

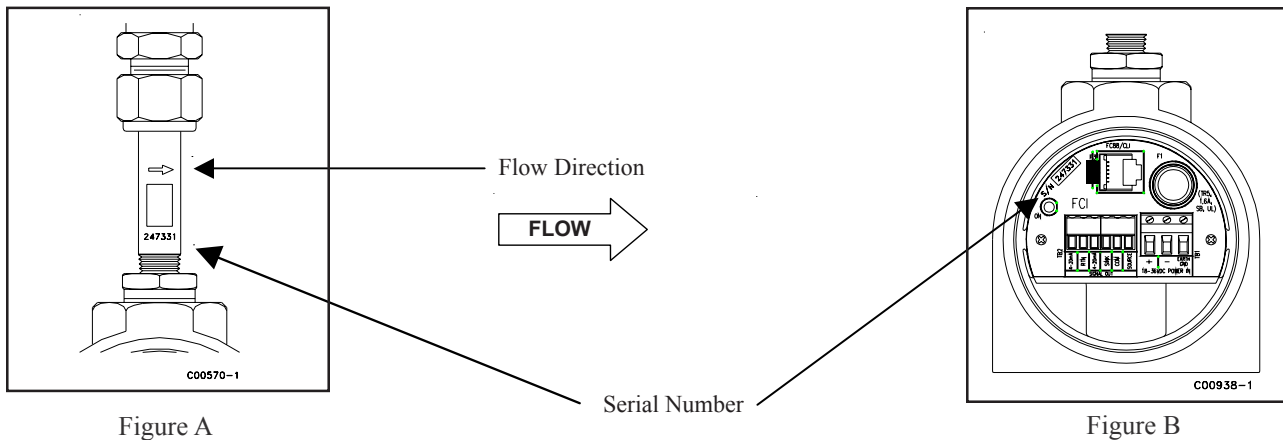
ST50 MASS FLOW METER Installation and Operation Guide

Pre-Installation

The ST50 can be specified with integral or remote electronics. The flow element has a serial number etched into the side of the extension pipe as shown on figure A. The transmitter circuit card has a serial number noted on the board as shown in figure B. The flow sensor and transmitter circuit have been calibrated as a matched set and should be paired together in service unless otherwise approved by a factory technician.

Flow Direction Alignment

All sensor elements have a flow arrow indicator marked on the element assembly at the reference flat. These flow elements have been calibrated in a particular direction and are designed to be used in service with the flow arrow facing in the same direction as flow in the pipe stream. See Appendix C for orientation and factory calibration details.



Recommended Straight Run

To optimize flow meter system performance, FCI recommends installation with a minimum of 20 pipe diameters upstream straight run and 10 pipe diameters of downstream straight run. Where straight run limitations significantly reduce the available pipe diameters, FCI utilizes Vortab flow conditioners to produce a transferable flow profile from the calibration installation to actual field installations. FCI's proprietary AVAL software is available to make flow meter installation evaluations where straight run limitations are considered. See Fig C for recommended installation.

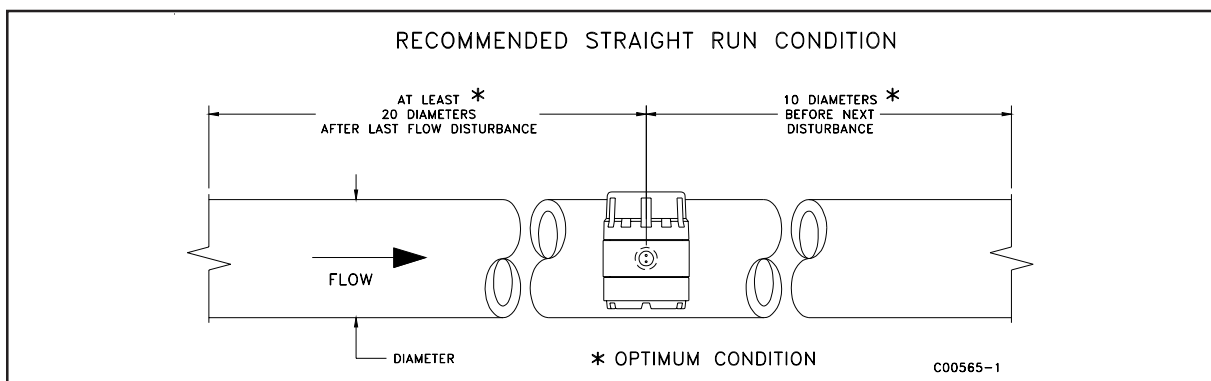


Figure C

FCI Flow Meters may be installed with less than the recommended straight run, but may have performance limitations. FCI offers Vortab flow conditioners for use in applications that have significant straight run limitations. FCI uses the AVAL application modeling software to predict meter performance in each installation. AVAL outputs are available to review prior to order placement and will indicate performance expectations both with and without Vortab Flow Conditioning.

Specifications

Instrument

Media Compatibility: Air, compressed air, and nitrogen
Pipe/Line Size Compatibility: 2” to 24” [51 mm to 610 mm]
Range: Air, compressed air, or nitrogen: 0.75 SFPS to 400 SFPS
 [0.23 MPS to 122 MPS]
Accuracy: Standard: ± 2% of reading, ± 0.5% of full scale
 Optional: ± 1% of reading, ± 0.5% of full scale
Repeatability: ±0.5% of reading
Temperature Compensation:
 Standard: 40°F to 100°F [4°C to 38°C]
 Optional: 0°F to 250°F [-18°C to 121°C]
Turndown Ratio: 3:1 to 100:1
Agency Approvals: 1
 FM/CSA: Nonincendive for use in Class 1, Division 2, Groups A, B, C and D T4 Ta = 60°C Indoor Hazardous (Classified) Locations.
 ATEX/IECEX: II 3 G EEx nA II T6; II 3 D T65°C (DC input power only)
 CPA, CE Mark, PED
Warranty: One year

Flow Element (Standard or FPC Type)

Installation: Insertion, variable length with 1/2” or 3/4” NPT(M) compression fitting.
Type: Thermal dispersion
Material of Construction: 316 stainless steel body with Hastelloy C thermowell sensors, 316 stainless steel compression fitting with Teflon or stainless steel ferrule
Pressure (Maximum Operating without Damage):
 Stainless steel ferrule: 500 psig [34 bar(g)]
 Teflon ferrule: 150 psig [10 bar(g)]
Temperature (Maximum Operation):
 Stainless steel ferrule: 0°F to 250°F [-18°C to 121°C]
 Teflon ferrule: 0°F to 200°F [-18°C to 93°C]

Process Connection: 1/2” MNPT or 3/4” MNPT with stainless steel or teflon ferrule

Insertion Length: Field adjustable lengths: 1” to 6” [25 mm to 152 mm]; 1” to 12”[25 mm to 305 mm]; or 1” to 18” [25 mm to 457 mm]

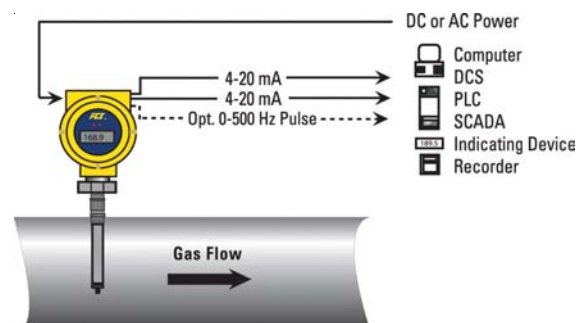
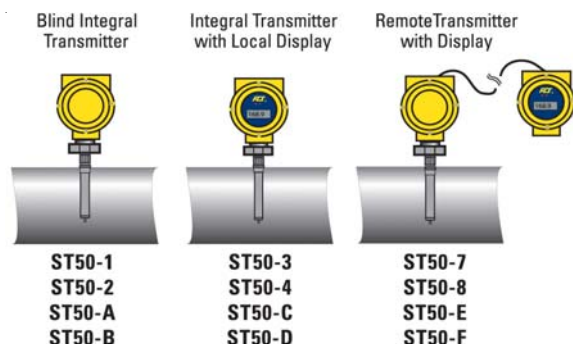
Flow Transmitter

Enclosure: NEMA 4X [IP67], aluminum, dual conduit ports with either 1/2” NPT or M20x1.5 entries. Epoxy coated.
Analog Output Signals: Dual 4-20 mA, configurable to flow rate and/or temperature (500 ohm max impedance) and a pulse output for total flow.
Output Pulse Source: Totalized flow or alarm set point. 15VDC. Pulse width at 50% duty cycle for rates 0 to 500Hz, 0.5 second pulse width for pulse rates below 1Hz. 25mA maximum load pulsed, 10mA maximum load if state set to normally on.
Output Pulse Sink: Totalized flow or alarm set point. Pulse width at 50% duty cycle for rates 1 to 500Hz, 0.5 second pulse width for rates below 1Hz. Customer power source and load not to exceed 40VDC and 150mA.
Communication Port: RS232C. Wireless IR to PDA. 2
Input Power:
 DC: 18Vdc to 36Vdc (6 Watt maximum)
 AC: 85Vac to 265Vac (12 Watt maximum, 1.6 Amp fuse) (CE Mark Approval from 100Vac to 240Vac)

Power Filter Board

	Amp Code	Rated Current	Voltage Rating
Littelfuse TR5 Series 374 1160 0410	1160	1.60A	250V
Breaking Capacity	50A/250V AC 50-60Hz cos φ = 1.0		

Operating Temperature: For Indoor or Outdoor Use
 0°F to 140°F [-18°C to 60 °C]
Maximum Relative Humidity: 100%
Maximum Altitude: 12,000 ft. (3,658m)
Digital Display: ±9999 Counts LCD, 0.45” H [11.4 mm] characters, user scalable to flow rate units or as 0-100%. 1
 1 For applications in Div. 1 / Zone 1 environments and/or for dual-line digital display with built-in totalizer display, see FCI Model ST51
 2 Requires user supplied PDA and FCI software P/N 019819-01



Installing Flow Element

Insertion Depth



Warning: The element is shipped with a protective sleeve surrounding the flow element. After removing the sleeve, take care to prevent the element from sliding through the compression fitting and contacting the opposing wall with any force as it may cause damage to the element and potentially upset the calibration.

The ST50 is available with both Teflon compression fitting ferrules and metal ferrules. While the Teflon ferrule configuration can be readjusted, it is possible that over tightening may result in permanent positioning or damage to the extension pipe and will make future adjustment difficult. While Teflon provides for some adjustability, it has a lower process pressure rating and is not designed for continuous adjustments. The metal ferrule version can only be tightened down once and it becomes permanently positioned. The Ferrule type is indicated in the instrument part number displayed on the instrument tag. This can be cross referenced to the ordering information sheet.

All flow meters have been calibrated with the flow element located at the centerline of the pipe and flow stream as indicated in Figure D. Couplings and threadollets come in various dimensions. Proper installation requires that the element be measured with consideration to process connection dimensions and pipe centerline. FCI recommends that the element be first installed in the line with the compression fitting lightly tightened around the extension, then slowly move the pipe extension forward until the element is at centerline as shown.



Warning: On top mount installations, particularly, take care to prevent the element from sliding through the compression fitting and contacting the opposing wall with any force as it may cause damage to the element and potentially upset the calibration.

FLOW ELEMENT INSTALLATION & “U” LENGTH ADJUSTMENT

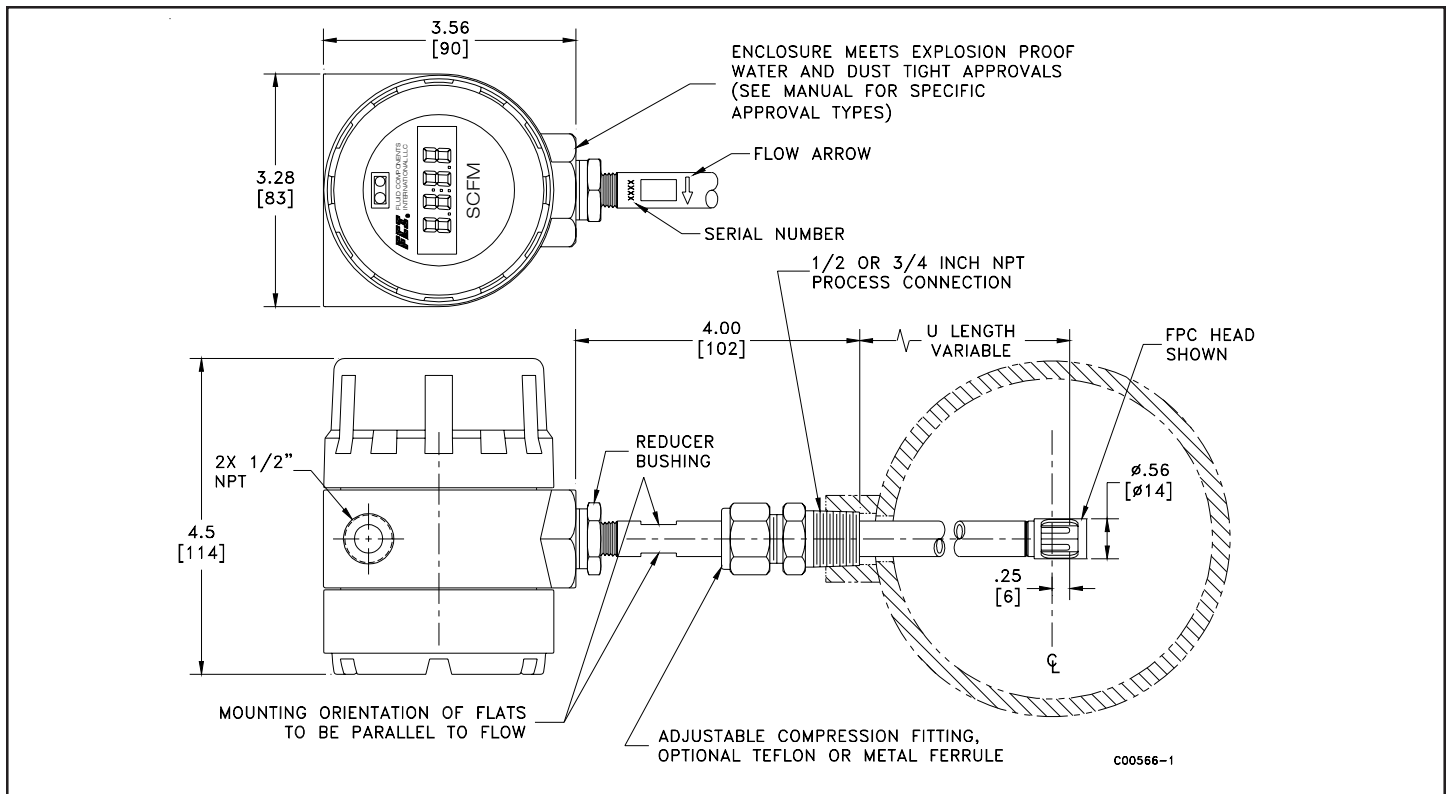


Figure D

Note: For proper performance, element shall be installed so that tip of probe is .25 inches [6mm] 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 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", 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

Instrument Wiring

Before the instrument is opened to connect power and signal, FCI recommends that the following ESD precautions be observed:

Use a wrist band or heel strap with a 1 megaohm resistor connected to ground. If the instrument is in the shop setting, there should be a static conductive mat on the work table or floor with a 1 megaohm resistor connected to ground. Connect the instrument to ground. Apply antistatic agents such as Static free made by Chemtronics (or equivalent) to hand tools to be used on the instrument. Keep high static producing items away from the instrument.

The above precautions are minimum requirements. The complete use of ESD precautions can be found in the U.S. Dept of defense handbook 263.



Warning: Only Qualified personnel are to wire or test this instrument. The operator assumes all responsibility for safe practices while wiring and trouble shooting.

FCI recommends installing an input power disconnect switch and fuse near the instrument to interrupt power during installation and maintenance. Operator must have power disconnected before wiring.

Safety instructions for the use of the ST50 series (18 to 36VDC version only) in Hazardous Areas. Approval, KEMA 06ATEX0207 X for Category 3 GD protection EEx nA T6 T65°. Special conditions for safe use:

- 1) Provision shall be made to prevent the rated Voltage from being exceeded by transient disturbances of more than 40%.
- 2) For applications in explosive atmospheres caused by air/dust mixtures, cables and conduit entries shall be provided a degree of protection of at least IP65 according to EN60529.

Input Power

The ST50 is available with both VDC and VAC input power configurations. Customers selecting VDC input power will have a VDC input board only. Similarly, the VAC power board is supplied only with VAC powered units. In addition, both boards are marked for either AC or DC power. Only connect the power specified on the wiring module as shown on Figures E and F respectively. Both VAC and VDC inputs require a Gnd wire to be connected. Input power terminal blocks are rated for 14-26 AWG.

To wire the instrument, ensure that the power is off. Pull the power and signal output wires through the port, using care not to damage wires. FCI recommends using crimp lugs on the output wires to ensure proper connection with the terminal strip. Connect the output wires as shown on figures E and F. Note that when the 4-20mA outputs are used simultaneously, a single return lead is used.

VDC Power Connection

VAC Power Connection

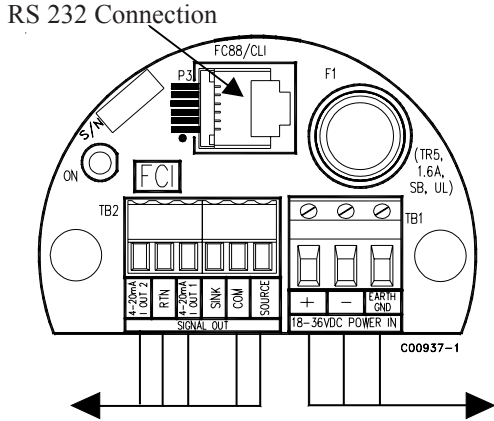


Figure E

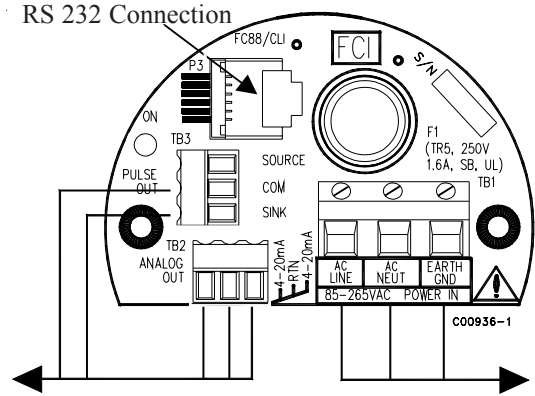


Figure F

VDC Power

As Shown:

- 18-36VDC power connected with gnd
- 4-20mA connected for flow and temperature
- Pulse Out in source mode

Note: In source mode, 15VDC Output max, 50mA max.

VAC Power

As Shown:

- 85-265 VAC power connected with gnd
- 4-20mA connected for flow and temperature
- Pulse Out in sink mode

Note: In sink mode, 40VDC max, 150mA max customer supplied power source.

Power Dissipation

AC Version

- Power dissipation values under nominal conditions:
- Instrument (Electronics + Sensor): 11.6 Watts
- Sensor only: 0.25 Watts

- Power dissipation values under maximum load conditions:
- Instrument (Electronics + Sensor): 12 Watts
- Sensor only: 0.30 Watts

DC Version

- Power dissipation values under nominal conditions:
- Instrument (Electronics + Sensor): 4.5 Watts
- Sensor only: 0.25 Watts

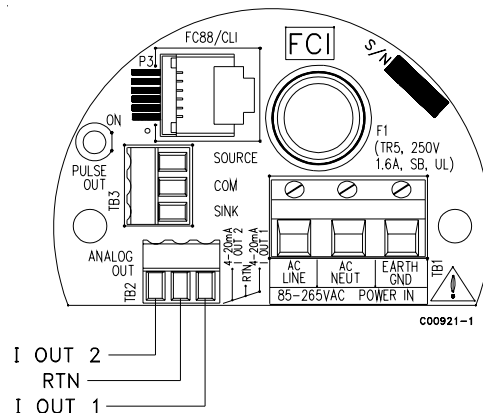
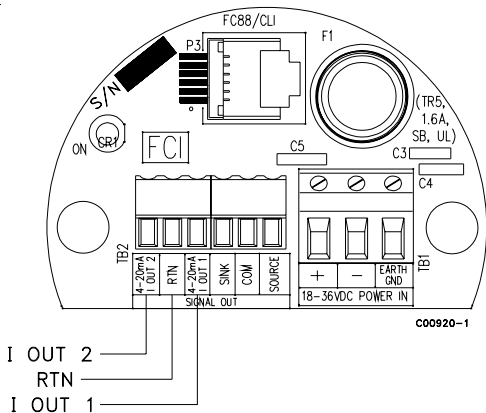
- Power dissipation values under maximum load conditions:
- Instrument (Electronics + Sensor): 6 Watts
- Sensor only: 0.30 Watts

Analog Output

4-20mA: The instrument is provided with a standard set up, of two 4-20mA outputs. Output 1 configured for flow and Output 2 configured for temperature. Terminal blocks rated for 14-28 AWG., 500 ohm max load per output.

VDC Input Power IO Board

VAC Input Power IO board



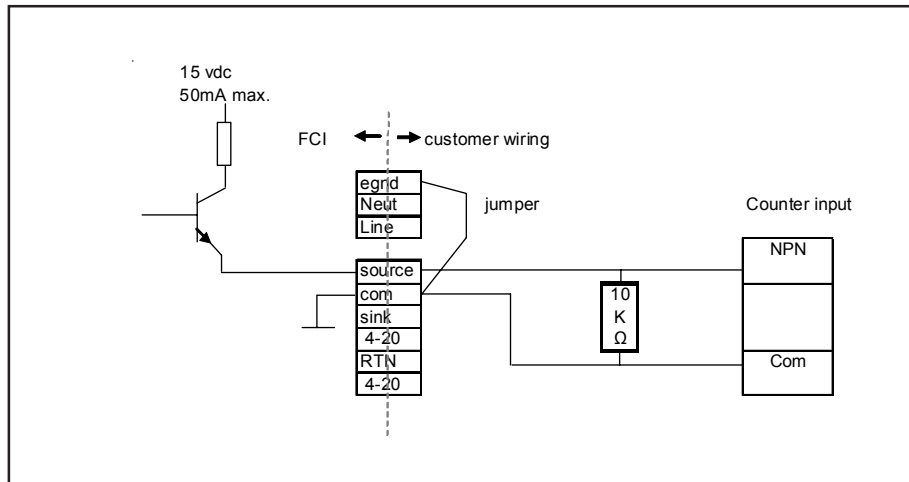
Output and Pulse configuration setup command “V”

Analog out		Select 1	Select 2	Select 3	Select 4
4-20mA out1		Flow	Flow	Temp	Temp
4-20mA out 2		Temp	Flow	Flow	Temp

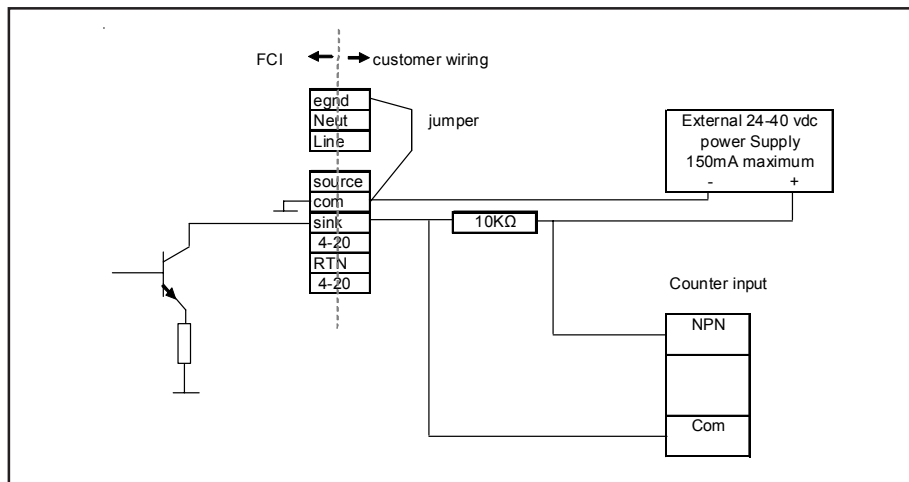
Pulse out		Select 1	Select 2	Select 3	Select 4
Source		pulse	pulse	Alarm0	Alarm0
	set	Factor	Factor	Setpoint	Setpoint
		Time	Time	sate	state
		state	state		
Sink		Pulse	Alarm1	Pulse	Alarm1
		Factor	Setpoint	Factor	Setpoint
		Time	sate	Time	sate
		state		state	

*Each sample period the number of pulses are calculated and output by the open collector. Any remaining fractional pulse in the calculation will be added to the next sample. Example:
 flow = 90 NCMM (= 1.5 NCMS), Pulse factor =1, sample time is 1.
 after 1 second the number of calculated pulses is 1.5, pulse out is 1. Remainder = 0.5
 after the next second the number of pulses is 2 (1.5+0.5), pulses out is 2. Remainder = 0

Pulse Output Wiring



ST50 Pulse Output (Source)



ST50 Pulse Output (Sink)

Setup Interface

All parameters on this meter are set through the RS232 interface connection (P3 plug) or PDA IR interface. A jumper selection determines which communication mode is active. The factory default communication mode is set for the RS232 interface. This setting allows the instrument to be setup with either a FC88 hand held communicator or a computer. The FC88 is powered through the meter and comes with the serial interface cable. If a computer interface is used, an adapter (RJ to 9 pin Computer Serial Port) is required and may be obtained from FCI: Part No. 014108-02.

Using Windows Terminal (usually located in Accessories) execute the program by double-clicking on the Terminal Icon.

1. Go to *Settings*.
2. Click on *Communication*.
3. Set for COM1 or COM2, 9600 Baud, 8 Bit, and No Parity. Press OK
4. Press the *ENTER* key to see the *Input Mode?* prompt.
5. Enter any of the meters single letter commands to execute a function (reference complete function menu in Appendix B).

If the PDA IR interface is used for communication, then jumper JP5 needs to be moved to the alternate position, see Figure G and H. See PDA IR Communication Interface section for more details. Spare jumpers are provided in the documentation package.

An additional command line interface (CLI) is available through the RS232 port. This interface is accessed with the “Y” command using a computer or FC88. The command line password is “357”. See Appendix B - Table 6 for command line details.

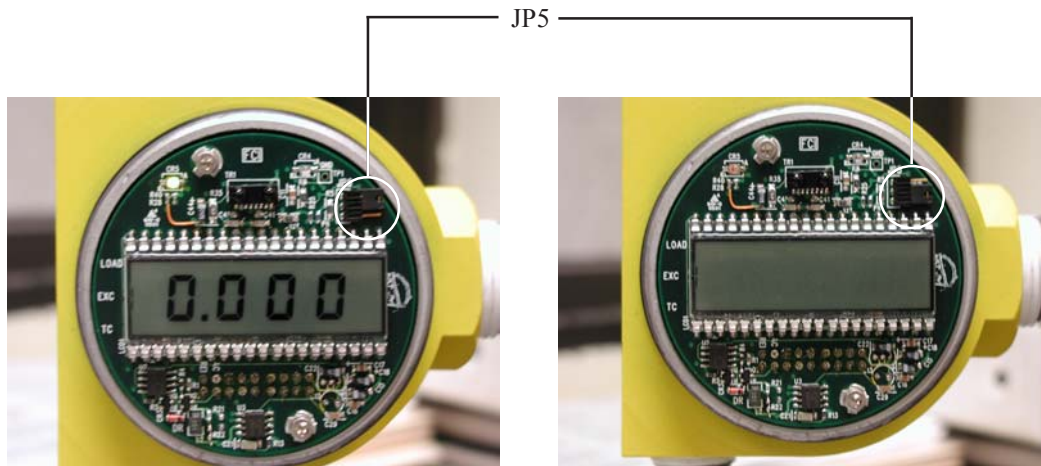
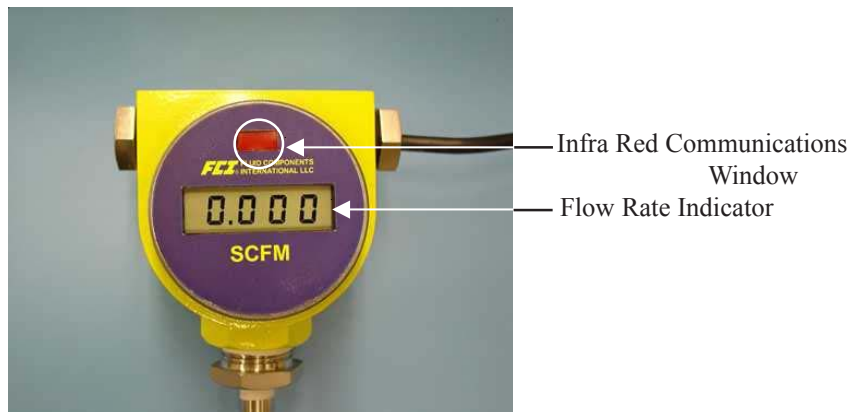


Figure G
JP5 factory set for RS232 interface

Figure H
JP5 set for PDA IR interface



Display and Transmitter Access

Start up and Commissioning

1. Verify all Input power and output signal wiring is correct and ready for initial power start up.
2. Apply power to instrument. The instrument will initialize in the Normal Operation Mode. All outputs will be active and instruments with the display option will indicate flow with the factory set flow unit. Allow 10 minutes for the instrument to warm up and come to the thermal equilibrium.

The following FC88 commands are typical commands that are used during start up and commissioning:

Command	Name	Description
T	Normal Operation Mode	All outputs are active
Z	Flow Unit Set-Up	Select Flow Units(4 English, 4 Metric)Pipe Dimensions
W	Totalizer	Enable/Disable
V	Output Configuration	Select one of 4 Configurations: Pulse and/or AlarmPulse factor and/or setpoint
F	K-Factor (default=1)	Flow factor
N	Warm Re-set	Re-initialize C/B
S	Totalizer Menu	Enables W menu (Option)

If the instrument is installed, and the process flow is zero, the instrument will now indicate 0.000. The engineering unit of flow is indicated on the instrument bezel. If the flow units are modified, additional units indicators are provided with adhesive backing.

Flow Unit Modification

Example: SCFM Flow Units and 3 inch Sch 40 round pipe size set up:

Enter	Display	Description
Enter	menu: >	From Normal Operation Mode
Z	E for English M for Metric >	Flow Unit Set-Up menu
E	0=SFPS, 1=SCFM, 2=SCFH, 3=LB/H, 4=GPM #	English units
1	R round duct or S rectangular>	Select Standard Ft ₃ /Min (SCFM)
R	Dia.: 4.0260000 Change? (Y/N)>	Select Round Duct
Y	Enter value: #	
3.068	area: 7.3926572 CMinflow: 0.0000000 Change? (Y/N)>	3 inch Sch. 40 pipe I.D.
N	Maximum flow: 462.04 Enter to continue	
Y	Cmaxflow: 462.04 Change? (Y/N)>	
Y	#	
462.04	CMintemp (F): -40.00000 Change? (Y/N)>	
N	CMaxtemp (F): 250.00000 Change? (Y/N)>	
N	Percent of Range is: OFF Change to ON?>	
N	LCD Mult Factor x1 Change? (Y/N)>	
N	100.0 SCFM	Instrument will end up in Normal Operation Mode

RS232 / FC88

Menu Control and Organization

All user entries begin at the input mode prompt “>”, except when the instrument is in the Main Function Mode. Most entries require at least two key strokes; a Capital letter and the [ENTER] key, or one or more numbers and the [ENTER] key. If the unit is in the Main Function Mode just press the desired function letter to make an entry.

Backspaces are made using the backspace [BKSP] key. Some entries are case sensitive between numbers and letters. Be sure the SHIFT key is pressed to indicate the correct case. A square after the prompt caret indicates the FC88 is in lower case. A slightly raised rectangle in the same spot indicates the FC88 is in the upper case.

It is recommended that the FC88 be plugged into the instrument before power is applied. If the FC88 is plugged in while the instrument power is on and the FC88 does not respond, press [ENTER], if there is still no response Press [N] or cycle the power.

Note: The Zero and Span may be changed from the original calibration, provided the new values are within the original calibrated range. i.e. If the original calibration was 1 to 100 SCFM (4-20mA), the new zero (4mA) must be equal to or greater than 1 SCFM, the new span (20mA) must be equal to or less than 100 SCFM.

Some entries require a Factory pass code. If this occurs contact FCI Field Service to continue programming the instrument. The instrument will prompt the user when this is necessary. Do not change any parameters that require this code unless there is an absolute understanding of the instrument's operation. The user can not exit some routines unless all entries are completed or the power is recycled.



Caution: Always press “T” before unplugging the FC88. If a frozen meter display is observed, reconnect the FC88 and wait 5 seconds for the meter to initialize. Disconnect the FC88 and confirm your meter display is varying.

The top level of the menu is shown in Appendix B - Table 5. Enter the large letter in the tables below to activate a command. The user may exit a command at any time entering “Q” [ENTER] in the menus: D, K, V, W, or Z.

C Calibration Information
Display only: A/D, Delta-R, Ref-R data values
D Diagnostics
Display only: List of unit parameters.
K Factory Calibration Settings
Display only: Cal. parameters, i.e. linearization and temperature compensation coefficients.
R Factory Reset
Replaces user data with factory calibration data

Table 1. Diagnostics and Factory Settings

Units		
Select	E=English	M=Metric
Select	0= SFPS	5 = SMPS
or	1 = SCFM	6 = NCMH
or	2 = SCFH	7 = NCMM
or	3 = LBS/H	8 = KG/H
or	4 = GPM	9 = LPM
For Volumetric or Mass Flow		
Select	R = Round pipe or duct	
or	S = Square duct	
Set	Diameter or Wide X High (in inches or mm)	
Set	CMaxflow = Maximum flow rate (span)	
Set	CMinflow = Minimum flow rate (zero)	
Note: Changing units requires rescaling the unit (set new zero and span).		

Table 2. “Z” Flow Units Set-Up and Scaling

Analog out					
	Select	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
4-20mA out 1		Flow	Flow	Temp	Temp
4-20mA out 2		Temp	Flow	Flow	Temp
Pulse out					
	Select	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Source out		Pulse	Pulse	Alarm0	Alarm0
	Set	Factor	Factor	Set pt.0	Set pt.0
	Set	Period	Period	State0	State0
	Set	State0	State0		
Sink		Pulse	Alarm1	Pulse	Alarm1
	Set		Set pt.1	Factor	Set pt.1
	Set	State1	State1	Period	State1
				State1	

Table 3. “V” Output Configuration Set-Up

“V” Menu Output Configuration Set Up

NOTE: The display comes up to the last setting saved and stays for 2 seconds. If **N** or [ENTER] is entered, the menu proceeds to the Pulse out. If **Y** is entered, the display moves to the selection options and/or asks for confirmation. If you miss the option, select [Enter] repeatedly to loop around.

Analog out

Output Mode
Selected

4-20mA #1: Flow
4-20mA #2: Temp

Change? (Y/N)>

4-20mA #1: Flow
4-20mA #2: Temp
Enter 1 to make the selection__

4-20mA #1:
4-20mA #2: Flow
Enter 2 to make the selection__

4-20mA #1: Temp
4-20mA #2: Flow
Enter 3 to make the selection__

4-20mA #1: Temp
4-20mA #2: Temp
Enter 4 to make the selection__

Pulse out

Pulse Out
Selected

Source: Pulse
Sink: Pulse

Change? (Y/N)>

Source: Pulse
Sink: Pulse
Enter 1 to make the selection #__

Source: Pulse
Sink: Alarm1
Enter 2 to make the selection #__

Source: Alarm0
Sink: Pulse
Enter 3 to make the selection #__

Source: Alarm0
Sink: Alarm1
Enter 4 to make the selection #__

PFactor: 1.000

Change? (Y/N)>

if yes
Enter new factor: ____

Sample Period: 1 second

Change? (Y/N)>

if yes
Enter new Sample Period: ____

If alarm is a selected output

Set point1: 000 Set points are in the same units as the flow or temp.

Change? (Y/N)>

if yes
Enter new set point: ____

Resume normal operation

Source state:

High to Low

Change to Low to High?>

Example: COMMAND V (Reference Table 3)

Case: 4-20mA #1 = flow, 4-20mA #2 = Temperature, Source Out = Pulse, Sink = Alarm

Pressing [V] [ENTER] will display “Output Mode Selected” followed by:
 “4-20mA #1 = Flow” followed by:
 “Change? (Y/N)”
 Press [ENTER] (no change).

The last saved mode will display at this point. i.e.,
 “Source: Pulse” “Sink: Pulse” followed by,
 “Change? (Y/N)” Select Y [Enter]. The display reads,
 “Source: Pulse” “Sink: Pulse” followed by,
 “Enter 1 to make the selection #.” Select [ENTER]. The next display reads,
 “Source: Pulse” “Sink: Alarm” followed by,
 “Enter 2 to make the selection #.” Select 2 and [ENTER]. The next prompt reads,
 “PFactor: 1.000” “Change? (Y/N)>” (this factor can be anywhere from 0.001 to 1000 - A pulse factor of 1.000 will output 1 pulse per unit of flow.)

If no change, select N and/or [ENTER] to continue.
 The next prompt is, “Sample Period”
 “Change? (Y/N)>” (this value may be set from 0.5 to 5 seconds)

If no change, select N and/or [ENTER] to continue.
 The next prompt is, “Source state: ” “High to Low” Change to “Low to High?>” (this selection toggles the pulse signal normally high or normally low).

[ENTER] to read display.
 “Switchpt1” “0.000000” the current set point.
 “Change? (Y/N)>” enter Y [ENTER] and enter # ____ . Set Point Value , i.e. 50 (value is in same units as the flow and must be within the calibrated range). [ENTER]. The next prompt is,
 “Sink state: ” “High to Low” Change to “Low to High?>”. Set the output signal to be normally “High” or normally “Low.” Pressing [Y] [ENTER] toggles the current setting. Pressing [ENTER] resumes normal operation.

PDA IR Communication Interface

The IR interface software is an optional accessory kit and can be ordered using FCI part number 019819-01. The software is compatible with PALM OS 4.1 or greater. If the software was ordered with the instrument, a CD should be located with the instrument documentation.

The factory has verified the following 3 PDA models. All commands meet their intended purpose and function properly.

1. Palm, Tungsten E, E2: Palm OS 5.2.1, 5.4.7
2. Palm, Zire 71, Palm OS 5.2.1
3. ecom instruments, m 515-EX, Intrinsically-safe. Palm OS 4.1

Procedure:

1. Download the software into the target PDA. When complete, a yellow and blue FCI icon will be available.
2. Verify JP5 jumper is set in the PDA IR interface position, see Figure H.
3. Select FCI icon on PDA device.
4. The opening menu is displayed, select start.
5. Five menu groups are displayed.

Process: displays current process variables (Flow and Temperature)

ID-Unit: displays model, firmware version, serial no. ...

Set-up: allows access to the following areas

Units	K Factor
Line size	Temp/Flow min/max
Totalizer	Output Cal
LCD	Output Config

Diagnostics: A/D values

Utilities: allows access to the following areas

- Reset
- Parameter memory
- Calibration coefficients
- Factory restore
- Process and System Faults

6. After entering into specific menu areas, point the PDA IR port towards the Instrument display. Begin with the PDA device within 5 feet of the instrument display. Select the "Get All" or "Get" button to retrieve information from the instrument. If a value needs to be changed, the value must first be retrieved.

Example: reading standard process variable information

1. Verify instrument and PDA are functioning.
2. Select FCI icon on the PDA.
3. Select the start button on the opening screen.
4. Select the "Process" button.
5. Point the PDA at the instrument display, start with the PDA no further than 5 feet from the instrument.
6. Select the "Get Data" button.
7. Flow and temperature Data will begin streaming to the PDA.
8. If the IR link is interrupted, a "Command response timed out" message will be displayed.
9. Repeat the process if the link is interrupted.

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 composed of 316 SS and Hastelloy C.

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. 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 enclosure is adequate and that no moisture is entering the enclosure.

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 flow indication. Clean the flow element, as necessary, with a soft brush and available solvents (compatible with Stainless Steel).

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Troubleshooting

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

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.

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

P_A = 19.7 PSIA

P_s = 14.7 PSIA

Q_s = 1485 SCFM

T_A = 120°F (580°R)

T_s = 70°F (530°R)

(Metric: P_s = 1.01325 bar(a))

T_s = 21.1°C (294.1K))

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

Calibration Parameters Verification

The instrument uses a set of predetermined calibration parameters to process flow signals. Most of these parameters should not change. A data package located with this manual contains the "ST50 Delta R Data Sheet". This contains the calibration parameters stored in the flow transmitter at the factory. To verify that these parameters have not changed, complete the following:

1. Identify the appropriate Delta R Data sheets by serial number of the instrument.
2. Press [D] [ENTER] to examine each of the parameters. The [ENTER] key allows scrolling one message at a time. Use Table 4 to verify parameters with the Delta R Data sheet ST50 Parameters.

S/W Version:		dR Min:		T SpanIDAC 0:	
Flow Factor:		dR Max:		T ZeroIDAC 0:	
Cmin Flow:		Cal Ref:		T SpanIDAC 1:	
Cmax Flow:		Tcslp:		T ZeroIDAC 1:	
Eng Units:		Tcslp 0:		State 0:	
Line Size 0:		Tcslp 2:		Switch Pt 0:	
Line Size 1:		Tot Menu:		State 1:	
Cmin Temp:		Tot Flag:		Switch Pt 1:	
Cmax Temp:		Totalizer:		K factor 1:	
Min Flow:		Rollover Cnt:		K factor 2:	
Max Flow:		Fix Pt Flag:		K factor 3:	
Density:		Pulse Factor:		K factor 4:	
*C1 [1]:		Pulse Out:		I factor:	
*C1 [2]:		Hours:		Temp Flag:	
*C1 [3]:		Sample Period:		Out Mode:	
*C1 [4]:		dR Slope:		Boxcar Max:	
*C1 [5]:		dr Off Set:		RTD-SLP-385:	
Break Pt:		Refr Slope:		% of Range:	
*C2 [1]:		Refr Off Set:		User Name:	
*C2 [2]:		SpanIDAC 0:		Shop Order #:	
*C2 [3]:		ZeroIDAC 0:		Serial No.:	
*C2 [4]:		SpanIDAC 1:		Model#:	
*C2 [5]:		ZeroIDAC 1:		LCD Multiplier	

Table 4. Diagnostic Test Sequence on Display

If parameters that have an asterisk (*) have changed, this may indicate a problem. Customer Service should be contacted. If the parameters have not changed, continue with the next section.

Hardware Verification

Equipment Required:

Digital Multimeter
Screw Driver

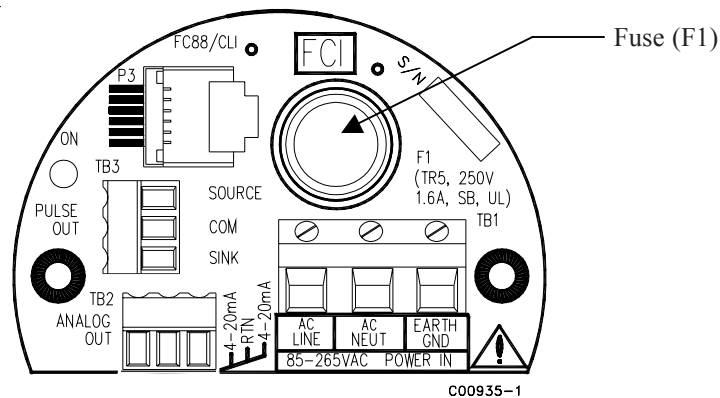
The ST50 Flowmeter is comprised of 4 basic components:

1. Sensor element.
2. Customer interface circuit board
3. Control circuit assembly circuit board module.
4. Electronics enclosure.

Step 1

Verify fuse (F1) located on the customer interface circuit board is in normal working condition.

Remove power from the instrument. Open the electronics enclosure exposing the customer interface circuit board. This circuit board is located under the shorter enclosure lid along with all of the power and input/output connections. Unscrew the clear cover on the fuse and pull the fuse out of the fuse holder. Check the fuse for continuity. If fuse reads open, replace with equivalent component (FCI part no. 019933-01), Wickmann Inc. series 374, amp code 1160, package 41.

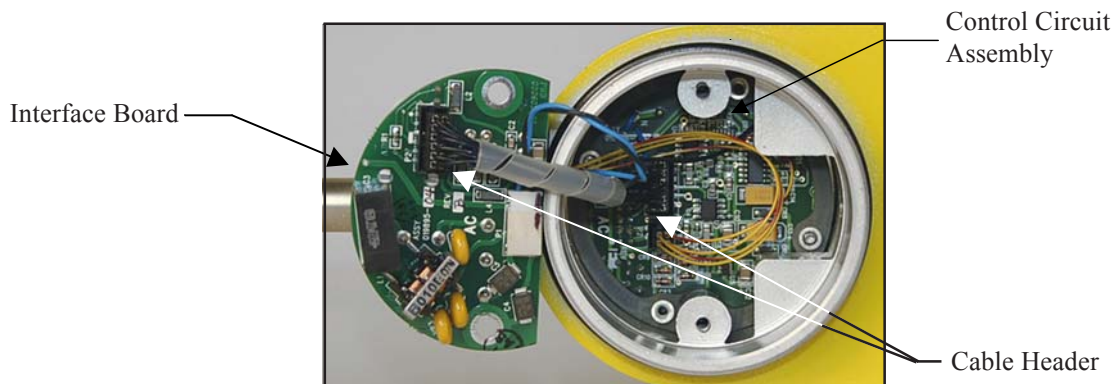


Ac power customer interface circuit board shown. Fuse (F1) on DC power customer interface circuit board located in similar position.

Step 2

Verify interconnecting cable from the customer interface board and the control circuit board assembly module are correctly seated into the appropriate header.

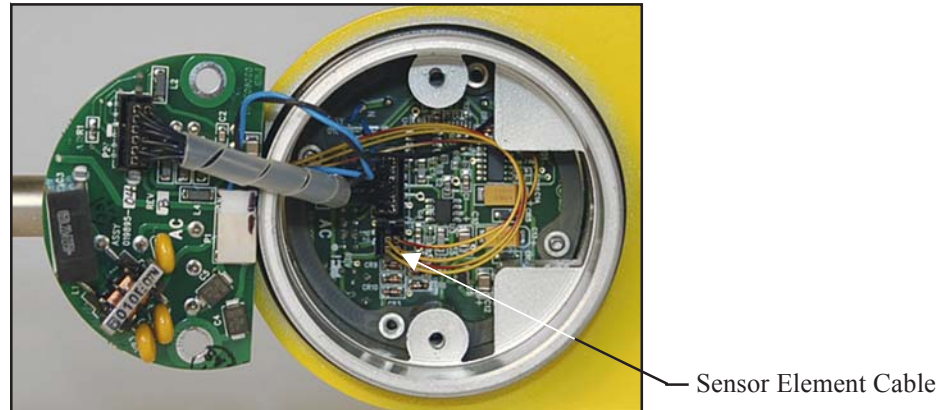
Remove power from the instrument. Open the electronics enclosure exposing the customer interface circuit board. This circuit board is located under the shorter enclosure lid along with all of the power and input/output connections. Remove the 2 screws securing the interface circuit board to the electronics enclosure. Carefully lift the interface face board exposing the interconnecting cable between the interface board and the control circuit assembly. Verify cable is seated firmly at both ends of the cable header.



Step 3

Verify sensor element continuity and resistance.

Remove sensor element cable from the bottom of the control circuit assembly. Note that 2 of the wires have a red stripe and are located closest to the interconnecting cable header. Using an ohm meter verify that resistance between the 2 red striped wires is approximately 1100 ohms +/- 20. This resistance is temperature dependant. The resistance at 70 degrees F should be 1082 ohms. Verify the resistance between the 2 natural colored wires are approximately the same.



Transmitter Circuit Calibration Check (Delta R Verification)

References

Delta ‘R’ Data Sheet

Equipment

FC88 Communicator or equivalent.©

DMV

Delta R Data Sheet-Match by serial numbers

2 Precision Decade Resistance boxes, 0.1% (Largest steps: 1K Ohm, smallest steps 0.01 Ohms)

Small flat Blade Screwdriver, 3/32 inches wide blade

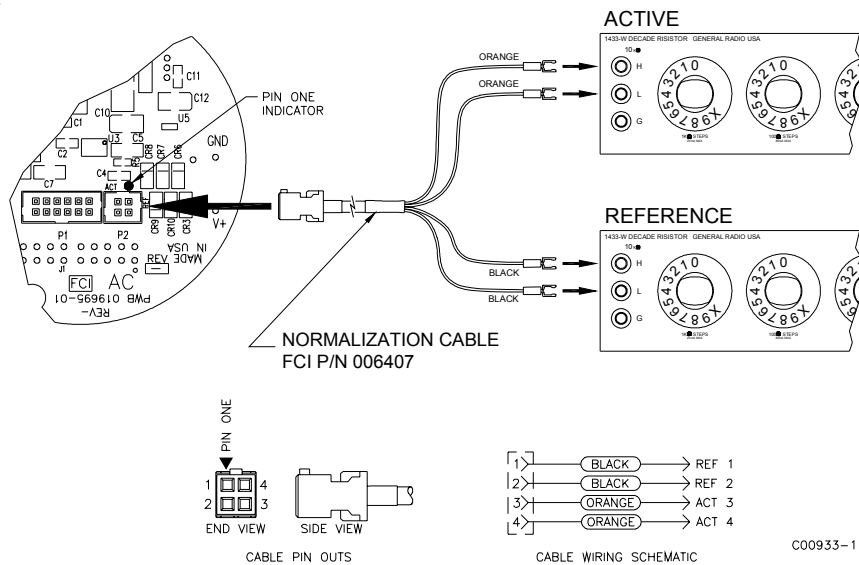
FCI Normalization Cable, FCI part number 006407

Procedure

1. Verify all “D” mode calibration parameters are correct according to the meters Delta R Data Sheet, before starting verification.
2. Turn power off
3. Mark all sensor element wires connected to the circuit board, so they may be reconnected to the proper terminals. Disconnect the wires.
4. Connect the resistance decade box to the electronics as per the appropriate diagram for the ST50.

NOTE: Interconnector wiring (resistance decade box to electronics) must be 24 AWG and 45 inches long, to avoid any inaccuracies in the Delta R verification, caused by improper wire lengths or wire gauges.

5. Set both decade boxes for the nominal resistance value (1000 ohms) +/- .01%
6. Connect DVM to the meters output termination and monitor the meter output.
7. Turn the power ON and allow the instrument 5 mins. To stabilize
8. With the FC88 connected, Press [T] [Enter] to view the Normal Operating Mode.
9. Adjust the Active Decade Box (Reference decade box remains fixed @ 1000 ohms) to achieve the appropriated Delta R for the displayed flow value and output, noted on the meters Delta R Data Sheet.
10. Note the [C] mode and verify the meters displayed TCDR and REFR values corresponding to the displayed flow rate as per the meters Delta R Data Sheet.
11. Return to the [T] mode to continue the verification.



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Appendix A - Approval Information

EC Information



EC DECLARATION OF CONFORMITY Model ST50

We, *Fluid Components International LLC*, located at 1755 La Costa Meadows Drive, San Marcos, California 92078-5115 USA, declare under our sole responsibility that the **ST50 Flowmeter Product Family**, to which this declaration relates, are in conformity with the following standards and Directives

Directive 94/9/EC ATEX

Certified by KEMA QUALITY B.V. (0344): Utrechtseweg 310, 6812 AR, Arnhem, The Netherlands
Type Examination Certificate No: KEMA 06ATEX0207 X, satisfies EN60079-15: 2003 and EN50281-1-1: 1998 + A1 requirements.

Directive 2004/108/EC EMC

Immunity specification: EN 61000-6-2: 2005
Emissions specification: EN 61000-6-4: 2007

Directive 2006/95/EC Low Voltage

Electrical Safety Specification: EN 61010-1: 2001, 2nd Edition

Directive 97/23/EC Pressure Equipment

The ST50 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.

*Issued at San Marcos, California USA
27, January 2010*

 Eric Wible
2010.01.28
17:04:54 -08'00'

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 92078 USA 760-744-6950 • 800-854-1993 • 760-736-6250
European Office: Persephonestraat 3-01 5047 TTTilburg – The Netherlands – Phone 31-13-5159989 • Fax 31-13-5799036

Doc no. 23EN000017D

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Appendix B - List Commands

COMMAND MNEMONIC	COMMAND FUNCTION	COMMAND DESCRIPTION
A	R	AvgDelta_r, AvgRef
B	R	Delta_r, Ref_r
C	R	Tcdelta_r, Ref_r
D	R	Diagnostics
F	R/W	Kfactors
G	R/W	Clear FlashEE, Boxcar Count, ADC to Ohms Cal
K	R/W	Cal Parameters
L	R/W	Output Cal
N	W	Warm Restart
R	W	Factory Restore
S	R/W	Totalizer Menu On/Off
T	R	Normal Mode
V	R/W	Output Config
W	R/W	Totalizer
Y	W	Command Line Interface
Z	W	Flow units, Pipe Size, and LCD Scaling

Table 5. ST50 List of Single Letter Commands

COMMAND MNEMONIC	COMMAND FUNCTION	COMMAND DESCRIPTION	DATA TYPE
BK	R/W	Break Point	Float
BM	R/W	Boxcar Filter Max	Integer
CM	R/W	Cminflow	Float
CR	R/W	Calibration Ref	Float
CX	R/W	Cmaxflow	Float
C1[1-5]	R/W	Coefficients set1	Float
C2[1-5]	R/W	Coefficients set2	Float
DI	R	Diagnostics	Null
DM	R/W	DeltaR Minimum	Float
DN	R/W	Density	Float
DR	R	Delta R	Float
DX	R/W	DeltaR Maximum	Float
DS	R/W	DeltaR Slope	Float
DF	R/W	DeltaR Offset	Float
EU	R/W	Engineering Units	Integer
FF	R/W	Flow Factor	Float
FP	R/W	Fix Point Flag	Integer
F0	R/W	Pulse Out State0	Integer
F1	R/W	Pulse Out State1	Integer
HR	R/W	Tot Dump Hours Cntr	Integer
IF	R/W	I Factor	Float

Table 6. ST50 List of CLI Commands

Table 6. ST50 List of CLI Commands, Cont.

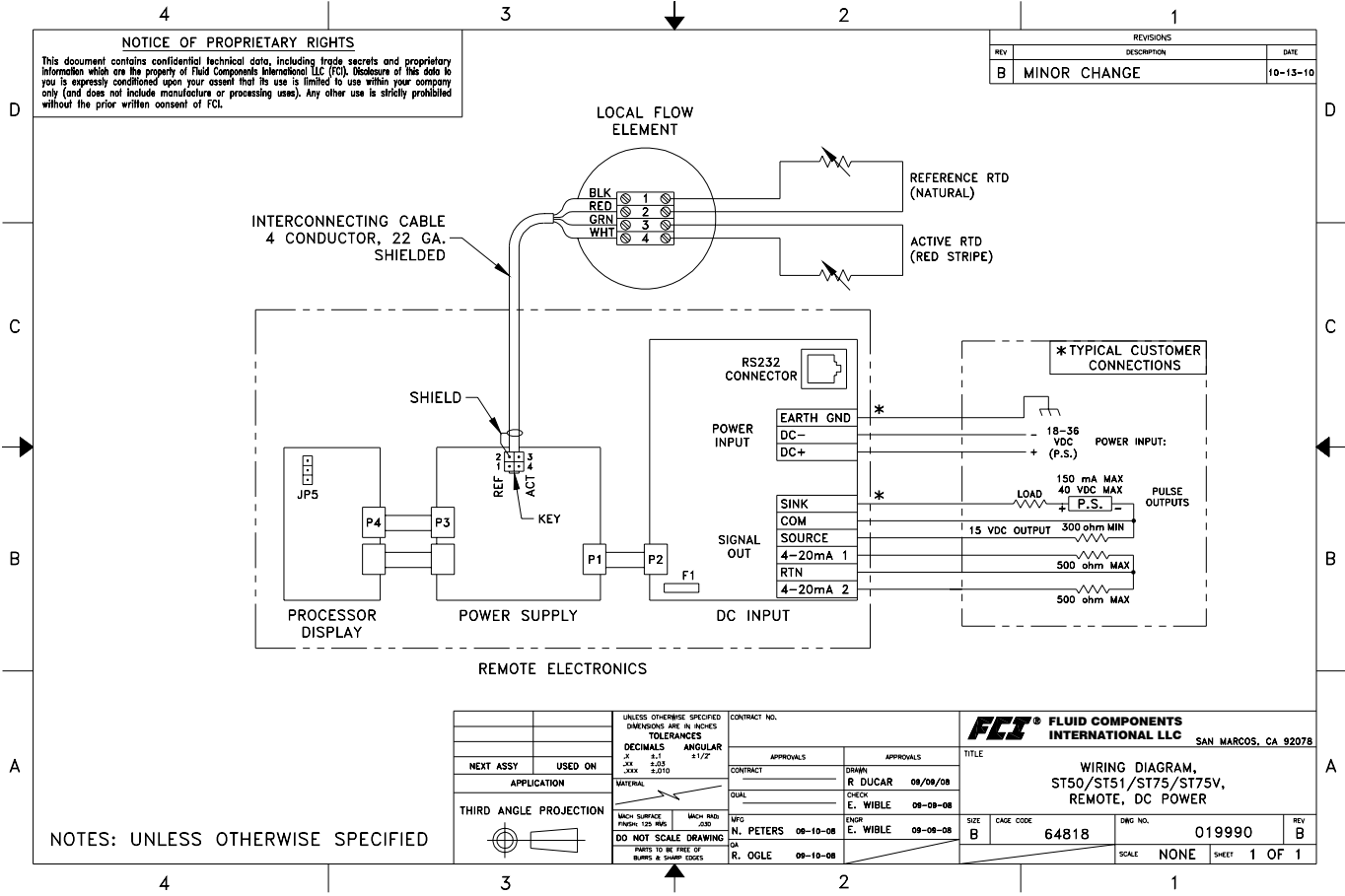
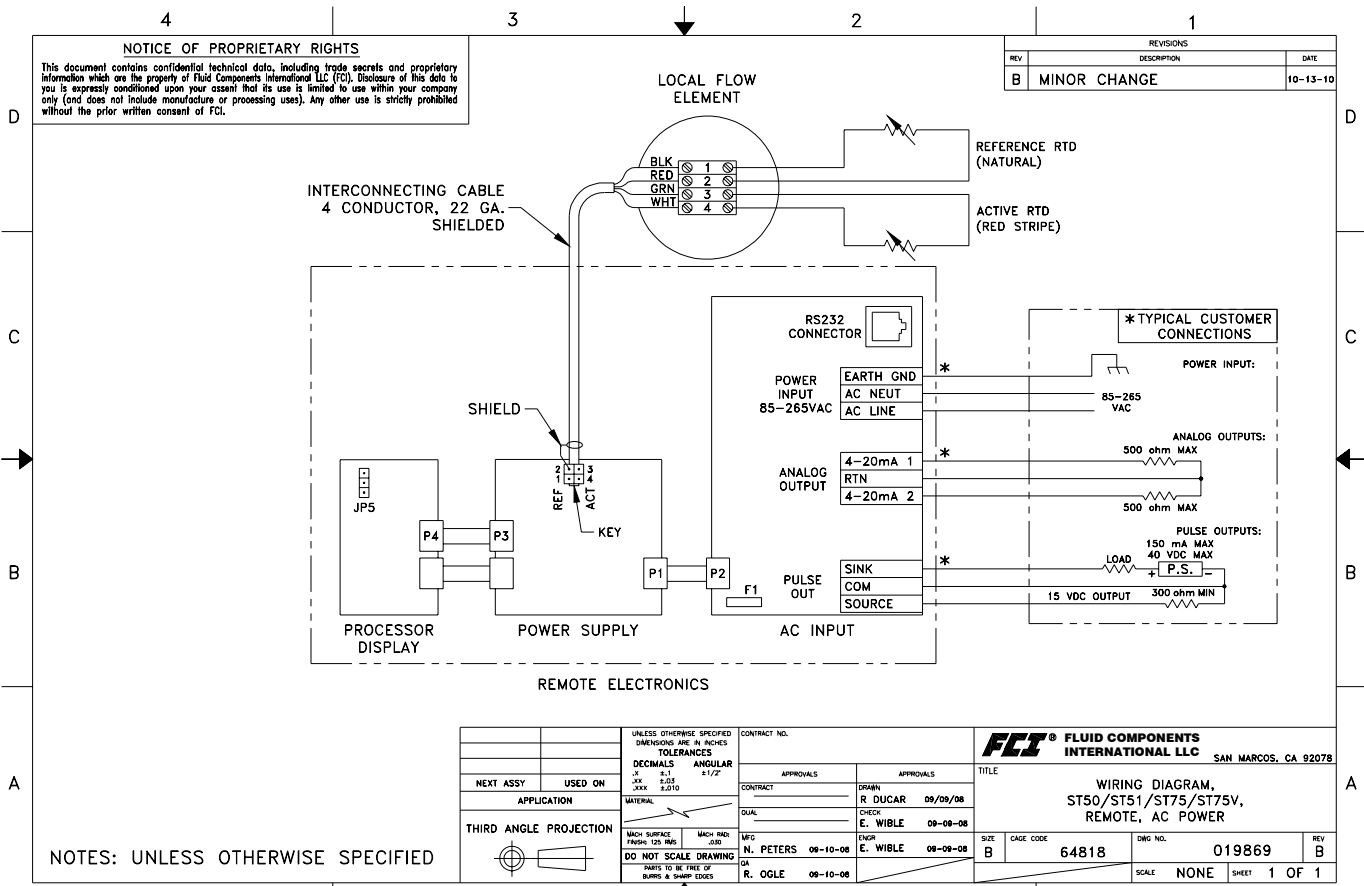
COMMAND MNEMONIC	COMMAND FUNCTION	COMMAND DESCRIPTION	DATA TYPE
K[1-4]	R/W	K Factors	Float
L0	R/W	Line Size0	Float
L1	R/W	Line Size1	Float
MN	R/W	Minflow	Float
MX	R/W	Maxflow	Float
OM	R/W	Outmode	Integer
PF	R/W	Pulse Factor	Float
PL	R/W	Pulse Out	Integer
PS	R/W	Pulse Sample Period	Float
PW	R/W	Pulse Width	Float
P0	R/W	Switch Point0	Integer
P1	R/W	Switch Point1	Integer
RO	R/W	RollOver Cntr	Long
RR	R	Reference R	Float
RS	R/W	RefR Slope	Float
RF	R/W	RefR Offset	Float
SF	R	SFPS Flow	Float
SN	R/W	Serial Number	String (16 chars max.)
SO	R/W	Shop Order Number	String (16 chars max.)
S0	R/W	SpanDAC0 for 4-20mA #1	Integer
S3	R/W	SpanDAC1 for 4-20mA #2	Integer
S2	W	Save FACTORY	N/A
TC	R	TCdeltar	Float
TD	R/W	Teslp	Float
TF	R/W	Totalizer OFF/ON Flag	Integer
TM	R/W	Cmintemp	Float
TP	R/W	Totalizer Temperature Flag	Integer
TT	R/W	Totalizer Value	Float
TX	R/W	Cmaxtemp	Float
TZ	R	Temperature	Float
T0	R/W	Teslp0	Float
T2	R/W	Teslp2	Float
T3	R/W	TSpanDAC0 for 4-20mA #1	Integer
T7	R/W	TSpanDAC1 for 4-20mA #2	Integer
T5	R/W	TZeroDAC0 for 4-20mA #1	Integer
T8	R/W	TZeroDAC1 for 4-20mA #2	Integer
UF	R	User Flow	Float
UK	R	User FlowK	Float
UN	R/W	User Name	String (16 chars max.)
VN	R	Version Number	String (16 chars max.)
XX	R/W	Test Flow Rate (SFPS)	Float
XY	W	Delete Test Flow Rate	Float
Z0	R/W	ZeroDAC0 for 4-20mA #1	Integer
Z2	R/W	ZeroDAC1 for 4-20mA #2	Integer

Command Line Password: 357

NOTE: When invoking a Write Function, there must be a space separating the Command characters and the data value. All Read and Write Functions are completed with a <CR>. To exit CLI, press <CR> following the last Command <CR>.

Examples: RBK<CR> (Read Breakpoint)
 WBK 2222<CR> (Write Breakpoint 2222)
 RC11<CR> (Read Coefficient C1,1)
 WC11 -234.567<CR> (Write Coefficient C1,1, -234.567)
 <CR> (Leave Command Line Mode)

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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.

Point of Contact

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

Warranty Repairs or Returns

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

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

Non-Warranty Repairs or Returns

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

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.



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

RA # _____

Return Authorization Request

1. Return Customer Information

Returning Company's Name: _____ Phone# _____
Return Contact Name: _____ Fax # _____
Email Address: _____

2. Return Address

Bill To: _____ Ship To: _____

3. Mandatory End User Information

Contact: _____ Company: _____ Country: _____

4. Return Product Information

Model No: _____ Serial No(s): _____
Failure Symptoms (Detailed Description Required): _____
What Trouble Shooting Was Done Via Phone or Field Visit by FCI: _____
FCI Factory Technical Service Contact: _____

5. Reason For Return [] Sensor Element [] Electronics [] As Found Testing [] Credit
[] Recalibrate (New Data) [] Recalibrate (Most Recent Data) [] Other
(Note: A new Application Data Sheet (ADS) must be submitted for all recalibrations and re-certifications)

6. Payment Via [] Faxed Purchase Order [] VISA [] MasterCard

(Note: A priced quotation is provided for all Non-Warranty repairs after equipment has been evaluated. All Non-Warranty repairs are subject to a minimum evaluation charge of \$250.00)

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

Visit FCI on the Worldwide Web: www.fluidcomponents.com

1755 La Costa Meadows Drive, San Marcos, California 92078 USA ‡ Phone: 760-744-6950 ‡ 800-854-1993 ‡ Fax: 760-736-6250

FCI Document No. 05CS000004C



The following Return Authorization Request form and Decontamination Statement **MUST be completed, signed and faxed back to FCI before** a Return Authorization Number will be issued. The signed Decontamination Statement and applicable MSDS Sheets **must be included with the shipment**. FCI will either fax, email or telephone you with the Return Authorization Number upon receipt of the signed forms.

Packing Procedures

1. **Electronics** should be wrapped in an **anti-static** or **static-resistant** bag, then wrapped in protective bubble wrap and surrounded with appropriate dunnage* in a box. Instruments weighing **more than 50 lbs., or extending more than four feet**, should be secured in wooden crates by bolting the assemblies in place.
2. **The sensor head must be protected** with pvc tubing, or retracted the full length of the probe, locked and secured into the Packing Gland Assembly (cap screws tightened down).
3. FCI can supply crates for a nominal fee.
4. No more than **four (4)** small units packaged in each carton.
5. **FCI will not be held liable for damage caused during shipping.**
6. To ensure immediate processing **mark** the RA number on the outside of the box. Items without an RA number marked on the box or crate may be delayed.
7. Freight **must be "PrePaid"** to FCI receiving door.

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

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

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

Certification Of Decontamination

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

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

Process Flow Media _____

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

Print Name _____

Authorized Signature _____ Date _____

Company Title _____

Instrument Warranty

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



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