

Installation, Operation and Maintenance
ST98 FlexMASter™ Series
with Profibus DP Profile 3



Model ST98 Insertion

Model ST98L In-Line

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1. General Information

Description

The model ST98 is a thermal mass flowmeter for air or gas measuring applications. The ST98 consists of a flow element, a flow transmitter, and an enclosure. An in-line flow element is used for pipe or tubing sizes ≤ 2 inches. For pipe sizes greater than 2 inches, an insertion flow element is used. The flow element's process connections can be threaded or flanged.

The ST98 flow transmitter accepts AC or DC input power. A display is optional. The output signal provided is a Profibus DP digital communication protocol. The output supports DP Profile 3, Class B with all mandatory parameters for a thermal mass flow device.

The ST98 enclosures provide environmental protection for the flow transmitter. The flow transmitter can be integrally mounted with the flow element or remotely mounted from it. Hazardous location local and remote enclosures are optional.

Theory of Operation

The flow element of the model ST98 uses the thermal dispersion operating principle: A low-powered heater produces a temperature differential between two resistance temperature detectors (RTDs) by heating one of the RTDs. Mass flow rate changes, cool the heated RTD and cause a change in the temperature differential between the RTDs. The instrument's flow transmitter converts the RTD temperature differential into a output signal and an optional indicated display value.

The signal from the unheated RTD is used to provide an indication of the air or gas temperature on the optional display.

Insertion 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. A heated RTD is inserted into the top thermowell. A reference RTD (with no heater) is inserted into the bottom thermowell. In order to correctly orient the sensing element, a flow arrow has been etched onto a machined flat portion of the sensing element. See Figure 1 for a view of the sensing element.

The element is inserted into the process media through a port in the process line.

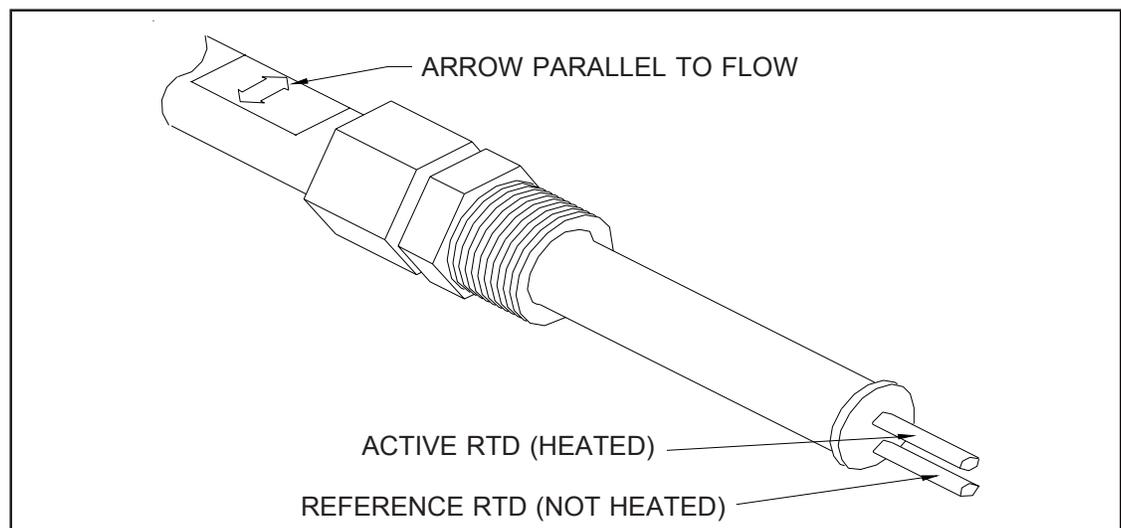


Figure 1. View of the Sensing Element

In-Line Sensing Element (Flow Tee)

The in-line sensing element is made in the same way as the insertion type of flow element. To correctly orient the in-line sensing element, a flow arrow has been etched onto one side of the sensing element. The in-line flow element is inserted in the process line with the flow arrow pointing in the same direction of flow. See Figure 2 for a cutaway view of the in-line element.

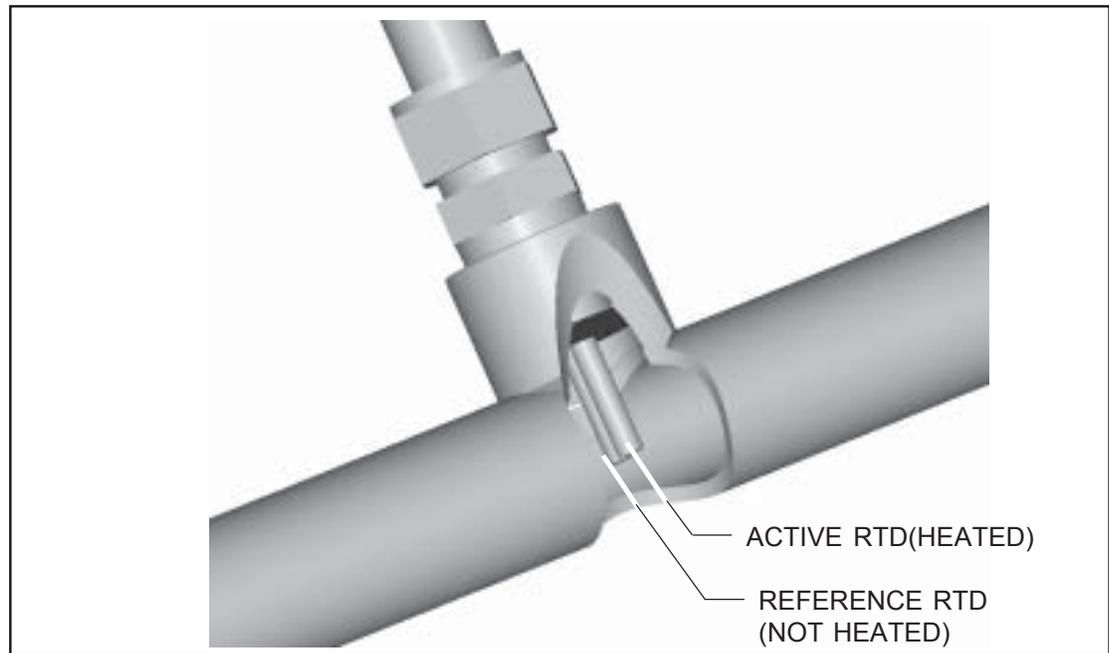


Figure 2. Cut-Away View Of The In-Line Flow Element Tube

Transmitter Electronics

The transmitter electronics convert the sensing element's RTD temperature differential into a flow signal that is read on a display. The output is a representation of the amount of flow or temperature present in the process. Both the flow output and process temperature can be displayed on an optional LCD display.

There are 2 types of enclosures available for the electronics:

1. Standard:
Polyester Coated Carbon Steel or Aluminum Rated NEMA/CSA Type 4/4X (equivalent to IP66) and Division 2 (Ex n). (This is a 6 X 6 X 4 Inch Square Enclosure / 152.4 X 152.4 X 101.6 mm)
2. Optional:
Aluminum rated for Hazardous Location use Class I and II, Division 1 and 2, Group B, C, D, E, F, G resists the effects of weather and corrosion. (This is a 4.8 X 9.31 Inch Cylindrical Enclosure / 121.8 X 236.47 mm)

Instrument Configuration

The instrument can be an integral arrangement (the electronics and the sensing element are combined in one enclosure), or the instrument can be a remote arrangement (the electronics and sensing element are in separate enclosures).

In the case of a remote enclosure, the standard configuration of the sensing element (local) enclosure is aluminum, rated for Hazardous Location use Class I and II, Division 1 and 2, Group B, C, D, E, F, G (previously referred to as NEMA7) and EEx d IIC and resists the effect of weather and corrosion. The dimensions are 4.68 X 4.82 inches (119 X 122 mm) and is cylindrical in nature.

Technical Specifications

INSTRUMENT

Flow Range:

ST98 Insertion Flow Element: 0.75 to 600 SFPS [0.21 to 172 NMPS]
ST98L Inline Flow Accessory: 0.0062 to 1850 SCFM [0.01 to 3,140 Nm³/h]
— Air at standard conditions; 70°F [21.1°C] and 14.7 psia [1.01325 bar (a)].

Media: All gases that are compatible with the flow element material.

Accuracy:

Flow: ±1% reading + 0.5% full scale standard accuracy
Temperature: ±2°F (display only, flow rate must be greater than 5 AFPS)

Repeatability:

Flow: ±0.5% reading
Temperature: ±1°F (flow rate must be greater than 5 AFPS)

Turndown Ratio:

Standard: Factory set and field adjustable from 10:1 to 100:1 within calibrated flow range.

Temperature Compensation:

Standard: ±30°F [±1°C] Optional: ±100°F [±38°C]

Flow Conditioning (optional):

VORTAB[®] Flow Conditioner: Meter Run (VMR), Insertion Sleeve (VIS) or Field Kit (VFK)

Agency Approvals: FM, CSA, T4 Rated (Pending Approval), CE Mark (EMC Directive 89/ 336/EEC), ATEX 02ATEX2042 112 EEx d IIC T6...T5 (Electronics) EEx d IIC T4...T2 (Flow Element)

Calibration: Performed on NIST traceable equipment.

FLOW ELEMENTS

Material of Construction: All-welded 316 stainless steel or Hastelloy C optional.

Operating Pressure: 0 to 250 psig [0 to 17 bar (g)], derated with Teflon ferrule.

Operating Temperature: Process temperature -40°F to 350°F [-40°C to 177°C];
Optional 500°F [250°C]

ST98 Insertion Flow Element

Process Connection: 3/4 inch male NPT stainless steel compression fitting: adjustable Teflon ferrule; 150 psig [10 bar (g)] and 200°F [93°C] max., or metal ferrule; 250 psig [17 bar (g)] and 500°F [260°C] max.; thread-on flange optional.

Insertion Length: Field adjustable lengths: 1 to 6 inches [25 to 152 mm], 1 to 12 inch [25 to 305 mm] or 1 to 21 inch [25 to 533 mm]; custom lengths optional.

ST98L Inline Flow Tube

The insertion flow element is threaded and keyed in an inline flow tube; calibrated and supplied as a single unit. Accessories include low flow injection tubes and built-in VORTAB[®] flow conditioners for optimum low flow rangeability and performance.

Size: 1 inch diameter tubing; 1 inch, 1 1/2 inch or 2 inch schedule 40 pipe.

Length: 9 nominal diameters

Process Connection: 3/4 inch NPT on 1 inch tubing; male or female NPT on 1 inch, 1 1/2 inch and 2 inch schedule 40 pipe.

Option: Flanges

**Technical
Specifications
(Cont'd)****FLOW TRANSMITTER**

Operating Temperature: 0 to 140°F [-18 to 60°C]

Input Power: 85 to 265 Vac or 22 to 30 Vdc; 10 watts maximum, 230 mA maximum

Output Signal: Digital Profibus-DP, Profile 3, Class B

Display (optional): 2 line/16 character per line, indicating flow rate and process temperature and/or totalized flow.

Remote Enclosure (optional):

Standard: NEMA/CSA Type 4X (equivalent to IP66) and Division 2 (Ex n)

Option: Aluminum rated for hazardous location use Class I and II, Division 1 and 2, Group B, C, D, E, F, G (previously referred to as NEMA 7 and EEx d IIC) resists the effects of weather and corrosion.

Remote Transmitter Configuration: Transmitter may be mounted remotely from flow element using interconnecting cable (up to 500 feet [152 m]).

APPROVALS

(FM/CSA pending), CENELEC, CE MARKING, (EMC Directive 89/336/EEC), ATEX, CCE, CRN

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 D - Customer Service.

Factory Calibration Note

The instrument is factory calibrated to the flow range specified in the order. There is no need to perform any verification or calibration steps prior to installing and placing the instrument in service.

Pre-Installation Procedure



CAUTION: Only qualified personnel should install this instrument. Install and follow safety procedures in accordance with the current National Electrical Code. 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.



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

Damage resulting from moisture penetration of the enclosure(s) is not covered by product warranty.

The flow transmitter contains electrostatic discharge (ESD) sensitive devices. Use standard ESD precautions when handling the circuit board assemblies. See below for ESD details.

Use Standard ESD Precautions

When opening an instrument enclosure or handling the flow transmitter use standard ESD precautions. 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 there should be 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.

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 the Flow Element Location

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

Mount the flow element at least 20 diameters downstream and 10 diameters upstream from any bends or interference in the process pipe or duct to achieve the greatest accuracy.

Verify Dimensions

The ST98 Insertion models have an adjustable insertion length ferrule until it is locked into position. Verify all dimensions before locking the fitting in place. See the appropriate figures in Appendix A.



NOTE: Two types of ferrules are available. One type of ferrule is made from Teflon. This can be tightened and loosened repeatedly at different places on the flow element. The other type of ferrule is made from Stainless Steel. This ferrule can only be tightened in one place on the flow element. The Stainless Steel Ferrule makes an indentation into the flow element for a more firm fit.

The ST98 In-Line Model's flow element has a tube or pipe length and diameter that is specified at the time of order. This dimension should be double checked with the process line.

Verify Flow Direction

Verify the flow direction and orientation of the flow element before placing it into the flow media. The insertion ST98 flow element has flat areas machined on the flow element near the enclosure end of the flow element. Etched on the flow element is a flow arrow indicating the direction of flow. See Figure 3. Align the ST98 flow element during installation so the flat areas are parallel to the direction of the process media flow, and the flow arrow points in the direction of process media flow. A flow direction arrow is etched on the in-line ST98L tube or pipe and should be pointing in the direction of flow. Failing to install the flow element correctly will reduce the accuracy of the flow meter.

Verify Serial Numbers

Verify the serial number of the flow element and electronics. The ST98 flow element has a serial number near the flat machined area or flow arrow. The same number is on the main electronics circuit board, and on the tag of the electronics enclosure. The flow element and the electronics are a matched set. Failure to observe serial numbers will cause inaccurate readings.

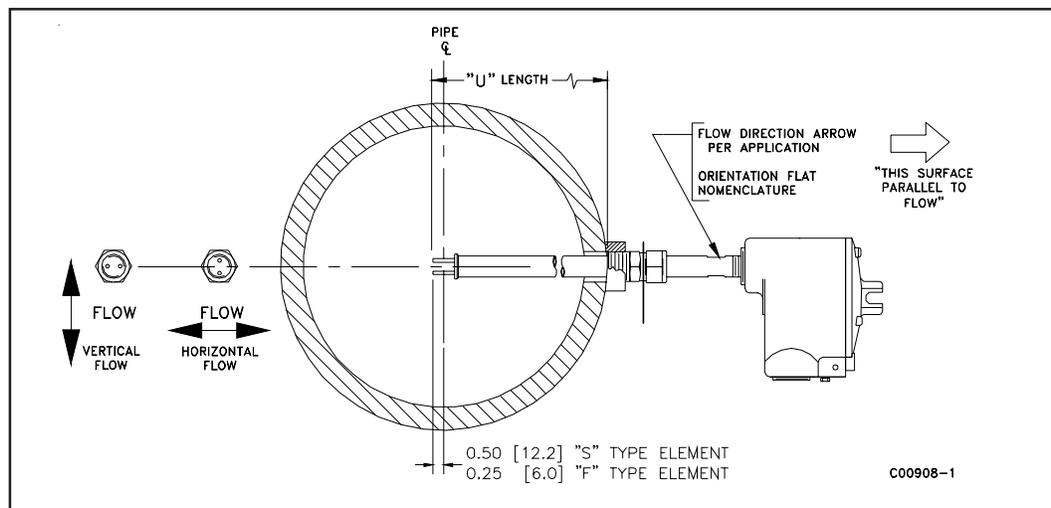


Figure 3. Model ST98 Insertion Flow Element (Remote) Showing Orientation

Install Flow Element

Install the flow element as specified for the process connection type used.



NOTE: The instrument accuracy will be reduced if the media flow is reversed from the flow direction of the flow arrow machined on the flow element or if the flats are not parallel, within $\pm 1^\circ$ of the flow direction.

Compression Fitting Mounting/ Removal (Insertion Mounting Only)



NOTE: For proper performance, element shall be installed so that tip of probe is .25 inches [6mm] for ‘F’ type and .50 inches [12.2mm] for ‘S’ type past pipe centerline. Instrument is specifically calibrated for centerline referenced installation. Critical for line sizes 4” [25mm] and smaller.

To assist in final installation, FCI suggests making a readable mark on the extension pipe to indicate the final desired compression fitting position on the extension pipe that will place the element at the centerline reference once the system is tightened down into place. With the compression fitting lightly tightened, hold the element assembly along the outside of the installation, or directly above, to visually verify the compression fitting location will ensure centerline installation. To calculate the actual “U” length dimension, take the inside diameter of the pipe or duct divide by 2, then add 0.25" or 0.50” depending on element type, then add for the pipe wall thickness and the process fitting offset that allows the compression fitting to securely seat in the process port. See Figure D above.

Align the flat parallel to flow and adjust the instrument depth. Upon determination of the final compression fitting location on the extension pipe, apply the proper thread sealant to the NPT threads, firmly tighten the compression fitting into the mating process connection. Torque varies per application. Tighten the compression nut to the torque indicated with the corresponding ferrule material. Manufacturer recommends 1-1/4 turns from hand tight baseline.

Ferrule	Torque
Teflon	65 in – lbs
316 SST	65 ft – lbs



CAUTION: Be sure there is no pressure in the process line before the instrument is removed.

NPT Pipe Thread Mounting/Removal (Insertion Mounting Only)



ALERT: DO NOT change the orientation of the flow element in the enclosure more than 180° as the interconnecting RTD and heater wiring could be stressed and damaged. DO NOT apply any torque to the flow element enclosure - only apply to NPT pipe surface itself.



NOTE: When mounting the flow element to the process pipe, it is important that a lubricant/sealant is applied to the male threads of all connections. A lubricant/sealant compatible with the process environment should be used. All connections should be tightened firmly. To avoid leaks do not overtighten or cross-thread connections.

The pipe thread configuration is similar to what is shown in Figure 3. Apply sealant compatible with the process media to male threads. Carefully insert into process mount. Threads are right-handed. Tighten with an open-end wrench on the hexagonal surface provided. Rotate until snug and continue to turn until flat is horizontal to process flow. To remove the flow element, unscrew it.



NOTE: Threaded flanges can be inserted onto an NPT or ferrule threaded sensing element. Use appropriate lubricant/sealant on the male threads, tighten the flange until snug, continue to turn until the sensing element flat is centered between two of the flanges mounting holes.

In-Line Mounting (ST98L)

There are several different ways the in-line model ST98L instrument can be mounted into the process line. The different ways the flow element can be mounted are as follows:

- Threaded male NPT mount
- Threaded female NPT mount
- Raised face flange mount
- Butt Weld mount

Figure 4 shows a Butt Weld, 2 inch Schedule 40 pipe, in-line model ST98L:

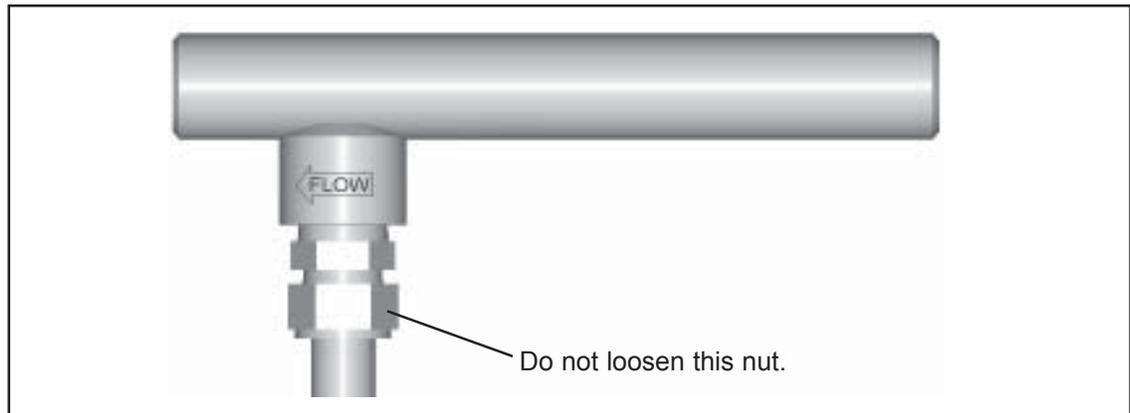


Figure 4. Model ST98L In-Line Butt Weld Mount

Mount the in-line Model ST98L as follows:

1. Verify that the process media flow is in the same direction as the flow arrow (see Figure 4).
2. For flange mounted instruments, apply the appropriate gasket and / or sealant to flange mounts as required.
3. For NPT mounted instruments, apply the appropriate sealant to the threads as required.
4. Mate (or weld the Butt Weld instrument) the instrument to the process line.
5. For flange mounts, attach the instrument with a bolt, two flat washers, lock washer and a nut for each bolt hole. Apply lubricant/sealant to the male threads of bolts or to the NPT threads and torque. Refer to ANSI B16.5 torque specifications.

ST98L Flow Element Removal / Installation:

1. If the flow element needs to be removed from the tee section for any reason, DO NOT allow the element to rotate during the removal/installation process. Flats are supplied on the flow element to hold the element from rotating during removal/installation. FCI recommends contacting customer service prior to beginning this process.

Install Flow Transmitter



ALERT: In applications where the flow element is located in an explosive environment, isolate the conduit before it leaves the environment. A potting Y may be used to provide the isolation.



NOTE: FCI recommends installing an input power disconnect switch and fuse near the flow transmitter to interrupt power during installation, maintenance, calibration, and troubleshooting procedures.

Remote Hardware Location (Option)

The outline dimensions shown in Appendix A show the physical dimensions for the proper mounting of the flow element and transmitter electronics enclosure. Select a location for the flow transmitter within 1000 feet (310 M) of the flow element. This location should be easily accessible with enough room to unscrew the enclosure top at any time. Secure the enclosure to a surface capable of providing support. Use appropriate hardware to secure the enclosure.

Make all electrical connections through the 3/4 inch NPT ports in the enclosure. Run all electrical cables through appropriate conduit or protective sheathing.



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

Minimum Wire Size

If the instrument is used in a remote configuration, a shielded, 8 conductor cable is to be used between the local and remote enclosures. Table 1 shows the smallest (maximum AWG number) copper wire that should be used in the cable and in other wiring. Use a lower gauge of wire (larger diameter) for less of a voltage drop. Contact FCI concerning greater distances than those listed in the table. The sensing element cable for the remote option must be shielded. The maximum wire size of the non-power connectors in the instrument is 16 AWG (1.47 mm). The maximum wire size of the power connectors in the instrument is 12 AWG (2.36 mm). Table 2 shows the AWG to millimeter conversions.



NOTE: All 8 conductors for the sensing element must be used for the instrument to operate correctly.

Table 1. Maximum AWG Number

Connection	Maximum Distance for AWG					
	10 ft. (3 m)	50 ft. (15 m)	100 ft. (31 m)	250 ft. (76 m)	500 ft. (152 m)	1000 ft. (310 m)
Input Power	20	18	18	16	16	14
Sensing Element Cable (Remote Instrument)	24	24	24	18	16	16
Digital Output	Type "A" Profibus Cable					

Table 2. Wire Conversion

WIRE GAGE CONVERSION TABLE				
Gage	Stranding Strands/Gage	Nominal O.D. of Strand (in)	Minimum O.D. of Wire	
			Inches	mm
24	10/34	0.0063	0.024	0.584
22	7/30	0.010	0.030	0.762
20	10/30	0.010	0.037	0.890
18	16/30	0.100	0.047	1.20
16	19/29	0.113	0.058	1.47
14	19/27	0.0142	0.071	1.85

Explosion Proof Enclosure Wiring(Cylindrical Enclosure)

1. Remove the customer connection cover from the instrument by loosening the Allen head screw at the base of the cover. Unscrew the cover shown in Figure 5.
2. Install conduit between the local (if used) and the remote enclosure, the power source and customer monitoring circuits. Provide watertight hardware and apply thread sealant to all connections to prevent water damage.

3. Connect the digital/communication cables to TS5 (see Figure 6) located on the customer interface board. The Profibus connector is labeled with A and B lines for in and out as well as a cable shield termination. The ST98 has no integrated terminating resistors. An external termination resistor network needs to be added at the end of the segment if the ST98 is the last instrument in the segment.
4. Connect the operating power to the customer termination board by removing the input wiring kit from the strain relief bracket (see Figure 6 for the bracket location). This kit contains a filter bead and three cable ties. For remote instruments only, the kit also contains 2 wire terminals for a ground wire to be placed between the flow element enclosure and the electronics enclosure.
5. Strip the incoming power wires to approximately 5/16 of an inch (7.94 mm).
6. Put the filter bead over the safety ground wire shown in Figure 6. Use 2 cable ties to secure the bead. The last cable tie should be about 3 inches from the end of the wire.
7. Attach the power wires to Terminal Strip TS1 (for AC) or TS4 (for DC) as shown in Figure 6. Secure the wires going to the Terminal Strip with a cable tie, secured to the cable tie bracket on the customer connection board.
8. For remote instruments only, (the flow element is in a separate enclosure from the electronics): Loosen the Allen head screw on the electronics cover. Unscrew the cover.

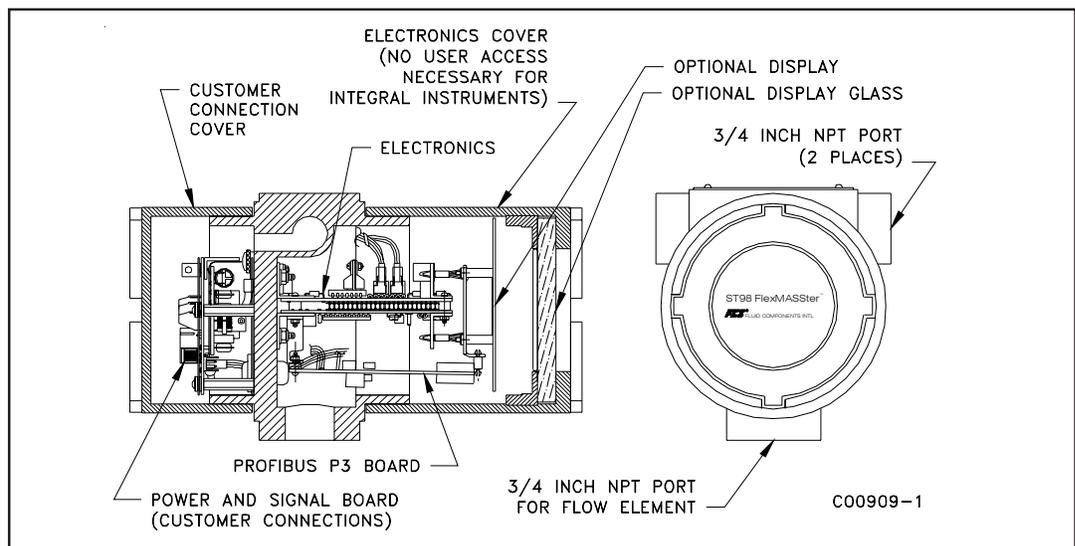


Figure 5. Circuit Board Placement

9. For remote instruments only: The flow element wires should be routed through the 3/4 inch NPT port for the flow element as shown in Figure 5. Connect the flow element wires to TS2 on the electronics assembly according to Figure 7. Connect the cable shield to HTR RTN. Leave the other end of the shield floating. A 14 AWG (1.85 mm) ground wire should also be routed between the enclosures (wire terminals are supplied in the kit).



NOTE: Connecting the shield in any other way will decrease the accuracy of the instrument. See Figure 7 for the wiring diagram.

CAUTION: Remote Configuration Only: Be sure an earth ground wire is connected between the ground terminal (see Figure 6) and the ground screw in the local enclosure. This is for the purpose of safety.

10. If a wire comes loose from the instrument during installation, refer to Chapter 5 - Troubleshooting for a complete instrument wiring diagram.
11. For remote instruments only: Screw on the electronics cover and tighten the Allen head screw.

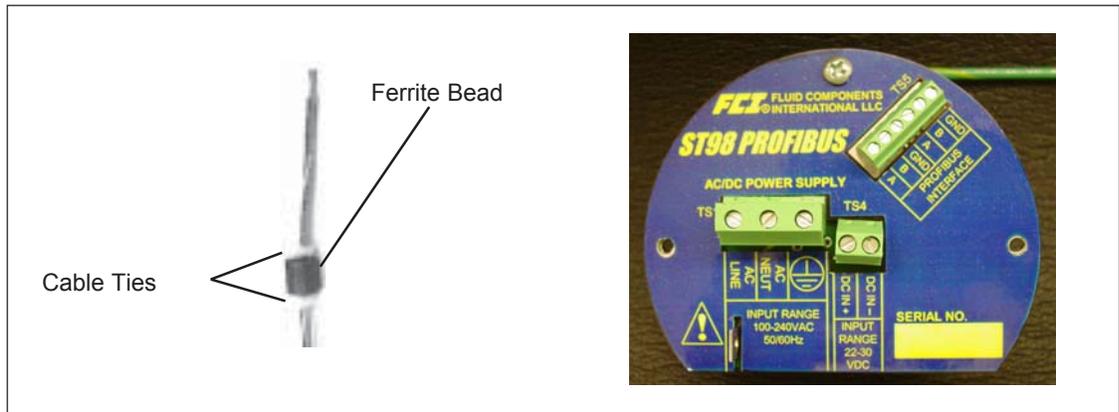


Figure 6. Customer Connection Board

12. Screw on the customer connection cover and tighten the Allen head screw.
13. There are enough threads on the flow element so the flow transmitter enclosure can be rotated for ease of viewing the display LCD if the option is present. Be sure the flow arrow still points in the direction of flow and the flat is parallel to the flow.
14. Verify proper installation. Ensure that the assemblies are secure and the wiring is correct.

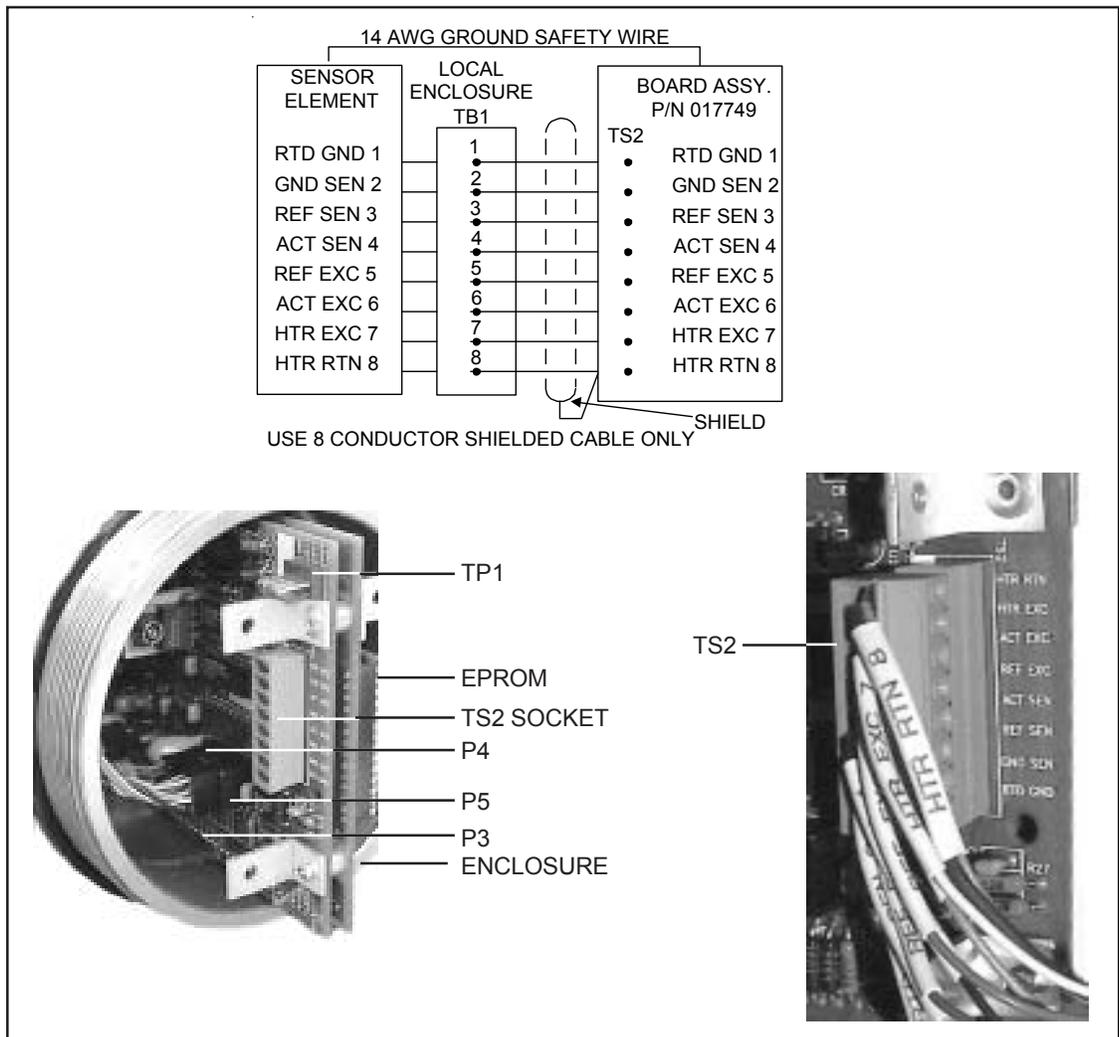


Figure 7. Remote Wiring Diagram

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

Square Nema 4 Type Enclosure Wiring

1. To wire the instrument loosen 3 cover hold down screws and open the cover. See Figure 8.
2. Install conduit between the local (if used) and the remote enclosure, the power source and customer monitoring circuits. Provide watertight hardware and apply thread sealant to all connections to prevent water damage.
3. Connect the digital/communication cables to TS5 located on the customer interface board. The Profibus connector is labeled with A and B lines for in and out as well as a cable shield termination. The ST98 has no integrated terminating resistors. An external termination resistor network needs to be added at the end of the segment if the ST98 is the last instrument in the segment.
4. Connect the operating power to the customer termination board by removing the input wiring kit from the strain relief bracket (see Figure 6 for the bracket location). This kit contains a filter bead and three cable ties. For remote instruments only, the kit also contains 2 wire terminals for a ground wire to be placed between the flow element enclosure and the electronics enclosure.
5. Strip the incoming power wires to approximately 5/16 of an inch (7.94 mm).
6. Attach the filter bead over the safety ground wire as shown in Figure 6 using 2 cable ties to secure the bead on the wire. The last cable tie should be about 3 inches from the end of the wire.

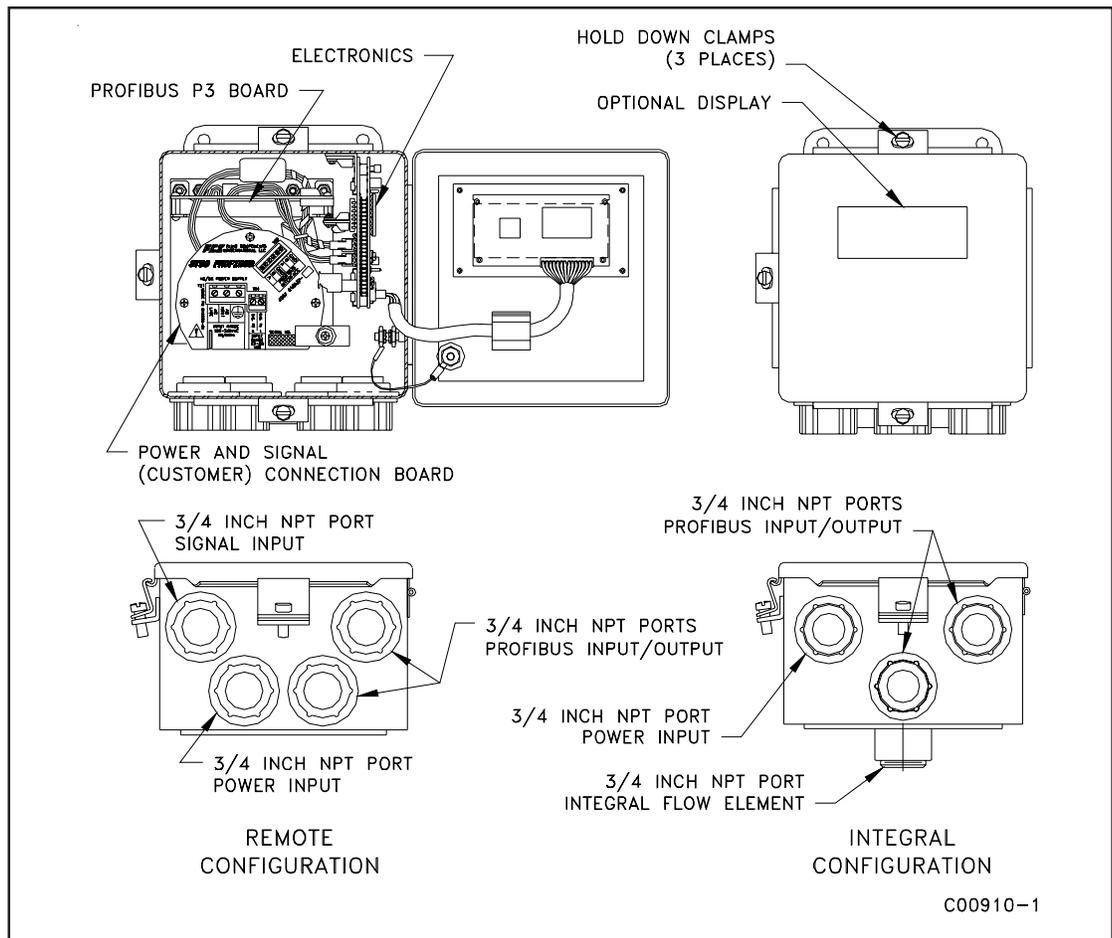
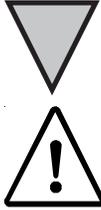


Figure 8. Optional Carbon Steel Enclosure

7. Attach the power wires to Terminal Strip TS1 (for AC) or TS4 (for DC) as shown in Figure 6. Secure the wires going to the Terminal Strip with a cable tie, secured to the cable tie bracket on the customer connection board.
8. For remote instruments only, (the flow element is in a separate enclosure from the electronics): The flow element wires should be routed through the 3/4 inch NPT port for the flow element as shown in Figure 8. Connect the flow element wires to TS2 on the electronics assembly according to Figure 7. Connect the cable shield to HTR RTN. Leave the other end of the shield floating.



NOTE: Connecting the shield in any other way will decrease the accuracy of the instrument. See Figure 7 for the wiring diagram.

CAUTION: Be sure a grounded wire is connected between the ground terminal (see Figure 6) and ground screw in the local enclosure. This is for the purpose of safety.

9. If a wire comes loose from the instrument during installation, refer to Chapter 5 - Troubleshooting for a complete instrument wiring diagram.
10. Close the cover and tighten the hold down screws.
11. There are enough threads on the flow element so the flow transmitter enclosure can be rotated for ease of viewing the display LCD if the option is present. Be sure the flow arrow still points in the direction of flow and the flat is parallel to the flow.
12. Verify proper installation. Ensure that the assemblies are secure and the wiring is correct.

Wiring the In-Line Flow Element (Option)

Electrically the in-line flow element is the same as the model ST98 insertion flow element. Wire the instrument using the local enclosure or remote enclosure and/or the pigtail wiring methods above.

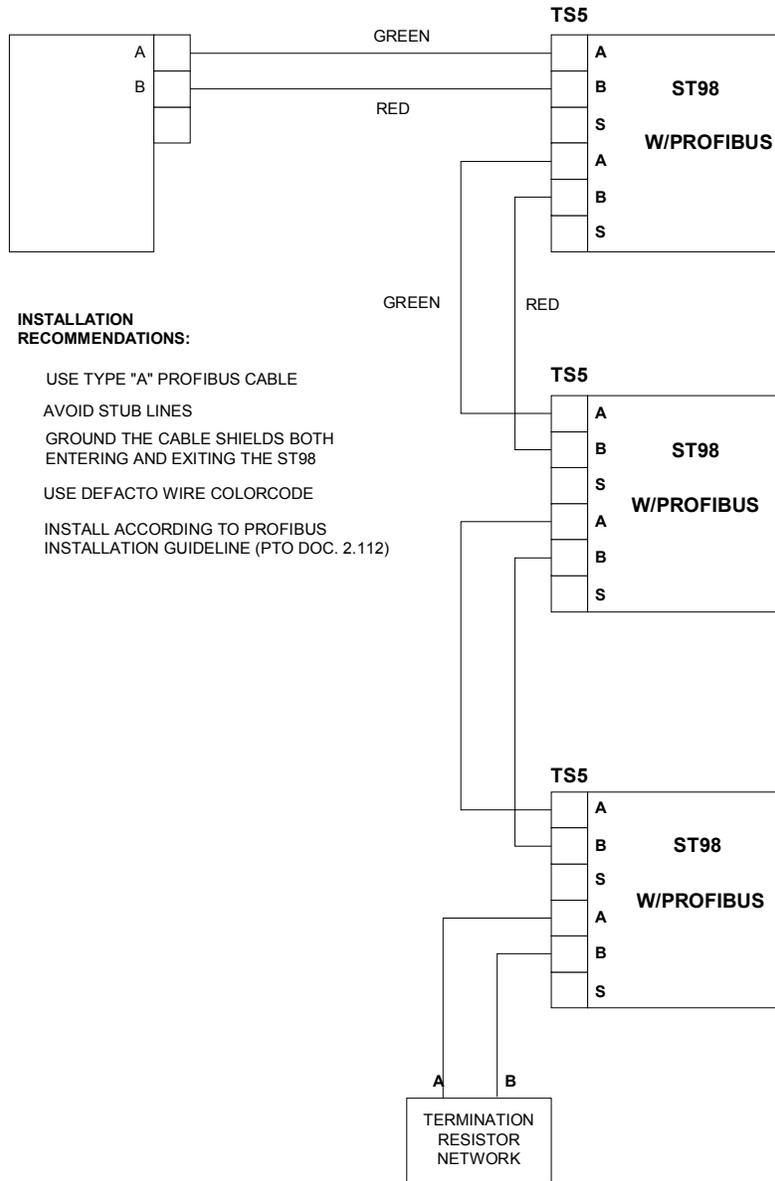
Remote Enclosure Bracket Installation

The remote enclosure can be rotated at various points around a 360° axis and bolted in place using 1/4-20 hardware. See Figure 10. See Appendix A for the dimensional drawing.



Figure 10. Remote Bracket Installation

ST98 W/PROFIBUS TYPICAL WIRING INTERCONNECT



INSTALLATION RECOMMENDATIONS:

- USE TYPE "A" PROFIBUS CABLE
- AVOID STUB LINES
- GROUND THE CABLE SHIELDS BOTH ENTERING AND EXITING THE ST98
- USE DEFACTO WIRE COLORCODE
- INSTALL ACCORDING TO PROFIBUS INSTALLATION GUIDELINE (PTO DOC. 2.112)

Apply Power

The input power should not be turned on until the installation has been completed with all connections verified, power and signal connection board assembly screwed down and the instrument ready to operate. Be sure any external circuit breakers are on.

3. Operation



ALERT: The flow transmitter contains electrostatic discharge (ESD) sensitive devices. Use standard ESD precautions when handling the flow transmitter. See Chapter 2, Installation for ESD details.

Introduction

The instrument has been configured and calibrated to customer specifications. Each instrument contains distinct operating limits and units of measurement. This chapter will show how to determine and manipulate the configuration of the instrument.

Start Up

Verify the wiring before applying power. Verify the correct power connections have been made to the flow transmitter and that the A and B Profibus lines are connected correctly.

1. Apply power.
2. When operating power is applied to the instrument the following messages will be displayed:

"Flow Rate",
"Flow Temperature"

3. Wait 5 minutes for the instrument to warm-up and stabilize.
4. The instrument automatically enters the flow metering mode. The instrument's display (if present), will show the normal operation.

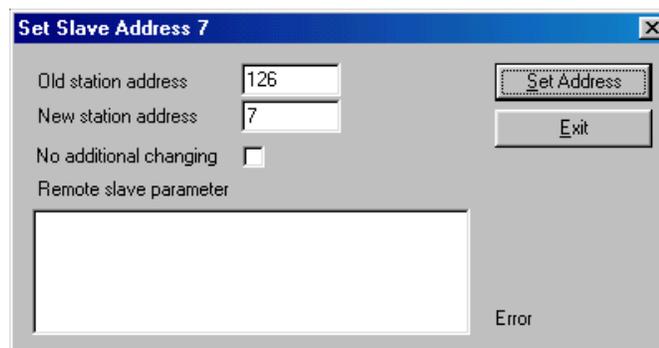
The flow meter displays an output signal that is representative of the calculated current process media flow.

If the display does not appear, or is out-of-range for the expected values, turn the power off and proceed to Chapter 5 -Troubleshooting.

Profibus DP Profile 3

ADDRESS SETUP

The ST98 Profibus address is set with the Profibus Configurator. (Sycon Configuration software used for this example). Factory default address is "30".



**Profibus
DP Profile 3
Operation**

Cyclic Data Description (Inputs)

The ST98 is a Profibus slave that transmits cyclic data (INPUT) to the master in prescribed DP format. For flow and Totalizer the DS-33 data structure is used.

Flow

DS-33: 5 bytes input

Flow (Floating Point) 4 Bytes	Status 1Byte
----------------------------------	-----------------

Totalizer

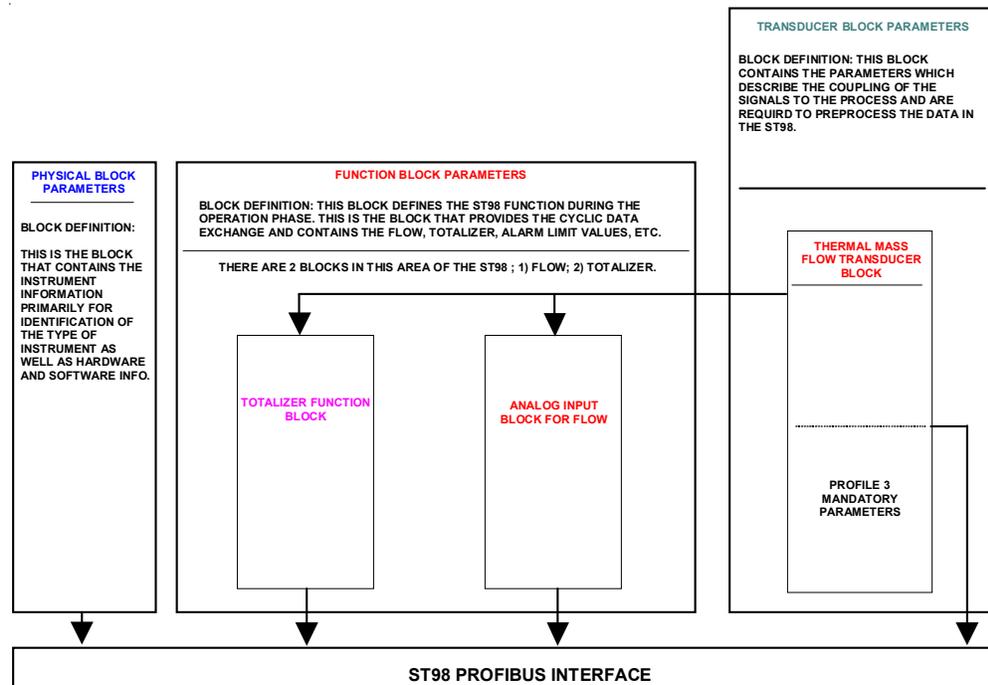
DS-33: 5 bytes input

Totalizer (Floating Point) 4 Bytes	Status 1 Byte
---------------------------------------	------------------

Acyclic data Description

The ST98 PROFIBUS DP Profile 3 Instrument is a Mass Flowmeter that uses the Profile 3 Parameter Block to organize the instrument parameter data. There are 3 major categories of data blocks; Physical Block, Function Block, and the Transducer Block. There is a manufacturer specific extension in the physical block that facilitates factory parameter restoration and the FCI specific Diagnostic Extension. The Transducer Block also has 4 FCI specific Parameter Extensions to set FCI specific flow units, and FCI range settings.

All parameters including FCI specific parameters are accessible through separate DTM software.



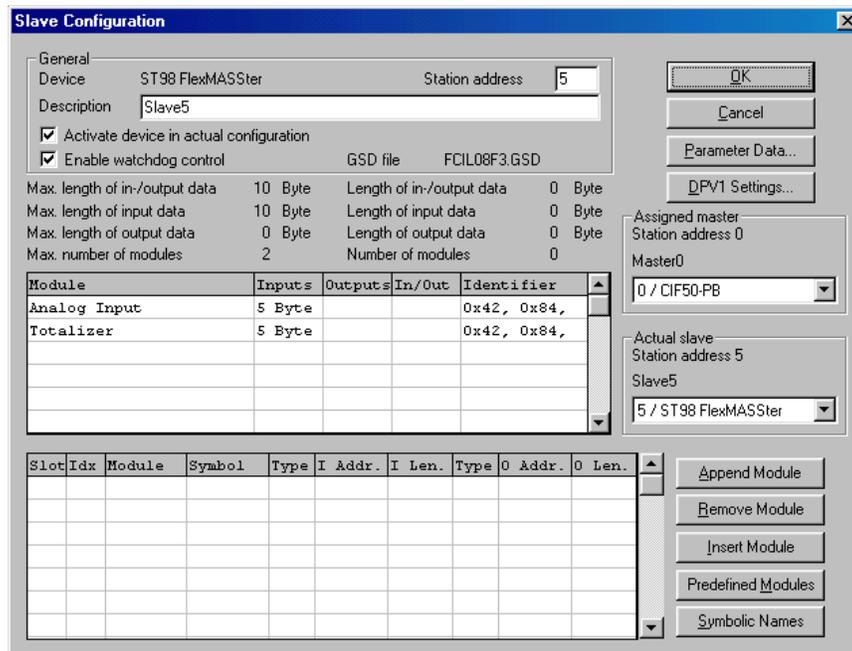
Commissioning Configure the PROFIBUS slave address with the Class 1 master of the process control system or a Class 2 master with the appropriate parameterizing and configuration tool (via the SET_SLAVE address telegram).

Load the device (ST98 Profibus DP P3 P/N 09EN000176) data (GSD) file FCIL08F3 into the process control system, and save it in the appropriate subdirectory.

Setup the PROFIBUS DP configuration for the cyclic data communication with the Class 1 master of the process control system.

Profibus Configurator

There are 2 modules from which to select, a Flow Module and a Totalizer Module.



Set the parameters and configure the ST98 instrument through either:

- 1) The Class 2 master and a configuration tool; or
- 2) ST98 DTM parameterization and configuration by using the FDT frame.

Setup Examples

Changing Profile 3 Flow Units

The Profile 3 Flow unit parameter is found in the TRANSDUCER BLOCK slot 1 index 84 or using the DTM (For DTM use begin at page 22 in this section of the manual).

Example: Setting units to Kg/h, you would enter 052C in Hex into slot 1, index 84.

Changing FCI Specific Flow Units

The FCI Flow units parameter is found in TRANSDUCER BLOCK EXTENSION in slot 1, index 115.

Example: Setting units to NCMH, you would enter 05F1 in Hex into slot 1, index 115.

When Flow units are modified, the following 3 parameters should also be modified; fci_minflow, fci_maxflow and fci_fs. These parameters are also found in the TRANSDUCER BLOCK, slot 1, index 116,117 and 118 respectively.

Example: Change SFPS to NCMH. The calibrated range for the instrument is 1.5 to 150.0 SFPS. The Full Scale is 125.00 SFPS. The customer line size is 4 in I.D (.3333 ft or 101.6 mm) (r=.16666). Reference conversion factors on page 34.

New **fci_minflow** = (Minflow)(Area)(C) = (1.5 SFPS) ($\pi \cdot r^2$) (101.94) = **13.333** NCMH

New **fci_maxflow** = (Maxflow)(Area)(C) = (150 SFPS) ($\pi \cdot r^2$) (101.94) = **1333.324** NCMH

New **fci_fs** = (Full Scale)(Area)(C) = (125 SFPS) ($\pi \cdot r^2$) (101.94) = **1111.103** NCMH

These values now need to be converted to hexadecimal values and input into the specified slot and index.

New **Nominal Size** = 101.6 mm = 42 CB 33 33

Parameter Name	Floating Point Value	Hexadecimal Value	Slot, Index
fci units	NA	05f1	1,115
Nominal Size	101.6	42 CB 33 33	1,77
fci_minflow	13.333	41 55 53 F7	1,116
fci_maxflow	1333.324	44 A6 AA 5E	1,117
fci fs	1111.103	44 8A E3 4B	1,118

Changing Pipe size Units

The ST98 Profibus Profile 3 instruments pipe size units are not directly settable. The pipe size units follow the Flow Units category; any of the flow units that are metric will set the pipe size units to mm (Millimeters), and any flow units that are English or Imperial units will set the pipe size units to in (Inches). Pipe size units are readable at slot 1 index 78.

Physical Block

Block Index	Parameter Name	Slot	Index	Data Type /Structure	Size	Read	Write
8	Software Revision	0	24	V_STRING	16	Yes	No
9	Hardware Revision	0	25	V_STRING	16	Yes	No
10	Device Manufacturer ID	0	26	UNSIGNED16	2	Yes	No
11	Device ID	0	27	V_STRING	16	Yes	No
12	Device Serial No.	0	28	V_STRING	16	Yes	No
13	Diagnosis	0	29	Octetstring	4	Yes	No
14	Diagnosis_Extension	0	30	Octetstring	6	Yes	No
24	Indent Number Selector	0	40	UNSIGNED8	1	Yes	Yes
128	CopyData(ST98 Memory)	0	49	V_STRING	2	Yes	Yes

DIAGNOSTICS
OCTET #1

BIT	FAULT
0	Hardware failure of the electronic
1	Hardware failure mechanics
3	Motor- temperature too high
4	Electronic temperature too high
5	Memory error
6	Failure in measurement
7	Device not initialized (No self calibration)
8	Self calibration failed

DIAGNOSTICS
OCTET # 2

BIT	FAULT
0	Zero point error (limit position)
1	Power supply failed (electrical, pneumatic)
2	Configuration not valid
3	New-start-up (warmstart up) carried out.
4	Re-start-up (coldstart up) carried out.
5	Maintenance required
6	Characterization invalid
7	Ident number violation

Octets 3 and 4 are reserved by the PNO and are not used.

DIAGNOSTICS EXTENSION
OCTET # 1

BIT	FAULT
0	Above Max A/D
1	Below Min A/D
2	Below Min Flow
3	Flow exceeds 120% of full scale
4	(not used)
5	(not used)
6	Above Max Flow
7	A/D Error - A/D conversion error

DIAGNOSTICS EXTENSION
OCTET # 2

BIT	FAULT
0	Sensor Error
1	Over Temp
2	Under Temp
3	Heater Shorted
4	Heater Open
5	+20V out of range
6	-8V out of range
7	Board Temp out of range

**Flow AI
Function
Block**

Block Index	Parameter Name	Slot	Index	Data Type /Structure	Size	Read	Write
10	Out (Flow)	1	26	DS-33	5	Yes	No
11	PV Scale	1	27	Float	8	Yes	Yes
12	Out Scale	1	28	DS-36	11	Yes	Yes
13	Lin Type	1	29	Unsigned8	1	Yes	Yes
14	Channel	1	30	Unsigned16	2	Yes	Yes
16	PV Ftime	1	32	Float	4	Yes	Yes
19	Alarm Hyst	1	35	Float	4	Yes	Yes
21	HI HI Lim	1	37	Float	4	Yes	Yes
23	HI Lim	1	39	Float	4	Yes	Yes
25	Lo Lim	1	41	Float	4	Yes	Yes
27	LO LO Lim	1	43	Float	4	Yes	Yes

**Totalizer AI
Function
Block**

Block Index	Parameter Name	Slot	Index	Data Type /Structure	Size	Read	Write
10	Total	2	26	DS-33	5	Yes	No
11	Unit Tot	2	27	Unsigned16	2	Yes	Yes
12	Channel	2	28	Unsigned16	2	Yes	Yes
13	Set Tot	2	29	Unsigned8	1	Yes	Yes
14	Mode Tot	2	30	Unsigned8	1	Yes	Yes
15	Fail Tot	2	31	Unsigned8	1	Yes	Yes
16	Preset Tot	2	32	Float	4	Yes	Yes
17	Alarm Hyst	2	33	Float	4	Yes	Yes
18	HI HI Lim	2	34	Float	4	Yes	Yes
19	HI Lim	2	35	Float	4	Yes	Yes
20	LO Lim	2	36	Float	4	Yes	Yes
21	LO LO Lim	2	37	Float	4	Yes	Yes

Transducer Block

Block Index	Parameter Name	Slot	Index	Data Type /Structure	Size	Read	Write
8	Calibr factor	1	70	Float	4	Yes	Yes
9	Low Flow Cutoff	1	71	Float	4	Yes	Yes
12	Zero Point	1	74	Float	4	Yes	Yes
13	Zero Point Adjust	1	75	Unsigned8	1	Yes	Yes
14	Zero Point Unit	1	76	Unsigned16	2	Yes	Yes
15	Nominal Size	1	77	Float	4	Yes	Yes
16	Nominal Size Units	1	78	Unsigned16	2	Yes	Yes
21	Mass Flow	1	83	DS-33	5	Yes	No
22	Mass Flow Units	1	84	Unsigned16	2	Yes	Yes
23	Mass Flow Lo Limit	1	85	Float	4	Yes	Yes
24	Mass Flow Hi Limit	1	86	Float	4	Yes	Yes
53	fci units	1	115	Unsigned16	2	Yes	Yes
54	fci_minflow	1	116	Float	4	Yes	Yes
55	fci_maxflow	1	117	Float	4	Yes	Yes
56	fci_fs	1	118	Float	4	Yes	Yes

Flow Units

Profile Flow Units

FLOW UNITS	P3 UNITS CODE NUM.	UNITS CODE IN HEX
Kg/s	1322	0x052A
Kg/m	1323	0x052B
Kg/h	1324	0x052C
Lb/s	1330	0x0532
Lb/m	1331	0x0533
Lb/h	1332	0x0534
Special	1999	0x07CF

FCI Specific Flow Units

FLOW UNITS	P3 UNITS CODE NUM.	UNITS CODE IN HEX
Profile		
Units	2000	0x07D0
SCFM	1360	0x0550
SCFH	1361	0x0551
NCMH	1521	0x05F1
NCMM	1522	0x05F2
SCFC	1523	0x05F3
SMPS	1524	0x05F4
SFPS	1525	0x05F5

Instrument Specific Alarms

There are 14 FCI manufacturer specific diagnostic alarms. Seven are “Process” related alarms, and seven are instrument fault alarms.

The alarm messages are the following:

Process Alarms:

Above Max Flow -	Process Flow has exceeded the instrument maximum calibrated flow range.
Below Min Flow -	Process flow has dropped below the instrument calibrated flow range.
Above Max A/D-	The Process flow signal has exceeded the range of the instrument A/D converter maximum setting.
Below Min A/D - converter.	The Process flow signal has dropped below the minimum level of the A/D converter.
Over Temp -	The process temperature has exceeded the sensor temperature range.
Under Temp - range.	The process temperature has dropped below the calibrated temperature range.
Over Range -	The process flow has exceeded the calibrated range of the instrument.

Instrument Alarms:

A/D Error -	Analog to digital conversion error
Sensor Error -	Generic flow sensor head fault
Shorted Heater -	Sensor head heater shorted
Open Heater -	Sensor head heater open
+20 Volts out of range -	20 volt supply is out of spec.
-8 volts out of range -	-8 volts supply is out spec.
Board Temp-	Electronics enclosure temperature has exceeded specification.

DTM Installation, Setup and Introduction (Optional)

The ST98 Profibus Profile 3 DTM software is an easy, quick and efficient configuration component, for the ST98 Profibus Flowmeter. It is based on FDT (Field Device Tool) technology that defines the interface between the tool and the description object of an instrument (DTM) like the ST98 Flowmeter.

The DTM (Device Type Manager) is a driver for the instrument like the ST98 Profibus Flowmeter. The DTM includes instrument specific data and functions, and all graphic elements and dialogues for setup and configuration of the ST98 Profibus Profile 3 Flowmeter.

Installation Requirements

The ST98 DTM is not an independently executable software program. It requires a Frame Application. Therefore the ST98 DTM needs to be installed into a FDT Framework. Some commercially available frame applications are PACTware, and FieldCare. PACTware is distributed by members of the PACTware Consortium e.V., and FieldCare is sold by Endress+Hauser

INSTALLING THE DTM INTO YOUR DCS/PC

To Install the ST98 DTM into your DCS or PC, a FDT Framework is required.

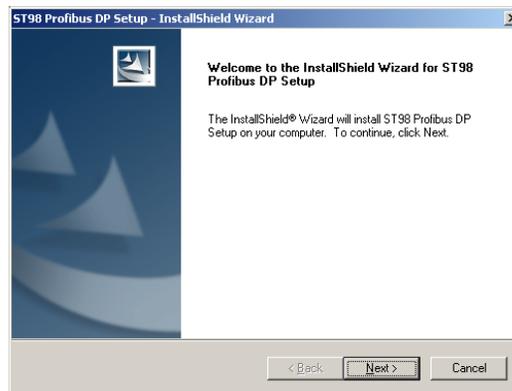
The information provided in this manual is based on using the PACTware Frame Application. For details on the installation and configuration of PACTware see the PACTware Users Manual.

STEP 1. RUN THE DTM SETUP SOFTWARE (P/N 020243-01)

Using the ST98 Installation CD run SETUP.EXE and follow the installation prompts.



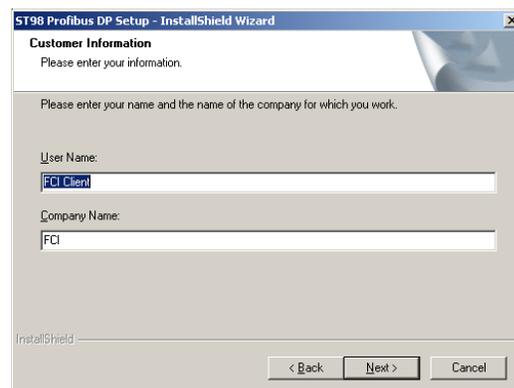
NOTE: If you are installing in a PC and are using Windows 2000 or Windows XP you need to have administrator rights in order too install the ST98 DTM.

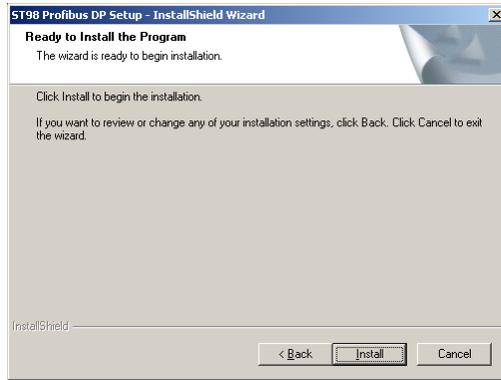


Press Next

Enter the User name. It could be the plant or facility name.

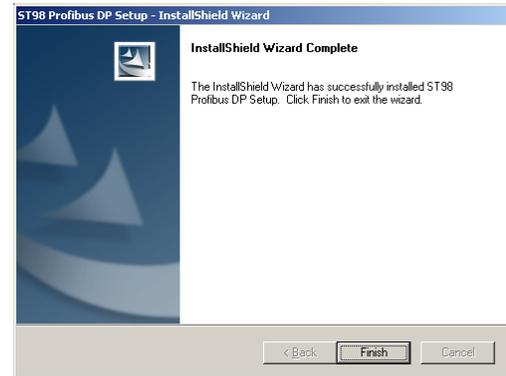
Enter your company name.





Press the Install button.

Press Finish to complete the installation



STEP 2. CONNECTING TO THE ST98 FLOWMETER USING THE DTM

Start the PACTware Frame application, login and proceed to the main PACTware screen.



Select and add the PROFIBUS Communication DTM

Then select and add the ST98 DTM.

Set the PROFIBUS BAUD Rate

Connect the Communication DTM then the ST98 DTM. You are now ready to start using the ST98 DTM.

A QUICK INTRODUCTION TO PROFIBUS PROFILE 3

The ST98 Profibus Flowmeter Process data and Configuration parameters are organized per the Profibus Profile 3 model for Mass Flowmeters. This model uses the Profibus DS-33 structure for Process data Input under Profibus DPV0 and the Function Blocks concept for the configuration and setup under Profibus DPV1.

The DS-33 structure consists of a maximum of 2 four bytes floating point numbers and a status byte, the two floating point numbers correspond to the Process Flow and the Process Totalizer values. The order of transmission and the selection of this parameters is done during parameterization with a Class 1 master configuration tool utilizing the ST98 GSD File.

The setup and configuration of the ST98 Flowmeter uses the functions blocks defined in the Profibus Profile 3 Standard for Mass Flowmeters. The configuration structure is organized into 3 major blocks called “Physical Block”, “AI Block” and the “Transducer Block” The Physical Block contains instrument identification information, The AI Block Contains the setup of the Flow and Totalizer data, with Alarm settings and scaling parameters. The Transducer Block contains the selection of Flow units, Pipe or Duct dimensions, and other setup parameters used by the ST98 Flowmeter.

Setup

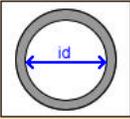
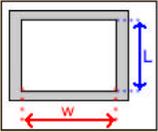
The ST98 DTM offer access to 8 instrument setup functions of the ST98 Profibus Flowmeter. This section will show you how to use these 8 setup functions of the ST98 Profibus instrument. The functions are:

Process Flow Units selection

Mass Flow	Status: <input type="text" value="Good (Non-Cascade)"/>	Value: <input type="text" value="0.36270"/>	kg/s
	Sub Status: <input type="text" value="Ok"/>	Limits: <input type="text" value="Ok"/>	
	High Limit: <input type="text" value="5000.000000"/>	kg/s	Low Limit: <input type="text" value="0.010000"/>
	Unit: <input type="text" value="kg/s"/>		

Pipe Type & Size Selection Calibration Factor

Low Flow Cutoff Zero Point Setup

Duct/Pipe	
Shape: <input type="text" value="Circular Pipe"/>	
Pipe Dimension	Duct Dimension
	
id: <input type="text" value="102.260002"/> mm	L: <input type="text" value="0.000000"/> mm
	W: <input type="text" value="0.000000"/> mm
Low Flow Cut Off: <input type="text" value="0.000000"/>	Calibration Factor: <input type="text" value="1.000000"/>
Zero Point: <input type="text" value="0.000000"/>	Zero Point Unit: <input type="text"/>
Zero Point Adjust: <input type="text" value="0"/>	

Max Flow (Upper Sensor Limits) FS (Input Range)

Min Flow (Lower Sensor Limit)

TRANSDUCER BLOCK - FCI Extension	
Sensor Mass Type: <input type="text" value="Profile Units"/>	
Upper Sensor Limit: <input type="text" value="150.00000"/>	Profile Unit: kg/h
Lower Sensor Limit: <input type="text" value="1.25000"/>	Profile Unit: kg/h
Input Range: <input type="text" value="125.00000"/>	Profile Unit: kg/h

SELECTING FLOW PROCESS UNITS

There are two types of units that are accessible through the ST98 DTM. First there are the Profile 3 Flow process Units and second the Manufacturer Specific Process flow units. The Manufacturer Specific Flow Units fall outside the definition of the Profile 3 standard and are handled as extensions.

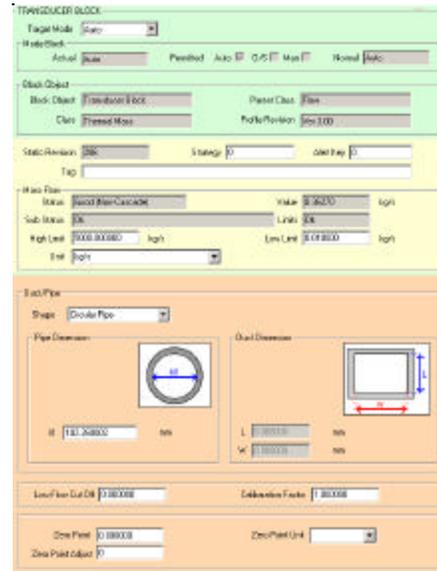
SETTING UP PROFILE 3 FLOW UNITS

In the “Transducer Block” screen of the ST98 DTM; in the “Mass Flow” grouping is the pull down menu for “Profile 3 “ Flow Units, called “Unit”; scroll down and select the desired unit, then Press the “Enter Key” in the Computer / DCS.

Select Transducer Block

Point and Click in the “Units” pull Down menu and select the preferred Flow Units.

Press “Enter” to send the request to the ST98.

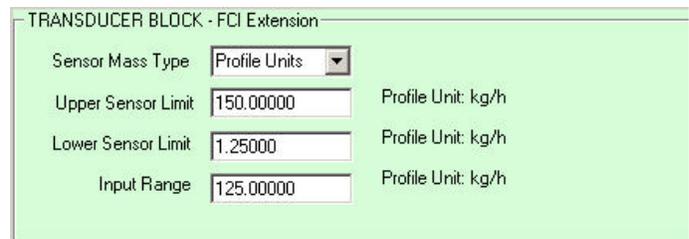


FCI SPECIFIC FLOW UNITS

In the “Transducer Block” menu tree there is a tab called “FCI Extension”, select this and the FCI extension menu will open up.

Point and Click in the “Sensor Mass Type” pull Down menu and select the preferred Flow Units.

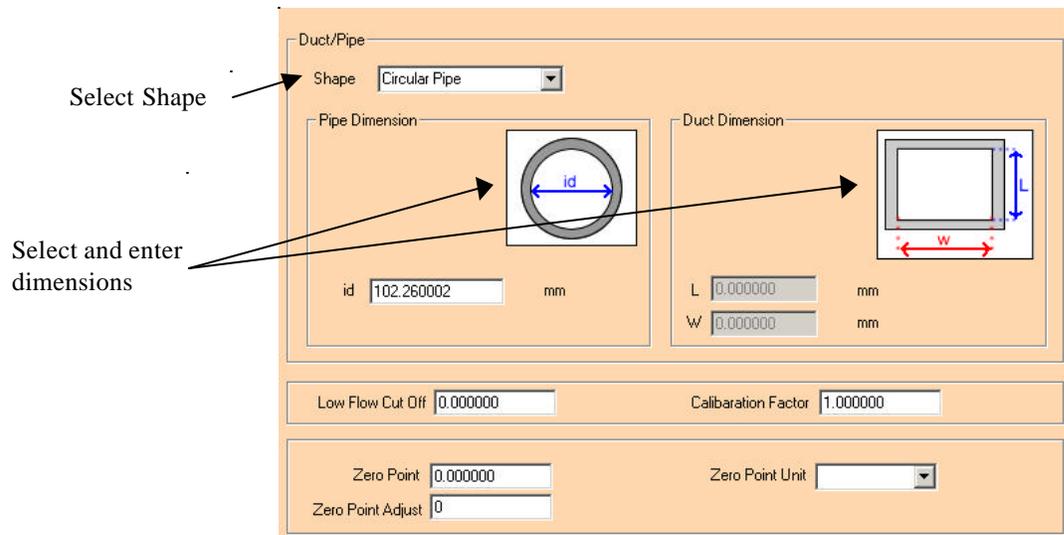
Press “Enter” to send the request to the ST98.



NOTE: The “Unit” field in the Transducer Block Mass Flow grouping will show “Manufacturer Specific”

LINE TYPE AND SIZE

In the “Transducer Block” screen of the ST98 DTM; in the “Duct/Pipe” grouping is the pull down menu for “Profile 3 “ plenum type, called “Shape”; scroll down and select the desired Plenum, then Press the “Enter Key” in the Computer / DCS.



In the Line Type and size menu, it is possible to select one of two types of line. There is the Circular Pipe type and the Rectangular Duct.
 The Pipe or Duct dimensional units will be of the same category as the Flow Units; that means that if the Flow units are metric, then the plenum dimensional units are in mm, if the flow units are English or Imperial then the plenum dimensional units are in Inches.

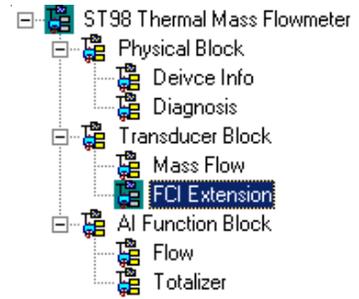
If a rectangular Duct is selected, the dimensional values are converted by the DTM to an equivalent Circular Pipe ID. Profibus Profile 3 allows dimensional information only for a circular Pipe.

READING AND SETTING THE MIN FLOW AND MAX FLOW VALUES FOR THE PROCESS FLOW

Start the PACTware Frame application, login and proceed to the main PACTware screen.

When Changing Flow Units its also important to adjust the MaxFlow Min Flow and FS of the new selected Flow units. Min Flow, MaxFlow and FS can be viewed and changed in the FCI Extension under the Transducer Block.

In the ST98 DTM menu tree select Transducer Block → FCI Extension.



Compute the new MaxFlow, the new MinFlow, and the new FS.

Enter the MaxFlow Value in the “Upper Sensor Limit” Parameter window.

Enter the MinFlow Value in the “Lower Sensor Limit” Parameter window.

Enter the FS Value in the “Input Range” Parameter window.

EXAMPLE ~ CHANGING FROM SCFM TO NCMM

An ST98 Profibus with a Methane Calibration range of 0 to 900 SCFM in a 12" line. There is a desire to change the flow units to NCMM.

Process

1. Reference the Delta R Sheet to find the Minflow in Standard Velocity. In this case, the Minflow is 1.292.
2. Find the Linesize0 (and Linesize1 if square duct). In this case the Linesize0 is 11.938 inches. Use the A_{round} equation to calculate the Area of a round pipe. In this case, the A_{round} is 0.777 ft².
3. Reference the Conversion table in Appendix C and get the Conversion Factor for NCMM; in this case it is 1.699.
4. Use Equation #2 from Appendix C to compute the new Minflow, Maxflow, and FS in NCMM.
 - A. $Q_{Minflow} = (1.292) (0.777) (1.699) = 1.706$ NCMM
 - B. $Q_{maxflow} = (23.150) (0.777) (1.699) = 30.561$ NCMM
 - C. $Q_{FullScale} = (19.27) (0.777) (1.699) = 25.439$ NCMM
5. Enter the new values into the Transducer Block—FCI Extension of the DTM software.
 - A. $Q_{Minflow}$ is entered into the Lower Sensor Limit window.
 - B. $Q_{maxflow}$ is entered into the Upper Sensor Limit window.
 - C. $Q_{FullScale}$ is entered into the Input Range window.

Configure Analog Input Process Data

The ST98 DTM Provides access to the configuration of the Cyclic Process data of the ST98 Profibus Profile 3 Instrument.

The ST98 Profibus Profile 3 can present both Flow process data and Totalizer Process Data. The presentation of the Process data is organized using the AI Flow Function Block, and the AI Totalizer Function Block.

SETTING UP THE FLOW ANALOG INPUT

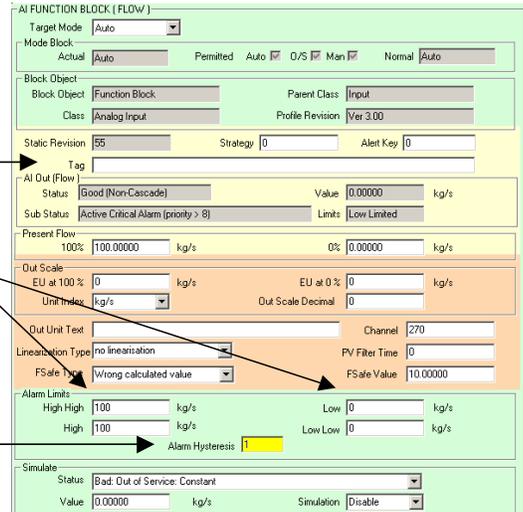
This Function Block gives access to some scaling and alarm settings of the Process flow.

It is recommended that the scaling not be changed for both 100% and 0%. Keep EU at 100% to a value of 100.00 and 0% at a value of 0.00.

A tag can be enter in this section of the block.

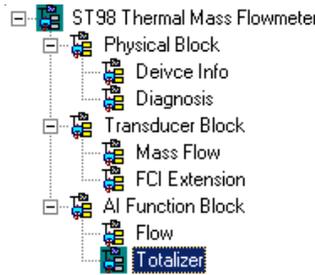
Flow Alarms can be changed by entering a new value and pressing the enter key.

The Alarm Hysteresis.



SETTING UP THE TOTALIZER ANALOG INPUT

This Function Block gives access to a number of Totalizer setup functions and alarm settings of the Process flow Totalizer for the ST98 with Profibus.



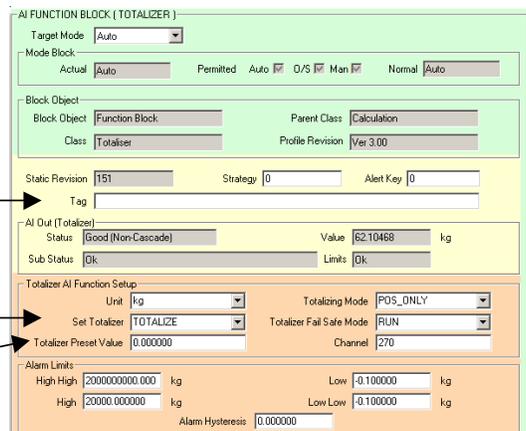
In the Menu Tree select **AI Function Block** —> **Totalizer**

The Totalizer Functions include the ability to “Stop” or “Start” the Totalizer, the ability to “Reset” and “Pre-set” the Totalizer, and to set the condition the Totalizer goes to when a fault of an alarm condition is encounter. The Totalizer Alarms can be set in this function block.

A tag can be enter in this section of the block.

Totalizer Set up: “TOTALIZE”, “PRE_SET” or “RESET”

Enter Totalizer Preset Value



TOTALIZE: Starts the TOTALIZER function, The PRESET assigns the TOTALIZER PRESET value to the TOTALIZER; while the RESET assigns a value of 0 to the TOTALIZER, and stops the TOTALIZER.

Totalizer Units are not settable by the user; the units are derived from the Flow Units. For example if the Flow units are Kg/s then the Totalizer units will be Kg.

The ST98 Flowmeter operates in a “POS_ONLY” totalizing mode.

Reading the Process Information

The DTM allows continuous reading of the Process Flow and the Totalizer data of ST98 Profibus Flowmeter. Flow data can be viewed in the in the Transducer Block and in the Flow AI Function Block, and Totalizer Process data can be viewed in the Totalizer AI Function Block.

GETTING THE PROCESS DATA

Start the PACTware Frame application, login and proceed to the main PACTware screen.

Transducer Block (Flow)

Flow Data can be found in the Transducer Block; located in the Mass Flow Group under the heading of “Value”.

Mass Flow			
Status	Good (Non-Cascade)	Value	0.36270 kg/s
Sub Status	Ok	Limits	Ok
High Limit	5000.000000 kg/s	Low Limit	0.010000 kg/s
Unit	kg/s		

AI Flow Function Block (Flow)

Flow data can also be found in the AI Flow Function Block; located in the AI Out (Flow) Group, in the field called Value.

AI Out (Flow)			
Status	Uncertain	Value	0.00000 kg/h
Sub Status	Substitute-Set	Limits	Ok

AI Totalizer Function Block

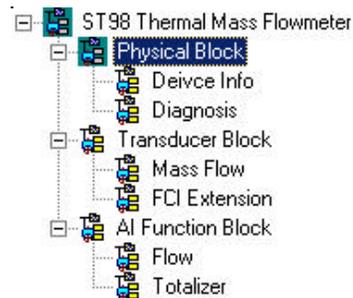
Process Totalizer information can be found in the AI Totalizer Function Block; locate in the AI Out (Totalizer) group under the heading of Value.

AI Out (Totalizer)			
Status	Good (Non-Cascade)	Value	62.10468 kg
Sub Status	Ok	Limits	Ok

Reading the Instrument ID Information

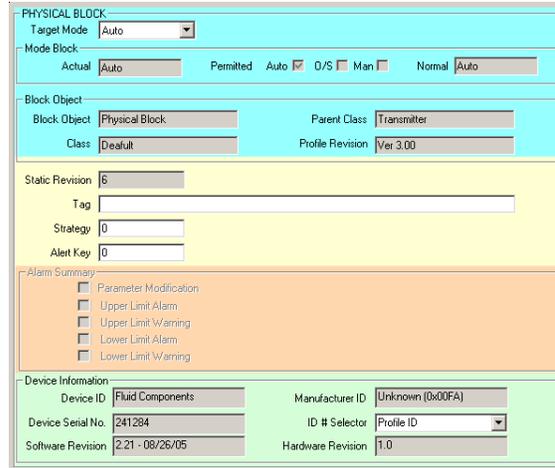
The ST98 DTM provides access to the ST98 Profibus device information, such as Software Version, Serial Number, Hardware Version, etc. The ST98 device ID is located in the Physical Block under device information.

In the tree menu, under Physical Block, select “Device Info”.



The Device Tab in the Physical Block also provides the ability to tag the instrument so that it can be easily identified in network. It also allows the user to change the “ID # Selector”. The use of the ID # Selector is dictated by the Profibus standard EN50170. The ST98 Profibus DP instrument has a Profile ident_number and a Manufacturer Specific Number issued by the PNO.

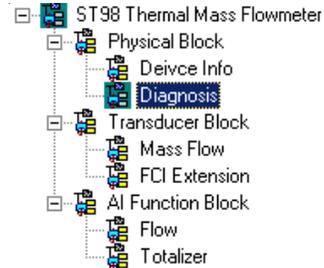
The ST98 Profibus DP has been assign the **08F3** as the Manufacturer specific number by the PNO. This number corresponds to the GSD File **FCIL08F3.GSD**.



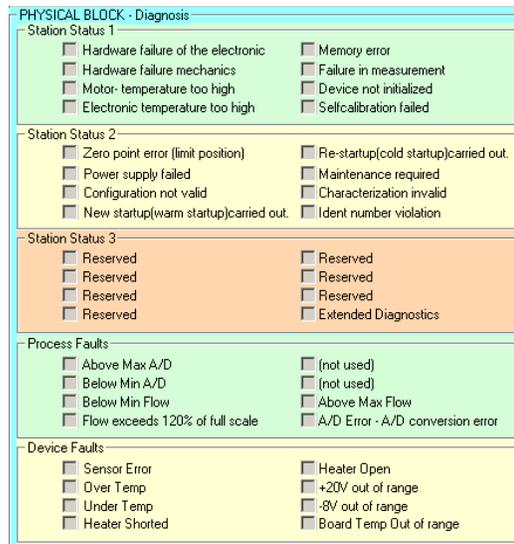
Accessing Diagnostic Data

The ST98 DTM gives access to both Profibus Diagnostic bytes and Manufacturer Specific Diagnostic data. The ST98 Manufacturer Specific Diagnostics is broken into 2 categories; Process related faults and Device faults. This information will help the service technician identifying the cause of a failure.

In the tree menu, under Physical Block, select “Diagnosis”.



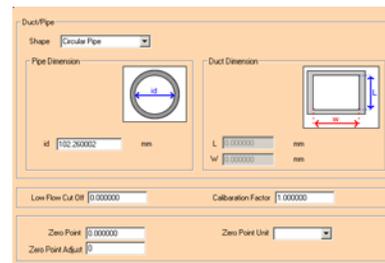
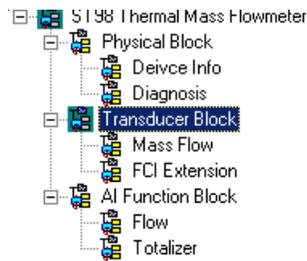
The First 3 Diagnosis bytes are mandated by the Profibus standard, and contain Profibus/Instrument Fault Information.



Quick Users Guide

Start the Frame application and establish a connection with the ST98 Slave.

SELECTING THE PIPE SIZE

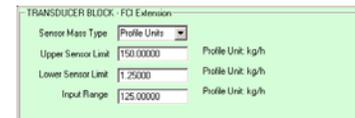
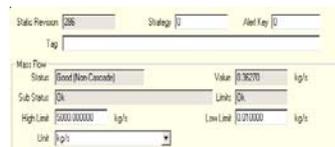
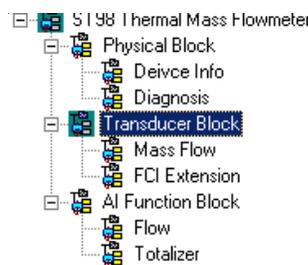


1. Select Transducer Block
-> Mass Flow

2. Select "Shape" Circular or Rectangular. Press "Enter"

3. Enter Dimensions (mm or inches). Press "Enter"

CHANGING FLOW UNITS (PROFILE 3)



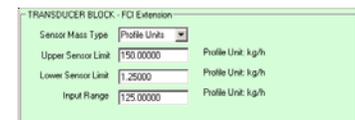
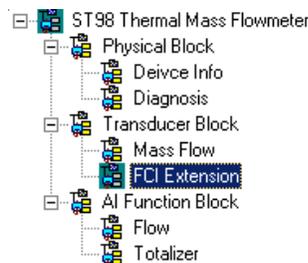
1. Select Transducer Block
-> Mass Flow

2. Select Flow Units from pull down menu in "Units" field.

3. Adjust "Upper Sensor Limit" to correspond with new units.
4. Adjust "Lower Sensor Limit" to correspond with new units.
5. Adjust Input Range with units.



CHANGING FLOW UNITS (FCI EXTENSION)



1. Select Transducer Block
-> FCI Extension

2. Select Flow Units from pull down menu in "Sensor Mass Type" field.

3. Adjust "Upper Sensor Limit" to correspond with new units.
4. Adjust "Lower Sensor Limit" to correspond with new units.
5. Adjust Input Range with units.



Profibus Profile 3 Parameters

The following is a summary list of the ST98 Profibus DP Parameters. The configuration and setup parameters of the ST98 are organized in the PROFIBUS PROFILE 3 for Mass Flowmeters, Class B Format; with some Manufacturer specific parameters added beyond the Profile.

Profile 3 divides the parameters into 3 types of block structures, called Physical Block, AI Block and Transducer Block. The ST98 has 1 Physical Block, 2 AI Blocks, and 1 Transducer Block. Below are the definitions of the parameters in these blocks.

PHYSICAL BLOCK PARAMETERS

Device ID:	This field identifies the device as a “Fluid Components” device
Device Serial No.:	This is the serial number assigned by the FCI factory to the instrument.
Device Manufacturer ID:	FCI does not use this field.
Indent Number Selector:	This is the Profile Identification Number. There are 2 types; one is mandatory and it contains full compliance to the instrument to the protocol mandatory parameters. The second one is the <ul style="list-style-type: none"> 0 – Profile identification number (mandatory) for Mass Flow Meter the number is 0x9740 (Hex) 2 – Profile identification number issued to the ST98 flowmeter by the PNO (Profibus International Organization)
Software Revision:	This is the ST98 Profibus software revision
Hardware Revision:	This represents the ST98 Profibus hardware Revision.
Diagnosis:	Basic Profibus Profile diagnostic information. When the MSB of the 4 th byte is set it indicates that more diagnostic information is available in the “DIAGNOSIS_EXTENSION” parameter. This contains the ST98 Process and instrument specific alarms.
Diagnosis_Extension:	This parameter contains the ST98 Process and Instrument alarms. There is a total of 14 alarms; 7 Process related and 7 Instrument related. <p>Process alarms:</p> <ul style="list-style-type: none"> Above Max Flow Flow Exceeds 120% of Full Scale Below Min Flow Above Max A/D Below Min A/D <p>Over Temp</p> <p>Under Temp</p> <p>ST98 Instrument Alarms:</p> <ul style="list-style-type: none"> Board Temp out of range A/D Error – A/D conversion error Sensor Error Heater Shorted Heater Open +20V out of range - 8V out of range

FLOW ANALOG INPUT BLOCK

Out (Flow):	Current value of Process Flow. Same as DPV0 Process flow.
PV Scale:	Conversion of Process Variable (Flow) into percent using the high and low scale values.
Out Scale:	Scale of Process Data.
Lin Type :	Type of linearization. The ST98 linearization type is “0” No Linearization.
Channel:	This refers to the active Transducer Block. The ST98 has only one block designated by the number 270.
PV Ftime:	Filter Time of the Process variable.
Alarm Hyst:	Hysteresis.
HI HI Lim:	Value of the upper limit of the Process Flow Alarm. User selectable.
HI Lim:	Value of the upper limit of warnings for the Process Flow.
Lo Lim:	Value of lower limit of warning for the Process Flow.
LO LO Lim:	Value of the lower limit of Process Flow alarms.

TOTALIZER ANALOG INPUT BLOCK

Total:	The Integrated quantity of the Flow rate (Totalizer Value).
Unit Tot:	The Totalizer Units.
Channel:	This refers to the active Transducer Block. The ST98 has only one block designated by the number 270.
Set Tot:	This parameter controls the state of the Totalizer operation mode. The possible modes are as follows: 0: TOTALIZE - Normal operation of the Totalizer 1: RESET - Sets the Totalizer value to “0” 2: PRESET - Sets the value of the Totalizer to the value of the PRESET_TOT parameter.
Mode Tot:	This parameter controls the behavior of totalization. The Profile allows for 4 possible selections: 0: BALANCED - true arithmetic integration 1: POS_ONLY - totalization of positive incoming rate values only. 2: NEG_ONLY - totalization of negative incoming rate values only. 3: HOLD - totalization stopped. The ST98 is a “POS_ONLY” instrument (Positive Totalization Instrument).
Fail Tot:	When a bad status condition exists, this parameter governs the behavior of the function block; there are 3 possible states (or behaviors) the instrument can be set to: 0: RUN - Continue to run, and ignore the status. 2: HOLD - Totalization is stopped during the bad status. 3: MEMORY - Totalization continues to output the last value with good status.
Preset Tot:	Contains the value to be use for presetting the totalizer by the use of the “SET_TOT” function.
Alarm Hyst:	Hysteresis.
HI HI Lim:	Value of the upper limit of the Process Totalizer Alarm.
HI Lim:	Value of the upper limit of warnings for the process Totalizer.
Lo Lim:	Value of lower limit of warning for the Process Totalizer.
LO LO Lim:	Value of the lower limit of Process Totalizer alarms.

TRANSDUCER BLOCK

Mass Flow:	Measured Mass Flow value of the ST98. This is the PV (Primary Variable).
Mass Flow Units:	This parameter contains the Flow units used by the Mass Flow Value for the Profile defined units.
Nominal Size:	This parameter contains the value of the ideal pipe size where the ST98 is being used. The DTM provides the ability to enter Rectangular duct dimensions.
Nominal Size Units:	This parameter contains the pipe size units. These are mm for metric flow units and Inches for Imperial or English flow units. These are not set by the user and are control by the flow units selected.
Calibr factor:	The Calibration Factor is a gain compensation value for the sensor. In the ST98 it is set to 1.
Low Flow Cutoff:	This parameter defines the low switching point for flow of the sensor. For the ST98 this value is typically set to 0.0.
Zero Point :	Offset compensation value for the Flow sensor. This value is typically set to “0” for the ST98 Flowmeter.
Zero Point Adjust:	This function is not used by the ST98. and is set to “0”.
Zero Point Unit:	This parameter is the selected unit code for the Zero Point parameter. This is not used by the ST98, and these units follow the flow units.
Mass Flow Lo Limit:	Absolute value of the lower range value of the sensor. In the ST98 this is typically set to just below the max flow calibrated value of the flowmeter.
Mass Flow Hi Limit:	Absolute value of the Upper range value of the sensor. In the ST98 this is typically set to above the max flow calibrated value of the flowmeter.
fci_units:	This parameter contains the FCI specific flow units codes.
fci_minflow:	This parameter contains the value of the minimum calibrated flow for the ST98 Flowmeter.
fci_maxflow:	This parameter contains the value of the maximum calibrated flow for the ST98 Flowmeter.
fci_fs:	This parameter contains the value of the user selectable range of operation of the ST98 Flow meter. This is typically set to 20% below the Maxflow value.

Recalculation of Flow Units

The following instructions explain how to recalculate and convert the Min Flow, MaxFlow, and FS to the new units of the ST98 Profibus when the Flow units are changed.

MaxFlow and Min Flow represent the factory-calibrated range, while FS represents the Customer select MaxFlow condition. The FS value must be within the Factory calibrated range. MaxFlow, MinFlow, and FS need to be in the customer selected flow units.

All FCI flowmeters use SFPS for the internal calculations. Standard Velocity units (SFPS) assume the standard conditions at calibration. FCI’s standard conditions are stated as 14.7 PSIA at 70 degrees F.

All necessary parameters to convert Standard Velocity to various other flow units are listed on the “Delta R Sheet.”

The key parameters for these conversions are: Minflow (the customer’s minimum flow rate in SFPS), Maxflow (the customer’s maximum flow rate in SFPS), F.S. (the customer’s 100% flow rate in SFPS), Standard Density (the density of the gas at calibration—always listed in pounds mass per cubic foot—LBM/FT³), Linesize0 (the pipe i.d. for round pipes or the width for square ducts) and Linesize1 (the length for square ducts only).

DEFINITIONS AND VARIABLES

A_{round} = The Area of a round pipe can be calculated by using the equation:

$$A_{\text{round}} \text{ (ft}^2\text{)} = \left(\frac{[(\text{Linesize0}^2) \delta]}{4} \right) \div 144$$

A_{square} = The Area of a square duct can be calculated by using the equation:

$$A_{\text{square}} \text{ (ft}^2\text{)} = [(\text{Linesize0})(\text{Linesize1})] \div 144$$

V_{std} = Standard Velocity.

Q = Standard Volumetric flowrate.

M = Mass flowrate.

C = Conversion Factor.

ρ = (Rho) Standard Density in LBM/FT³

CONVERSION EQUATIONS

Equation# 1

For converting English Standard Velocity to Metric Standard Velocity flow rates (SFPS, SMPS):

$$V_{\text{std}} = (\text{Minflow}) \text{ (C)}$$

Equation #2

For converting Standard Velocity to Standard Volumetric flow rates (SCFS, SCFM, SCFH, NCMM, NCMH):

$$Q = (\text{Minflow}) \text{ (Area) (C)}$$

Equation #3

for converting Standard Velocity to Standard Mass flow rates (LB/S, LB/M, LB/H, KG/S, KG/M, KG/H):

$$M = (\text{Minflow}) (\rho_{\text{std}}) \text{ (Area) (C)}$$

CONVERSION EQUATIONS

Conversion Factor Table (C)		
Standard Velocity Units	Standard Volumetric Units	Mass Flow Units
SFPS = 1.000	NCMM = 1.699	KG/S = 0.4536
SMPS = 0.3048	NCMH = 101.94	KG/M = 27.216
	SCFS = 1.000	KG/H = 1632.9
	SCFM = 60.00	LB/S = 1.000
	SCFH = 3600	LB/M = 60.00
		LB/H = 3600

4. Maintenance



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

ALERT: The flow transmitter contains electrostatic discharge (ESD) sensitive devices. Use standard ESD precautions when handling the flow transmitter. See Chapter 3 Installation for ESD details.

Maintenance

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

Without detailed knowledge of the environmental parameters of the application surroundings and process media, FCI cannot make specific recommendations for 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 recalibrate if necessary. See Chapter 6 - Troubleshooting. FCI recommends every 18 months at a minimum.

Electrical Connections

Periodically inspect cable connections on terminal strips and terminal blocks. Verify that terminal connections are tight and physically sound 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 flow element wiring on a "common sense" basis related to the application environment. Periodically the conductors should be inspected for corrosion and the cable insulation checked for signs of deterioration.

Flow Element Connections

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

Insertion Type Flow Element Assembly

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

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5. Troubleshooting



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



ALERT: The electronics contains electrostatic discharge (ESD) sensitive devices. Use standard ESD precautions when handling the electronics. See Chapter 3, Installation for ESD details.

Quick Check

Verify the serial numbers of the flow element and electronics match.
 Verify all cables are seated firmly.
 Verify all customer connections are correct.
 Verify the wiring is per the wiring diagram in Chapter 2.
 Verify the installation is correct as shown in Chapter 2.
 Check customer fuses and power switches.

General Function Check

Tools Needed - General Function Check -
 Digital Multimeter (DMM)
 Allen Wrench 1/16 Inch (for aluminum, circular enclosure)
 Medium size flat blade Screwdriver (for steel, square enclosure)

Application Verification

After verifying that the flow meter is functioning, review the application parameters as shown below to verify the calibration matches the process media.

Equipment Needed

Flow Instrument Calibration Data
 Process Parameters and Limits

Check Serial Numbers

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

Check the Instrument Installation

Review information in Chapter 3 - Installation, to verify correct mechanical and electrical installation. Verify the flow element is mounted at least 20 diameters downstream and 10 diameters upstream from any bends or interference in the process pipe or duct.

Check for Moisture

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

**Application
Verification
Con't**

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 gas medium.

Verify Standard Versus Actual Process Conditions

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

Equation:

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

Where:

Q_A = Volumetric Flow Q_s = Standard Volumetric Flow
 P_A = Actual Pressure T_A = Actual Temperature
 P_s = Standard Pressure T_s = Standard Temperature
 PSIA and °R are used for pressure and temperature units.

(Metric: Where bar(a) and °K are used for pressure and temperature.)

Example:

Q_A = 1212.7 ACFM Q_s = 1485 SCFM
 P_A = 19.7 PSIA T_A = 120°F (580°R)
 P_s = 14.7 PSIA T_s = 70°F (530°R)

(Metric: P_s = 1.01325 bar(a)
 T_s = 21.1°C (294.1K))

$$\left(\frac{1212.7 \text{ ASFM}}{1} \right) \left(\frac{19.7 \text{ PSIA}}{580^\circ \text{ R}} \right) \left(\frac{530^\circ \text{ R}}{14.7 \text{ PSIA}} \right) = 1485 \text{ SFCM}$$

**Check the
Hardware**

Troubleshooting the Flow Element

Use Table 6 to determine if the flow element is wired correctly or has failed. Table 6 is for resistances at a process temperature of about 70°F (21.1°C). To determine the exact resistance at another process temperature use the temperature versus resistance table in Appendix A.

Turn off the input power to the instrument. Unplug TS2 from the circuit board assembly and measure the resistances as shown in Table 6.

See Figure12 for component placement and Figure 13 for a view of the plug. If the instrument is set up in a 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 6. Figure 14 shows the terminal block configuration. If the resistance is correct then the cable between the enclosures is probably bad or not connected properly (loose, corroded, or connected to the wrong terminal).

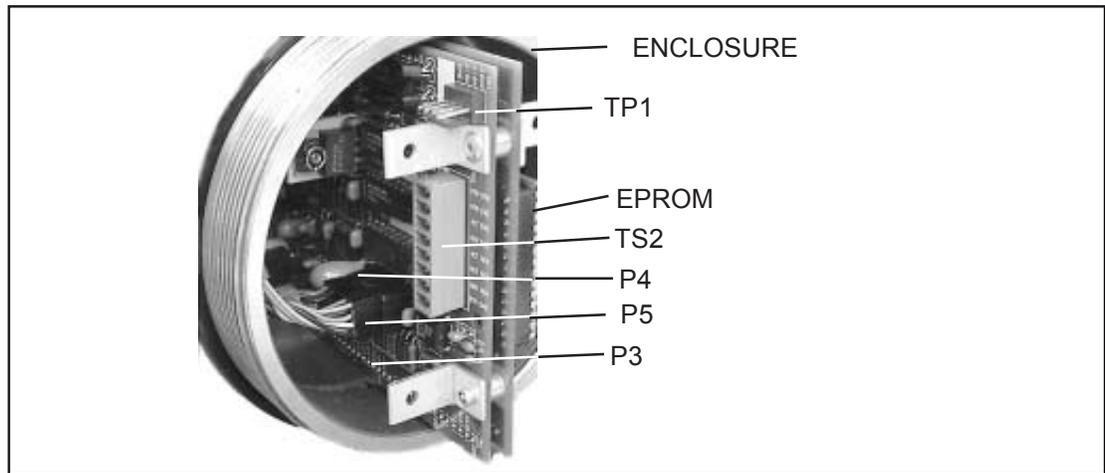


Figure 12. Component Identification

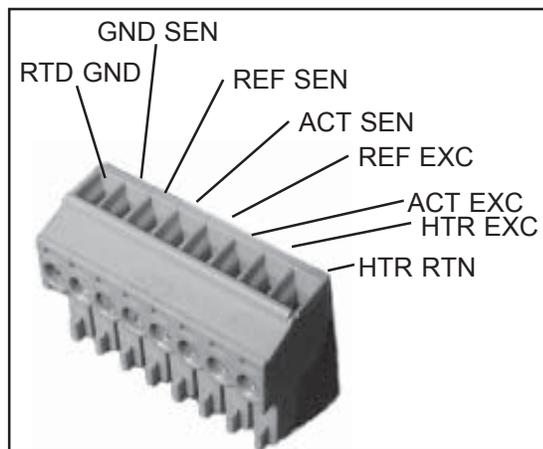


Figure 13. TS2 Connector Plug

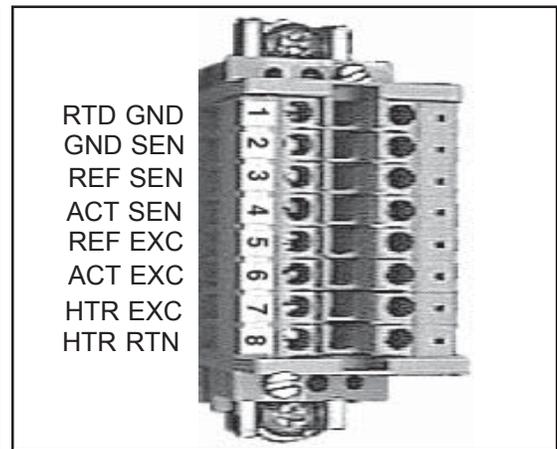


Figure 14. Terminal Block In Local Enclosure

Table 6. Flow Element Resistance at TS2 or Local Terminal Block

LUG OR PIN NUMBER	RESISTANCE
(7) HTR EXC TO (8) HTR RTN	110 - 118 OHMS
(4) ACT SEN TO (2) GND SEN	1.1K OHM
(3) REF SEN TO (2) GND SEN	1.1K OHM
(3) REF SEN TO (4) ACT SEN	2.2K OHMS
(1) RTD GND TO (2) GND SEN	0 OHMS
(4) ACT SEN TO (6) ACT EXC	0 OHMS
(3) REF SEN TO (5) REF EXC	0 OHMS
SHIELD TO HTR RTN (8) (FOR REMOTE INSTALLATIONS)	0 OHMS

The resistance of the Active and Reference sensor will depend on the temperature of the sensing element. Refer to the "Temperature Versus Resistance" Table in Appendix A.

When measuring the resistance of the flow element through a long remote cable, the cable resistance must be subtracted from the measurement. The residual resistance of the DVM and its leads should also be considered. See Table 7 to calculate the resistance for copper wire. Each wire gauge size number increase represents a factor of 1.26 resistance increase over the previous size. Moving three gauge sizes higher doubles the resistance. To convert the table values to ohms per meter, multiply the value by 0.0394.

Table 7. Resistance Versus Wire Size

AWG (mm) Size	Ohms Per 1000 Feet (304M)
14 (1.85)	2.52
16 (1.47)	4.02
18 (1.20)	6.39
20 (0.890)	10.1
22 (0.762)	16.2
24 (0.584)	25.7

Check the Flow Element Voltages

Use the following voltage measurements if power cannot be easily removed from the instrument or if resistance measurement fail to resolve the problem. Be sure the sensor heater current is set to 75 mA LO by pressing [O] on the FC88 and selecting the heater current. Be sure to set the heater current back to where it was before beginning this procedure. Make the voltage measurements found in Table 8 at terminal strip TS2 on the flow transmitter, or on the Local Terminal Block.

Table 8. Approximate Flow Element Voltages AT 70° F (21.1 °C)

LUG OR PIN NUMBER	CURRENT	VOLTAGE*
(7) HTR EXC TO (8) HTR RTN	75 mA	APPROXIMATELY 8.85 VDC
(7) HTR EXC TO (8) HTR RTN	90 mA	APPROXIMATELY 10.62 VDC
(4) ACT SEN TO (6) ACT EXC	N/A	APPROXIMATELY 0.00 VDC
(3) REF SEN TO (5) REF EXC	N/A	APPROXIMATELY 0.00 VDC
(5) REF EXC TO (1) RTD GND	N/A	APPROXIMATELY 2.20 VDC
(6) ACT EXC TO (1) RTD GND	N/A	APPROXIMATELY 2.21 - 2.82 VDC**
(4) ACT SEN TO (3) REF SEN	N/A	APPROXIMATELY 0.24 VDC**

Cable resistance of the remote flow element will affect the TS2 voltage readings at the electronics enclosure.

*Voltages varies with Temperature and Flow and the Sensor Heater Current Selection.

**Voltage will vary with the process flow rate.

Verification of the Electronics

Check the Flow Transmitter Voltages

Check the voltages in Table9 being sure the volt meter is in the volt mode.

Table 9. Instrument Voltages

PIN NUMBER	VOLTAGE
P3-1 TO P3-5	-2 TO +3 VDC
P3-1 TO P3-6	+5 ± 0.2 VDC
P3-1 TO P3-11	+2 ± 0.01 VDC
TP1 +15 TO TP1 GND	+15 ± 0.5 VDC
TP1 +20 TO TP1 GND	+20 ± 0.5 VDC
TP1 +10 TO TP1 GND	+10 ± 0.01 VDC

If the voltage checks correspond to Table 9, the electronics are functioning properly.

**Spare
Parts**

FCI recommends one of each of the following should be kept as a spare: One identically set up ST98 Flow meter. Contact FCI for specific recommendations.

**Defective
Parts**

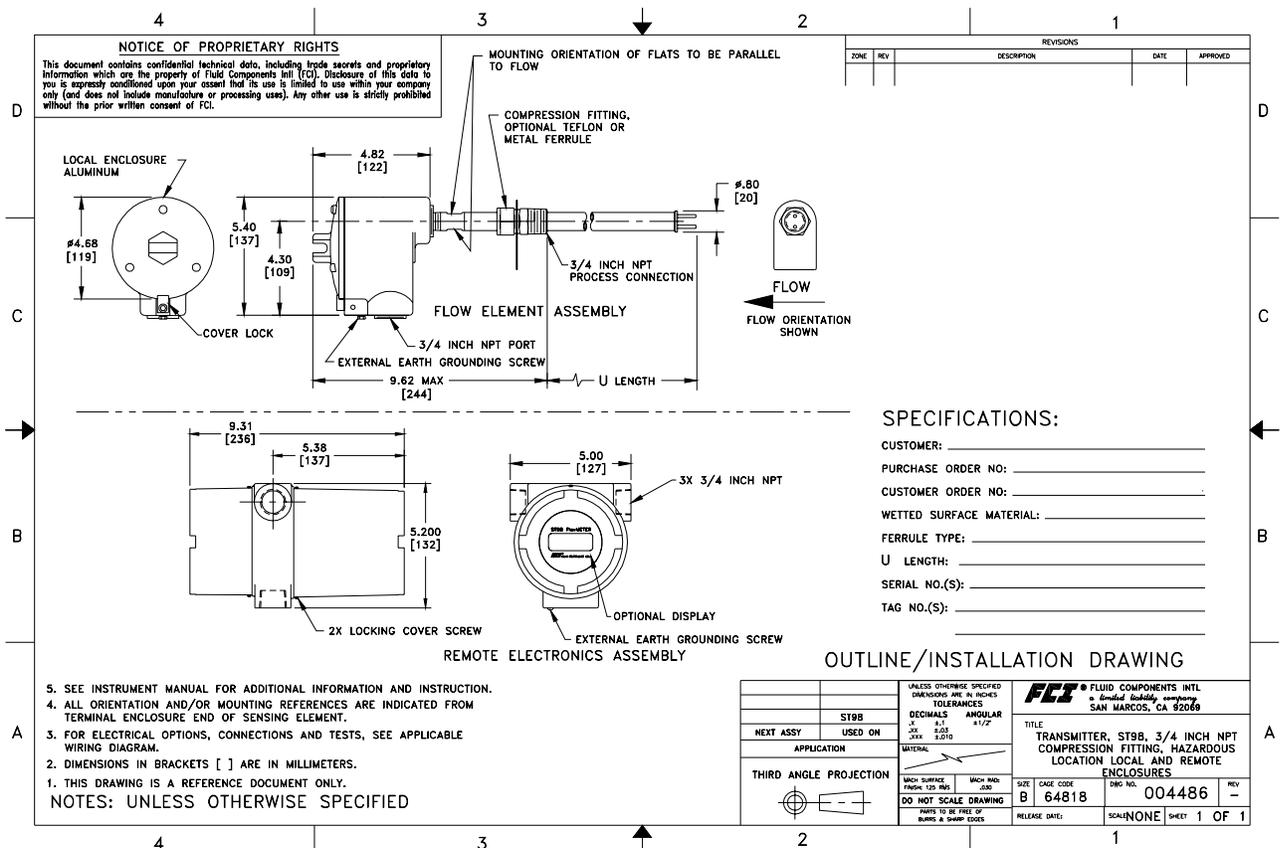
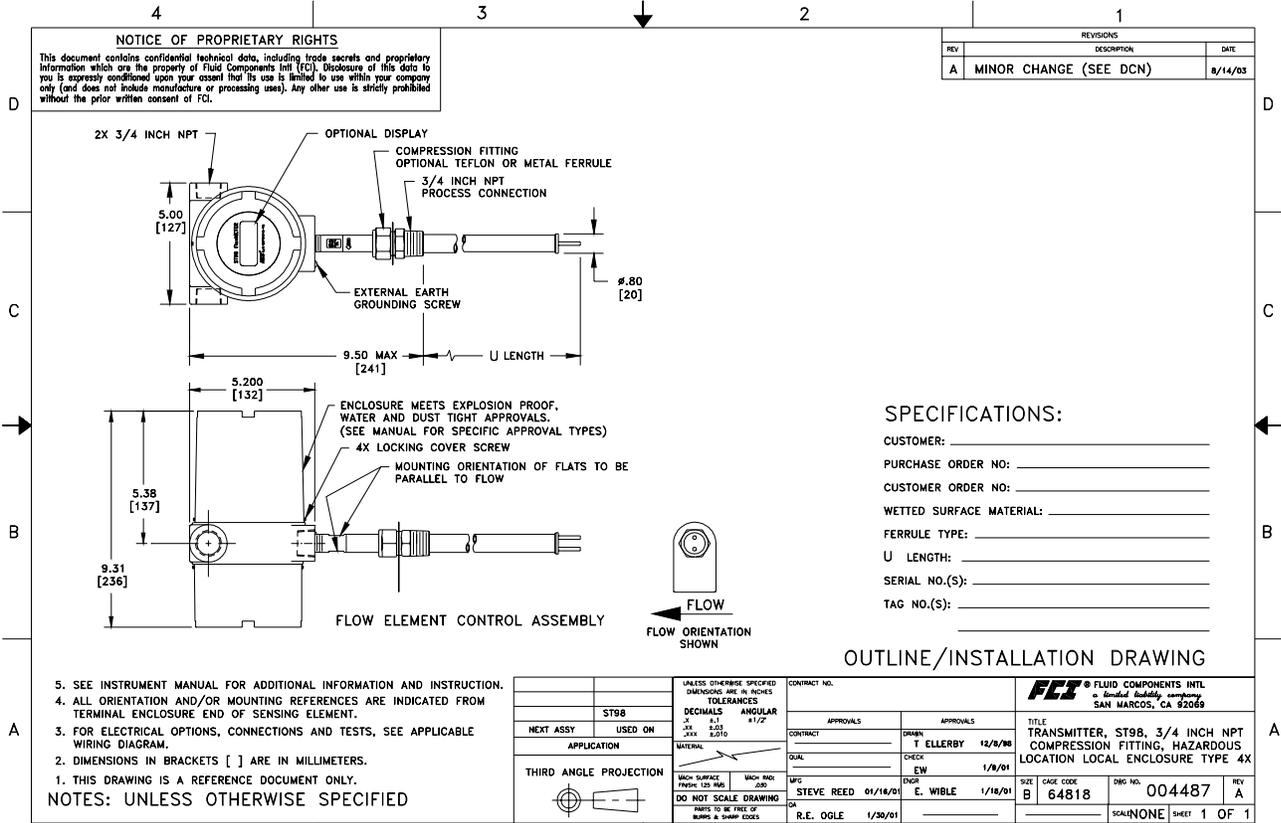
Before returning any equipment to FCI, please obtain an RA number for authorization, tracking, and repair/replacement instructions. If a return is required, remove defective instrument, replace with spare, calibrate, then return defective instrument to FCI freight prepaid for disposition.

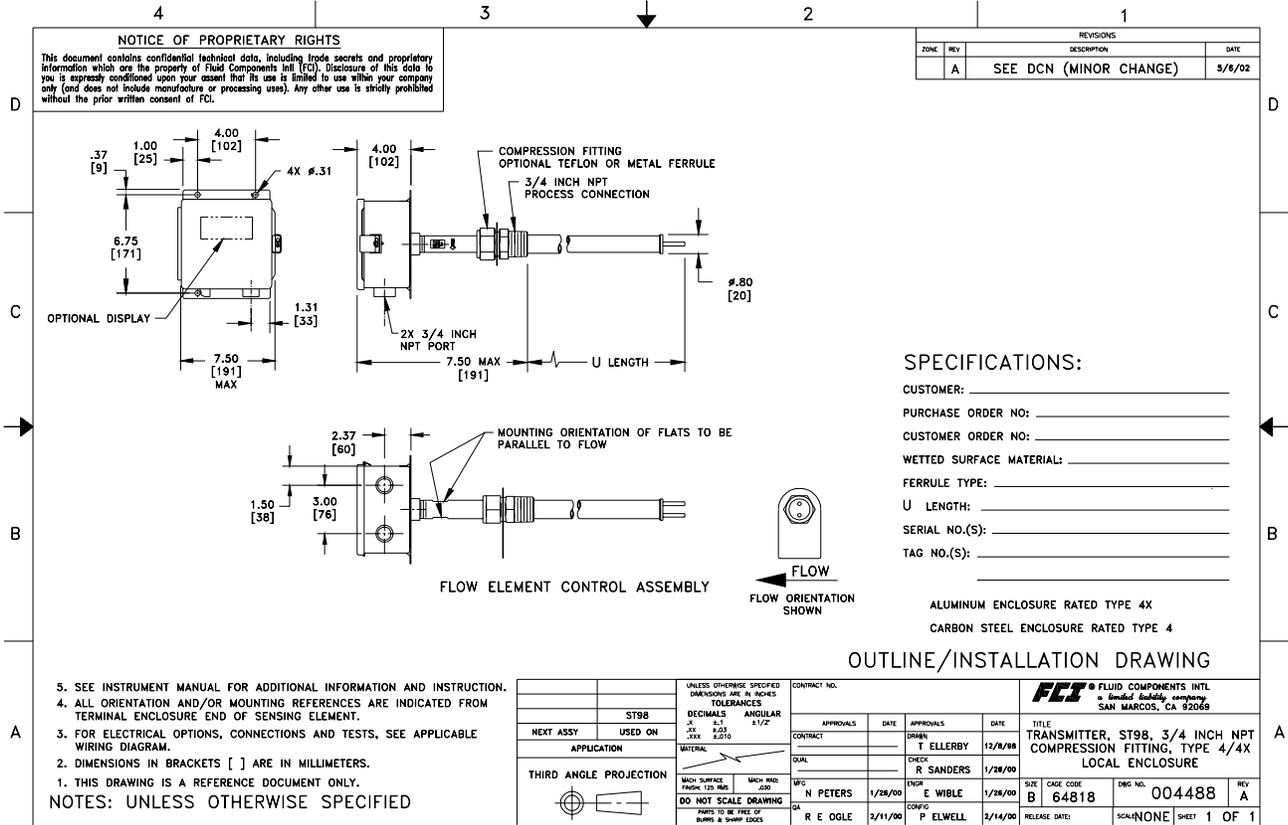
**Customer
Service**

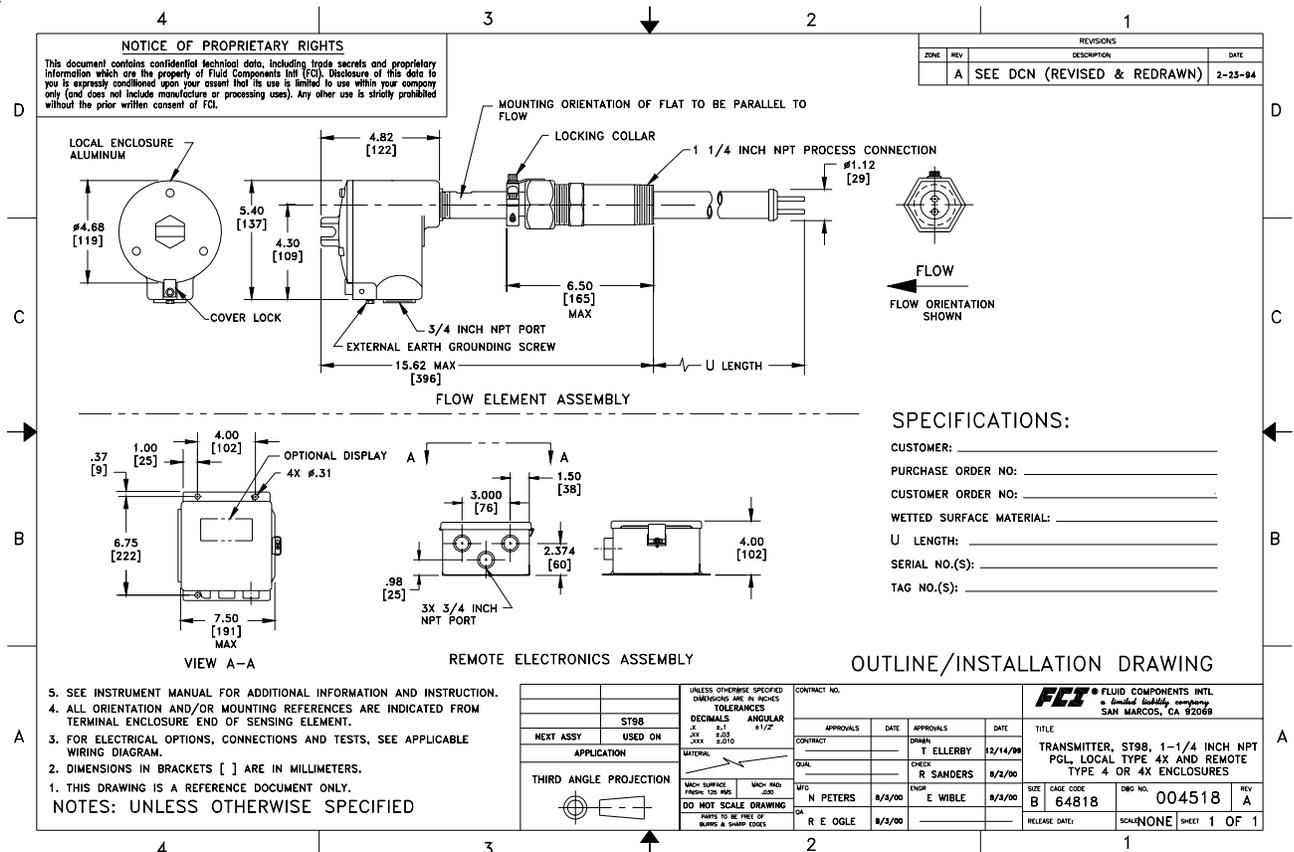
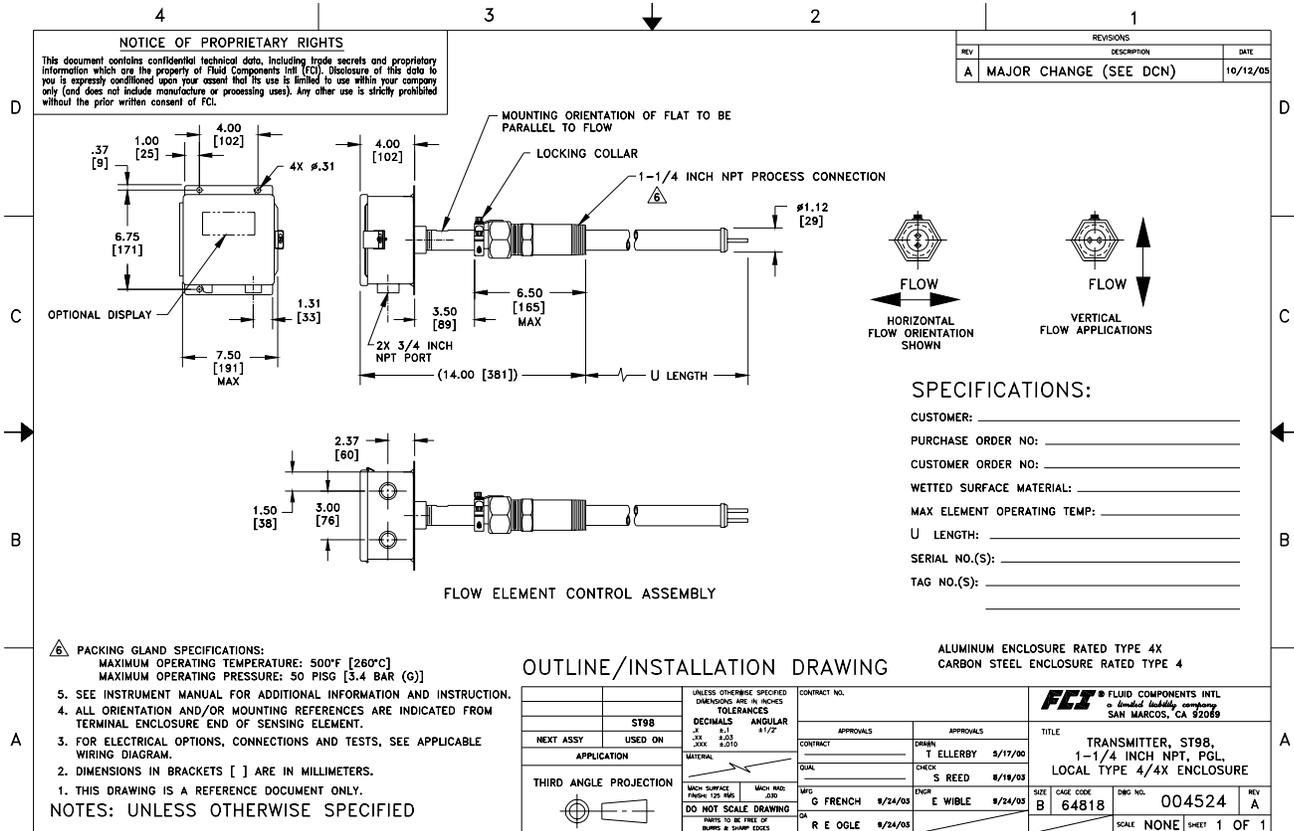
1. In the event of problems or inquiries regarding the flowmeter, please contact the regional or country authorized FCI Field Agent. There is an extensive list of these representatives at the front of this manual.
2. Before contacting the FCI representative, please be sure that all the applicable information is near so that a more effective, efficient and timely response may be provided.
3. Refer to Appendix D for specific Customer Service policy provisions.

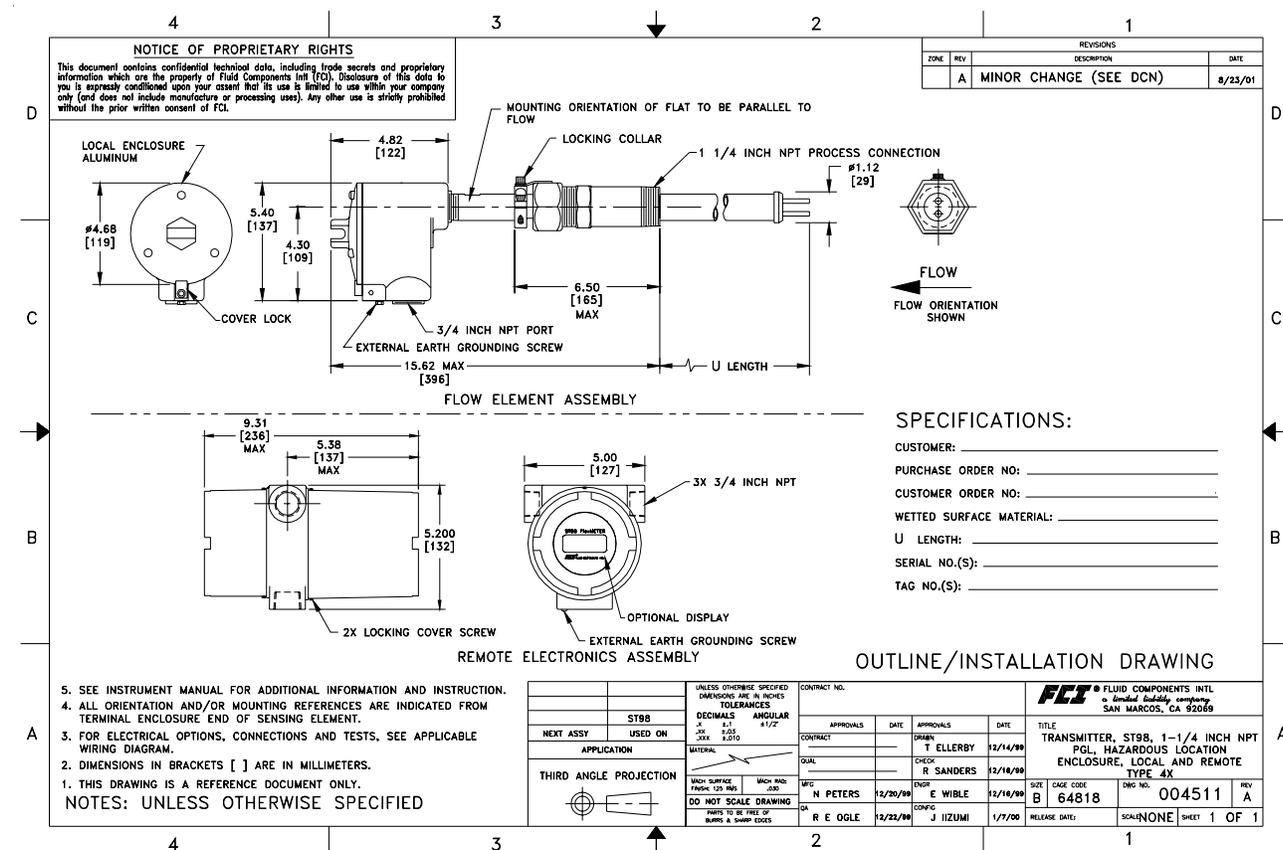
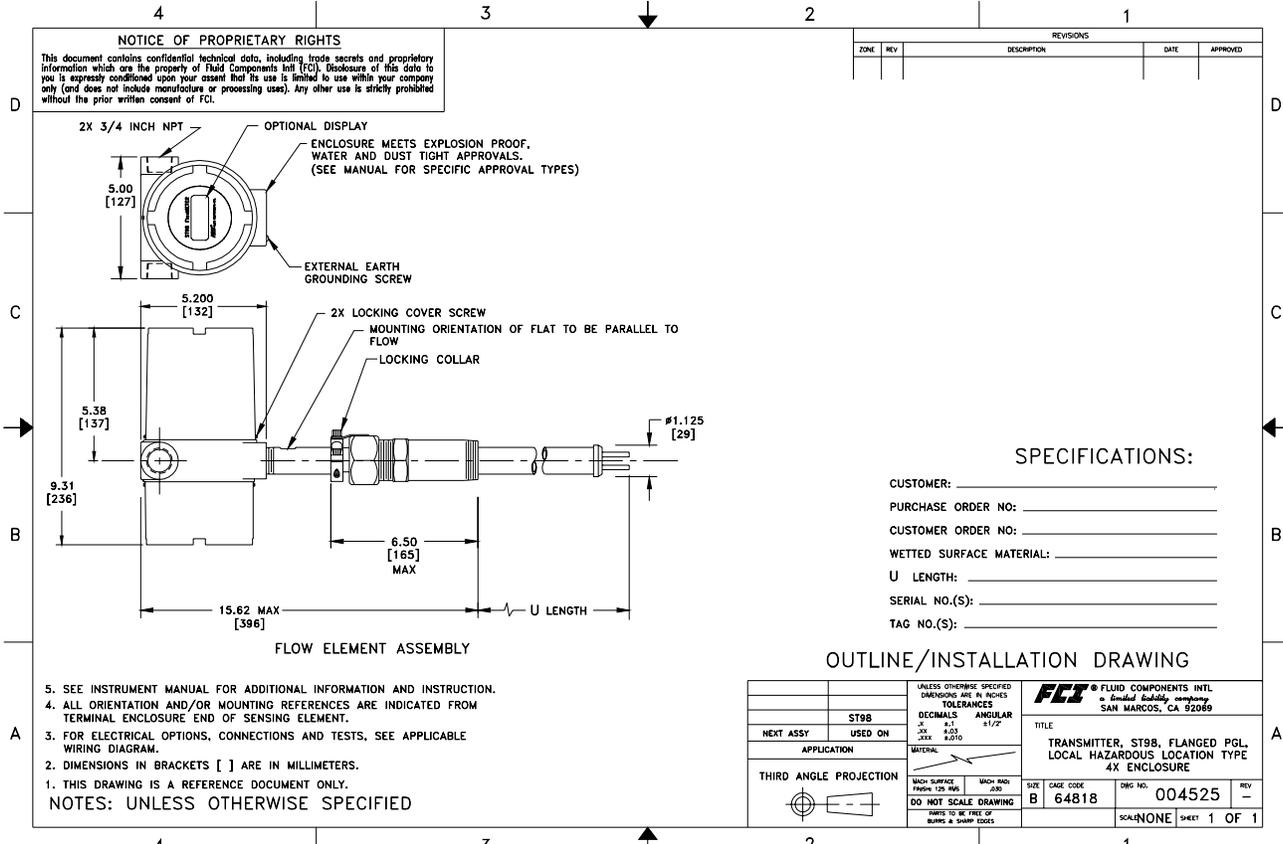
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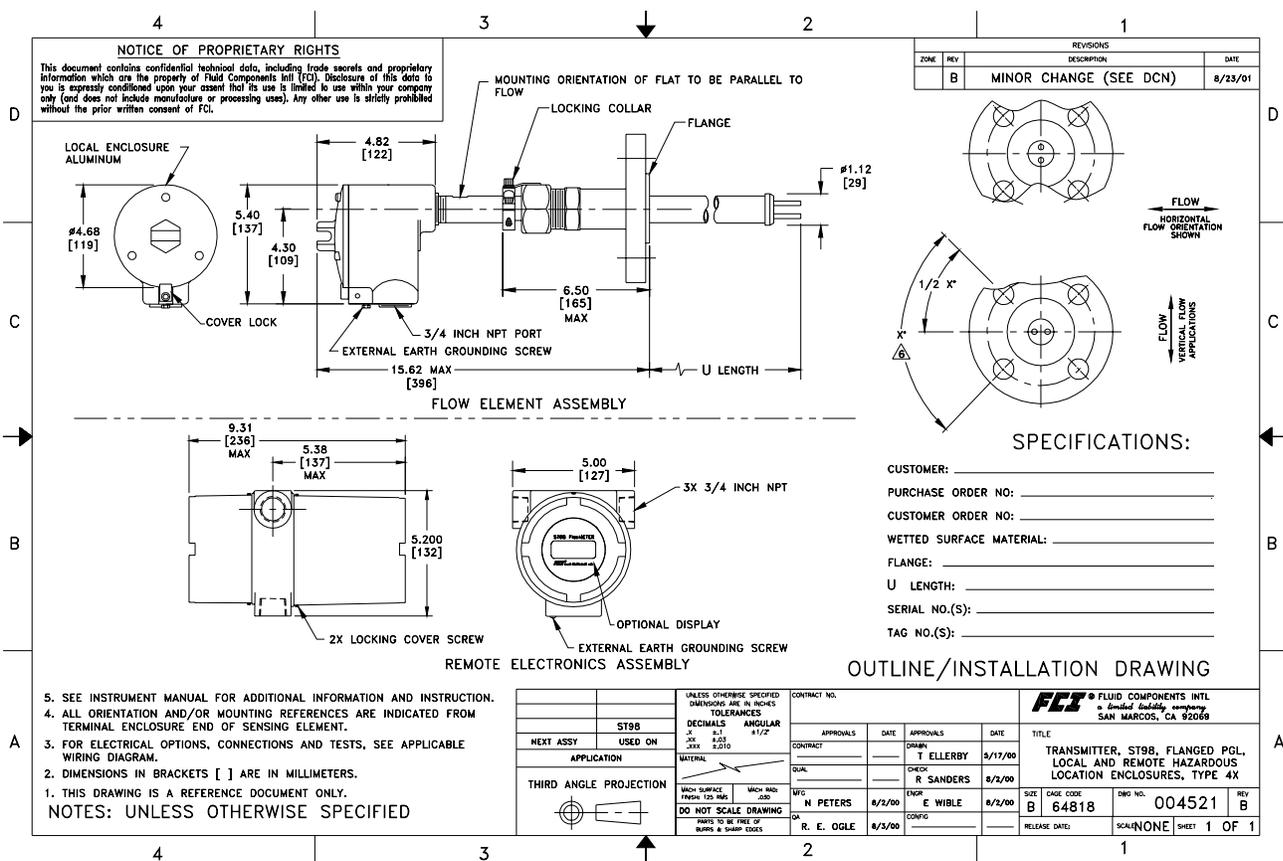
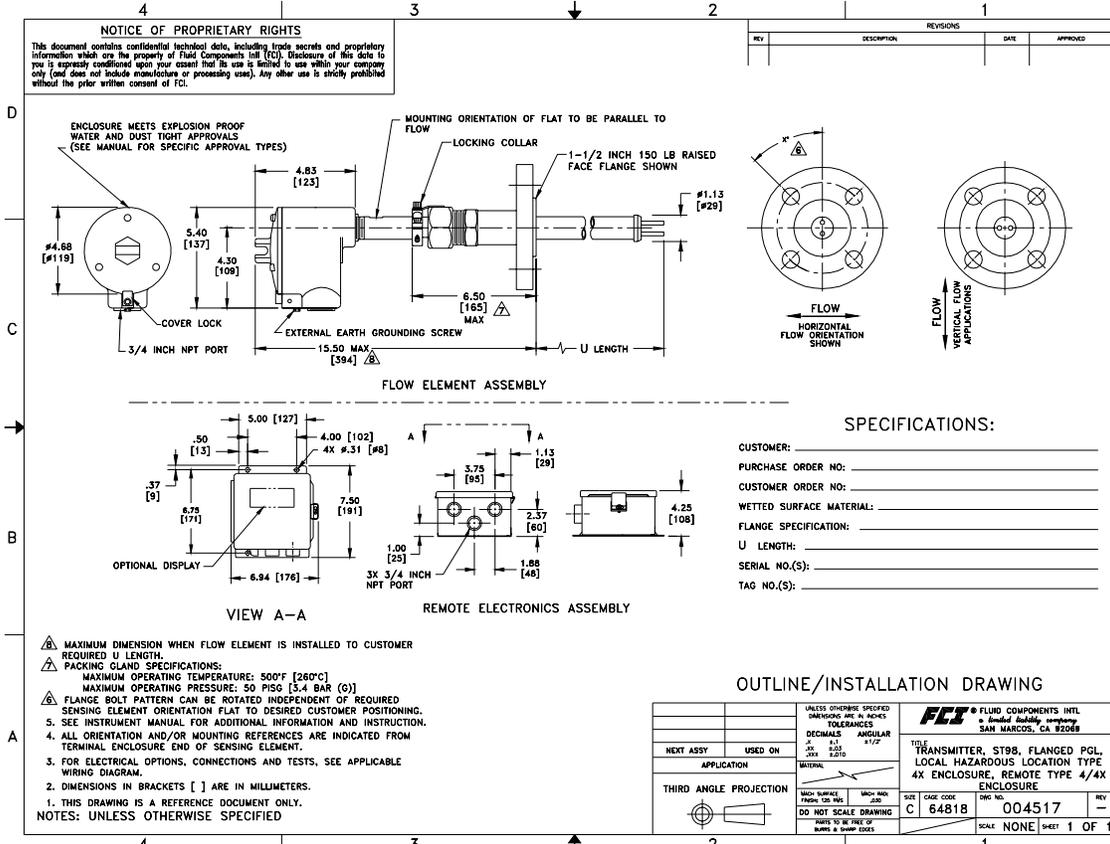
Appendix A. Drawings

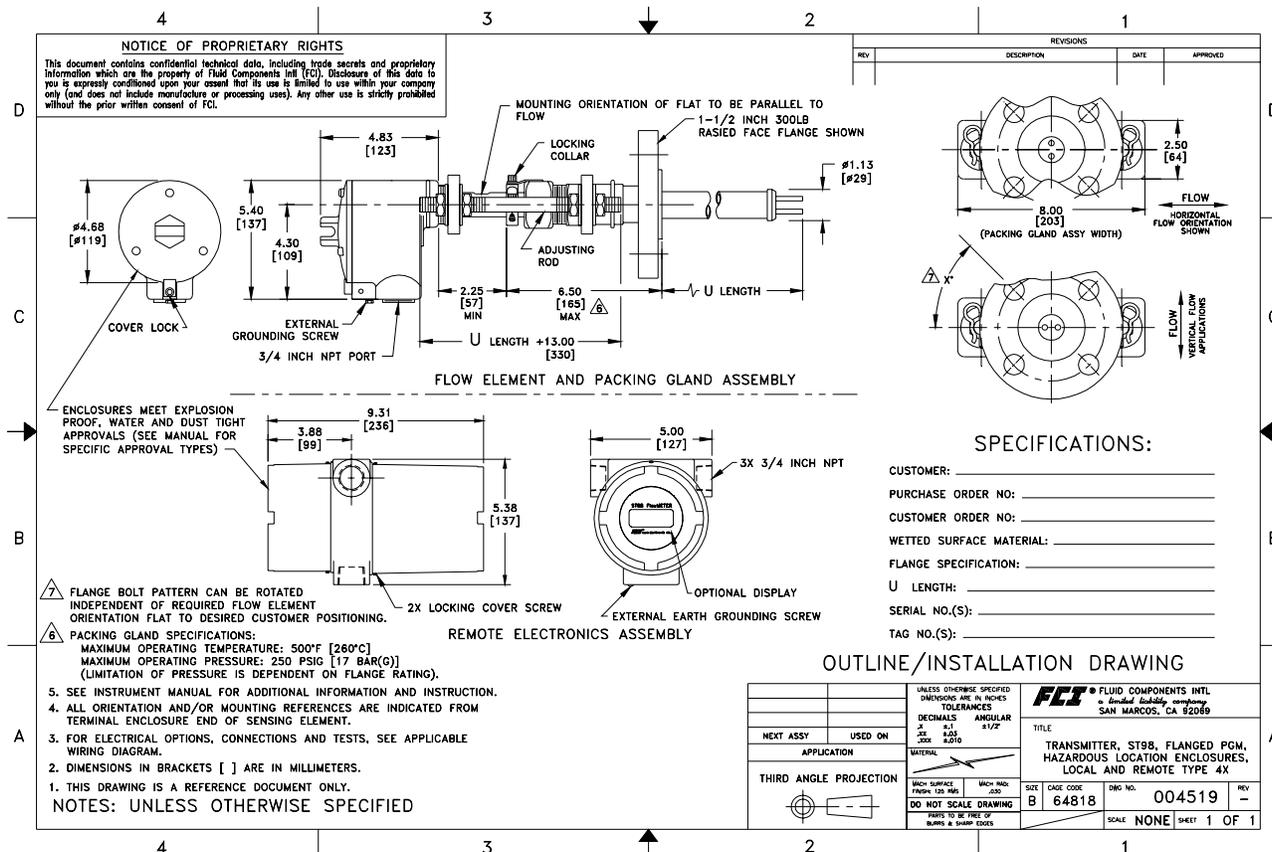
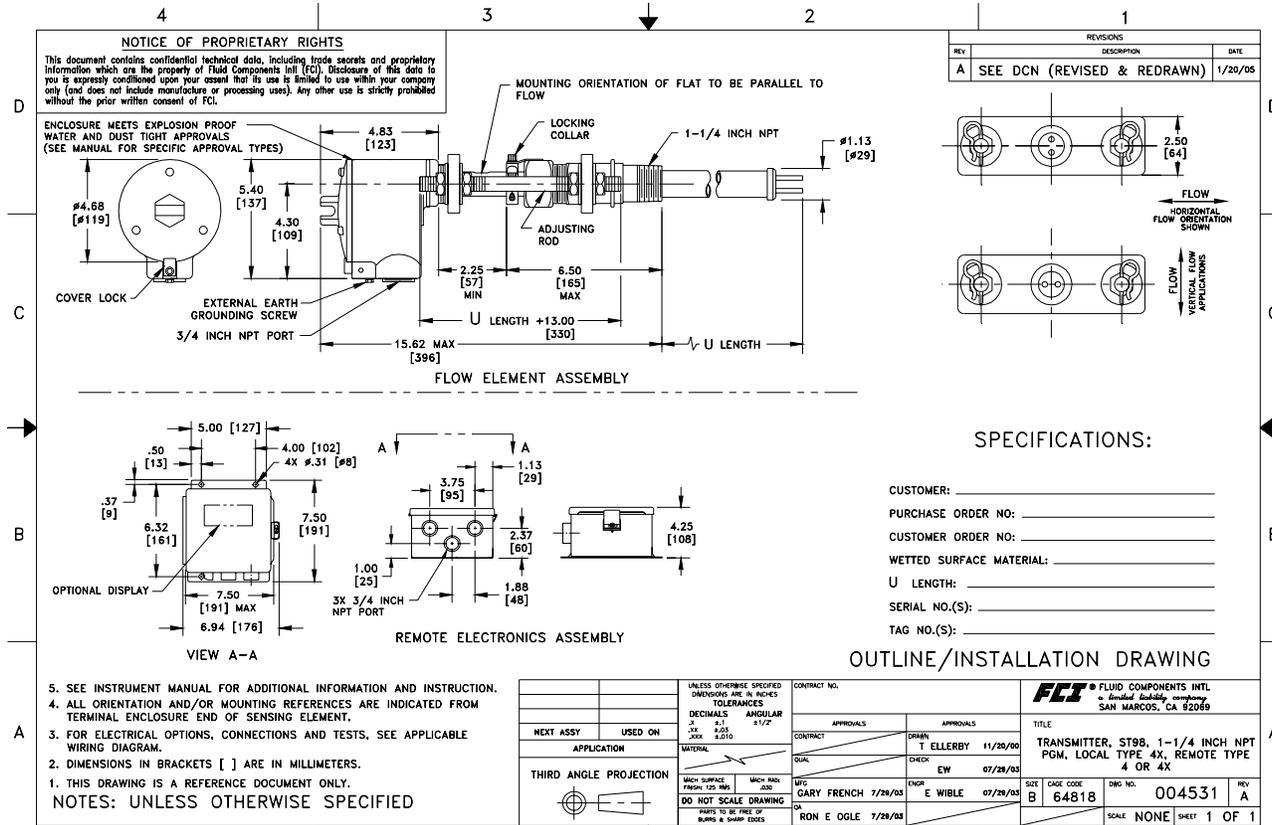


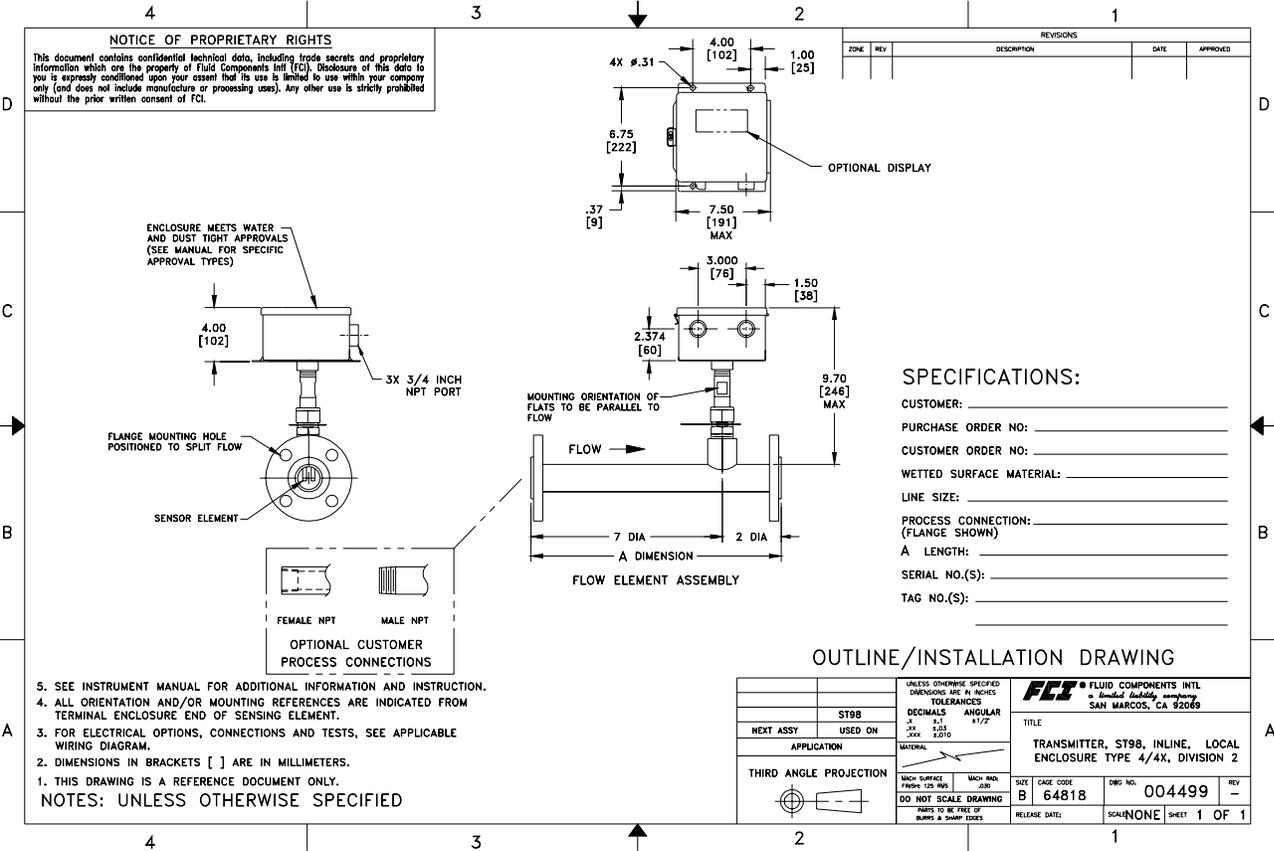
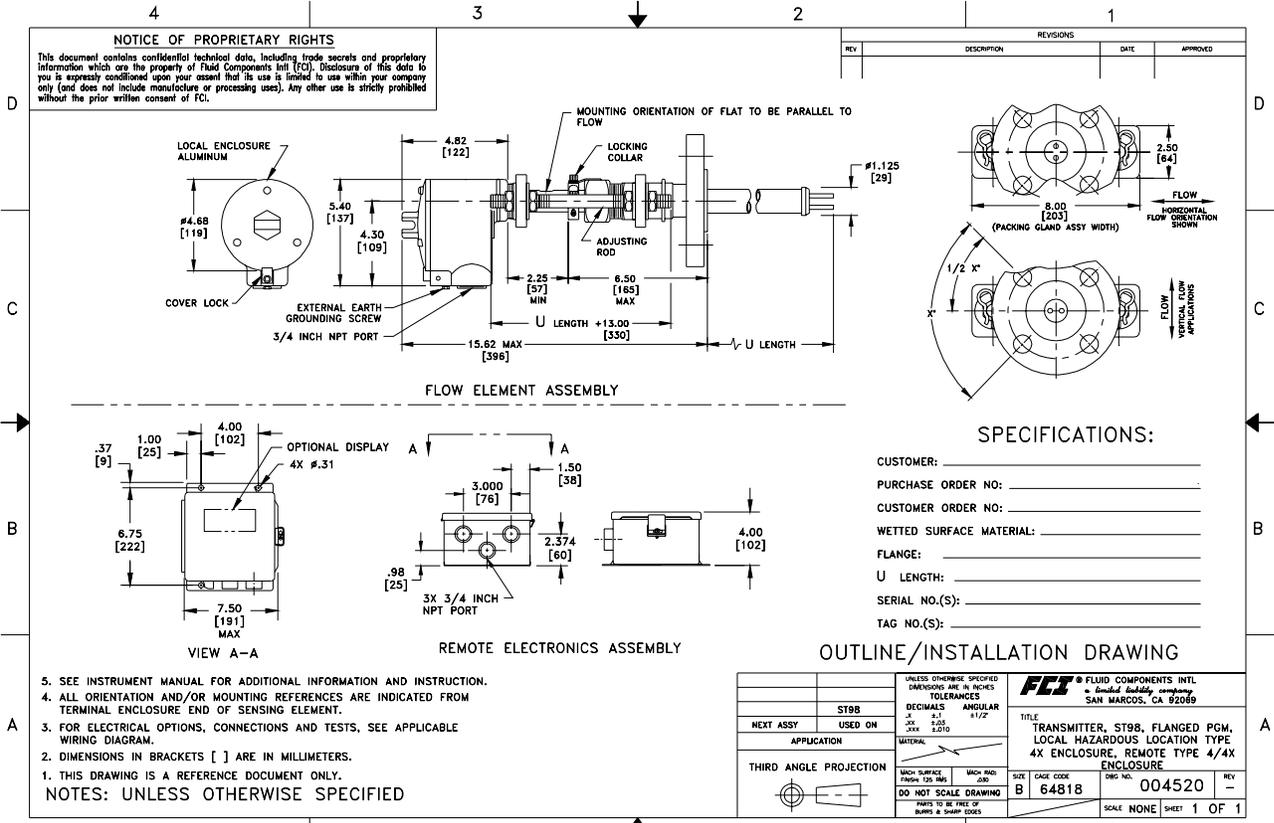


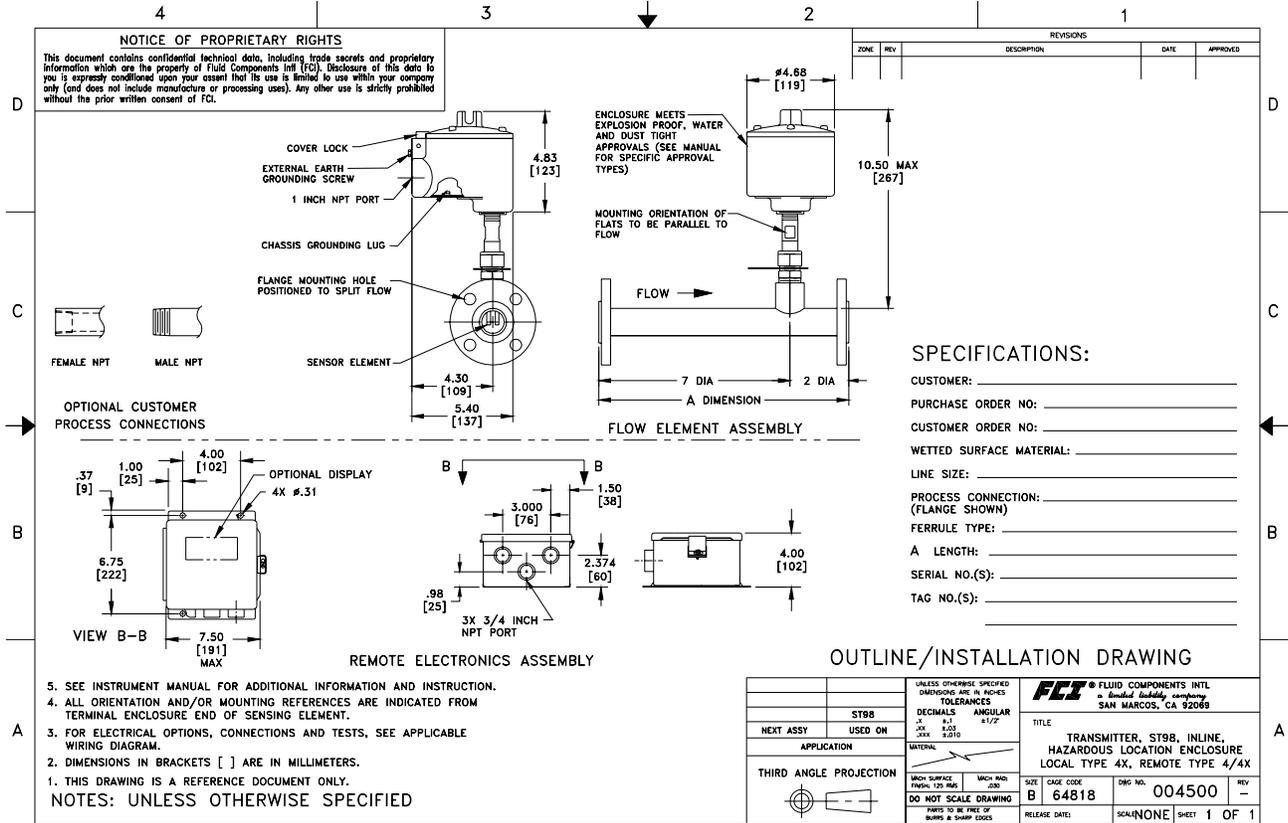


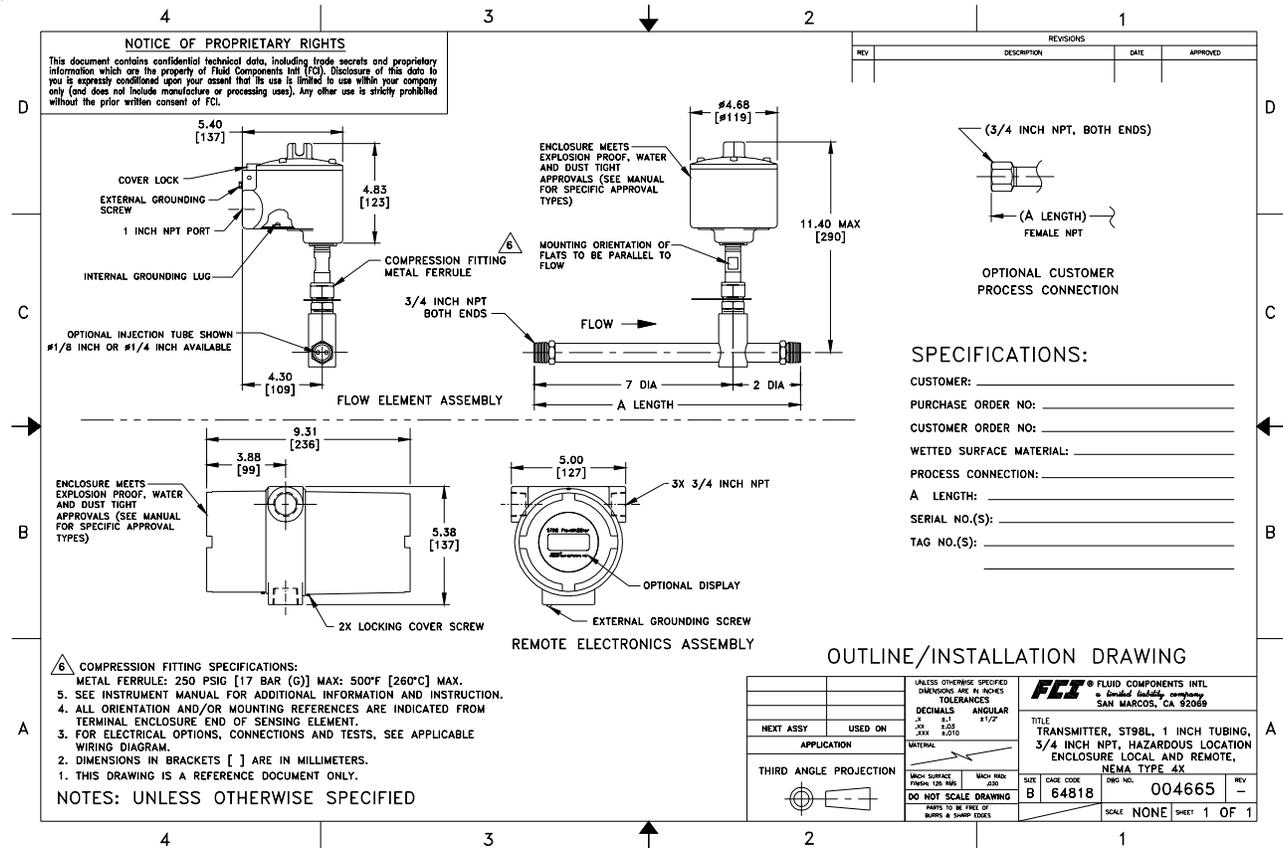
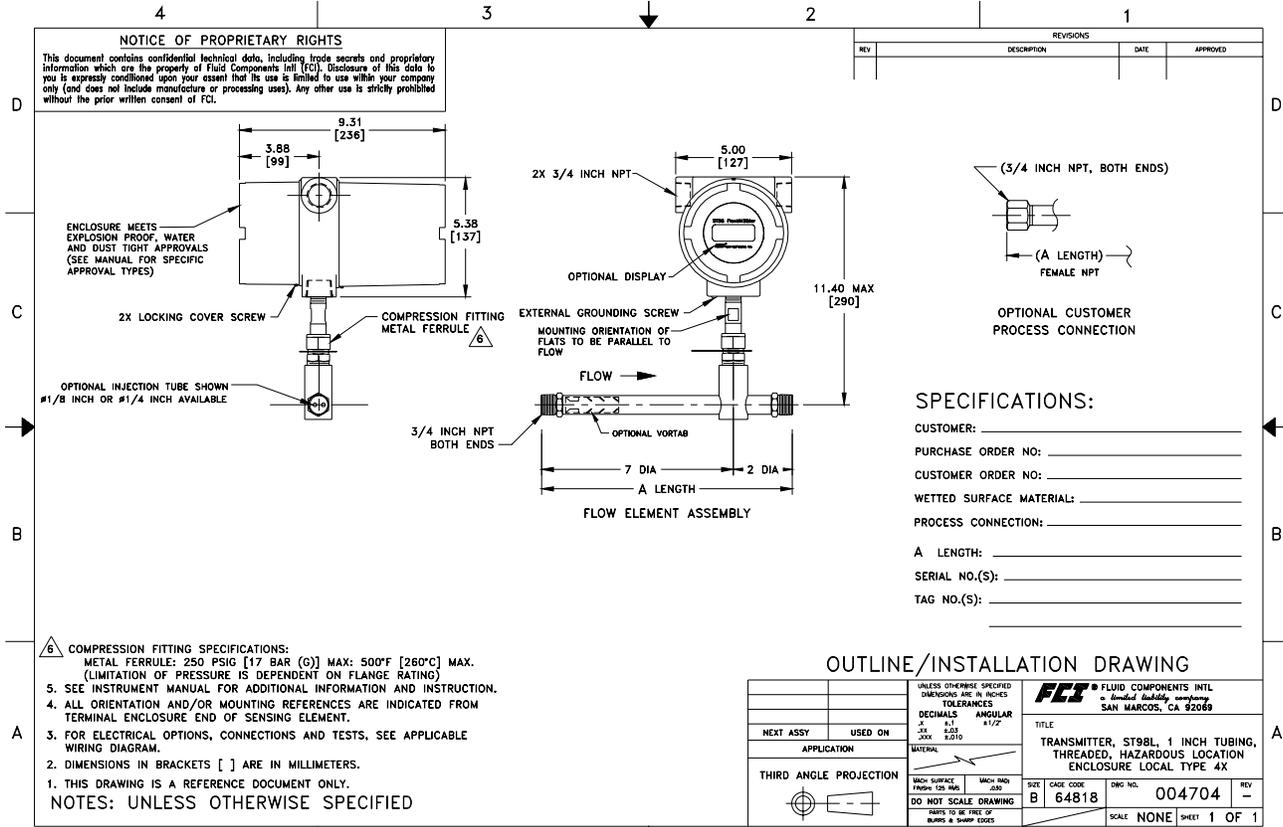


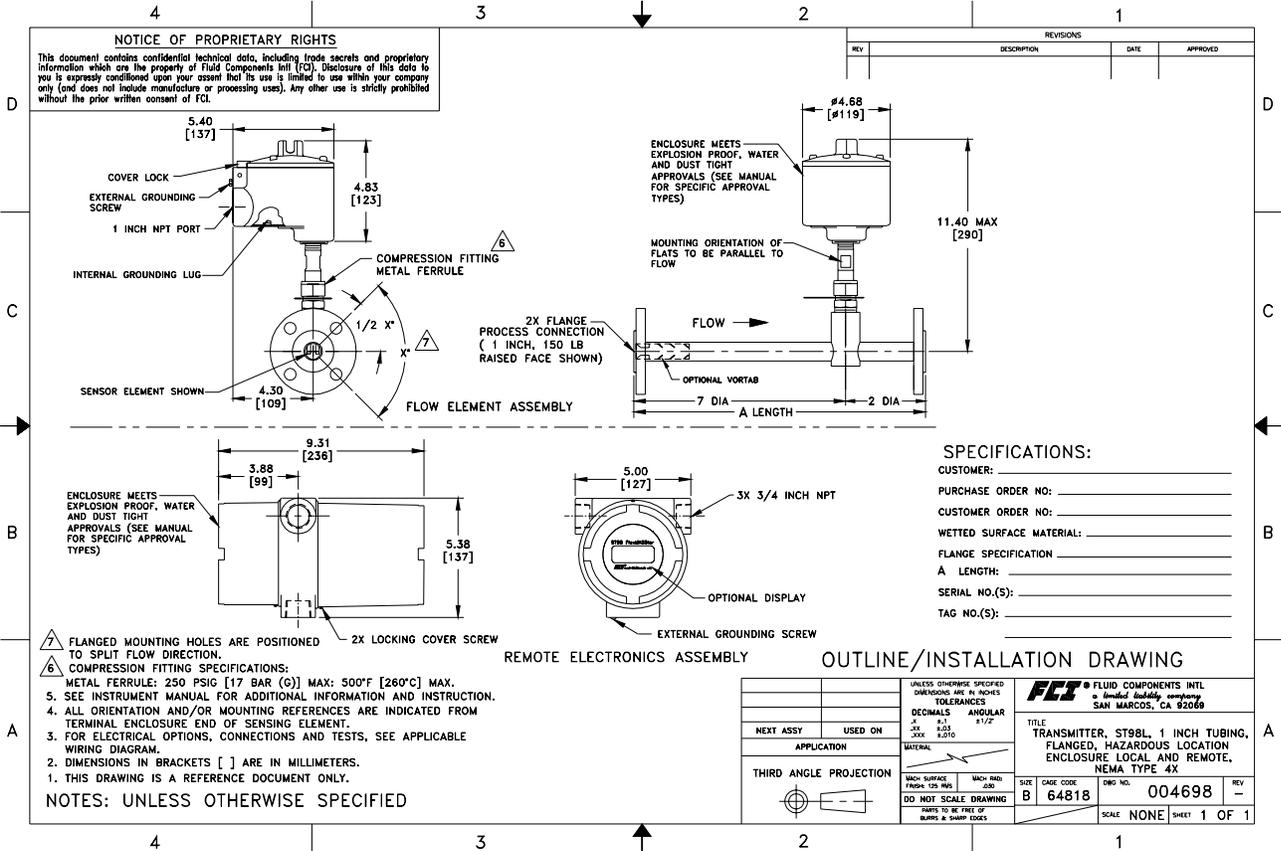
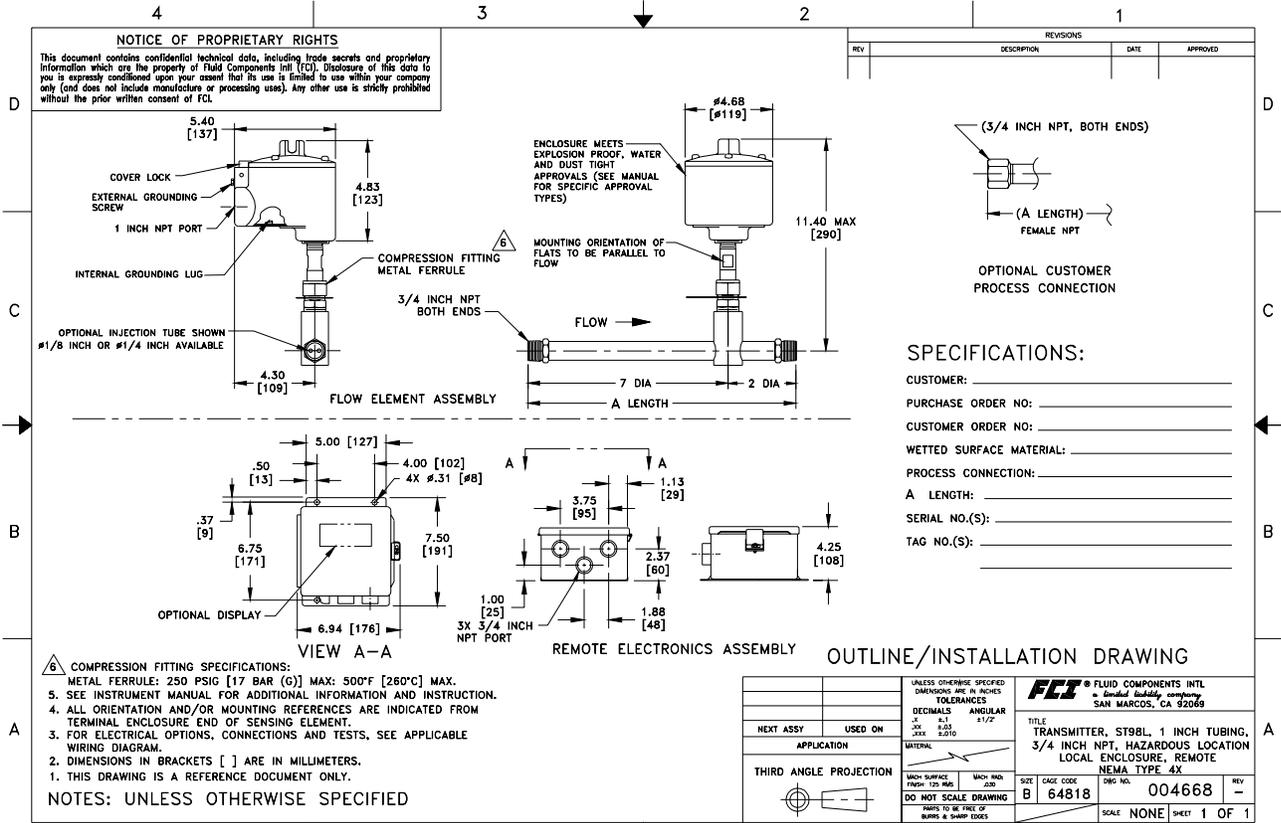












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Appendix B. Glossary of Terms

A/D number	Analog to Digital number.
Area	Cross-sectional area for a process line. Area of a Circular duct = πr^2 or $\pi \left(\frac{\text{I.D.}}{2}\right)^2$ Area of rectangular duct = Length x Width
DeIR	The active RTD A/D number minus the reference RTD A/D number.
DVM	Digital Voltmeter.
EPROM	Erasable Programmable Read Only Memory.
Firmware	Software plus hardware. The software is written and then stored in a hardware EPROM chip.
Flow Element	The portion of the flow meter that contains the thermowells, RTDs, and produces a signal with a defined relationship to the flow rate.
Flow Transmitter	The portion of the flow meter that conditions, converts, and scales the flow element signal.
RefR	The A/D number corresponding to the reference RTD resistance.
RTD	A Resistance Temperature Detector operates on the principle of change in resistance as a function of temperature.
SFPS	Standard Feet Per Second.
ΔR	The difference between two resistance values.
ΔT	The difference between two temperature values.

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Appendix C. Approval Information

CE Information



CE DECLARATION OF CONFORMITY Model ST98

We, *Fluid Components Intl*, located at 1755 La Costa Meadows Drive, San Marcos, California 92069-5187 USA, declare under our sole responsibility that the **ST98 Series Flowmeter Product Family**, models ST98/ST98L, to which this declaration relates, are in conformity with the following standards and Directives

EMC Directive 89/336/EEC of May 3, 1989 of the European Union:

Immunity specifications: EN 50082-2: 1995; EN 61000-4-2 1995; EN 61000-4-4 1995; EN 61000-4-8 1995; ENV 50140 1993 and ENV 50204

Emissions specification: EN55011 1991 Group 1 Class B and CISPR 11 1990 Group 1 Class B.

Low Voltage Directive 73/23/EEC:

Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use- IEC 61010-10 1990 +A1 1992, +A2 1995.

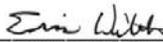
Pressure Equipment Directive (PED) 97/23/EC:

The ST98 Model does not have a pressure bearing housing and is therefore not considered as pressure equipment by itself according to article 1, section 2.1. The Model ST98L is in conformity with the sound engineering practices as defined in the Pressure Equipment Directive (PED) 97/23/EC article 3, paragraph 3.

ATEX Directive 94/9/EC

EC-Type Examination Certificate Number: KEMA 02ATEX2042 satisfies EN50014 and EN50018 requirements.

*Issued at San Marcos, California USA
01, May 2003*


Eric Wible, Engineering Manager

Flow/Liquid Level/Temperature Instrumentation

Visit FCI on the Worldwide Web: www.fluidcomponents.com
1755 La Costa Meadows Drive, San Marcos, California 92069 USA 760-744-6950 • 800-854-1993 • 760-736-6250
European Office: Persephonestraat 3-01 5047 TILburg – The Netherlands – Phone 31-13-5159989 • Fax 31-13-5799036

Doc no. 23EN000009B

ATEX Information

Safety Instructions for the use the ST98 Flexmasster in Hazardous Areas Approval KEMA 02 ATEX 2042 for Category II 2G protection EEx d IIC T6..T5 Electronics Category II 2G protection EEx d IIC T4..T2 Element

Dansk	Sikkerhedsforskrifter	Italiano	Normative di sicurezza
Deutsch	Sicherheitshinweise	Nederlands	Veiligheidsinstructies
English	Safety instructions	Português	Normas de segurança
Υπ	Υπ δει εις ασφαλειας	Español	Instrucciones de seguridad
Suomi	Turvallisuusohjeet	Svenska	Säkerhetsanvisningar
Français	Consignes de sécurité		

DK Dansk- Sikkerhedsforskrifter

Disse sikkerhedsforskrifter gælder for Fluid Components, ST98 Flexmasster EF-typeafprøvningsattest-nr. KEMA 02 ATEX 2042 (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) ST98 Flexmasster 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 1" NPT og/eller 3/4" NPT gevind for montering af en Ex-„d“ kabelindføring, der er atteresteret iht. EN 50018
- 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.

DA Deutsch-Sicherheitshinweise

Diese Sicherheitshinweise gelten für die Fluid Components, ST98 Flexmasster flowmeter gemäß der EG-Baumusterprüfbescheinigung Nr. KEMA 02 ATEX 2042 (Bescheinigungsnummer auf dem Typschild) der Kategorie II 2 G.

1) Die Errichtung von Ex-Anlagen muss grundsätzlich durch Fachpersonal vorgenommen werden.

2) Der ST98 Flexmasster 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 3/4" und/oder 1" NPT Gewinde für den Einbau einer nach EN 50 018 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, ST98 Flexmasster flowmeter to the EC type approval certificate no. KEMA 02 ATEX 2042 (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 ST98 Flexmasster must be grounded.

3) The terminals and electronics are installed in a flame proof and pressure-tight housing with following notes:

- The gap between the housing and cover is an ignition-proof gap.
- The Ex-„d“ housing connection has a 1" and/or 3/4 " NPT cable entry for mounting an Ex-d cable entry certified acc. to EN 50 018.
- 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 Υπ_δεί_εις ασφαλείας

Αυτές οι οδηγίες ασφαλείας ισχύουν για τα Ροόμετρα της Fluid Components τύπου ST98 Flexmasster που φέρουν Πιστοποιητικό Εγκρίσεως Ευρωπαϊκής Ένωσης, με αριθμό πιστοποίησης KEMA 02 ATEX 2042 (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 αντικρηκτική προστασία πρέπει να γίνει από εξειδικευμένο προσωπικό.
- 2) Το όργανο τύπου ST98 Flexmasster πρέπει να είναι γειωμένο.
- 3) Τα τερματικά ηλεκτρικών συνδέσεων (κλέμες) και τα ηλεκτρονικά κυκλώματα είναι εγκατεστημένα σε περίβλημα αντικρηκτικό 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" αντικρηκτικό περίβλημα, έχει ανοίγματα εισόδου καλωδίου με διάμετρο $\frac{3}{4}$ ή/και 1 ίντσα NPT, κατάλληλα για τοποθέτηση υποδοχής αντικρηκτικού καλωδίου πιστοποιημένης κατά EN 50 018
 - Βεβαιωθείτε ότι πριν το άνοιγμα καλύμματος του του "Ex-d" αντικρηκτικού 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 αντικρηκτικού περιβλήματος πρέπει να είναι εντελώς βιδωμένο και ασφαλισμένο, σφίγγοντας μία από τις βίδες ασφαλείας του περιβλήματος.

FIN Suomi - Turvallisuusohjeet

Nämä turvallisuusohjeet koskevat Fluid Components, ST98 Flexmasster EY-tyyppitarkastustodistuksen nro. KEMA 02 ATEX 2042 mukaisesti (todistuksen numero näkyy tyypikilvestä) käytettäessä räjähdysvaarallisissa tiloissa luokassa II 2G.

- 1) Ex-laitteet on aina asennettava ammattihenkilökunnan toimesta.
- 2) ST98 Flexmasster on maadoitettava.
- 3) Syöttöjännitteen kytkemisessä tarvittavat liittimet ja elektroniikka on asennettu koteloon jonka rakenne kestää räjähdyspaineen seuraavin lisäyksin :
 - Kotelon ja kannen välissä on räjähdysten purkausväli.
 - Ex-d liittintäkotelossa on $\frac{3}{4}$ " NPT ja/tai 1" NPT kierre EN 50 018 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 Consignes de sécurité

Ces consignes de sécurité sont valables pour le modèle ST 98 Flexmasster de la société Fluid Components (FCI) conforme au certificat d'épreuves de type KEMA 02 ATEX 2042 (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 ST98 Flexmasster 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 $\frac{3}{4}$ " NPT et/ou 1" NPT pour le montage d'un presse-étoupe Ex-d certifié selon la NE 50 018.
 - 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, ST98 Flexmasster secondo il certificato CE di prova di omologazione n° KEMA 02 ATEX 2042 (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 ST98 Flexmasster 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 filettatura 3/4" e/o 1" NPT per il montaggio di un passacavo omologato Ex-d secondo EN 50 018.
 - 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 è 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, ST98 Flexmasster overeenkomstig de EG-typeverklaring nr. KEMA 02 ATEX 2042 (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 ST98 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 een ¾" of een 1" NPT schroefdraad voor aansluiting van een volgens EN 50 018 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 servicewerkzaamheden) 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, ST98 Flexmasster conforme o certificado de teste de modelo N.º KEMA 02 ATEX 2042 (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 ST98 Flexmasster 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.
 - O envólucro de conexão Ex-“d“ possui uma rosca 1" NPT e/ou 3/4" NPT para a entrada de cabos Ex-“d“ certificado conforme a norma EN 50 018.
 - 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 explosiva.
 - 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 ST98 Flexmasster de Fluid Components, según la certificación CE de modelo N° KEMA 02 ATEX 2042 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 ST98 Flexmasster 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 rosca 3/4" y/o 1" NPT, donde deberán conectarse prensaestopas certificados Exd según EN50 018.
 - Antes de la apertura de la tapa de la caja "Exd" (p. ej. durante los trabajos de conexión 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, debiéndose asegurar apretando los tornillos de bloqueo.

S Svenska - Säkerhetsanvisningar

Säkerhetsanvisningarna gäller för Fluid Components, Flödesmätare typ ST98 Flexmaster enligt EG-typkontrollintyg nr KEMA 02 ATEX 2042 (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) ST98 Flexmaster 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 kapslingen har en 3/4" och / eller 1" NPT gänga för montering av en EN 50 018 typkontrollerad Ex- „d“ kabel förskruvning
 - 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 skruvar man i en av lockets insex låsskruvar .

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Appendix D. 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 E-Mail

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 e-mail.

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's Worldwide Web at www.fluidcomponents.com. For product support call 1 (800) 854-1993 and follow the prerecorded instructions. A person from the Technical Support Staff will be paged and promptly return the call.

Point of Contact

The point of contact for service, or return of equipment to FCI is an authorized FCI service representative.

Reference Documents

- Return Authorization Request/Certificate of Non-Contamination (Document 1)
- Warranties (Document 2)

Documents 1 and 2 follow this page.

Hardware Return Procedure

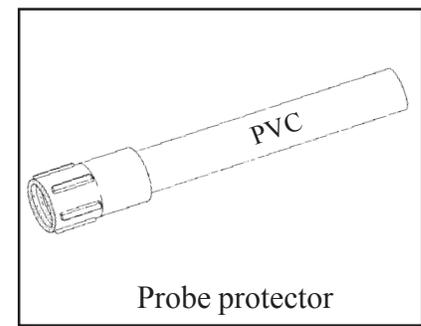
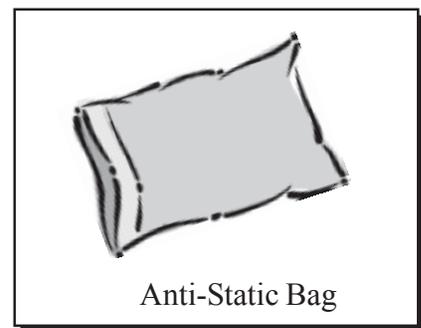
Complete a Return Authorization (RA) Request/Certificate of Non-Contamination form (Document 1). Mail or fax it to FCI Customer Service Department. After FCI issues an RA number, complete the following steps:

1. Thoroughly clean the hardware.
2. Package each instrument with protective packing material similar to the original FCI shipment cartons indicated below. **All damage occurring in transit is the customer’s responsibility.**
 - a. Instruments weighing less than 25 pounds (11.34 KG) each are to be covered with protective wrap, i.e. bubble wrap or surrounded with "popcorn". Instruments weighing greater than 60 pounds (27.7 KG) or extending more than four feet should be secured in wooden crates by bolting the sensing element assembly in place.
 - b. Protect the sensing element with a cardboard tube or other sturdy wrapping as shown below.
 - c. Protect the electronics with an Anti-Static bag like the one shown below.
 - d. Do not pack more than four small instruments in each carton.
 - e. Packages weighing in excess of 70 pounds (31.8 KG) or with a combined length and girth of more than 138 inches (350 cm) cannot be shipped by United Parcel Service. Larger packages or crates should be shipped by carriers who specialize in the transport of industrialized instrumentation.
 - f. The RA number should be noted on the packing list and marked clearly on the outside of the box.
3. Prepay freight to the FCI receiving door.

Shipping/Handling Charges

All Shipping (Warranty/Nonwarranty Repairs or Returns)
 The customer prepays all shipping, freight, duty/entry and handling charges from the customer site to the FCI door. If the customer does not prepay, FCI will invoice the customer for the charges that appear on the freight bill. Address the return equipment to:

FLUID COMPONENTS INTERNATIONAL LLC
 1755 LA COSTA MEADOWS DRIVE
 SAN MARCOS, CA. 92078-5115 USA
 ATTN: REPAIR DEPT.



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.

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 customer's account until either all freight charges are cleared or until the customer agrees to have any freight costs incurred by FCI deducted, 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 within five days of 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 specifically excepted by the FCI Customer Service Manager. FCI reserves the right to bill for travel times at FCI's discretion.

Customers are charged for shipping costs related to the transfer of equipment to and from the job site. They are also invoiced for field service work and travel expenses by FCI's Accounting Department.

Document 1. FCI RETURN AUTHORIZATION REQUEST

Customer Information	R.A. Number:
Name of Company Returning Hardware _____	
Contact Name: _____	Phone # _____ Fax # _____
Customer Bill to Address: _____	Ship to: _____
_____	_____
_____	_____
Purchase Agent Contact: _____	Phone # _____ Fax # _____
Product Information	
Model Number(s) _____	Serial Number(s) _____
Sending: Electronics only <input type="checkbox"/>	Sensor only <input type="checkbox"/>
Complete unit <input type="checkbox"/>	Number of units _____
Failure Symptoms _____	

Troubleshooting done in the field by: FCI representative <input type="checkbox"/> or by Customer <input type="checkbox"/> _____	

Action to be taken by FCI: Recalibrate <input type="checkbox"/> Electronics Repair <input type="checkbox"/> Sensor Element Repair <input type="checkbox"/> Upgrade <input type="checkbox"/> Other <input type="checkbox"/>	
<i>(Note: Re-calibration/Re-certification requires the completion of a new Application Data Sheet)</i>	
Authorization to repair, if under: \$500 <input type="checkbox"/> \$1000 <input type="checkbox"/>	Purchase Order Reference: _____
Probe Protector Requested <input type="checkbox"/>	Antistatic Bag Requested <input type="checkbox"/>
Process Flow Media: _____	
Who is your FCI factory technical contact: _____	
Has the local FCI representative been contacted for assistance? _____	
Note: FCI will charge a handling fee on all non-warranty evaluations. _____	
 	
Decontamination Information	
<p>Exposure to hazardous materials is regulated by Federal, state (California), County and City laws and regulations. These laws provide FCI's employees with the right to know the hazardous materials with which they come in contact while handling FCI's products. Consequently, FCI's employees must have access to data regarding the hazardous materials which the equipment has been exposed to in customer process(es). Accordingly, prior to returning the instrument for repair, sign the certification below and thoroughly comply with the instructions, if applicable.</p> <p>I certify that the item(s) has (have) been thoroughly and completely cleaned and if the item(s) has (have) been exposed to or contacted by a hazardous material, hazardous substance or toxic materials or substances that the undersigned can assure the returned item(s) has (have) been thoroughly and completely decontaminated and neutralized of such substances and contamination. I have also attached a Material Safety Data Sheet (MSDS) which covers all hazardous material, hazardous substance or toxic materials or substances exposed to or contacted by the instrument. Furthermore, I understand that this Certificate, or providing a MSDS, shall not waive our responsibility to provide a neutralized, decontaminated, and clean product for repair to FCI.</p>	
Authorized Signature _____	Date _____
Cleanliness of a returned item or the acceptability of the MSDS shall be at the sole discretion of FCI.	

Document 2. Warranties

Warranties

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



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