FLUID COMPONENTS INTERNATIONAL LLC

Installation, Operation & Maintenance Manual

FLT®93 Series FlexSwitch™
Flow, Level, Temperature Switch / Monitor

Models: FLT93B, FLT93C, FLT93F, FLT93L, FLT93S

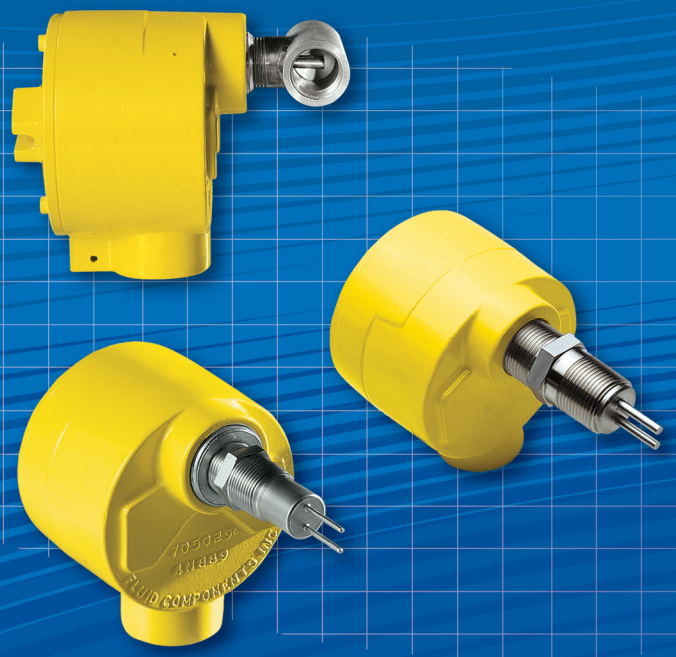

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Table of Contents

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1 GENERAL

Description

The FLT Series models are multipurpose measurement instruments. The models included in this manual are FLT93B (Basic), FLT93C (Sanitary), FLT93F (Fast Response), FLT93L (In-Line) and FLT93S (Heavy Duty). Each model is a single instrument that is capable of detecting fluid flow and temperature. It is also able to detect liquid level or fluid media interfaces. The instrument has two field adjustable alarm setpoints, two buffered voltage outputs, as well as a built-in calibration circuit. The output of the alarm setpoints are relay contacts that can be used to control customer process applications. One buffered voltage output is available for flow or level monitoring and the second buffered voltage output is available for temperature monitoring.

Theory of Operation

The flow switch is a fixed position, single-point flow, level, interface and temperature switch. The operation of the sensing element is based upon the thermal dispersion principle: A low-powered heater is used to produce a temperature differential between two Resistance Temperature Detectors (RTDs). The RTD temperature differential varies as a function of forced convection for flow measurement and as a function of fluid thermal conductivity for level and interface measurement. The measurement of the fluid's temperature is obtained from the non-heated RTD.

Sensing Element

The sensing element consists of two thermowells (hollow tubes) that when inserted into the flow process allows an unimpeded flow inside the process line. The top thermowell has a heated RTD inserted into it. The bottom thermowell has a reference RTD inserted into it. In order to correctly orient the sensing element a flow arrow has been etched onto the threaded portion of the sensing element. See the figure below for a view of the sensing element.

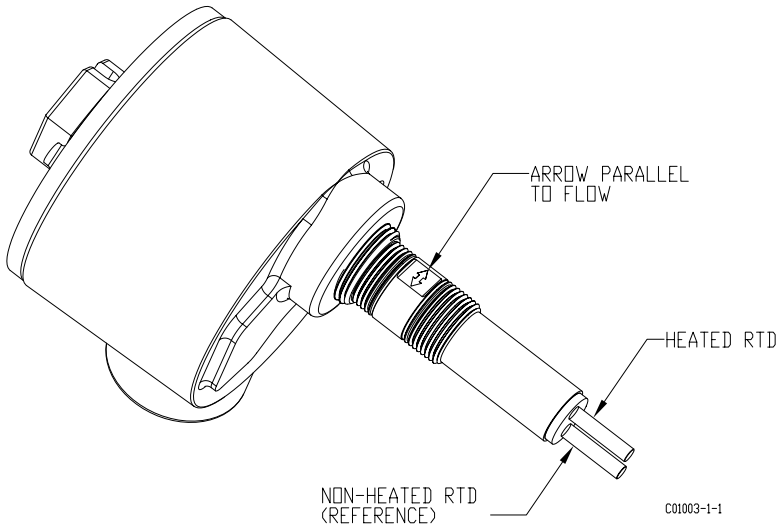

Figure 1 – View of the Sensing Element

Control Circuit

The control circuit converts the sensing element's RTD temperature differential into an analog DC voltage signal. Dual comparators monitor the sensing element signal and activates the relay alarm circuits if the signal exceeds an adjustable setpoint.

The control circuit contains field selectable jumpers that are used to configure the instrument for the application.

Safety Instructions

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

Warning: Exposure to some chemicals may degrade the sealing properties of the materials used in the following devices: relays K1 and K2, model CIT J109F1CS1018VDC.36G. FCI recommends periodic inspections of the relays for degradation and replace them when degradation occurs.

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

Specific Conditions of Use

- Refer to Annex 1 of Report No. NL/DEK/ExTR14.0088 for the process and ambient temperature range of the pigtail version
- The risk of electrostatic discharge from painted enclosures shall be minimized.
- An ignition hazard due to impact or friction from sensor and flanges containing titanium, shall be avoided.
- Flameproof joints are not intended to be repaired.

Technical Specifications

Application

Flow rate and/or level/interface and temperature sensing in liquid, gas and slurry applications.

Sensing Element

- **Process Connection**

Model B

Standard: 3/4" male NPT.

Models S and F

Standard: 3/4" male NPT.

Optional: 1" BSP, 1" or 1 1/4" male NPT; flanges, spool pieces, sanitary fittings or retractable sensing element.

Model L

Standard: 1" male NPT or 3/4" female NPT.

Optional: Flange and low-flow orifice.

Model C

Standard: Sanitary flange

- **Insertion Length**

Model B

Standard: 1.2" [30 mm], 2" [51 mm], 4" [102 mm].

Models S and F

Standard: 1.2" [30 mm], 2" [51 mm], 4" [102 mm], 6" [152 mm], 9" [229 mm], 12" [305 mm],18" [457 mm].

Optional: Custom-specified lengths.

Model L

Threaded connections: 3.375" [86 mm] in-line body length.

Flanged connections: 12" [305 mm] in-line body length.

Model C

See chart on outline dimensional, Appendix A.

- **Sensor Wetted Materials**

Model B

Standard: 316L stainless steel with all-welded construction.

Models S and F

Standard: 316L stainless steel with all-welded construction.
Optional: Hastelloy C, Monel 400, electro-polished stainless steel and titanium (FLT93S only). Other spray coatings are available on special request (i.e., tantalum, chromium carbide, Kynar).

Model L

Standard: 316L stainless steel with all-welded construction.
Optional: Hastelloy C, Monel 400 and titanium.

Model C

Standard: 316L stainless steel with all-welded construction electro-polished to 20 Ra.

- **Operating Temperature**

All Models

Standard temperature configuration:
-40 °F to +350 °F [-40 °C to +177 °C]
Medium temperature configuration:
-100 °F to +500 °F [-73 °C to +260 °C]

Model S Only

High temperature configuration:
-100 °F to +850 °F [-73 °C to +454 °C]

- **Operating Pressure (w/NPT Process Connection)**

Models S, B, F and L

2350 psig [162 bar(g)] -100 °F to 500 °F [-73 °C to 260 °C]

Models S, B

1450 psig [100 bar(g)] 501 °F to 850 °F [261 °C to 454 °C]

Model C

1500 psig [103 bar(g)] -100 °F to 500 °F [-73 °C to 260 °C]

Higher ratings available with special construction and test certification.

Environmental Conditioning

Indoor or outdoor use.
Maximum Relative Humidity: 100%
Maximum Altitude: 12,000 ft.

Control Circuit (5208)

- **Configuration**

Standard: Plug-in, socket mounted with dual alarm/trip epoxy sealed relays.
Optional: Rack-mount configuration (card cage or enclosure not included).

- **Output Signals**

Standard: Analog DC voltage related to flow or level/interface signal and analog DC voltage proportional to temperature.

- **Input Power**

Standard: Field selectable for 120 VAC (108-132 VAC), 13 W 100 mA maximum; 230 VAC (207-253 VAC), 14 W 50 mA maximum; 24 VDC (21-30 VDC), 7 W, 230 mA maximum or 24 VAC (18-28 VAC), 7 W, 230 mA maximum.
Optional: Low supply voltage operation for applications with line voltage supplies lower than 108 VAC. Field selectable for 100 VAC (90-110 VAC), 13 W, 100 mA maximum; 200 VAC (180-220 VAC) 14 W, 50 mA maximum.
All AC power rated at 50-60 Hz.
Power "ON" amber LED provided.

- **Serviceable Fuse Rating**

For the 120/230 VAC input power configuration, there are two serviceable fuses located on the top side of the control circuit. These are labeled F1 and F2.

Fuse Specifications

Power: 1.6 amps, 250 VAC, Slo-Blo® (time delay)
Package size: TRS (8.5 x 8 mm) radial lead plug-in type
FCI part number: 019933-01
Tyco part number: 37411600410

For the 24 VDC/VAC input power configuration, there is a fuse located on the bottom side of the control circuit. The replacement of this fuse requires a qualified technician knowledgeable in SMD, and RoHS soldering practices.

Fuse Specifications

Power: 1.5 amps, 125 VDC, SLO-BLO® (time delay)
Package size: 6.1 x 2.69 mm SMD
FCI part number: 020399-02
Littelfuse part number: 045201.5

- **Heater Power**

Field or factory selected to optimize switching performance and rangeability and selectable for specific fluid service requirements.

Typical Service	*Sensing Element*	*Power (W)*
Gas or Air	S/B-Style	0.75
	F-Style	0.25
Liquids	S/B-Style	3.0

The above typical service power selections are for reference only. Depending on application requirements, surface temperature rating requirements, and rangeability expectations, alternate power selections may be recommended. Other intermediate power selections can be made.

- **Relay Rating**

Standard: Dual alarm, SPDT or single alarm DPDT field configurable, 6 amps resistive load at 240 VAC, 120 VAC, 24 VDC.
Optional: Dual alarm SPDT or single alarm DPDT field configurable hermetically sealed relay, 0.5 amps at 115 VAC/2 amps at 28 VDC.

- **Electrical Enclosure**

Aluminum (epoxy coated) or optional stainless steel. Enclosures are rated for hazardous location use (Class I and II, Division 1 and 2, Group B, C, D, E, F and G; and Ex db IIC, Ex tb IIIC) and weather and corrosion resistant (NEMA and CSA Type 4X and equivalent to IP66).

- **Operating Temperature**

Ambient -40 °F to +140 °F [-40 °C to + 60 °C]

For Flow Service

- **Setpoint Range**

  Models S, B

  Water-based Liquids:
  0.01 FPS to 0.5 FPS [0.003 MPS to 1.52 MPS] with 0.75 watt heater;
  0.01 FPS to 3.0 FPS [0.003 MPS to 0.9 MPS] with 3.0 watt heater.
  Hydrocarbon-based Liquids:
  0.01 FPS to 1.0 FPS [0.003 MPS to 0.3 MPS] with 0.75 watt heater;
  0.01 FPS to 5.0 FPS with [0.003 MPS to 1.5 MPS] with 3.0 watt heater.

  Air/Gas:
  0.25 SFPS to 120 SFPS [0.08 NMPS to 37 NMPS] with 0.75 watt heater at standard conditions; 70 °F [21.1 °C], 14.7 psia [1.013 bar(g)].

  Other Fluids: Contact the factory for approximate rangeability.

  Model F

  Air/Gas:
  0.25 SFPS to 120 SFPS [0.08 NMPS to 37 NMPS] 0.25 watt heater at standard conditions; 70 °F [21.1 °C], 14.7 psig [1.013 bar(g)].

  Model L

  Water-based Liquids: 0.015 cc/sec to 50 cc/sec
  Hydrocarbon-based Liquids: 0.033 cc/sec to 110 cc/sec
  Air/Gas: 0.6 cc/sec to 20,000 cc/sec

  Model C

  Water-based Liquids: 0.01 FPS to 3.0 FPS [0.003 MPS to 0.9 MPS]
  Syrup: to 5.0 FPS [0.0003 MPS to 1.5 MPS]
  Air/Gas: 0.25 SFPS to 120 SFPS [0.08 NMPS to 36.6 NMPS]

- **Factory Calibrated Switch Point Accuracy**
  Any flow rate within the instrument flow range may be selected as a setpoint alarm. A factory-calibrated setpoint adjustment may be optimally preset with accuracy of ±2% of setpoint velocity over an operating temperature range of ±50 °F [±28 °C].

- **Monitoring Accuracy**
  Based on the non-linear output voltage (P1, pins 1 & 2) over the entire flow range, a 100 °F (56 °C) max. temperature span, and a max. operating pressure range of ±100 psig [±7 bar(g)]:

  Liquids: ±5% reading or ±0.04 SFPS [±0.012 NMPS], whichever is larger.
  Gases: ±5% reading or ±2 SFPS [±0.61 NMPS], whichever is larger.

- **Repeatability**
  ±0.5% reading

For Level/Interface Service

- **Accuracy**
  Models S, B
  ±0.25" [±6.4 mm]
  Model F
  ±0.1" [±2.5 mm]

- **Repeatability**
  Models S, B
  ±0.125" [±3.2 mm]
  Model F
  ±0.05" [±1.3 mm]

For Temperature Service

- **Accuracy**
  ±2.0 °F [±1 °C] with field setpoint adjustment. Monitoring accuracy
  ±3.5 °F [±2 °C] with standard curve fit output voltage operation across the selected instrument temperature range. Higher accuracy available with factory calibrations.

- **Repeatability**
  ±1.0 °F [±0.6 °C]
  The above accuracy is based on liquid or slurry service and in gas service with a minimum 1 SFPS [0.3 NMPS] velocity past the sensing element or with the heater deactivated for temperature sensing service only.

- **SIL**
  SIL-2 compliant, safe failure fraction (SFF) 82% to 84%

Factory Application–Specific Setup and Setpoint Calibration

Standard instrument factory default settings (unless otherwise selected at order entry):

- 120 VAC input power for all domestic units.
- 230 VAC for all other agency approval units. Field selectable.
- Dual SPDT alarms set for: **Alarm No. 1**: Preset for flow or level and to de-energize with decreasing conditions; **Alarm No. 2**: Preset to de-energize for increasing temperature at 10 °F [5 °C] below the maximum instrument process temperature.
- Heater power at 0.25 watt on Model F or 0.75 watt on Model S/B.
- Mode switch set to "operate".

Factory calibration including set up for specific service, process fluid and alarm conditions optionally available. Contact factory for fluid handling capabilities.

Agency Approvals

FM, FMc
XP, Class I, Division 1, Groups B, C, D
DIP, Class II/III, Division 1, Groups E, F, G
NI, Class I, Division 2, Groups A, B, C, D
NI, Class II/III, Division 2, Groups E, F, G
T4, Ta = 60 °C; T3A, Ta = 60 °C

ATEX

Integral version:
II 2 G Ex db IIC T4…T2 Gb
II 2 D Ex tb IIIC T135 °C…T300 °C Db
Remote enclosure + electronics:
II 2 G Ex db IIC T6 Gb
II 2 D Ex tb IIIC T85 °C Db
Local enclosure + sensor:
II 2 G Ex db IIC T4…T1 Gb
II 2 D Ex tb IIIC T135 °C…T345 °C Db

IECEx
Integral version:
Ex db IIC T4…T2 Gb
Ex tb IIIC T135 °C…T300 °C Db
Remote enclosure + electronics:
Ex db IIC T6 Gb
Ex tb IIIC T85 °C Db
Local enclosure + sensor:
Ex db IIC T4…T1 Gb
Ex tb IIIC T135 °C…T345 °C Db

Other Certifications: SIL-2 rated, CRN, probe complies with Canadian Electrical Code requirements of ANSI/UL 122701 as a single seal device, CE marking, RoHS compliant.

Shipping Weight (approximate)

Integral: 8 lb [3.6 kg]
Remote: 13 lb [5.9 kg]

2 INSTALLATION

Receiving/Inspection

- Unpack carefully.
- Verify that all items in the packing list are received and are correct.
- Inspect all instruments for damage or contaminants prior to installation.

If the above three items are satisfactory, proceed with the installation. If not, then stop and contact a customer service representative.

Packing/Shipping/Returns

These issues are addressed in Appendix E - Customer Service.

Factory Calibration Note

The instrument is factory calibrated to the applications as specified at the time of order. There is no need to perform any verification or calibration steps prior to installing and placing the instrument in service unless the application has changed.

Pre-Installation Procedure

Warning: This instrument must be installed by qualified personnel only. Install and follow safety procedures in accordance with local and national electrical codes and regulations. Ensure that power is OFF during installation. Any instances where power is applied to the instrument will be noted in this manual. Where the instructions call for the use of electrical current, the operator assumes all responsibility for conformance to safety standards and practices.

Caution: The instrument contains electrostatic discharge (ESD) sensitive devices. Use standard ESD precautions when handling the control circuit. See below, for ESD details.

The instrument is not designed for weld-in-place applications. Never weld to a process connection or a structural support.

Damage resulting from moisture penetration of the control circuit or flow element enclosure is not covered by product warranty.

Use Standard ESD Precautions

Use standard ESD precautions when opening an instrument enclosure or handling the control circuit. FCI recommends the use of the following precautions: Use a wrist band or heel strap with a 1 megohm resistor connected to ground. If the instrument is in a shop setting use workstations with static conductive mats on the work table and floor with a 1 megohm resistor connected to ground. Connect the instrument to ground. Apply antistatic agents to hand tools to be used on the instrument. Keep high static producing items away from the instrument such as non-ESD approved plastic, tape and packing foam.

For sensors and flanges containing titanium, ignition hazards due to impact or friction must be avoided according to EN/IEC 60079-0, clause 8.3.

The above precautions are minimum requirements to be used. The complete use of ESD precautions can be found in the U.S. Department Of Defense Handbook 263.

Prepare or Verify Sensing Element Location

Prepare the process pipe for installation, or inspect the already prepared location to ensure that the instrument will fit into the system.

Review the requirement for the supply power and alarm circuit connections.

Verify Dimensions

Verify the instrument's dimensions versus the process location to be sure of a correct fit. Also see Appendix A for dimensions.

Verify Sensing Element Flow Direction and Placement Orientation (Flow Application)

For flow detection, the sensing element surface marked with direction arrows should be oriented parallel to the process flow. The flow can be from either direction.

For optimum accuracy, mount the sensing element away from any bends or interference in the process pipe or duct for a minimum of 20 pipe diameters upstream (before the flow meter) and ten pipe diameters downstream (after the flow meter).

For liquid flow service, locate the sensing element in the process pipe so that the thermowells are always completely wet.

When mounted in a tee or section of pipe larger than the normal process pipe, position in a vertical run of pipe with flow upward. This will prevent air or gas bubbles from becoming trapped at the sensor assembly.

Vertical positioning with flow downward is only recommended for higher flow rate applications (consult FCI).

Verify Sensing Element Flow Direction and Placement Orientation (Level Application)

If the sensing element is side-mounted on the process vessel, then the surface marked with direction arrows should be vertically oriented.

If the sensing element is top- or bottom-mounted on the process vessel, the orientation of the surface marked with direction arrows does not matter.

Install the Sensing Element

Male NPT Mounting

When mounting the sensing element to the process pipe, it is important that a lubricant/sealant be applied to the male threads of all connections. Be sure to use a lubricant/sealant compatible with the process environment. All connections should be tightened firmly. To avoid leaks, do not overtighten or cross-thread connections. See Figure 2 below and the appropriate drawings in Appendix A for proper mounting.

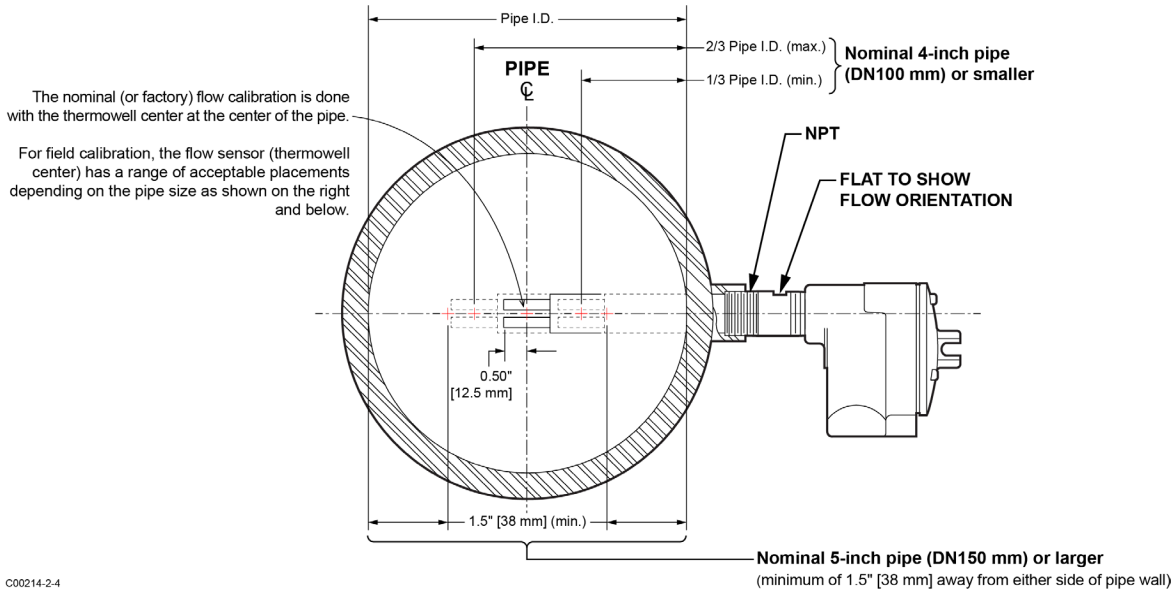

Figure 2 – NPT Pipe Thread Mount

Flange Mounting

For flange mounted sensing elements, attach the process mating flange with care. The correct orientation of the sensing element must be maintained to ensure optimum performance or calibration. See Figure 3 below and the appropriate drawings in Appendix A.

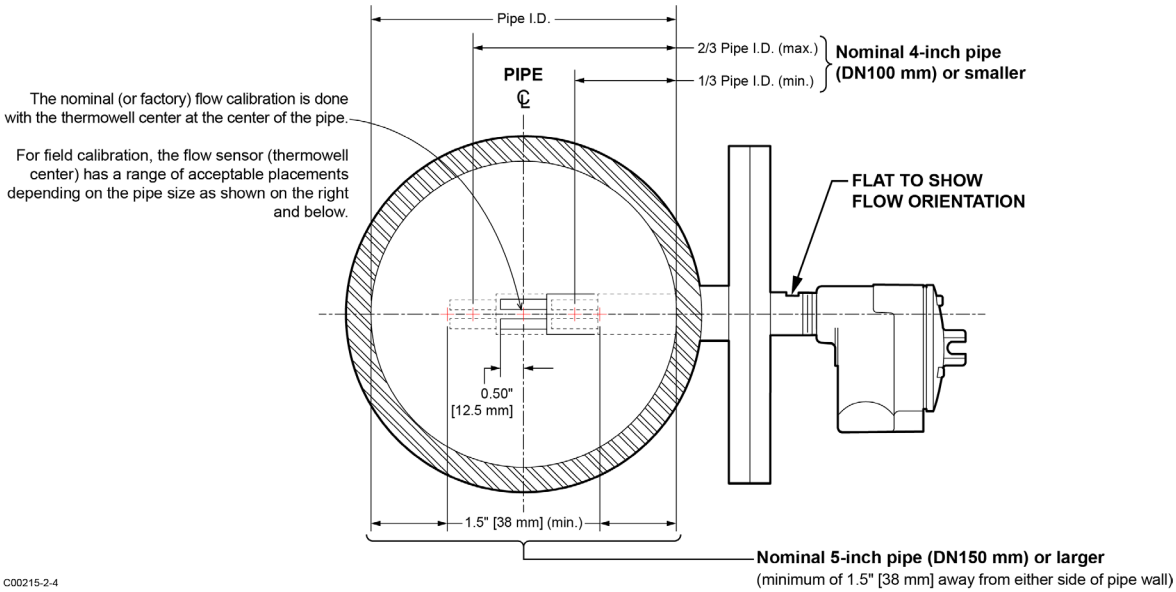

Figure 3 – Flange Mount

Packing Gland Assembly

For applications involving the use of a packing gland (low or medium pressure) refer to the drawings in Appendix A for additional detail.

1. Threaded or flanged packing gland mounts are available. The valve assembly with appropriate connections are customer supplied. Follow the male NPT mounting procedure above to attach the pipe thread portion or flange mounting portion as applicable.
2. Tighten the packing nut until the internal packing is tight enough so that the friction fit on the shaft is adequate to prevent leakage but not prevent the shaft from sliding. Position the etched flow arrow parallel with the flow (±1° of level) and position the flow arrow so it is pointing in the direction of the flow.
3. Proceed to insert the probe into the process media line.
4. For medium pressure packing gland only (PGM): Use the adjusting nuts on the all-thread to pull the sensing element into proper predetermined depth position.
5. For medium pressure packing gland only (PGM): Tighten the opposing lock nuts on the all-threads.
6. Tighten the packing nut another half to full turn until tight (approximately 65 to 85 ft-lbs [88 to 115 N-m] torque).
7. Rotate the split ring locking collar to line up with the connecting strap welded to the packing nut. Tighten the two 1/4-28 hex socket cap screws on the split ring locking collar.

Reverse these steps for removal.

In-line NPT Assembly (FLT93L)

Check the body length of the in-line assembly to make sure the assembly will fit into the process line. See the appropriate drawing in Appendix A to determine the assembly length. The direction of flow is important for proper operation. There is a flow direction arrow on the in-line pipe that is to point in the direction of flow. See Figure 4 below for the correct orientation.

If the instrument is a butt weld assembly, be sure to do the following: Remove the circuit board, properly ground the flow element before welding.

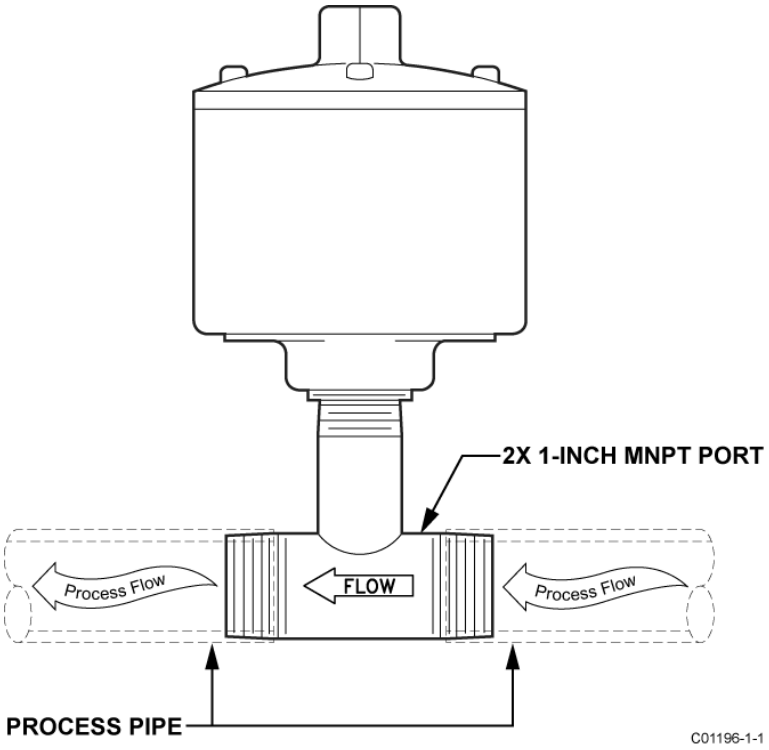

Figure 4 – FLT93L In-Line Flow Element (Shown with 1-Inch MNPT Ports)

Sanitary Assembly (FLT93C)

The instrument is inserted into the process connection with removable clamp fittings. The Removable Clamp (RC) sanitary assembly contains a removable clamp connection to the flow element. The Clean-In-Place (CIP) sanitary assembly has the flow element directly welded into the process stand pipe. Otherwise these instruments function exactly the same as an FLT93F or FLT93S. See Appendix A for outline dimensions of the instruments. Figure 5 also shows the sanitary assemblies.

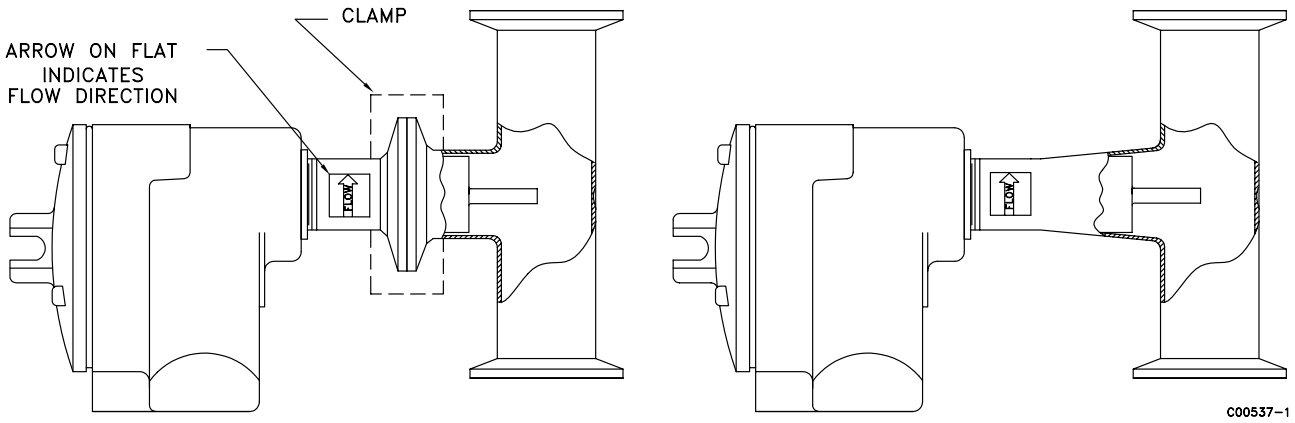

Figure 5 – FLT93C Sanitary Flow Elements (RC and CIP)

Install and Wire the Enclosure(s)

Warning: In applications where the sensing element is located in an explosive environment, isolate the conduit before it leaves the environment. A silicone encapsulant/potting compound can be used to provide the isolation.

Install an input power disconnect switch and fuse near the instrument to interrupt power during installation and maintenance. *Always disconnect/shut-off power before wiring.*

Caution: Pulling wires can cause damage to the control circuit. Therefore, remove the control circuit from the enclosure and use extreme care when pulling wires into the enclosure.

Mount and wire the control circuit either locally or remotely (option) by following the local or remote enclosure procedure below.

Disconnect Device

IEC 61010-1 requires the installation of an external switch or circuit breaker on the 120/220 VAC power source. It is recommended that the switch or the circuit breaker be in close proximity to the flow switch and within easy reach of the operator. The recommended breaker trip value for 120/220 VAC is 3 amps. If 24 VDC/VAC input power is being used a disconnect switch or breaker is also recommended. Recommended breaker value is 3 amps. All disconnect devices shall be clearly marked for the flow switch.

Minimum Wire Size

Table 2-1 shows the smallest (maximum AWG number) copper wire that is used in the electrical cables. Use a lower gauge of wire for less of a voltage drop. Contact FCI concerning greater distances than those listed in the table. The sensing element cable must be shielded. If the cable is spliced the shield wire must be continued through the splice. If a terminal block is used, the shield must have its own terminal.

Table 2-1 Maximum AWG Number

Connection	Maximum Distance for AWG					
	10 ft. (3m)	50 ft (15m)	100 ft. (31m)	250 ft. (76m)	500 ft. (152m)	1000 ft. (305m)
AC/DC Power	22	22	22	20	18	16
Relay (6A)	28	22	20	16	12	10
Flow Element Wires*	22	20	20	18	18	18

* Requires a shielded cable with the shield wire connected to the terminal board only.

Enclosures Covers

All enclosure covers must be in place and securely closed to achieve environmental and safety classifications.

Tighten all circular thread-on covers about 1 full turn past hand tight.

Cover locks must be in place and secure if required by a particular approval.

Note: Nitrile (buna-N) O-rings are standard on the circular thread covers. These O-rings have a 250 °F (121 °C) maximum usage temperature.

A Viton O-ring [400 °F (204 °C) max. temp.] is available for the thread-on covers.

To receive a Viton O-ring, provide FCI with the following information:

- Shipping address
- Quantity required
- Desired P/N:
  Use P/N 000391-01 for the single conduit port enclosure (Local)
  Use P/N 000391-07 for the dual conduit port enclosure (Remote)

Cable and Conduit Entry Devices

The cable and conduit entry devices and blanking elements shall be of a certified flameproof type Ex db and Ex tb suitable for T ratings up to 106 °C, suitable for the conditions of use and correctly installed. With the use of conduit entries a sealing device shall be provided immediately on the entrance of the device.

All cable glands and conduit fittings, including conduit plugs, must meet or exceed the area approval where the unit is being installed.

Enclosure Grounding

To ensure an Ex-compliant installation, follow the below steps to ground the enclosure.

Warning: Ensure that all power is OFF before wiring any circuit.

Tools required:

- Wire Stripper for 10-12 AWG (3.3-5.3 mm^2)
- Crimping Tool for 10-12 AWG (3.3-5.3 mm^2), TE Connectivity CERTI-CRIMP Direct Action Hand Tool 49935 (or equivalent)
- M4 hex key/Allen wrench

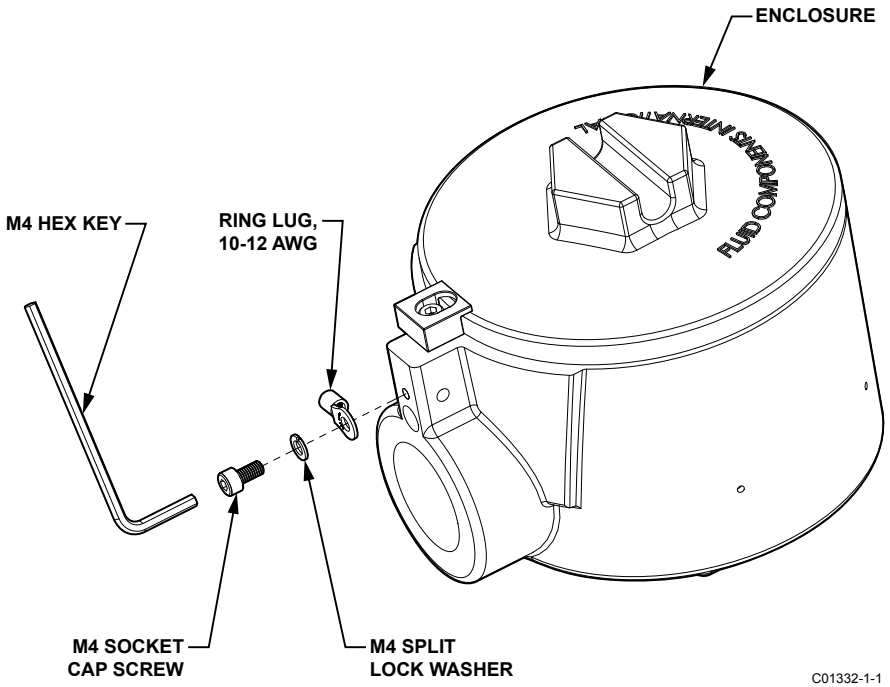

Figure 6 – Removing Ground Wire Securing Hardware from Enclosure

1. Strip .250"-.281" [6.35-7.14 mm] insulation from ground wire, stranded or solid (12-10 AWG).

   Note: Avoid nicking or cutting wire strands when stripping the wire insulation.

2. Remove M4 socket cap screw, M4 split washer and ring lug from enclosure using M4 hex key (Allen wrench). The enclosure's ground wire hardware is installed at the factory. See Figure 6 above.
3. Place center of ring lug barrel in appropriate crimping tool chamber. Squeeze tool handles together with just enough force to hold barrel in place (do not deform barrel).
4. Insert stripped end of ground wire into barrel. Place the wire such that the insulation does not enter barrel and that the stripped wire end does not extend beyond barrel.

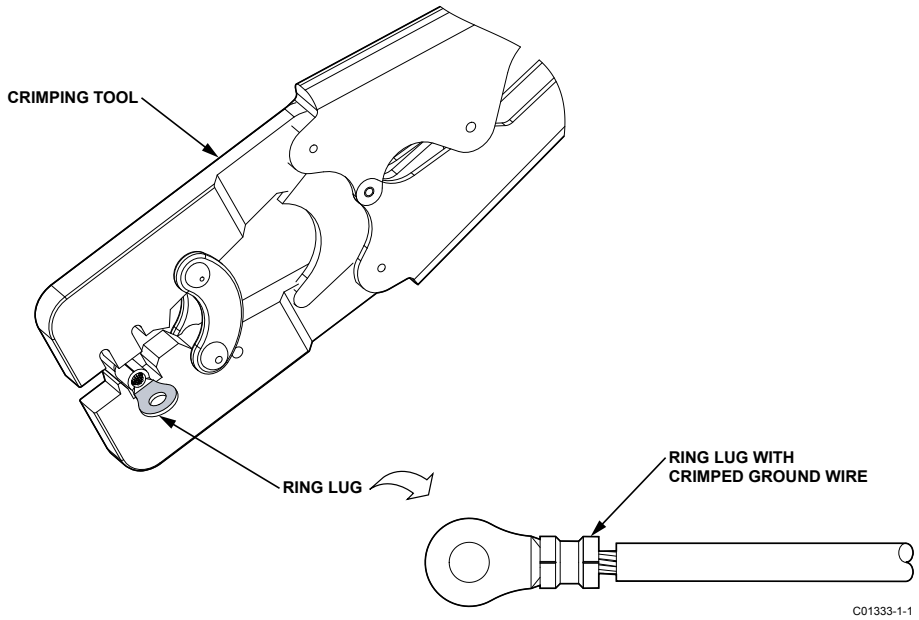

Figure 7 – Crimping Ground Wire Ring Lug

5. While holding the wire in place, squeeze the tool handles together until the ratchet releases, then allow the tool handle to open fully. See Figure 7.

   Caution: The crimping jaws bottom before ratchet releases. This feature ensures maximum electrical tensile performance of the crimp. Do NOT re-adjust the ratchet.

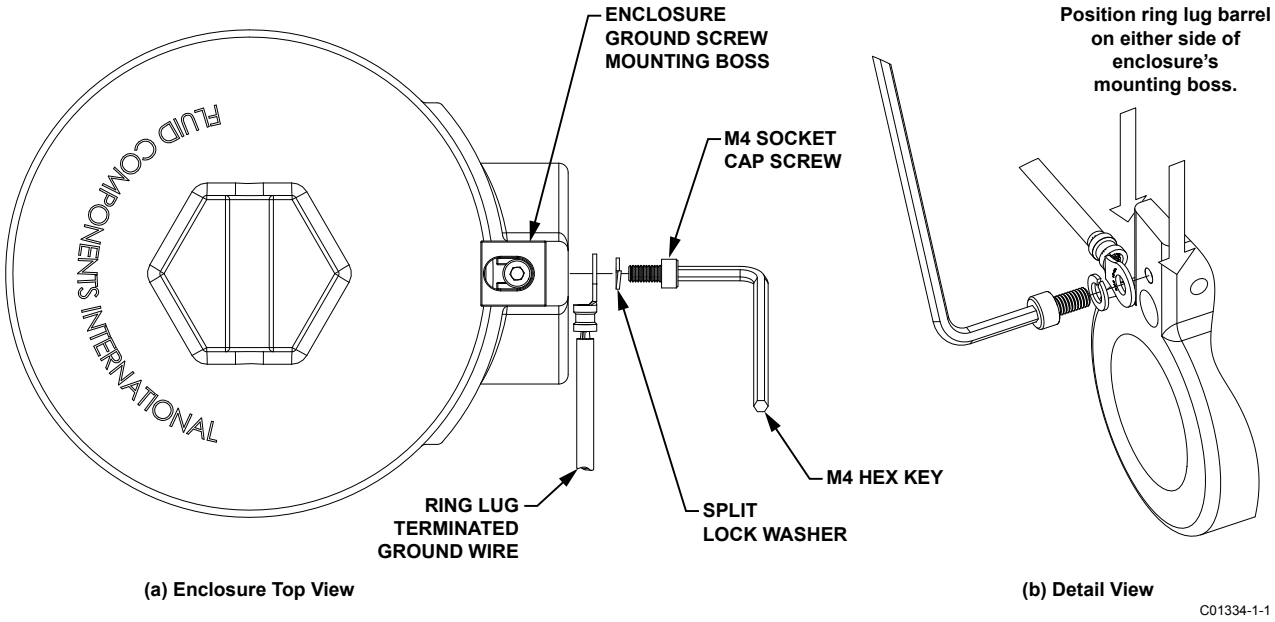

Figure 8 – Installing Ring Lug Terminated Ground Wire

6. Install ground wire ring lug with end of lug barrel touching the side of the enclosure's mounting boss as shown in Figure 8. Place the ring lug on either side of the mounting boss as needed for the installation. Install with the hardware in this order: socket cap screw, split lock washer, ring lug. Torque cap screw to 23 in-lb (2.6 N-m).

Wiring the Local Enclosure Configuration

Warning: Ensure that all power is OFF before wiring any circuit.

This procedure is for instruments with the control circuit located in the sensing element enclosure.

7. Remove the control circuit from the terminal board socket by loosening the two thumbscrews on top of the transformer bracket. Note: the screws are captive. Note the orientation of the control circuit. Grab hold of the transformer bracket where the screws are and unplug the control circuit from the terminal board by pulling on the transformer bracket.
8. Install conduit between the local enclosure, disconnect device and the power source and monitoring circuit. Provide watertight hardware and apply thread sealant to all connections to prevent water damage.
9. Refer to the *Wiring Input Power* section at the end of this section for the available input power configurations. Input power wiring configurations are the same for local and remote enclosure options and also any output relay configuration. Wire in accordance with the system requirements.
10. When connecting the relay wiring, do so with complete understanding of what the process requires of the instrument. The instrument has dual SPDT or single DPDT relay output contacts dependent on the jumper configuration for each alarm switch point. For the relay terminals and logic, refer to Figure 9 below. Also refer to Table 3-5 and Table 3-6 in Section 3 - Operation. Relay contacts are shown with the relays de-energized.

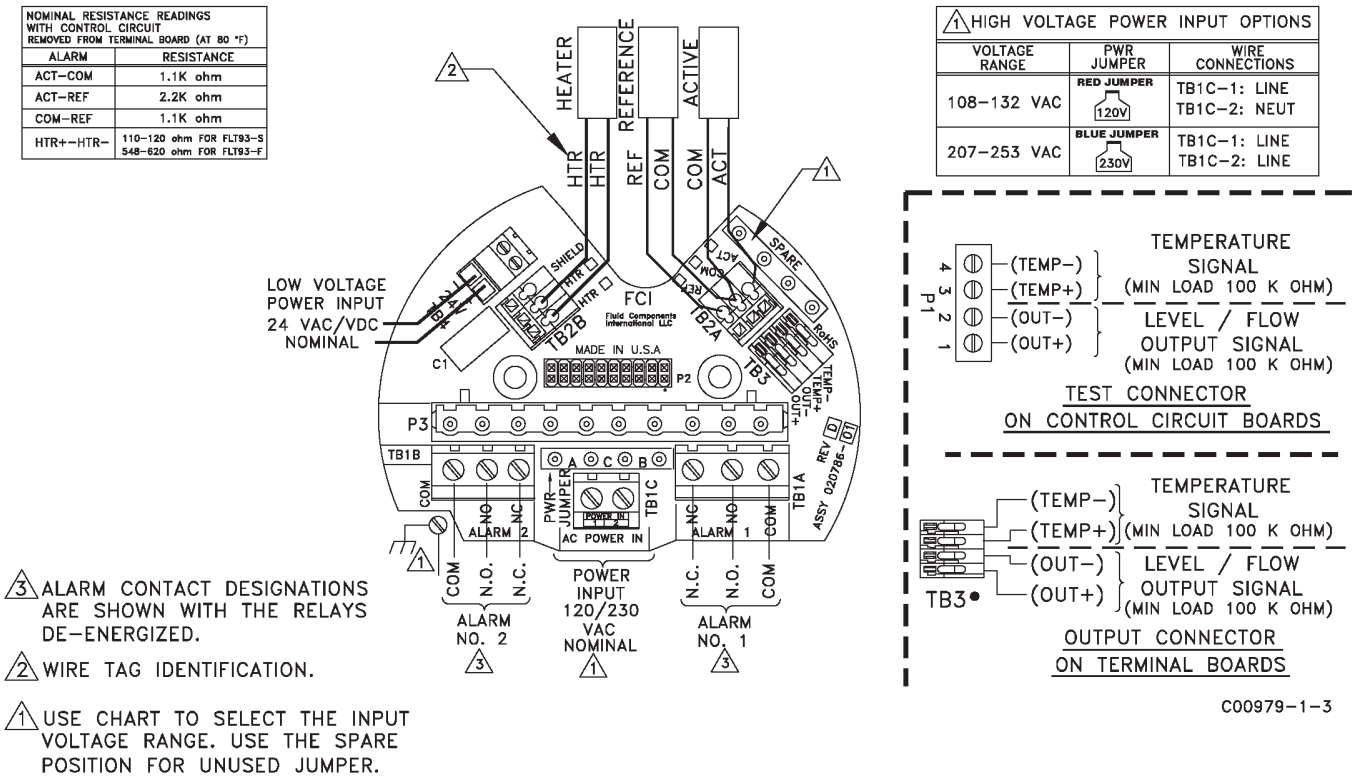

Figure 9 – Local Wiring Diagram

Wiring The Remote Enclosure Configuration

This procedure is for instruments with the control circuit located remotely (remote housing) from the sensing element (local enclosure).

Locate the Remote Hardware Location

Warning: Ensure that all power is off before wiring any circuit.

Drawings in Appendix A show the remote enclosure along with the physical dimensions to properly mount it. Select a location for the remote enclosure within 1000 feet (305 m) of the sensing element NOTE: Maximum cable length is 1000 ft. Pigtail sensing elements cannot be located more than 10 feet (3 m) from the enclosure unless the pigtail is extended with the proper size cable listed in Table 2-1. If the cable is extended the cable connections should be located in a junction box with a 6-position terminal block. All 5 conductors and the shield must have their own termination. The remote enclosure should be easily accessible with enough room to open the enclosure cover at any time. Secure the remote enclosure solidly to a vertical surface capable of providing support. Use appropriate hardware to secure the enclosure.

1. Remove the control circuit from the terminal board socket by loosening the two thumbscrews on top of the transformer bracket. Note: The screws are captive. Note the orientation of the control circuit. Grab hold of the transformer bracket where the screws are and unplug the control circuit from the terminal board by pulling on the transformer bracket.
2. Install conduit between the remote (electronics) enclosure, disconnect device and the power source\monitoring circuit. Install conduit from the remote electronics enclosure to the local (sensing element) enclosure. Provide watertight hardware and apply thread sealant to all connection to prevent water damage.
3. Refer to "Wiring Input Power" on the next page for the available input power configurations. Input power wiring configurations are the same for local and remote enclosure options and also any output relay configuration.
4. Run a five-conductor, shielded cable from the local enclosure to the remote enclosure. Use Table 2-1 to determine which wire gauge to use (wire between the local and remote enclosures). It is recommended to include a 14 AWG wire between the two enclosures connected to the grounding lugs and then to earth ground close to the control circuit housing, with the connection not to exceed 1 ohm.
5. When connecting the relay wiring, do so with complete understanding of what the process requires of the instrument. The instrument has dual SPDT or single DPDT relay output contacts dependent on the jumper configuration for each alarm switch point. For the relay terminals and logic, refer to Figure 10. Also refer to Table 3-5 and Table 3-6 in Section 3 - Operation. Relay contacts are shown with the relays de-energized. Wire in accordance with the system requirements.

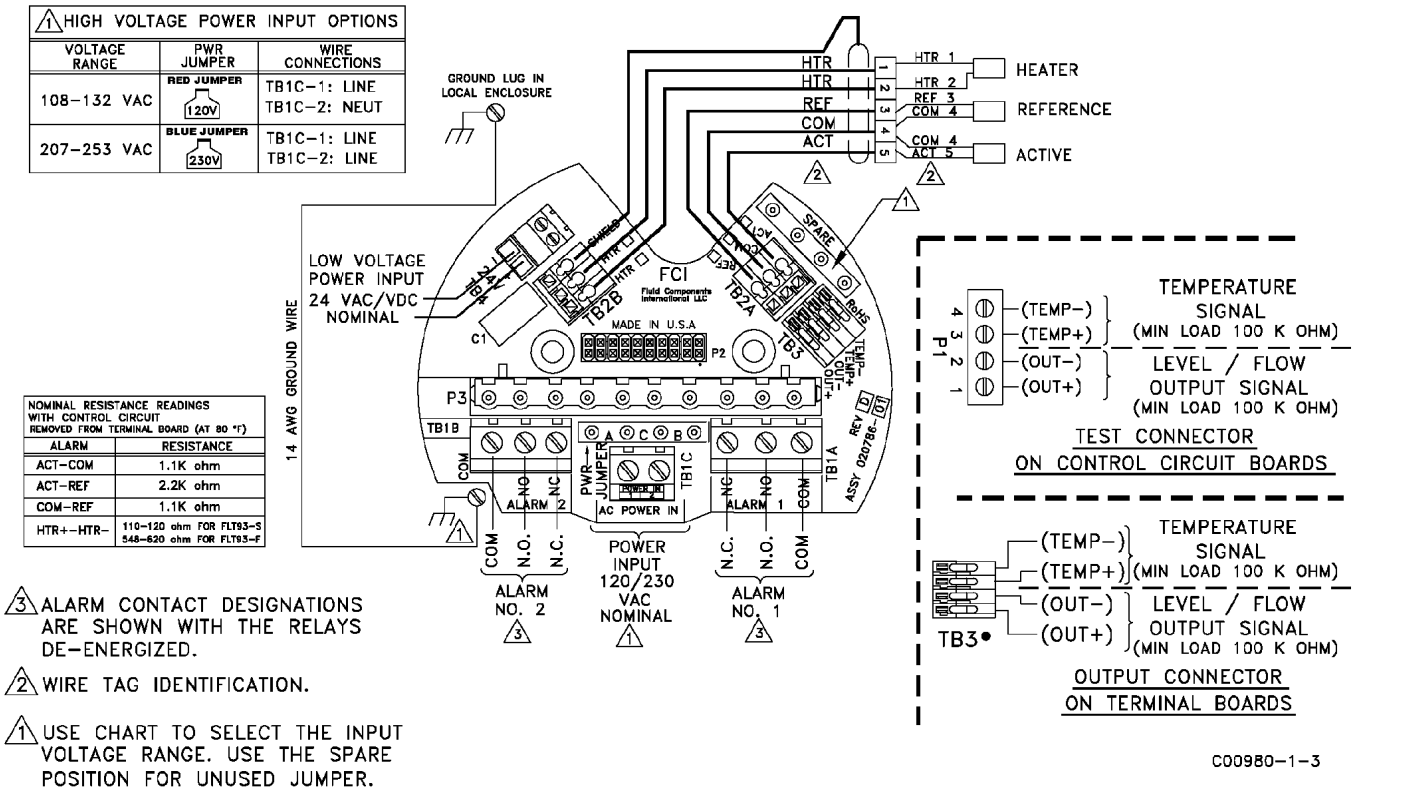

Figure 10 – Remote Wiring Diagram

Wiring Output Signal Terminals

The primary outputs on the FLT are the relays. Voltage ouputs relative to flow/level and temperature are provided on the terminal board at TB3. The signal voltage at positions 1 and 2 represents the process change (non-linear to flow). The signal voltage at positions 3 and 4 is proportional to the temperature at the sensing element. See Figures 9 and 10. See also Section 3 for the physical layout of the control circuit.

Caution: Do not ground terminal 2 of TB3. (Terminal 2 is the negative lead of the process signal.) This terminal is 9 volts above the control circuit ground. The peripheral using this signal must have a differential input.

These voltages can be used by other peripherals with a minimum load of 100K ohms. The terminal block can be wired with between gauge 24 and 20 wire. The maximum recommended length of wire is 100 feet. Shielding is required on any length of cable. Terminate the shield to earth ground.

To easily monitor output voltages locally while the instrument is powered, the control circuit has test points available at P1. These test points can be probed with pointed test leads or hooked on to with test clips (Pomona Mini Grabbers or Easy Hooks). See Figure 16 (Operation).

Wiring Input Power

The "Normal AC Line Input Voltages" and the "24 VDC/VAC" are the standard configurations provided and are selectable in the field. Refer to Table 2-2. An option for "Low AC Line Input Voltages" is available.

120 or 230 VAC Input: When wiring the terminal board for 120 or 230 VAC, refer to Table 2-2, and Figures 11, 12 and 13. Note the required power jumper and the position of the power input wires. The wire gauge range for TB1 is 24 to 12 AWG. Make sure all wires going into one position are properly attached by tugging on each wire individually. Once the terminal board is wired, the control circuit can be connected to the terminal board and secured with the thumbscrews. The control circuit does not need to be configured for power input.

24 VDC/VAC: When wiring the terminal board for 24 VDC/VAC refer to Table 2-2 and Figure 14. TB4 is a compression screw terminal block that has a wire range of 30 to 12 AWG. Make sure that all wires going into one position are properly attached by tugging each wire individually. When using 24 VDC the polarity does not need to be considered. DC can be connected in either polarity.

Table 2-2 Input Power Wiring Configurations

	5208 – A X X STANDARD AC LINE INPUT VOLTAGES		**5208 – (A or B) X X 24 VDC/VAC**	**5208 – B X X LOW AC LINE INPUT VOLTAGES**	
Power Jumper	RED	BLUE	NA	RED	BLUE
Main Feed	108 - 132 VAC	207 - 253 VAC	21 - 30 VDC 18 - 28 VAC	90 - 110 VAC	180 - 220 VAC
LINE 1	TB1C-1	TB1C - 1	NA	TB1C-1	TB1C - 1
NEUT / LINE 2	TB1C-2	TB1C-2		TB1C-2	TB1C-2
- 24 VDC/VAC	NA	NA	TB4- 24 DC/AC	NA	NA
+ 24 VDC/VAC	NA	NA	TB4+ 24 DC/AC	NA	NA

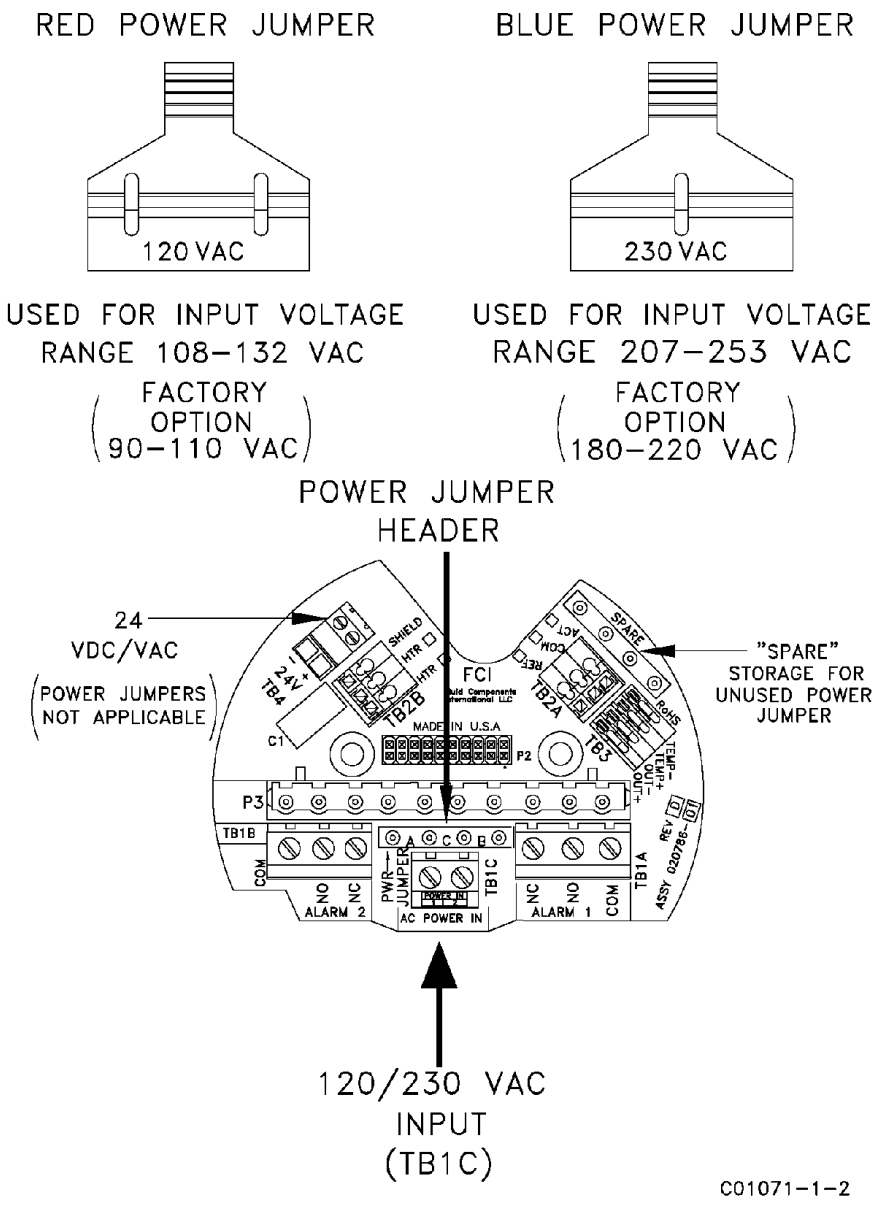

Figure 11 – Power Jumper Diagram

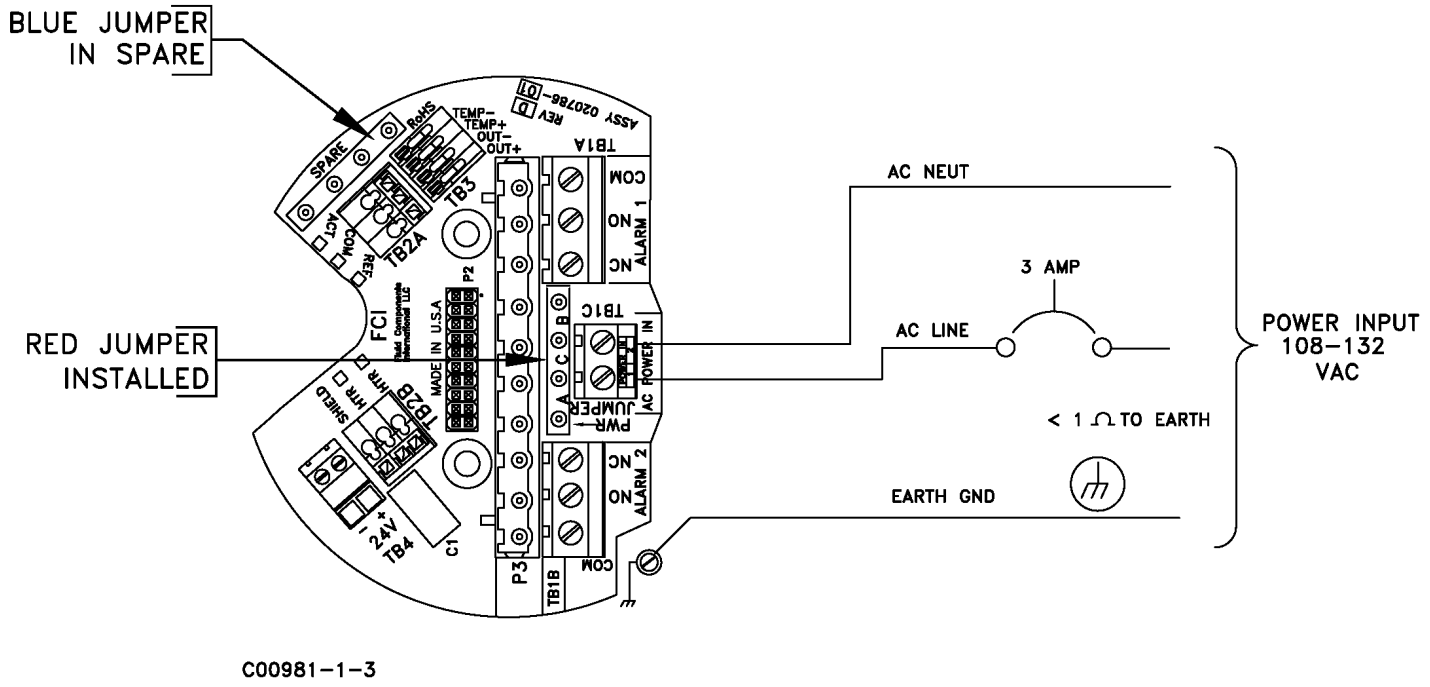

Figure 12 – 120 VAC Input Power Wiring Diagram

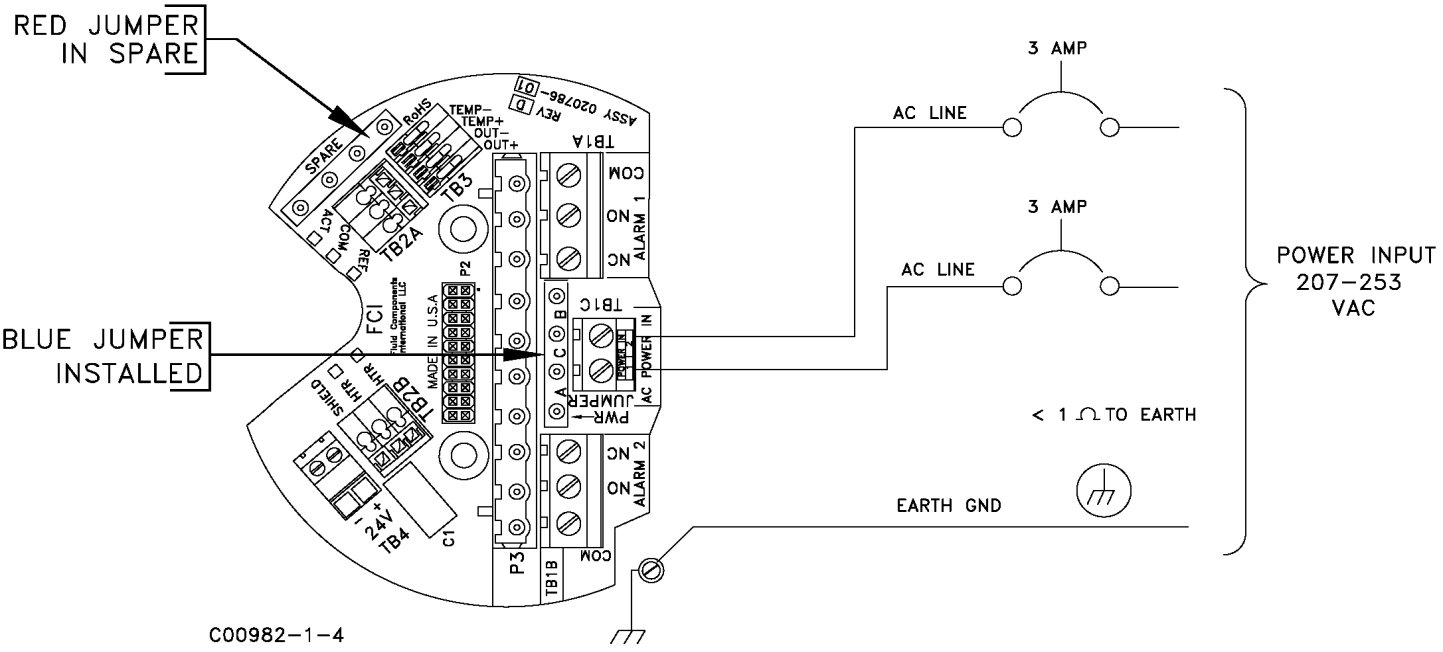

Figure 13 – 230 VAC Input Power Wiring Diagram

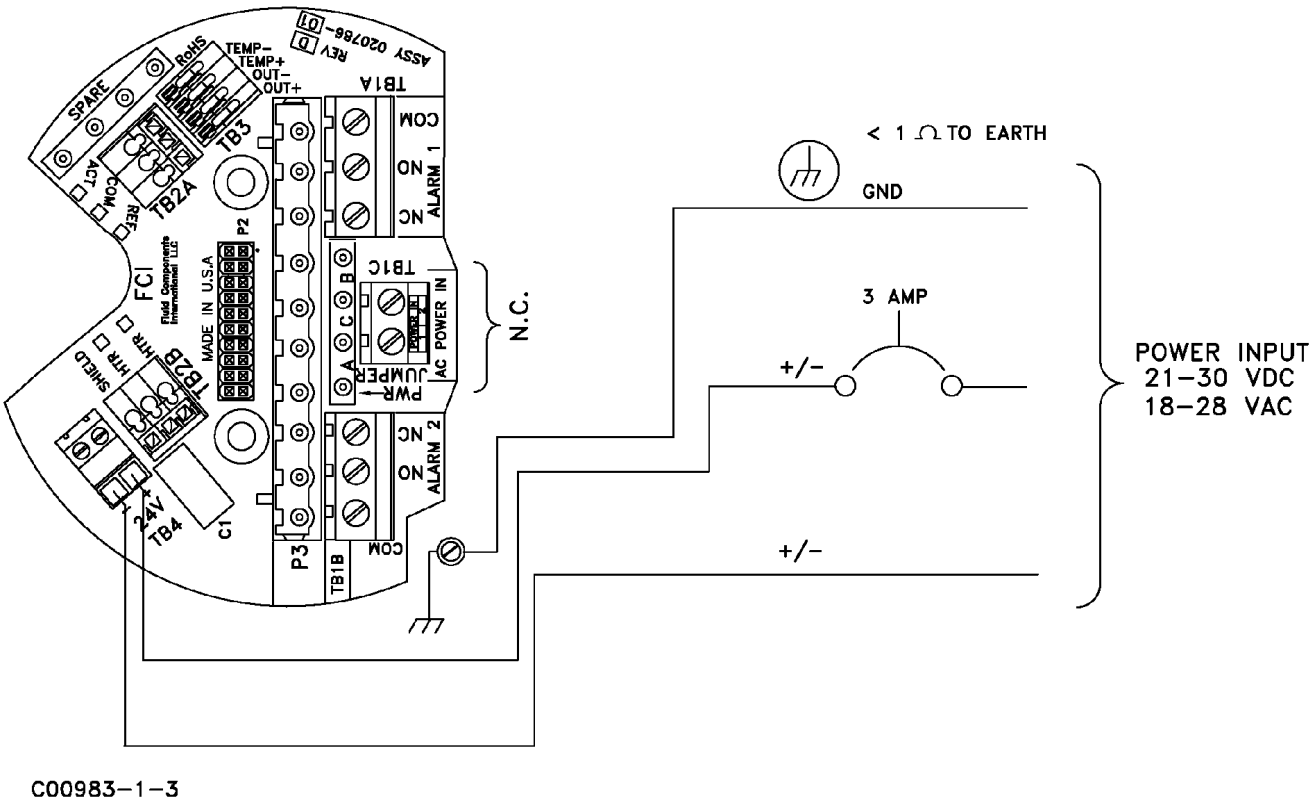

Figure 14 – 24 VAC/VDC Input Power Wiring Diagram

Figures 12, 13 and 14 can be cross referenced in Appendix A with FCI drawings 022580 [Wiring Diagram FLT93/5208 Integral Control Circuit] and 022581 [Wiring Diagram FLT93/5208 Remote Control Circuit].

3 OPERATION

Caution: The control circuit contains electrostatic discharge (ESD) sensitive devices. Use standard ESD precautions when handling the control circuit. See "Use Standard ESD Precautions" on page 5 for ESD details.

Factory Default Jumper Configuration

Unless a custom factory setup or calibration is specified, the instrument is delivered in a standard factory configuration. The standard default jumper configuration is shown in Table 3-1 below.

Table 3-1 Standard Jumper Default Configuration

Parameter	Description
Heater Power	FLT93S, FLT93B: 0.75 watts for air or liquid level applications. (J13)
	FLT93F: 0.25 watts for air or liquid level applications. (J14)
Number of Alarms	Two (J23). Each alarm has one set of SPDT contacts
Alarm No. 1 Red LED Setpoint Pot, R26	Set to monitor flow or level signals (J20). Relay energized at flow or wet (J27)
Alarm No. 2 Green LED Setpoint Pot, R25	Set to monitor temperature signals (J19). Relay energized below temperature (J25). Setpoint at approximately: 350 °F (121 °C) for standard temperature 500 °F (260 °C) for medium temperature 850 °F (454 °C) for high temperature (FLT93S Only)

If the order includes custom factory setup and calibration, leave all settings alone. The instrument is ready for service without changes.

If custom factory setup or calibration was not ordered, configure the control circuit using the jumper tables (Tables 3-2 to 3-6) and then follow the setpoint adjustment section that is appropriate for the application.

Configuration Jumpers

If the order did not specify for the control circuit to be factory configured, the standard configuration can be changed using Figure 15 and Table 3-1 through Table 3-6. The factory default configuration is shown underlined.

Heater Cut-Off

The 5208 control circuit has a heater cutoff switch that limits the skin temperature of the sensing element to a temperature differential of approximately 150 °F (66 °C) above the process temperature. In the case where the instrument is used as a gas flow switch, and the heater wattage is set too high, the temperature differential between the RTDs may exceed the usable input range of the control circuit. The usable input range can also be exceeded in the case where the instrument is used in liquid flow applications where the heater wattage is set at the highest value, and the sensing elements go dry. When the temperature differential is less than 150 °F (66 °C) the heater automatically turns back on. The yellow power indicator LED (DS3) turns on and off with the heater for a visual indication of the heater state. The LED will alternate between on and off (i.e., flashing) until the condition is corrected.

The reason for operating in the above extreme conditions is to insure that the input signal range is at the widest point making the alarm setpoint adjustment easier to perform. If the heater does cycle the operator may need to use the next lower wattage setting.

In some applications it is desirable to set the heater wattage high, even though the sensing element goes into the heater cutoff mode. An example is when the instrument is used to detect the interface of two liquids. These liquids may have viscosities that will have signals very close to each other. In order to have the maximum signal difference between the signals the heater wattage is set to its maximum. If the sensing element detects a dry condition the control circuit will indicate a heater cutoff condition. The sensing element will not be damaged if it is left dry with the maximum heater wattage. The alarms can be set so one alarm will switch at the interface and one alarm can detect when the element goes dry.

Alarm Setpoint Adjustments

Numerical Adjustment Versus Adjustment by Observation

An alarm setpoint is established using either numerical adjustment or adjustment by observation. The adjustment by observation requires the customer to establish normal process operation and adjust the alarm setpoint relative to this condition. The numerical approach requires measuring normal and alarm process conditions with a voltmeter and setting up the instrument in the calibrate mode based on these values. The adjustment by observation requires less time to establish the alarm setpoint. The numerical adjustment requires control of the process as well as additional time to establish the alarm setpoint. Use the adjustment procedure that is the most appropriate for the application requirement.

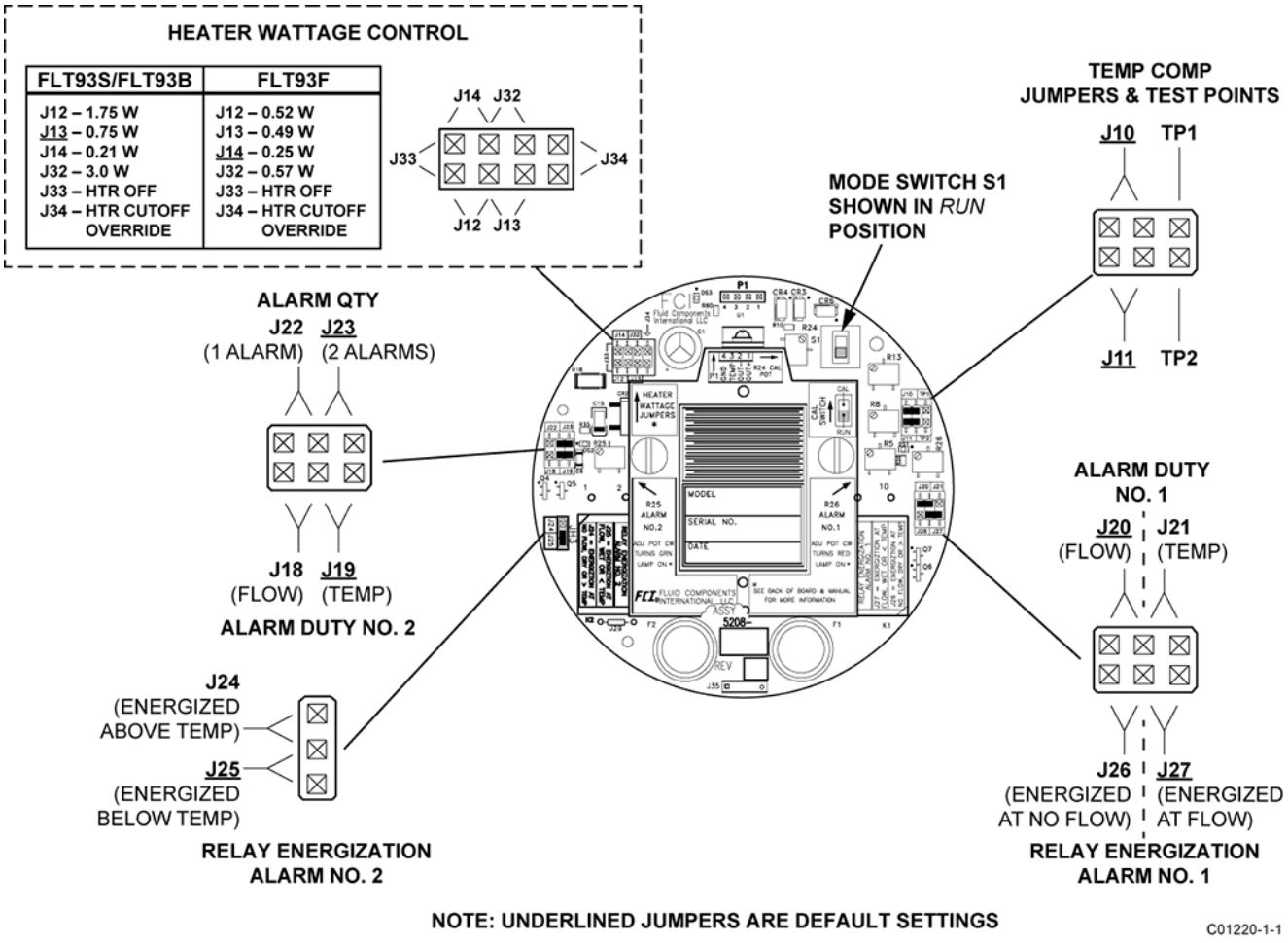

Figure 15 – 5208 Control Circuit Jumper Locations

Table 3-2 Selectable Heater Wattage Control

Jumper	J32	J12	J13	J14	J33
FLT93S/FLT93B Element Wattage (110-ohm Heater)	3 watts	1.75 watts	0.75 watts*	0.21 watts	OFF
FLT93F Element Wattage (560-ohm Heater)	0.57 watts	0.52 watts	0.49 watts	0.25 watts*	OFF

*J13 is standard for FLT93S/FLT93B and J14 is standard for FLT93F

Table 3-3 Fixed Heater Wattage Control (T4 Settings)

Jumper	J13	J14	J33
FLT93F Element Wattage (560-ohm Heater)	N.A.	0.25 watts	OFF
FLT93S/FLT93B Element Wattage (110-ohm Heater)	0.75 watts	N.A.	OFF

Table 3-4 Alarm Duty/Application

	Flow/Level	Temperature
Alarm No. 1	J20	J21
Alarm No. 2	J18	J19

Table 3-5 Relay Energization

Jumper	Alarm No. 1
J27	Relay De-Energized With Low Flow, Low Level (Dry) Or High Temperature
J26	Relay De-Energized With High Flow, High Level (Wet) Or Low Temperature

Jumper	Alarm No. 2
J25	Relay De-Energized With Low Flow, Low Level (Dry) Or High Temperature
J24	Relay De-Energized With High Flow, High Level (Wet) Or Low Temperature

Table 3-6 Alarm Qty./Relay Contact Configuration

Jumper	Configuration
J23	Dual SPDT (One Relay Per Alarm)
J22	Single DPDT (Disables Alarm No. 2)

Numerical Alarm Setpoint Adjustment

The control circuit has two mutually exclusive alarms identified as Alarm No. 1 and Alarm No. 2. Each has an alarm setpoint adjustment potentiometer and LED indicator. Both alarms can be set up for one of three applications; flow, level/interface, or temperature. The following application specific adjustment procedures are generic and can be used for setting either or both alarms. Use Figure 16 to help locate the important setup components (potentiometers, LEDs, etc.)

Air/Gas Flow Applications

1. Remove the instrument's enclosure cover.
2. Ensure the configuration jumpers on the control circuit are correct for this application. See Tables 3-2 through 3-6.
3. Make sure the input power is wired correctly (see Section 2).
4. Apply power to the instrument. Verify the yellow LED is on. Allow fifteen minutes for the instrument to warm-up.
5. Verify the Mode switch is in the RUN position.
6. Attach a DC voltmeter to the P1 test points with the positive (+) lead to position one (red) and the negative (-) lead to position two (blue).
7. Establish the normal process flow condition and allow the signal to stabilize.

Note: The output signal at the P1 test points will vary inversely with changes in the process flow rate. The output signal level is relative to the type of process media being measured and the heater wattage setting. See Figures 16 and 17.

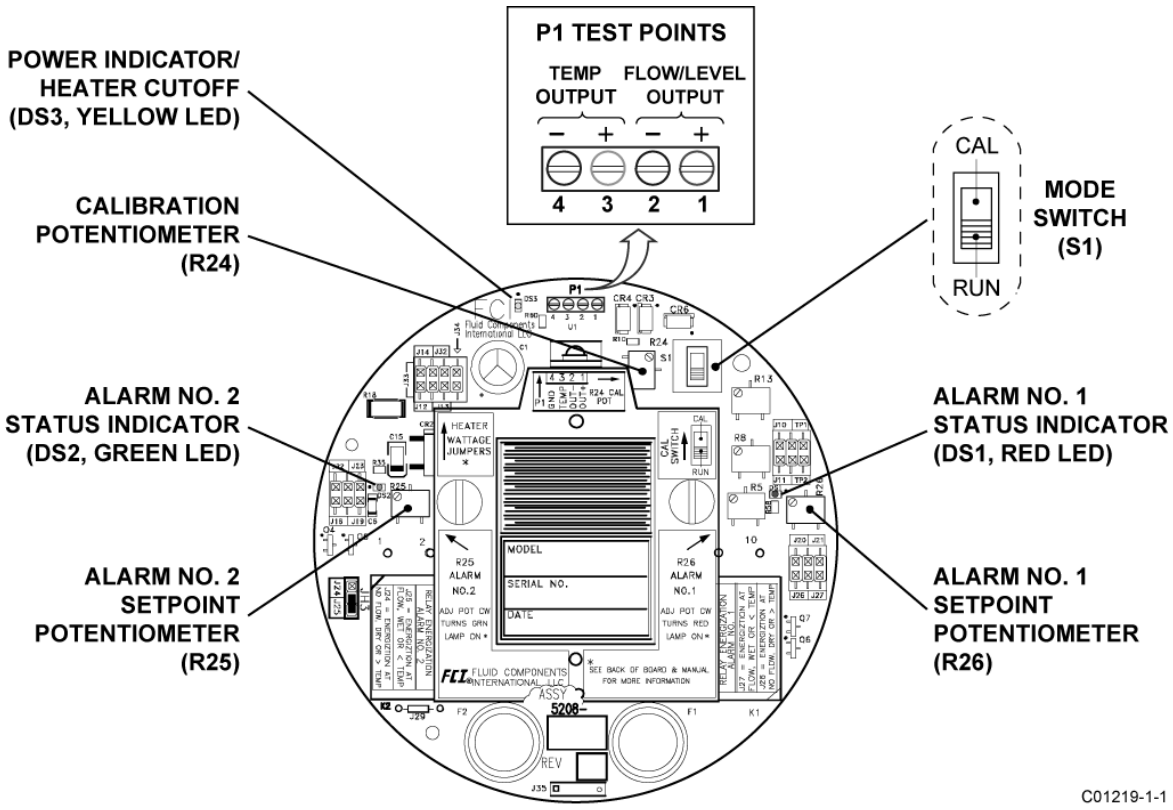

Figure 16 – Control Circuit Component Locations

8. Record the normal flow signal value.

   Normal Flow Signal = _____ volts DC

9. Follow either the *Detecting Decreasing Flow* or the *Detecting Increasing Flow* procedure for each flow application alarm.

Detecting Decreasing Flow (Low Flow Alarm)

1. Stop the process flow and allow the signal to stabilize.
2. Record the no-flow signal. Observe that the no-flow signal is greater than the normal flow signal.

   No-Flow Signal = _____ volts DC

3. Determine the setpoint by calculating the average of the normal (step 8) and no-flow output signals; e.g., if the normal signal is 2.000 volts and the no-flow signal is 5.000 volts, then the calculated setpoint would be 3.500 volts.
4. Record this value.

   Calculated Setpoint = _____ volts DC

   Note: The calculated setpoint must be at least 0.050 volts greater than the normal signal to ensure that the alarm will reset.

5. Move the Mode switch to the CAL position.
6. Adjust the calibration potentiometer (R24) until the voltmeter equals the calculated setpoint.
7. For the appropriate alarm, determine whether the status LED is on or off (red for Alarm No. 1 or green for Alarm No. 2). If the LED is off, turn the setpoint adjustment potentiometer (R26 for Alarm No. 1 or R25 for Alarm No. 2) slowly clockwise just until the LED turns on.
   – OR –
   If the LED is on, turn the setpoint adjustment potentiometer (R26 for Alarm No. 1 or R25 for Alarm No. 2) counterclockwise until the LED turns off and then turn pot slowly clockwise just until the LED turns on.
8. If this is the only flow application alarm to be set up, then skip to the *Continue With The Air/Gas Flow Applications Procedure*.

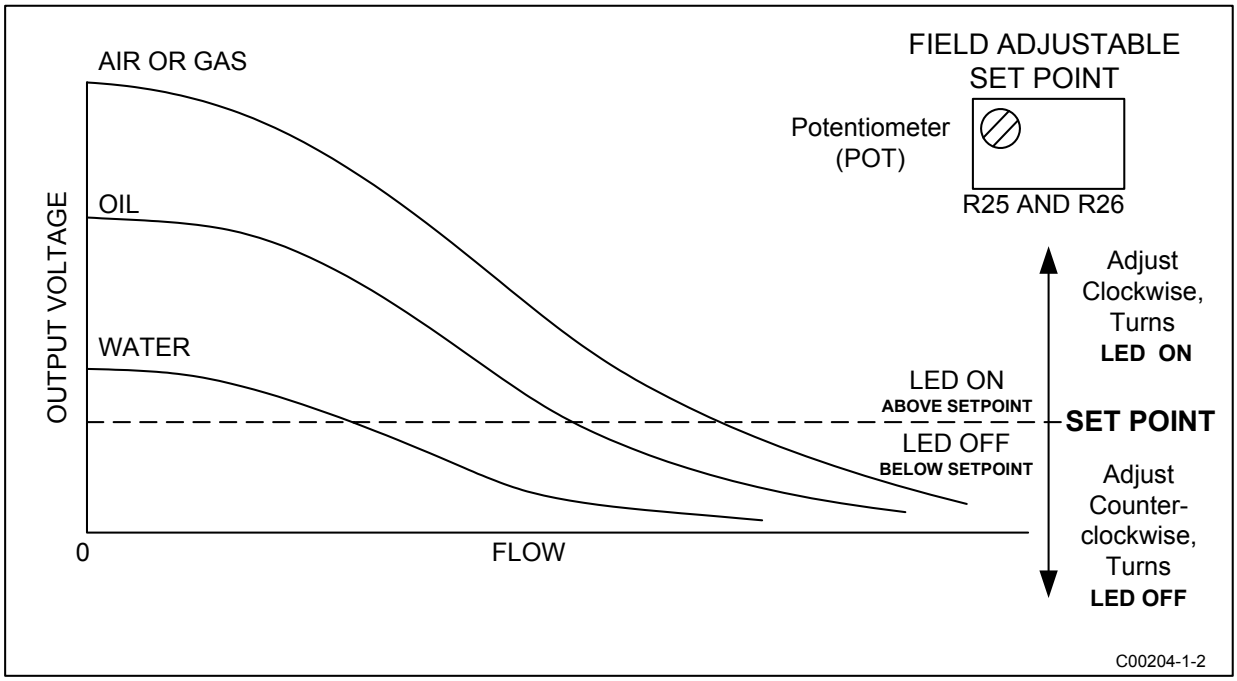

Figure 17 – Flow Application Signal Output

Detecting Increasing Flow (High Flow Alarm)

1. Establish the excessive process flow condition and allow the signal to stabilize.
2. Record the high flow signal. Observe that the high flow signal is less than the normal flow signal.

   High Flow Signal = _____ volts DC
3. Determine the setpoint by calculating the average of the normal (step 8, page 20 - *Air/Gas Flow Applications*) and high flow output signals; e.g., if the normal signal is 2.000 volts and the high flow signal is 1.000 volts, then the calculated setpoint would be 1.500 volts. Record this value.

   Calculated Setpoint = _____ volts DC

   Note: The calculated setpoint must be at least 0.50 volts less than the normal signal to ensure that the alarm will reset.
4. Move the Mode switch to the CAL position.
5. Adjust the calibration potentiometer (R24) until the voltmeter equals the calculated setpoint.
6. For the appropriate alarm, determine whether the status LED is on or off (red for Alarm No. 1 or green for Alarm No. 2). If the LED is on, turn the setpoint adjustment potentiometer (R26 for Alarm No. 1 or R25 for Alarm No. 2) slowly counterclockwise just until the LED turns off.
   – OR –
   If the LED is off, turn the setpoint adjustment potentiometer (R26 for Alarm No. 1 or R25 for Alarm No. 2) clockwise until the LED turns on and then turn pot slowly counterclockwise just until the LED turns off.

Continue With The Air/Gas Flow Applications Procedure

1. Move the Mode switch to the RUN position.
2. Establish the normal process flow condition. For low-flow alarm setups, verify that the status LED is off. For high flow alarm setups, verify that the status LED is on.
3. Establish the process alarm condition and monitor the voltmeter display.
4. When the output signal passes through the calculated setpoint value, verify that the status LED turns on for low-flow alarms, or turns off for high flow alarms, and that the relay contacts change state.
5. Reestablish the normal process flow condition. Verify that the LED and the relay contacts reset.
6. Disconnect the voltmeter from P1.
7. Replace the enclosure cover.

Note: The alarm can be set for a specific flow rate. Follow the Air/Gas Flow Applications procedure up to step 7 except establish the specific flow rate rather than the normal flow. The output signal will be the setpoint value. Determine whether the alarm should actuate with decreasing or increasing flow and skip to the appropriate step 4 in Detecting Decreasing Flow or Detecting Increasing Flow, respectively. Enter the specific flow rate value as the setpoint. Then follow the Continue With the Air/Gas Flow Procedure steps.

The default relay logic configuration is for the relay coil to be de-energized when the flow signal voltage is greater than the setpoint value; i.e., in a normal process flow condition the relay coil is energized if the alarm has been set for low-flow detection and de-energized if the alarm has been set for high flow detection. It is recommended to have the relay coils energized when the process condition is normal. This lets the relay go into a fail-safe alarm state in case of a power failure.

Wet/Dry Liquid Level Applications

1. Remove the instrument's enclosure cover.
2. Ensure the configuration jumpers on the control circuit are correct for this application. See Tables 3-2 through 3-6.
3. Make sure the input power is wired correctly (see Section 2).
4. Apply power to the instrument. Verify the yellow LED is on. Allow fifteen minutes for the instrument to warm-up.
5. Verify the Mode switch is in the RUN position.
6. Attach a DC voltmeter to P1 with the positive (+) lead to position one (red) and the negative (-) lead to position two (blue).
7. Raise the process fluid level so the sensing element is wet.
8. Allow the output signal to stabilize and record the wet condition value.

   Wet Condition Signal = _____ volts DC

   Note: The output signal at P1 is relative to the type of process media detected. See Figure 18.
9. Lower the process fluid level so the sensing element is dry.
10. Allow the output signal to stabilize and record the dry condition value. Observe that the dry signal is greater than the wet signal.

    Dry Condition Signal = _____ volts DC
11. Determine the setpoint by calculating the average of the wet and dry output signals; e.g., if the wet signal is 0.200 volts and the dry signal is 4.000 volts, then the calculated setpoint would be 2.100 volts.

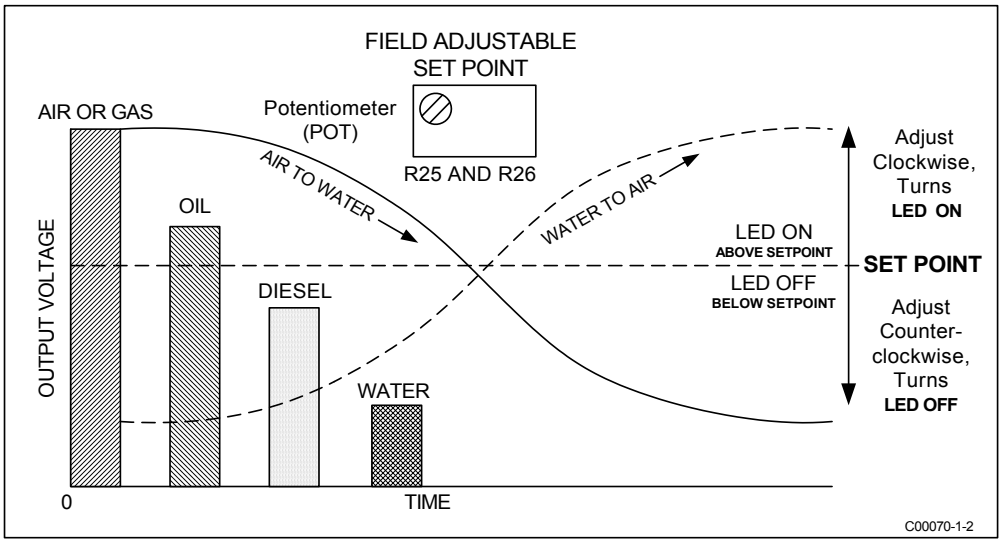

Figure 18 – Level Application Signal Output

12. Record this value.

    Calculated Setpoint = _____ volts DC

    Note: The calculated setpoint must be at least 0.030 volts greater than the wet signal and 0.040 volts less than the dry signal to ensure that the alarm will reset.

13. Move the Mode switch to the CAL position.
14. Adjust the calibration potentiometer (R24) until the voltmeter equals the calculated setpoint.
15. For the appropriate alarm, determine whether the status LED is on or off (red for Alarm No. 1 or green for Alarm No. 2).
16. Follow either the *Detecting Dry Condition* or the *Detecting Wet Condition* for each level application alarm.

Detecting Dry Condition (Low Level Alarm)

If the status LED is off, turn the setpoint adjustment potentiometer (R26 for Alarm No. 1 or R25 for Alarm No. 2) slowly clockwise just until the LED turns on.

– OR –

If the status LED is on, turn the setpoint adjustment potentiometer (R26 for Alarm No. 1 or R25 for Alarm No. 2) counterclockwise until the LED turns off and then turn pot slowly clockwise just until the LED turns on.

Detecting Wet Condition (High Level Alarm)

If the status LED is on, turn the setpoint adjustment potentiometer (R26 for Alarm No. 1 or R25 for Alarm No. 2) slowly counterclockwise just until the LED turns off.

– OR –

If the status LED is off, turn the setpoint adjustment potentiometer (R26 for Alarm No. 1 or R25 for Alarm No. 2) clockwise until the LED turns on and then turn pot slowly counterclockwise just until the LED turns off.

17. Move the Mode switch to the RUN position. Observe that the status LED is on if the sensing element is dry or off if the sensing element is wet.
18. Monitor the voltmeter display while raising or lowering the process fluid level. When the output signal passes through the setpoint, observe that the status LED and relay contacts change state.
19. Reestablish the normal level condition. Verify that the LED and relay contacts reset.
20. Disconnect the voltmeter from P1.
21. Replace the enclosure cover.

    Note: The default relay logic configuration is for the relay coil to be de-energized when the level signal is greater than the setpoint value; i.e., the relay coil will be de-energized when the sensing element is dry. It is recommended to have the relay coils energized when the process condition is normal. This lets the relay go into a fail-safe alarm state in case of a power failure.

Liquid Flow Applications

1. Remove the instrument's enclosure cover.
2. Make sure the input power is wired correctly (see Section 2).
3. As necessary, set the following control circuit configuration jumpers. See Tables 3-2 through 3-6.
   Application: J20 or J18 (Flow/Level) for alarm No. 1 or No. 2, respectively.
   Heater Power: J32 (3 watts for FLT93S/FLT93B or 0.57 watts for FLT93F).
4. Apply power to the instrument. Verify the yellow LED is on. Allow fifteen minutes for the instrument to warm-up.
5. Verify the Mode switch is in the RUN position.
6. Attach a DC voltmeter to P1 connector with the positive (+) lead to position one (red) and the negative (-) lead to position two (blue).

   Note: The output signal at connector P1 varies inversely with changes in the process flow rate. The output signal level is also relative to the type of process media being measured. See Figure 17.

7. Establish the normal process flow condition and allow the signal to stabilize.

8. Record the normal flow signal value.

   Normal Flow Signal = _____ volts DC

9. Follow either the *Detecting Decreasing Flow* or *Detecting Increasing Flow* procedure for each Liquid flow application alarm.

Detecting Decreasing Flow (Low Flow Alarm)

1. Stop the process flow and allow the signal to stabilize.
2. Record the no-flow signal. Observe that the no-flow signal is greater than the normal flow signal.

   No-Flow Signal = _____ volts DC

3. Determine the setpoint by calculating the average of the normal and no-flow output signals; e.g., if the normal signal is 0.080 volts and the no-flow signal is 0.300 volts, then the calculated setpoint would be 0.190 volts.
4. Record this value.

   Calculated Setpoint = _____ volts DC

   Note: The calculated setpoint must be at least 0.050 volts greater than the normal signal to ensure that the alarm will reset.

5. Move the Mode switch to the CAL position.
6. Adjust the calibration potentiometer (R24) until the voltmeter equals the calculated setpoint.
7. For the appropriate alarm, determine whether the status LED is on or off (red for No. 1 or green for No. 2).

   If the LED is off, turn the setpoint adjustment potentiometer (R26 for Alarm No. 1 or R25 for Alarm No. 2) slowly clockwise just until the LED turns on

   – OR –

   If the LED is on, turn the setpoint adjustment potentiometer (R26 for Alarm No. 1 or R25 for Alarm No. 2) counterclockwise until the LED turns off and then turn pot slowly clockwise just until the LED turns on.

8. If this is the only flow application alarm to be set up, then skip to *Continue With The Liquid Flow Applications Procedure*.

Detecting Increasing Flow Rate (High Flow Alarm)

1. Establish the excessive flow condition and allow the signal to stabilize.
2. Record the high flow signal. Observe that the high flow signal is less than the normal flow signal.

   High Flow Signal = _____ volts DC

3. Determine the setpoint by calculating the average of the normal (step 8 - *Liquid Flow Applications*) and high flow output signals; i.e., if the normal signal is 0.38 volts and the high flow signal is 0.13 volts, then the calculated setpoint would be 0.255 volts.
4. Record this value.

   Calculated Setpoint = _____ volts DC

   Note: The calculated setpoint must be at least 0.050 volts less than the normal signal to ensure that the alarm will reset.

5. Move the Mode switch to the CAL position.
6. Adjust the calibration potentiometer (R24) until the voltmeter equals the calculated setpoint.
7. For the appropriate alarm, determine whether the status LED is on or off (red for No. 1 or green for No. 2).

   If the LED is on, turn the setpoint adjustment potentiometer (R26 for Alarm No. 1 or R25 for Alarm No. 2) slowly counterclockwise just until the LED turns off.

   – OR –

   If the LED is off, turn the setpoint adjustment potentiometer (R26 for Alarm No. 1 or R25 for Alarm No. 2) clockwise until the LED turns on and then slowly turn pot counterclockwise just until the LED turns off.

Continue With The Liquid Flow Applications Procedure

1. Move the Mode switch to the RUN position.
2. Establish the normal process flow condition. For low-flow alarm setups, observe that the status LED is off. For high flow alarm setups observe that the status LED is on.
3. Establish the process alarm condition and monitor the voltmeter display.
4. When the output signal passes through the calculated setpoint value observe that the status LED should turns on for low-flow alarms or off for high flow alarms, and that the relay contacts change state.
5. Reestablish the normal process flow condition. Observe that the LED and the relay contacts reset.
6. Disconnect the voltmeter from P1.
7. Replace the enclosure cover.

Note: The alarm can be set for a specific flow rate. Follow the Liquid Flow Applications procedure up to step 7 except establish the specific flow rate rather than the normal flow. The output signal will be the setpoint value. Determine whether the alarm should actuate with decreasing or increasing flow and skip to the appropriate step 4 in Detecting Decreasing Flow or Detecting Increasing Flow respectively. Enter the specific flow rate value as the setpoint. Then continue with the rest of the procedure.

The default relay logic configuration is for the relay coil to be de-energized when the flow signal voltage is greater than the setpoint value; i.e., in a normal process flow condition the relay coil is energized if the alarm has been set for low-flow detection and de-energized if the alarm has been set for high flow detection. It is recommended to have the relay coils energized when the process condition is normal. This lets the relay go into a fail-safe alarm state in case of a power failure.

Adjustment by Observation

Note: The control circuit has two mutually exclusive alarms identified as Alarm No. 1 and Alarm No. 2. Each alarm has its own setpoint adjustment potentiometer and LED indicator. Each alarm can be set up for one of three applications: flow, level/interface, or temperature. The following application specific adjustment procedures are generic and can be used for setting either or both alarms. The mode switch must be in the RUN position. Use Figure 16 to help locate the adjustment potentiometers and LEDs.

Flow Applications

1. Ensure that the instrument has been properly installed in the pipeline. Fill the pipeline so the sensing element is surrounded by the process medium.
2. Apply power to the instrument. Allow fifteen minutes for the sensing element to stabilize.
3. Flow the pipeline at the normal or expected rate. Remove the enclosure cover to access the control circuit for adjustments.

Detecting Decreasing Flow (Low Flow Alarm)

If the status LED is off, turn the setpoint adjustment potentiometer clockwise until the LED turns on. With the LED on, slowly turn the potentiometer counterclockwise one turn past the point at which the LED just turns off. The potentiometer may have up to one-quarter turn of hysteresis; therefore, if the mark is overshot, repeat the procedure.

Detecting Increasing Flow (High Flow Alarm)

If the status LED is on, turn the setpoint adjustment potentiometer counterclockwise until the LED turns off. With the LED off, slowly turn the potentiometer clockwise one-half turn past the point at which the LED just turns on. The potentiometer may have up to one-quarter turn of hysteresis; therefore, if the mark is overshot, repeat the procedure.

Level Applications

1. Ensure that the instrument has been properly installed in the vessel.
2. Apply power to the instrument. Allow fifteen minutes for the sensing element to stabilize.
3. Remove the enclosure cover to access the control circuit for adjustments.

Detecting Dry Condition (Adjustment With Sensing Element Wet)

Verify that the sensing element is wet. If the status LED is off, turn the setpoint adjustment potentiometer clockwise until the LED turns on. With the LED on, slowly turn the potentiometer counterclockwise one turn past the point at which the LED just turns off. The potentiometer may have up to one-quarter turn of hysteresis; therefore, if the mark is overshot, repeat the procedure.

Detecting Wet Condition (Adjustment With Sensing Element Dry)

Caution: Give consideration to the fact that air or gas flowing over the sensing element may decrease the output signal resulting in a false alarm. If the sensing element is exposed to air or gas flow in the dry condition, or where the process media is highly viscous, make setpoint adjustments in the wet condition only.

Field adjustments made in the dry condition should be performed in the actual service environment or within a condition that approximates that environment. Provision should be made for the worst case condition of air or gas flow on the sensing element. If the status LED is on, turn the setpoint adjustment potentiometer counterclockwise until the LED turns off. (If the LED cannot be turned off, the instrument must be set in the wet condition.)

With the LED off, slowly turn the potentiometer clockwise 1 turn past the point at which the LED just goes on. The potentiometer may have up to one-quarter turn of hysteresis; therefore, if the mark is overshot, repeat the procedure.

Signal Output for Level Applications

The output signal at P1 is lowest in water and highest in air. See Figure 18.

Temperature Applications

For temperature versus voltage values, see Table 3-7 located at the rear of this section. These values have an accuracy of ±5 °F (±2.78 °C). There is also a conversion formula later in this section to convert the temperature output voltage to degrees Fahrenheit. If a factory calibration chart was ordered look at the back of this manual. Make sure the serial number of the chart matches the instrument to be adjusted. Remove the instrument's enclosure cover.

1. Remove the instrument's enclosure cover.

   Caution: If both alarms are to be used for temperature, then remove the heater control jumper from the heater, control header. The jumper may be stored on the control circuit by plugging it on position J33. Placing the jumper here will not turn on the heater. If one alarm is for temperature and the other is for flow or level, then set the heater power according to the application. Use alarm No. 2 for the temperature alarm. See Table 3-2 or 3-3.

2. Apply power to the instrument. Verify the yellow LED is on. Allow fifteen minutes for the instrument to warm-up.
3. Verify the Mode switch is in the RUN position.
4. Attach a DC voltmeter to P1 with the positive (+) lead to position 3 (yellow) and the negative (-) lead to position 4 (black).
5. Establish the normal process temperature condition and allow the signal to stabilize.
6. Record the normal temperature signal value.

   Normal Temperature Signal = _____ volts DC

   Note: The output signal at connector P1 varies in proportion to the process temperature.

7. Follow either the *Detecting Increasing Temperature* or the *Detecting Decreasing Temperature* procedure for each temperature application alarm.

Detecting Increasing Temperature (High Temperature Alarm)

1. Move the Mode switch to the CAL position.
2. Adjust the calibrate potentiometer (R24) until the voltmeter equals the desired temperature signal as indicated in Table 3-7.
3. For the appropriate alarm, determine whether the status LED is on or off (red for Alarm No. 1 or green for Alarm No. 2).

   If the LED is off, turn the setpoint adjustment potentiometer (R26 for Alarm No. 1 or R25 for Alarm No. 2) slowly clockwise just until the LED turns on.

   – OR –

   If the LED is on, turn the setpoint adjustment potentiometer (R26 for Alarm No. 1 or R25 for Alarm No. 2) counterclockwise until the LED turns off and then slowly turn pot clockwise just until the LED turns on.

   If this is the only temperature application alarm to be set up, then skip to the *Continue With The Temperature Applications Procedure*.

Detecting Decreasing Temperature (Low Temperature Alarm)

1. Move the Mode switch to the CAL position.
2. Adjust the calibration potentiometer (R24) until the voltmeter equals the normal temperature signal.
3. For the appropriate alarm, determine whether the status LED is on or off (red for Alarm No. 1 or green for Alarm No. 2).

   If the LED is on, turn the setpoint adjustment potentiometer (R26 for Alarm No. 1 or R25 for Alarm No. 2) slowly counterclockwise just until the LED turns off.

   – OR –

   If the LED is off, turn the setpoint adjustment potentiometer (R26 for Alarm No. 1 or R25 for Alarm No. 2) clockwise until the LED turns on and then slowly turn pot counterclockwise just until the LED turns off.

Continue With The Temperature Applications Procedure

1. Move the Mode switch to the RUN position.
2. Establish the normal process temperature condition. For the high temperature alarm setups, observe that the status LED is off at normal temperatures. For the low temperature alarm setups, observe that the status LED is on at normal temperatures.
3. Establish the process alarm condition and monitor the voltmeter display.
4. When the output signal passes through the setpoint value, observe that the status LED turns on for high temperature alarms or off for low temperature alarms, and that the relay contacts change state.
5. Reestablish the normal process temperature condition. Observe that the LED and relay contacts reset.
6. Disconnect the voltmeter from P1.
7. Replace the enclosure cover.

Note: The default relay logic configuration is for the relay coil to be de-energized when the temperature signal voltage is greater than the setpoint value; i.e., in a normal process temperature condition the relay coil is energized. It is recommended to have the relay coils energized when the process temperature is normal. This lets the relay go into a fail-safe alarm state in case of a power failure.

Converting Temp Out Voltage to Temp in Degrees F or Degrees C

This formula is useful when monitoring the temperature output voltage with a data acquisition system where the formula can be used in the program.

Use the following formula to determine what the temperature is in degrees Fahrenheit, if the FLT temperature output voltage is known.

$y = a + b(x/0.002) + c(x/0.002)^2$

Where:

y = Temperature in Degrees F

x = FLT Temperature Output Voltage

a = -409.3253

b = 0.42224

c = .00001904

Use the following equation to convert the temperature from degrees Fahrenheit to Celsius:

C = (F - 32) x 5/9

Table 3-7. Temperature versus Voltage Output

0.00385 OHMS/OHMS/ºC 1000 OHM PLATINUM SENSORS

Temp Output Voltage	°F	°C	Temp Output Voltage	°F	°C	Temp Output Voltage	°F	°C	Temp Output Voltage	°F	°C
1.400	-104	-76	1.600	-59	-51	1.800	-14	-25	2.000	32	0
1.405	-103	-75	1.605	-58	-50	1.805	-13	-25	2.005	33	1
1.410	-102	-75	1.610	-57	-49	1.810	-12	-24	2.010	34	1
1.415	-101	-74	1.615	-56	-49	1.815	-10	-24	2.015	35	2
1.420	-100	-73	1.620	-55	-48	1.820	-9	-23	2.020	37	3
1.425	-99	-73	1.625	-54	-48	1.825	-8	-22	2.025	38	3
1.430	-98	-72	1.630	-53	-47	1.830	-7	-22	2.030	39	4
1.435	-97	-71	1.635	-51	-46	1.835	-6	-21	2.035	40	4
1.440	-95	-71	1.640	-50	-46	1.840	-5	-20	2.040	41	5
1.445	-94	-70	1.645	-49	-45	1.845	-4	-20	2.045	42	6
1.450	-93	-70	1.650	-48	-44	1.850	-2	-19	2.050	43	6
1.455	-92	-69	1.655	-47	-44	1.855	-1	-19	2.055	45	7
1.460	-91	-68	1.660	-46	-43	1.860	0	-18	2.060	46	8
1.465	-90	-68	1.665	-45	-43	1.865	1	-17	2.065	47	8
1.470	-89	-67	1.670	-43	-42	1.870	2	-17	2.070	48	9
1.475	-88	-66	1.675	-42	-41	1.875	3	-16	2.075	49	10
1.480	-86	-66	1.680	-41	-41	1.880	4	-15	2.080	50	10
1.485	-85	-65	1.685	-40	-40	1.885	6	-15	2.085	52	11
1.490	-84	-65	1.690	-39	-39	1.890	7	-14	2.090	53	12
1.495	-83	-64	1.695	-38	-39	1.895	8	-13	2.095	54	12
1.500	-82	-63	1.700	-37	-38	1.900	9	-13	2.100	55	13
1.505	-81	-63	1.705	-36	-38	1.905	10	-12	2.105	56	13
1.510	-80	-62	1.710	-34	-37	1.910	11	-12	2.110	57	14
1.515	-79	-61	1.715	-33	-36	1.915	12	-11	2.115	58	15
1.520	-77	-61	1.720	-32	-36	1.920	14	-10	2.120	60	15
1.525	-76	-60	1.725	-31	-35	1.925	15	-10	2.125	61	16
1.530	-75	-60	1.730	-30	-34	1.930	16	-9	2.130	62	17
1.535	-74	-59	1.735	-29	-34	1.935	17	-8	2.135	63	17
1.540	-73	-58	1.740	-28	-33	1.940	18	-8	2.140	64	18
1.545	-72	-58	1.745	-26	-32	1.945	19	-7	2.145	65	19
1.550	-71	-57	1.750	-25	-32	1.950	20	-6	2.150	67	19
1.555	-70	-56	1.755	-24	-31	1.955	22	-6	2.155	68	20
1.560	-68	-56	1.760	-23	-31	1.960	23	-5	2.160	69	20
1.565	-67	-55	1.765	-22	-30	1.965	24	-5	2.165	70	21
1.570	-66	-55	1.770	-21	-29	1.970	25	-4	2.170	71	22
1.575	-65	-54	1.775	-20	-29	1.975	26	-3	2.175	72	22
1.580	-64	-53	1.780	-18	-28	1.980	27	-3	2.180	74	23
1.585	-63	-53	1.785	-17	-27	1.985	28	-2	2.185	75	24
1.590	-62	-52	1.790	-16	-27	1.990	30	-1	2.190	76	24
1.595	-60	-51	1.795	-15	-26	1.995	31	-1	2.195	77	25
2.200	78	26	2.400	125	52	2.600	172	78	2.800	219	104
2.205	79	26	2.405	126	52	2.605	173	78	2.805	220	105
2.210	80	27	2.410	127	53	2.610	174	79	2.810	221	105

Table 3-7. Temperature versus Voltage Output (continued)

0.00385 OHMS/OHMS/ºC 1000 OHM PLATINUM SENSORS

Temp Output Voltage	°F	°C	Temp Output Voltage	°F	°C	Temp Output Voltage	°F	°C	Temp Output Voltage	°F	°C
2.215	82	28	2.415	128	53	2.615	175	80	2.815	223	106
2.220	83	28	2.420	129	54	2.620	176	80	2.820	224	107
2.225	84	29	2.425	131	55	2.625	178	81	2.825	225	107
2.230	85	30	2.430	132	55	2.630	179	82	2.830	226	108
2.235	86	30	2.435	133	56	2.635	180	82	2.835	227	109
2.240	87	31	2.440	134	57	2.640	181	83	2.840	229	109
2.245	89	31	2.445	135	57	2.645	182	84	2.845	230	110
2.250	90	32	2.450	136	58	2.650	184	84	2.850	231	111
2.255	91	33	2.455	138	59	2.655	185	85	2.855	232	111
2.260	92	33	2.460	139	59	2.660	186	86	2.860	233	112
2.265	93	34	2.465	140	60	2.665	187	86	2.865	235	113
2.270	94	35	2.470	141	61	2.670	188	87	2.870	236	113
2.275	96	35	2.475	142	61	2.675	189	87	2.875	237	114
2.280	97	36	2.480	144	62	2.680	191	88	2.880	238	115
2.285	98	37	2.485	145	63	2.685	192	89	2.885	239	115
2.290	99	37	2.490	146	63	2.690	193	89	2.890	241	116
2.295	100	38	2.495	147	64	2.695	194	90	2.895	242	117
2.300	101	39	2.500	148	65	2.700	195	91	2.900	243	117
2.305	103	39	2.505	149	65	2.705	197	91	2.905	244	118
2.310	104	40	2.510	151	66	2.710	198	92	2.910	245	119
2.315	105	41	2.515	152	67	2.715	199	93	2.915	247	119
2.320	106	41	2.520	153	67	2.720	200	93	2.920	248	120
2.325	107	42	2.525	154	68	2.725	201	94	2.925	249	121
2.330	108	42	2.530	155	68	2.730	202	95	2.930	250	121
2.335	110	43	2.535	156	69	2.735	204	95	2.935	251	122
2.340	111	44	2.540	158	70	2.740	205	96	2.940	253	123
2.345	112	44	2.545	159	70	2.745	206	97	2.945	254	123
2.350	113	45	2.550	160	71	2.750	207	97	2.950	255	124
2.355	114	46	2.555	161	72	2.755	208	98	2.955	256	124
2.360	115	46	2.560	162	72	2.760	210	99	2.960	257	125
2.365	117	47	2.565	164	73	2.765	211	99	2.965	258	126
2.370	118	48	2.570	165	74	2.770	212	100	2.970	260	126
2.375	119	48	2.575	166	74	2.775	213	101	2.975	261	127
2.380	120	49	2.580	167	75	2.780	214	101	2.980	262	128
2.385	121	50	2.585	168	76	2.785	216	102	2.985	263	128
2.390	122	50	2.590	169	76	2.790	217	103	2.990	264	129
2.395	124	51	2.595	171	77	2.795	218	103	2.995	266	130
3.000	267	130	3.200	315	157	3.400	363	184	3.600	412	211
3.005	268	131	3.205	316	158	3.405	365	185	3.605	414	212
3.010	269	132	3.210	317	159	3.410	366	186	3.610	415	213
3.015	270	132	3.215	319	159	3.415	367	186	3.615	416	213
3.020	272	133	3.220	320	160	3.420	368	187	3.620	417	214
3.025	273	134	3.225	321	161	3.425	370	188	3.625	419	215

Table 3-7. Temperature versus Voltage Output (continued)

0.00385 OHMS/OHMS/ºC 1000 OHM PLATINUM SENSORS

Temp Output Voltage	°F	°C	Temp Output Voltage	°F	°C	Temp Output Voltage	°F	°C	Temp Output Voltage	°F	°C
3.030	274	134	3.230	322	161	3.430	371	188	3.630	420	215
3.035	275	135	3.235	323	162	3.435	372	189	3.635	421	216
3.040	276	136	3.240	325	163	3.440	373	190	3.640	422	217
3.045	278	136	3.245	326	163	3.445	374	190	3.645	423	217
3.050	279	137	3.250	327	164	3.450	376	191	3.650	425	218
3.055	280	138	3.255	328	165	3.455	377	192	3.655	426	219
3.060	281	138	3.260	330	165	3.460	378	192	3.660	427	220
3.065	282	139	3.265	331	166	3.465	379	193	3.665	428	220
3.070	284	140	3.270	332	167	3.470	381	194	3.670	430	221
3.075	285	140	3.275	333	167	3.475	382	194	3.675	431	222
3.080	286	141	3.280	334	168	3.480	383	195	3.680	432	222
3.085	287	142	3.285	336	169	3.485	384	196	3.685	433	223
3.090	288	142	3.290	337	169	3.490	385	196	3.690	435	224
3.095	290	143	3.295	338	170	3.495	387	197	3.695	436	224
3.100	291	144	3.300	339	171	3.500	388	198	3.700	437	225
3.105	292	144	3.305	340	171	3.505	389	198	3.705	438	226
3.110	293	145	3.310	342	172	3.510	390	199	3.710	439	226
3.115	294	146	3.315	343	173	3.515	392	200	3.715	441	227
3.120	296	146	3.320	344	173	3.520	393	200	3.720	442	228
3.125	297	147	3.325	345	174	3.525	394	201	3.725	443	228
3.130	298	148	3.330	346	175	3.530	395	202	3.730	444	229
3.135	299	149	3.335	348	175	3.535	396	202	3.735	446	230
3.140	301	149	3.340	349	176	3.540	398	203	3.740	447	230
3.145	302	150	3.345	350	177	3.545	399	204	3.745	448	231
3.150	303	151	3.350	351	177	3.550	400	205	3.750	449	232
3.155	304	151	3.355	353	178	3.555	401	205	3.755	451	233
3.160	305	152	3.360	354	179	3.560	403	206	3.760	452	233
3.165	307	153	3.365	355	179	3.565	404	207	3.765	453	234
3.170	308	153	3.370	356	180	3.570	405	207	3.770	454	235
3.175	309	154	3.375	357	181	3.575	406	208	3.775	455	235
3.180	310	155	3.380	359	181	3.580	407	209	3.780	457	236
3.185	311	155	3.385	360	182	3.585	409	209	3.785	458	237
3.190	313	156	3.390	361	183	3.590	410	210	3.790	459	237
3.195	314	157	3.395	362	183	3.595	411	211	3.795	460	238
3.800	462	239	4.000	511	266	4.200	561	294	4.400	612	322
3.805	463	239	4.005	513	267	4.205	563	295	4.405	613	323
3.810	464	240	4.010	514	268	4.210	564	295	4.410	614	323
3.815	465	241	4.015	515	268	4.215	565	296	4.415	616	324
3.820	467	241	4.020	516	269	4.220	566	297	4.420	617	325
3.825	468	242	4.025	518	270	4.225	568	298	4.425	618	326
3.830	469	243	4.030	519	270	4.230	569	298	4.430	619	326
3.835	470	244	4.035	520	271	4.235	570	299	4.435	621	327

Table 3-7. Temperature versus Voltage Output (continued)

0.00385 OHMS/OHMS/ºC 1000 OHM PLATINUM SENSORS

Temp Output Voltage	°F	°C	Temp Output Voltage	°F	°C	Temp Output Voltage	°F	°C	Temp Output Voltage	°F	°C
3.840	472	244	4.040	521	272	4.240	571	300	4.440	622	328
3.845	473	245	4.045	523	273	4.245	573	300	4.445	623	328
3.850	474	246	4.050	524	273	4.250	574	301	4.450	624	329
3.855	475	246	4.055	525	274	4.255	575	302	4.455	626	330
3.860	477	247	4.060	526	275	4.260	576	302	4.460	627	331
3.865	478	248	4.065	528	275	4.265	578	303	4.465	628	331
3.870	479	248	4.070	529	276	4.270	579	304	4.470	629	332
3.875	480	249	4.075	530	277	4.275	580	305	4.475	631	333
3.880	481	250	4.080	531	277	4.280	581	305	4.480	632	333
3.885	483	250	4.085	533	278	4.285	583	306	4.485	633	334
3.890	484	251	4.090	534	279	4.290	584	307	4.490	635	335
3.895	485	252	4.095	535	279	4.295	585	307	4.495	636	335
3.900	486	252	4.100	536	280	4.300	586	308	4.500	637	336
3.905	488	253	4.105	538	281	4.305	588	309	4.505	638	337
3.910	489	254	4.110	539	282	4.310	589	309	4.510	640	338
3.915	490	255	4.115	540	282	4.315	590	310	4.515	641	338
3.920	491	255	4.120	541	283	4.320	592	311	4.520	642	339
3.925	493	256	4.125	543	284	4.325	593	312	4.525	643	340
3.930	494	257	4.130	544	284	4.330	594	312	4.530	645	340
3.935	495	257	4.135	545	285	4.335	595	313	4.535	646	341
3.940	496	258	4.140	546	286	4.340	597	314	4.540	647	342
3.945	498	259	4.145	548	286	4.345	598	314	4.545	649	343
3.950	499	259	4.150	549	287	4.350	599	315	4.550	650	343
3.955	500	260	4.155	550	288	4.355	600	316	4.555	651	344
3.960	501	261	4.160	551	288	4.360	602	316	4.560	652	345
3.965	503	261	4.165	553	289	4.365	603	317	4.565	654	345
3.970	504	262	4.170	554	290	4.370	604	318	4.570	655	346
3.975	505	263	4.175	555	291	4.375	605	319	4.575	656	347
3.980	506	264	4.180	556	291	4.380	607	319	4.580	657	347
3.985	508	264	4.185	558	292	4.385	608	320	4.585	659	348
3.990	509	265	4.190	559	293	4.390	609	321	4.590	660	349
3.995	510	266	4.195	560	293	4.395	610	321	4.595	661	350
4.600	663	350	4.800	714	379	5.000	765	407	5.200	817	436
4.605	664	351	4.805	715	379	5.005	767	408	5.205	818	437
4.610	665	352	4.810	716	380	5.010	768	409	5.210	820	438
4.615	666	352	4.815	718	381	5.015	769	410	5.215	821	438
4.620	668	353	4.820	719	382	5.020	770	410	5.220	822	439
4.625	669	354	4.825	720	382	5.025	772	411	5.225	824	440
4.630	670	355	4.830	721	383	5.030	773	412	5.230	825	441
4.635	671	355	4.835	723	384	5.035	774	412	5.235	826	441
4.640	673	356	4.840	724	384	5.040	776	413	5.240	828	442
4.645	674	357	4.845	725	385	5.045	777	414	5.245	829	443

Table 3-7. Temperature versus Voltage Output (continued)

0.00385 OHMS/OHMS/ºC 1000 OHM PLATINUM SENSORS

Temp Output Voltage	°F	°C	Temp Output Voltage	°F	°C	Temp Output Voltage	°F	°C	Temp Output Voltage	°F	°C
4.650	675	357	4.850	727	386	5.050	778	415	5.250	830	443
4.655	677	358	4.855	728	387	5.055	779	415	5.255	832	444
4.660	678	359	4.860	729	387	5.060	781	416	5.260	833	445
4.665	679	360	4.865	730	388	5.065	782	417	5.265	834	446
4.670	680	360	4.870	732	389	5.070	783	417	5.270	835	446
4.675	682	361	4.875	733	389	5.075	785	418	5.275	837	447
4.680	683	362	4.880	734	390	5.080	786	419	5.280	838	448
4.685	684	362	4.885	736	391	5.085	787	420	5.285	839	449
4.690	686	363	4.890	737	392	5.090	789	420	5.290	841	449
4.695	687	364	4.895	738	392	5.095	790	421	5.295	842	450
4.700	688	364	4.900	739	393	5.100	791	422	5.300	843	451
4.705	689	365	4.905	741	394	5.105	792	422	5.305	845	451
4.710	691	366	4.910	742	394	5.110	794	423	5.310	846	452
4.715	692	367	4.915	743	395	5.115	795	424	5.315	847	453
4.720	693	367	4.920	745	396	5.120	796	425	5.320	849	454
4.725	694	368	4.925	746	397	5.125	798	425	5.325	850	454
4.730	696	369	4.930	747	397	5.130	799	426	5.330	851	455
4.735	697	369	4.935	748	398	5.135	800	427	5.335	852	456
4.740	698	370	4.940	750	399	5.140	802	428	5.340	854	457
4.745	700	371	4.945	751	399	5.145	803	428	5.345	855	457
4.750	701	372	4.950	752	400	5.150	804	429	5.350	856	458
4.755	702	372	4.955	754	401	5.155	805	430	5.355	858	459
4.760	703	373	4.960	755	402	5.160	807	430	5.360	859	459
4.765	705	374	4.965	756	402	5.165	808	431	5.365	860	460
4.770	706	374	4.970	757	403	5.170	809	432	5.370	862	461
4.775	707	375	4.975	759	404	5.175	811	433	5.375	863	462
4.780	709	376	4.980	760	404	5.180	812	433	5.380	864	462
4.785	710	377	4.985	761	405	5.185	813	434	5.385	866	463
4.790	711	377	4.990	763	406	5.190	815	435	5.390	867	464
4.795	712	378	4.995	764	407	5.195	816	435	5.395	868	465

Fail-Safe Alarm Setting

These procedures set the second relay to detect component failure (fail-safe).

Low Flow Alarm Settings

Install the following jumpers for the low flow fail-safe setup: J18, J20, J23, J24, J27.

The following information is assumed:

Relay is de-energized in the ALARM condition.

Alarm 1 setpoint is adjusted for desired low flow alarm velocity or signal.

Alarm 2 setpoint is adjusted slightly below minimum signal output (over range flow).

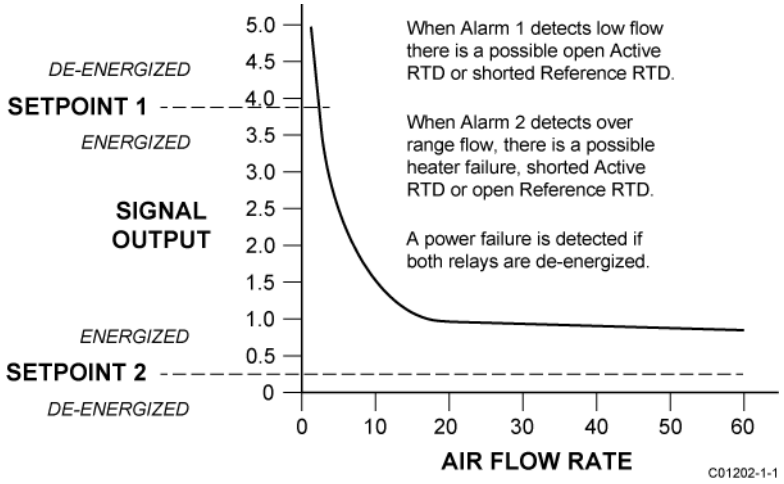

Figure 19 – Low Flow Fail-Safe Alarm

High Flow Alarm Settings

Install the following jumpers for the high flow fail-safe setup: J18, J20, J23, J25, J26.

The following information is assumed:

Relay is de-energized in the ALARM condition.

Alarm 1 setpoint is adjusted for desired high flow alarm velocity or signal.

Alarm 2 setpoint is adjusted above maximum signal output (under range flow not to exceed 7.0 volts).

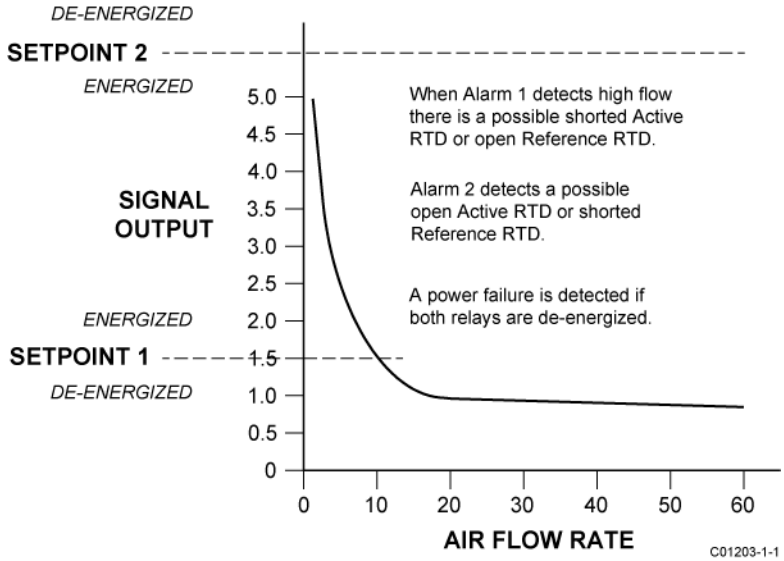

Figure 20 – High Flow Fail-Safe Alarm

Low Level Alarm Settings (Sensing Element Normally Wet)

Install the following jumpers for the low level fail-safe setup: J18, J20, J23, J24, J27.

The following information is assumed:

Relay is de-energized in the ALARM condition.

Alarm 1 setpoint is adjusted for the mean value between the air and liquid signals.

Alarm 2 setpoint is adjusted to approximately half of the liquid signal. (A lower setting might be needed if the liquid is moving.)

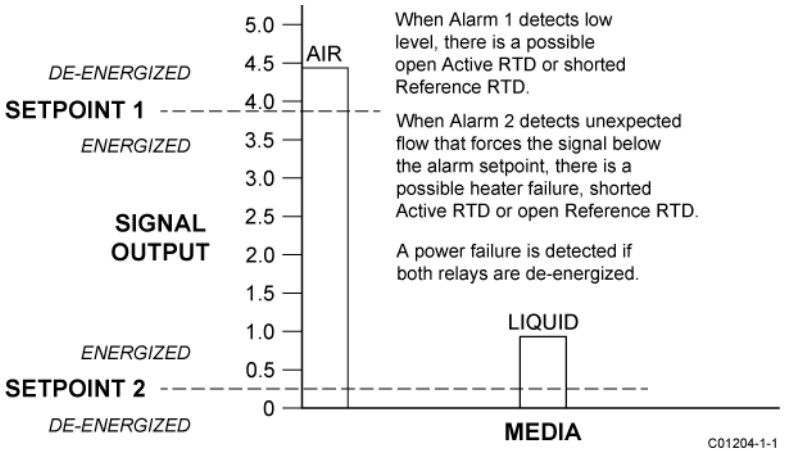

Figure 21 – Low Level Fail-Safe Alarm

High Level Alarm Settings (Sensing Element Normally Dry)

Install the following jumpers for the high level fail-safe setup: J18, J20, J23, J25, J26.

The following information is assumed:

Relay is de-energized in the ALARM condition.

Alarm 1 setpoint is adjusted for the mean value between the air and liquid signals.

Alarm 2 setpoint is adjusted above maximum signal output for air (not to exceed 7.0 volts).

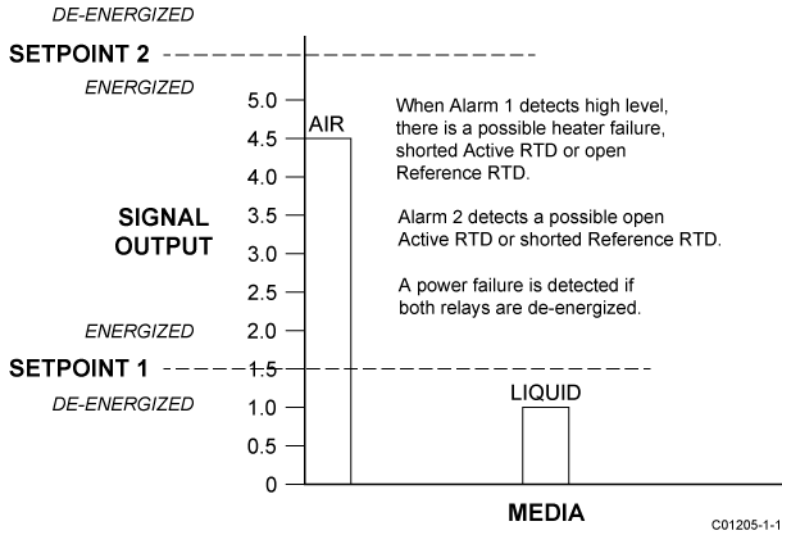

Figure 22 – High Level Fail-Safe Alarm

4 MAINTENANCE

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

Caution: The insturment contains electrostatic discharge (ESD) sensitive devices. Use standard ESD precautions when handling the control circuit. See Section 2, Operation, for ESD details.

The FCI instrument requires very little maintenance. There are no moving parts or mechanical parts subject to wear in the instrument. The sensor assembly which is exposed to the process media is all stainless steel construction and is only susceptible to chemical attack based on the corrosion relationship of the RTD thermowell material with the process media.

Maintenance

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

Calibration

Periodically verify the calibration of the output and re-calibrate if necessary. See Section 3 for instructions.

Cleaning

If cleaning is necessary, use a cloth dampened with plain water to avoid danger of ignition due to electrostatic charges on painted enclosure according to EN/IEC 60079-0 clause 7.4.2 and 7.4.3.

Electrical Connections

Periodically inspect cable connections on terminal strips and terminal blocks. Verify that terminal connections are tight and in good condition with no sign of corrosion.

Remote Enclosure

Verify that the moisture barriers and seals protecting the electronics in the local and remote enclosures are adequate and that no moisture is entering those enclosures.

Electrical Wiring

FCI recommends occasional inspection of the system's interconnecting cable, power wiring and sensing element wiring on a common sense basis related to the application environment. Periodically inspect conductors for corrosion as well as the cable insulation for signs of deterioration.

Sensing Element Connections

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

Sensing Element Assembly

Periodically remove the sensing element for inspection based on historical evidence of debris, foreign matter, or scale buildup during appropriate plant shutdown schedules and procedures. Check for corrosion, stress cracking, and/or buildup of oxides, salts, or other substances. The thermowells must be free of excessive contaminants and be physically intact. Any debris or residue buildup could cause inaccurate switching. Clean the sensing element with a soft brush and available solvents that are compatible with the instruments wetted metal.

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5 TROUBLESHOOTING

Warning: Only qualified personnel should attempt to test this instrument. The operator assumes all responsibilities for safe practices while troubleshooting.

Caution: The control circuit contains electrostatic discharge (ESD) sensitive devices. Use standard ESD precautions when handling the control circuit. See Section 2, Operation, for ESD details.

Tools Needed

Digital Multimeter (DMM)
3 Slotted Screwdrivers - 3/32" (2 mm); 1/8" (3 mm); 1/4" (6 mm)
Small Phillips head screwdriver

Quick Check

- Verify that the control circuit is seated firmly in the terminal board socket.
- Verify that LED DS3 (yellow LED) is on when power is applied.
- If LED DS3 flashes the heater power is set too high for most applications.
- Ensure that the jumpers are in the correct position. See Section 3 for the correct positions. Check input power.
- Ensure that the Mode switch is in the RUN position (switch S1 positioned toward the heat sink).
- Check any customer supplied fuses or disconnects.
- See the troubleshooting chart in Figure 23 at the end of this section.

Non-maintenance Observations

At this point, observe the system setup to verify operation. No disassembly or testing is required at this time.

Check Serial Numbers

Verify that the serial number of the sensing element and the control circuit are the same number. The sensing element and the control circuit are a matched set and cannot be operated independently of each other. The exception to this is if a removal and replacement have been done for repair purposes. All calibrations and jumpers must have been done and set.

Check Input Power

Verify that the correct power source is turned on and connected. Verify that the correct power jumper is installed and the power wiring is correct for the application. See Section 3 for the correct positions.

Check the Instrument Installation

Review the information on instrument installation in Section 2 to verify correct mechanical and electrical installation.

Check for Moisture

Check for moisture on the control circuit, whether in the local sensor enclosure (integral) or remote control circuit enclosure (remote). Moisture on the control circuit may cause intermittent operation.

Check Application Design Requirements

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

1. Review the application design with plant operation personnel and plant engineers.
2. Ensure that plant equipment such as pressure and temperature instruments conform to the actual conditions.
3. Verify operating temperature, operating pressure, line size, and process medium.

If conditions and specifications are satisfactory, then refer to the troubleshooting chart in the back of this section for troubleshooting suggestions.

Troubleshooting the Flow Element

Use Tables 5-1 and 5-2 to determine if the flow element is wired correctly or has failed. Turn off the input power to the instrument. Unplug the control circuit from its socket and measure the resistances below from the terminal board.

If the instrument is set up in remote configuration (flow element enclosure separate from the control circuit enclosure), and the ohm readings are incorrect, disconnect the flow element cable at the local (flow element) enclosure. Measure the resistance as shown in Table 5-2. If the resistances are correct then the cable between the enclosures is probably bad or not connected properly (loose, corroded, or connected to the wrong terminals).

For normally dry conditions check for moisture on the sensing element. If a component of the process media is near its saturation temperature it may condense on the sensing element. Place the sensing element where the process media is well above the saturation temperature of any of the process gases.

Table 5-1. Resistance at Control Circuit Terminal Board

NOMINAL RESISTANCE READINGS AT THE TERMINAL BOARD @ 78 °F PROCESS TEMPERATURE	
TERMINAL NUMBER	RESISTANCE
ACT TO COM	1.1 K OHMS*
ACT TO REF	2.2 K OHMS*
COM TO REF	1.1 K OHMS*
HTR+ TO HTR-	110-120 OHMS FOR FLT93S 548-620 OHMS FOR FLT93F

(See Fig. 23 for test points)

Table 5-2. Resistance at Flow Element enclosure Terminal Block (Remote Applications Only)

NOMINAL RESISTANCE AT LOCAL ENCLOSURE TERMINAL BLOCK	
TERMINAL NO.	RESISTANCE
1 TO 2	110 OHMS FOR FLT93S 548-620 OHMS FOR FLT93F
3 TO 4	1.1 K OHMS*
3 TO 5	2.2 K OHMS*
4 TO 5	1.1 K OHMS*
SHIELD CONNECTED TO CONTROL CIRCUIT SOCKET ONLY. NO CONNECTION TO LOCAL ENCLOSURE OR ITS TERMINAL BLOCK **	

* Approximate at 78 °F (26 °C) process temperature.

** Reference wiring diagrams in the Installation section of the manual.

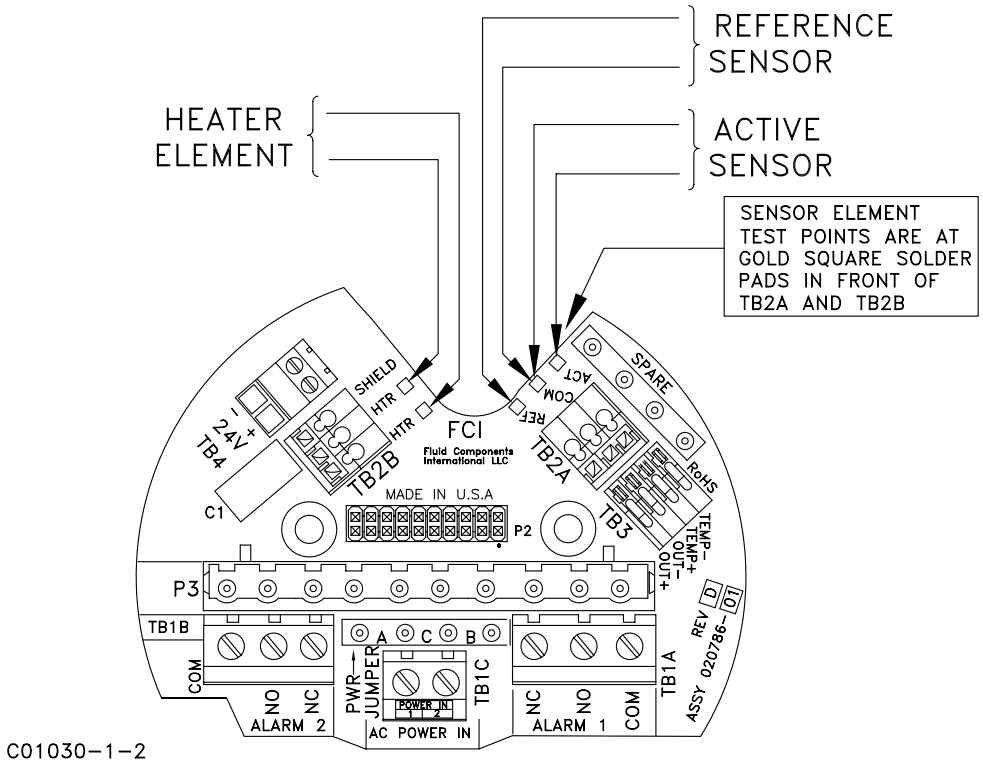

Figure 23 – Terminal Board, Test Points

Troubleshooting the Control Circuit

Table 5-3. Troubleshooting Chart

Seq.	Observation	Action
1	Is the Yellow Power indicator LED: Dim, Off or Blinking	**Yellow LED dim or OFF** With the power applied, measure the 9-volt reference voltage at P1, pins 2 (blue) to 4 (black). See Figure 16 for the location of P1. Verify a voltage of 9 volts DC ±2% (8.82-9.18 V). **Not OK: Low Reading:** A low reading may indicate incorrect power is being applied. Turn off the power and remove the control circuit. Caution: While the power is on, use extreme care when measuring the input voltage. Check the input power wiring on the terminal board and make corrections if necessary. Before reinstalling the control circuit, apply the input voltage to verify or correct. Check disconnects. Turn off the power and reinstall the control circuit. Apply power and re-check the 9-volt reference. **Not OK: No Reading:** Go to step 2 and check the fuses. **OK:** If the 9-volt reference measures correctly and the yellow LED is off, refer to the Troubleshooting the Flow Element discussion in this section. On remote installations, the interconnect cable may be miswired or a wire may be disconnected. If the flow element resistances are not correct contact the factory. If the sensor is OK then proceed to step 4. **Yellow LED Blinking:** For Liquid Flow Applications: Line is Dry. Make sure that the line is packed. For Gas Flow Applications: Heater power set too high. Set to a lower value. For Liquid Level Applications: Heater power set too high. Set to lower value. For Liquid Interface Application: In some cases it is necessary to set the heater power to the maximum value to achieve the maximum signal difference between the two liquids. Blinking is okay.
2	Fuse Check	Turn off the power and remove the control circuit. For installations using 120/230 VAC, remove F1 and F2. With an ohmmeter, measure the continuity of the fuses. If one or both of the fuses are open, replace and recheck if the control circuit functions properly. If the one or both fuses open again, contact the factory. If the fuses are OK but the control circuit does not power up contact the factory. For installations using 24 VAC/VDC, remove the bottom insulator and locate F3. With an ohmmeter, measure the continuity across the fuses. If the fuse is open, replace and recheck if the control circuit functions properly. If fuse opens again, contact the factory. If the fuse is OK but the control circuit does not power up contact the factory.
3	Flow switch not responding	Is the Mode switch in the “RUN” position? Is the signal voltage reacting to flow or liquid level movement and is the signal within the usable range of 0-7.0 volts at P1 pin 1 (red) and 2 (blue)? **Not OK:** Go to step 4.

Table 5-3. Troubleshooting Chart (continued)

Seq.	Observation	Action
4	Signal Voltage Observation	With the power applied, note the position of the heater wattage control jumper plug and remove it. Place the jumper plug temporally on position J33. With a voltmeter measure the voltage at P1 pins 1 (red) and 2 (blue). **a) The voltage is 0 volts ±25 mV: OK** Reinstall the jumper plug and wait 5 minutes. Go to c) or d) whichever is applicable. **b) The voltage is out of tolerance: NOT OK.** Make sure the serial numbers from the sensor element and the control circuit match. If the serial numbers match then go the Restoring the Temp Comp Adjustments procedure in appendix D then go to c) or d) whichever is applicable. **c) The voltage is between 0 and 7 volts and changes with flow or level changes: OK.** See Step 5 switch point **d) The voltage is still about 0 volts: or the voltage is stuck over ±7 volts: or the voltage is negative between 0 and –7 volts and changes with flow or level changes: Not OK.** The sensing element may be miswired or defective. Miswiring is more common on remote installations at the initial installation. Refer to the Troubleshooting the Flow Element discussion in this section. On remote installations, the interconnect cable may be miswired or a wire may be disconnected. If the flow element resistances are not correct contact the factory.
5	Alarm Switch	Make sure that the jumpers are set correctly. The related settings are the "Alarm Duty," "Alarm Quantity," and "Energization." Refer to the charts in Section 3 or the label on the bottom side of the control circuit. Using the Mode Switch set to CAL, check and record the alarm settings. Compare these settings to the signals generated by the process and make adjustment if necessary. Refer to the Operation section for guidelines on setting a switch point in your particular application.

Enclosures

To maintain Hazardous Locations Approvals, no repairs are allowed for defective or damaged enclosures. These enclosures shall be replaced by FCI to ensure the flameproof threaded joints continue to comply in accordance to the certifications.

Spares

FCI recommends an extra control circuit to be kept as a spare. The control circuit part number is 5208-XXX. The dash number can be found on the control circuit, the enclosure and on the order documents. Also recommended is an extra terminal board as a spare, part number 020786-01.

Defective Parts

Before returning any equipment to FCI, please obtain an RA number for authorization, tracking, and repair/replacement instructions. If a return is required, remove defective instrument, replace with spare, calibrate, then return defective instrument to FCI freight prepaid for disposition.

Customer Service

1. In the event of problems or inquiries regarding the instrument, please contact an authorized FCI field agent for the region or country. Refer to the FCI website: http://www.fluidcomponents.com/ for a list of field service representatives (which includes phone and email contact information) and a list of service centers around the world.
2. Before contacting the FCI representative, please be sure that all the applicable information is near so that a more effective, efficient and timely response may be provided.
3. Refer to Appendix E for specific Customer Service policy provisions.

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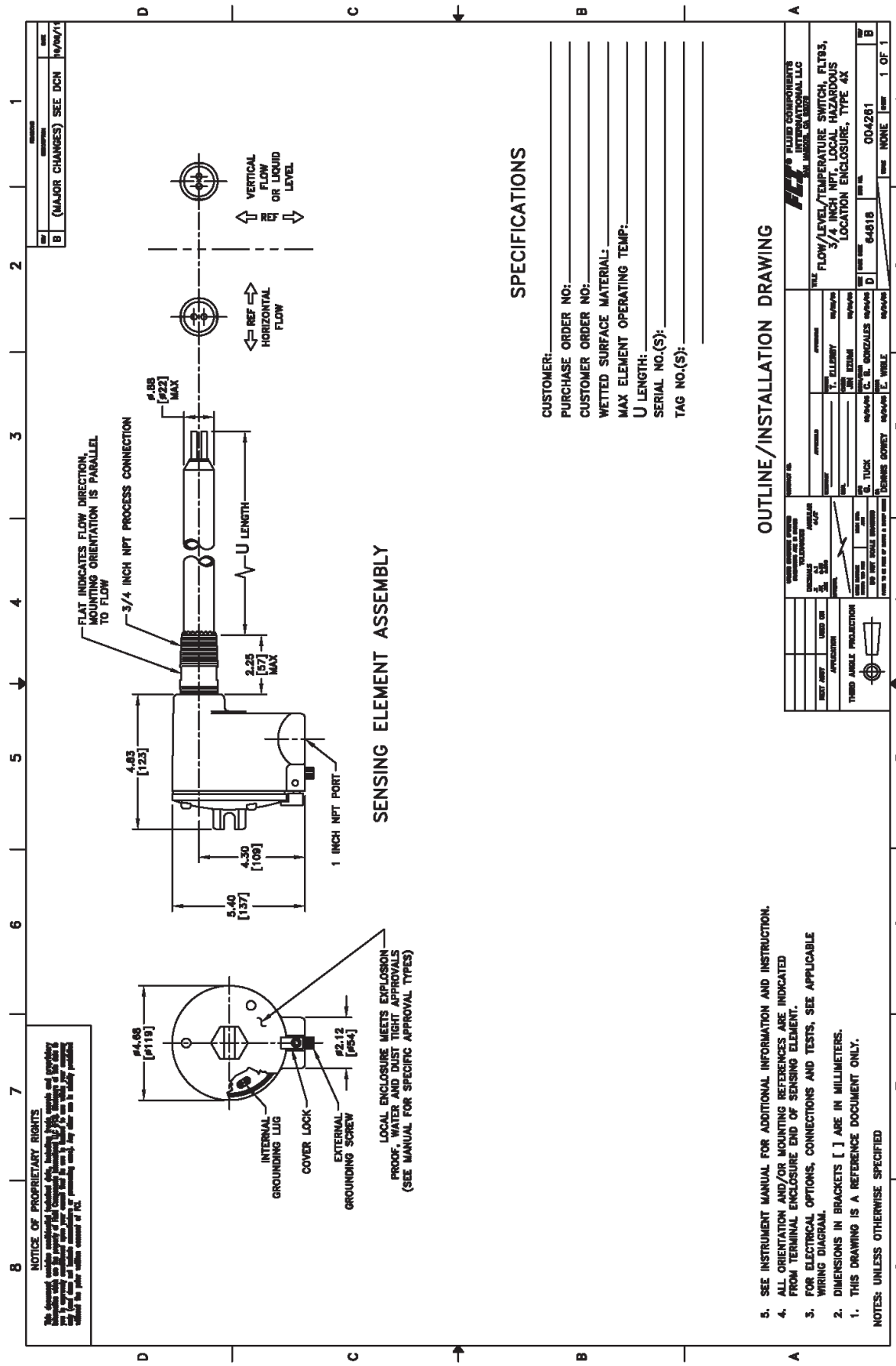
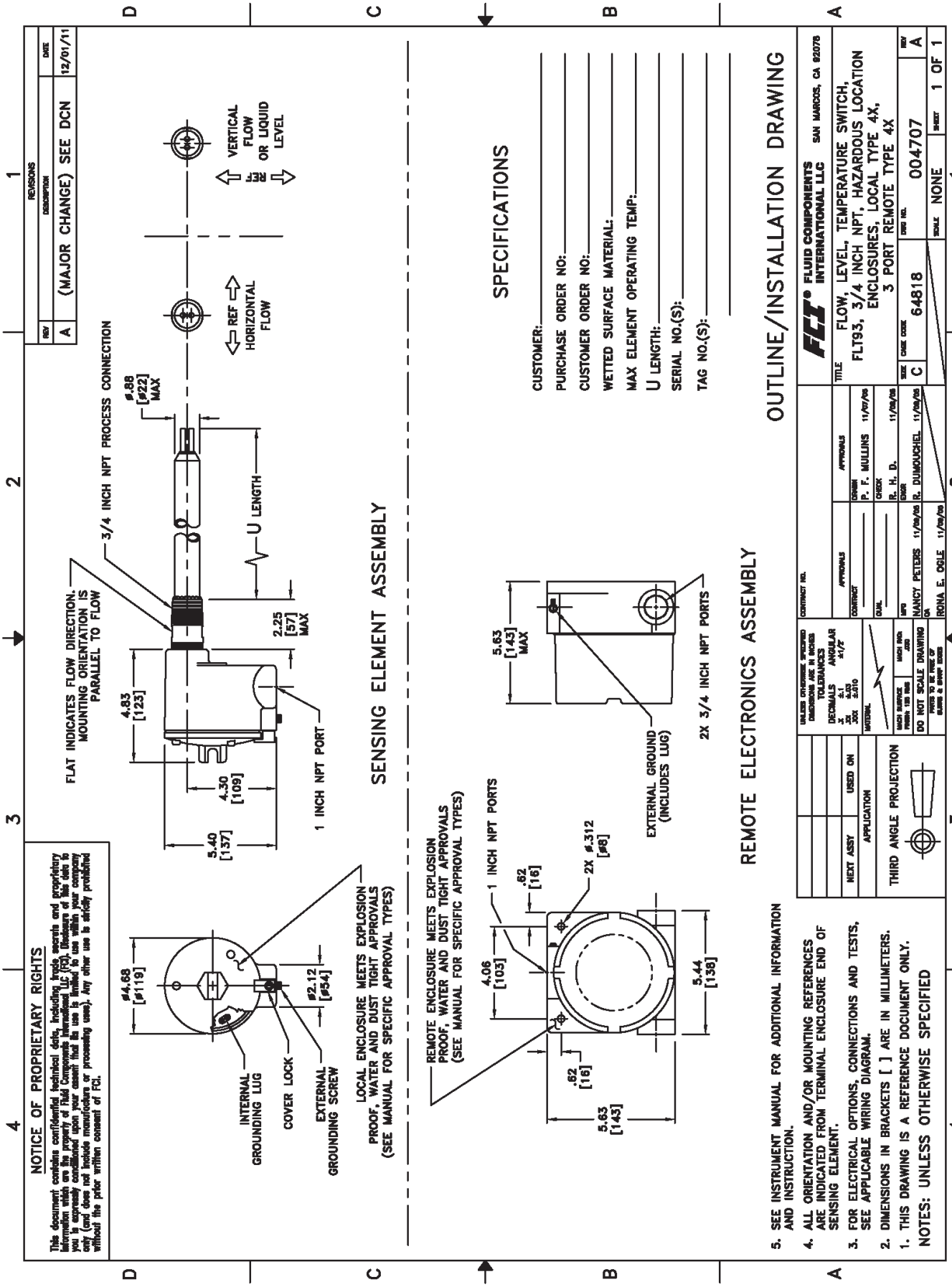
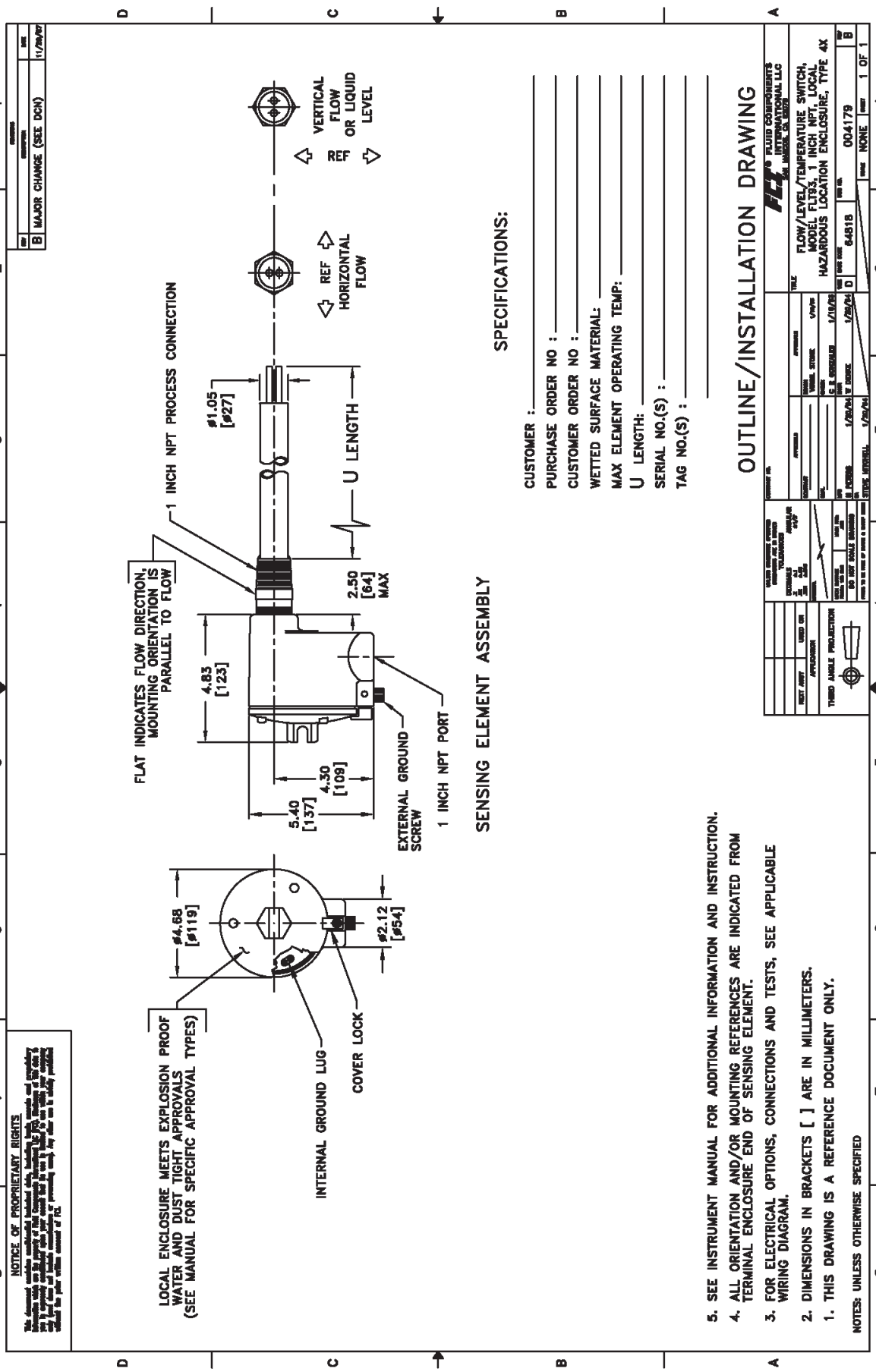
APPENDIX A DRAWINGS



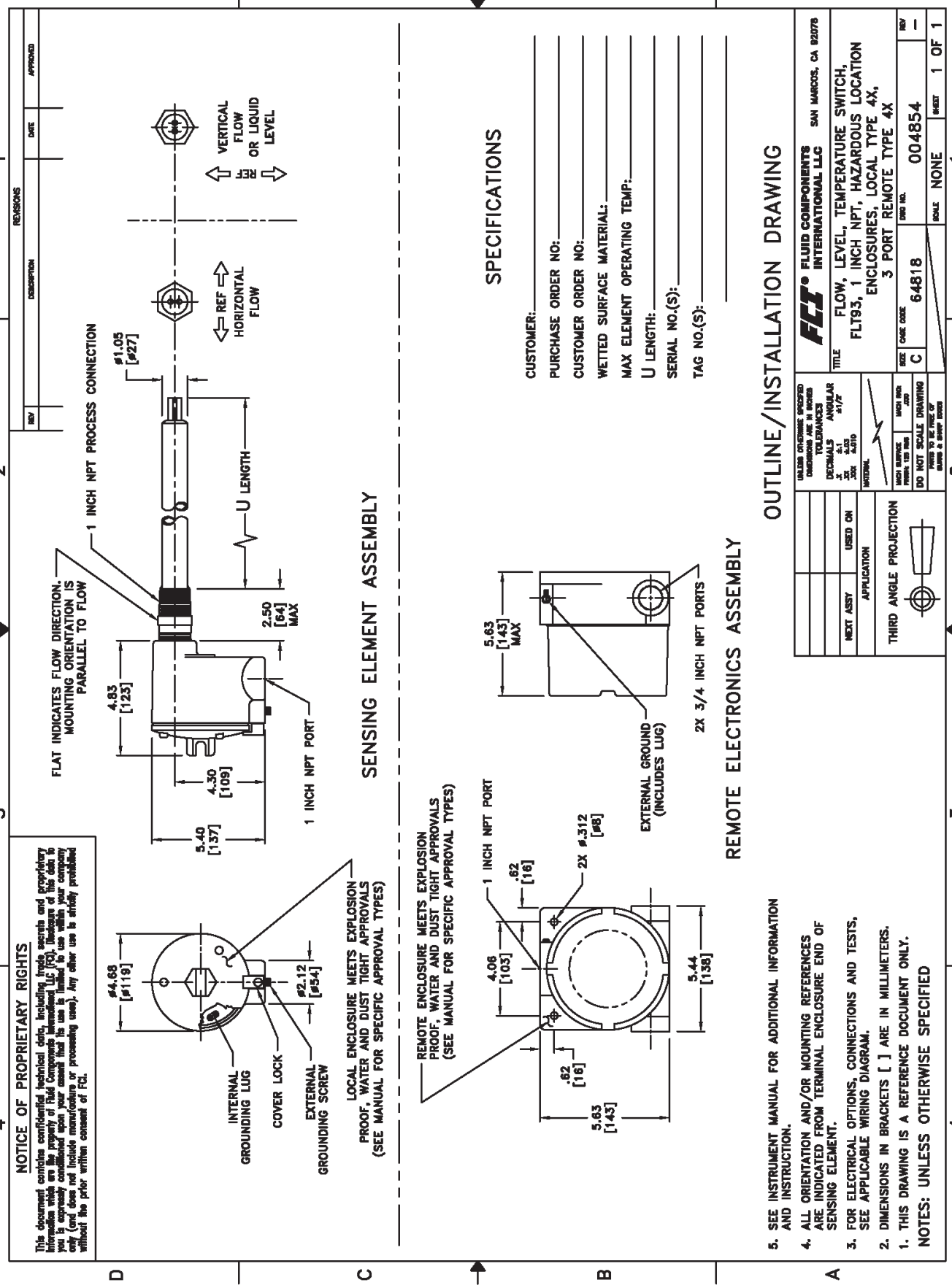
3/4" NPT with Local Hazardous Location Type 4X Enclosure



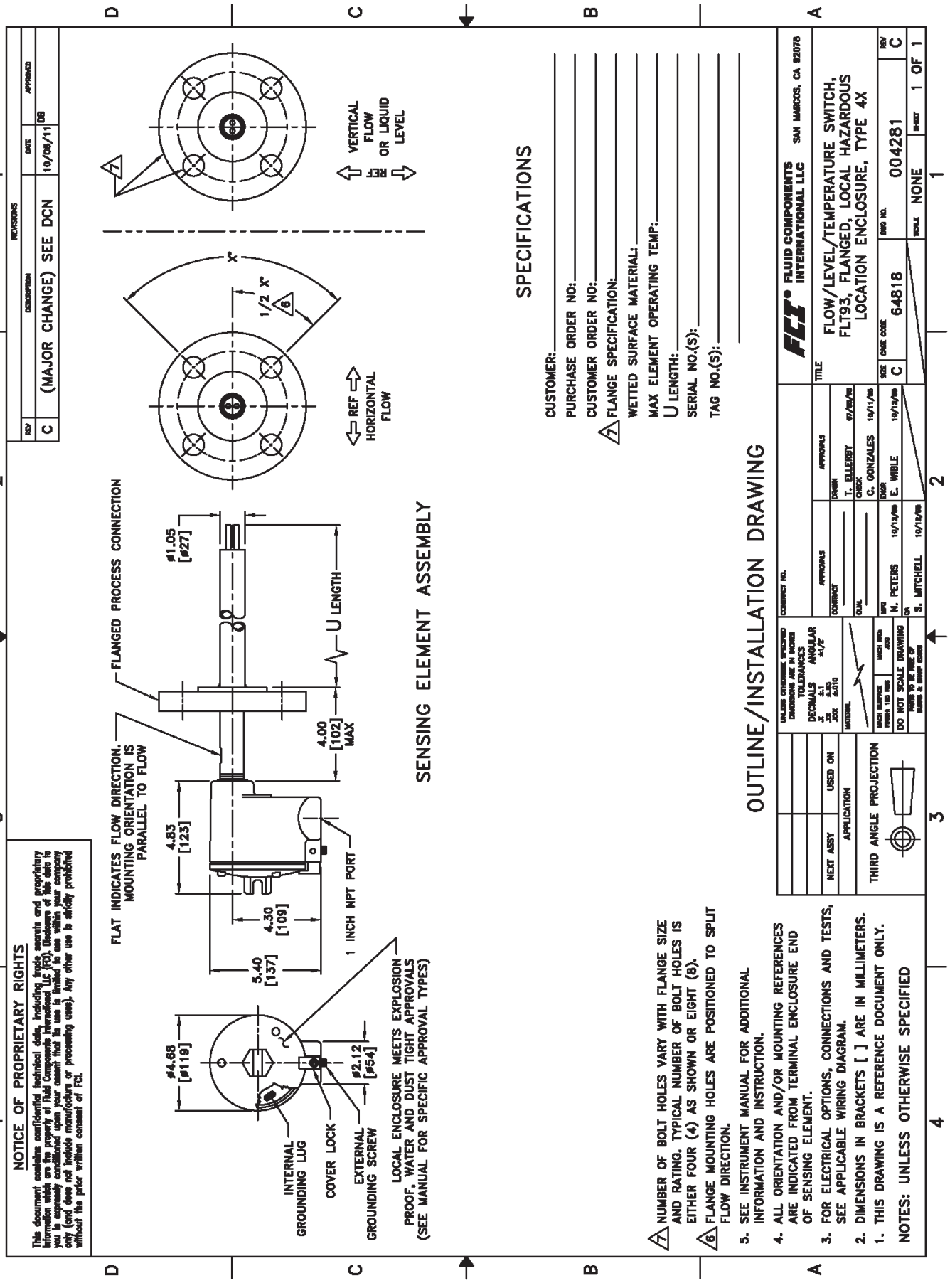
3/4" NPT with Local Hazardous Location Type 4X Enclosure: 3-Port Remote Type 4X



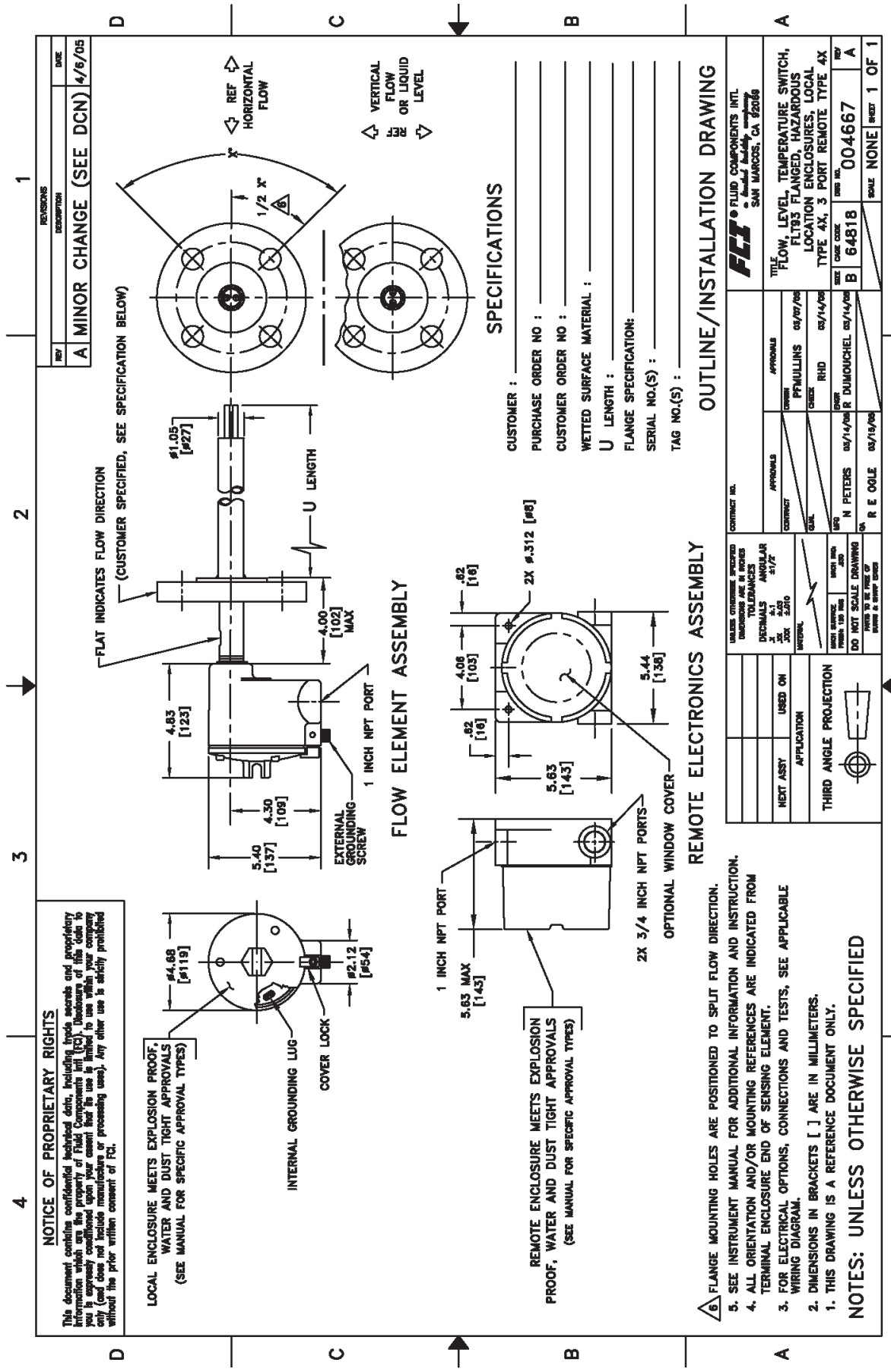
1" NPT with Local Hazardous Location Type 4X Enclosure



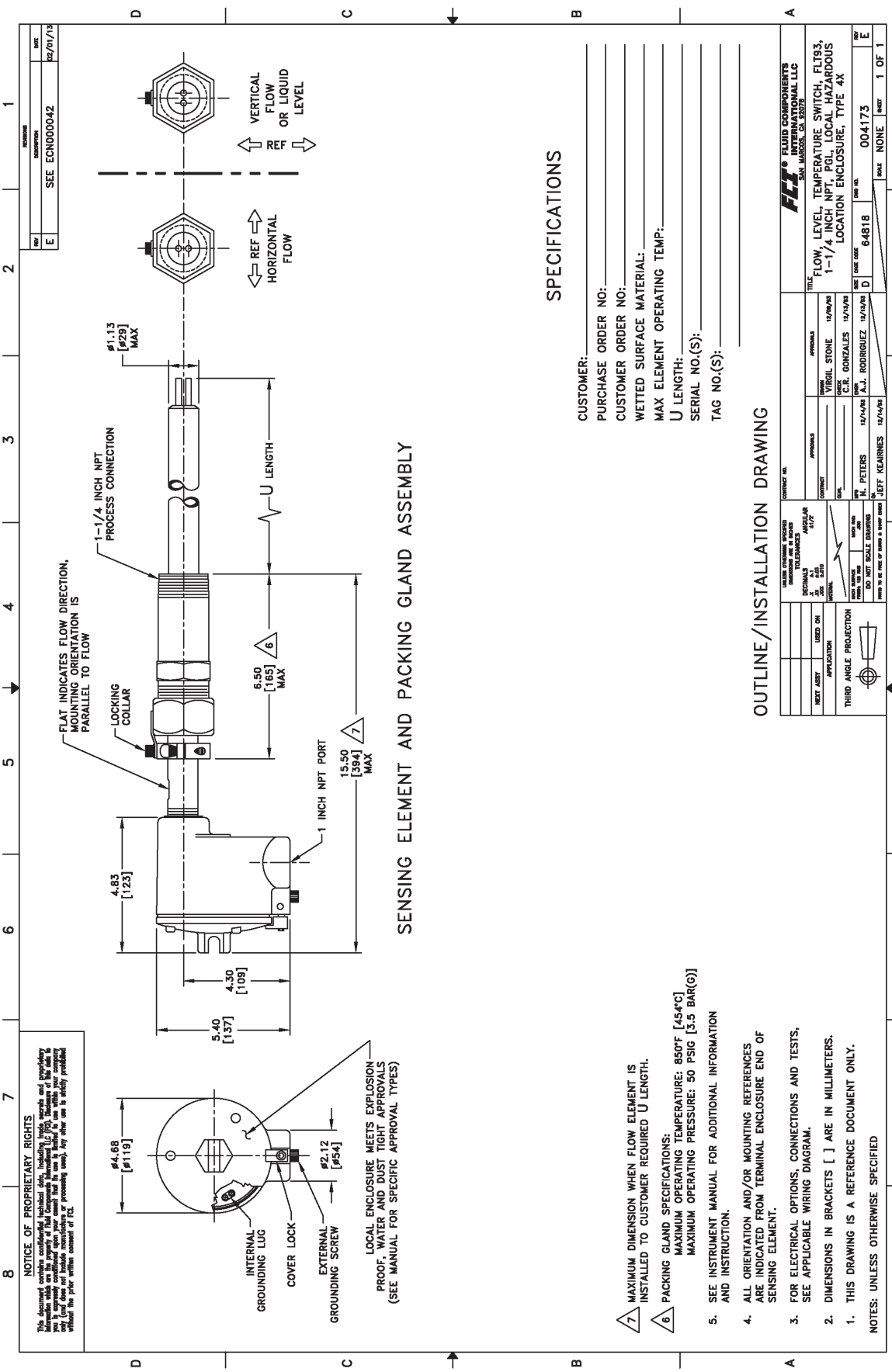
1" NPT with Local Hazardous Location Type 4X Enclosure: 3-Port Remote Type 4X



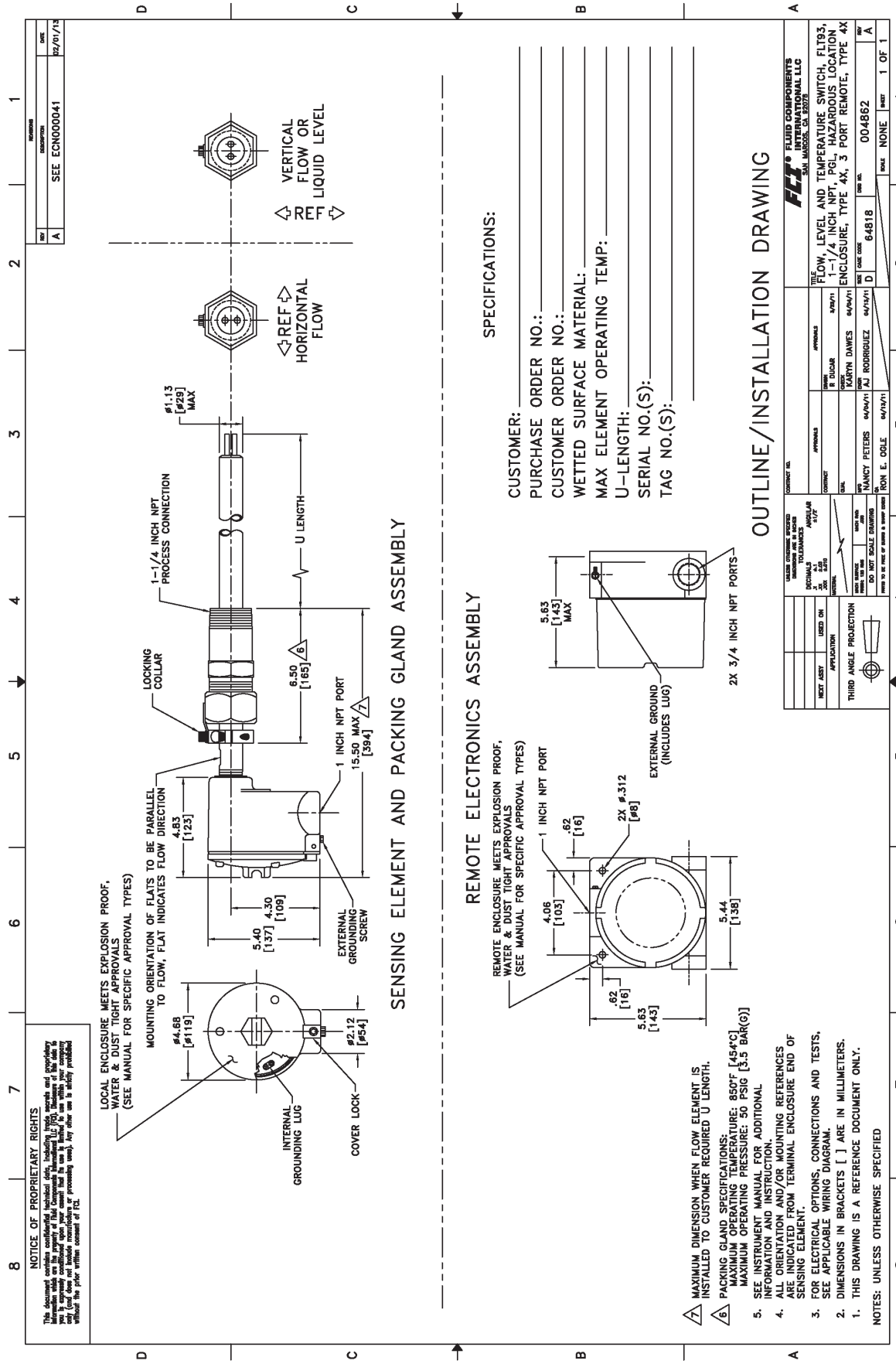
Flanged with Local Hazardous Location Type 4X Enclosure



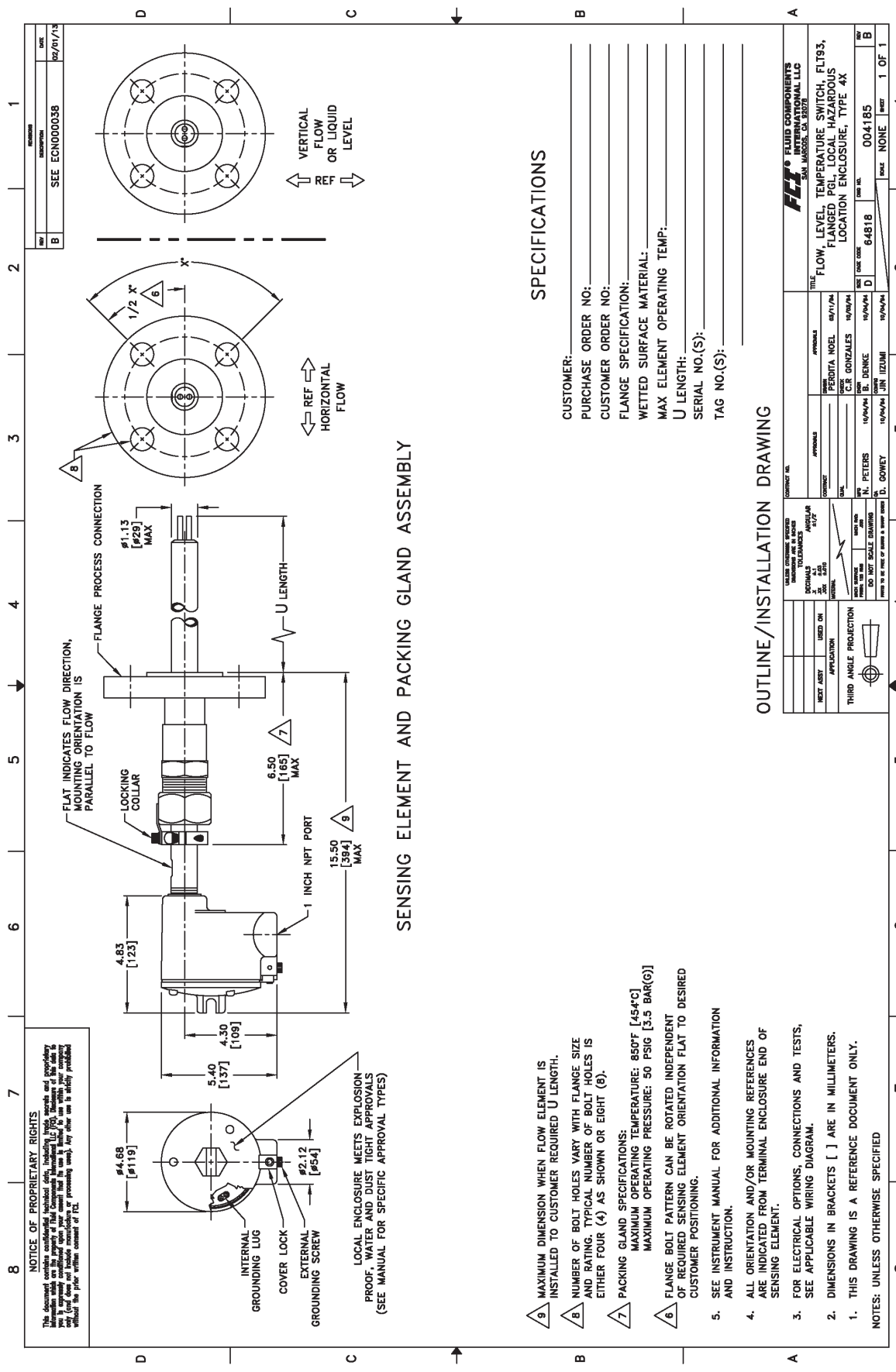
Flanged with Local Hazardous Location Type 4X Enclosure: 3-Port Remote Type 4X



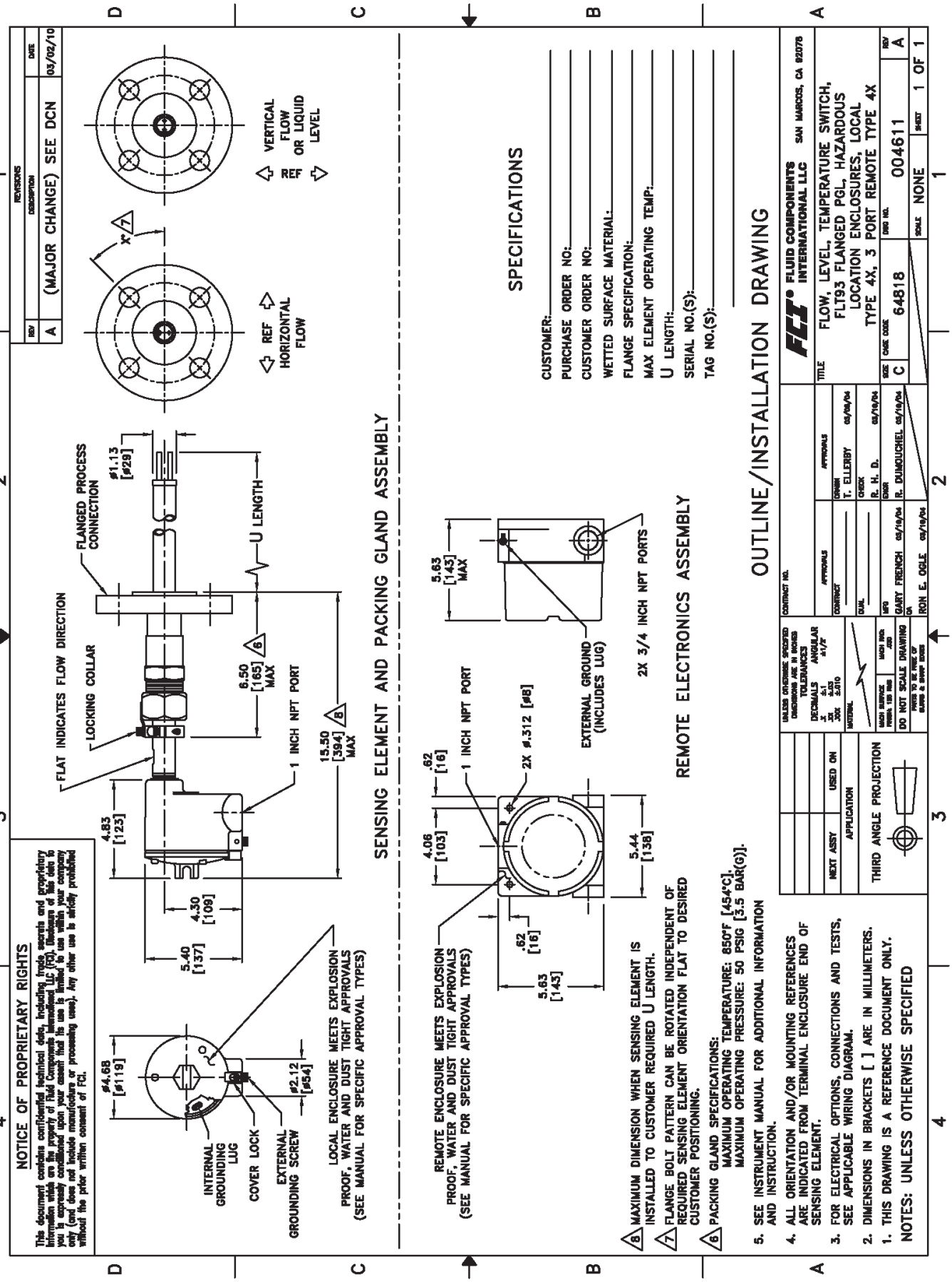
1-1/4" NPT Low Pressure Packing Gland with Local Hazardous Location Type 4X Enclosure



1-1/4" NPT Low Pressure Packing Gland with Local Hazardous Location Type 4X Enclosure: 3-Port Remote Type 4X



Flanged Low Pressure Packing Gland with Local Hazardous Location Type 4X Enclosure



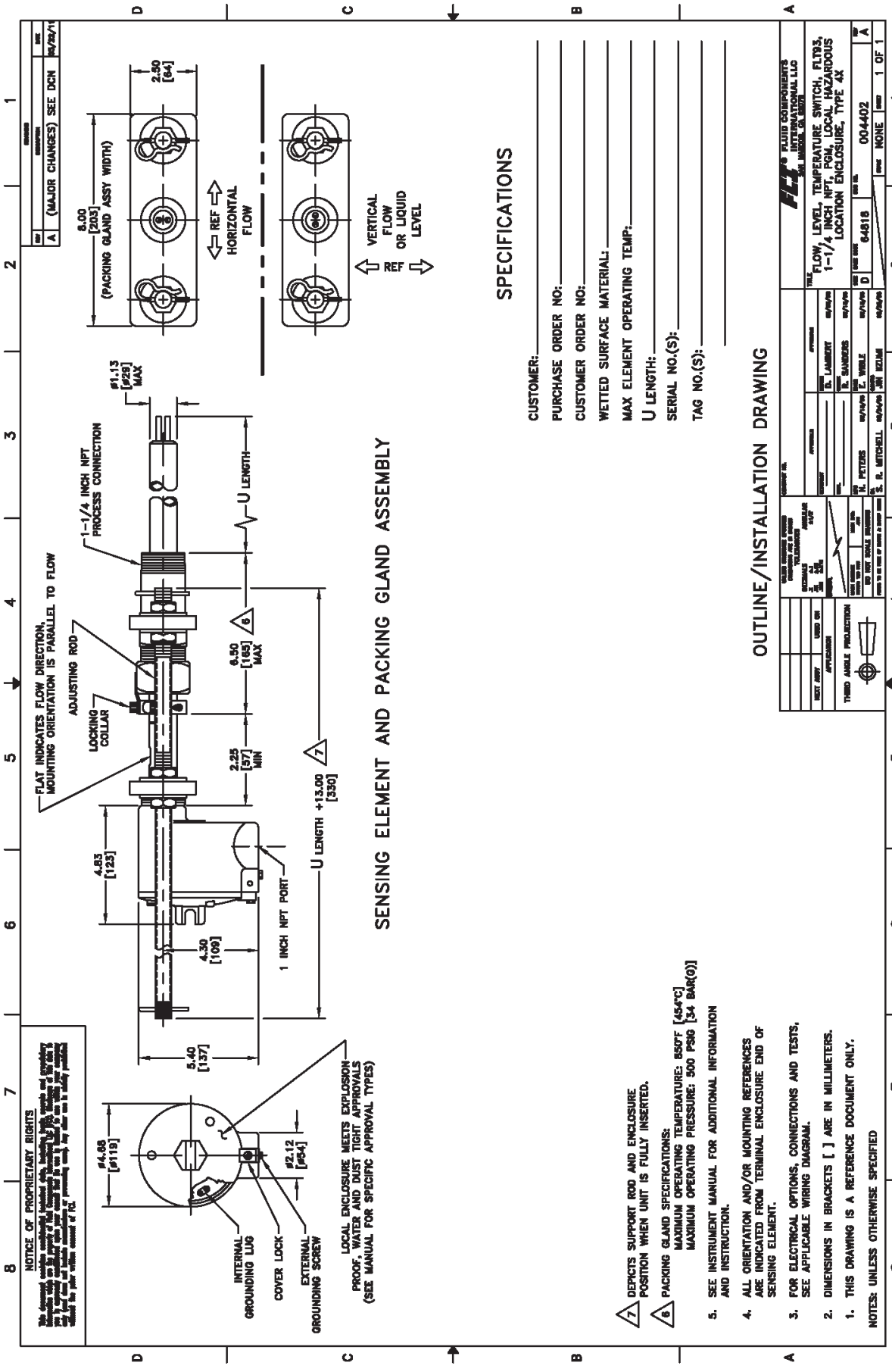
1. THIS DRAWING IS A REFERENCE DOCUMENT ONLY.
2. DIMENSIONS IN BRACKETS [ ] ARE IN MILLIMETERS.
3. FOR ELECTRICAL OPTIONS, CONNECTIONS AND TESTS, SEE APPLICABLE WIRING DIAGRAM.
4. ALL ORIENTATION AND/OR MOUNTING REFERENCES ARE INDICATED FROM TERMINAL ENCLOSURE END OF SENSING ELEMENT.
5. SEE INSTRUMENT MANUAL FOR ADDITIONAL INFORMATION AND INSTRUCTION.

⑥ PACKING GLAND SPECIFICATIONS:
MAXIMUM OPERATING TEMPERATURE: 850°F [454°C].
MAXIMUM OPERATING PRESSURE: 50 PSIG [3.5 BAR(G)].

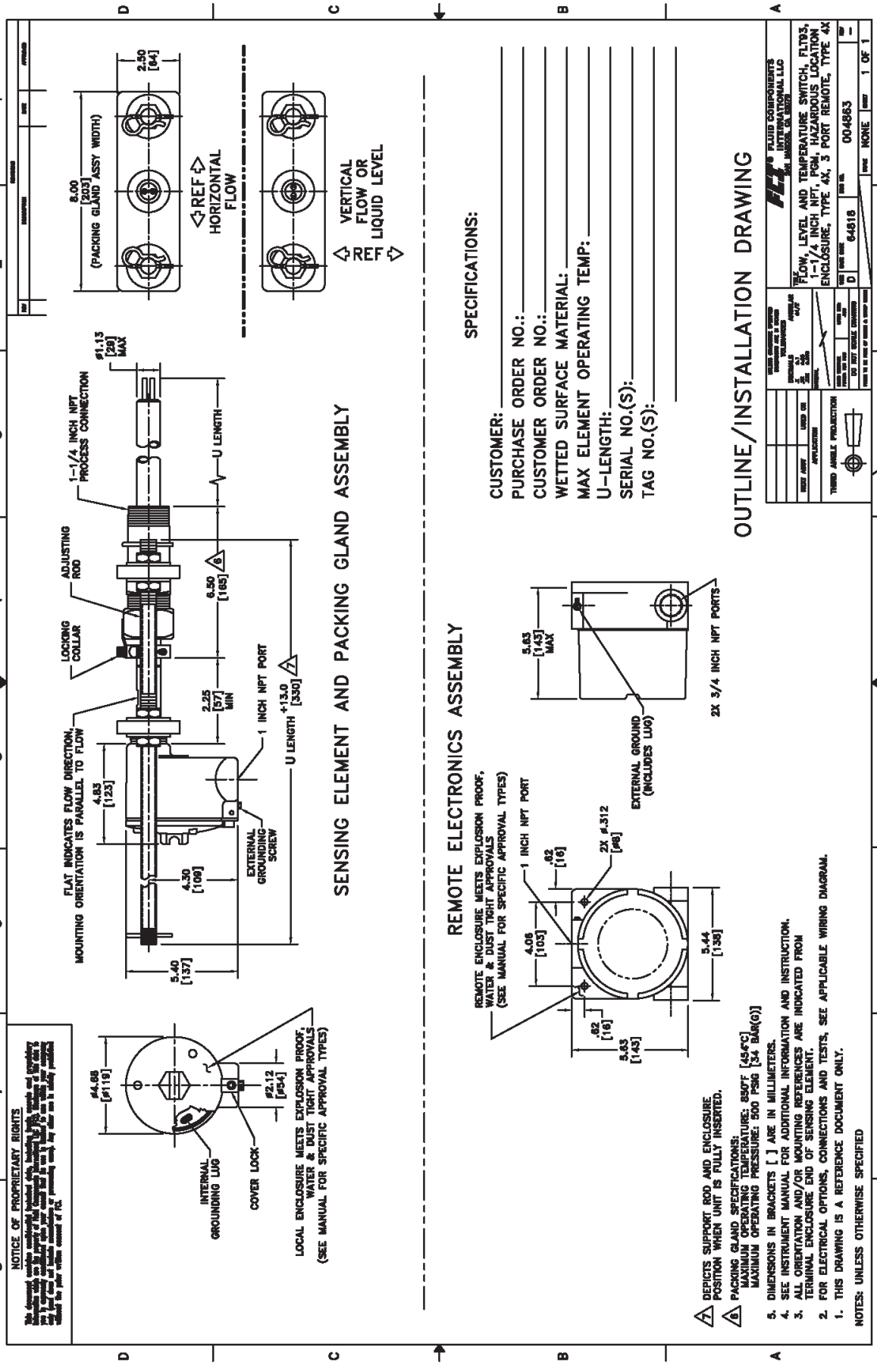
⑦ FLANGE BOLT PATTERN CAN BE ROTATED INDEPENDENT OF REQUIRED SENSING ELEMENT ORIENTATION FLAT TO DESIRED CUSTOMER POSITIONING.

⑧ MAXIMUM DIMENSION WHEN SENSING ELEMENT IS INSTALLED TO CUSTOMER REQUIRED U LENGTH.

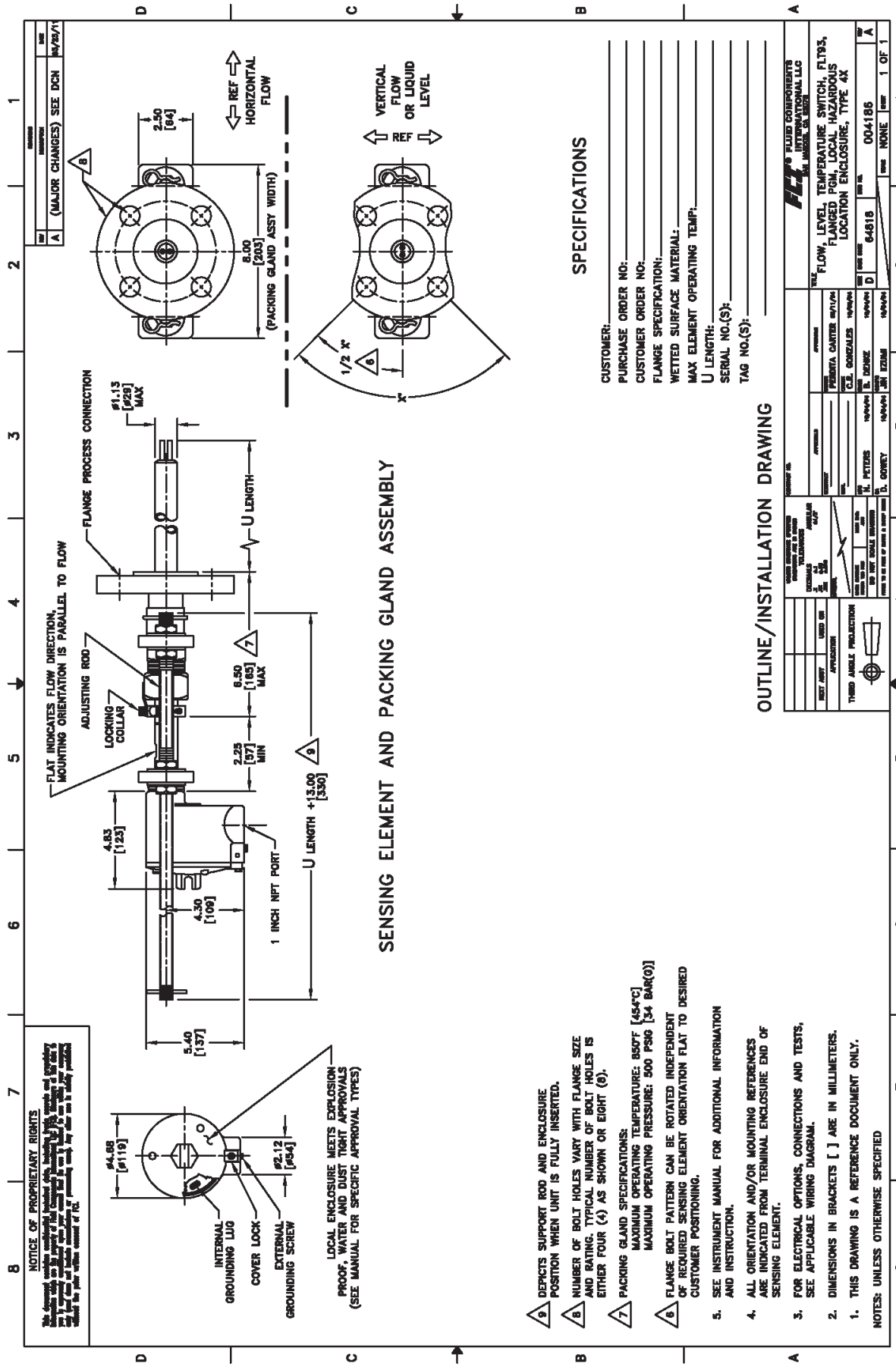
Flanged Low Pressure Packing Gland with Local Hazardous Location Type 4X Enclosure: 3-Port Remote Type 4X



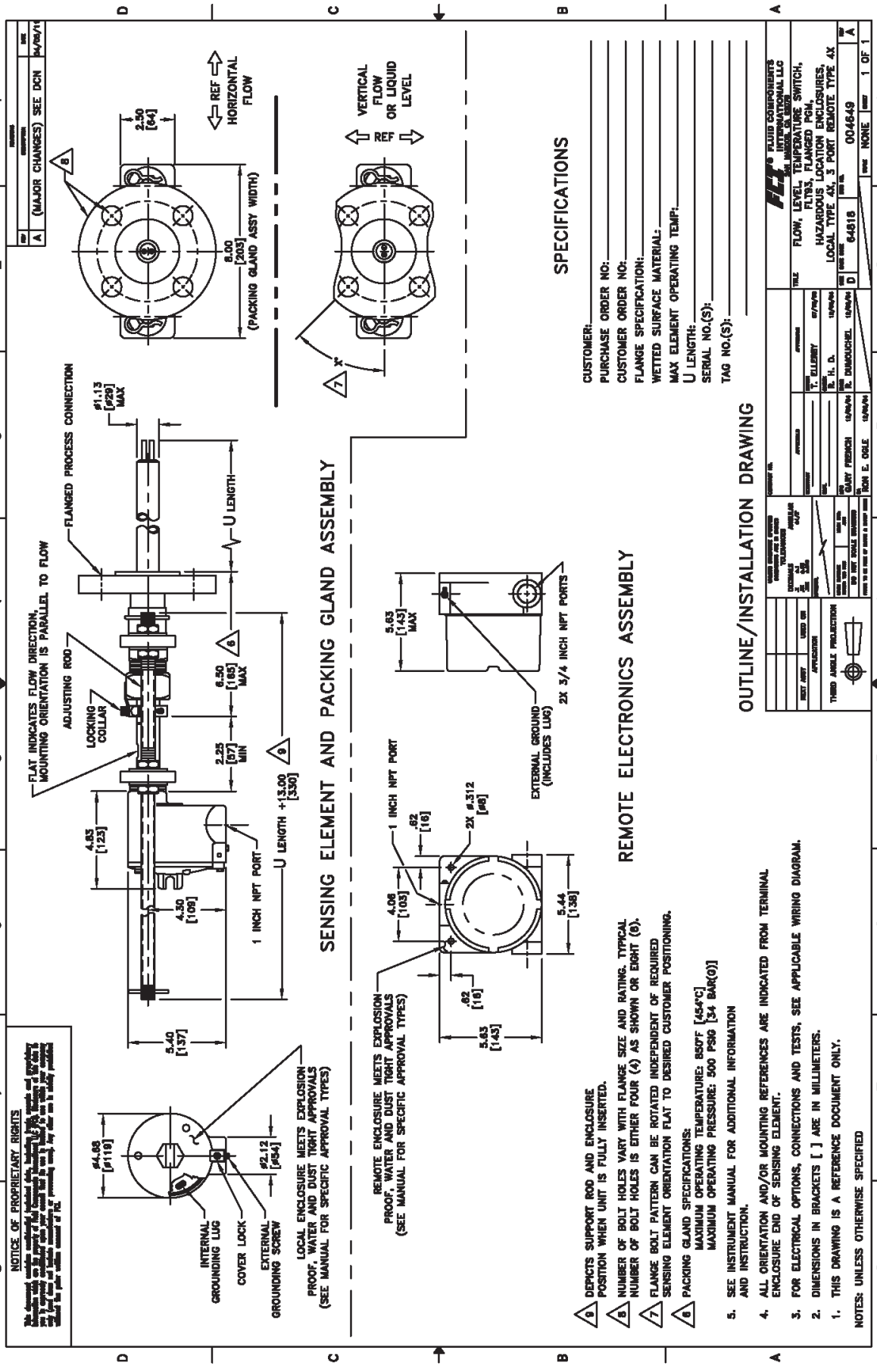
1-1/4" NPT, Medium Pressure Packing Gland with Local Hazardous Location Type 4X Enclosure



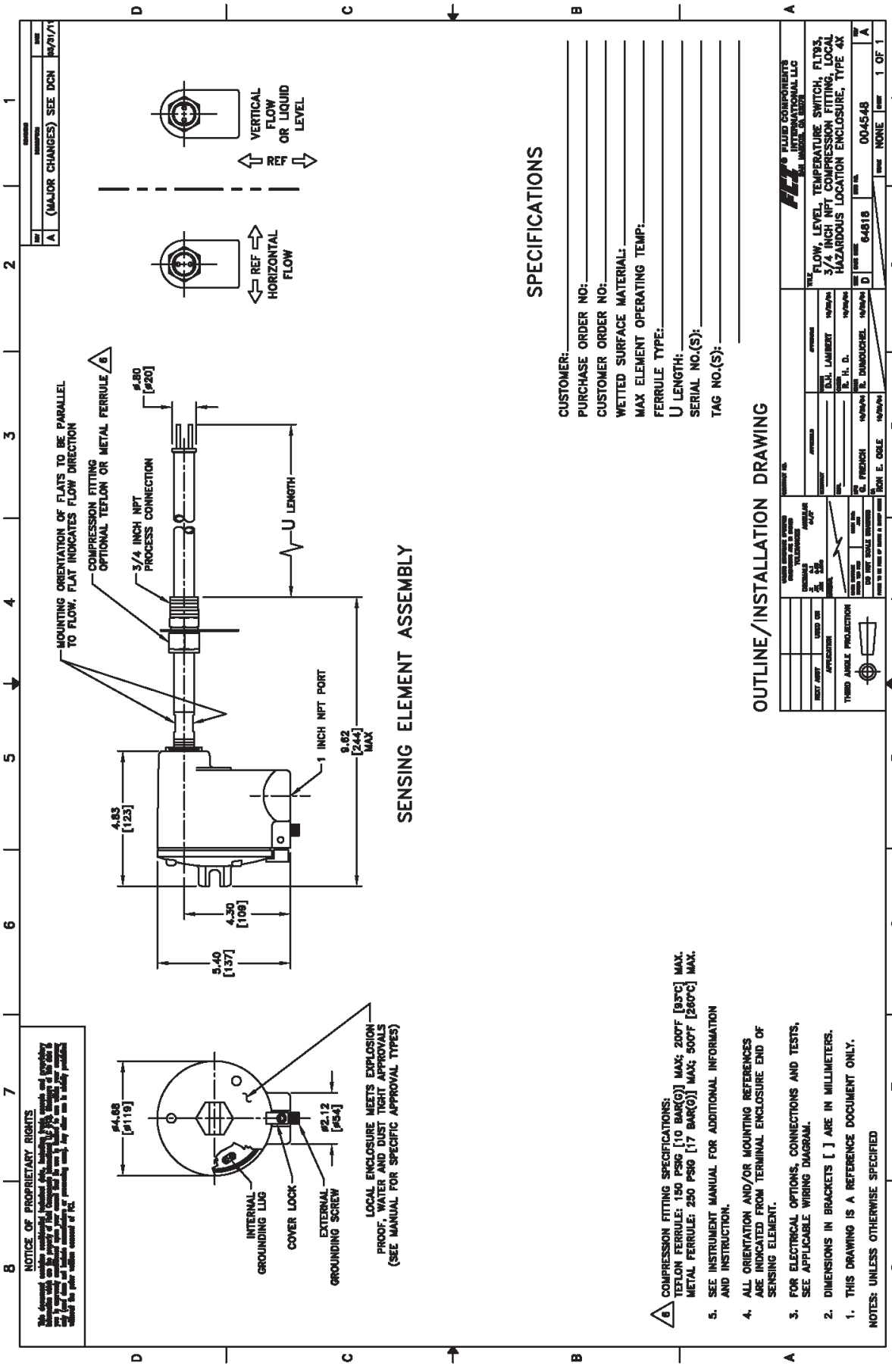
1-1/4" NPT, Medium Pressure Packing Gland with Local Hazardous Location Type 4X Enclosure: 3-Port Remote Type 4X



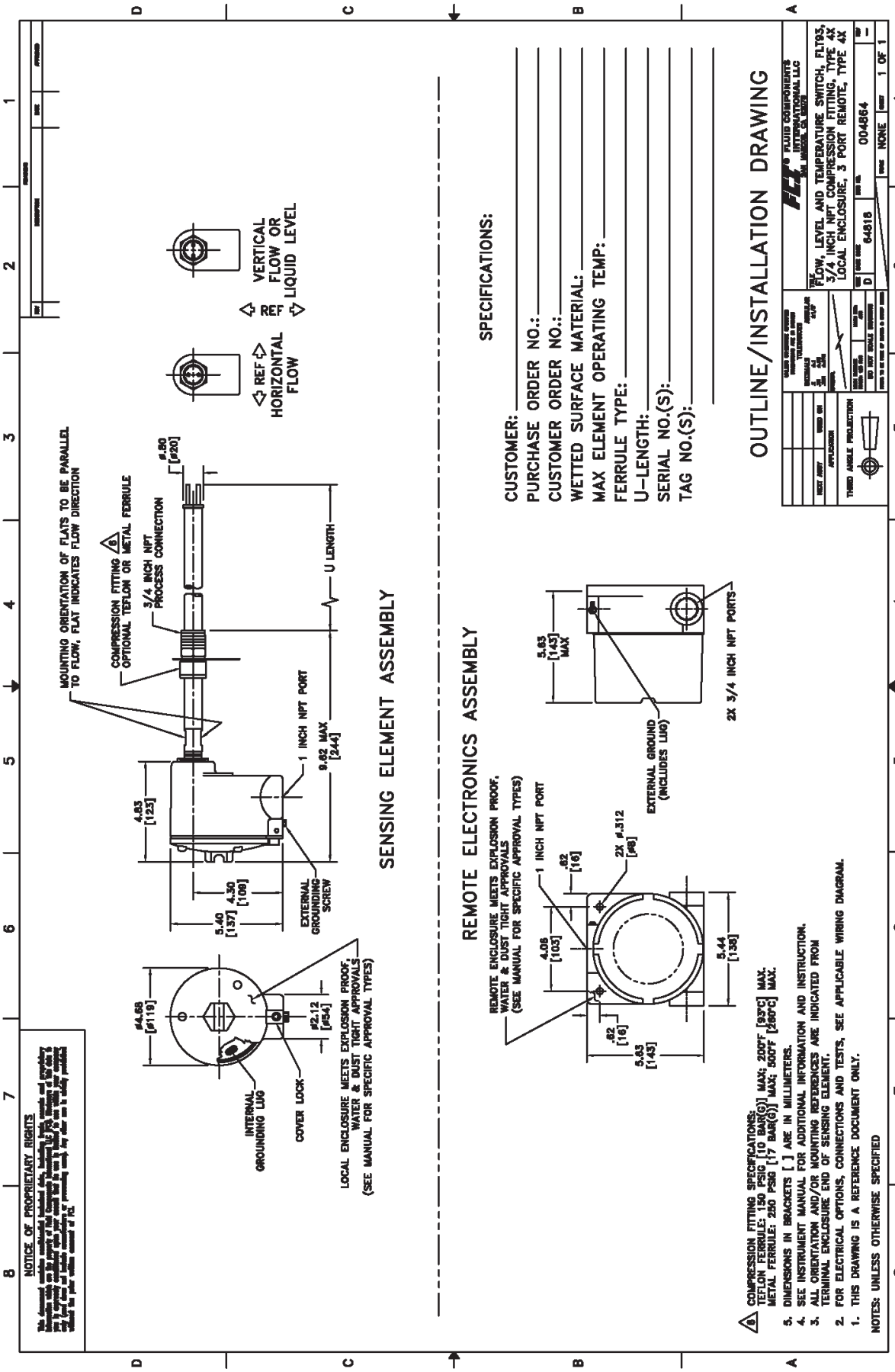
Flanged, Medium Pressure Packing Gland with Local Hazardous Location Type 4X Enclosure



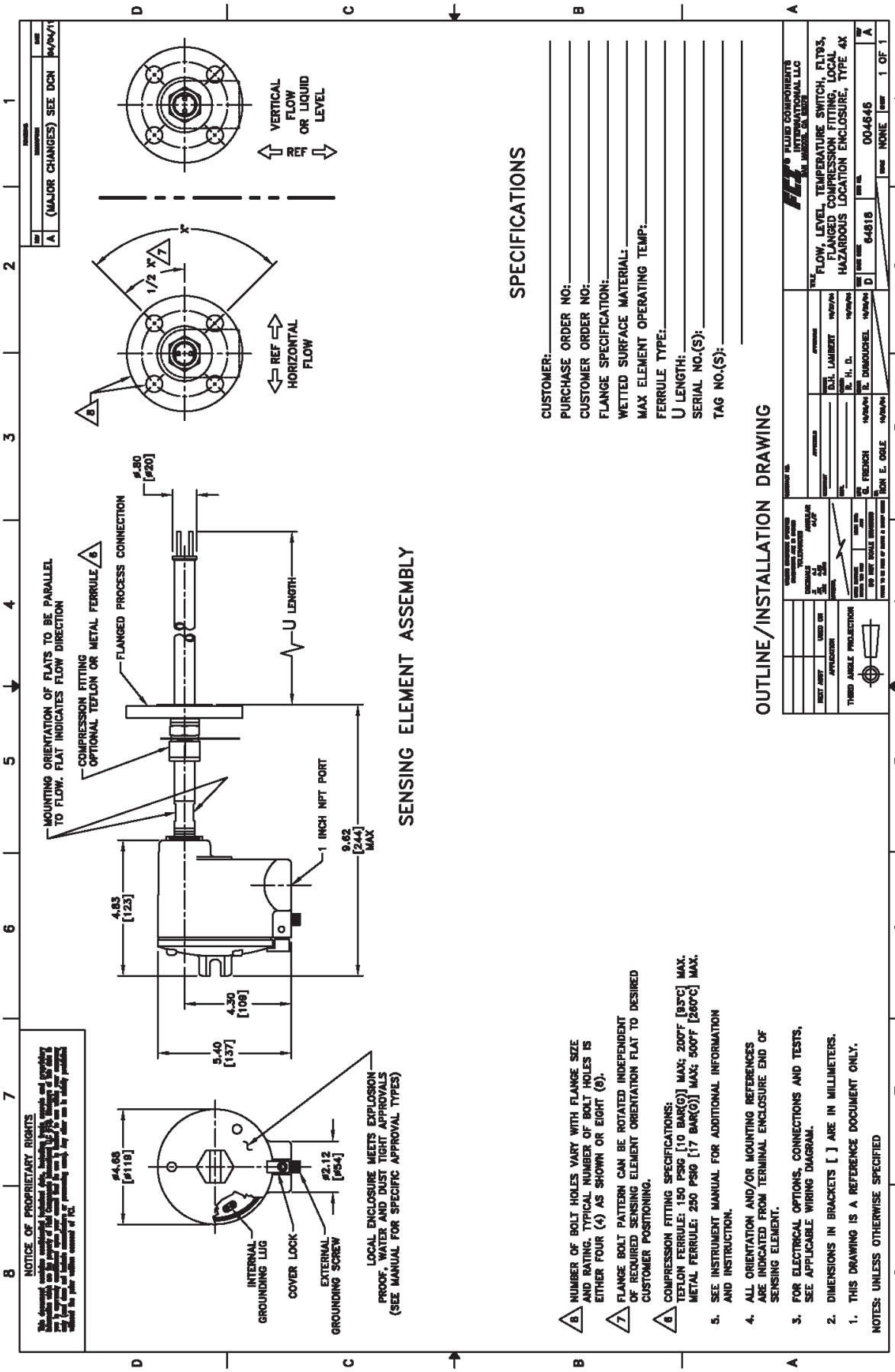
Flanged, Medium Pressure Packing Gland with Local Hazardous Location Type 4X Enclosure: 3-Port Remote Type 4X



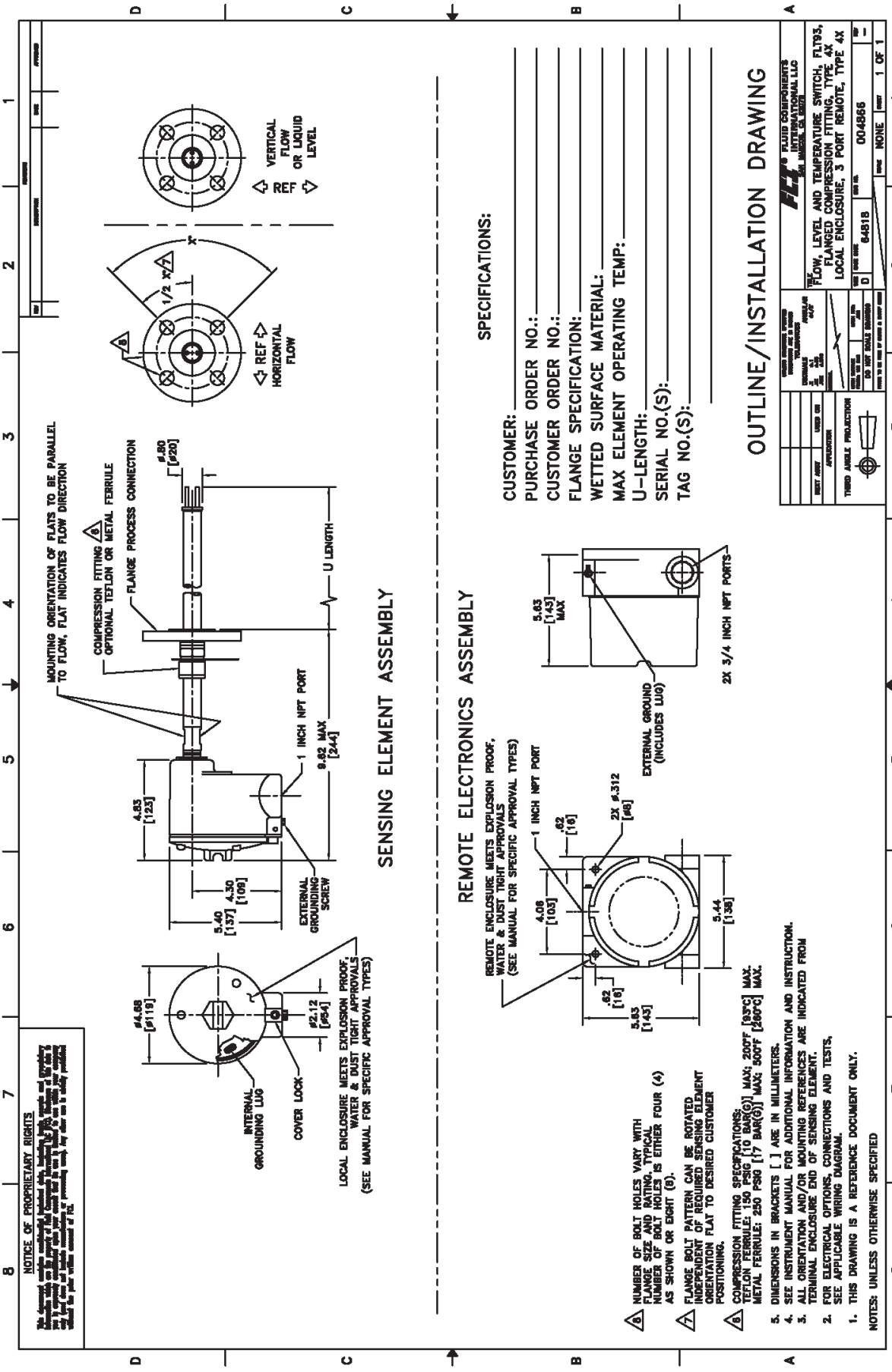
3/4" MNPT Compression Fitting with Local Hazardous Location Type 4X Enclosure



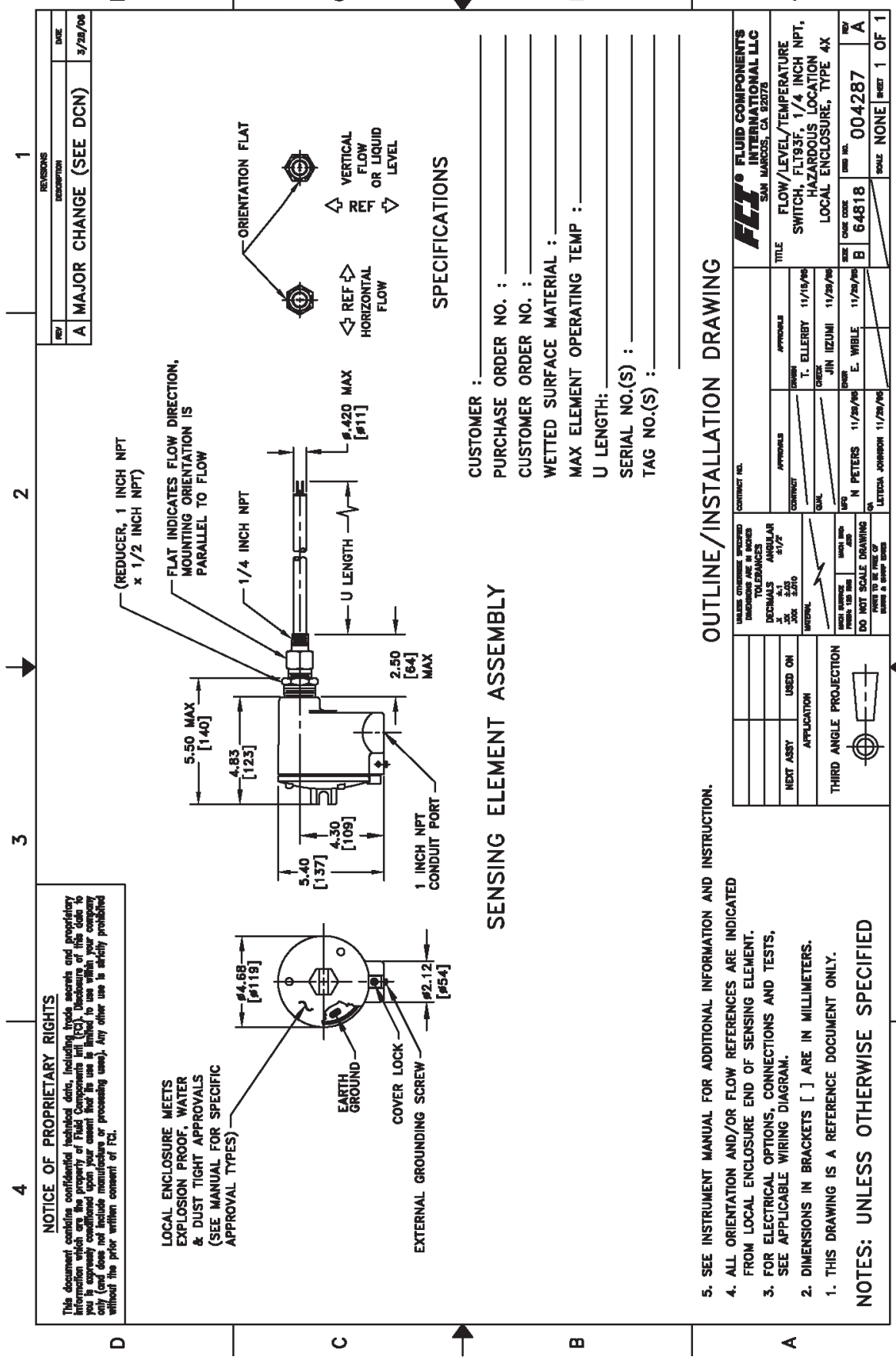
3/4" MNPT Compression Fitting with Local Hazardous Location Type 4X Enclosure: 3-Port Remote Type 4X



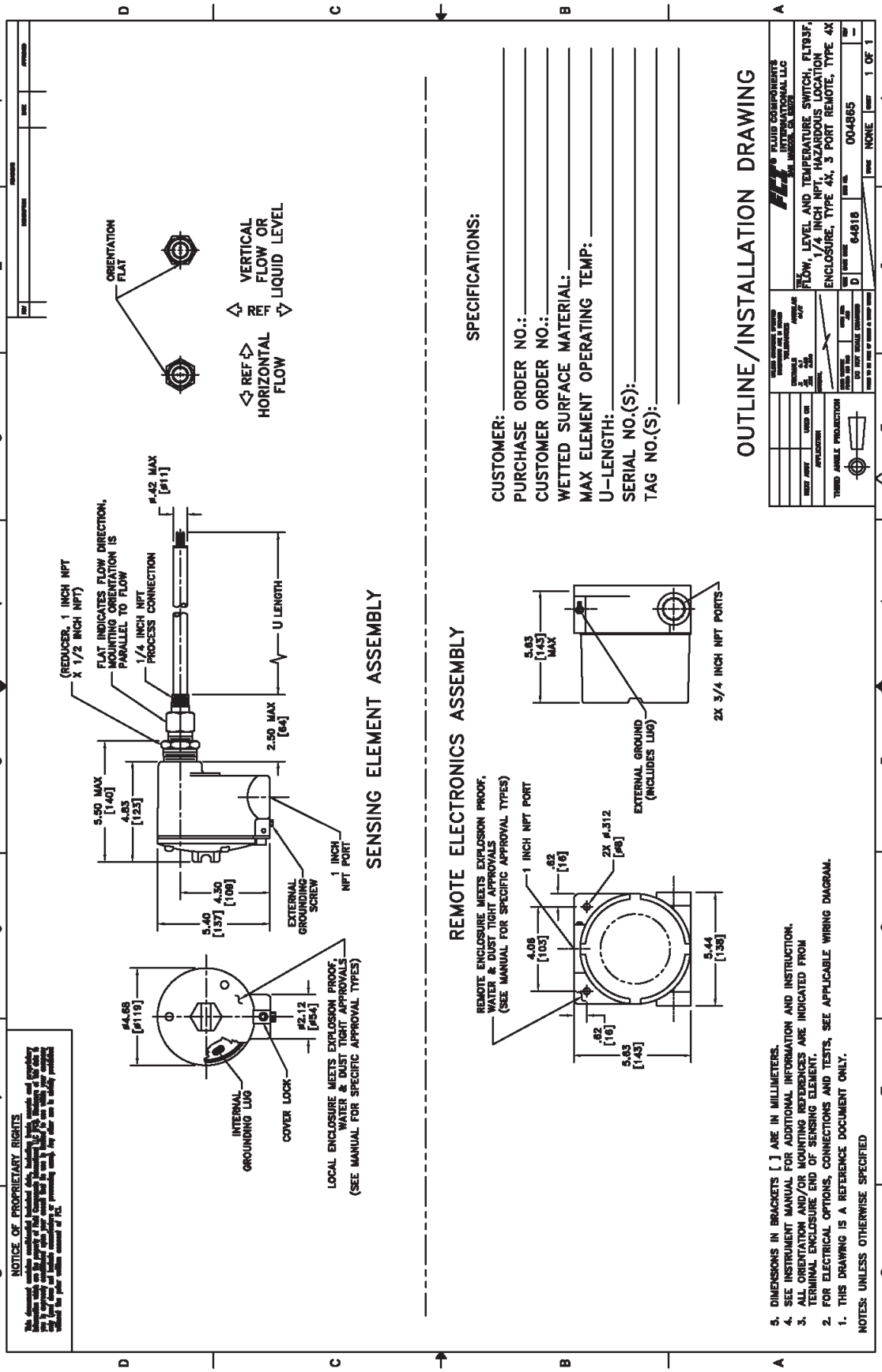
Flanged Compression Fitting with Local Hazardous Location Type 4X Enclosure



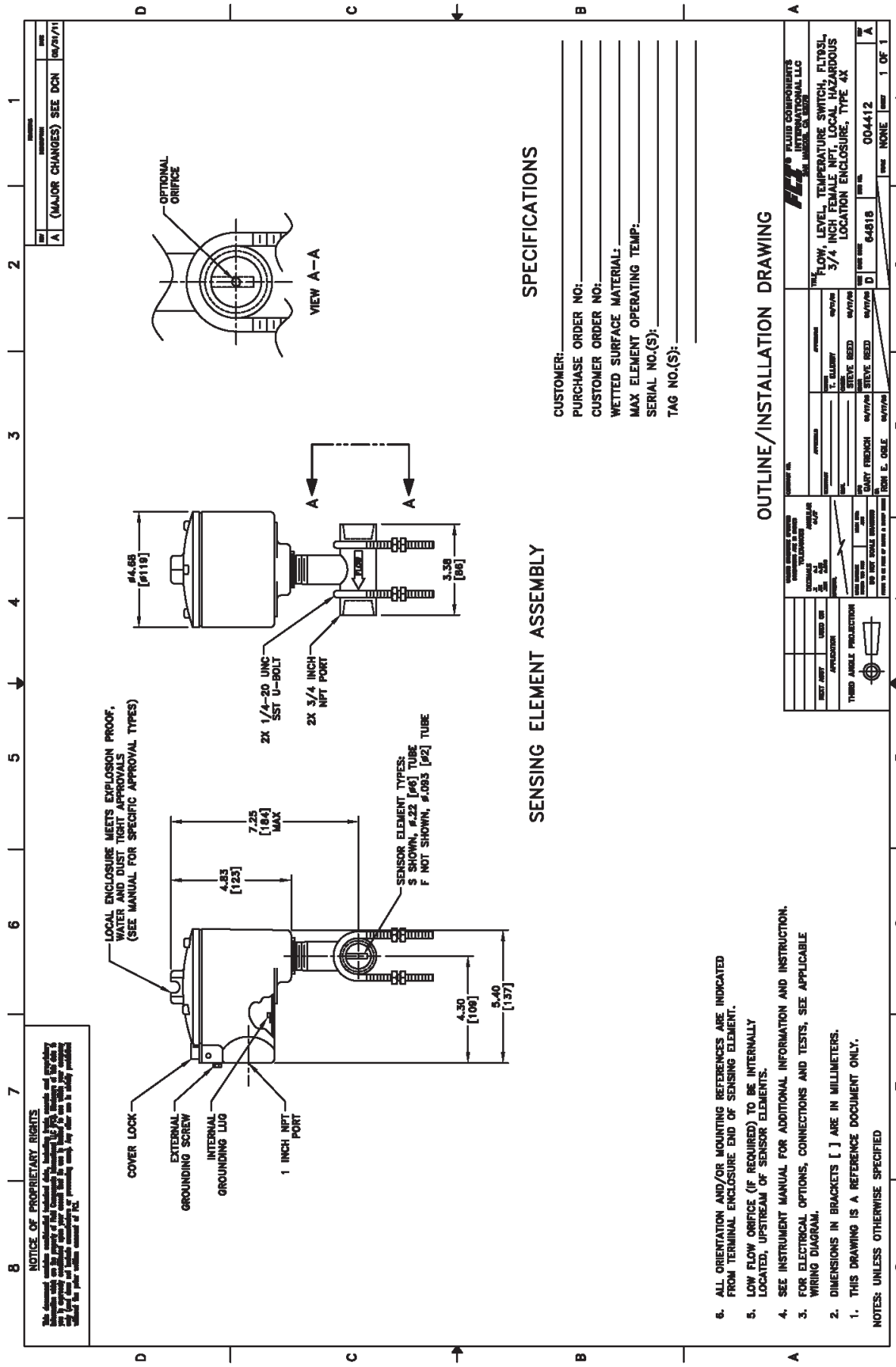
Flanged Compression Fitting with Local Hazardous Location Type 4X Enclosure: 3-Port Remote Type 4X



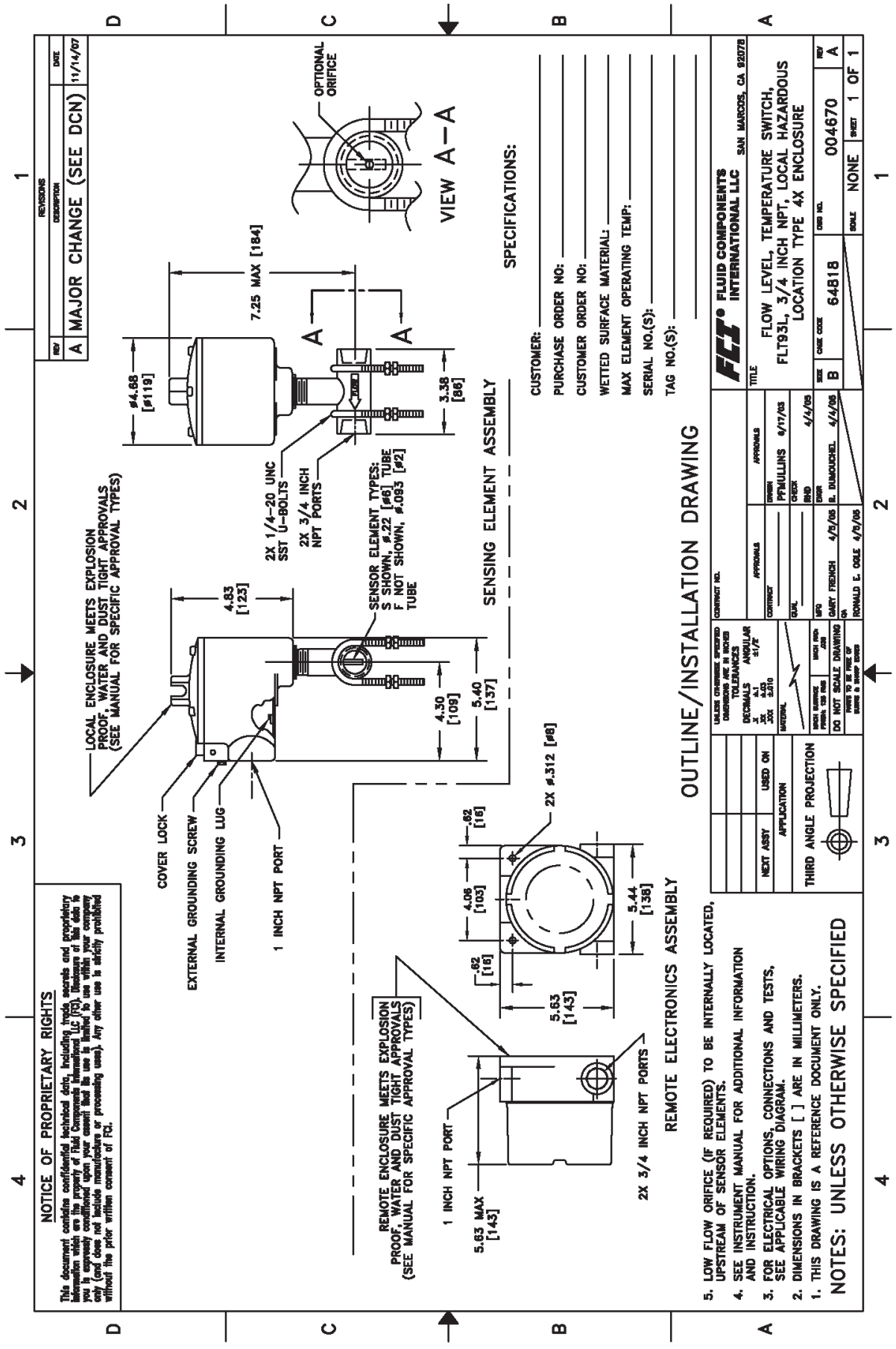
FLT93F Style Head : 1/4" NPT with Local Hazardous Location Type 4X Enclosure



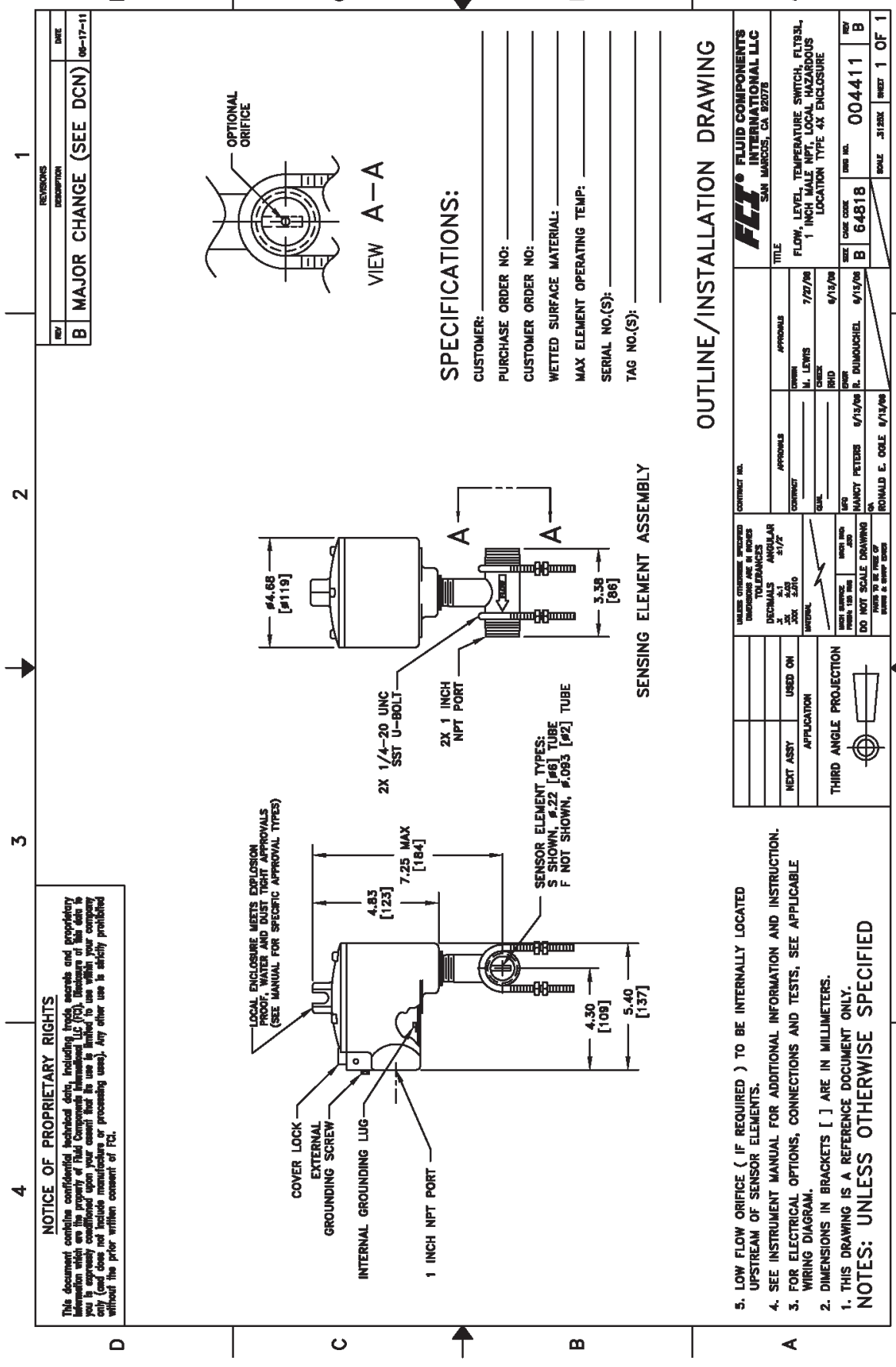
FLT93F Style Head: 1/4" NPT with Local Hazardous Location Type 4X Enclosure: 3-Port Remote Type 4X



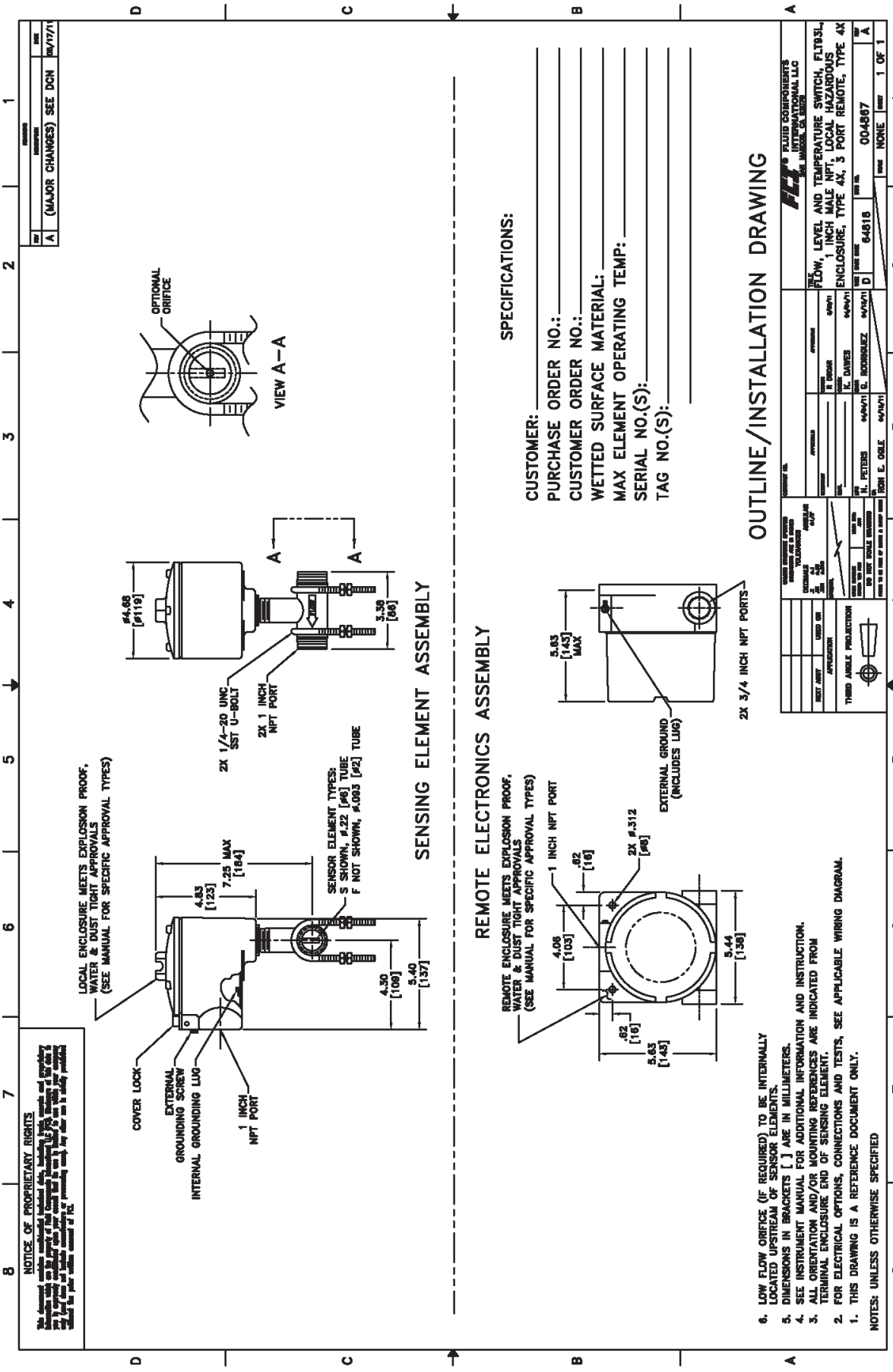
FLT93L: 3/4" NPT with Local Hazardous Location Type 4X Enclosure



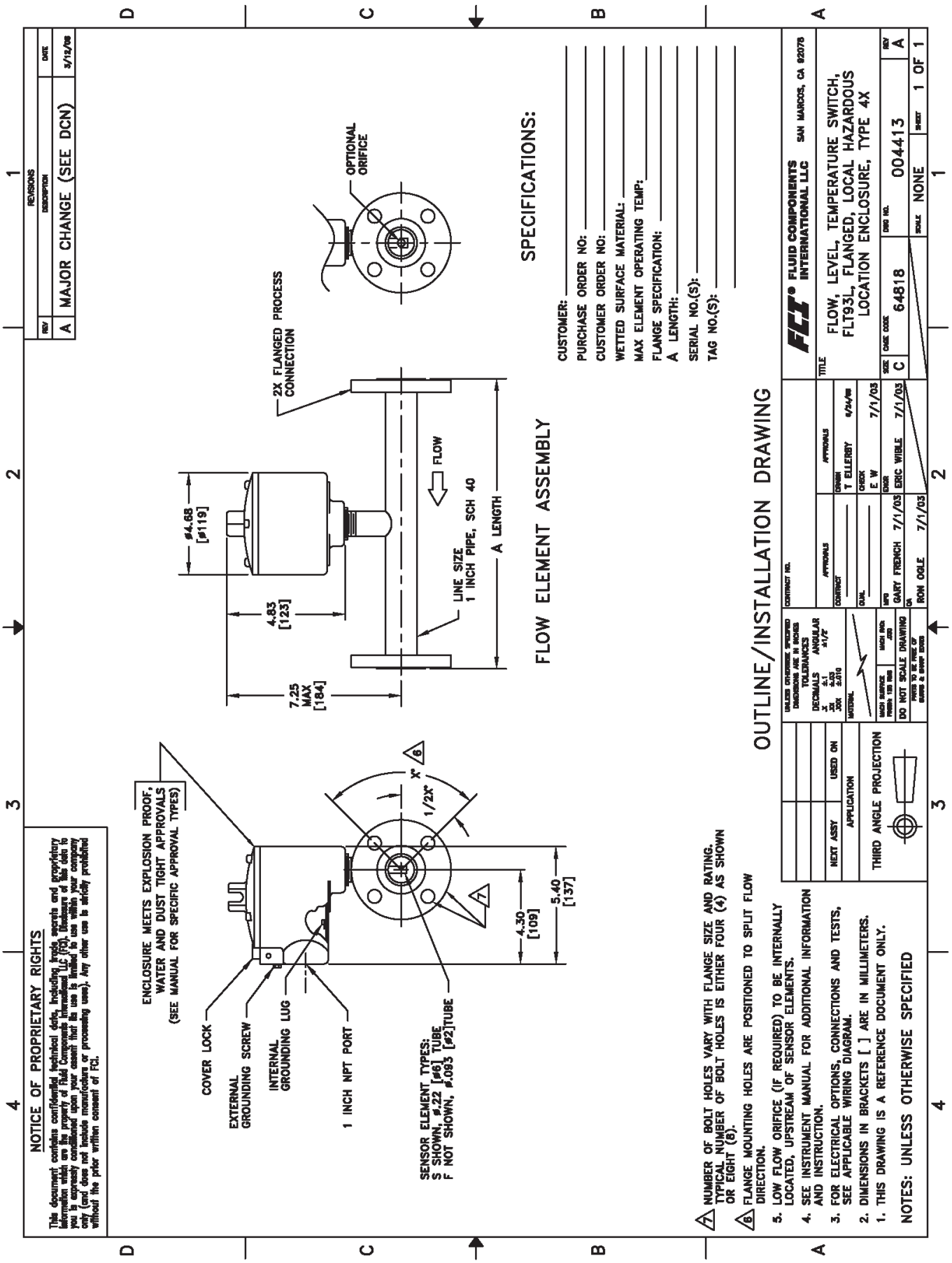
FLT93L: 3/4" NPT with Local Hazardous Location Type 4X Enclosure: 3-Port Remote Type 4X



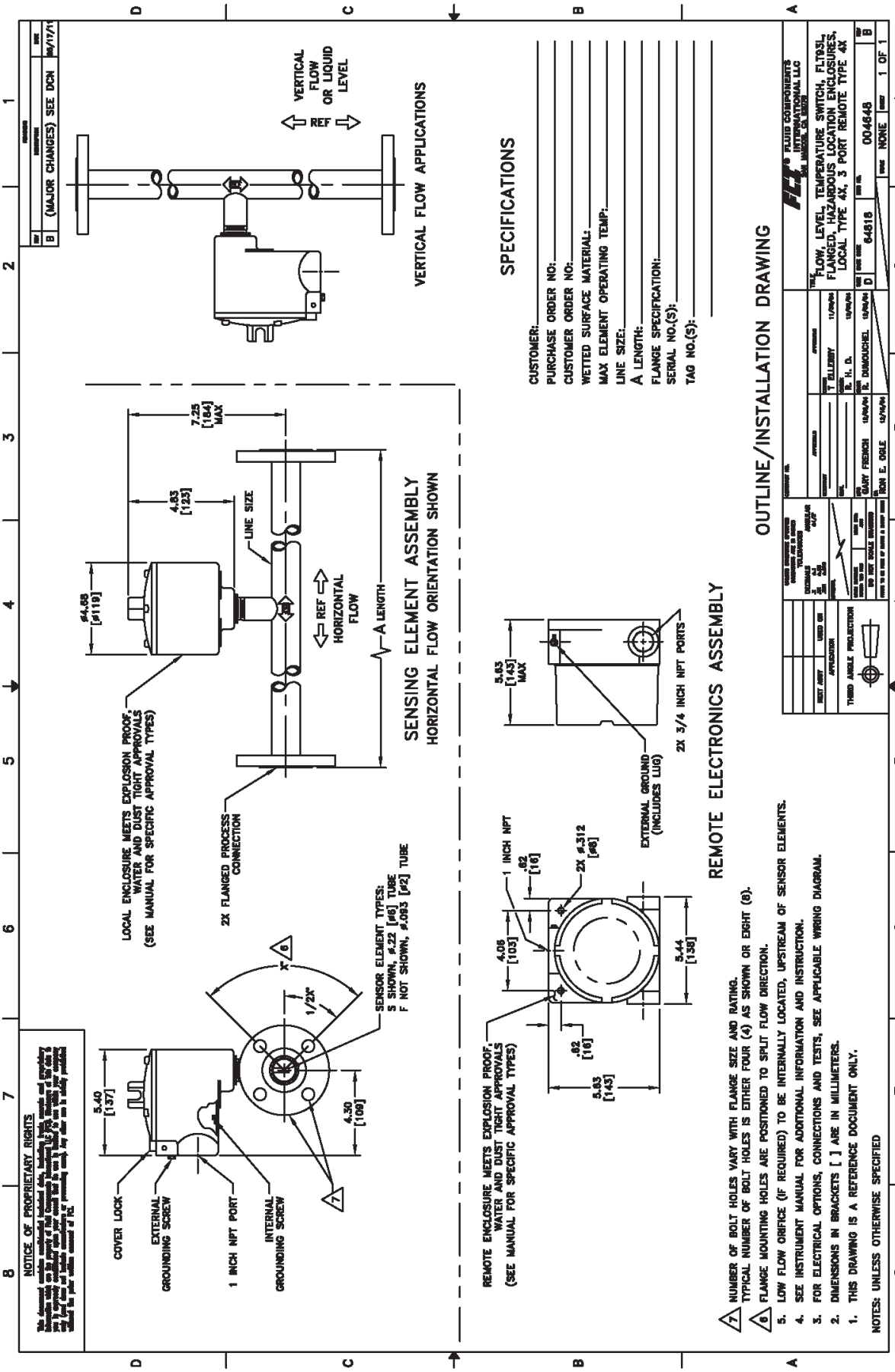
FLT93L: 1" NPT with Local Hazardous Location Type 4X Enclosure



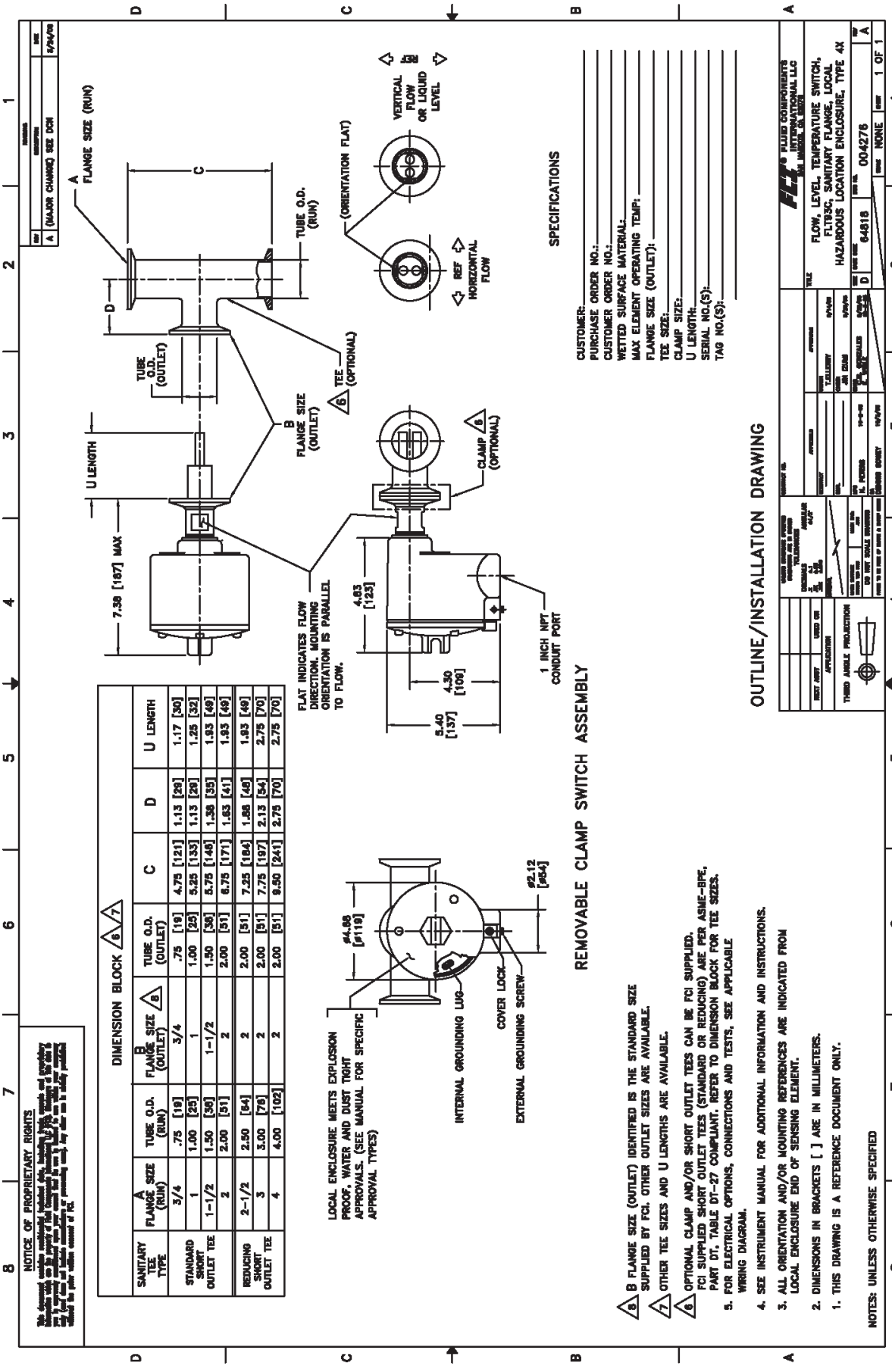
FLT93L: 1" NPT with Local Hazardous Location Type 4X Enclosure: 3-Port Remote Type 4X



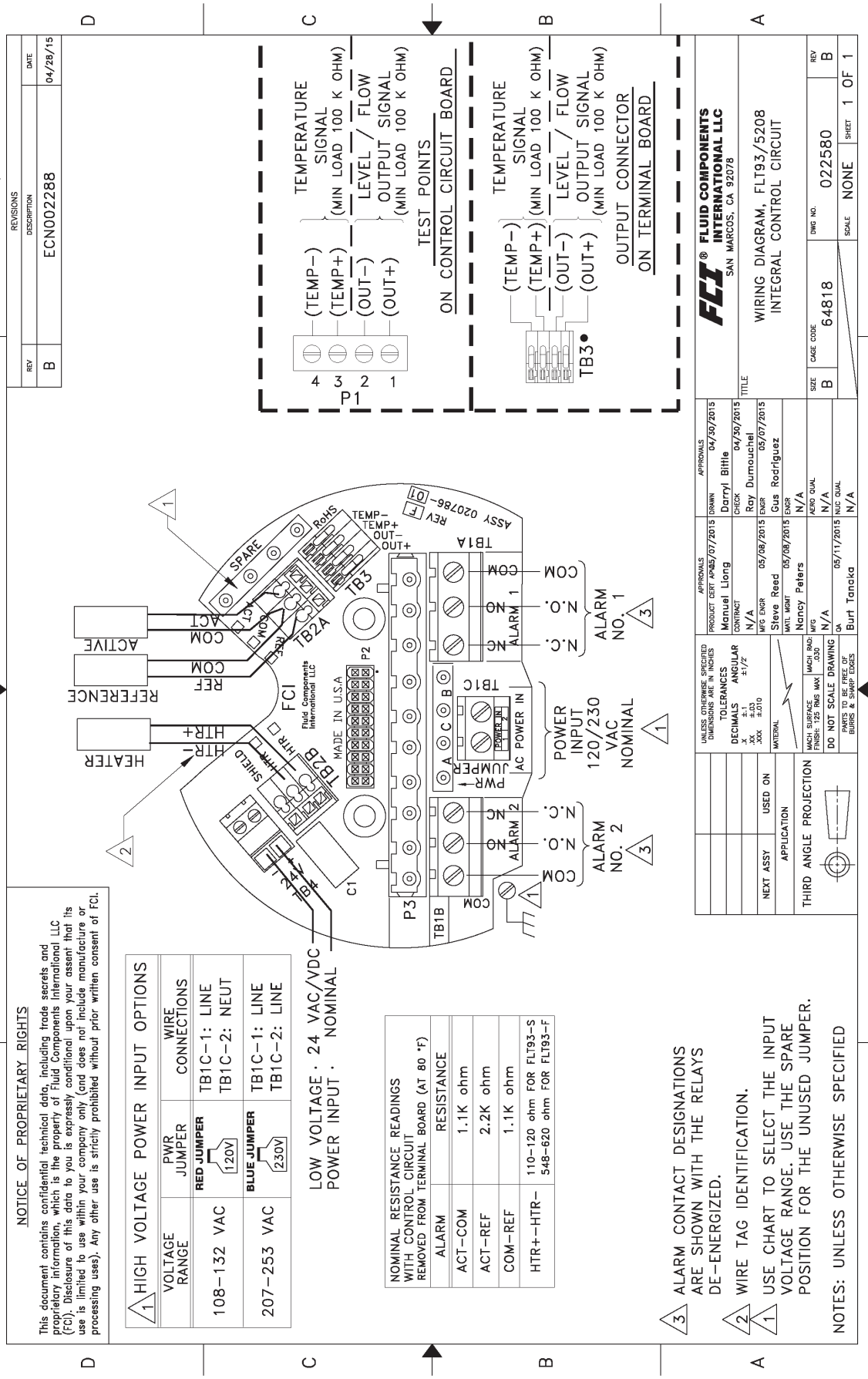
FLT93L: Flanged with Local Hazardous Location Type 4X Enclosure



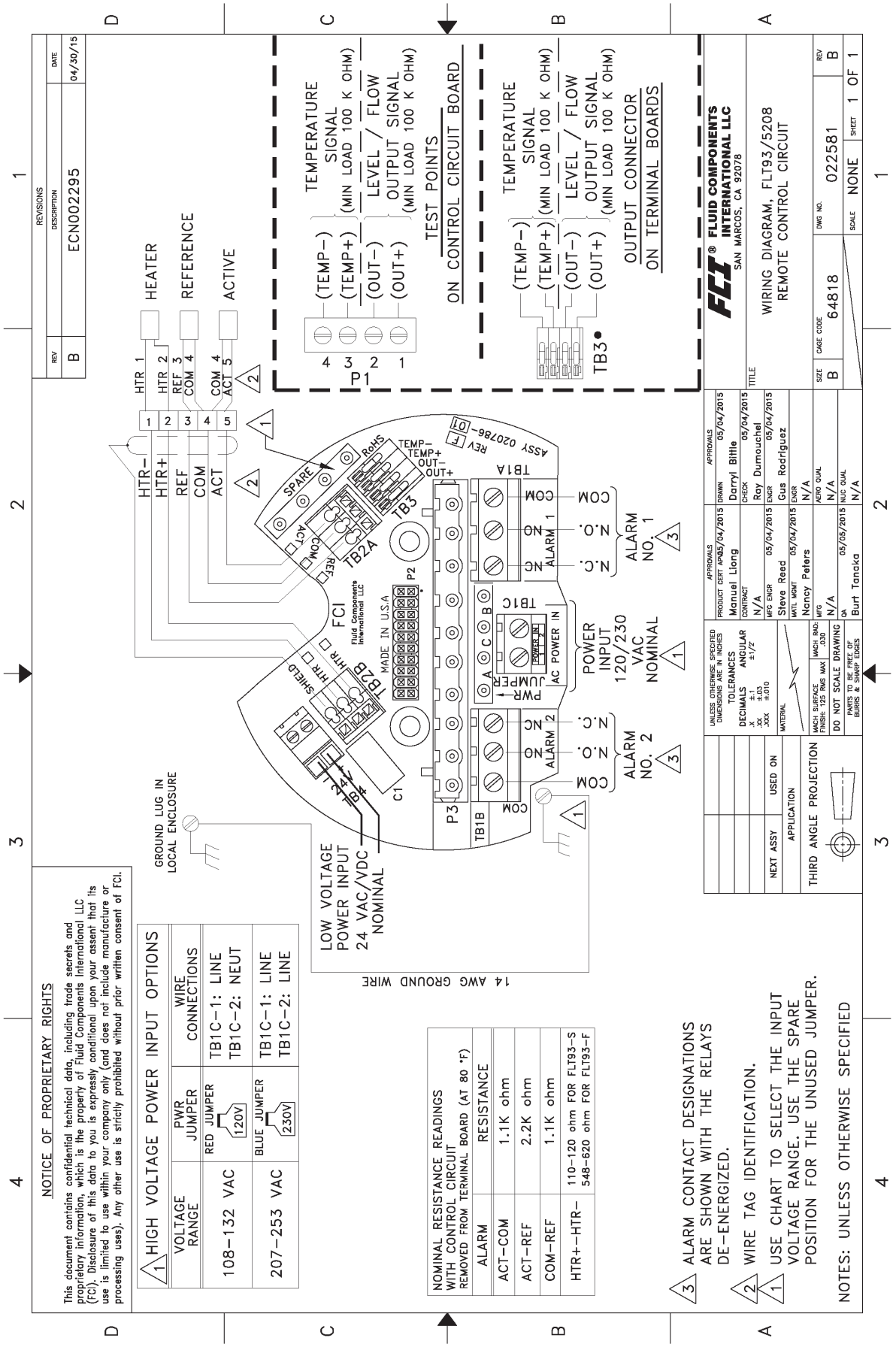
FLT93L: Flanged with Local Hazardous Location Type 4X Enclosure: 3-Port Remote Type 4X



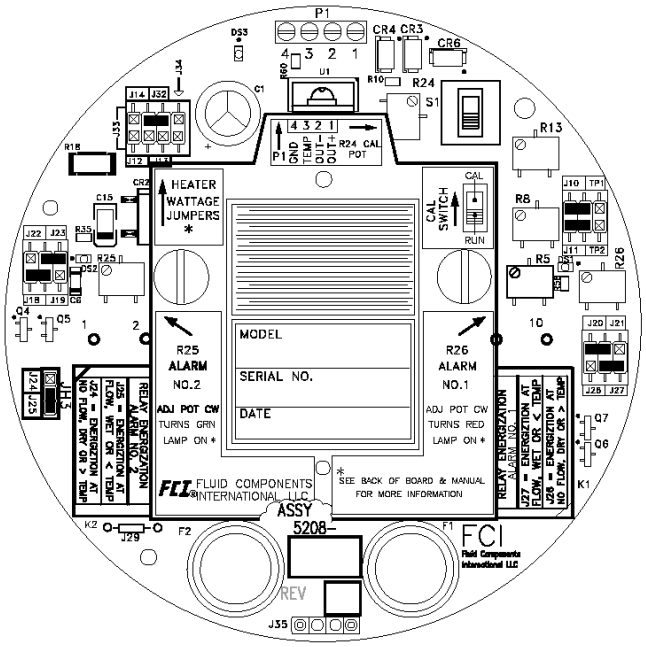
FLT93C : Sanitary Flange with Local Hazardous Location Type 4X Enclosure



FLT93 Surface Mount: Local Wiring Diagram



FLT93 Surface Mount : Remote Wiring Diagram



1 FIGURE 1
COMPONENT SIDE

5208-

9	PART NUMBER	INPUT POWER CONFIGURATION BLOCK 3	DES
	020787-01	STD: NORMAL LINE A.C. 120 VAC, 230 VAC, 24 VDC, 24 VAC	A
	020788-01	LOW LINE A.C. 100 VAC, 200 VAC, 24 VDC, 24 VAC	B

9	PART NUMBER	RELAY CONTACT RATING CONFIGURATION BLOCK 5	DES
	020789-01	STD: 6 AMP AT 120 VAC EPOXY SEALED SPDT	1
	020790-01	EXTERNAL RELAYS 18 VDC SIGNAL OUTPUT 4	2
	020791-01	0.5 AMP AT 120 VAC HERMETICALLY SEALED SPDT	3
	023017-01	LOW CURRENT, 1 mA TO 2 AMPS, 1 TO 60 VDC 30 WATT MAX GOLD CONTACTS	4

9	MODEL	PART NUMBER	HEATER WATTAGE CONTROL	DES
	-S ELEMENT	020792-01	VARIABLE	A
		020793-01	FIXED (171 °F DELTA T MAX, T4 RATING)	B
	-F ELEMENT	020794-01	VARIABLE	C
		020795-01	FIXED (171 °F DELTA T MAX, T4 RATING)	D

9 APPROVED FOR EUROPEAN USE.

8. TEST PROCEDURE 04EN000595.

7. SCHEMATIC NO. 020780-01.

6. SEE THE OP SHEET FOR ASSEMBLY INSTRUCTIONS.

5 RELAYS ARE RATED FOR RESISTIVE LOADS ONLY.

4 FOR USE WITH A SEPARATELY MOUNTED RELAY ASSEMBLY (P/N 705649)
THE CONTROL CIRCUIT PROVIDES A SWITCHING VOLTAGE AT THE TERMINAL BOARD FOR ALARMS 1 & 2. FROM THE TERMINAL BOARD, WIRES ARE CONNECTED TO A RELAY ASSEMBLY. THE RELAYS ASSEMBLY HAS 2 EACH DPDT RELAY WITH A CHOICE OF RATINGS, AND CASES. PLASTIC SEALED CASE 2 AMP AT 115 VAC OR 10 AMPS AT 115 VAC RESISTIVE. NUCLEAR QUALIFIED 10 AMP 115 VAC RELAY WITH PLASTIC DUST COVER. HERMETICALLY SEALED RELAYS ARE 0.3 OR 0.5 AMP AT 115 VAC.

3 SUB ASSEMBLY 020783-01 INCLUDED AS PART OF THIS OPTION.

2. ALL PLUGGABLE JUMPERS ARE SHOWN IN THE DEFAULT POSITIONS. DEFAULT SETTINGS ARE AS FOLLOWS:
HEATER WATTAGE CONTROL = 0.75 WATTS (J13) FOR THE FLT-S ELEMENT;
0.25 WATTAGE (J14) FOR THE FLT-F ELEMENT.
ALARM NO. 1 SET TO MONITOR FLOW OR LEVEL SIGNAL (J20)
ALARM NO. 2 SET TO MONITOR TEMPERATURE SIGNAL (J19)
ALARM NO. 1 RELAY ENERGIZED AT FLOW OR WET (J27)
ALARM NO. 2 RELAY ENERGIZED AT BELOW TEMPERATURE (J25)
ALARM QUANTITY JUMPER SET FOR 2 EA (J23)

1 SEE FIGURE 1 ABOVE IN CONJUNCTION WITH THE SUBASSEMBLIES FOR CLARIFICATION OF THE REFERENCE DESIGNATOR LOCATIONS. VIEW OF THE FINAL CONFIGURATION MAY VARY FROM FIG 1.

FLT93 PWB Module: 5208

APPENDIX B GLOSSARY

Abbreviations

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

Definitions

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

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APPENDIX C APPROVAL INFORMATION

Safety Instructions for the Use of the FLT93 Flowswitch in Hazardous Areas
Approvals DEKRA 22ATEX0007X and IECEx DEK14.0080X for:

Integral Version:	II 2 G	Ex db IIC T4…T2 Gb
	II 2 D	Ex tb IIIC T135 °C…T300 °C Db
Remote Enclosure + Electronics:	II 2 G	Ex db IIC T6 Gb
	II 2 D	Ex tb IIIC T85 °C Db
Local Enclosure + Sensor:	II 2 G	Ex db IIC T4…T1 Gb
	II 2 D	Ex tb IIIC T135 °C…T345 °C Db
Pigtail Variant:	II 2 G	Ex db IIC T4…T3 Gb
	II 2 D	Ex tb IIIC T135 °C…T200 °C Db

(Pigtail variant does not carry IECEx certification.)

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

DK Dansk – Sikkerhedsforskrifter

Disse sikkerhedsforskrifter gælder for Fluid Components, FLT93 Flowswitch EF-typeafprøvningsattest-nr. DEKRA 22ATEX0007 X (attestens nummer på typeskiltet) er egnet til at blive benyttet i eksplosiv atmosfære kategori II 2 G.

1) Ex-anlæg skal principielt opstilles af specialiseret personale.
2) FLT93 Flowswitch skal jordforbindes.
3) Klemmerne og elektronikken er monteret i et hus, som er beskyttet af en eksplosionssikker kapsling med følgende noter:
   - Gevindspalten mellem huset og låget er på en sådan måde, at ild ikke kan brede sig inden i det.
   - Ex-„d“ tilslutningshuset er forsynet med et NPT- eller metrisk kabelindgange med gevind for montering af en Ex-„d“ kabelindføring, der er attesteret iht. EN/IEC 60079-1
   - Det er vigtigt at sørge for, at forsyningsledningen er uden spænding eller eksplosiv atmosfære ikke er til stede, før låget åbnes og når låget er åbent på „d” huset (f.eks. ved tilslutning eller servicearbejde).
   - Låget på „d” huset skal være skruet helt ind, når apparatet er i brug. Det skal sikres ved at dreje en af låseskruerne på låget ud.

D A Deutsch – Sicherheitshinweise

Diese Sicherheitshinweise gelten für die Fluid Components, FLT93 Flowswitch gemäß der EG-Baumusterprüfbescheinigung Nr. DEKRA 22ATEX0007 X (Bescheinigungsnummer auf dem Typschild) der Kategorie II 2 G.

1) Die Errichtung von Ex-Anlagen muss grundsätzlich durch Fachpersonal vorgenommen werden.
2) Der FLT93 Flowswitch muß geerdet werden.
3) Die Klemmen und Elektroniken sind in einem Gehäuse in der Zündschutzart druckfeste Kapselung („d“) eingebaut.
   - Der Gewindespalt zwischen dem Gehäuse und dem Deckel ist ein zünddurchschlagsicherer Spalt.
   - Das Ex-“d“ Anschlussgehäuse besitzt ein Kabeleinführungen mit Gewinde NPT oder metrisch für den Einbau einer nach EN/IEC 60079-1 bescheinigten Ex-“d“ Kabeleinführung.
   - Es ist sicherzustellen, dass vor dem Öffnen und bei geöffnetem Deckel des „d“ Gehäuses (z.B. bei Anschluss oder Service- Arbeiten) entweder die Versorgungsleitung spannungsfrei oder keine explosionsfähige Atmosphäre vorhanden ist.
   - Der Deckel des „d“ Gehäuses muss im Betrieb bis zum Anschlag hineingedreht sein. Er ist durch eine der Deckelarretierungsschrauben zu sichern.

GB IRL English – Safety instructions

These safety instructions are valid for the Fluid Components, FLT93 Flowswitch to the EC type approval certificate no. DEKRA 22ATEX0007 X (certificate number on the type label) for use in potentially explosive atmospheres in Category II 2 G.

1) The installation of Ex-instruments must be made by trained personnel.
2) The FLT93 Flowswitch must be grounded.
3) The terminals and electronics are installed in a flame proof and pressure-tight housing with following notes:
   - The gap between the housing and cover is an ignition-proof gap.
   - The Ex-"d" housing connection has threaded NPT or metric cable entries for mounting an Ex-d cable entry certified according to EN/IEC 60079-1.
   - Make sure that before opening the cover of the Ex"d" housing, the power supply is disconnected or there is no explosive atmosphere present (e.g. during connection or service work).
   - During normal operation: The cover of the "d" housing must be screwed in completely and locked by tightening one of the cover locking screws.

GR Ελληνική – Υποδείξεις ασφαλείας

Αυτές οι οδηγίες ασφαλείας ισχύουν για τα Ροόμετρα της Fluid Components τύπου FLT93 Flowswitch που φέρουν Πιστοποιητικό Εγκρίσεως Ευρωπαϊκής Ένωσης, με αριθμό πιστοποίησης DEKRA 22ATEX0007 X (ο αριθμός πιστοποίησης βρίσκεται πάνω στην ετικέτα τύπου του οργάνου) για χρήση σε εκρηκτικές ατμόσφαιρες της κατηγορίας II 2 G.

1) Η εγκατάσταση των οργάνων με αντιεκρηκτική προστασία πρέπει να γίνει από εξειδικευμένο προσωπικό.
2) Το όργανο τύπου FLT93 Flowswitch πρέπει να είναι γειωμένο.
3) Τα τερματικά ηλεκτρικών συνδέσεων (κλέμες) και τα ηλεκτρονικά κυκλώματα είναι εγκατεστημένα σε περίβλημα αντιεκρηκτικό και αεροστεγές σύμφωνα με τις ακόλουθες παρατηρήσεις:
   - Το κενό ανάμεσα στο περίβλημα και στο κάλυμμα είναι τέτοιο που αποτρέπει την διάδοση σπινθήρα.
   - Το "Ex-d" αντιεκρηκτικό περίβλημα, έχει ανοίγματα εισόδου καλωδίου με NPT με σπείρωμα ή με καταχωρίσεις καλωδίων μετρικών, κατάλληλα για τοποθέτηση υποδοχής αντιεκρηκτικού καλωδίου πιστοποιημένης κατά EN/IEC 60079-1
   - Βεβαιωθείτε ότι πριν το άνοιγμα καλύμματος του του "Ex-d" αντιεκρηκτικού περιβλήματος, η τάση τροφοδοσίας είναι αποσυνδεδεμένη ή ότι δεν υφίσταται στη περιοχή εκρηκτική ατμόσφαιρα (π.χ. κατά τη διάρκεια της σύνδεσης ή εργασιών συντήρησης)
   - Κατά τη διάρκεια ομαλής λειτουργίας: Το κάλυμα του "d" καλύμματος αντιεκρηκτικού περιβλήματος πρέπει να είναι εντελώς βιδωμένο και ασφαλισμένο, σφίγγοντας μία από τις βίδες ασφαλείας του περιβλήματος.

FIN Suomi – Turvallisuusohjeet

Nämä turvallisuusohjeet koskevat Fluid Components, FLT93 Flowswitch EY-tyyppitarkastustodistuksen nro. DEKRA 22ATEX0007 X mukaisesti (todistuksen numero näkyy tyyppikilvestä) käytettäessä räjähdysvaarallisissa tiloissa luokassa II 2G.

1) Ex-laitteet on aina asennettava ammattihenkilökunnan toimesta.
2) FLT93 Flowswitch on maadoitettava.
3) Syöttöjännitteen kytkemisessä tarvittavat liittimet ja elektroniikka on asennettu koteloon jonka rakenne kestää räjähdyspaineen seuraavin lisäyksin:
   - Kotelon ja kannen välissä on räjähdyksen purkausväli.
   - Ex-d liitäntäkotelossa on NPT tai metriset kaapeliyhteydet EN/IEC 60079-1 mukaisen Ex-d kaapeliläpiviennin asennusta varten
   - Kun "d"-kotelon kansi avataan (esim. liitännän tai huollon yhteydessä), on varmistettava, että joko syöttöjohto on jännitteetön tai ympäristössä ei ole räjähtäviä aineita.
   - "d" -kotelon kansi on kierrettävä aivan kiinni käytön yhteydessä ja on varmistettava kiertämällä yksi kannen lukitusruuveista kiinni.

F B L Français – Consignes de sécurité

Ces consignes de sécurité sont valables pour le modèle FLT93 Flowswitch de la société Fluid Components (FCI) conforme au certificat d'épreuves de type DEKRA 22ATEX0007 X (numéro du certificat sur l'étiquette signalétique) conçu pour les applications dans lesquelles un matériel de la catégorie II2G est nécessaire.

1) Seul un personnel spécialisé et qualifié est autorisé à installer le matériel Ex.
2) Les FLT93 Flowswitch doivent être reliés à la terre.
3) Les bornes pour le branchement de la tension d'alimentation et l'électronique sont logées dans un boîtier à enveloppe antidéflagrante avec les notes suivantes:
   - Le volume entre le boîtier et le couvercle est protégé en cas d'amorçage.
   - Le boîtier de raccordement Ex-d dispose d'un filetage NPT ou métriques pour le montage d'un presse-étoupe Ex-d certifié selon la EN/IEC 60079-1.
   - Avant d'ouvrir le couvercle du boîtier « d » et pendant toute la durée où il le restera (pour des travaux de raccordement, d'entretien ou de dépannage par exemple), il faut veiller à ce que la ligne d'alimentation soit hors tension ou à ce qu'il n'y ait pas d'atmosphère explosive.
   - Pendant le fonctionnement de l'appareil, le couvercle du boîtier « d » doit être vissé et serré jusqu'en butée. La bonne fixation du couvercle doit être assurée en serrant une des vis d'arrêt du couvercle.

I Italiano – Normative di sicurezza

Queste normative di sicurezza si riferiscono ai Fluid Components, FLT93 Flowswitch secondo il certificato CE di prova di omologazione n° DEKRA 22ATEX0007 X (numero del certificato sulla targhetta d'identificazione) sono idonei all'impiego in atmosfere esplosive applicazioni che richiedono apparecchiature elettriche della Categoria II 2 G.

1) L'installazione di sistemi Ex deve essere eseguita esclusivamente da personale specializzato.
2) I FLT93 Flowswitch devono essere collegati a terra.
3) I morsetti per il collegamento e l'elettronica sono incorporati in una custodia a prova di esplosione („d") con le seguenti note:
   - La sicurezza si ottiene grazie ai cosidetti „interstizi sperimentali massimi", attraverso i quali una eventuale accensione all'interno della custodia non può propagarsi all'esterno o raggiungere altre parti dell'impianto.
   - La scatola di collegamento Ex-d ha una NPT o metrico filettatura per il montaggio di un passacavo omologato Ex-d secondo EN/IEC 60079-1.
   - Prima di aprire il coperchio della custodia „d" (per es. durante operazioni di collegamento o di manutenzione) accertarsi che l'apparecchio sia disinserito o che non si trovi in presenza di atmosfere esplosive.
   - Avvitare il coperchio della custodia „d" fino all'arresto. Per impedire lo svitamento del coperchio é possibile allentare una delle 2 viti esagonali poste sul corpo della custodia, incastrandola nella sagoma del coperchio.

NL B Nederlands – Veiligheidsinstructies

Deze veiligheidsinstructies gelden voor de Fluid Components, FLT93 Flowswitch overeenkomstig de EG-typeverklaring nr. DEKRA 22ATEX0007 X (nummer van de verklaring op het typeplaatje) voor gebruik in een explosieve atmosfeer volgens Categorie II 2G.

1) Installatie van Ex-instrumenten dient altijd te geschieden door geschoold personeel.
2) De FLT93 moet geaard worden.
3) De aansluitklemmen en de electronika zijn ingebouwd in een drukvaste behuizing met de volgende opmerkingen:
   - De schroefdraadspleet tussen de behuizing en de deksel is een ontstekingsdoorslagveilige spleet.
   - De Ex-d aansluitbehuizing heeft ingepaste NPT of metrische kabelingangen schroefdraad voor aansluiting van een volgens EN/IEC 60079-1 goedgekeurde Ex- 'd' kabelinvoer.
   - Er moet worden veilig gesteld dat vóór het openen bij een geopende deksel van de 'd' behuizing (bijv. bij aansluit- of service-werkzaamheden) hetzij de voedingsleiding spanningsvrij is, hetzij geen explosieve atmosfeer aanwezig is.
   - De deksel van de 'd' behuizing moet tijdens bedrijf tot aan de aanslag erin geschroefd zijn. Hij moet door het eruit draaien van een van de dekselborgschroeven worden geborgd.

P Português – Normas de segurança

Estas normas de segurança são válidas para os Fluid Components, FLT93 Flowswitch conforme o certificado de teste de modelo N.º DEKRA 22ATEX0007 X (número do certificado na plaqueta com os dados do equipamento)
são apropriados para utilização em atmosferas explosivas categoria II 2 G.

1) A instalação de equipamentos em zonas sujeitas a explosão deve, por princípio, ser executada por técnicos qualificados.
2) Os FLT93 Flowswitch precisam ser ligados à terra.
3) Os terminais e a electrónica para a conexão da tensão de alimentação estão instalados num envólucro com protecção contra ignição á prova de sobrepressão com as seguintes notas:
   - A fenda entre o envólucro e a tampa deve ser á prova de passagem de centelha.
   - A conexão de caixa Ex-"d"tem entradas de NPT roscadas ou de cabos métricos para montagem de uma entrada de cabo Ex-d certificada de acordo com a EN/IEC 60079-1.
   - Deve-se assegurar que, antes de abrir a tampa do armário „d" (por exemplo, ao efectuar a conexão ou durante trabalhos de manutenção), o cabo de alimentação esteja sem tensão ou que a atmosfera não seja explosíva.
   - Durante a operação, a tampa do envólucro „d" deve estar aparafusada até o encosto. A tampa deve ser bloqueada, por um dos parafusos de fixação.

E Español – Instrucciones de seguridad

Estas indicaciones de seguridad son de aplicación para el modelo FLT93 Flowswitch de Fluid Components, según la certificación CE de modelo Nº DEKRA 22ATEX0007 X para aplicaciones en atmósferas potencialmente explosivas según la categoría II 2 G (el número de certificación se indica sobre la placa informativa del equipo).

1) La instalación de equipos Ex tiene que ser realizada por personal especializado.
2) Los FLT93 Flowswitch tienen que ser conectados a tierra.
3) Los bornes de conexión y la unidad electrónica están montados dentro de una caja con protección antideflagrante y resistente a presión, considerándose los siguientes puntos:
   - La holgura entre la rosca de la tapa y la propia de la caja está diseñada a prueba contra ignición.
   - La caja tiene conexiones eléctricas para entrada de cables con roscas NPT o métricas, donde deberán conectarse prensaestopas certificados Exd según EN/IEC 60079-1.
   - Antes de la apertura de la tapa de la caja "Exd" (p. ej. durante los trabajos de conexionado o de puesta en marcha) hay que asegurar que el equipo se halle sin tensión o que no exista presencia de atmósfera explosiva.
   - Durante el funcionamiento normal: la tapa de la caja antideflagrante tiene que estar cerrada, roscada hasta el tope, debiendose asegurar apretando los tornillos de bloqueo.

S Svenska – Säkerhetsanvisningar

Säkerhetsanvisningarna gäller för Fluid Components, Flödesmätare typ FLT93 Flowswitch enligt EG-typkontrollintyg nr DEKRA 22ATEX0007 X (intygsnumret återfinns på typskylten) är lämpad för användning i explosiv gasblandning i kategori II 2 G.

1) Installation av Ex- klassade instrument måste alltid utföras av fackpersonal.
2) FLT93 Flowswitch måste jordas.
3) Anslutningsklämmorna och elektroniken är inbyggda i en explosions och trycktät kapsling med följande kommentar:
   - Spalten mellan kapslingen och lockets gänga är flamsäker.
   - Ex-d instrumenthölje har NPT- eller metrisk gängor för montering av en EN/IEC 60079-1 typkontrollerad Ex- „d" kabelanslutning.
   - När Ex- „d"-kapslingens lock är öppet (t.ex. vid inkoppling - eller servicearbeten) ska man se till att enheten är spänningslös eller att ingen explosiv gasblandning förekommer.
   - Under drift måste Ex - d"-kapslingens lock vara iskruvad till anslaget. För att säkra locket skruvarman i en av lockets insex låsskruvar.

Annex 1

Annex 1 to Report No. NL/DEK/ExTR14.0088/02

Note 1: in this document [.] is used as decimal separator.

Type designation

The Flow, Level or Temperature FlexSwitch Series FLT93 are divided into three styles:
Insertion style: FLT93S, FLT93F and FLT93C
Basic insertion style: FLT93B
In-line style: FLT93L

FLT93	S	3	B	1	A	custom	B	4	custom	0	custom
		I	II	III	IV	V till VII	VIII	IX	X till XII	XIII	XIV till XV

Pos.	Explanation	Value	Explanation
	Type of sensor	FLT93S FTL93F FLT93C	Insertion style with larger OD thermowells (S=Std response time) Insertion style with small OD thermowells (F=Fast response time) Insertion style with larger OD thermowells Sanitary version
I.	Agency Approval	3 6	ATEX approved IECEx approved
II.	Customer tagplate	B	316L stainless steel
III.	Process temperature	1 2	-40 °C to + 177 °C -40 °C to + 260 °C (only with remote enclosure, pos. XIII ≠ 0) (Refer to thermal data in this Annex.)
IV.	Material of sensor	A B C D E	316 (L) stainless steel (only for S and F type of sensor) 316 (L) stainless steel electro polished Hastelloy C276 (only for S and F type of sensor) Monel 400 (only for S and F type of sensor) Titanium grade 2 (only for S type of sensor)
V till VII	Process connections, size of process connection and insertion length	custom	Process connection & size not relevant for Ex type of protection Insertion length till 3,050 mm. Material of flange stainless steel, carbon steel or same as sensor
VIII.	Local enclosure (local = at sensor)	B C D H J E	Pigtail version; sensor with cable pigtail (only when I=3 and XIII = B, G or C) Aluminum Ex d enclosure with (1) 1" NPT cable entry Aluminum Ex d enclosure with (2) 3/4" NPT feed-through cable entry Aluminum Ex d enclosure with (2) 1/2" NPT side-by-side cable entry Aluminum Ex d enclosure with (2) M20x1.5 side-by-side cable entry Stainless steel Ex d enclosure with (1) 1" NPT cable entry
IX.	Configuration (type of electronics)	4 5	Standard version of electronics Electronic with hermitically sealed relays contacts
X till XII	Application alarm point 1, 2, calibrations	custom	Not relevant for Ex type of protection
XIII.	Remote enclosure	0 B H J C	None (the electronics is mounted inside local enclosure of pos. VIII.) Aluminum Ex d enclosure with (2) 3/4" NPTfeed-through cable entry Aluminum Ex d enclosure with (2) 1/2" NPT side-by-side cable entry Aluminum Ex d enclosure with (2) M20x1.5 side-by-side cable entry Stainless steel Ex d enclosure with (1) 1" NPT cable entry
XIV till XV	Cable material & length	custom	PVC or Teflon cable, length not relevant of Ex type of protection

Annex 1 to Report No. NL/DEK/ExTR14.0088/02

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Model decoding FLT93B series Basic Insertion style

FLT93	**B**	**B**	**custom**
		I	II till V

Pos.	Explanation	Value	Explanation
	Type of sensor	FLT93B	Model FLT93B is a preconfigured version of FCI's model FLT93S in the following configuration: FLT series Basic • Type of sensor: S style (insertion style with larger OD thermowells) • Process temperature: -40 °C to + 177 °C • Material of sensor: 316L stainless steel • Process connection: 3/4 " NPT Male • Local enclosure: electronics integral in aluminum Ex d enclosure with single cable entry
I.	Agency Approval	B	ATEX approved IECEx approved
II.	Insertion length	custom	Insertion length till 102 mm
III.	Identification Tag	custom	Not relevant for Ex type of protection
IV.	Input Power	custom	Field selectable, see electrical data

Annex 1 to Report No. NL/DEK/ExTR14.0088/02

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Model decoding FLT93L series In-line style

FLT93L	**3**	**B**	**1**	**custom**	**1**	**custom**	**B**	**4**	**custom**	**0**	**custom**
	I	II	III	IV	V	VI	VII	VIII	IX till XI	XII	XIII till XIV

Pos.	Explanation	Value	Explanation
	Type of sensor	FLT93L	In-line version (thermowells placed inside pipe spoolpiece)
I.	Agency Approval	3 6	ATEX approved IECEx approved
II.	Customer tagplate	B	316L stainless steel
III.	Process temperature	1 2	-40 °C to + 177 °C -40 °C to + 260 °C (only with remote enclosure, pos. XII ≠ 0) (Refer to thermal data in this Annex.)
IV.	Sensor configuration	custom	Not relevant for Ex type of protection
V.	Material of sensor	1 2 3 4	316 (L) stainless steel Hastelloy C276 Monel 400 Titanium grade 2
VI.	Process connections	custom	Process connection not relevant for Ex type of protection. Material of flange stainless steel, carbon steel or same as sensor.
VII.	Local enclosure (local = at sensor)	B C H J D E	Sensor with cable pigtail: requires Ex d adapter and cable gland (only when I = 3 and XII = B, G, C) Aluminum Ex d enclosure with (1) 1" NPT cable entry Aluminum Ex d enclosure with (2) 1/2" NPT side-by-side cable entry Aluminum Ex d enclosure with (2) M20x1.5 side-by-side cable entry Aluminum Ex d enclosure with (2) 3/4" NPT feed-through cable entry Stainless steel Ex d enclosure with (1) 1" NPT cable entry
VIII.	Configuration (type of electronics)	4 5	Standard version of electronics Electronic with hermitically sealed relays contacts
IX till XI	Application alarm point 1, 2, calibrations	custom	Not relevant for Ex type of protection
XII.	Remote enclosure	0 B H J G C	None (the electronics is mounted inside local enclosure of pos. VII.) Aluminum Ex d enclosure with (1) 1" NPT cable entry Aluminum Ex d enclosure with (2) 1/2" NPT side-by-side cable entry Aluminum Ex d enclosure with (2) M20x1.5 side-by-side cable entry Aluminum Ex d enclosure with (2) 3/4" NPT feed-through cable entry Stainless steel Ex d enclosure with (1) 1" NPT cable entry
XIII till XIV	Cable material & length	custom	PVC or Teflon cable, length not relevant of Ex type of protection

Annex 1 to Report No. NL/DEK/ExTR14.0088/02

Note 1: in this document [.] is used as decimal separator.

Thermal data

The relation between temperature class, maximum surface temperature, ambient temperature and process temperature of the different configurations are indicated below.

Integral version

Integral enclosure with (1) 1" NPT or (2) 1/2" NPT or (2) M20x1.5 side-by-side cable entry variant:

Temperature class	Maximum surface temperature	Ambient temperature	Process temperature
T4	T135 ºC	-40 °C to +45 °C	-40 °C to +45 °C
T3	T200 ºC	-40 °C to +65 °C	-40 °C to +110 °C
T2	T300 ºC	-40 °C to +65 °C	-40 °C to +177 °C

Integral enclosure with (2) 3/4" NPT feed-through cable entry variant:

Temperature class	Maximum surface temperature	Ambient temperature	Process temperature
T4	T135 ºC	-34 °C to +45 °C	-34 °C to +45 °C
T3	T200 ºC	-34 °C to +50 °C	-34 °C to +110 °C
T2	T300 ºC	-34 °C to +50 °C	-34 °C to +177 °C

Remote enclosure + electronics

Remote enclosure with (1) 1" NPT or (2) 1/2" NPT or (2) M20x1.5 side-by-side cable entry variant:

Temperature class	Maximum surface temperature	Ambient temperature
T6	T85 °C	-40 °C to +60 °C

Remote enclosure with (2) 3/4" NPT feed-through cable entry variant:

Temperature class	Maximum surface temperature	Ambient temperature
T6	T85 °C	-34 °C to +60 °C

Local enclosure + sensor

Local enclosure with (1) 1" NPT or (2) 1/2" NPT or (2) M20x1.5 side-by-side cable entry variant:

Temperature class	Maximum surface temperature	Ambient temperature	Process temperature
T4	T135 ºC	-40 °C to +45 °C	-40 °C to +45 °C
T3	T200 ºC	-40 °C to +65 °C	-40 °C to +110 °C
T2	T300 ºC	-40 °C to +65 °C	-40 °C to +177 °C
T1	T345 ºC	-40 °C to +65 °C	-40 °C to +260 °C

Local enclosure with (2) 3/4" NPT feed-through cable entry variant:

Temperature class	Maximum surface temperature	Ambient temperature	Process temperature
T4	T135 ºC	-34 °C to +45 °C	-34 °C to +45 °C
T3	T200 ºC	-34 °C to +50 °C	-34 °C to +110 °C
T2	T300 ºC	-34 °C to +50 °C	-34 °C to +177 °C
T1	T345 ºC	-34 °C to +50 °C	-34 °C to +260 °C

Annex 1 to Report No. NL/DEK/ExTR14.0088/02

Note 1: in this document [.] is used as decimal separator.

Pigtail version (only for ATEX)

Local enclosure in pigtail variant:

Temperature class	Maximum surface temperature	Ambient temperature	Process temperature
T4	T135 ºC	-20 °C to +45 °C	-20 °C to +45 °C
T3	T200 ºC	-20 °C to +55 °C	-20 °C to +55 °C

Electrical data

Power supply : 115 Vac (± 15) 50/60 Hz; 13 watts, 100 mA max.
: 230 Vac (± 10) 50/60 Hz; 14 watts, 50 mA max.
: 24 Vac (18 V to 26 Vac) 50/60 Hz; 7 watts, 230 mA max.
: 24 Vdc (21 V to 30 Vdc); 7 watts, 230 mA max.
Relay Rating : 115 Vac / 240 Vac or 24 Vdc, 6A
Sensing Element Heater Power : 3.0 W max.

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APPENDIX D TEMPERATURE COMPENSATION

Introduction

Temperature compensation (Temp Comp) is an essential part of the FLT FlexSwitch circuitry. When the Temp Comp is set correctly, the instrument stays accurate over a process temperature range of 100 °F. The instrument is a thermal dispersion device. It relies on the temperature differential between the reference RTD, which is at the process media temperature, and the active RTD, which is heated to produce a temperature differential (TD). For example; with constant temperature, flow rate, process media and heater power, the TD is reduced and reaches a stable value. If the process media temperature goes up and all other conditions stay the same, the TD is reduced. Without Temp Comp the circuitry would process the signal as an increased flow rate.

To understand Temp Comp the output signal needs to be understood first. This temperature output signal is the absolute voltage drop across the reference RTD, and proportional to temperature. The instrument uses this voltage for two purposes. The voltage drop across the reference RTD is subtracted from the voltage drop across the Active RTD to produce a voltage differential. The voltage differential is used to set flow or liquid level alarms. Also, the voltage drop across the reference RTD adds to, or subtracts from, the output signal as a function of TD.

Note: To adjust the Temp Comp correctly certain parameters must be measured and calculated. Convert all temperature measurements to degrees Fahrenheit before a temperature differential is found. These parameters and measurements are discussed later in this appendix.

Factory Temperature Compensation Settings

A Temp Comp adjustment procedure is performed on the instrument before it is shipped. Under normal conditions this setting will not have to be done by the customer. However, if there have been changes in environment since the instrument was ordered then the following instructions may need to be done by the customer.

Restoring Temp Comp Adjustments

When the control circuit is replaced or if the Temp Comp potentiometers are accidently moved the adjustments must be restored. There are three adjustments that need to be made on the control circuit in order to set the Temp Comp. Two of the adjustments are done with no power applied to the instrument and a third adjustment is done with power applied. Calibration values for each instrument are on the Temp Comp calibration sheet that is found in the plastic page protector at the back of this manual. The calibration values are listed by the serial number of the instrument.

Equipment Required

- 5-1/2 digit digital multimeter (DMM). (Small clip leads are desirable.)
- Flat screw driver, capable of adjusting control circuit potentiometers.
- Temp Comp calibration values from the page protector in the back of this manual.
- Insulating varnish or equivalent to reseal the potentiometers.

Caution: The instrument contains electrostatic discharge (ESD) sensitive devices. Use standard ESD precautions when handling the control circuit. See Section 2, Installation, for ESD details.

Procedure

1. Turn off the instrument power. Remove the control circuit from the terminal board.
2. Write down where the heater wattage control jumper is located in the area of the upper left hand side of the control circuit (11 o'clock, P1 at top). Remove the heater wattage control jumper and place it on position J33. Refer to Figure 15 for the jumper location.
3. Remove jumpers J10 and J11 at the right side of the control circuit (2 o'clock) and set them aside.
4. Connect the DMM from TP1 (by J10), to the right jumper post of J10. Set the DMM to ohms. See Figure 16 for component placement.
5. Adjust potentiometer R5 (3 o'clock, next to the right thumbscrew) until the DMM reads the ohm value for R5 as shown on the Temp Comp calibration sheet that is in the plastic page protector in the back of this manual.
6. Remove the DMM, and reconnect it between TP2 (by J11), and the right jumper post of J11. Figure 15 shows jumper post location.
7. Adjust pot R8 (next to J10) until the ohm value for R8 is as shown on the Temp Comp Cal sheet.
8. Remove the DMM and reinstall jumpers J10 and J11. Continue.

Balance Procedure

The following steps are the flow element balance procedure required to complete the Temp Comp restoration and must be used when installing remote units with more than 10 feet of cable.

1. Connect the DMM to P1 with the positive lead connected to position 1 (Red) and the negative lead connected to position 2 (Blue). Re-install the control circuit on the terminal board. Set the DMM to volts DC. Place the heater jumper on J33.
2. Turn on the instrument power and wait fifteen minutes for the instrument to stabilize. During this time make sure that the process media is flowing or the sensing elements are submerged. Do not make the following adjustment in still gas.
3. Adjust potentiometer R13 (to the right of S1) until the DMM reads 0 volts ±5 mV.
4. Turn off the instrument power and remove the DMM. Re-install the heater jumper in its original position.

The Temp Comp adjustments are now restored. Turn on the power and make sure the instrument is functioning properly. Make adjustments to the alarm setpoints if needed.

Field Temp Comp Calibration

If the application of the instrument changes the Temp Comp may need to be re-calibrated. An example of when the Temp Comp needs to be re-calibrated is as follows: The process media is gas, the factory set Temp Comp is 40 to 140 °F. The instrument is then placed in an application that varies in temperature from 300 to 400 °F. In this case the instrument's accuracy would be greater with a new Temp Comp calibration performed.

Another example of where the accuracy will be affected and a Temp Comp calibration would need to be done is when the process media is changed, i.e. from water to heavy oil.

Temp Comp calibration is possible to do in the field if the test conditions are met and the data is measured correctly. However, in many applications it is difficult to achieve these parameters and it is easier to have the switch factory calibrated. To do the procedure the following parameters are required:

- The maximum temperature change does not exceed 100 °F.
- The maximum temperature does not exceed the instruments rated maximum temperature.
- The velocity at which the switch will alarm needs to be known, and the same at both test temperatures.

Equipment Required

1 each, DC Power Supply, 0 to 20 Vdc minimum, at 0.5 Amps.

2 each, 5-1/2 Digit DMM with 4 wire clip leads.

1 each, #1 flat blade screw driver.

1 each, Flat screw driver, capable of adjusting control circuit potentiometers.

As required, Insulating varnish or equivalent to reseal the potentiometers.

Procedure

1. Turn off the instrument power.
2. Install the instrument into the pipe or a test stand where it can be calibrated. Start the process media flowing at a normal rate. Cool the process media to the lowest temperature in the expected operating range.
3. Remove the control circuit. Disconnect the element wires on terminal board, TB2A AND TB2B. Note: These are spring terminals.
4. Connect the DMMs and the power supply to the sensing element as shown in Figure 24.
5. Set the power supply voltage to the proper voltage as shown in Table D-1. Turn on the power supply and check the voltage setting.
6. Stop the process media flow and make sure that the media is at no flow and then let the instrument stabilize for fifteen minutes.
7. Record the resistance values of the sensing elements and calculate the resistance differential (DR). If DR does not exceed the maximum DR of 280 ohms then proceed with the calibration. If the DR is above 280 ohms use the next lower heater wattage setting and let the instrument stabilize. Recheck the DR.
8. Start the process media flowing at the desired switch point velocity and at the low temperature, let the instrument stabilize for fifteen minutes.
9. Record the resistance values of the active and reference RTDs at the low temperature.
10. Raise the temperature of the process media to the maximum expected temperature. The difference between the low and the high temperature is not to exceed 100 °F.
11. Set the flow rate to the same value used for the low temperature.

Note: The flow rate must be the same at both the low and high temperature. For gases, the flow rate must be held constant in terms of volumetric flow rate (SCFM, NCMH, etc.).

12. With the instrument power on, let the instrument stabilize for fifteen minutes.
13. Record the resistance values of the active and reference RTDs for the high temperature.
14. Calculate the Temp Comp factor with the formula shown below.

$$\text{TEMP COMP FACTOR} = \frac{\Delta R \text{ Low Temperature} - \Delta R \text{ High Temperature}}{(R \text{ Reference High Temperature}) - (R \text{ Reference Low Temperature})}$$

The Temp Comp factor is not to exceed ±0.041.

15. If the Temp Comp factor is within tolerance, turn off the power to the instrument and stop the process media if needed. Disconnect the DMM's and the power supply from the instrument. Reconnect the sensing element wires to the control circuit socket and reinstall the socket in the enclosure if it was previously removed. Do not pinch the wires between the socket and the enclosure.
16. Look up the resistance values to adjust potentiometers R5 and R8 in the Temp Comp Factor table (Table D-2). Follow the procedure in the Restoring Temp Comp adjustment section using the values found in the table below.
17. If the calculated Temp Comp factor exceeds the allowable tolerance by a small amount (±0.01), using the maximum Temp Comp factor may make the instrument perform satisfactorily. However, if the factor is out of tolerance by more than ±0.01 then it will be necessary to repeat the calibration to verify the result. Continue with the adjustment procedure if the second result is within tolerance.

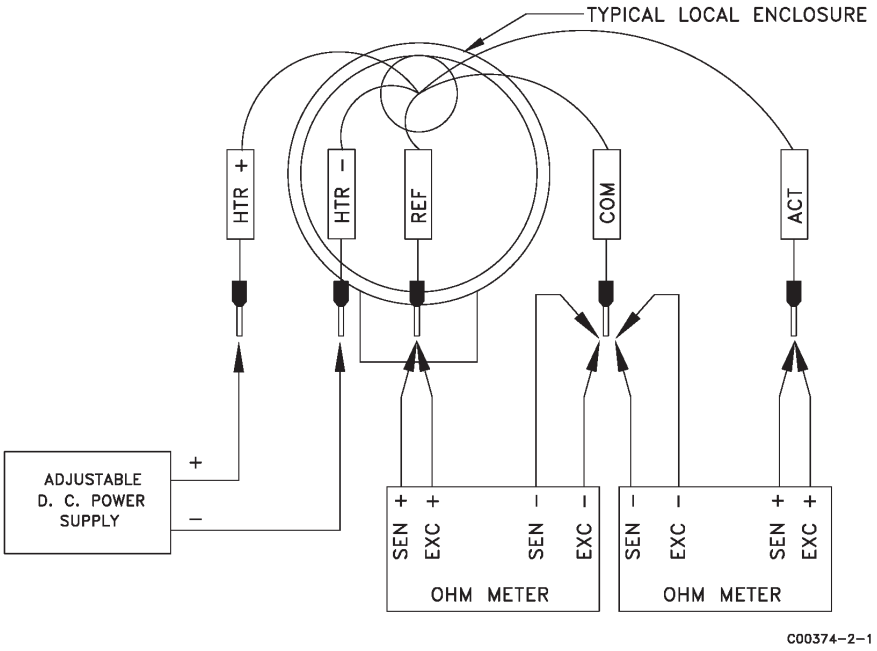

Figure 24 – Sensing Element Calibration Connections

Table D-1. Heater Voltage Settings

POWER SUPPLY SETTINGS				
FLT93S	3 Watts	1.75 Watts	0.75 Watts	0.21 Watts
	Set For 18.0 Vdc	Set For 13.8 Vdc	Set For 9.0 Vdc	Set For 4.9 Vdc
FLT93F	0.57 Watts	0.52 Watts	0.49 Watts	0.25 Watts
	Set For 18.0 Vdc	Set For 17.0 Vdc	Set For 15.0 Vdc	Set For 11.8 Vdc

Table D-2. Temp Comp Factor Table

TEMP COMP FACTOR	R5 K OHMS	R8 K OHMS
0.042	119.75	263.16
0.041	119.88	256.41
0.04	120.00	250.00
0.039	120.13	243.9
0.038	120.25	238.10
0.037	120.38	232.56
0.036	120.5	227.27
0.035	120.63	222.22
0.034	120.75	217.39
0.033	120.88	212.77
0.032	121.00	208.33
0.031	121.13	204.08
0.030	121.25	200.00
0.029	121.38	196.08
0.028	121.5	192.31
0.027	121.63	188.68
0.026	121.75	185.19
0.025	121.88	181.82
0.024	122.00	178.57
0.023	122.13	175.44
0.022	122.25	172.41
0.021	122.38	169.49
0.020	122.5	166.67
0.019	122.63	163.93
0.018	122.75	161.29
0.017	122.88	158.73
0.016	123.00	156.25
0.015	123.13	153.85
0.014	123.25	151.52
0.013	123.38	149.25
0.012	123.50	147.06
0.011	123.63	144.93
0.010	123.75	142.86
0.009	123.88	140.85
0.008	124.00	138.89
0.007	124.13	136.99
0.006	124.25	135.14
0.005	124.38	133.33
0.004	124.50	131.58
0.003	124.63	129.87
0.002	124.75	128.21
0.001	124.88	126.58
0.000	125.00	125.00
-0.001	125.13	123.46
-0.002	125.25	121.95
-0.003	125.38	120.48
-0.004	125.50	119.05
-0.005	125.63	117.65
-0.006	125.75	116.28
-0.007	125.88	114.94
-0.008	126.00	113.64
-0.009	126.13	112.36
-0.010	126.25	111.11
-0.011	126.38	109.89
-0.012	126.50	108.70
-0.013	126.63	107.53
-0.014	126.75	106.38
-0.015	126.88	105.26
-0.016	127.00	104.17
-0.017	127.13	103.09
-0.018	127.25	102.04
-0.019	127.38	101.01
-0.020	127.50	100.00
-0.021	127.63	99.01
-0.022	127.75	98.04
-0.023	127.88	97.09
-0.024	128.00	96.15
-0.025	128.13	95.24
-0.026	128.25	94.34
-0.027	128.38	93.46
-0.028	128.50	92.59
-0.029	128.63	91.74
-0.030	128.75	90.91
-0.031	128.88	90.09
-0.032	129.00	89.29
-0.033	129.13	88.50
-0.034	129.25	87.72
-0.035	129.38	86.96
-0.036	129.50	86.21
-0.037	129.63	85.47
-0.038	129.75	84.75
-0.039	129.88	84.03
-0.040	130.00	83.33
-0.041	130.13	82.64
-0.042	130.25	81.97

APPENDIX E 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, please perform the troubleshooting techniques outlined in this document.

By Mail

Fluid Components International LLC

1755 La Costa Meadows Dr.

San Marcos, CA 92078-5115 USA

Attn: Customer Service Department

By Phone

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

By Fax

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

By Email

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

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

International Support

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

After Hours Support

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

Point of Contact

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

Warranty Repairs or Returns

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

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

Non-Warranty Repairs or Returns

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

Extended Warranty

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

Return to Stock Equipment

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

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

Field Service Procedures

Contact an FCI field representative to request field service.

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

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

Field Service Rates

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

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

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. 05CS000004D [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 Hygenist 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 three (3) years for non-calibration defects and one (1) year for calibration defects from date of shipment to Buyer, and provided further, that an examination by Seller discloses to Seller's reasonable satisfaction that the defect is covered by this warranty and that the Buyer has not returned the equipment in a damaged condition due to Buyer's or Buyer's employees', agents', or representatives' negligence and Buyer has not tampered, modified, redesigned, misapplied, abused, or misused the goods as to cause the goods to fail. In addition, this warranty shall not cover damage caused by Buyer's exposure of the goods to corrosive or abrasive environments. Moreover, Seller shall in no event be responsible for (1) the cost or repair of any work done by Buyer on material furnished hereunder (unless specifically authorized in writing in each instance by Seller), (2) the cost or repair of any modifications added by a Distributor or a third party, (3) any consequential or incidental damages, losses, or expenses in connection with or by reason of the use of or inability to use goods purchased for any purpose, and Seller's liability shall be specifically limited to free replacement, or refund of the purchase price, at Seller's option, provided return or rejection of the goods is made consistent with this paragraph, and the Seller shall in no event be liable for transportation, installation, adjustment, loss of good will or profits, or other expenses which may arise in connection with such returned goods, or (4) the design of products or their suitability for the purpose for which they are intended or used. Should the Buyer receive defective goods as defined by this paragraph, the Buyer shall notify the Seller immediately, stating full particulars in support of his claim, and should the Seller agree to a return of the goods, the Buyer shall follow Seller's packaging and transportation directions explicitly. In no case are the goods to be returned without first obtaining a return authorization from the Seller. Any repair or replacement shall be at Seller's factory, unless otherwise directed, and shall be returned to Seller transportation prepaid by Buyer. If the returned goods shall prove defective under this clause they will be replaced or repaired by Seller at no charge to Buyer provided the return or rejection of such material is made within a reasonable period, but in no event longer than (1) year from the date of shipment of the returned goods or the unexpired terms of the original warranty period whichever is later. If the goods prove to be defective under this paragraph, the Buyer shall remove the goods immediately from the process and prepare the goods for shipment to Seller. Continued use or operation of defective goods is not warranted by Seller and damage occurring due to continued use or operation shall be for Buyer's account. Any description of the goods contained in this offer is for the sole purpose of identifying them, and any such description is not part of the basis of the bargain, and does not constitute a warranty that the goods will conform to that description. The use of any sample or model in connection with this offer is for illustrative purposes only, is not part of the basis of the bargain, and is not to be construed as a warranty that the goods will conform to the sample or model. No affirmation of that fact or promise made by the Seller, whether or not in this offer, will constitute a warranty that the goods will conform to the affirmation or promise. THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES WITH RESPECT TO THE GOODS OR THEIR INSTALLATION, USE, OPERATION, REPLACEMENT OR REPAIR, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS OF PURPOSE; AND THE GOODS ARE BEING PURCHASED BY BUYER "AS IS". SELLER WILL NOT BE LIABLE BY VIRTUE OF THIS WARRANTY OR OTHERWISE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL LOSS OR DAMAGE RESULTING FROM THE USE OR LOSS OF USE OF THE GOODS.

Flow & Level Instrumentation
Solutions for Industrial Processes

FCI's Quality Management System is
ISO 9001 and AS9100 Certified

Visit FCI online at www.fluidcomponents.com

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