OPERATION AND MAINTENANCE MANUAL

microtuf®

MODEL FS4200 SERIES – MASS FLOW SWITCH

MODEL LS3200 SERIES – POINT LEVEL SWITCH

DOCUMENT 3242-OM-04

REVISION 4

MARCH 2002

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MODEL NO.________________ SERIAL NO.________________________

DATE OF SHIPMENT ____________ INSTALLATION DATE__________

CUSTOMER TAG NO.____________ PO NO.______________________

OPTIONS____
____

SPECIAL NOTES____
____

BEFORE STARTING

DELTA M appreciates your choosing our product for your liquid level or liquid/gas flow switching application. We are committed to providing reliable, quality instrumentation to our customers.

To ensure the maximum and intended benefit of this instrument, we encourage you to read this brief operation and maintenance manual in its entirety prior to unpacking and installing the unit.

The following precautions should be noted immediately:

- **USE A 1 1/8 INCH (28.575mm) OPEN-END WRENCH TO TIGHTEN AT THE HEX FLATS OF THE MNPT OF A STANDARD SWITCH. (IF YOU HAVE A NON-STANDARD SWITCH AN ALTERNATE SIZE WRENCH MAY BE REQUIRED). DO NOT USE THE INSTRUMENT HEAD TO TIGHTEN THE SWITCH TO THE MOUNTING PORT. ROTATION OF THE INSTRUMENT HEAD WITH RESPECT TO THE SENSOR BODY CAN CAUSE INTERNAL WIRING DAMAGE (SEE FIGURES 1).**

- **THE SWITCH BODY MUST BE ORIENTED TO HAVE THE TWIN SENSORS PARALLEL TO THE LEVEL BEING DETECTED WHEN BEING INSTALLED HORIZONTALLY FOR POINT LEVEL APPLICATIONS. LIKEWISE, FOR FLOW APPLICATIONS, THE SWITCH BODY MUST BE ORIENTED TO HAVE THE TWIN SENSORS PERPENDICULAR TO THE FLOW BEING DETECTED. DUE TO THE PIPE THREAD MOUNTING, IT MAY BE NECESSARY TO MAKE A TRIAL FIT, ADD OR REMOVE TEFLON TAPE OR OTHER PIPE THREAD SEALANT, AND REINSTALL TO ACHIEVE A SATISFACTORY SEAL WITH THE SENSORS PROPERLY ORIENTED. FOR VERTICAL INSTALLATIONS FOR POINT LEVEL DETECTION THE ORIENTATION MAKES NO DIFFERENCE. PROPER ORIENTATION IS MARKED ON THE SWITCH BODY FOR REFERENCE (SEE FIGURE 5).**

- **A GROUND WIRE MUST BE ATTACHED TO THE GROUND SCREW LOCATED INSIDE THE INSTRUMENT ENCLOSURE FOR PROPER OPERATION. FOR CENELEC/CE OPTION THE GROUND SCREW IS LOCATED OUTSIDE THE BODY OF THE INSTRUMENT ENCLOSURE (SEE FIGURE 6).**

- **BE SURE TO APPLY THE PROPER VOLTAGE AS CONFIGURED AT THE FACTORY. DO NOT APPLY 115 VAC TO 24 VDC VERSIONS OR 24 VDC TO 115 VAC VERSIONS. (LIKEWISE 230 VAC).**

- **FOR OPTIMUM OPERATION, CALIBRATION MUST BE ACCOMPLISHED AT ACTUAL PROCESS TEMPERATURE AND PRESSURE CONDITIONS IN GASES AND AT ACTUAL PROCESS TEMPERATURE CONDITIONS IN LIQUIDS.**

- **DO NOT SANDBLAST OR ABRASIVE CLEAN THE SENSING PROBES. THE SENSING PROBES COULD BE DAMAGED BY ABRASIVES.**

- **ALL DIMENSIONS GIVEN IN THIS MANUAL ARE IN INCHES (AND MILLIMETERS).**

If you have any questions prior to or during installation and calibration, please do not hesitate to call the factory for assistance. We want to ensure the very best possible installation and operational results for your benefit.

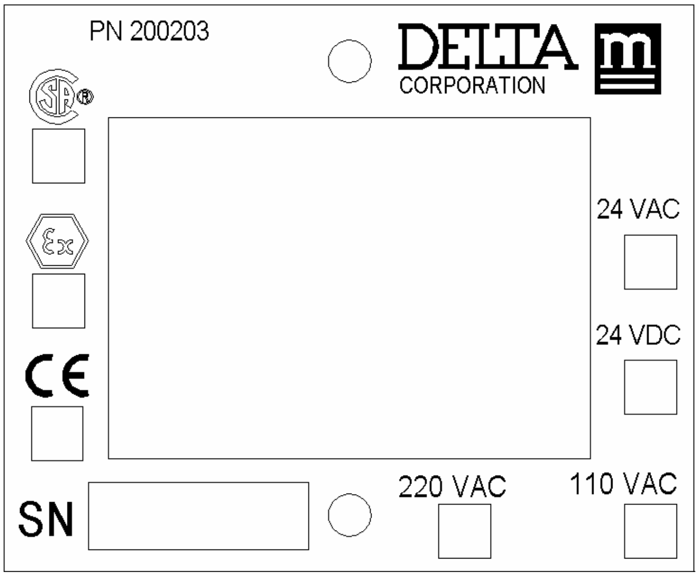
NOTICE

This manual covers the following model numbers:

microtuf® Series Models		FS4200	LS3200
Agency Approvals	Explosion-Proof rating	Mass Flow Switch	Point Level Switch
CENELEC European	EEx d IIB T4 (Killark Enclosure) EEx d IIC T4 (Akron Electric Enclosure) See Figure 1A and 1B	FS42CN	LS32CN
CSA Canadian Standards	T4A Class I, Group B,C,D Class II, Group E,F,G (Both Akron Electric and Killark)	FS42CS	LS32CS
Non-Approved	Non-Explosion Proof	FS42NX	LS32NX
Switch Kits (No Enclosures)	Not Rated	FS42SK	LS32SK
CE	EMC Directive: 89/336/EEC	Option – CE	Option -CE

SPECIAL NOTICE

The electronic assemblies contained in the microtuf® models are configured for specific voltages and have specific modifications to accommodate the various agency approvals. When ordering spare electronics, replacements, or exchanges in the field please ensure you identify the specific configuration you have by noting the boxes marked on the transformer configuration tag.



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1.0 INTRODUCTION

The DELTA M microtuf® Switch is the state-of-the-art in gaseous and liquid flow switching or liquid level control. Flow or level detection is accomplished by using a high resolution **thermal differential** technique. The sensor wetted parts are of durable 316 series stainless steel, all welded construction with no moving parts. The switch is easy to install and adjust, giving reliable, low maintenance performance in the most demanding applications.

2.0 DESCRIPTION

The microtuf® Switch uses a **thermal differential** technique to sense changes in the heat transfer characteristics of a media. Figures 1A and 1B show the outline of the microtuf® Switch. The sensor consists of a pair of matched, Resistance Temperature Detectors (RTD's) encased in twin 316 series stainless steel tubes. One RTD is self-heated using a constant DC current. The other RTD is unheated to provide an accurate process temperature reference. The **thermal differential** created between the heated and reference RTD pair is a function of the density and/or velocity of the media with which the sensor is in contact. Other physical properties may have a secondary effect as well. The differential is greatest at a no flow (or dry) condition and decreases as the rate of flow increases (or as a liquid quenches the sensor/wet condition).

The DELTA M Corporation sensor excitation method relies on constant current to the heated and reference sensors. Thus power to the heated sensor is not constant but changes linearly with temperature as the sensor resistance changes. Temperature compensation is accomplished by using the amplified reference sensor voltage which also changes linearly with temperature, as a dynamic reference. During calibration dry/no flow and wet/full flow conditions are impressed across the trip point potentiometer. Since this reference is not fixed but is set with respect to the reference sensor voltage, as temperature changes the trip point potentiometer voltage changes with temperature exactly the same as that of the heated sensor voltage with which it is being compared. Thus full temperature compensation is achieved with non constant power.

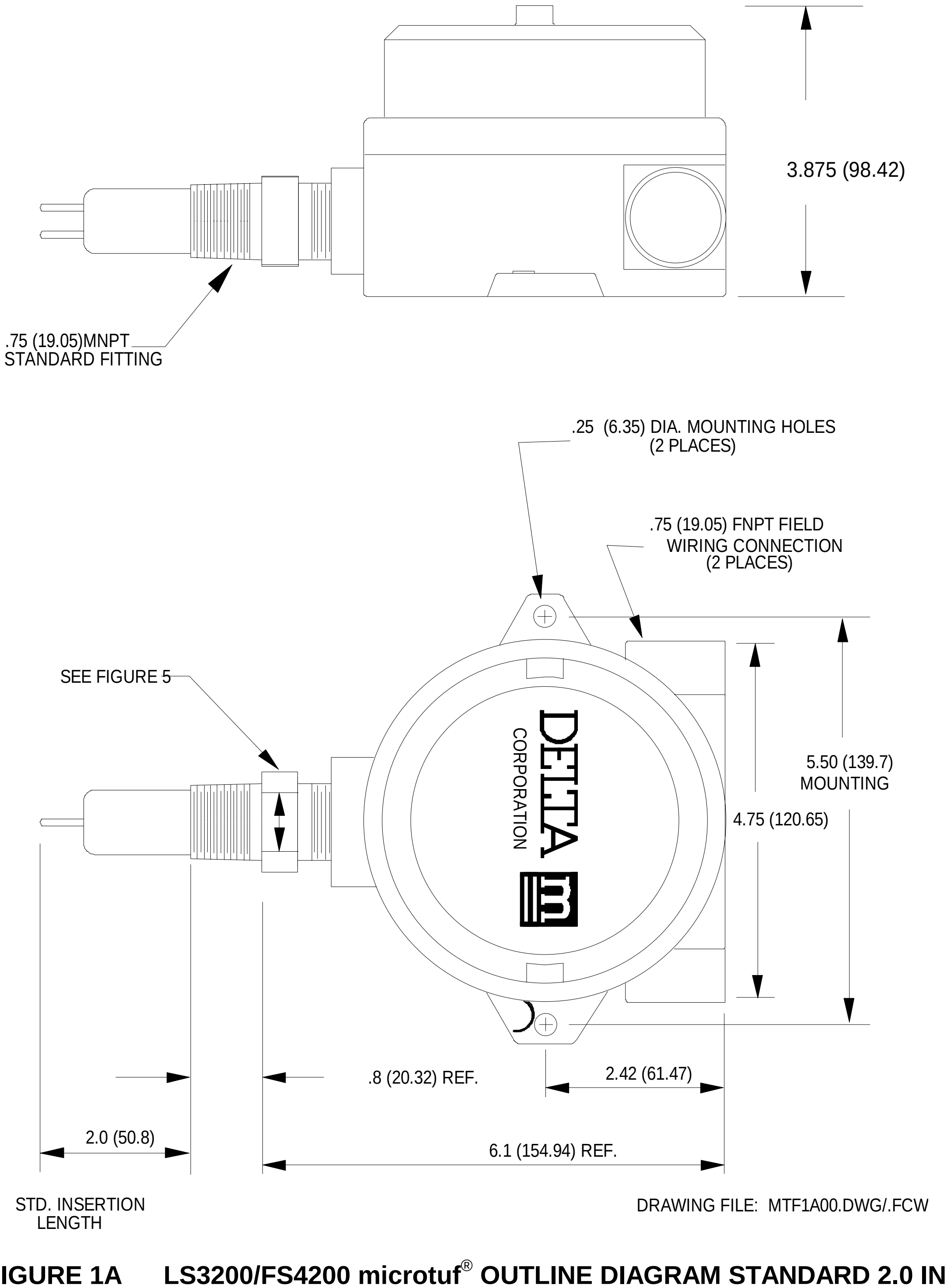
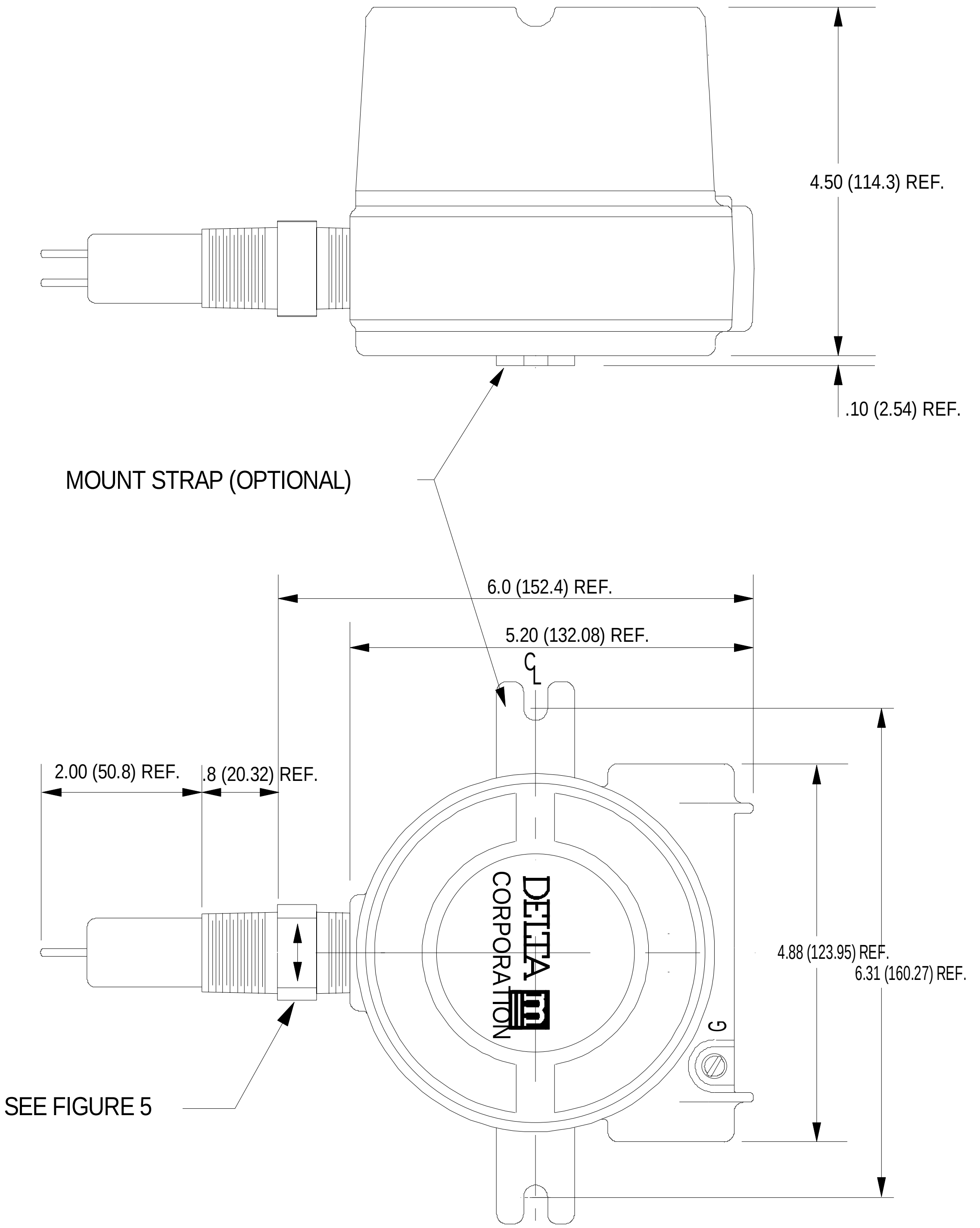


FIGURE 1A LS3200/FS4200 microtuf® OUTLINE DIAGRAM STANDARD 2.0 INCH INSERTION (KILLARK ENCLOSURE – NEMA 4-EExd 11B, T4) (MTF1A00.DWG/.FCW)



DRAWING FILE: MTF1B00.DWG /.FCW

DIMENSIONS IN INCHES (MILLIMETERS)

FIGURE 1B LS3200/FS4200 microtuf® OUTLINE DIAGRAM STANDARD 2.0 INCH INSERTION (AKRON ELECTRIC ENCLOSURE – NEMA 4X – EexdIIC, T4) (MTF1B00.DWG/.FCW)

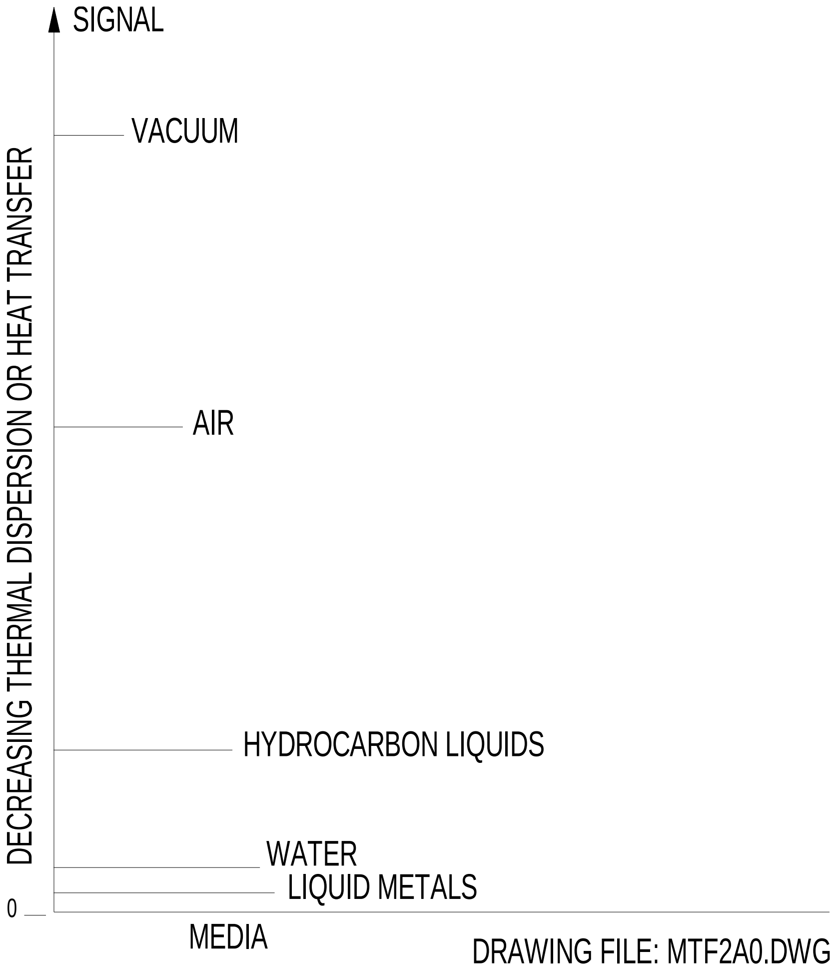
2.1 Level Switching

The thermal differential created between the heated and reference unheated RTD pair is a function of the liquid or gas medium with which the sensor is in contact.

The point level measurement application uses the heat transfer differences between two media to detect liquid level. For example, air has a relatively poor heat transfer characteristic so the heated sensor will become relatively hot. If the sensor is then immersed in water, the relatively high heat transfer characteristics of water will cool the heated RTD surface causing a decrease in the signal output.

This same rational applies for any two media in contact with the sensor. Each medium will have its own characteristic heat transfer properties. As long as there is a reasonable difference in the heat transfer properties between the two media, the microtuf® can discriminate between them. Figure 2A shows the relative signal output of the microtuf® sensor to a range of different media. The maximum difference in output occurs between vacuum and liquid metal. However, a significant difference occurs between water and hydrocarbon liquids so the microtuf ® can be used to detect a water/hydrocarbon liquid-liquid interface. In general, the interface between any two media with differing heat transfer properties can be detected.

FIGURE 2A: RELATIVE CHANGE IN RESPONSE OF A HEATED RTD IMMERSED IN VARIOUS MEDIA



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2.2 Flow Switching

Most mass flow monitoring techniques calculate mass indirectly by measuring volumetric flow such as gallons per minute or cubic cm per second, then either measure density separately or calculate it from temperature measurements of the fluid and, finally, combine density and volumetric flow to obtain mass flow. The DELTA M thermal-differential technique is one of two methods that directly measure the mass flow. For ease of comparison most flow applications are presented in terms of velocity which is independent of the flow cross sectional area (i.e. feet per second (FPS)). The true mass flow equivalent would be FPS multiplied by density but for simplicity FPS is used and density effects are ignored. This is normally not critical for flow switching applications.

When the sensor is inserted into a liquid or gas the heated RTD is strongly affected by the velocity of the medium. Flow past the heated RTD changes the heat transferred from the surface of the sensor. This cooling effect reduces the temperature of the sensor. The microtuf® compares this change to a preset flow trip point to switch the output. Figure 2B shows the model FS4200 signal change vs. flow rate for air, light hydrocarbon liquids, and water. The signal change vs velocity has the same general shape for all three media but the change is larger for air and the sensitive range is different for each. For air and most gaseous media the range is 0.1 to 500 feet per second (FPS). For most liquid media the range is 0.01 to 5 FPS. Appendices in section 9.0 contain flow conversion information to facilitate conversion from various units and pipe dimensions into flow velocity in feet per second.

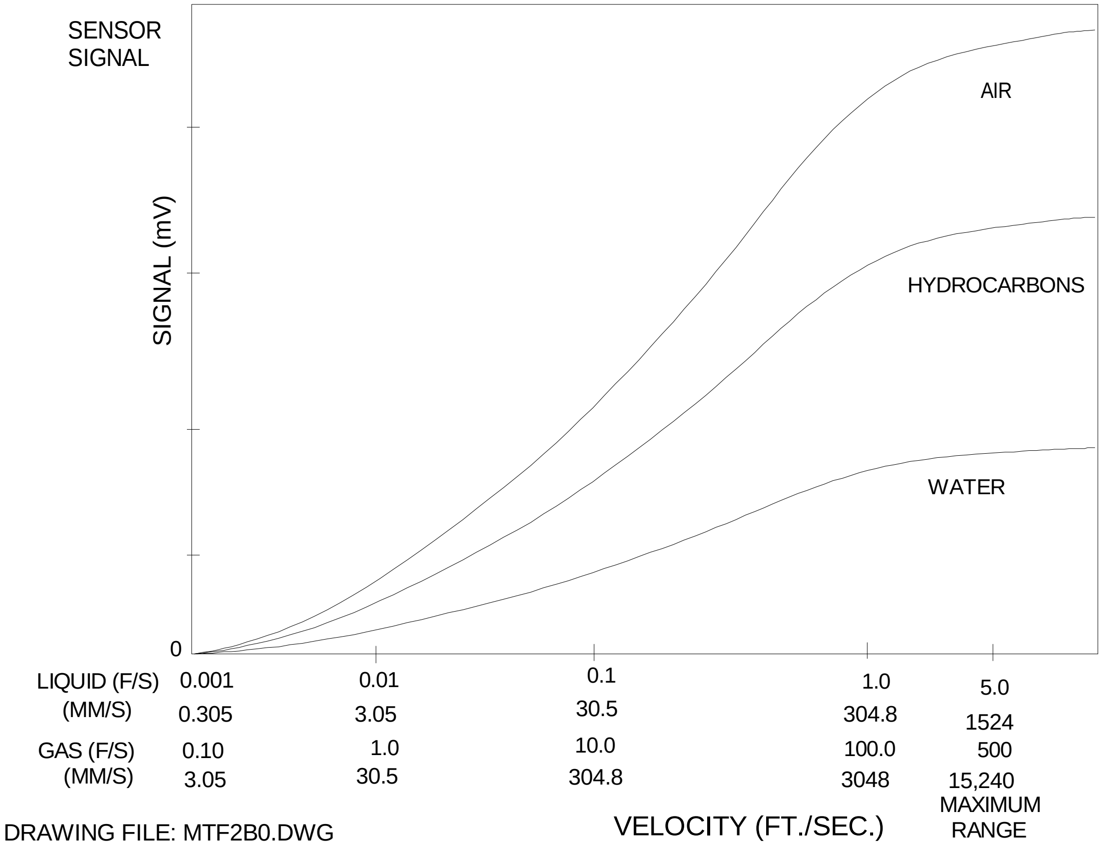

FIGURE 2B **microtuf® MODEL FS4200 FLOW RESPONSE FOR THREE MEDIA AND CALIBRATION SETTINGS FOR EACH**

Figure 3.A shows a block diagram of the microtuf® switch.

Once the switch is set to respond to the minimum and maximum flow rates (or wet vs. dry conditions), the trip point is set by adjusting the Trip Adjust Potentiometer. Solid state electronics transform the flow (or wetting) induced temperature differential into a voltage that is compared to a control voltage. Matching voltages cause actuation of a relay to indicate a change in state (flow vs. no-flow or dry vs. wet).

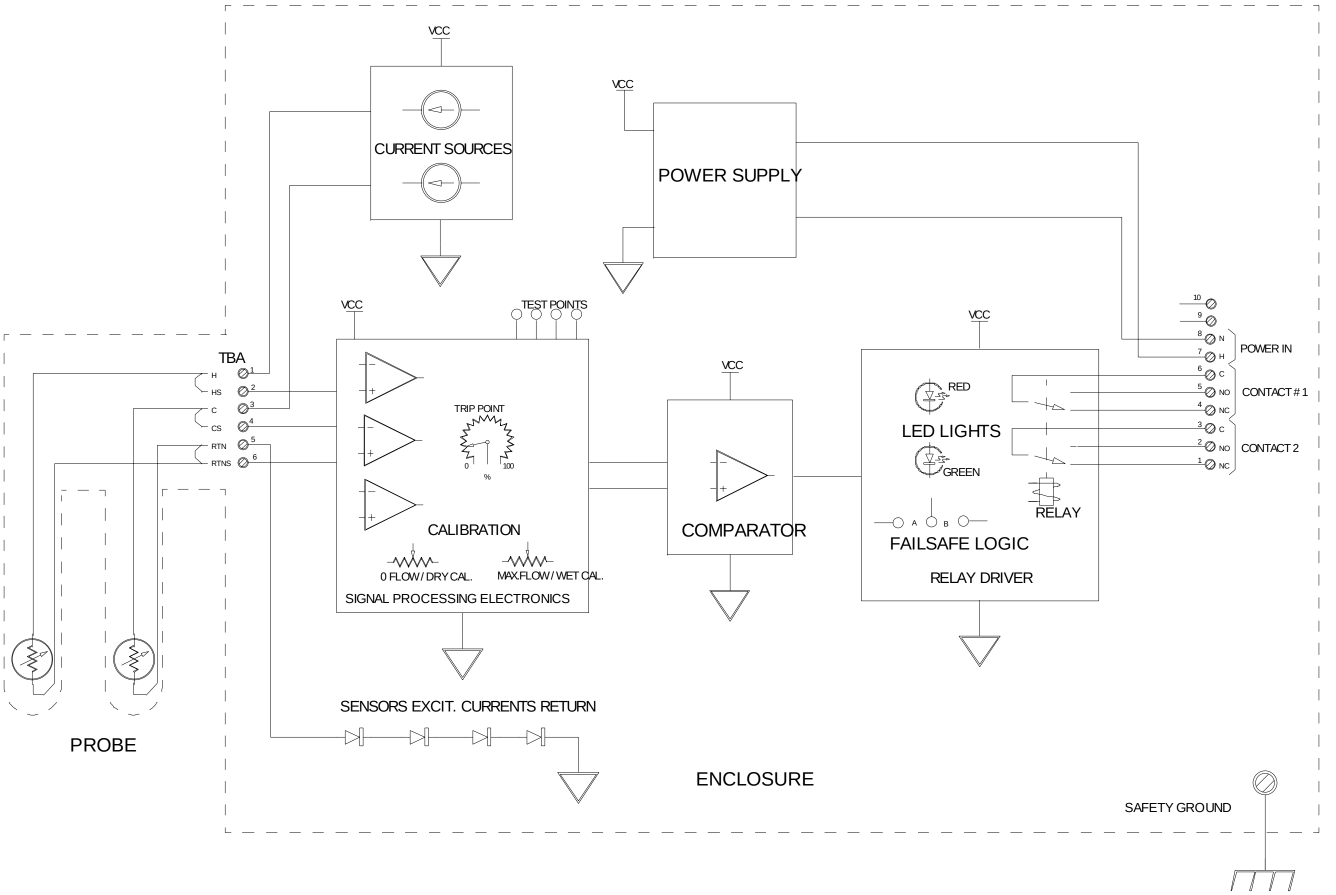

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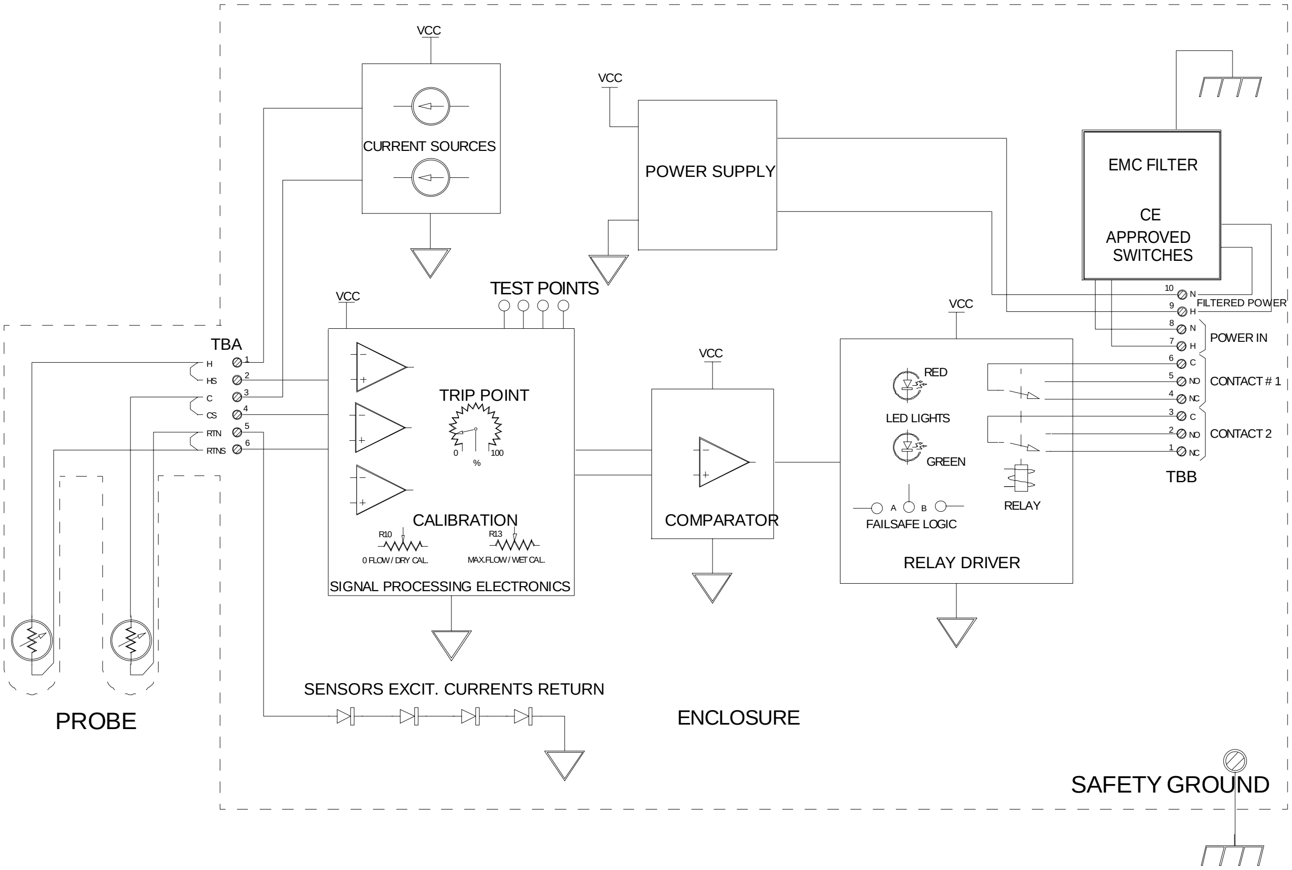
FIGURE 3A: MICROTUF SERIES SWITCH BLOCK DIAGRAM
MODELS LS32CS/FS42CS, LS32CN/FS42CN, LS32NX/FS42NX,
AND LS32SK/FS42SK
(MTF3A00.DWG/.FCW)

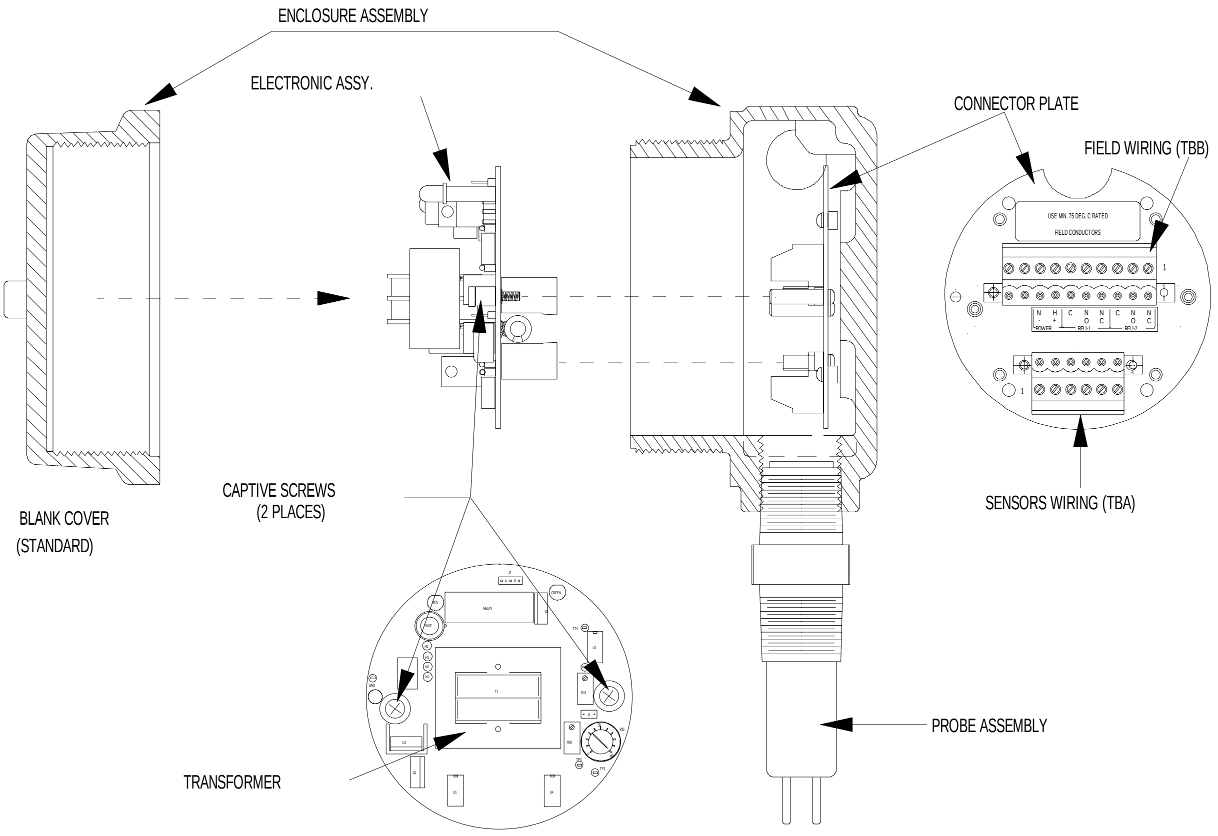
Figure 3B shows a block diagram of the microtuf® switch with the addition of an EMC filter required for the CE options (see section 7.0).



DRAWING FILE: MTF3B00.DWG

FIGURE 3B: MICROTUF MODELS **WITH THE CE OPTION** SWITCH BLOCK DIAGRAM (MTF3B00.DWG)

The instrument enclosure at the top of unit contains the microtuf® Switch electronics board which is removable to access the terminal block and facilitate field wiring (see Figure 4.0). For applications where the electronics must be located away from the sensors due to elevated process temperature, accessibility, etc., another instrument head containing the electronics is remotely located (See option RE-Remote Electronics section 3.2.2).



DRAWING FILE: MTF400.DWG /.FCW

FIGURE 4 microtuf® SWITCH ASSEMBLY (MTF400.DWG/.FCW)

3.0 INSTALLATION

3.1 Mechanical Installation

The standard microtuf® Switch has a .75 inch (19.05mm) MNPT mount designed for easy installation through a threaded port. Optional configurations include .5” (12.7mm) or 1.0” (25.4mm) MNPT and flange mounts. Conduit is recommended for all wiring to the switch.

IMPORTANT

USE A 1 1/8 INCH (28.575mm) OPEN-END WRENCH TO TIGHTEN AT THE HEX FLATS OF THE MNPT OF A STANDARD SWITCH. (IF YOU HAVE A NON-STANDARD SWITCH AN ALTERNATE SIZE WRENCH MAY BE REQUIRED). DO NOT USE THE INSTRUMENT HEAD TO TIGHTEN THE SWITCH TO THE MOUNTING PORT. ROTATION OF THE INSTRUMENT HEAD WITH RESPECT TO THE SENSOR BODY CAN CAUSE INTERNAL WIRING DAMAGE.

IMPORTANT

THE SWITCH BODY MUST BE ORIENTED TO HAVE THE TWIN SENSORS PROPERLY ORIENTED. DUE TO THE PIPE THREAD MOUNTING, IT MAY BE NECESSARY TO MAKE A TRIAL FIT, ADD OR REMOVE TEFLON TAPE OR OTHER PIPE THREAD SEALANT, AND REINSTALL TO ACHIEVE A SATISFACTORY SEAL WITH THE SENSORS PROPERLY ORIENTED. PROPER ORIENTATION IS MARKED ON THE SWITCH BODY FOR REFERENCE. SEE FIGURE 5.0 FOR DETAILS.

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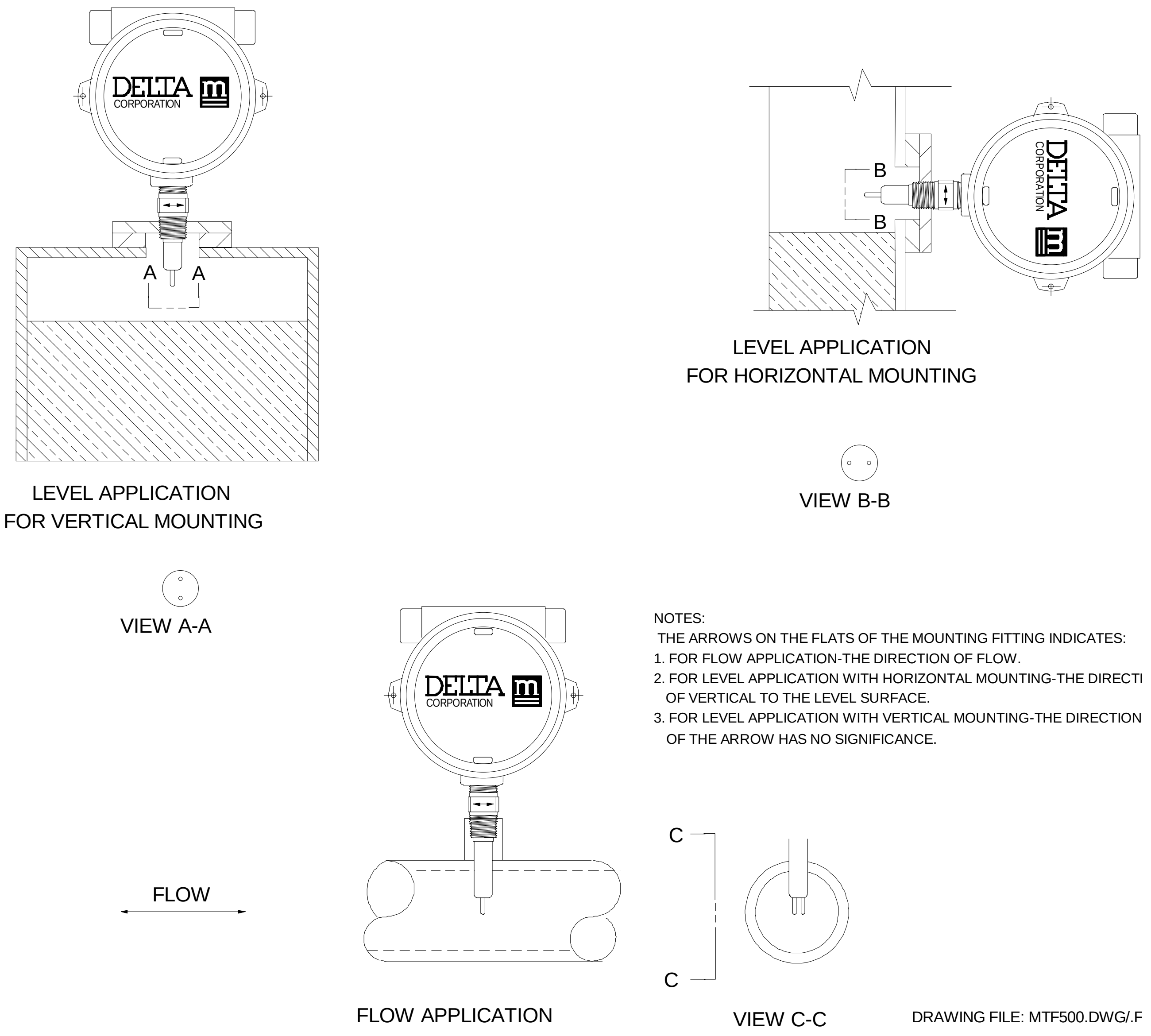


NOTES:
THE ARROWS ON THE FLATS OF THE MOUNTING FITTING INDICATES:
1. FOR FLOW APPLICATION-THE DIRECTION OF FLOW.
2. FOR LEVEL APPLICATION WITH HORIZONTAL MOUNTING-THE DIRECTI
OF VERTICAL TO THE LEVEL SURFACE.
3. FOR LEVEL APPLICATION WITH VERTICAL MOUNTING-THE DIRECTION
OF THE ARROW HAS NO SIGNIFICANCE.

FIGURE 5: PROPER ORIENTATION OF THE SENSOR PROBE FOR LEVEL AND FLOW APPLICATION IS INDICATED BY THE ARROW ON THE FLAT OF THE MOUNTING FITTING. (MTF500.DWG/.FCW)

3.2 Electrical Installation

3.2.1 microtuf® Local Electronics (LE Option/Standard)

Remove the instrument enclosure lid by unscrewing in a counter clockwise direction. Unscrew (CCW) the printed circuit board captive screws (See Figure 4.0 for locations). Remove the PC board by grasping the transformer and pulling it straight out. Connect power and alarm relay wiring to Terminal Block (TBB) as shown in Figure 6.0. Reinstall the microtuf® Switch electronics and tighten the captive screws.

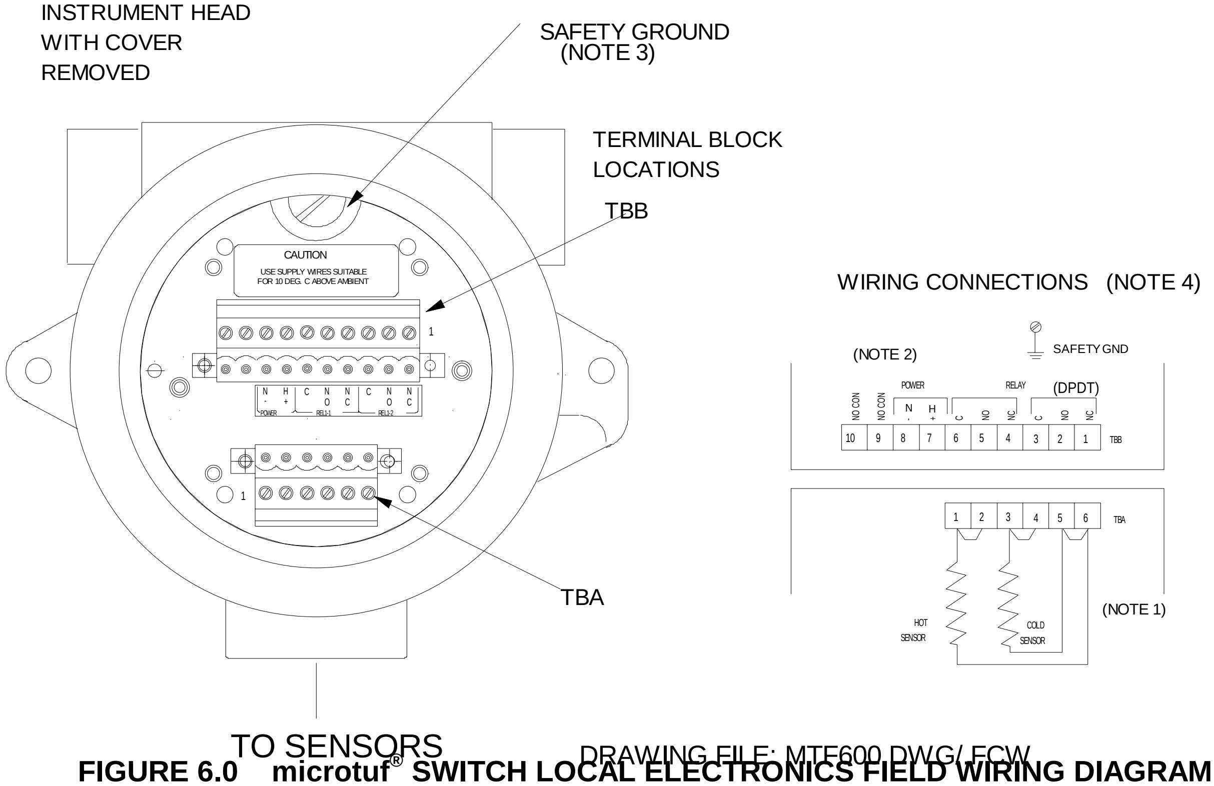


FIGURE 6.0 microtuf® SWITCH LOCAL ELECTRONICS FIELD WIRING DIAGRAM (MTF600FCW/.DWG)

NOTES:

1. **Connections to sensors terminal block A (TBA) are factory installed and should not be disconnected in the field. Note Jumpers 1-2, 3-4, and 5-6 must be in place on TBA for proper operation of local electronics.**
2. **For 24 VDC operation (factory prepared), connect +positive to TBB7 and –negative return to TBB8. For 115 VAC or 230 VAC connect hot to TBB7 and neutral to TBB8.**
3. **Connect ground wire to ground screw located in or on the instrument enclosure.**
4. **Use supply wires suitable for 10 Degree C above ambient.**

IMPORTANT

A GROUND WIRE MUST BE ATTACHED TO THE GROUND SCREW LOCATED INSIDE OR OUTSIDE OF THE INSTRUMENT ENCLOSURE FOR PROPER OPERATION.

3.2.2 Remote Electronics (RE Option)

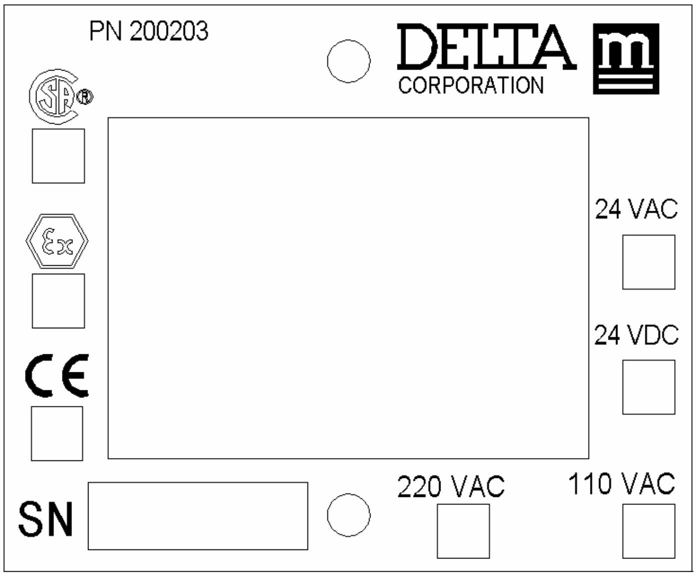
For the remote electronics option, mount the remote instrument head using two mounting wings or bracket provided. Connect the switch wiring between the microtuf® Switch remote electronics as shown in Figure 7.0. Connect power wiring and alarm relay wiring to the remote enclosure as shown in Figure 7.0. Upon completion of wiring reinstall the microtuf® Switch electronics and secure with the captive screws.

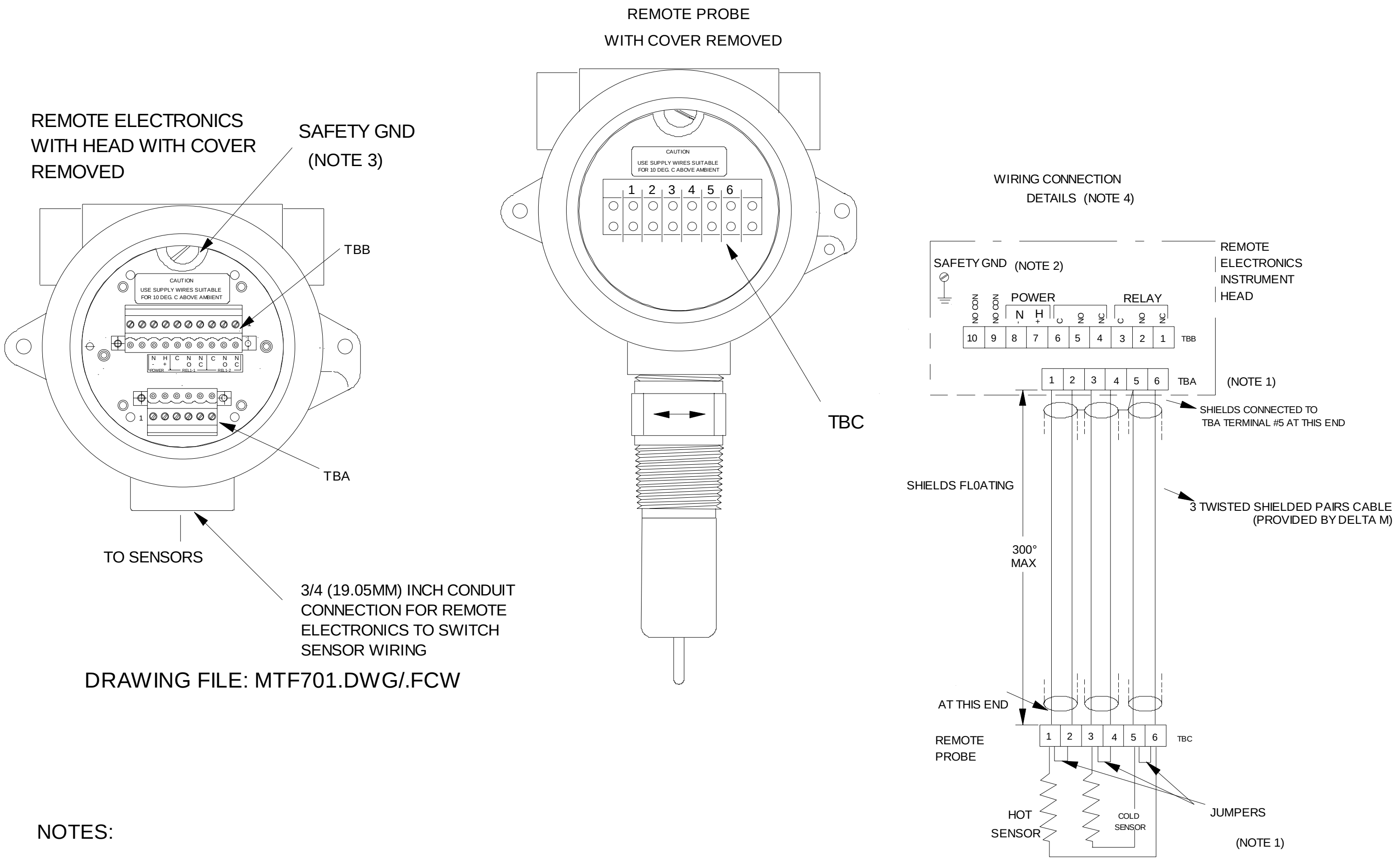
IMPORTANT

BE SURE TO APPLY THE PROPER VOLTAGE AS CONFIGURED AT THE FACTORY. DO NOT APPLY 115 VAC TO 24 VDC VERSIONS OR 24 VDC TO 115 VAC VERSIONS (LIKEWISE 230 VAC).

SPECIAL NOTICE

The electronic assemblies contained in the microtuf® models are configured for specific voltages and have specific modifications to accommodate the various agency approvals. When ordering spare electronics, replacements, or exchanges in the field please ensure you identify the specific configuration you have by noting the boxes marked on the transformer configuration tag.

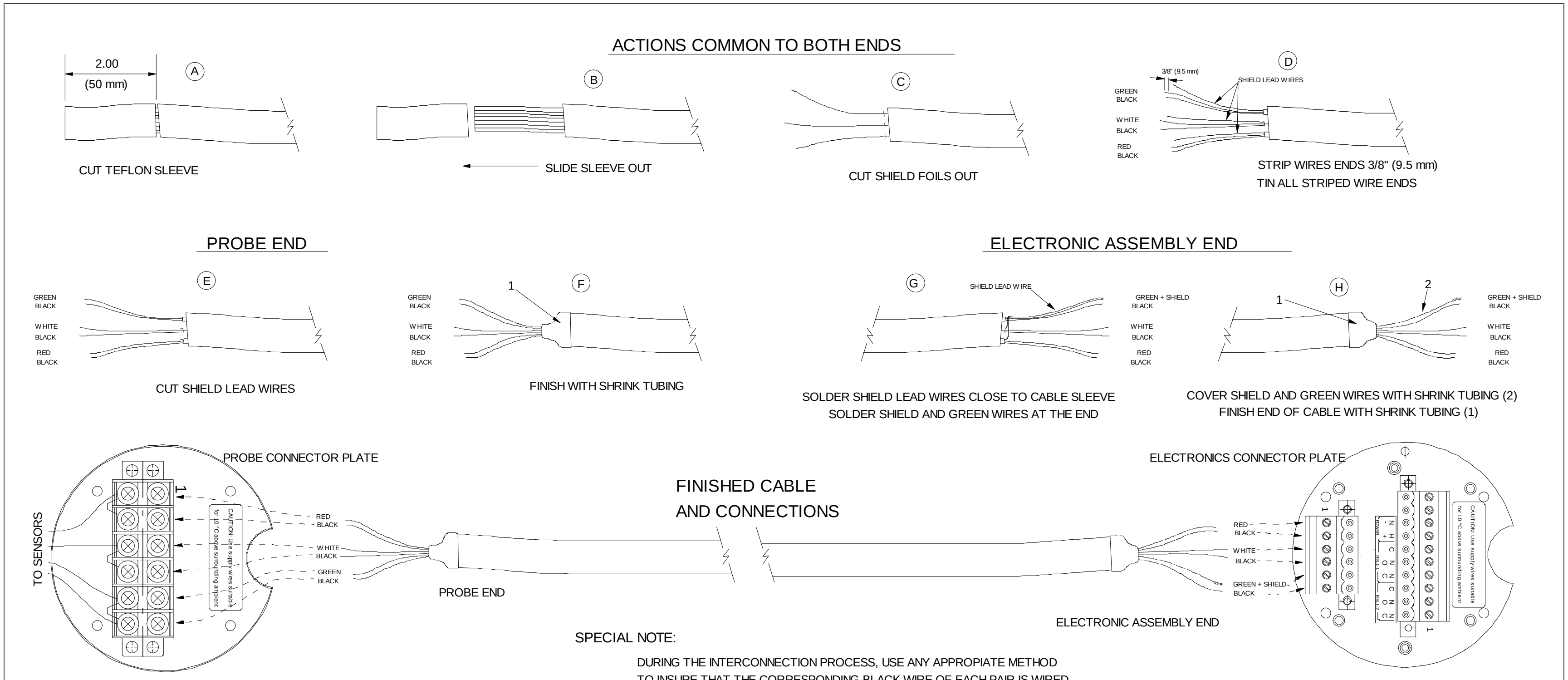




NOTES:

1. JUMPER WIRES 1-2, 3-4, AND 5-6 MUST BE IN PLACE ON TBC IN THE REMOTE PROBE FOR PROPER OPERATION OF THE REMOTED ELECTRONICS.
2. FOR 24VDC OPERATION (FACTORY PREPARED), CONNECT + POSITIVE TO TBB7 AND - NEGATIVE RETURN TO TBB8. FOR 115VAC OR 230 VAC CONNECT HOT TO TBB7 AND NEUTRAL TO TBB8.
3. CONNECT GROUND WIRE TO GROUND SCREW LOCATED IN OR ON THE INSTRUMENT ENCLOSURE.
4. USE SUPPLY WIRES SUITABLE FOR 10 DEGREE C ABOVE AMBIENT.

FIGURE 7A microtuf® FLOW SWITCH REMOTE ELECTRONICS OPTION FIELD WIRING DIAGRAM (MTF701.DWG/.FCW)



SPECIAL NOTE:

DURING THE INTERCONNECTION PROCESS, USE ANY APPROPIATE METHOD TO INSURE THAT THE CORRESPONDING BLACK WIRE OF EACH PAIR IS WIRED TO THE CORRECT TERMINALS.

MATERIALS

	STANDARD TEMP. PROBE (MAX. AMBIENT / ENCLOSURE TEMP. 75 °C)	MED. & HIGH TEMP PROBES (MAX. AMBIENT / ENCLOSURE TEMP. 200 °C)
CABLE	DELTA M PART # 101567	DELTA M PART # 101539
SRINK TUBE 1	PVC, 1/4" (13 mm) OD	TEFLON, 1/4" (13 mm) OD
SRINK TUBE 2	PVC, 1/8" (6.5 mm) OD	TEFLON, 1/8" (6.5 mm) OD

USE: 3242OM - FIG. 11
5100 - OM

DIRECTORY:
FILE: MTF1100.FCW/DWG

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ALL DIMENSIONS ARE IN INCHES
UNLESS OTHERWISE SPECIFIED

TOLERANCES
DECIMALS: .X ±.030
.XX ±.020
.XXX ±.010
FRACTIONS: ±1/32
ANGULAR: ±0°-30'
FINISH:

DO NOT SCALE THIS DRAWING

APPROVALS

DESIGNED BY:	GREG COX/R.BODINE	DATE:	03-12-00
DRAWN BY:	D. McCOY	DATE:	03-15-00
ENGINEERING:	O. GARCIA	DATE:	03-19-00
DEPT. MANAGER:		DATE:	
DOCUMENT CONTROL:		DATE:	

REVISION	REVISED BY	ECO NUMBER	DATE	APPROVED

DELTA M CORPORATION
1003 LARSEN DRIVE
OAK RIDGE, TN 37830

REMOTE ELECTRONICS CABLE
TERMINATION AND CONNECTIONS

SCALE: none
PAGE: 1 OF 1
SIZE B
DWG. NO. MTF11
REV. 00

FIGURE 7B microtuf® REMOTE ELECTRONICS CABLE TERMINATION AND CONNECTIONS

NOTES:

1. **Connections to sensors terminal block A (TBA) are factory installed and should not be disconnected in the field. Note Jumpers 1-2, 3-4, and 5-6 must be in place on TBA for proper operation of local electronics.**
2. **For 24 VDC operation (factory prepared), connect +positive to TBB7 and –negative return to TBB8. For 115 VAC or 230 VAC connect hot to TBB7 and neutral to TBB8.**
3. **Connect ground wire to ground screw located in or on the instrument enclosure.**

4.0 OPERATION AND CALIBRATION OF THE microtuf® FS4200 SWITCH FOR FLOW APPLICATIONS

4.1 Pre-Operational Check

With the switch installed and process conditions at no-flow, the following procedure can be used to verify preliminary operation.

4.1.1 Remove the instrument enclosure cover by turning counter clockwise (ccw) to expose the microtuf® Switch electronics.

4.1.2 Turn on power at its source.

4.1.3 Observe that either the red or green LED comes on.

4.1.4 If neither lamp illuminates refer to the trouble shooting Section, 6.2.

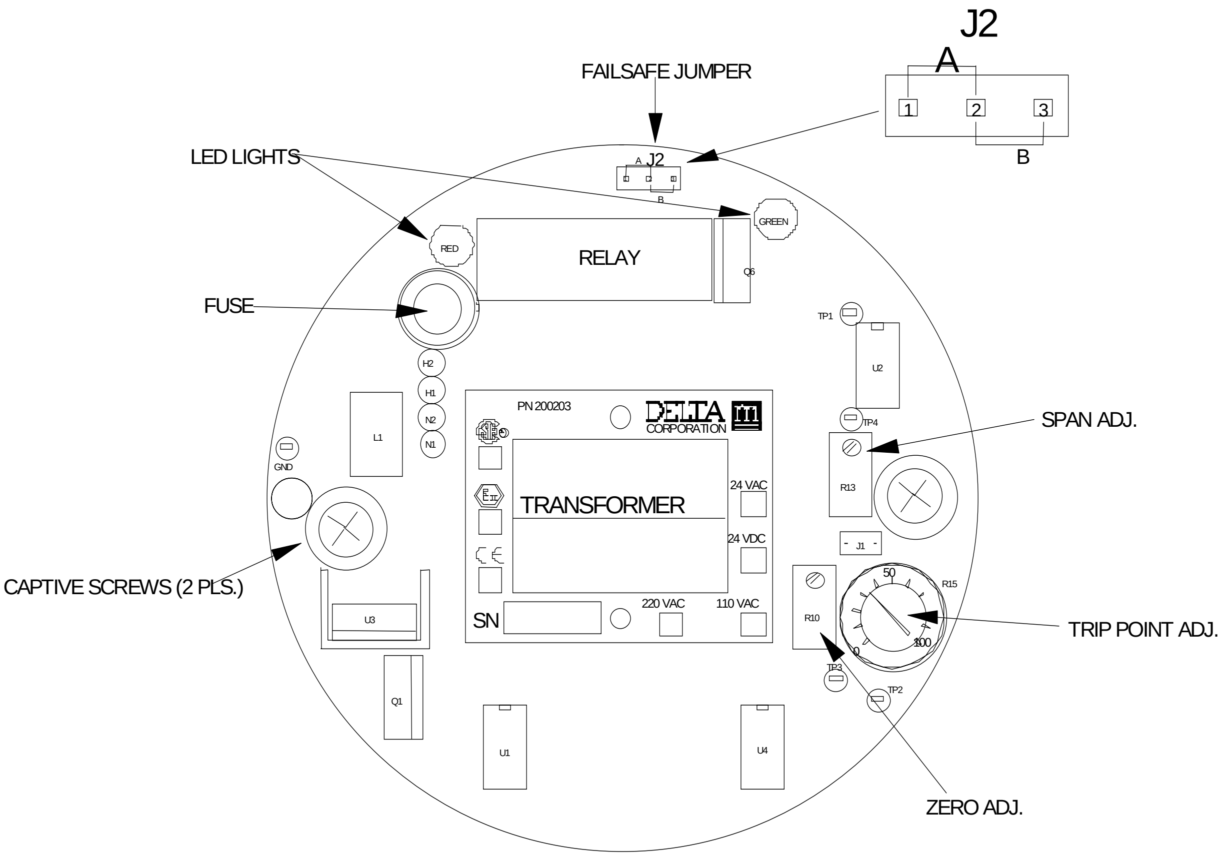
4.2 L.E.D. and Relay Status Logic (Fail-safe)

4.2.1 The L.E.D.s (Red; Green) are an indication of the sensors status (ie. flow below the setpoint or flow above the set point) and are not affected by the position of the failsafe jumper J-2. The failsafe jumper J-2 changes the relay activation status allowing the user to select the failsafe power off condition most appropriate to the application. Refer to the tables below that show the logic conditions between the sensors, L.E.D. lights, relay coil and contacts for each position of the failsafe jumper J-2.

4.2.2 Normal Operation (as set at factory)

The switch comes configured from the factory with the following operation with the J-2 jumper in the B(2-3) position. (Refer to Figure 8.0.)

SENSOR STATUS	RED LED	GREEN LED	RELAY COIL STATUS	RELAY CONTACT STATUS
No Flow or Flow Below Set Point	ON	OFF	Activated	o NC →o NO
Flow or Flow Above Set Point	OFF	ON	Deactivated	→o NC o NO



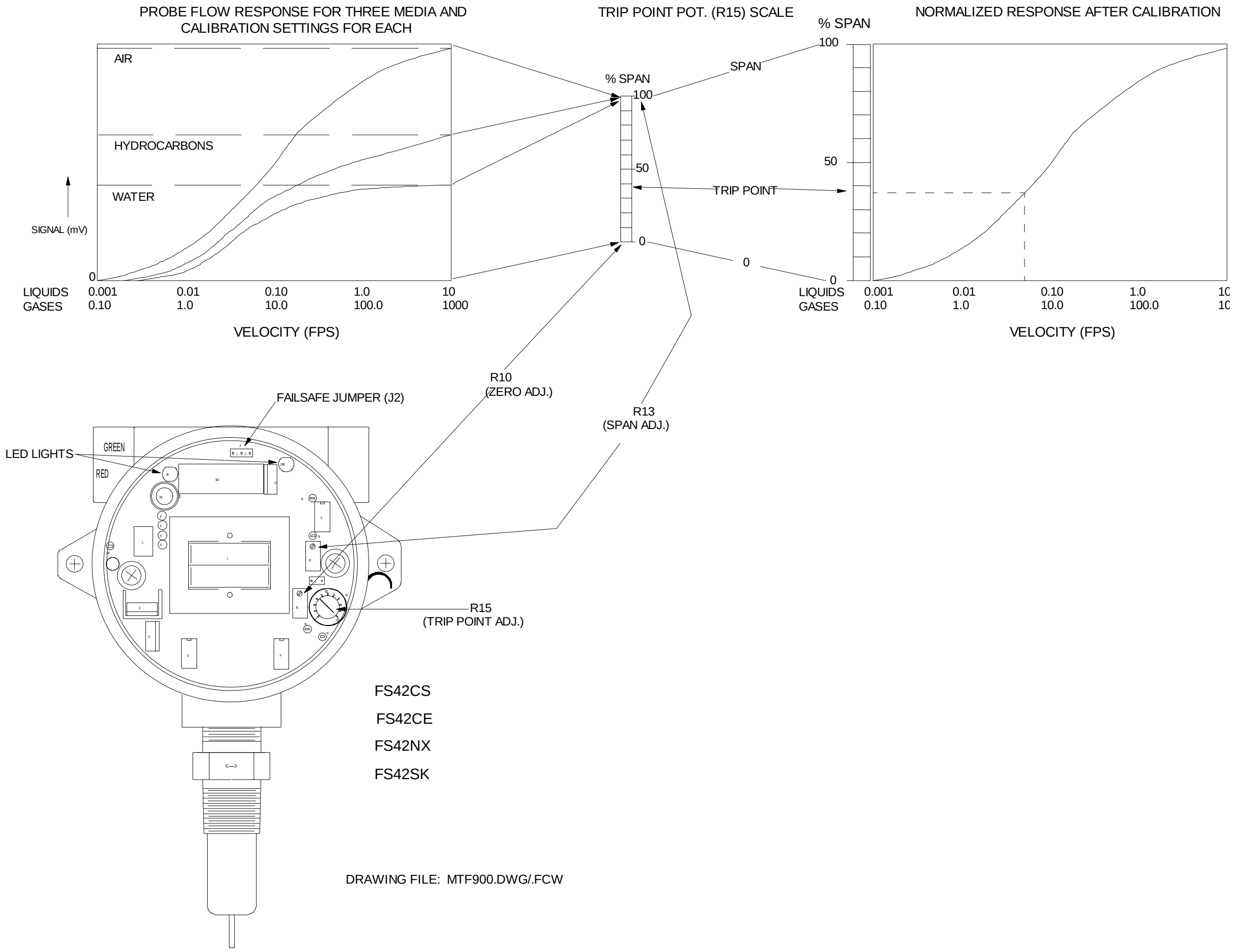
DRAWING FILE: MTF800.DWG/.FCW

FIGURE 8.0 microtuf® SWITCH ELECTRONICS (MTF800.FCW/.DWG)

4.2.3 Alternate Operation (Field Selectable)

The relay logic may be reversed by moving the J-2 jumper to position A(1-2). (Refer to Figure 8.0.)

SENSOR STATUS	RED LED	GREEN LED	RELAY COIL STATUS	RELAY CONTACT STATUS
No Flow or Flow Below Set Point	ON	OFF	Deactivated →	o NC o NO
Flow or Flow Above Set Point	OFF	ON	Activated →	o NC o NO



DRAWING FILE: MTF900.DWG/.FCW

FIGURE 9.0 microtuf® FS4200 FLOW SWITCH CALIBRATION REFERENCE DRAWING
(MTF900.DWG.FCW)

4.3 Calibration – Flow

****IMPORTANT****
FOR OPTIMUM OPERATION, CALIBRATION MUST BE ACCOMPLISHED AT ACTUAL PROCESS TEMPERATURE AND PRESSURE CONDITIONS IN GASES AND AT ACTUAL PROCESS TEMPERATURE CONDITIONS IN LIQUIDS.

See Figures 8.0 and 9.0 for location of potentiometers and LEDS on electronics PCB.

4.3.1 Calibration Procedure for Flow Switches

1. Remove the instrument enclosure lid by turning ccw.

2. Apply power to FS4200. **Allow 5 minute warm-up.**

3. Ensure that the pipeline is filled with fluid and at no or minimum flow.

4. Set the trip adjust pot to zero fully counterclockwise (fully ccw).

5. Adjust the zero adjust pot so that the Red LED just does illuminate. This is a 25 turn pot. If the Green LED is on, turn the pot ccw. If the Red LED is on, turn the pot clockwise (cw).

6. Toggle the zero adjust pot back and forth until the switching point is well defined. Leave the Red LED illuminated.

7. Adjust the liquid or gas flow to maximum velocity. Insure that the flow is homogenous, constant and free of bubbles if a liquid.

   NOTE

   The flow rate (maximum) should be at least 5 fps (liquid) or 500 fps (gas) if possible for best calibration.

8. Set the trip adjust pot to 100 (fully cw).

9. Adjust the span adjust pot so that the Green LED just does illuminate. This is a 25 turn pot.
   If the Green LED is on, turn the pot cw. If the Red LED is on, turn the pot ccw.

10. Toggle the span adjust pot back and forth until the switching point is well defined. Leave the Green LED illuminated.

11. If the switch is to be used for flow - no flow, set the trip adjust pot to 50 and go to step 14. (Note: This adjustment can be set for tripping points between 10% and 90% of the span from no flow to max flow).

12. A more exact flow rate setting may be made by establishing the flow at the desired rate with a separate flow meter and proceeding to step 13, to establish the trip point.

13. Adjust the trip adjust pot to obtain a trip as exhibited by an LED illumination. If a trip on decreasing flow is desired set for Red LED illumination. If a trip on increasing flow is desired set for Green LED illumination.

14. Verify that the switch will reset by returning the actual product flow to the maximum or minimum flow rates.

5.0 OPERATION AND CALIBRATION OF THE microtuf® LS3200 SERIES SWITCH FOR POINT LEVEL APPLICATIONS

5.1 Pre-Operational Check

The switch is installed **and the product level is below sensor level (dry)**, the following procedure can be used to verify preliminary operation.

1. Remove the instrument enclosure cover by turning counter clockwise to expose the LS3200 Switch electronics.
2. Turn on power at its source.
3. Observe that either the red or green LED comes on.
4. If neither lamp illuminates refer to the trouble shooting Section, 6.2.

5.2 L.E.D. and Relay Status Logic (Fail-Safe)

5.2.1 The L.E.D.s (Red and Green) are an indication of the sensors status (ie. dry or wet) and are not affected by the position of the fail-safe jumper J-2. The fail-safe jumper J-2 changes the relay activation status allowing the user to select the fail-safe power off condition most appropriate to the application. Refer to the tables below that show the logic conditions between the sensors, L.E.D. lights, relay coil and contacts for each position of the fail-safe jumper J-2.

5.2.2 Normal Operation (as set at factory)

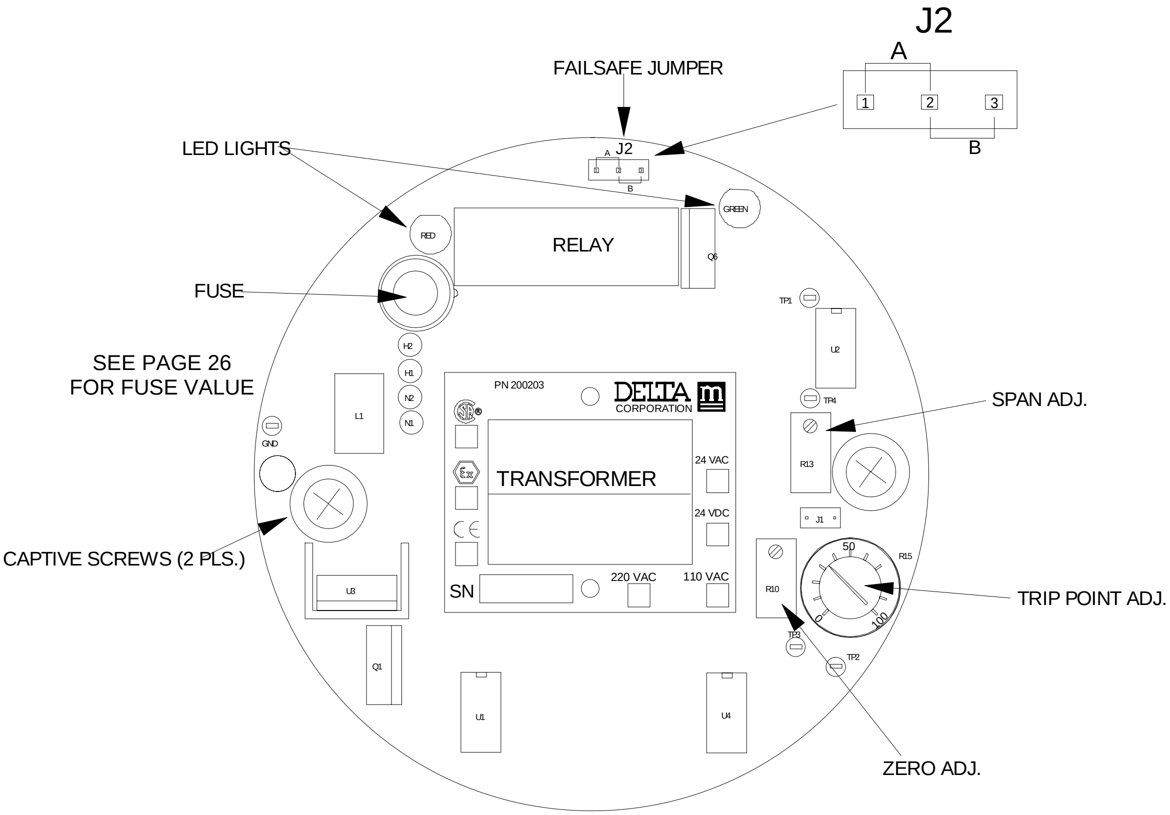
The switch comes configured from the factory with the following operation with the J-2 jumper in the B (2-3) position. (Refer to Figure 8.0.)

SENSOR STATUS	RED LED	GREEN LED	RELAY COIL STATUS	RELAY CONTACT STATUS
Dry, or Lower Thermal Dispersion Fluid (ie. hydrocarbons)	ON	OFF	Activated →	o NC → o NO
Wet, or Higher Thermal Dispersion Fluid (ie. water)	OFF	ON	Deactivated →	→ o NC o NO

5.2.3 Alternate Operation (Field Selectable)

The relay logic may be reversed by moving the J-2 jumper to position A(1-2). (Refer to Figure 8.0.)

SENSOR STATUS	RED LED	GREEN LED	RELAY COIL STATUS	RELAY CONTACT STATUS
Dry, or Lower Thermal Dispersion Fluid (ie. hydrocarbons)	ON	OFF	Deactivated	o NC o NO
Wet, or Higher Thermal Dispersion Fluid (ie. water)	OFF	ON	Activated	o NC o NO



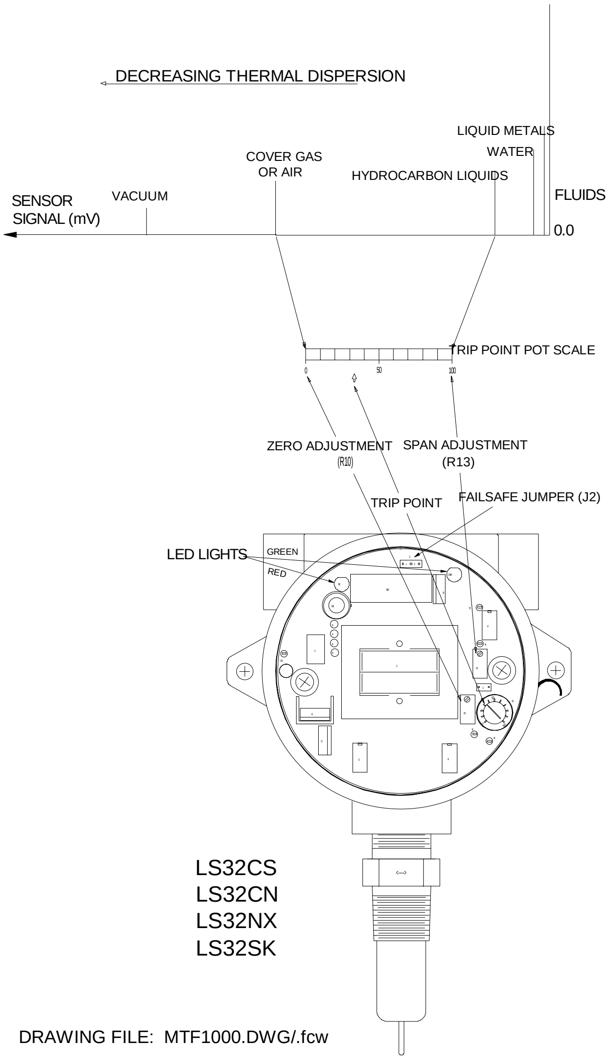
DRAWING FILE: MTF800.DWG/.FCW

FIGURE 8.0 **microtuf® SWITCH ELECTRONICS (MTF800.FCW/.DWG)**

5.3 Calibration – Level

****IMPORTANT****

FOR OPTIMUM OPERATION CALIBRATION MUST BE ACCOMPLISHED AT ACTUAL PROCESS TEMPERATURE CONDITIONS.



DRAWING FILE: MTF1000.DWG/.fcw

FIGURE 10.0 microtuf® LS3200 POINT LEVEL SWITCH CALIBRATION REFERENCE DRAWING (MTF1000.DWG/.FCW)

5.3 Calibration - Level

Using Figure 10.0 as a location guide adjust the system as follows:

1. Remove the instrument enclosure lid by turning ccw.

2. Apply power to the unit. **Allow 5 minute warm-up.**

3. For optimum calibration results, wet sensor and drain but do not dry.

4. Ensure that the tank liquid level is below the probe sensor tips.

5. Set the trip adjust pot to zero, fully counterclockwise (fully ccw).

6. Adjust the zero adjust pot so that the Red LED just does illuminate. This is a 25 turn pot. If the green LED is on, turn the pot counterclockwise (ccw). If red LED is on, turn the pot clockwise (cw).

7. Toggle the zero adjust pot back and forth until the switching point is well defined. Leave the Red LED illuminated.

8. Raise the level of the liquid to be detected until the probe/sensor tips are submerged and wet (covered).

9. Set the trip adjust pot to 100 (fully cw).

10. Adjust the span adjust pot so that the Green LED just does illuminate. This is a 25 turn pot. If the Green LED is on, turn the pot cw. If the Red LED is on, turn the pot ccw.

11. Toggle the span adjust pot back and forth until the switching point is well defined. Leave the green LED illuminated.

12. Adjust the trip adjust pot to 80 and the calibration is complete. Setting this pot to 80 gives an approximate equal trip time from wet to dry and from dry to wet. Setting this pot closer to zero will speed up dry to wet trip time and slow down wet to dry trip time. Setting this pot closer to 100 will slow down the dry to wet trip time and speed up wet to dry trip time.

6.0 MAINTENANCE AND TROUBLE SHOOTING

6.1 Cleaning

The switch can be cleaned by soaking, spraying solvents or detergent-and-water onto the sensor tubes, or by ultrasonic cleaning.

Lime deposits can be safely removed by soaking in 20% hydrochloric acid. Warming to 150°F is permissible to speed this process.

For unusual cleaning problems, call DELTA M and determine the exact materials of construction and chemical compatibility before using strong acids or unusual cleansers.

****IMPORTANT****

DO NOT SANDBLAST OR ABRASIVE CLEAN THE SENSING PROBES. THE SENSING PROBES COULD BE DAMAGED BY ABRASIVES.

6.2 Troubleshooting

6.2.1 Power and Continuity Verification

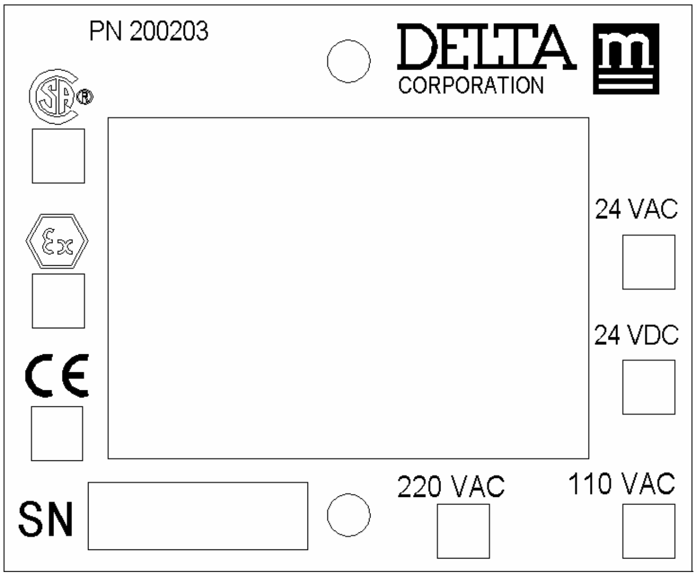
1. Turn power off to the microtuf® Switch.
2. Remove the instrument enclosure cover (ccw).
3. Loosen the two PC captive screws (see Figure 4.0 for location).
4. Unplug the PC board from the instrument enclosure by pulling straight out on the transformer.
5. Reapply power and verify correct voltage at pins 7 (positive for DC) and 8 (negative for DC) of TBB (see Figures 6.0 or 7.0).
6. If voltage is correct, verify the fuse (F1) on the PC board is not blown (See Figure 8.0). If fuse is not blown proceed to 6.2.2.
7. If fuse is blown replace with appropriate value (See 7.0 Specification).

6.2.2 Sensor/Electronics Functionality Verification

1. Turn power off to microtuf® Switch.
2. Allow a 5 minute cool down.
3. Measure the resistance of each RTD at pins 1 and 6 of TBA (see Figure 6.0 or 7.0) for the hot RTD and pins 3 and 5 of TBA for the cold RTD. These resistances should be 110 ± 10 ohms (with sensors at approximately 70°F) and within 5% of each other in value.
4. Measure the insulation resistance between pin 1 of TBA and the case of the microtuf® Switch. It should be greater than 20 megohms.
5. If the microtuf® Switch sensor assembly resistances are not as specified above, the switch sensor assembly must be replaced.
6. If the microtuf® Switch sensor assembly resistances are as specified, the microtuf® Switch PC electronic board must be replaced.

SPECIAL NOTICE

The electronic assemblies contained in the microtuf® models are configured for specific voltages and have specific modifications to accommodate the various agency approvals. When ordering spare electronics, replacements, or exchanges in the field please ensure you identify the specific configuration you have by noting the boxes marked on the transformer configuration tag.



7.0 SPECIFICATIONS

TYPE:	Thermal Differential-Dual RTD Sensors
PROCESS CONNECTIONS:	0.75” (19.05mm) MNPT Standard, 0.5"(12.7mm), 1" (25.4mm) MNPT, and various flanges optional.
INSERTION LENGTH:	Two inch (50.8mm) Standard, (shorter 0.5 inch (12.7mm) and longer to 120 inch (3048mm) optional).
CONSTRUCTION MATERIALS:	Wetted parts are 316L SS welded construction (alternate materials for corrosive environments available as options. Consult factory.)
AGENCY INSTRUMENT RATINGS:	CSA Explosion Proof: (CS series) T4A Class I, Group B, C, and D Class II, Group E, F, and G CENELEC/Explosion Proof (CN Series): EEx d IIC T4(Akron Electric Enclosure) EEx d IIB T4(Killark Enclosure) CE: EMC Directive: 89/336/EEC (CE Option)
OPERATING TEMPERATURE:	Process: -70°C to + 200°C (-100°F to +390°F) standard (to + 600°C (+1000°F) optional Electronics: -40°C to +60°C (-40°F to +140°F)
PRESSURE RATED:	To 3000 psig (20.4 MPa)
RANGE	Gaseous Mass Flow: 0.1 to 500 fps Liquid Mass Flow: 0.01 to 5 fps
REPEATABILITY:	± 1% of Set Point or ± 1/32 inch (±.8mm)
TIME RESPONSE:	0.5 to 10 seconds no-flow (dry) to flow (wet) and 2 to 60 seconds flow (wet) to no-flow (dry) (application dependent)
INPUT POWER:	115 Vac, 50/60HZ standard. (230 Vac, 50/60HZ, 24 Vdc, or 24 Vac optional); 3.1w. maximum.

FUSE REQUIREMENTS (F1):

	DELTA M PART NO.	
	CSA/FM	CENELEC
115 Vac: 1/4 amp	101603	101605
230 Vac: 1/4 amp	101603	101605
24 Vdc: 1/4 amp	101603	101605

OUTPUT:	5A, 250 VAC, DPDT Standard (Optional 10A, 250 Vac SPDT) 5A 30 VDC
STABILITY:	Temperature compensated over entire range.

8.0 WARRANTY AND SERVICE

8.1 Warranty

DELTA M Corporation warranties microtuf® switches for a period of two years from the date of shipment and will repair or replace this product in the event of a defect in materials or workmanship. To have a product repaired, it should be returned at customer's expense, after obtaining return authorization as described in Section 7.2, to a repair facility designated by DELTA M and, after repair, DELTA M will prepay transportation to return the product to the customer. This limited warranty only covers failures due to defects in materials or workmanship which occur during normal use.

LIMITS AND EXCLUSIONS

DELTA M CORPORATION SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, LOSS OF USE, LOSS OF SALES, OR INCONVENIENCE) RESULTING FROM THE USE OF THESE PRODUCTS, OR ARISING OUT OF ANY BREACH OF THIS WARRANTY. EXCEPT AS SET FORTH ABOVE, THERE ARE NO EXPRESS OR IMPLIED WARRANTIES OR WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

8.2 Service

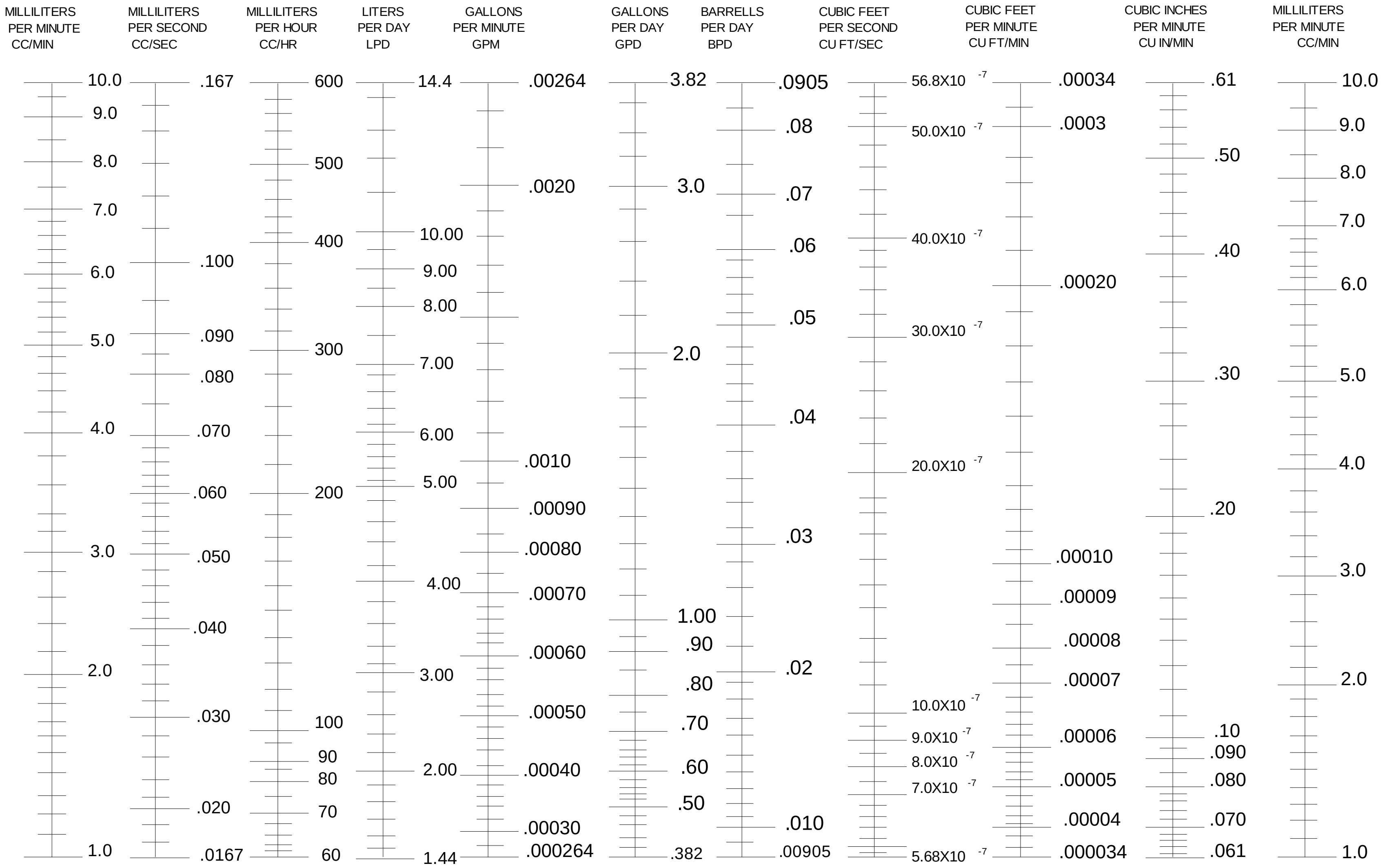
To receive prompt service call DELTA M's Customer Service Dept. (865) 483-1569 or toll free 1-800-922-0083. A representative will assist you in determining if the unit must be returned to the factory. A Return Authorization Number (RAN) will be given and should clearly mark the outside of the returning package. **Prior to calling, be sure to have the model number and serial number information for quick identification and service response.**

9.1 VOLUME FLOW CONVERSION CHART

Convert known units to cubic feet per second (CFPS) or gallons per minute (GPM) for use with Chart A.2

TO CONVERT FROM	TO	MULTIPLY BY
Gallons Per Minute (GPM)	Cubic Feet Per Per Second (CFPS)	2.228 E-03
Gallons Per Day (GPD)	CFPS	1.547 E-06
Barrels Per Day (BPD)	CFPS	6.531 E-5
Cubic Ft. Per Minute (CFPM)	CFPS	1.667 E-02
Cubic In. Per Minute (CIPM)	CFPS	9.645 E-06
Milliliters Per Minute (MLPM)	CFPS	5.886 E-07
Milliliters Per Second (MLPS)	CFPS	3.531 E-05
Milliliters Per Hour (MLPH)	CPFS	9.810 E-09
Liters Per Day (LPD)	CPFS	4.087 E-07
Gallons Per Day (GPD)	GPM	6.944 E-04
Barrels Per Day (BPD)	GPM	2.931 E-02
Cubic Ft. Per Second (CFPS)	GPM	4.488 E+02
Cubic Ft. Per Minute (CFPM)	GPM	7.481
Cubic In. Per Minute (CIPM)	GPM	4.329 E-03
Milliliters Per Minute (MLPM)	GPM	2.642 E-04
Milliliters Per Second (MLPS)	GPM	4.403 E-06
Milliliters Per Hour (MLPH)	GPM	1.585 E-02
Liters Per Day (LPD)	GPM	1.835 E-04

FLOW CONVERSION CHART



THIS LINE CHART PROVIDES AN EASY METHOD FOR CONVERTING UNITS OF VOLUME FLOW. SIMPLY DRAW A LINE PERPENDICULAR TO THE SCALE LINES THROUGH A VALUE OF FLOW AND READ THE EQUIVALENT VALUE ON ANY OF THE OTHER SCALES.

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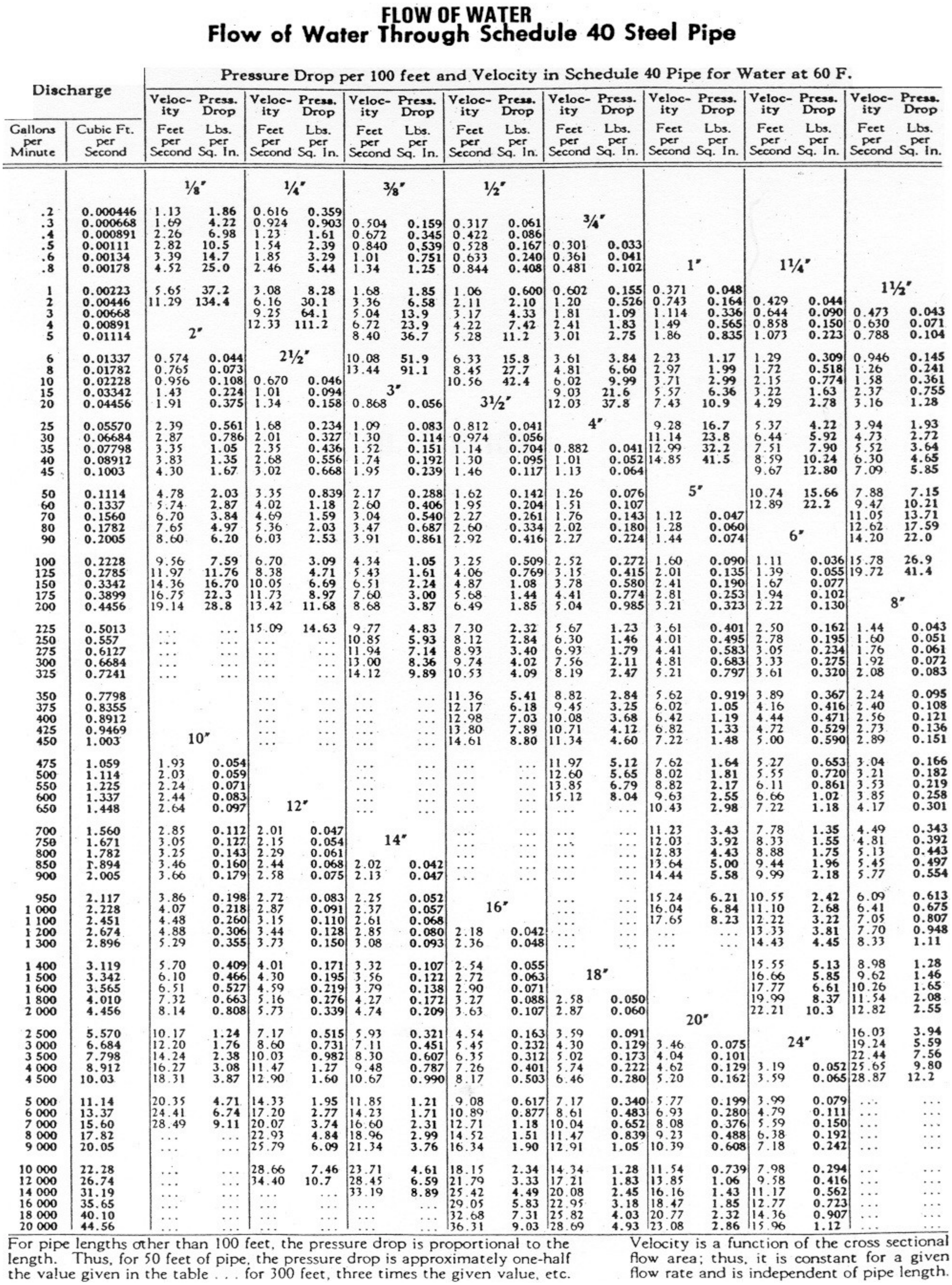
9.3 FLOW OF WATER THROUGH SCHEDULE 40 STEEL PIPE



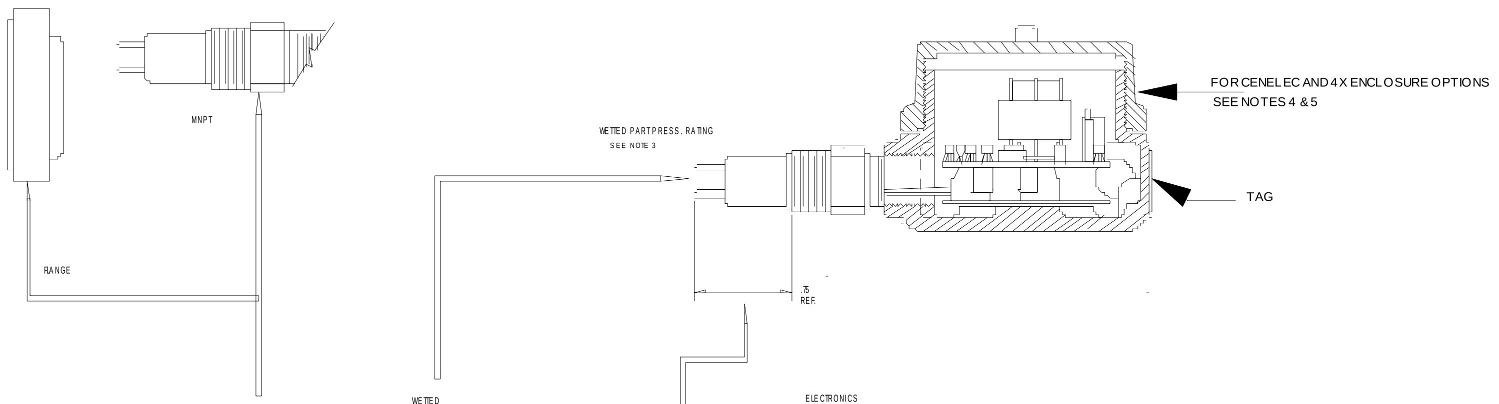
FLOW OF WATER
Flow of Water Through Schedule 40 Steel Pipe

Discharge		Pressure Drop per 100 feet and Velocity in Schedule 40 Pipe for Water at 60 F.															
		Velocity	Press. Drop	Velocity	Press. Drop	Velocity	Press. Drop	Velocity	Press. Drop	Velocity	Press. Drop	Velocity	Press. Drop	Velocity	Press. Drop	Velocity	Press. Drop
Gallons per Minute	Cubic Ft. per Second	Feet per Second	Lbs. per Sq. In.	Feet per Second	Lbs. per Sq. In.	Feet per Second	Lbs. per Sq. In.	Feet per Second	Lbs. per Sq. In.	Feet per Second	Lbs. per Sq. In.	Feet per Second	Lbs. per Sq. In.	Feet per Second	Lbs. per Sq. In.	Feet per Second	Lbs. per Sq. In.
		⅛"		¼"		⅜"		½"									
.2	0.000446	1.13	1.86	0.616	0.359												
.3	0.000668	1.69	4.22	0.924	0.903	0.504	0.159	0.317	0.061	¾"							
.4	0.000891	2.26	6.98	1.23	1.61	0.672	0.345	0.422	0.086								
.5	0.00111	2.82	10.5	1.54	2.39	0.840	0,539	0.528	0.167	0.301	0.033						
.6	0.00134	3.39	14.7	1.85	3.29	1.01	0.751	0.633	0.240	0.361	0.041						
.8	0.00178	4.52	25.0	2.46	5.44	1.34	1.25	0.844	0.408	0.481	0.102	1"		1¼"			
1	0.00223	5.65	37.2	3.08	8.28	1.68	1.85	1.06	0.600	0.602	0.155	0.371	0.048			1½"	
2	0.00446	11.29	134.4	6.16	30.1	3.36	6.58	2.11	2.10	1.20	0.526	0.743	0.164	0.429	0.044		
3	0.00668			9.25	64.1	5.04	13.9	3.17	4.33	1.81	1.09	1.114	0.336	0.644	0.090	0.473	0.043
4	0.00891			12.33	111.2	6.72	23.9	4.22	7.42	2.41	1.83	1.49	0.565	0.858	0.150	0.630	0.071
5	0.01114	2"				8.40	36.7	5.28	11.2	3.01	2.75	1.86	0.835	1.073	0.223	0.788	0.104
6	0.01337	0.574	0.044	2½"		10.08	51.9	6.33	15.8	3.61	3.84	2.23	1.17	1.29	0.309	0.946	0.145
8	0.01782	0.765	0.073			13.44	91.1	8.45	27.7	4.81	6.60	2.97	1.99	1.72	0.518	1.26	0.241
10	0.02228	0.956	0.108	0.670	0.046			10.56	42.4	6.02	9.99	3.71	2.99	2.15	0.774	1.58	0.361
15	0.03342	1.43	0.224	1.01	0.094	3"				9.03	21.6	5.57	6.36	3.22	1.63	2.37	0.755
20	0.04456	1.91	0.375	1.34	0.158	0.868	0.056	3½"		12.03	37.8	7.43	10.9	4.29	2.78	3.16	1.28
25	0.05570	2.39	0.561	1.68	0.234	1.09	0.083	0.812	0.041	4"		9.28	16.7	5.37	4.22	3.94	1.93
30	0.06684	2.87	0.786	2.01	0.327	1.30	0.114	0.974	0.056			11.14	23.8	6.44	5.92	4.73	2.72
35	0.07798	3.35	1.05	2.35	0.436	1.52	0.151	1.14	0.704	0.882	0.041	12.99	32.2	7.51	7.90	5.52	3.64
40	0.08912	3.83	1.35	2.68	0.556	1.74	0.192	1.30	0.095	1.01	0.052	14.85	41.5	8.59	10.24	6.30	4.65
45	0.1003	4.30	1.67	3.02	0.668	1.95	0.239	1.46	0.117	1.13	0.064			9.67	12.80	7.09	5.85
50	0.1114	4.78	2.03	3.35	0.839	2.17	0.288	1.62	0.142	1.26	0.076	5"		10.74	15.66	7.88	7.15
60	0.1337	5.74	2.87	4.02	1.18	2.60	0.406	1.95	0.204	1.51	0.107			12.89	22.2	9.47	10.21
70	0.1560	6.70	3.84	4.69	1.59	3.04	0.540	2.27	0.261	1.76	0.143	1.12	0.047			11.05	13.71
80	0.1782	7.65	4.97	5.36	2.03	3.47	0.687	2.60	0.334	2.02	0.180	1.28	0.060			12.62	17.59
90	0.2005	8.60	6.20	6.03	2.53	3.91	0.861	2.92	0.416	2.27	0.224	1.44	0.074	6"		14.20	22.0
100	0.2228	9.56	7.59	6.70	3.09	4.34	1.05	3.25	0.509	2.52	0.272	1.60	0.090	1.11	0.036	15.78	26.9
125	0.2785	11.97	11.76	8.38	4.71	5.43	1.61	4.06	0.769	3.15	0.415	2.01	0.135	1.39	0.055	19.72	41.4
150	0.3342	14.36	16.70	10.05	6.69	6.51	2.24	4.87	1.08	3.78	0.580	2.41	0.190	1.67	0.077		
175	0.3899	16.75	22.3	11.73	8.97	7.60	3.00	5.68	1.44	4.41	0.774	2.81	0.253	1.94	0.102		
200	0.4456	19.14	28.8	13.42	11.68	8.68	3.87	6.49	1.85	5.04	0.985	3.21	0.323	2.22	0.130	8"	
225	0.5013	...	...	15.09	14.63	9.77	4.83	7.30	2.32	5.67	1.23	3.61	0.401	2.50	0.162	1.44	0.043
250	0.557	...	...	...	...	10.85	5.93	8.12	2.84	6.30	1.46	4.01	0.495	2.78	0.195	1.60	0.051
275	0.6127	...	...	...	...	11.94	7.14	8.93	3.40	6.93	1.79	4.41	0.583	3.05	0.234	1.76	0.061
300	0.6684	...	...	...	...	13.00	8.36	9.74	4.02	7.56	2.11	4.81	0.683	3.33	0.275	1.92	0.072
325	0.7241	...	...	...	...	14.12	9.89	10.53	4.09	8.19	2.47	5.21	0.797	3.61	0.320	2.08	0.083
350	0.7798			...	...	...	...	11.36	5.41	8.82	2.84	5.62	0.919	3.89	0.367	2.24	0.095
375	0.8355			...	...	...	...	12.17	6.18	9.45	3.25	6.02	1.05	4.16	0.416	2.40	0.108
400	0.8912			...	...	...	...	12.98	7.03	10.08	3.68	6.42	1.19	4.44	0.471	2.56	0.121
425	0.9469			...	...	...	...	13.80	7.89	10.71	4.12	6.82	1.33	4.72	0.529	2.73	0.136
450	1.003	10"		...	...	...	...	14.61	8.80	11.34	4.60	7.22	1.48	5.00	0.590	2.89	0.151
475	1.059	1.93	0.054			...	...	...	...	11.97	5.12	7.62	1.64	5.27	0.653	3.04	0.166
500	1.114	2.03	0.059			...	...	...	...	12.60	5.65	8.02	1.81	5.55	0.720	3.21	0.182
550	1.225	2.24	0.071			...	...	...	...	13.85	6.79	8.82	2.17	6.11	0.861	3.53	0.219
600	1.337	2.44	0.083			...	...	...	...	15.12	8.04	9.63	2.55	6.66	1.02	3.85	0.258
650	1.448	2.64	0.097	12"		...	...	...	...	...	...	10.43	2.98	7.22	1.18	4.17	0.301
700	1.560	2.85	0.112	2.01	0.047			...	...	...	...	11.23	3.43	7.78	1.35	4.49	0.343
750	1.671	3.05	0.127	2.15	0.054	14"		...	...	...	...	12.03	3.92	8.33	1.55	4.81	0.392
800	1.782	3.25	0.143	2.29	0.061			...	...	...	...	12.83	4.43	8.88	1.75	5.13	0.443
850	1.894	3.46	0.160	2.44	0.068	2.02	0.042	...	...	...	...	13.64	5.00	9.44	1.96	5.45	0.497
900	2.005	3.66	0.179	2.58	0.075	2.13	0.047	...	...	...	...	14.44	5.58	9.99	2.18	5.77	0.554
950	2.117	3.86	0.198	2.72	0.083	2.25	0.052			...	...	15.24	6.21	10.55	2.42	6.09	0.613
1 000	2.228	4.07	0.218	2.87	0.091	2.37	0.057	16"		...	...	16.04	6.84	11.10	2.68	6.41	0.675
1 100	2.451	4.48	0.260	3.15	0.110	2.61	0.068			...	...	17.65	8.23	12.22	3.22	7.05	0.807
1 200	2.674	4.88	0.306	3.44	0.128	2.85	0.080	2.18	0.042	...	...	...	...	13.33	3.81	7.70	0.948
1 300	2.896	5.29	0.355	3.73	0.150	3.08	0.093	2.36	0.048	...	...	...	...	14.43	4.45	8.33	1.11
1 400	3.119	5.70	0.409	4.01	0.171	3.32	0.107	2.54	0.055					15.55	5.13	8.98	1.28
1 500	3.342	6.10	0.466	4.30	0.195	3.56	0.122	2.72	0.063	18"				16.66	5.85	9.62	1.46
1 600	3.565	6.51	0.527	4.59	0.219	3.79	0.138	2.90	0.071					17.77	6.61	10.26	1.65
1 800	4.010	7.32	0.663	5.16	0.276	4.27	0.172	3.27	0.088	2.58	0.050			19.99	8.37	11.54	2.08
2 000	4.456	8.14	0.808	5.73	0.339	4.74	0.209	3.63	0.107	2.87	0.060	20"		22.21	10.3	12.82	2.55
2 500	5.570	10.17	1.24	7.17	0.515	5.93	0.321	4.54	0.163	3.59	0.091					16.03	3.94
3 000	6.684	12.20	1.76	8.60	0.731	7.11	0.451	5.45	0.232	4.30	0.129	3.46	0.075	24"		19.24	5.59
3 500	7.798	14.24	2.38	10.03	0.982	8.30	0.607	6.35	0.312	5.02	0.173	4.04	0.101			22.44	7.56
4 000	8.912	16.27	3.08	11.47	1.27	9.48	0.787	7.26	0.401	5.74	0.222	4.62	0.129	3.19	0.052	25.65	9.80
4 500	10.03	18.31	3.87	12.90	1.60	10.67	0.990	8.17	0.503	6.46	0.280	5.20	0.162	3.59	0.065	28.87	12.2
5 000	11.14	20.35	4.71	14.33	1.95	11.85	1.21	9.08	0.617	7.17	0.340	5.77	0.199	3.99	0.079	...	...
6 000	13.37	24.41	6.74	17.20	2.77	14.23	1.71	10.89	0.877	8.61	0.483	6.93	0.280	4.79	0.111	...	...
7 000	15.60	28.49	9.11	20.07	3.74	16.60	2.31	12.71	1.18	10.04	0.652	8.08	0.376	5.59	0.150	...	...
8 000	17.82	...	...	22.93	4.84	18.96	2.99	14.52	1.51	11.47	0.839	9.23	0.488	6.38	0.192	...	...
9 000	20.05	...	...	25.79	6.09	21.34	3.76	16.34	1.90	12.91	1.05	10.39	0.608	7.18	0.242	...	...
10 000	22.28	...	...	28.66	7.46	23.71	4.61	18.15	2.34	14.34	1.28	11.54	0.739	7.98	0.294	...	...
12 000	26.74	...	...	34.40	10.7	28.45	6.59	21.79	3.33	17.21	1.83	13.85	1.06	9.58	0.416	...	...
14 000	31.19	...	...	...	...	33.19	8.89	25.42	4.49	20.08	2.45	16.16	1.43	11.17	0.562	...	...
16 000	35.65	...	...	...	...	...	...	29.05	5.83	22.95	3.18	18.47	1.85	12.77	0.723	...	...
18 000	40.10	...	...	...	...	...	...	32.68	7.31	25.82	4.03	20.77	2.32	14.36	0.907	...	...
20 000	44.56	...	...	...	...	...	...	36.31	9.03	28.69	4.93	23.08	2.86	15.96	1.12	...	...

For pipe lengths other than 100 feet, the pressure drop is proportional to the length. Thus, for 50 feet of pipe, the pressure drop is approximately one-half the value given in the table . . . for 300 feet, three times the given value, etc.

Velocity is a function of the cross sectional flow area; thus, it is constant for a given flow rate and is independent of pipe length.

9.4 MODEL NUMBER DESIGNATION AND AVAILABLE OPTIONS



	PRODUCT FAMILY	MOUNTING/ PROCESS FITTING	WETTED PARTS MATERIAL	INSERTION LENGTH	ELECTRONICS INPUT POWER	LOCATION AND ENCLOSURES	SPECIAL OPTIONS
	A A A A A A	B B B	C C	D D D. D	E E E	F F	G G
	FS42CS	0 7 5	S 6	0 0 2 0 0	1 1 0	L E	0 0
STANDARD	FS42CS FLOWSWITCH (CSA)	075 -0.75 IN. MNPT	S6 -STAINLESS STEEL 316L	002.00 - 2.00 INCHES	FACTORY CONFIGURABLE	LE - LOCAL ELECTRONICS	
MODELS:	MICROTUF®R SERIES LS32CS - LEVEL SWITCH - CSA APPROVED FS42CS - FLOWSWITCH - CSA APPROVED FS42CN - FLOWSWITCH - CENELEC FS42CN - FLOWSWITCH - CENELEC	050 - 0.5 IN. MNPT (12.7) 075 -0.75 IN. MNPT (19.05) 100 - 1.00 IN. MNPT (25.4) 200 - 2.00 IN. MNPT (50.8) F-- - FLAT FACE FLG R--- RAISED FACE FLG -A- - 150 LB. RATING -B- - 300 LB RATING -C- - 600 LB RATING -D- - 1500 LB RATING --1 - 1.00 INCH (25.4) --2 - 2.00 INCH (50.8) --3 - 3.00 INCH (76.2) --S - SPECIAL 3A1 - 1.5" FLANGE SANITARY (38.1) 3A2 - 1.0" FLANGE SANITARY (25.4)	S4 - STAINLESS STEEL, 304 SL - STAINLESS STEEL, 304L S6 - STAINLESS STEEL, 316L HB - HASTELLOY B HC - HASTELLOY C IO - INCONEL 600 A2 - ALLOY 20 MN - MONEL TI - TITANIUM TC - TEFLON COATED SM - SPECIAL MATERIAL	000.50 - 0.50 INCHES (12.7) TO 120.00 - 120.00 INCHES (3048)	110 - 110VAC 220 - 220VAC 24D - 24VDC 24A - 24VAC SEE NOTE 1	LE - LOCAL ELECTRONICS RE - REMOTE ELECTRONICS	CB - CALIBRATION REQUIRED EN - EXTENDED NECK LENGTH XW- EXPLOSION PROOF WINDOW COVER MT- MEDIUM TEMPERATURE SENSOR (300°C/572°F) DS - DOUBLE SIDED HEAD CE - CE MARK VI - VARIABLE INSERTION LT - LIVE TAP RT - RTD OUTPUT TO - THERMOCOUPLE OUTPUT

SHOWN IS STANDARD FS42CS

SPECIAL OPTIONS CONT.

4X - NEMA 4X RATED ENCLOSURE
SH - STAINLESS STEEL HOUSING W/BLANK COVER
SW - STAINLESS STEEL HOUSING W/GLASS LENS COVER

(MM EQUIVALENT)

NOTES:

1. THE MICROTUF SWITCH FAMILY INPUT POWER IS FACTORY CONFIGURABLE TO THE POWERS LISTED THE CUSTOMER MUST ORDER HIS SELECTION. THE 24 V AC SELECTION IS A SPECIAL ORDER

2. THE BLOCKS THAT ARE NOT COVERED IN EACH MODEL NUMBER MUST BE FILLED WITH ZEROS (0).

3. THE SENSORS AND INSERTION EXTENSION HAVE A MAX.IMUM WORKING PRESSURE (MWP) RATING OF 3000 PSI; THE ACTUAL PROBE PRESS. RATING DEPENDS ON THE PROCESS MOUNTING FITTING RATING.

4. CENELEC OPTION USES CENELEC APPROVED KILLARK OR AKRON ENCLOSURES, SEE DRAWING MT0083 FOR DETAILS.

5. 4X OPTION USES AKRON ENCLOSURE; SH & SW OPTIONS KILLARK SS ENCLOSURES, SEE DRAWING MT0083 FOR DETAILS.

REFERENCE: APPROVAL AGENCIES

DIRECTORY: MT008007 FILE: SHEET1.FCW

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ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED

TOLERANCES
DECIMALS X ± [illegible]
XX ± [illegible]
XXX ± [illegible]
FRACTIONS: ± 1/32
ANGULAR ± [illegible]
FINISH

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APPROVALS

DESIGNED BY:	O. GARCIA	DATE:	5-20-99
DRAWN BY:	O. GARCIA	DATE:	9-09-99
ENGINEERING:	R. W. McCULLOCH	DATE:	9-17-99
DEPT. MANAGER:	A. D. WHITE	DATE:	9-17-99
DOCUMENT CONTROL:		DATE:	

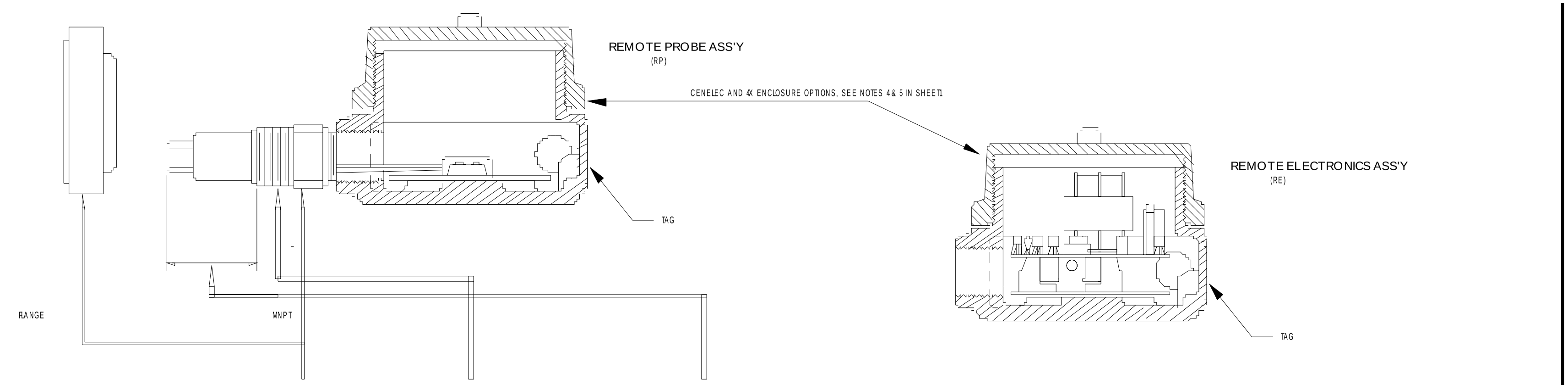
REVISION	REVISED BY	ECO NUMBER	DATE	APPROVED
07	O. GARCIA	01004		
06	D. MCCOY	2K25	12-21-00	R.W.McCULLOCH
05	D. MCCOY	2K22	11-7-00	R.W.McCULLOCH
04	D. MCCOY	2K20	11-3-00	R.W.McCULLOCH
03	O. GARCIA	2K19	10-30-2K	R.W.McCULLOCH
02	O. GARCIA	2K10	9-06-2K	R.W.McCULLOCH
01	O. GARCIA	99009	12-17-99	R.W.McCULLOCH

DELTA CORPORATION
1003 LARSEN DRIVE
OAK RIDGE, TN 37830

MICROTUF® SERIES
Ex. PROOF. MODEL NUMBERS

SCALE: NTS SIZE: B DWG. NO.: MT0080 REV.: 07
PAGE 1 OF 2

9.4 MODEL NUMBER DESIGNATION AND AVAILABLE OPTIONS



PRODUCT FAMILY		MOUNTING/ PROCESS FITTING		WETTED PARTS MATERIAL		INSERTION LENGTH		ELECTRONICS INPUT POWER		LOCATION AND ENCLOSURES		SPECIAL OPTIONS	EXAMPLE:
A A A A A A	—	B B B	—	C C	—	D D D . D	—	E E E	—	F F	—	G G	STANDARD ASSEMBLIES
FS42CS		0 7 5		S 6		0 0 2 0 0		0 0 0		R P		0 0	REMOTE PROBE TAG MODEL NUMBER
FS42CS		0 0 0		0 0		0 0 0 0 0		1 1 0		R E		0 0	REMOTE ELEX. TAG MODEL NUMBER

SEE NOTE 2, in SHEET 1.

FS42CS - FLOW SWITCH (CSA)

075 -0.75 IN. MNPT

S 6 -STAINLESS STEEL 316L

002.00 - 2.00 INCHES

FACTORY CONFIGURABLE

RE - REMOTE ELECTRONICS
RP - REMOTE ELECTRONICS PROBE

MODELS: MICROTUF Ⓡ SERIES

LS32CS - LEVEL SWITCH - CSA APPROVED
FS42CS - FLOW SWITCH - CSA APPROVED

LS32CN - LEVEL SWITCH - CENELEC APPROVED
FS42CN - FLOW SWITCH - CENELEC APPROVED

050 - 0.5 IN. MNPT (12.7)
075 -0.75 IN. MNPT (19.05)
100 - 1.00 IN. MNPT (25.4)
200 - 2.00 IN. MNPT (50.8)
F - - - FLAT FACE FLG
R - - - RAISED FACE FLG
- A - - 150 LB. RATING
- B - - 300 LB RATING
- C - - 600 LB RATING
- D - - 1500 LB RATING
- - 1 - 1.00 INCH (25.4)
- - 2 - 2.00 INCH (50.8)
- - 3 - 3.00 INCH (76.2)
- - S - SPECIAL
3A1 - 1.5" FLANGE SANITARY (38.1)
3A2 - 1.0" FLANGE SANITARY (25.4)

S4 - STAINLESS STEEL, 304
SL - STAINLESS STEEL, 304L
S6 - STAINLESS STEEL, 316L
HB - HASTELLOY B
HC - HASTELLOY C
IO - INCONEL 600
A2 - ALLOY 20
MN - MONEL
TI - TITANIUM
TC - TEFLON COATED
SM - SPECIAL MATERIAL

000.50 - 0.50 INCHES (12.7)
TO
120.00 - 120.00 INCHES (3048)

(MM EQUIVALENT)

110 - 110VAC
220 - 220VAC
24D - 24VDC
24A - 24VAC
SEE NOTE 1, in SHEET 1.

LE - LOCAL ELECTRONICS
RE - REMOTE ELECTRONICS

CB - CALIBRATION REQUIRED
EN - EXTENDED NECK LENGTH
XW - EXPLOSION PROOF WINDOW COVER
MT - MEDIUM TEMPERATURE SENSOR (300°C/572°F)
CE - CE MARK
VI - VARIABLE INSERTION
LT - LIVE TAP
RT - RTD OUTPUT
TO - THERMOCOUPLE OUTPUT
4X - NEMA 4X RATED ENCLOSURE
SH - STAINLESS STEEL HOUSING W/BLANK COVER
SW - STAINLESS STEEL HOUSING W/GLASS LENS COVER

REFERENCE: APPROVAL AGENCIES

REVISION	REVISED BY	ECO NUMBER	DATE	APPROVED
07	O. GARCIA	01004		
06	D. MCCOY	2K25	12-21-00	R. W. McCULLOCH
05	D. MCCOY	2K22	11-7-00	R. W. McCULLOCH
04	D. MCCOY	2K20	11-3-2K	R. W. McCULLOCH
03	O. GARCIA	2K19	10-30-2K	R. W. McCULLOCH
02	O. GARCIA	2K10	9-06-2K	R. W. McCULLOCH
01	O. GARCIA	99009	12-17-99	R. W. McCULLOCH

DIRECTORY: MT00800 FILE: SHEET2.FCW

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TOLERANCES
DECIMALS X [illegible]
XX [illegible]
XXX [illegible]
FRACTIONS: [illegible]
ANGULAR [illegible]
FINISH

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APPROVALS

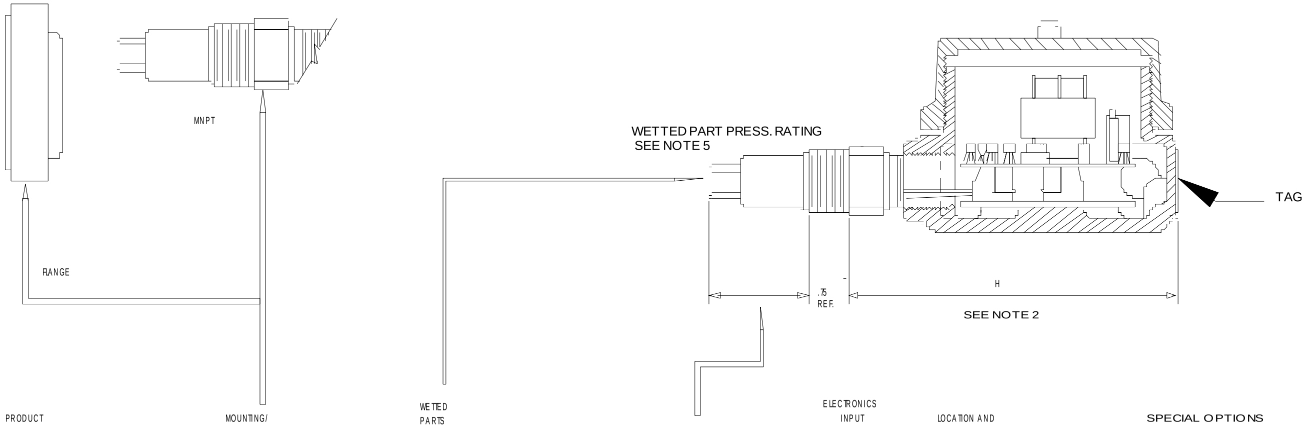
DESIGNED BY:	O. GARCIA	DATE:	5-20-99
DRAWN BY:	O. GARCIA	DATE:	9-10-99
ENGINEERING:	R. W. McCULLOCH	DATE:	9-17-99
DEPT. MANAGER:	A. D. WHITE	DATE:	9-17-99
DOCUMENT CONTROL:		DATE:	

DELTA CORPORATION
1003 LARSEN DRIVE
OAK RIDGE, TN 37830

MICROTUF Ⓡ SERIES
Ex. PROOF. REMOTE PROBE / ELECTRONICS
MODEL NUMBERS

SCALE NTS SIZE B DWG NO. MT0080 REV. 07
PAGE 2 OF 2

9.4 MODEL NUMBER DESIGNATION AND AVAILABLE OPTIONS



PRODUCT FAMILY		MOUNTING/ PROCESS FITTING		WETTED PARTS MATERIAL		INSERTION LENGTH		ELECTRONICS INPUT POWER		LOCATION AND ENCLOSURES		SPECIAL OPTIONS
A A A A A A A	—	B B B	—	C C	—	D D D. D	—	E E E	—	F F	—	G G
FS42NX		0 7 5		S 6		0 0 2 0 0		1 1 0		L E		0 0

SHOWN IS STANDARD FS42NX

STANDARD FS42NX FLOW SWITCH

MODELS : MICROTUF® SERIES
LS32NX - LEVEL SWITCH
FS42NX - FLOW SWITCH
SEE NOTE 4

07 5 -0.75 IN. MNPT

0 5 0 - 0.5 IN. MNPT
1 0 0 - 1.00 IN. MNPT
2 0 0 - 2.00 IN. MNPT
F - - - FLAT FACE FLG
R - - - RAISED FACE FLG
- A - - 150 LB. RATING
- B - .300 LB RATING
- - 1 - 1.00 INCH
- - 2 - 2.00 INCH
- - 3 - 3.00 INCH
- - S - SPECIAL
3 A 1 -1.50 IN. SANITARY
3 A 2 -1.00 IN. SANITARY

S 6 -STAINLESS STEEL 316L

S 4 - STAINLESS STEEL, 304
S L - STAINLESS STEEL, 304L
H B - HASTELLOY B
H C - HASTELLOY C
I O - INCONEL 600
A 2 - ALLOY 20
M N - MONEL
S M - SPECIAL MATERIAL

002.00 - 2.00 INCHES

000.50 - 0.50 INCHES
TO
120.00 - 120.00 INCHES

FACTORY SET

110 - 110VAC
220 - 220VAC
24D - 24VDC
24A - 24VAC
SEE NOTE 1

LE - LOCAL ELECTRONICS

LE - LOCAL ELECTRONICS
RE - REMOTE ELECTRONICS

CB - CALIBRATION REQUIRED
EN - EXTENDED NECK LENGTH
XW- EXPLOSION PROOF WINDOW COVER
MT- MEDIUM TEMPERATURE SENSOR (300°C/572°F)
HT - HIGH TEMPERATURE SENSOR (458 °C/850 °F)
UT - ULTRA HIGH TEMPERATURE SENSOR (600 °C/1323 °F)
RT - RTD OUTPUT
TO- THERMOCOUPLE OUTPUT
VI - VARIABLE INSERTION
LT - LIVE TAP
CO- CLAMP ON
HF - HIGH FLOW RATE
DS - DOUBLE SIDED HEAD
CE - CE MARK
WH- WHEATHER HEAD
SH - S.S. ENCLOSURE W/BLANK COVER
SW- S.S. ENCLOSURE W/GLASS LENS COVER

NOTES:

1. THE LS32NX / FS42NX SWITCH FAMILIES INPUT POWER IS FACTORY SET TO THE POWERS LISTED. THE CUSTOMER MUST ORDER HIS SELECTION. THE 24 V AC SELECTION IS A SPECIAL ORDER.
2. H IS MEASURED FROM THE BOTTOM FLAT OF THE MNPT FITTING OR FROM THE TOP SURFACE OT THE FLANGE TO THE TOP OF THE ENCLOSURE.
3. THE BLOCKS THAT ARE NOT COVERED IN EACH MODEL NUMBER MUST BE FILLED WITH ZEROS (0).
4. THE LS32NX AND FS42NX, MOSTLY USE A RATED EXPLOSION PROOF ENCLOSURE, HOWEVER THE UNIT INCLUDING THE SENSOR AS AN INSTRUMENT IS NOT RATED EXPLOSION PROOF NOR AGENCY APPROVED.
5. SOME SENSORS AND INSERTION EXTENSIONS HAVE A MAX. WORKING PRESS. (MWP) RATING OF 3000 PSI; THE ACTUAL PROBE PRESS. RATING DEPENDS ON THE PROCESS MOUNTING FITTING RATING. (CONSULT THE FACTORY)

REFERENCE: SALES

DIRECTORY: MT06002 FILE: SHEET1.FCW

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TOLERANCES
DECIMALS .X ± .030
.XX ± .010
.XXX ± .005
FRACTIONS: ± 1/32
ANGULAR ± 1/2°
FINISH
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DESIGNED BY:	O. GARCIA	DATE: 9-09-99
DRAWN BY:	O. GARCIA	DATE: 12-06-99
ENGINEERING:	R.W. McCULLOCH	DATE: 12-08-99
DEPT. MANAGER:	A. D. WHITE	DATE: 12-07-99
DOCUMENT CONTROL:		DATE:

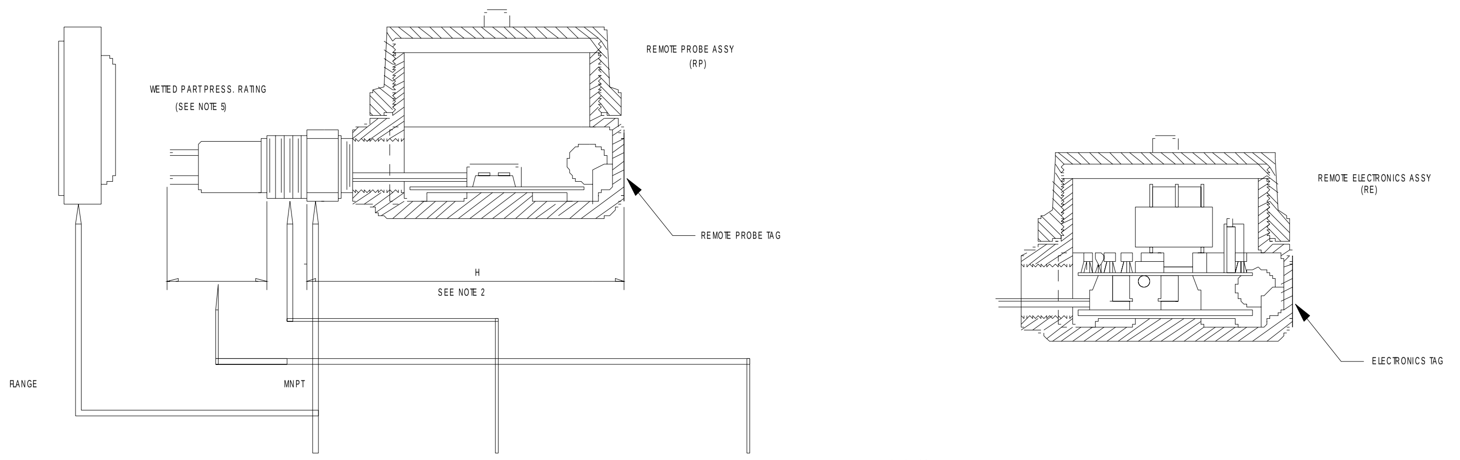
REVISION	REVISED BY	ECO NUMBER	DATE	APPROVED
02	D. MCCOY	2K20		
01	O. GARCIA	2K10	9-6-2K	RW MCCULLOCH

DELTA CORPORATION
1003 LARSEN DRIVE
OAK RIDGE, TN 37830

MICROTUF® SERIES
LS32NX/FS42NX NON EX-PROOF MODEL NUMBERS

SCALE PAGE 1 OF 2 SIZE B DWG NO. MT0060 REV. 02

9.4 MODEL NUMBER DESIGNATION AND AVAILABLE OPTIONS



	PRODUCT FAMILY	MOUNTING/ PROCESS FITTING	WETTED PARTS MATERIAL	INSERTION LENGTH	ELECTRONICS INPUT POWER	LOCATION AND ENCLOSURES	SPECIAL OPTIONS	EXAMPLE:
	A A A A A A	B B B	C C	D D D. D	E E E	F F	G G	STANDARD ASSEMBLIES SEE NOTE 3
	FS42NX	0 7 5	S 6	0 0 2 0 0	0 0 0	R P	0 0	REMOTE PROBE TAG MODEL NUMBER
	FS42NX	0 0 0	0 0	0 0 0 0 0	1 1 0	R E	0 0	REMOTE ELEX. TAG MODEL NUMBER
STANDARD	FS4100 - FLOW SWITCH	07 5 -0.75 IN. MNPT	S6 -STAINLESS STEEL 316L	002.00 - 2.00 INCHES	FACTORY SET	RE - REMOTE ELECTRONICS RP - REMOTE ELECTRONICS PROBE	CE - CE MARK WH - WHEATHER HEAD CB - CALIBRATION REQUIRED EN - EXTENDED NECK LENGTH XW - EXPLOSION PROOF WINDOW COVER MT - MEDIUM TEMPERATURE SENSOR (300°C/572°F) HT - HIGH TEMPERATURE SENSOR (458°C/850°F) UT - ULTRA HIGH TEMPERATURE SENSOR (600°C/1323°F) RT - RTD OUTPUT TO - THERMOCOUPLE OUTPUT VI - VARIABLE INSERTION LT - LIVE TAP CO - CLAMP ON HF - HIGH FLOW RATE DS - DOUBLE SIDED HEAD SH - S.S. ENCLOSURE W/BLANK COVER SW - S.S. ENCLOSURE W/GLASS LENS COVER	
	MODELS: MICROTUF Ⓡ SERIES LS32NX - LEVEL SWITCH FS42NX - FLOW SWITCH SEE NOTE 4	0 5 0 - 0.5 IN. MNPT 1 0 0 - 1.00 IN. MNPT 2 0 0 - 2.00 IN. MNPT F _ _ - FLAT FACE FLG R - - - RAISED FACE FLG - A - _ 150 LB. RATING - B - -300 LB RATING - - 1 - 1.00 INCH - - 2 - 2.00 INCH - - 3 - 3.00 INCH S PL - SPECIAL 3 A 1 - 1.5 in. SANITARY 3 A 2 - 1.0 in. SANITARY	S 4 - STAINLESS STEEL, 304 S L - STAINLESS STEEL, 304L H B - HASTELLOY B H C - HASTELLOY C I O - INCONEL 600 A 2 - ALLOY 20 M N - MONEL S M - SPECIAL MATERIAL	000.50 - 0.50 INCHES TO 120.00 - 120.00 INCHES	110 - 110VAC 220 - 220VAC 24D - 24VDC 24A - 24VAC SEE NOTE 1	RE - REMOTE ELECTRONICS RP - REMOTE ELECTRONICS PROBE		

NOTES:

1. THE LS32NX / FS42NX SWITCH FAMILIES INPUT POWER IS FACTORY SET TO THE POWERS LISTED. THE CUSTOMER MUST ORDER HIS SELECTION, THE 24 VAC SELECTION IS AN SPECIAL ORDER
2. H IS MEASURED FROM THE BOTTOM FLAT OF THE MNPT FITTING OR FROM THE TOP SURFACE OF THE FLANGE TO THE TOP OF THE ENCLOSURE.
3. THE BLOCKS THAT ARE NOT COVERED IN EACH MODEL NUMBER MUST BE FILLED WITH ZEROS (0).
4. THE LS32NX AND FS42NX, MOSTLY USE RATED EXPLOSION PROOF ENCLOSURES, HOWEVER THE UNIT INCLUDING THE SENSOR AS AN INSTRUMENT IS NOT RATED EXPLOSION PROOF NOR AGENCY APPROVED.
4. SOME SENSORS AND INSERTION EXTENSION HAVE A MAX. WORKING PRESS. (MWP) RATING OF 3000 PSI; THE ACTUAL PROBE PRESS. RATING DEPENDS ON THE PROCESS MOUNTING FITTING RATING. (CONSULT THE FACTORY)

REFERENCE: SALES

DIRECTORY: MT006002
FILE: SHEET2.FCW

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TOLERANCES
DECIMALS X ± [illegible]
XX ± [illegible]
XXX ± [illegible]
FRACTIONS: ± 1/32
ANGULAR ± [illegible]
FINISH ✓

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APPROVALS

DESIGNED BY:	O. GARCIA	DATE:	9-09-99
DRAWN BY:	O. GARCIA	DATE:	12-06-99
ENGINEERING:	R.W. McCULLOCH	DATE:	12-08-99
DEPT. MANAGER:	A. D. WHITE	DATE:	12-07-99
DOCUMENT CONTROL:		DATE:	

REVISION	REVISED BY	ECO NUMBER	DATE	APPROVED
02	D. MCCOY	2K20		
01	O. GARCIA	2K10	9-6-2K	RW MCCULLOCH

DELTA CORPORATION
1003 LARSEN DRIVE
OAK RIDGE, TN 37830

MICROTUF Ⓡ SERIES
LS32NX/FS42NX REMOTE PROBE / ELECTRONICS
NON EX-PROOF MODEL NUMBERS

SCALE: NTS
PAGE 2 OF 2
SIZE: B
DWG NO.: MT0060
REV.: 02