KURZ INSTRUMENTS INC.

Series 950
Mass Flow Switches
User's Guide

Document Number: 360103, Preliminary Review II

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Document Title: Series 950 Mass Flow Switches User's Guide

Document Number: 360103, Preliminary Review II

Publication Date: February 1991

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The Series 950 Mass Flow Switches are warranted to be free from defects in material or workmanship for one year from the date of shipment from the factory. Kurz's obligation is limited to repairing, or at its option, replacing products and components that, on verification, prove to be defective. Warranty work will be performed at the factory in Monterey, California. Kurz shall not be liable for installation charges, for expenses of buyer for repairs or replacement, for damages from delay or loss of use, or other indirect or consequential damages of any kind. Kurz extends this warranty only upon proper use and/or installation of the product in the application for which it is intended and does not cover products that have been serviced or modified by any person or entity other than Kurz Instruments, Incorporated and its authorized service technicians. This warranty does not cover damaged sensors, units that have been subjected to unusual physical or electrical stress, or upon which the original identifications marks have been removed or altered.

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Important Notice

The Kurz "dual-sting" MetalClad™ sensor used in the Series 950 Mass Flow Switches produces heat during normal operation. The sensor is designed for use in flows of air and other **NONEXPLOSIVE** gases. The sensor should not be used in flows of explosive gases unless it is equipped with the intrinsic safety circuit. Even when so equipped, the sensor can reach temperatures sufficient to ignite explosive gases unless the temperature of the gas flow itself is kept within established limits. **DO NOT USE THIS SENSOR IN FLOWS OF EXPLOSIVE GASES WITHOUT FIRST CONTACTING KURZ INSTRUMENTS FOR DETAILED SAFETY INFORMATION. FAILURE TO HEED THIS WARNING COULD RESULT IN EXPLOSION, DAMAGE TO FACILITIES, SERIOUS INJURY OR DEATH.**

Table of Contents

Unit Description Sheet

Customer Name: ______________________________

P.O. Number: ______________________________

Date of Order: ______________________________

Complete Model Number: ______________________________

Kurz Order Number: ______________________________

Serial Number: ______________________________

Calibration Reference

Nominal Temperature:

____ Standard +25° C (+77° F)

____ Special (specify):________________

Nominal Atmospheric Pressure:

____ Standard 760 mm (29.92 inches) of Hg

____ Special (specify):________________

Input Power:

____ Standard +18 to 24 Vdc, 0.5% regulation

____ Special (specify): ________________

Environmental Process Temperature:

____ AT (Ambient Temp.) -40° F to +257° F

____ HT (High Temp.) +32° F to +482° F

Sensor's Material:

	____	316 SS
	____	Hastelloy™ C276
	____	Monel™
	____	Titanium
	____	Hard Nickel-Chrome on 316 SS
	____	Titanium Nitride on 316 SS
	____	Special (specify): ____________________

Sensor's Support & Shield Material:

	____	316 SS
	____	Hastelloy™ C276
	____	Monel™
	____	Titanium
	____	Special (specify): ____________________

Probe Support Tube Length

-08 (0.5 in. diameter tube):	____	3 in.
	____	6 in.
	____	12 in. (Standard, 316 SS)
	____	24 in. (Standard, 316 SS)
	____	36 in.
	____	Special (specify): ____________________

Probe Support Tube Length (continued)

-16 (1.0 in. diameter tube):

- ____ 3 in.
- ____ 6 in.
- ____ 12 in.
- ____ 24 in.
- ____ 36 in. (Standard, 316 SS)
- ____ 48 in.
- ____ 60 in. (Standard, 316 SS)
- ____ Special (specify): ____________________

Electronic Assembly:

- ____ 10 Amp Relay Ratings
- ____ Intrinsic Safety Circuit
- ____ Factory-Set Relays
  Set-Point A (specify): ____________ Alarm
  Set-Point B (specify): ____________ Alarm
  Set-Point A (specify): ____________ Delay
  Set-Point B (specify): ____________ Delay
- ____ Special (specify): ____________________
  ____
  ____

Other (specify): ________________________________

____

____

____

Section 1: Product Overview

This section contains a general description of the Series 950 Mass Flow Switch. A synopsis of the flow switch's principles of operation has been included in the latter portion of this section.

1.1 Series 950 Subassemblies

The Series 950 subassemblies primarily consist of:

- Kurz "dual-sting" MetalClad™ sensor
- Probe support
- Electronic enclosure
- Flow switch

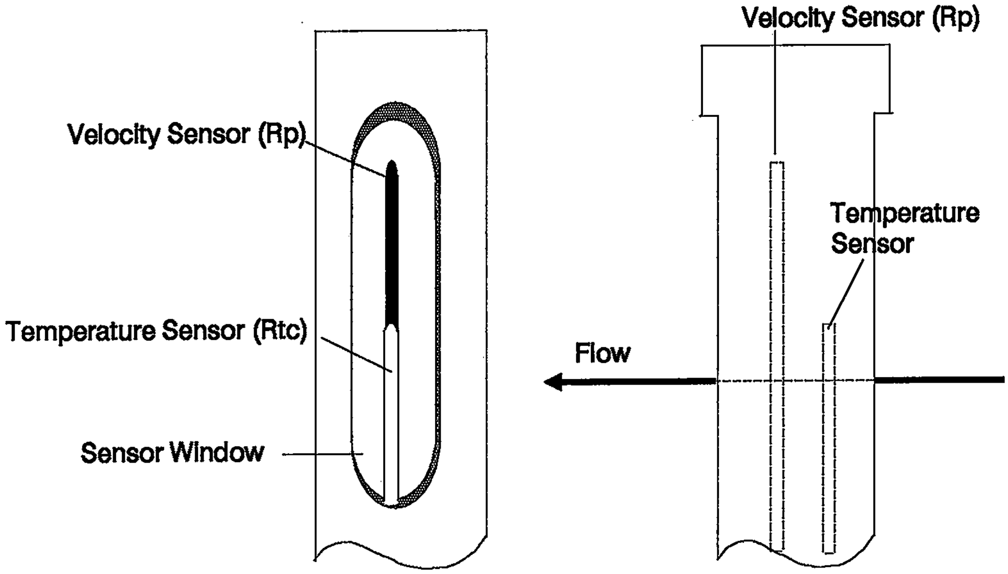
1.1.1 Kurz "Dual-Sting" MetalClad™ Sensor

The Kurz "dual-sting" MetalClad™ sensor is constructed by using two temperature-sensitive resistance temperature detectors (RTDs) of reference-grade 385 platinum windings around a high purity ceramic core, sheathed in a protective material (316 stainless steel being standard; other materials and coatings are optional).

The Kurz "dual-sting" MetalClad™ sensor is in fact two sensors in one. The "large dual-sting" (LD) MetalClad™ , all-welded metal sensor in which the temperature compensation winding (R_{tc}) and velocity winding (R_p) are mounted in seperate mandrels or stings; thus, providing much improved thermal isolation from the probe mounting structure and a fast time response to changes in temperatures. The latest sensor development of Kurz is the extremely "fast dual-sting" (FD) MetalClad™, all-welded metal sensor which has an almost instantaneous time response to fast process temperature changes.

The temperature compensation winding (R_{tc}) is the shorter of the two mandrels (stings); in that matter, the velocity winding (R_p) is the longer. Refer to Figure 1.1-1 for a close-up view of a Kurz "dual-sting" MetalClad™ sensor within its protective window.

Figure 1.1-1. *Kurz "Dual-Sting" MetalClad™ Sensor*



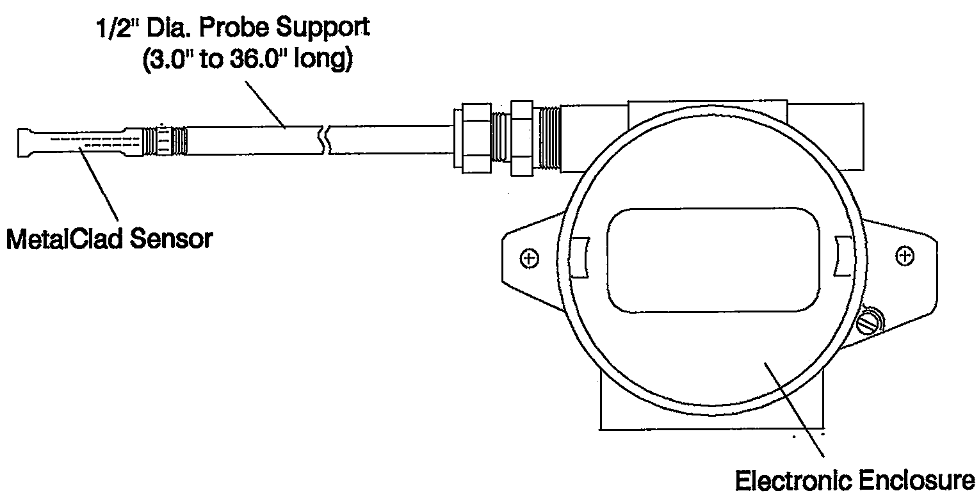
CAUTION: The Kurz "dual-sting" MetalClad™ sensor's **standard** rating is for monitoring flow rates of nonexplosive gases only; however, is equipped with an intrinsic safety circuit on the bridge board. The intrinsic safety circuit employs a ballast-resistor and zener diode combination to limit the amount of power supplied to the sensor in the unlikely event of a serious failure. Even with the intrinsic safety circuit installed, the sensor normally operates at a temperature differential (overheat) of approximately +75° to 100° Fahrenheit (F) above the ambient temperature of the gas flow it is monitoring. It is the user's responsibility to ensure that the ambient temperature of an explosive gas flow is kept at least 20% below the gas ignition temperature. For further information pertaining the specifications of the intrinsic safety circuit for process operations with flow conditions of an explosive gas or gas mixture, contact your local Kurz representative, or contact Kurz Instruments, Incorporated at (408) 646-5911.

1.1.2 Probe Support

The metalworks of the probe support are constructed of a supportable material (316 stainless steel being standard; other materials and coatings are optional). The probe support can be ordered in two sizes which allows convenient mounting with compression fittings:

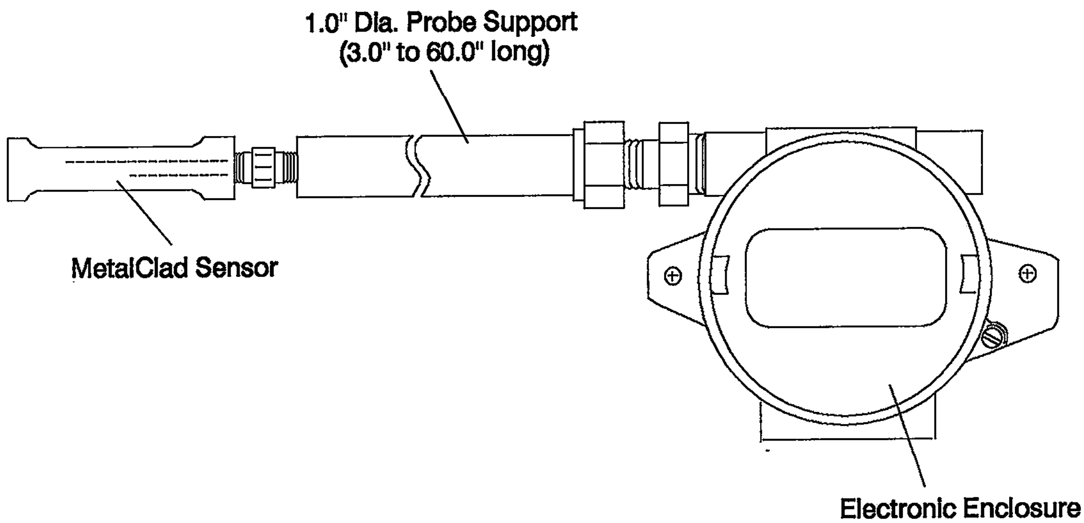
a) Series 950-08: A half (8/16) inch diameter tube having support lengths from 3.0" to 36.0" (standard lengths 12.0" and 24.0"). Ideal for small industrial ducts and pipes with diameters between 2.0" and 36.0". Figure 1.1-2 shows an example of a Series 950-08 probe assembly.

Figure 1.1-2. *Series 950-08 Probe Assembly*



b) Series 950-16: One (16/16) inch diameter tube having support lengths from 3.0" to 60.0" (standard lengths are 36.0" and 60.0"). Ideal for large industrial ducts and pipes. Figure 1.1-3 shows an example of a Series 950-16 probe assembly.

Figure 1.1-3. *Series 950-16 Probe Assembly*



1.1.3 Electronic Enclosure

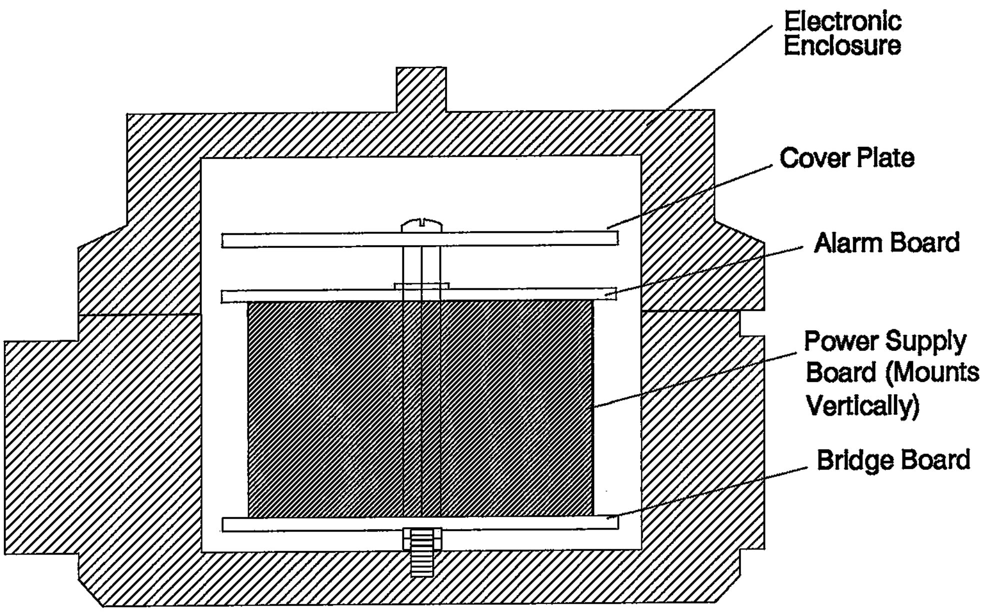
The electronic enclosure is directly attached to the probe support. This weatherproof, explosive resistant, metal enclosure also serves as a heat sink to the transistor on the bridge board.

Although the sensor is capable of extremely high and low temperatures, the enclosure must be maintained between -25° to +65° Celsius (C). The electrical components of the electronic assembly are not warranted by their respective manufacturers to operate above +65° C. To prevent excessive heating of the enclosure and the associated circuitry of the flow switch, the probe support should be ordered to an extended length.

1.1.4 Flow Switch

The electronic assembly of the flow switch consists of three circuit boards that are assembled together and mounted in the electronic enclosure. Figure 1.1-4 illustrates the placements of the electronic assembly in the electronic enclosure.

Figure 1.1-4. *Electronic Assembly of the Flow Switch*



The bridge board contains a classical Wheatstone bridge and associated circuitry. The primary function of the circuitry is to electrically balance the sensor's current signal (100-600 mA range) with reference to the Wheatstone bridge and from the amount of electrical energy (power) needed to maintain the sensor's temperature differential or overheat when affected by the flow of air or other gases passing the velocity winding (R_p): A contingent process on the rate of change in mass flow measured by the cooling effect of the velocity winding (R_p) against the temperature winding (R_{tc}); in which, are in a direct representation to the velocity of the air flow.

Note: The sensor's cable is an integral circuitry of the bridge board. Resistance in the cable's length is part of the calibration process we call *temp comp* in determining the balance point of the Wheatstone bridge. In no event should you alter the length of the sensor's cable.

The alarm board is considered the main circuit board because technically it contains the high and low comparators, the threshold adjust circuitry and two independent relays, each having adjustable set-point and two selectable ranges for time delay (0-30 seconds and 0-300 seconds). Each relay may be operated as either a low alarm or high alarm through the use of jumpers on the board. *Low* means a change in state of the relay occurs when the rate of flow goes below the "low" set-point vice versa *high* means a change in state of the relay occurs when the rate of flow goes above the "high" set-point. Since the relays are independent, the user can set up both relays to be low, both relays to be high or one low and one high. The time delay function initiates when the rate of flow alleviates below the "low" set-point or when the rate of flow becomes normal at any time, the relay is immediately changed to its normal state and the time delay circuit is reset. The time delay is useful to prevent relay chattering for systems that operate close to the set-point. When the rate of flow exceeds a user-selected "high" set-point or drops below a user-selected "low" set-point, a corresponding relay abruptly responds; actuating alarms, lights or other external devices connected to the appropriate terminals on Terminal Block 1 (TB1). An LED provided for each relay functions in the same manner by indicating which relay has been triggered by the offset. Normally opened (N.O.) and normally closed (N.C.) contacts are also included on the terminal strip to suit the user's needs.

The power supply board interfaces the bridge board and alarm board. The power supply board regulates the electrical energy (+24.0 Vdc input supply) to provide the necessary signals for the internal operation of the electronic assembly; i.e., reference voltages (positive and negative), and regulated or unregulated voltages. It also serves as a electrical path for either the bridge voltage or current sense voltage to be transmittted from the bridge board to the alarm board.

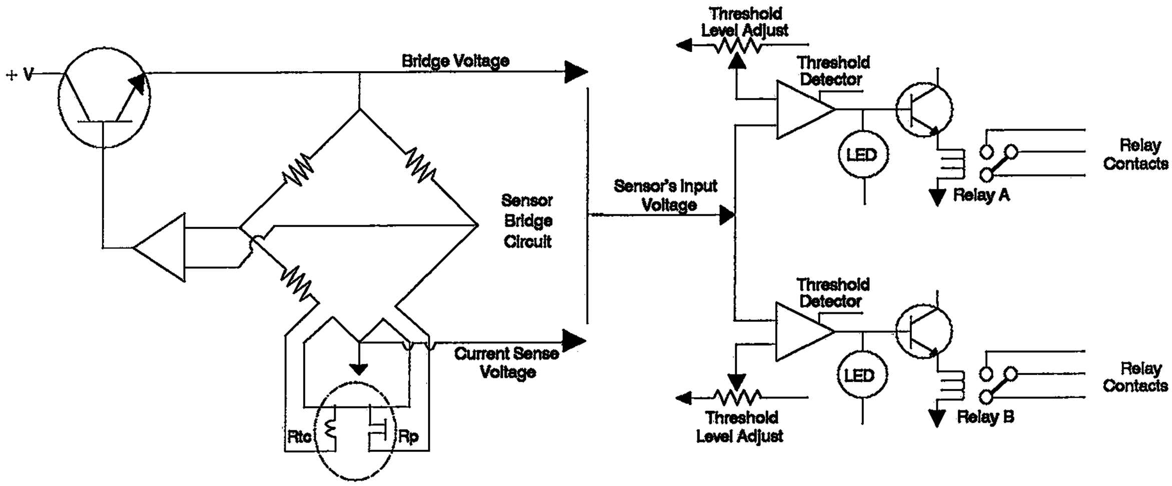
1.2 Principles of Operation

The fundamental idea behind any thermal sensor is that the rate of flow of any fluid that is capable of absorbing heat--be it air, gas or a liquid--can be inferred from the heat transferred or carried away from a well-defined, well-known, heated element.

The Kurz "dual-sting" MetalClad™ sensor, then, can be constructed and operated as constant-temperature thermal anemometer by using two temperature-sensitive resistance temperature detectors (RTDs), one that detects ambient temperature and factors it out, and one that is heated to a specified overheat above the ambient temperature, approximately +75° to +100° Fahrenheit (F). The sensor, once constructed, is operated by a classical Wheatstone bridge. The two windings function as legs of a balanced Wheatstone bridge circuit. The larger winding, we call R_{tc}, for resistor, temperature compensation. This winding is used to measure the ambient temperature of the flow in which the sensor is inserted. The bridge circuit is set up during a part of the calibration process we call *temp comp* to supply sufficient power of the smaller winding (R_p, for resistor, probe) to maintain a constant temperature differential or overheat, above the temperature of the passive R_{tc} winding. The greater the rate of flow passing the sensor, the more current is required to maintain the temperature differential (overheat) constant. Subsequently, the circuit produces as its output a voltage that represents the heat transfer between the heated winding and the gas stream. Thus, you have a signal indicative of the rate of flow of the fluid, with temperature variations already factored out. The thermal sensor, because it responds to the amount of heat being carried away, and because heat is carried away by molecules, inherently and automatically compensates for variations in density or pressure (more pressure means more molecules, which means more mass flow).

A simplified diagram of the flow switch's electrical assembly is provided in figure 1.2-1. As shown, the temperature and velocity windings of the Kurz "dual-sting" MetalClad™ sensor form two legs of a balanced Wheatstone bridge. As flow increases, the bridge draws more current to stay balanced. This current is drawn across a resistor to generate either a bridge voltage or a current sense voltage signal.

Figure 1.2-1. *Simplified Diagram of the Electrical Assembly*



This signal is then transmitted to the main circuit board as the inputs to the high and low comparators. These comparators are used as high and low threshold detectors, which are set by high and low threshold adjustment potentiometers. Two modes of operation are selectable from the high and low threshold adjustment potentiometers through the placement of jumpers on the main circuit board:

a) Normal Mode b) Fail-Safe Mode

Normal Mode basically means the relay coil is not energized in normal flow operating range; i.e., whenever the rate of flow alleviates below a "low" set-point or deviates above a "high" set-point, the relay is activated. Thus, a N.O. contact would switch to the closed position.

Fail-Safe Mode means the relay coil is energized whenever the rate of flow is above a "low" set-point and below a "high" set-point in normal flow operating range. Therefore, the N.O. contact becomes a closed contact and opens upon abnormal flow conditions. It is called *Fail-Safe* because the loss of power also causes the normally energized relay to open, and a relay coil failure will also open the contacts.

End of Section 1

Section 2: Installation

The instructions given in this section are necessarily general in nature. Refer to the appropriate engineering drawings in Appendix A for the probe assembly dimensions and field wiring interconnect information. If you need further assistance with your installation, contact your local Kurz representative, or contact Kurz Instruments, Incorporated at (408) 646-5911.

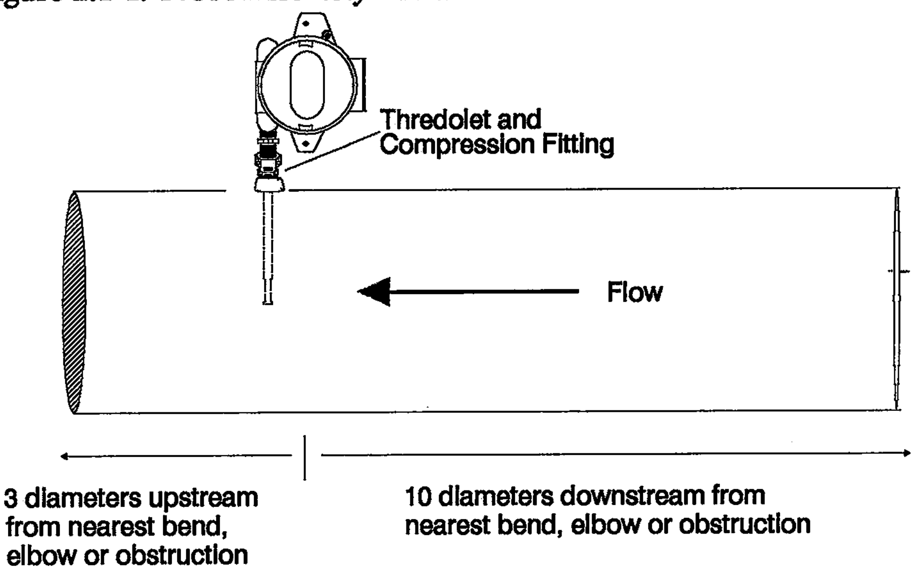
2.1 Determining Probe Assembly Location

If possible, you should locate the probe assembly at least three pipe or duct diameters upstream and 10 diameters downstream from the nearest bend, elbow or other obstruction in the pipe or duct. The chosen location should also provide sufficient clearance for inserting and removing the probe assembly; i.e., the clearance between the pipe or duct and any obstruction should equal at least the length of the probe support which includes the sensor's electronic enclosure plus two or three inches for maneuverability.

If a "perfect" location is not available, it is usually possible to find a location and depth that has repeatable flow conditions. Since this is a flow switch and not a flow meter, this is acceptable. Usually a depth of one-third the duct diameter is sufficient for larger ducts (greater than six inches). For small pipes we recommend placing the active portion of the sensor near the pipe's center-line.

Make sure the probe assembly is rotated or such that the sensor's protective window allows an unobstructed flow to pass the sensor. The shorter mandrel or sting (R_{tc}) should be facing the oncoming flow. An example of a probe assembly location is illustrated in Figure 2.1-1.

Figure 2.1-1. *Probe Assembly Location*



2.2 Installation of the Probe Assembly

In most cases, the probe assembly is held in place by means of a compression fitting attached to the outside of the pipe or duct. The mounting hardware and procedures to attach the probe assembly vary, depending on your mounting configuration.

Note: The unit is shipped with a protective rubber cap covering the sensor. Make sure you remove this cap prior to installation.

All mounting hardware needed to mount the probe assembly in a pipe or duct are readily available from Kurz Instruments, Incorporated.

- **Extended support fitting (ESF; special).** These fittings allow installers to use a supporting pipe nipple for added rigidity and protection of the probe assembly. The Thredolet™ and nipple are supplied. The nipple length (316 stainless steel material) is used to position the sensor's depth.

- **Compression fitting (CF).** For installation in pipe, a Thredolet™ carbon steel coupler[1] can be provided for welding onto pipe. Specify size of National Pipe Thread (NPT) pipe the coupling is to be welded to, as well as the wall thickness of that pipe (Schedule 40, 80 and etc.). The coupling must accept the appropriate Male National Pipe Thread (MNPT) fitting (see "tube compression fitting").

- **Tube compression fitting**[2]. The following tube compression fitting should be used for the appropriate probe assembly:

  a) Series 950-08: 8AD8, a half inch diameter male adapter (compression fitting with a half inch MNPT).

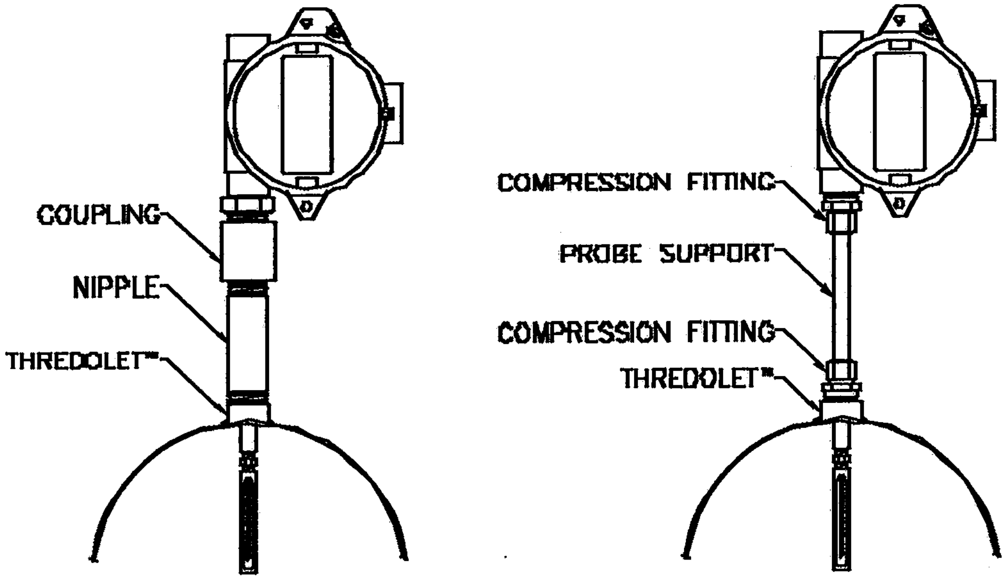
  b) Series 950-16: 16AD16, a one inch diameter male adapter (compression fitting with a one inch MNPT).

  Note: The compression fitting supplied is 304 stainless steel with a Teflon™ ferrule so that the depth of the probe assembly can be postioned as needed. Applications only for process temperatures less than +400° F.

- **Adjustable stop collar with set screw (special).** The optional stainless steel stop collar can be attached to the probe support to ensure that the probe assembly is not inserted beyond the predetermined depth.

  The installations of a probe assembly using a ESF and CF fittings are shown in Figure 2.2-1.

Figure 2.2-1. *Shown Left: ESF Fitting* *Shown Right: CF Fitting*



1 Thredolet fittings are also available in aluminum and stainless steel.

2 Optional stainless steel ferrules are available for permanent compression on probe.

The steps necessary to perform a compression fitting installation are as follows:

Step 1. With minimum or no flow in the line, drill a probe-insertion hole at a selected location in the pipe. The diameter of the hole should be $^1/_{16}$ of an inch larger than the diameter of the probe support. For the Series 950-08, this means a probe-insertion hole $^9/_{16}$ of an inch and for the Series 950-16, 1 $^1/_{16}$ inches in diameter.

Step 2. Weld the Thredolet™ coupler directly over the probe-insertion hole.

Step 3. Insert the probe assembly to the predetermined depth (near the pipe's center-line). Make sure that the probe assembly is rotated such that the sensor's protective window allows unobstructed flow to pass the sensor and the shorter mandrel or sting (R_{tc}) is facing the oncoming flow.

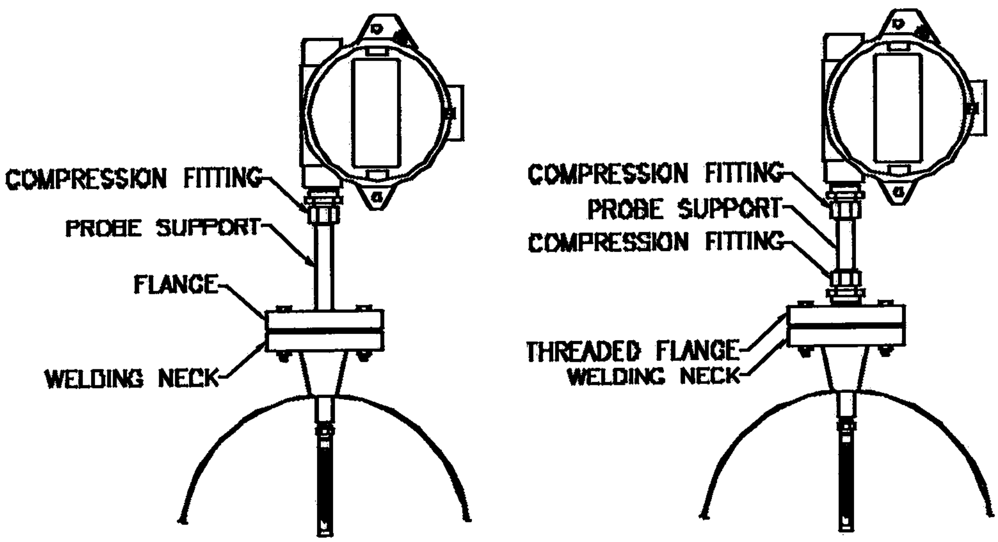
Step 4. Tighten the tube compression fitting until the probe assembly is held firmly in place.

This type of installation allows the probe assembly to be readily removed for routine maintenance by simply untightening the tube compression fitting and sliding the probe assembly out the pipe. Please note that the compression fitting installation is for low pressure applications only (less than 50 psi). If a high pressure application is necessary, a restraint chain or a flange-mounted unit should be used. **Be careful!**

- **FNG welded Flange (special).** For high-pressure and hazardous gas applications (up to 1000 psi), the probe assembly can be equipped with an integral welded flange for bolting onto a customer-supplied welding neck flange.

  The installations of a probe assembly using a FNG hardware are shown in Figure 2.2-2.

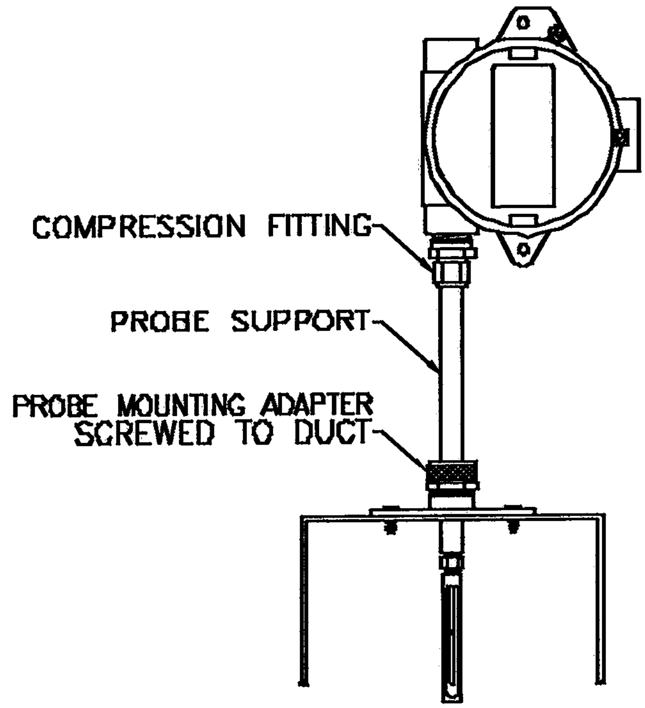
Figure 2.2-2. *FNG Mounting Installations*



- **Probe mounting adapter (PMA; special).** For sheet metal and light pipe, the simple probe mounting adapter is often sufficient. For a Series 950-08, a PMA-08 attached to a 2.0" x 2.0" stainless steel plate with four corner mounting holes is used. For a Series 950-16, a PMA-16 attached to a 3.0" x 3.0" stainless steel plate with four corner mounting holes is used. The PMA-08 has a half inch bored-through compression fitting while the PMA-16 has a one inch bored-through compression fitting.

  The installation of a probe assembly using a PMA hardware is shown in Figure 2.2-3. For round ducts, curved probe mounting adapters are available upon special order (specify radius).

Figure 2.2-3. *PMA Installation*

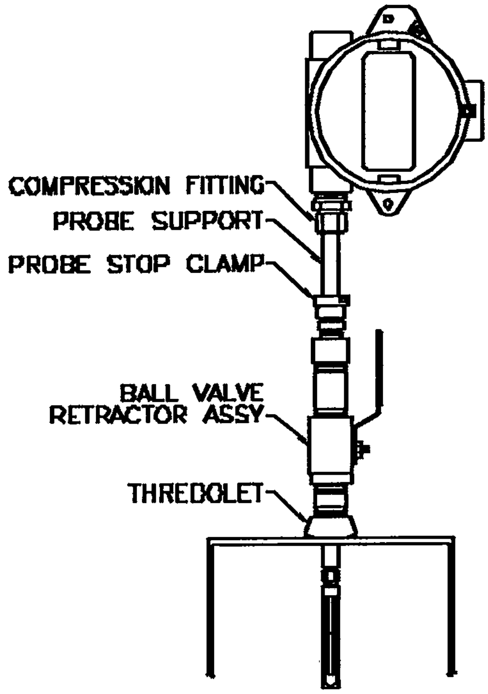


- **Ball valve retractor (BVR) assembly.** Designed for installation in existing lines without shutdown of flow ("hot tapping") or with shutdown of flow ("cold tapping"). The BVR assembly includes a Thredolet™ carbon steel coupler to be welded to a pipe. The tube compression fitting on the uppermost section of the BVR assembly provides a good seal when tightened down. A stainless steel stop collar is also included to set in advance the placement depth of the probe assembly.

  The ball valve allows free passage of the probe assembly when open, yet seals off the flow when closed to allow retraction of the probe assembly; in addition, is used during initial drilling into the pipe using a standard hot-tap or pressurized drill.

  Figure 2.2-4 illustrates the BVR assembly hardware installed with the probe assembly.

Figure 2.2-4. *BVR Assembly Installation*



CAUTION: If the probe assembly is used with the BVR assembly in flows of explosive gases, you must be extremely careful to ensure that both the probe and the BVR assembly are properly sealed to prevent gas leaks. Do not use the BVR assembly in lines pressurized above 75 psi absolute. After proper installation in the BVR assembly, the probe assembly will remain secure under normal operating conditions. However, if the unit is subjected to pressure in excess of 75 psi absolute, the probe assembly may eject from the BVR assembly at high velocity. **Such an ejection is extremely dangerous and exposes personnel to the risk of serious injury or death.**

Cold Tapping

The steps necessary to perform a cold-tap installation are as follows:

Step 1. With minimum or no flow in the line, drill a probe-insertion hole at a selected location in the pipe. The diameter of the hole should be 1/16 of an inch larger than the diameter of the probe support. For the Series 950-08, this means a probe-insertion hole 9/16 of an inch and for the Series 950-16, 1 1/16 inches in diameter.

Step 2. Weld the Thredolet™ coupler directly over the probe-insertion hole.

Step 3. Fasten the BVR assembly firmly together to the Thredolet™ coupler.

Step 4. Position the stop collar on the probe support to the predetermined depth and tighten the set screw.

Step 5. Open the ball valve and insert the probe assembly until the stop collar abuts with the tube compression fitting.

Step 6. Make sure that the probe assembly is rotated or such that the sensor's protective window allows unobstructed flow to pass the sensor and the shorter mandrel or sting (R_{tc}) is facing the oncoming flow.

Step 7. Tighten the tube compression fitting until the probe assembly is held firmly in place.

Step 8. To verify that the BVR assembly is properly sealed and to ensure safe operation of the probe assembly, you should pressure-test all joints with soap bubble solution.

Hot Tapping

Hot tapping requires the use of special drilling equipment. Such equipment is available from the Mueller Company in Decatur, Illinois. Kurz Instruments, Incorporated recommends Mueller's E-5 drilling machine for the Series 950-08 and Mueller's D-5 drilling machine for the Series 950-16. Contact the Mueller Company at (217) 423-4471 for product details. Either machine allows you to install the BVR assembly **before** you tap the line.

The steps necessary to perform a hot-tap installation are as follows:

Step 1. Weld the Thredolet™ coupler onto the pipe in the location where you want to drill the probe-insertion hole.

Step 2. Remove the ball valve and the short pipe nipple from the rest of the BVR assembly (the ball valve and the short pipe nipple should remain attached to each other).

Step 3. Fasten the short pipe nipple securely into the Thredolet™ coupler.

Step 4. Fasten the appropriate Mueller-supplied adapter nipple into the ball valve (**contact Mueller for adapter nipple ordering information**).

Step 5. Attach the correct drill bit to the drilling machine (**refer to the manufacturer's instructions**).

Step 6. Fasten the drilling machine securely onto the adapter nipple.

Step 7. Open the ball valve and extend the boring bar through the ball valve to drill the hole.

Step 8. Retract the boring bar to the outside of the ball valve and close the ball valve.

Step 9. Remove the drilling machine and the adapter nipple from the ball valve.

Step 10. Fasten the remaining parts of the BVR assembly to the ball valve.

Step 11. Position the stop collar on the probe support to the predetermined depth and tighten the set screw.

Note: Once you have mounted the BVR assembly to the pipe, you can insert or remove the probe assembly with or without a pressurized flow in the line. If, however, pressure in the line exceeds approximately 50 psi, you should alleviate the flow before inserting or removing the probe assembly.

Step 12. Open the ball valve and insert the probe assembly until the stop collar abuts with the tube compression fitting.

Step 13. Make sure that the probe assembly is rotated or such that the sensor's protective window allows unobstructed flow to pass the sensor and the shorter mandrel or sting (R_{tc}) is facing the oncoming flow.

Step 14. Tighten the tube compression fitting until the probe assembly is held firmly in place.

Step 15. To verify that the BVR assembly is properly sealed and to ensure safe operation of the probe assembly, you should pressure-test all joints with soap bubble solution.

2.3 Field Calibration Procedures

The flow switch may have been pre-set at the factory (optionally available). However, should you need to configure the flow switch to your specifications, review the field calibration procedures in this subsection. Figure 2.3-1 illustrates the location and description of the adjustment potentiometers, mode configuration jumpers and time delay range for the Series 950 Mass Flow Switch as well as the barrier terminal strip description. Table 2.3-1 describes the jumper configurations for the flow switch.

Figure 2.3-1. *Setup Configuration of the Main Circuit Board*

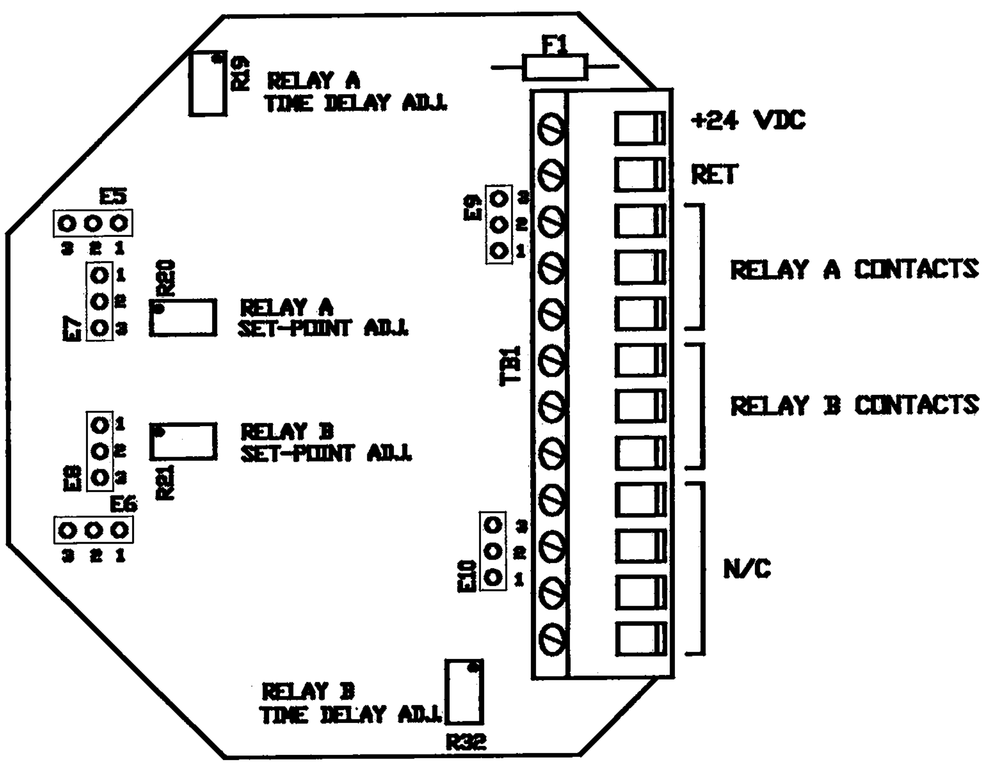


Table 2.3-1. *Jumper Configuration Table*

JUMPER CONFIG. TABLE		
E7	3 2 1	RELAY "A", HI ALARM
E7	3 2 1	RELAY "A", LOW ALARM
E8	3 2 1	RELAY "B", LOW ALARM
E8	3 2 1	RELAY "B", HIGH ALARM
E9	1 2 3	RELAY "A", DELAY, 0-30 SEC.
E9	1 2 3	RELAY "A", DELAY, 0-300 SEC.
E10	1 2 3	RELAY "B", DELAY, 0-30 SEC.
E10	1 2 3	RELAY "B", DELAY, 0-300 SEC.
E5	3 2 1	RELAY "A", NORMAL MODE
E5	3 2 1	RELAY "A", FAIL SAFE MODE
E6	3 2 1	RELAY "B", NORMAL MODE
E6	3 2 1	RELAY "B", FAIL SAFE MODE

By placing jumpers in selected positions and making adjustments to the appropriate potentiometers you can:

- Configure each alarm to operate in a Normal or Fail-Safe Mode.
- Configure the alarms to monitor two low flow conditions, two high flow conditions, or a low and a high condition.
- Configure the relays to activate at a specific rate of flow.
- Configure the time delay for each relay so that the relay does not activate in response to brief fluctuations of flow.

2.3.1 Normal or Fail-Safe Mode Operation

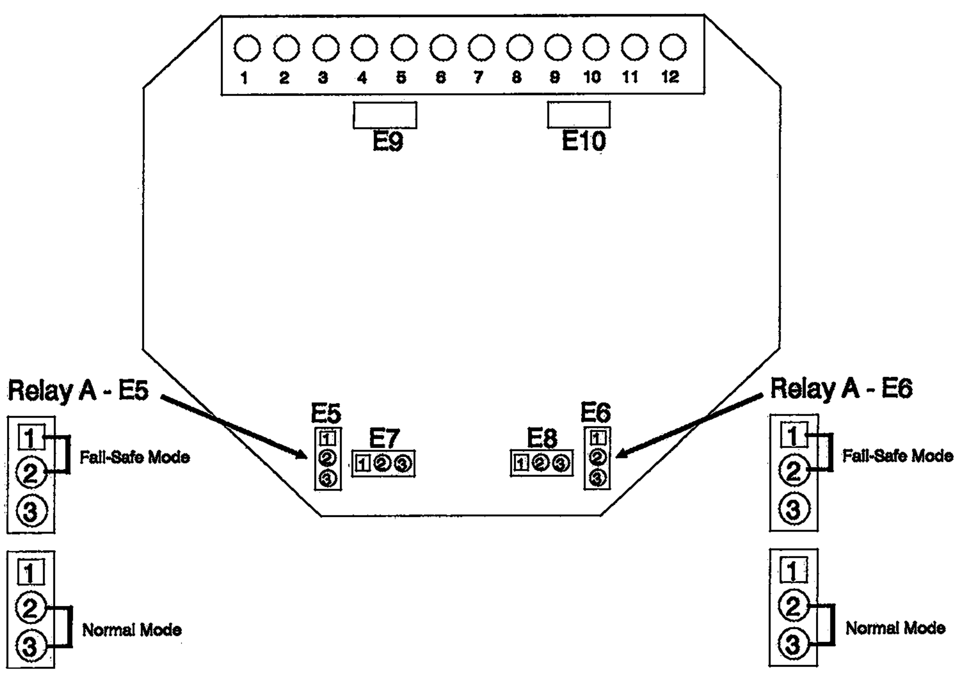
Each relay can be configured to operate in a "Normal" or in a "Fail-Safe" Mode. The relay mode selection determines the state of the relay when alarm conditions occur and also determines the type of alarm conditions that activate the relay.

The relay mode selections are summarized in Table 2.3-2. Refer to Figure 2.3-2 for the location of the jumpers used to configure the relay modes.

Table 2.3-2. *Relay Mode Selections*

Relay Configuration:	Jumper Configuration:		Alarm Conditions That Activate the Relay:	Normal State:	Activated State:
	Relay A	Relay B			
Normal Mode	E5(2-3)	E6(2-3)	Flow out of range	Open	Closed
Fail-Safe Mode	E5(1-2)	E6(1-2)	Flow out of range or power has failed	Closed	Open

Figure 2.3-2. *Jumpers E5 and E6 for Relay Mode Operation*



Normal Mode Operation

To configure Relay A for Normal Mode operation, place a shunt between pins 2 and 3 of jumper E5; to configure Relay B, place a shunt between pins 2 and 3 of jumper E6 .

If a relay is configured to operate in this mode, the relay coil is not energized and the relay is open at all times **except** when flow conditions are outside of the user-selected set-point ranges (the flow switch must be operational). When a relay is configured in this way, it is referred to as a "normally open" (N.O.) relay.

The only two conditions that cause the "Normal" relay to activate and close are:

a) The rate of flow is equal to or above the "high" (Relay A) or "high" (Relay B) set-point.

b) The rate of flow is equal to or less than the "low" (Relay B) or "low" (Relay A) set-point.

The non-activated and activated states of the normal relay are shown in Table 2.3-3.

Table 2.3-3. *Non-Activated and Activated States of a Relay Configured for Normal Mode Operation*

Alarm Conditions:	Normal Mode Relay Contacts		Flow Conditions That Activate the Relay:
	Relay A	Relay B	
"High"	Closed(3&5) Open (3&4)	Open (6&8) Closed(6&7)	Flow above set-point
"High"	Open (3&5) Closed(3&4)	Closed(6&8) Open (6&7)	Flow below set-point
"Low"	Open(3&5) Closed(3&4)	Open (6&8) Closed(6&7)	Flow above set-point
"Low"	Closed(3&5) Open (3&4)	Closed(6&8) Open (6&7)	Flow below set-point
Power Failure[1]	Open (3&5) Closed(3&4)	Open (6&8) Closed(6&7)	Unknown

[1] *If the unit is not powered, the normal relays remain open (in-active) no matter what flow conditions are present; to monitor for a power failure as well as for flow, configure one or both relays for "Fail-Safe" operation.*

Fail-Safe Mode Operation

To configure Relay A for Fail-Safe Mode operation, place a shunt between pins 1 and 2 of jumper E5; to configure Relay B, place a shunt between pins 1 and 2 of jumper E6.

If a relay is configured to operate in this mode, the relay coil is energized and the relay closes when power is initially applied to the flow switch; remains closed at all times **except** when flow conditions are outside of the user-selected set-point ranges or power to the flow switch is absent. When a relay is configured in this way, it is referred to as a "normally closed" (N.C.) relay.

The three conditions that cause the "Fail-Safe" relay to activate and open are:

a) The rate of flow is equal to or above the "high" (Relay A) or "high" (Relay B) set-point.

b) The rate of flow is equal to or less than the "low" (Relay B) or "low" (Relay B) set-point.

c) Power to the flow switch has failed regardless of flow conditions.

The non-activated and activated states of the "Fail-Safe" relay are shown in Table 2.3-4.

Table 2.3-4. *Non-Activated and Activated States of a Relay Configured for Fail-Safe Mode Operation*

Alarm Conditions:	Fail-Safe Mode Relay Contacts		Flow Conditions That Activate the Relay:
	Relay A	Relay B	
"High"	Open (3&5) Closed(3&4)	Open (6&8) Closed(6&7)	Flow above set-point
"High"	Closed(3&5) Open (3&4)	Closed(6&8) Open (6&7)	Flow below set-point
"Low"	Closed(3&5) Open (3&4)	Closed(6&8) Open (6&7)	Flow above set-point
"Low"	Open (3&5) Closed(3&4)	Open (6&8) Closed(6&7)	Flow below set-point
Power-Failure	Open (3&5) Closed(3&4)	Open (6&8) Closed(6&7)	Unknown

Note: A "Fail-Safe" relay is activated when flow conditions are out of the user-selected set-point ranges or when power to the flow switch has failed. To differentiate a power-fail condition from an out-of-range flow condition, check the relay LEDs. If the relay has been activated by a low or high flow rate, the associated LED will be on. If the relay has been activated by a power-failure condition, the associated LED will be off.

2.3.2 Configuring the Alarm Conditions

The flow switch can be used to monitor two low flow rates, two high flow rates, or a low flow rate and a high flow rate. Jumpers E7 and E8 are used to configure the relay for these flow conditions.

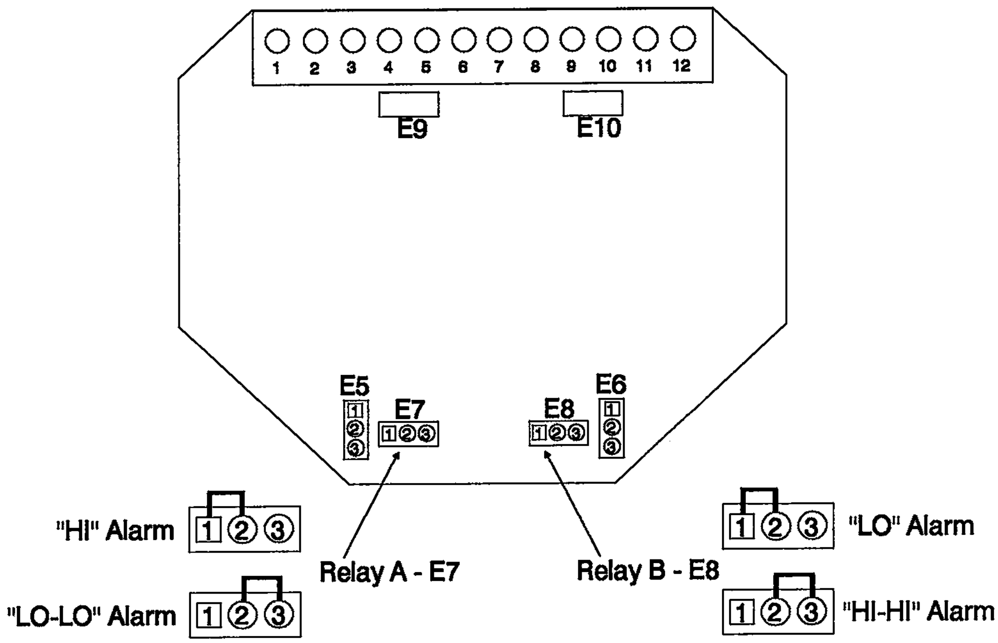
Table 2.3-5 shows how to configure the relays to respond to the various flow conditions. Refer to Figure 2.3-3 for the jumper locations.

Table 2.3.5. *Setting Alarm Flow Conditions that Activate the Relays*

Alarms Set For:	**Relay A**	**Relay B**	**Jumper**	**Jumper**	**0% ---- Visual Reference[1] ---- 100%**
HI/LO	HI	LO	E7(1-2)	E8(1-2)	B / Rate of Flow In-Range / A
HI/HI-HI	HI	HI-HI	E7(1-2)	E8(2-3)	Rate of Flow In-Range / A / B
LO/LO-LO	LO-LO	LO	E7(2-3)	E8(1-2)	A / B / Rate of Flow In-Range

[1] *Shaded areas indicate flow ranges in which one or both alarms are active. Flow set-points vary depending on adjustments made to the relay potentiometers.*

Figure 2.3-3. *Jumpers E7 and E8 for the Alarm Conditions*



2.3.3 Adjusting the Alarm Set-Points

If the alarm set-points have not been preset by Kurz Instruments, Incorporated (optionally available), you will need to adjust the respective set-point potentiometers. A label on the top of the cover plate identifies the configuration of the alarms (LL/LO, LO/HI and HI/HH) and the location of the set-point A and set-point B potentiometers and LEDs. The potentiometers are easily accessed and the LEDs are visible through holes in the cover plate that protects the electronic assembly inside the sensor's electronic enclosure.

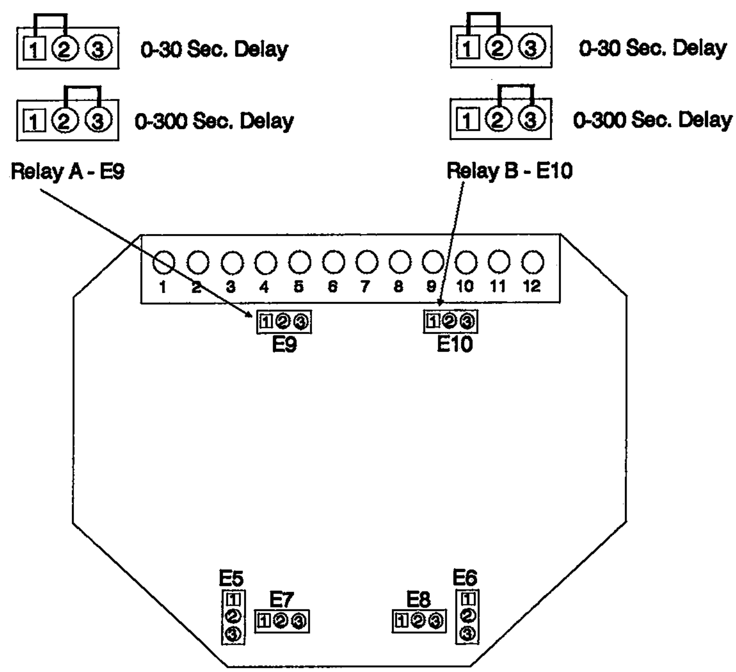
First, the time delay adjustment potentiometer should be set to "zero" and the 0-30 second jumper should initially be selected (change it after the set-point is established). It is very difficult to make the set-point adjustment if the time delay is not set at "zero" delay. To set the high alarm for either Relay A or B, adjust the rate of flow to the "high" set-point value and adjust the set-point potentiometer until the relay LED lights up. To set the low alarm for either Relay A or B, adjust the rate of flow to the "low" set-point value and adjust the set-point potentiometer until the relay LED lights up.

Please note that even though the adjustment potentiometer can be turned to an equivalent sensor voltage level below "zero" flow, the "low" set-point must be set up above "zero" flow to function reliably.

2.3.4 Setting the Time Delay

A delay circuit, associated with each relay, prevents the flow switch from activating the alarms during brief fluctuations in the flow. Each relay can be set for a time delay of 0-30 seconds or 0-300 seconds. The location of the jumpers E9 and E10, used to configure the time delay for each relay are shown in Figure 2.3-4.

Figure 2.3-4. *Jumpers E9 and E10 for the Time Delay*



After setting the set-points, the time delay potentiometers may be set. The potentiometers have 10 turns form zero to full scale. Each turn is approximately 10% of the selected time delay range. Our experience is that a minimum equipment protection and to provide a fast response to flow upset.

To measure the exact time delay, quickly change the rate of flow above a "high" set-point (or above a "low" set-point) and measure the time for the LED to light up. If desired, an ohmmeter can be connected to the relay outputs to verify operation. Next quickly change the rate of flow back to the normal flow condition. The LED will go off almost immediately after the set-point is crossed and the delay circuit will be reset.

2.3.5 Hypothetical Situation

Lets assume that we wish to use the Series 950 Mass Flow Switch as a low combustion air flow interlock switch. The chosen output relay (lets select Relay A) is wired in series with the control wires for the fuel solenoid valve such that the fuel will shut off in the event of a loss of combustion air. We will choose the Fail-Safe Mode so that the loss of power to the flow switch will also shut off the fuel valve.

The time delay potentiometer is set to "zero" since we want a fast response to a loss of air flow. The "low" alarm set-point is field-adjusted to a value substantially below the normal operating point since a fan failure most likely represents no air flow.

Note: We recommend that the set-point potentiometers be factory-adjusted in a wind tunnel, if a precise velocity is desired.

Following figure 2.3-1 and table 2.3-1 on pages 11 and 12 of this section, the following setup will be used for Relay A:

Setup	Jumper
Fail-Safe Mode	E5(2&3)
Low Alarm	E7(2&3)
Time Delay	E9(1&2)

Terminal Hook-Up
TB1-1 +24.0 Vdc
TB1-2 power supply return (RET)
TB1-3 low side of solenoid power
TB1-4 no connection (N/C)
TB1-5 high side of solenoid power

In normal operation, Relay A contacts (3 & 5) are closed energizing the fuel solenoid valve. If the "low" set-point is reached the contact opens shutting off the power to the fuel solenoid. Also, if the +24.0 Vdc power is lost or if the Relay A coil were to become an open circuit, contacts 3 & 5 will open, shutting off the fuel.

Since the flow switch has two independent relay alarm circuits, it is also suggested that Relay B be configured exactly the same as Relay A, and that they be connected in series with each other and in series with the solenoid valve. This gives redundancy for the unlikely event that one of the alarm circuits should fail.

End of Section 2

Section 3: Routine Maintenance & Trouble-Shooting

This section describes the routine maintenance and trouble-shooting procedures for the Series 950 Mass Flow Switch.

3.1 Routine Maintenance

The Series 950 flow switch is virtually maintenance free. The only routine maintenance required is occasional cleaning.

3.1.1 Occasional Cleaning

The Kurz "dual-sting" MetalClad™ sensor render it resistant to particulate contamination in most applications; nevertheless, performs best when it is kept relatively free of contamination. You should, therefore, remove the probe assembly and check the sensor at regular intervals, cleaning it if necessary.

Make sure that power is off during cleaning. When the sensor does need to be cleaned, use a fine wire brush, crocas cloth or fine grit emery cloth to remove built-up contamination from the sensor. Be careful not to damage the sensor during removal or reinsertion. A bent sensor may develop a short and would need to be replaced.

Some sensors may have small specks of excess metal adhering to their shield material (sheaths). This is normal and in no way degrades the performance of the sensors. Do **NOT** attempt to remove such specks. Doing so may change the system's calibration.

3.2 Trouble-Shooting

Once you have installed the Series 950 flow switch, operation is primarily a matter of maintaining the +18.0 to 24.0 Vdc power source to the unit. The system will continue to operate for prolonged periods without intervention.

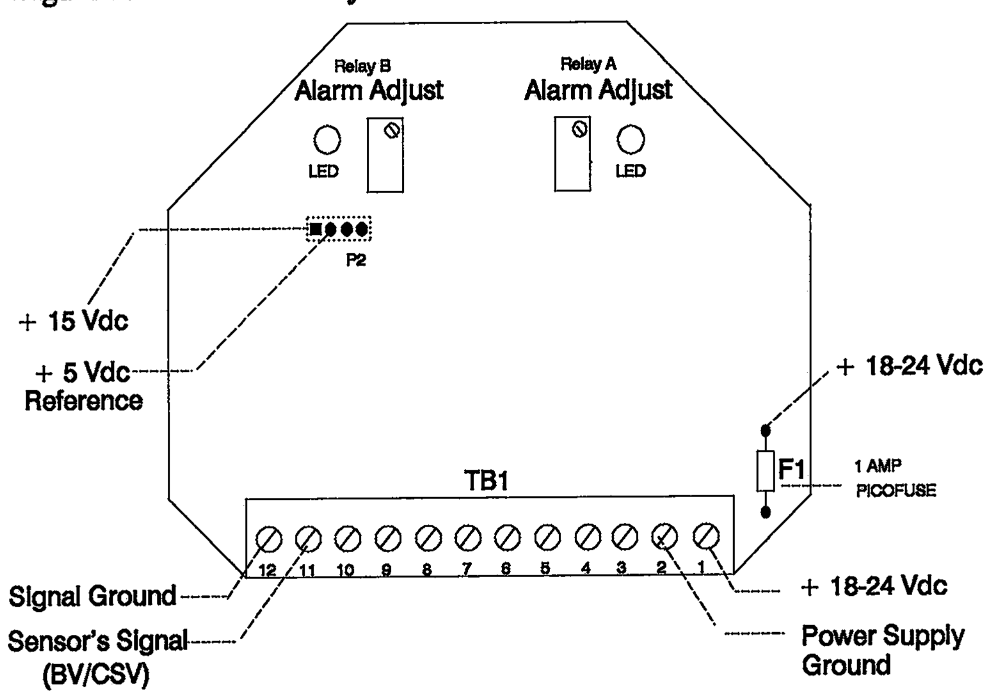
However, if the flow switch is not operating in the manner you expect, the following test procedures can be performed to help identify the faulty connection or module:

- Check the +24.0 Vdc input voltage
- Check the internal +15.0 Vdc supply voltage
- Check the internal +5.0 Vdc reference voltage
- Check the sensor's signal
- Check the relays

These procedures should be done by a qualified technician, familiar with electronic test equipment and measurements. Review the electronic configurations to make certain the unit is set up for the use intended.

All test points are accessible on the alarm board (the top board in the electonic assembly) after the cover plate has been removed. You will need a digital voltmeter (DVM) to make voltage and resistance measurements. Refer to figure 3.2-1 for the locations of the test points.

Figure 3.2-1. *Location of Test Points on the Alarm Board*



3.2.1 Check the +24.0 Vdc Input Voltage

The power supply should be connected to terminals 1 and 2 of terminal block 1 (TB1). The +18.0 to 24.0 Vdc power source should be connected to terminal 1 and the power supply ground should be connected to terminal 2. With the power supply turned off, make sure these connections are secure.

With the power supply turned on, check the voltage between terminal 1 (+ 18.0 to 24.0 Vdc) and terminal 2 (power supply ground). If the input voltage is correct at the terminals, check for this voltage on the other side of the fuse F1. If the fuse is blown, replace it with a 1 Amp, fastblow picofuse.

3.2.2 Check the Internal + 15.0 Vdc Supply Voltage

The power supply board uses the +24.0 Vdc supply to generate a +15.0 Vdc power supply. Measure the voltage between terminal 12 (signal ground) and pin 1 of P2. The voltage measured should be +15.0 Vdc +/-5.0%.

3.2.3 Check the Internal +5.0 Vdc Reference Voltage

The power supply board also uses the +24.0 Vdc supply to generate a +5.0 Vdc reference voltage. Measure the voltage between terminal 12 (signal ground) and pin 2 of P2. The voltage measured should be +5.0 Vdc +/-5.0%.

3.2.4 Check the Sensor's Signal

The sensor's signal will vary with the flow velocity. As the velocity increases, the amount of power required to maintain the standard overheat increases. To verify that the sensor and bridge circuit is operating this way, measure the voltage between terminal 12 (signal ground) and terminal 11 of TB1. This voltage should range from +0.6 to 3.0 Vdc +/-2.5% (CSV) for a flow of 0 to 12,000 SFPM (Standard Feet Per Minute).

(If you have an optional configuration that uses the a voltage mode circuit, instead of, the standard current-sense voltage circuit, this voltage will range between +2.0 to 8.0 Vdc +/-2.5%.)

If the readings are not in range, check the sensor's wire connections. The four wires from the sensor are connected to a terminal block on the bridge board. The colors of the sensor's wires may vary, depending on the kind of cable used. Refer to Table 3.2-1.

With the power supply turned off, remove the screw that holds the electronic assembly to bottom of the electronic enclosure. Be careful not to break connections by pulling the assembly too far from the electronic enclosure. If the sensor's wires are removed be certain to hook them up as wired from the Kurz factory.

Table 3.2-1. *Sensor's Wire Colors and Terminal Connections*

Signal	Standard Teflon™	Teflon™ Wire	Tefzel™	Terminal
R_{tc}	WHT/BLU	WHT	WHT/BLU	1
R_p	WHT/ORG	RED	WHT/ORG	2
R_{tc} GND	WHT	WHT	WHT	3
R_p GND	WHT/GRN	RED	WHT/GRN	3
Shield	Shield	N/A	Shield	*

* *Shield is used on a remote electronic assembly and is connected to earth ground. The circuit ground used on the bridge board (i.e. R_{tc} GND, R_p GND, and GND) is not connected to any other ground.*

If the sensor appears to be at fault, check the resistance of the RTD windings. First, remove the sensor's wires from the terminal block. Using a DVM, measure the resistance between R_{tc} and R_{tc} GND. It should be approximately 165 ohms at room temperature. Next, measure the resistance between R_p and R_p GND. It should be approximately 10 ohms also at room temperature. Values obtained that are substantially different indicate a damaged sensor.

Note: For Teflon™ wire, a five-wire sensor's cable design configured to operate to a four-wire sensor's cable design has a significant difference in resistance between R_{tc} and R_{tc} GND. When measured, it should be approximately 300 ohms at room temperature. To denote this difference between the two designs, there is a yellow wire in place of one of the red wires (R_p).

3.2.5 Check the Relays

Using a DVM, check that the high and low relays are switching. To do this you can either vary the flow in such a way as to activate the alarms or you can adjust the alarm thresholds so that the rate of flow is above and below the thresholds.

Testing the resistance between the common terminal and the normally open or normally closed terminals, the relay should look open or closed depending on the flow condition. Please refer to Table 2.3-1 of Section 2, page 12 for the relay configurations.

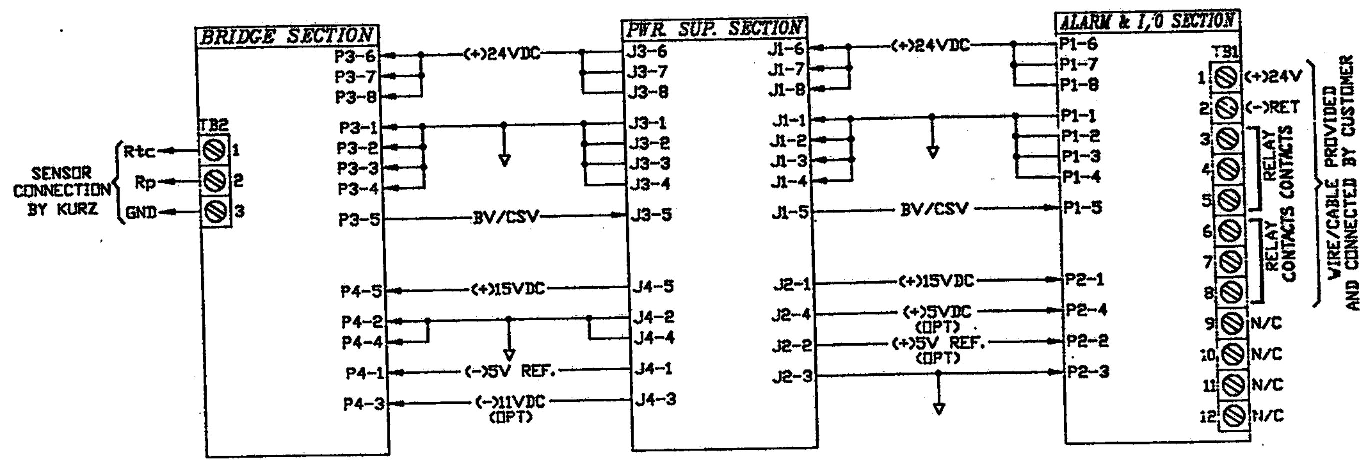
End of Section 3

Appendix A: Engineering Drawings

This appendix contains engineering drawings for the standard configuration of the Series 950 Mass Flow Switch. If you have ordered a custom-built system, related engineering drawings are also included.

Note: If you want to perform your own warranty service, you must first obtain written authorization from Kurz Instruments, Incorporated. **Unauthorized service performed during the warranty period voids your warranty.** Please read the warranty statement at the front portion of this user's guide before performing any services.

Drawing Number	Description
340248, Rev. 0	Wiring Diagram, Series 950 Flow Switch
300067, Rev. B (1 of 2)	Schematic Diagram, 950, I/O & Alarm Section
300067, Rev. B (2 of 2)	Schematic Diagram, 950, Pwr. Sup. and Bridge Section
700950-02, Rev. C	Flow Switch, Model 950-08, Ass'y.
700950-03, Rev. C	Flow Switch, Model 950-16, Ass'y.



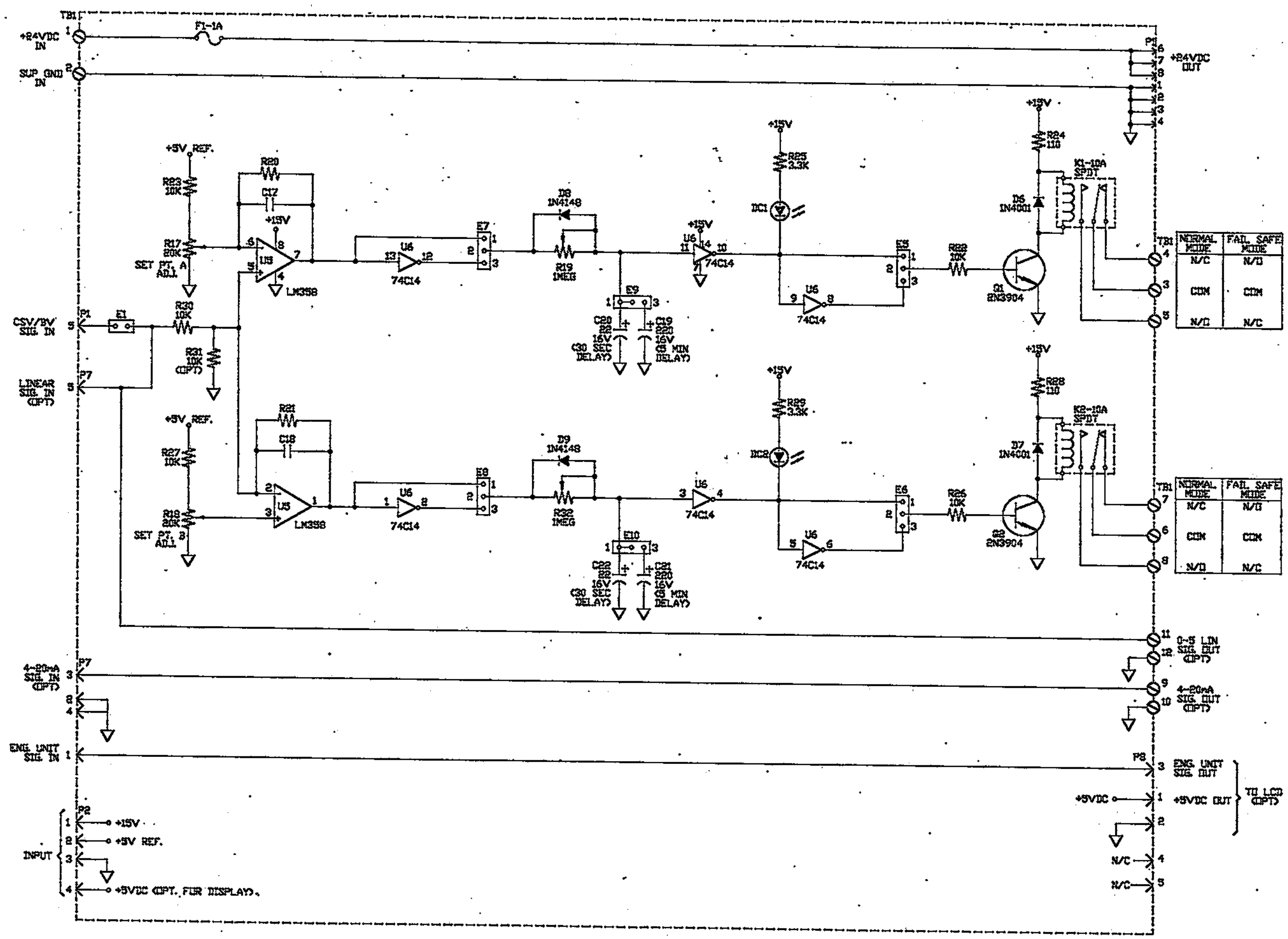
NOTES: UNLESS OTHERWISE SPECIFIED
1. REF. DES. ARE FOR REF. ONLY AND MAY NOT APPEAR ON COMPONENTS.

KURZ INSTRUMENTS INC.

TITLE: WIRING DIAGRAM SERIES 950, FLOWSWITCH

DWG. SIZE	DWG. NO.	REV.
C	340248	0

REV	DESCRIPTION
B	REDRAWN & REVISED (ECO 871327)



JUMPER CONFIG. TABLE		
E7	3 2 1	ALARM "A", HI RELAY.
E7	3 2 1	ALARM "A", LO-LO RELAY.
E8	3 2 1	ALARM "B", LO RELAY
E8	3 2 1	ALARM "B", HI-HI RELAY.
E9	1 2 3	ALARM "A", DELAY, 0-30 SEC.
E9	1 2 3	ALARM "A", DELAY, 0-5 MIN.
E10	1 2 3	ALARM "B", DELAY, 0-30 SEC.
E10	1 2 3	ALARM "B", DELAY, 0-5 MIN.
E5	3 2 1	ALARM "A", NORMAL MODE.
E5	3 2 1	ALARM "A", FAIL SAFE MODE.
E6	3 2 1	ALARM "B", NORMAL MODE.
E6	3 2 1	ALARM "B", FAIL SAFE MODE.

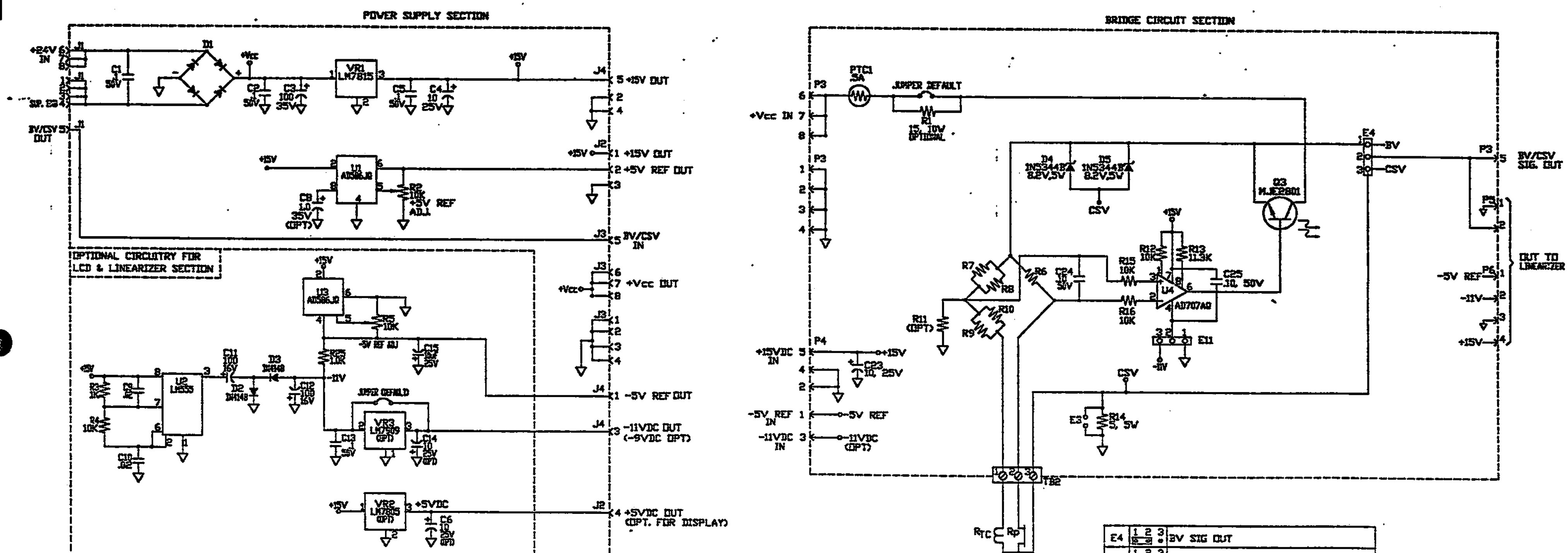
REF. DES. TABLE	
LAST USED	NOT USED
F1	
E11	E2
D9	
R32	
DC2	
Q2	
PTC1	
U6	
VR3	
C24	C7,16
TB2	
P8	
J4	
K2	

NOTES:
1. THIS DWG TO BE USED IN CONJUNCTION WITH PCB ASSY. DWG #420146-01.
2. ALL RESISTORS ARE IN OHMS, 1/8W, ±1%.
3. ALL CAPACITORS ARE IN MICROFARADS.
4. C17, 18, R20, 21 -2E OPTIONAL PARTS ASSEMBLED AS REQUIRED.
5. R31 IS OPTIONAL FOR BV SIGNAL INPUT.

KURZ INSTRUMENTS INC.

SCHEMATIC DIAGRAM, 950, I/O & ALARM SECTION

DWG. SIZE D — DWG. NO. 300067 — REV. B — SHEET 1 OF 2



E4	1 2 3	BV SIG OUT
E4	1 2 3	CSV SIG OUT (DEFAULT)
E11	1 2 3	U4, PIN 4: -11VDC (SPECIAL LOW B.V. TEMP. COMP. ONLY)
E11	1 2 3	U4, PIN 4: GND (DEFAULT)
JUMPER CONFIG. TABLE		

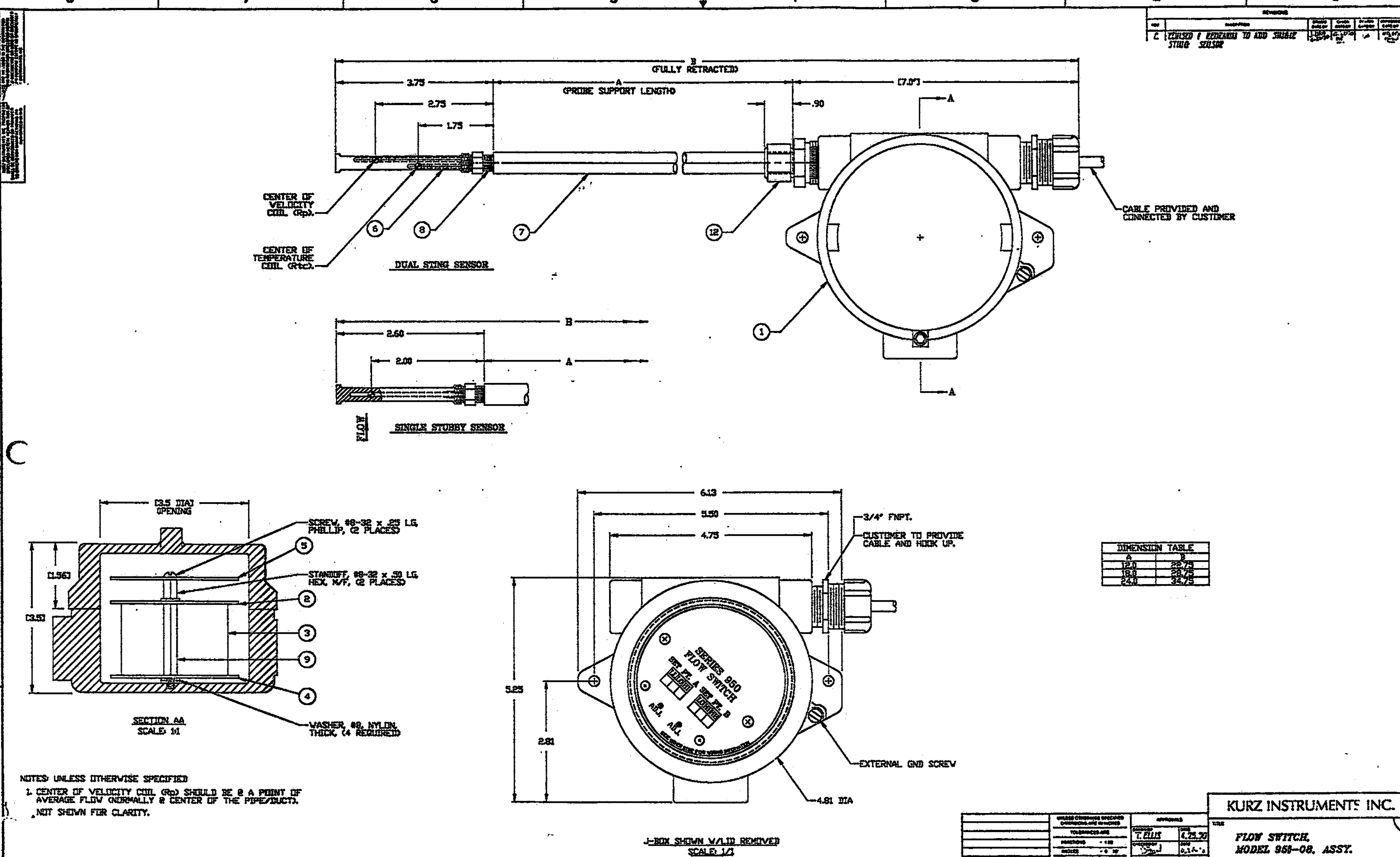
NOTES:
1. THIS DWG TO BE USED IN CONJUNCTION WITH PCB ASSY. DWG #420146-02 & -03.
2. ALL RESISTORS ARE IN OHMS, 1/8W, ±1%.
3. ALL CAPACITORS ARE IN MICROFARADS.
4. RESISTORS R6-10 ARE TEMP. COMP. SELECTED.

KURZ INSTRUMENTS INC.

SCHEMATIC DIAGRAM, 950, PWR. SUP. & BRIDGE SECTION

300067 B

SCALE NONE SHEET 1 OF 2



NOTES: UNLESS OTHERWISE SPECIFIED

1. CENTER OF VELOCITY COIL (Rp) SHOULD BE @ A POINT OF AVERAGE FLOW (NORMALLY @ CENTER OF THE PIPE/DUCT).
* NOT SHOWN FOR CLARITY.

DIMENSION TABLE

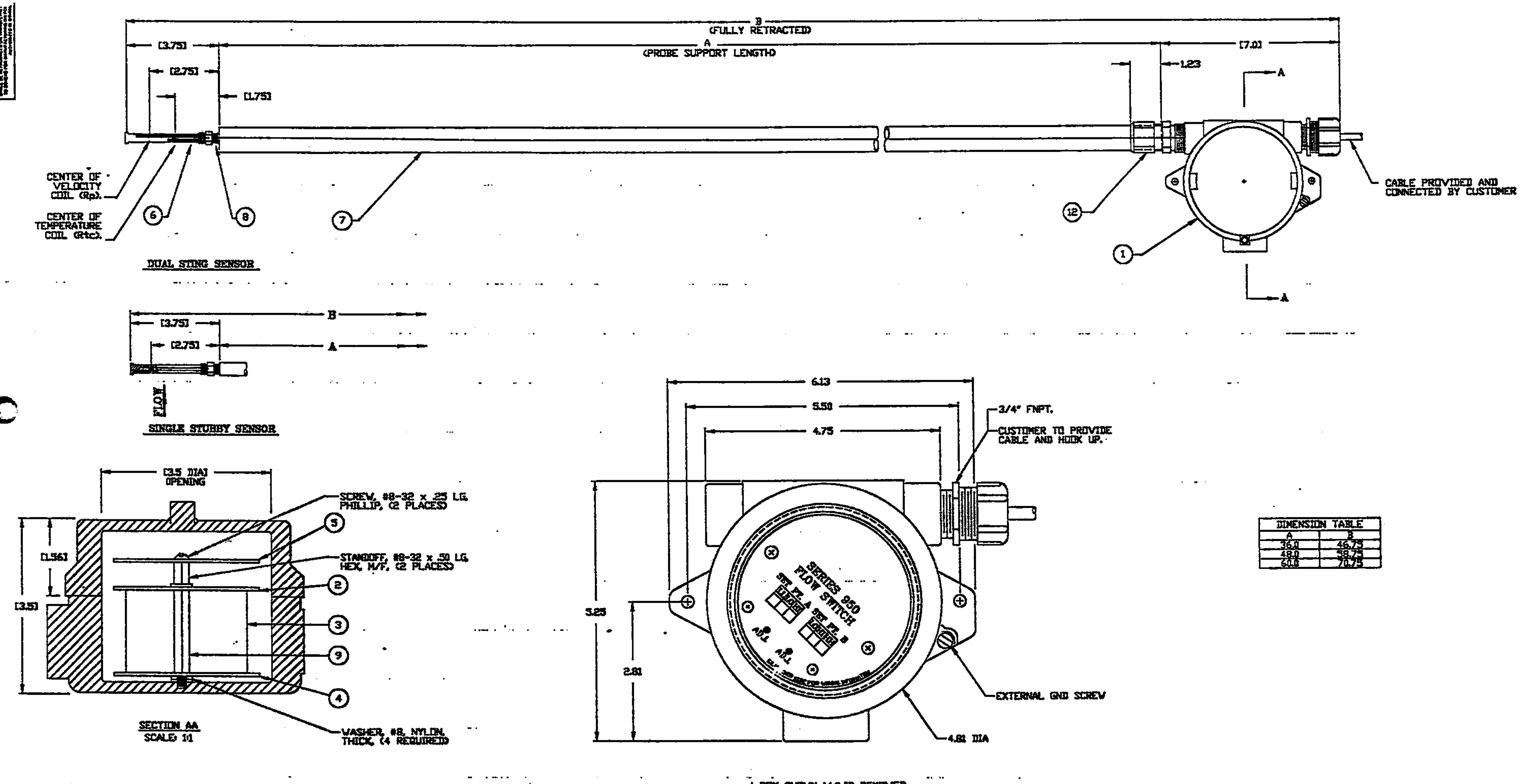
A	B
12.0	22.75
18.0	28.75
24.0	34.75

KURZ INSTRUMENTS INC.

FLOW SWITCH,
MODEL 958-08, ASSY.

T. ELLIS 4.25.70

D 700950.02 C



DIMENSION TABLE	
A	B
36.0	46.75
48.0	58.75
60.0	70.75

NOTES: UNLESS OTHERWISE SPECIFIED

1. CENTER OF VELOCITY COIL (Rp) SHOULD BE @ A POINT OF AVERAGE FLOW (NORMALLY @ CENTER OF THE PIPE/DUCT).

2. NOT SHOWN FOR CLARITY.

KURZ INSTRUMENTS INC.

FLOW SWITCH,
MODEL 950-16, ASSY

T. ELLIS 4.25.??

D 700250_03 C

SCALE 1/2 & AS NOTED SHEET 1 OF 1