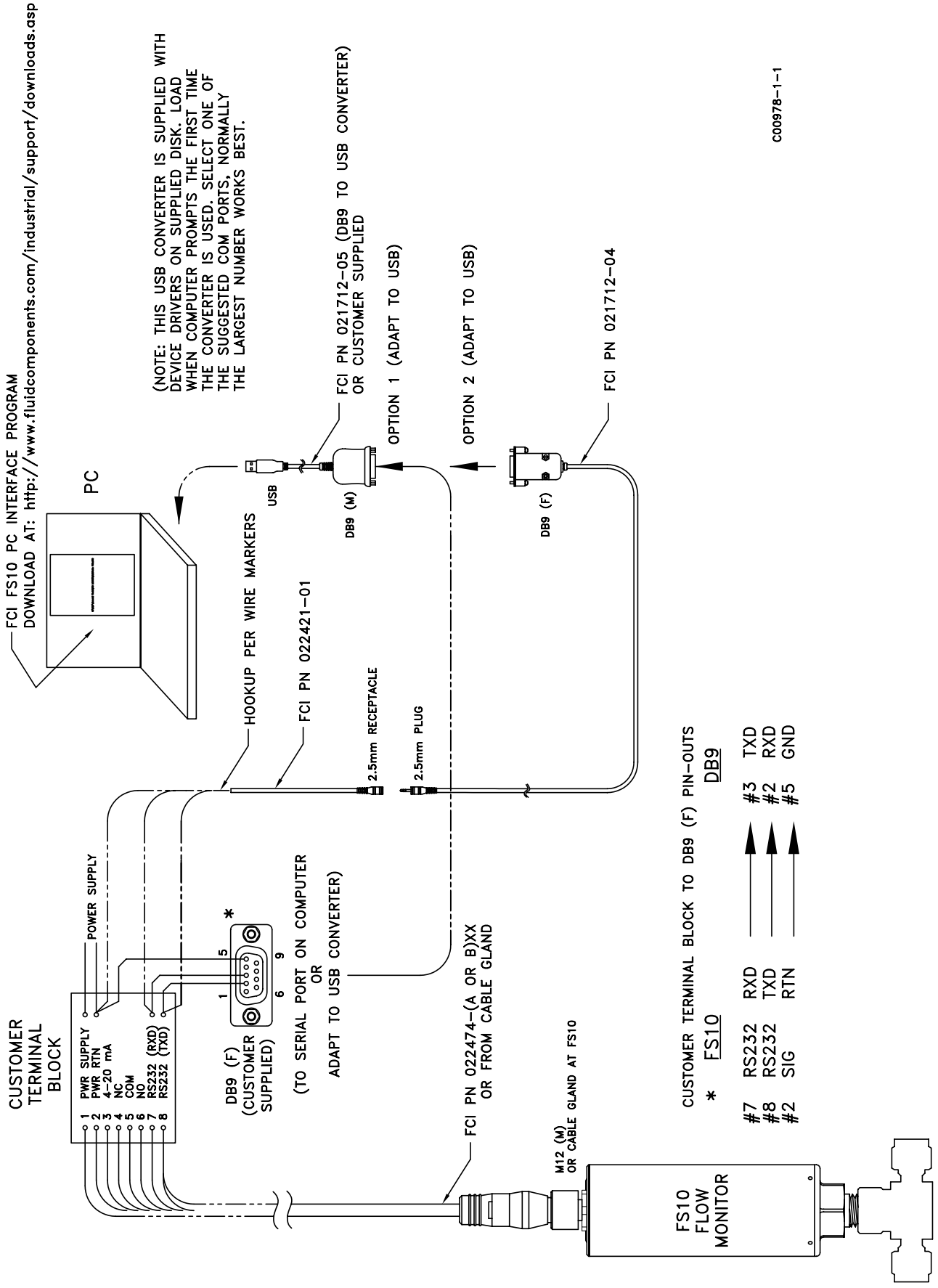
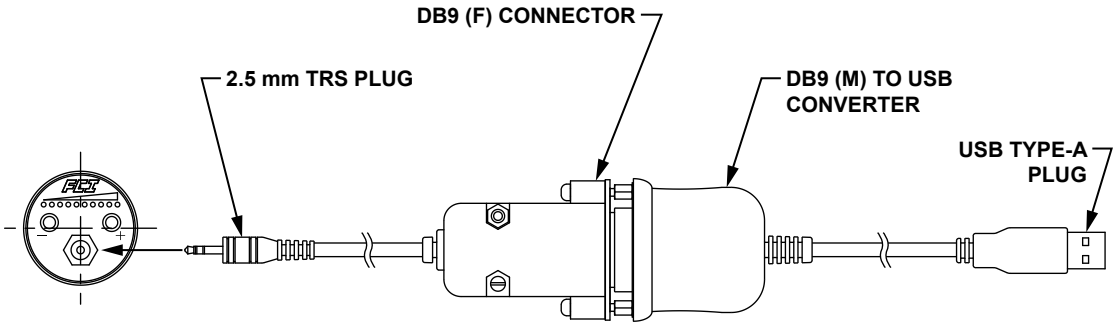
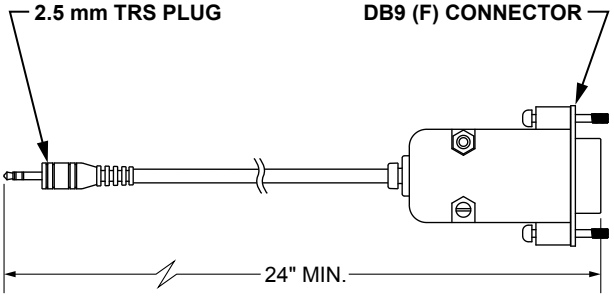



**Figure 26 – RS232 to Computer Hookup Using Installed Power and Wiring**

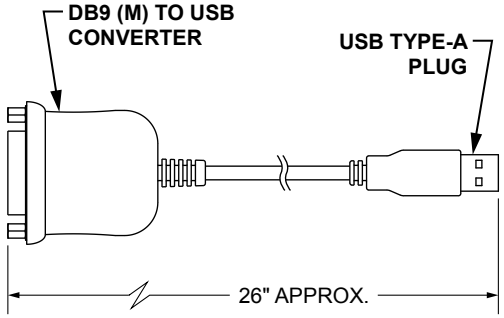
## PC Interface Kits




**021712-02 CONFIG**
2.5 mm TRS PLUG JACK (ON REMOTE MODELS)
TO USB PLUG; FS10 PC INTERFACE SOFTWARE – KIT



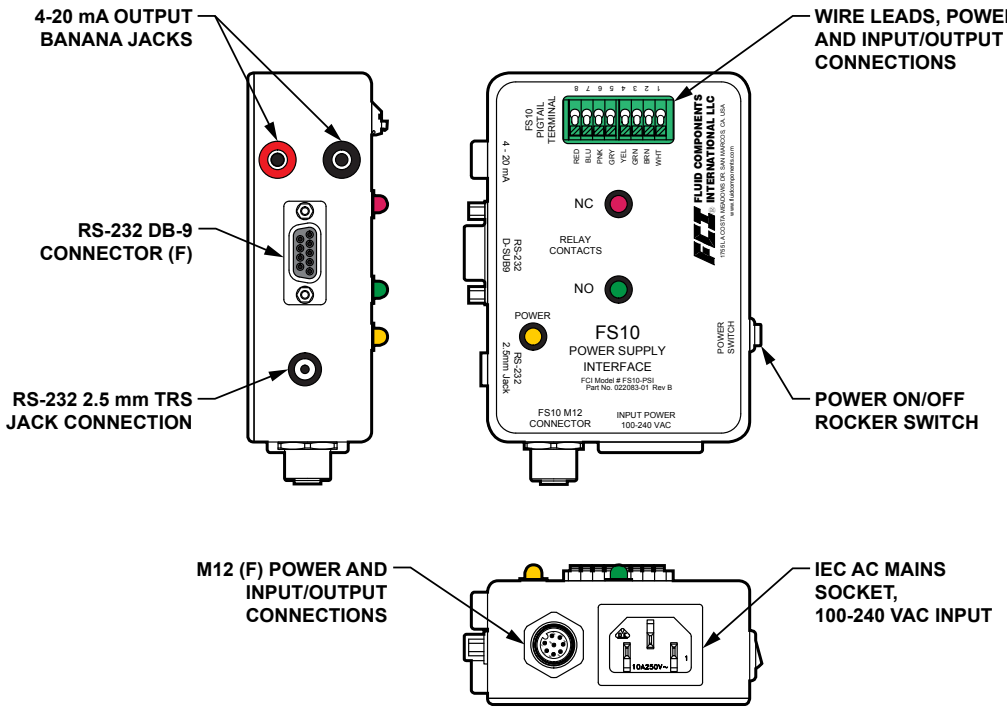

**021712-04 CONFIG**
2.5 mm TRS PLUG JACK WITH 24" – 48" INTERCONNECTING
CABLE TO DB9 (F) CONNECTOR. (ACTUAL CONNECTORS
MAY VARY PICTORIALLY)



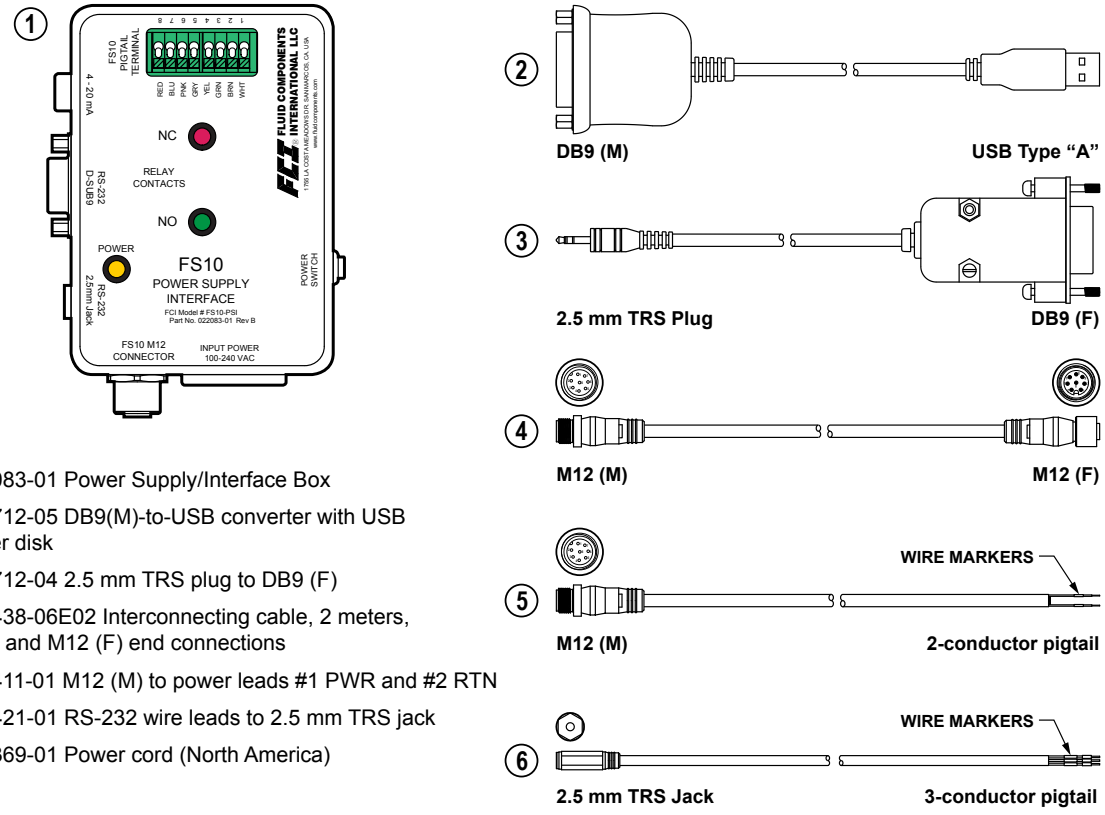

**021712-05 CONFIG**
USB CONVERTER WITH DB9 (M) AND 26" INTERCONNECTING
CABLE TO PIGTAIL USB TYPE-A PLUG. (ACTUAL CONNECTORS
MAY VARY PICTORIALLY)

C01515-1-1

**Figure 27 – FS10 PC Interface Kit for Remote, RS-232 to USB**




**(a) 022083-01 Power Supply/Interface Box**




1. PN 022083-01 Power Supply/Interface Box
2. PN 021712-05 DB9(M)-to-USB converter with USB PC driver disk
3. PN 021712-04 2.5 mm TRS plug to DB9 (F)
4. PN 021438-06E02 Interconnecting cable, 2 meters, M12 (M) and M12 (F) end connections
5. PN 022411-01 M12 (M) to power leads #1 PWR and #2 RTN
6. PN 022421-01 RS-232 wire leads to 2.5 mm TRS jack
7. PN 013369-01 Power cord (North America)

**(b) 022083-02 Power Supply/Interface Box Kit**

C01516-1-1

***Note***: The FS10 PC interface software is available for download at https://www.fluidcomponents.com/

**Figure 28 – FS10 Power Supply/Interface Box and Kit**

## Interface Components, Output Cables

The various cable assemblies available for relay output and open collector (MOSFET) output are listed below.

**Relay Output Cables**

- 022474-A02 – 8-pin M12 (F) connector with 6 feet [2 meters] pigtail and wire markers
- 022474-A05 – 8-pin M12 (F) connector with 15 feet [5 meters] pigtail and wire markers
- 022474-A10 – 8-pin M12 (F) connector with 30 feet [10 meters] pigtail and wire markers

**Open Collector (N-Channel MOSFET) Output Cables**

- 022474-B02 – 8-pin M12 (F) connector with 6 feet [2 meters] pigtail and wire markers
- 0022474-B05 – 8-pin M12 (F) connector with 15 feet [5 meters] pigtail and wire markers
- 022474-B10 – 8-pin M12 (F) connector with 30 feet [10 meters] pigtail and wire markers

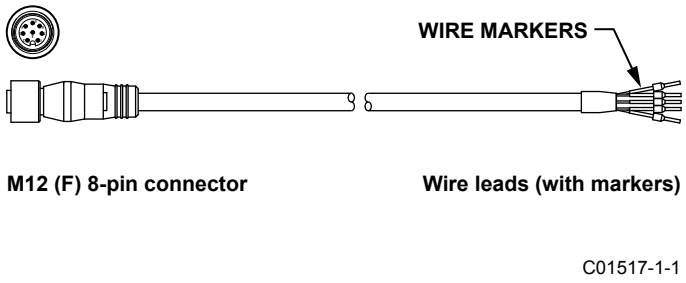



**Figure 29 – FS10 Relay and Open Collector Output Cable**

## Interface Components, Miscellaneous Cables

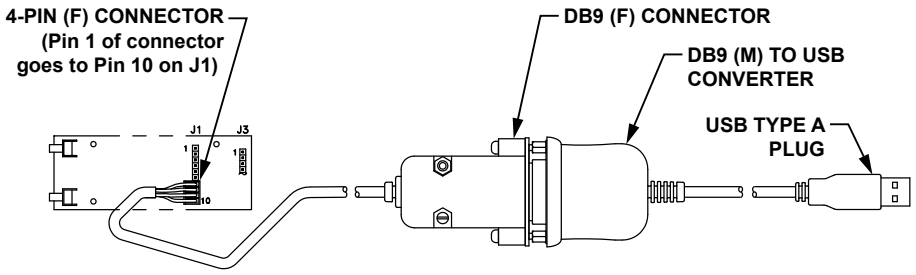
The cable assemblies listed below are also part of the Power Supply/Interface Box Kit 022083-02. See also "Figure 28 – FS10 Power Supply/ Interface Box and Kit" on page 61 for details.

**Miscellaneous Cables**

- 021438-06E02 – Interconnecting cable, 6 feet [2 meters], 8-pin M12 (M) and M12 (F) end connections (item #4 in 022083-02 kit)
- 022411-01 – 8-pin M12 (M) connector with 39" [1 meter] 2-conductor pigtail with wire markers (item #5 in 022083-02 kit)
- 022421-01 – 2.5 mm TRS jack with 36" [0.9 meter] 3-conductor pigtail with wire markers (item #6 in 022083-02 kit)

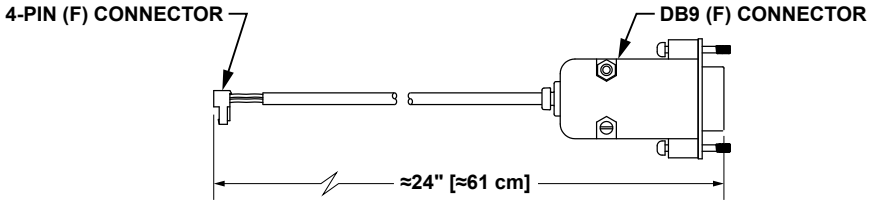
## Board Connector Cable Assemblies – OEM

The following cable assemblies pertain to OEM board applications only.

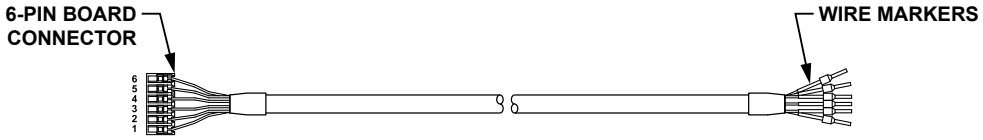



**021712-01 CONFIG**
Make from 021712-03 and 021712-05
FS10 circuit board RS-232 4-pin terminal connection to USB plug;
FS10 PC Interface Software – Kit

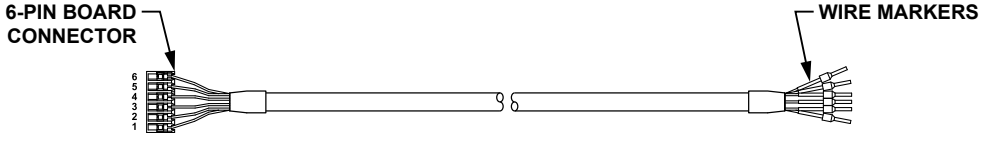
DETAIL: 4-pin female connector for FS10 board (terminal block J1, pins 7-10) with 24-inch interconnecting cable to DB9 connector (FCI P/N 021712-03) mated to USB converter with extension 26-inch pigtail to USB “A” plug (FCI P/N 021712-05)




**021712-03 CONFIG**
IDC terminal connector with 24-inch interconnecting cable to DB9 (F) connector (actual connectors may vary pictorially).




**022542-A CABLE ASSEMBLY**
IDC connector, I/O, FS10,
OEM relay output




**022542-B CABLE ASSEMBLY**
IDC connector, I/O, FS10,
OEM collector output (N-Channel MOSFET)

C01518-1-1

**Figure 30 – OEM Board Connector Cable Assemblies**

## DB9 RS-232 Connector Pinout

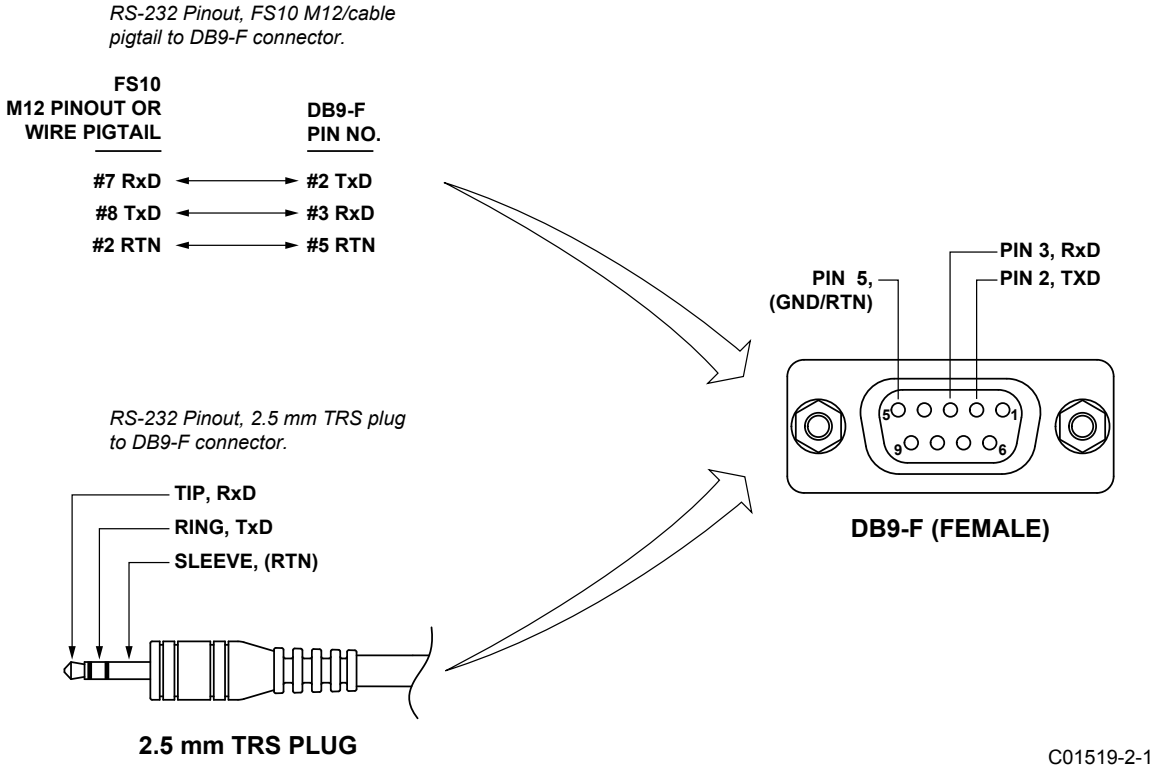
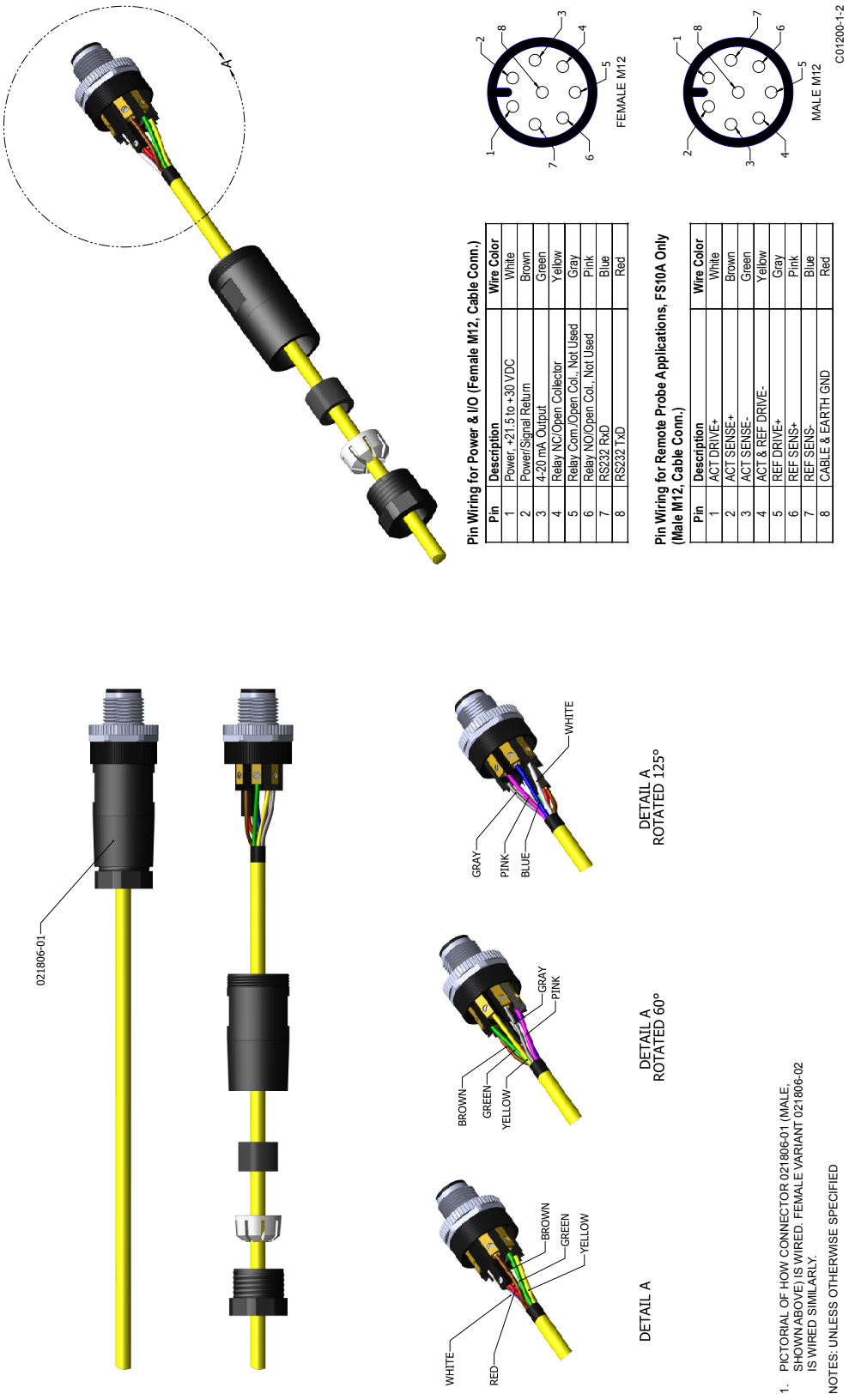



**Figure 31 – DB9 RS-232 Connector Pinout**

## Field Wireable Connector, M12, 8-Pin Male/Female, FS10




**Pin Wiring for Power & I/O (Female M12, Cable Conn.)**

| Pin | Description | Wire Color |
|---|---|---|
| 1 | Power, +21.5 to +30 VDC | White |
| 2 | Power/Signal Return | Brown |
| 3 | 4-20 mA Output | Green |
| 4 | Relay NC/Open Collector | Yellow |
| 5 | Relay Com./Open Col., Not Used | Gray |
| 6 | Relay NO/Open Col., Not Used | Pink |
| 7 | RS232 RxD | Blue |
| 8 | RS232 TxD | Red |

**Pin Wiring for Remote Probe Applications, FS10A Only (Male M12, Cable Conn.)**

| Pin | Description | Wire Color |
|---|---|---|
| 1 | ACT DRIVE+ | White |
| 2 | ACT SENSE+ | Brown |
| 3 | ACT SENSE- | Green |
| 4 | ACT & REF DRIVE- | Yellow |
| 5 | REF DRIVE+ | Gray |
| 6 | REF SENS+ | Pink |
| 7 | REF SENS- | Blue |
| 8 | CABLE & EARTH GND | Red |

NOTES: UNLESS OTHERWISE SPECIFIED

1. PICTORIAL OF HOW CONNECTOR 021806-01 (MALE, SHOWN ABOVE) IS WIRED. FEMALE VARIANT 021806-02 IS WIRED SIMILARLY.

**Figure 32 – Field Wireable Connector, M12, 8-pin Male/Female, FS10**

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# APPENDIX C 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. 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 email 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, visit the FCI website at 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 details.

### 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.

FLUID COMPONENTS INTERNATIONAL LLC
1755 La Costa Meadows Drive, San Marcos, CA 92078-5115 USA
760-744-6950 / 800-854-1993 / Fax: 760-736-6250
Web Site: www.fluidcomponents.com
E-mail: techsupport@fluidcomponents.com

**RA #_____**

# 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 No: _____ Serial No(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)*

6. **Payment Via** ❑ Faxed Purchase Order ❑ VISA ❑ MasterCard

*(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 charge of $250.00)*

Factory Return Shipping Address:

Fluid Components International LLC
1755 La Costa Meadows Drive
San Marcos, CA 92078-5115
Attn: Repair Department
RA #_____

FCI Document No. 05CS000004 D [U]

FLUID COMPONENTS INTERNATIONAL LLC

The following Return Authorization Request form and Decontamination Statement ***MUST be completed, signed and faxed back to FCI 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 Packing 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.

* Approriate dunnage as defined by UPS, will protect package contents from a drop of 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_____

Authorized Signature_____ Date _____

Company Title _____

Visit FCI on the Worldwide Web: www.fluidcomponents.com
1755 La Costa Meadows Drive, San Marcos, California 92078-5115 USA ‡ Phone: 760-744-6950 ‡ 800-854-1993 ‡ Fax: 760-736-6250

FCI Document No. 05CS000004D [U]

## 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 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.

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*Solutions for Industrial Processes*

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Room 107, Xianfeng Building II, No.7 Kaituo Road, Shangdi IT Industry Base, Haidian District | Beijing 100085, P. R. China
Phone: 86-10-82782381 Fax: 86-10-58851152