

MODEL 978-C Suspended Solids Monitor Installation & Instruction Manual

(for use with Serial #1178 and higher, sold on or after 4/7/2014)



MODEL 978-C
Suspended Solids Monitor
Installation & Instruction Manual

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TABLE OF CONTENTS

1. PRINCIPLE OF OPERATION	1
2. INSTALLATION	2
A. Insertion-Type Sensor	2
Dimensions.....	2
Installation	3
Insertion.....	4
Removal	4
B. Submersible-Type Sensor	6
Dimensions.....	6
Installation	6
C. Electronic Signal Converter	7
Dimensions.....	7
3. WIRING	9
A. General.....	9
B. Wiring Diagram	10
C. Alarm Unit Connections and Adjustments (Optional)	11
4. CALIBRATION.....	12
A. General.....	12
B. Laboratory	14
C. In-Line	16
D. Output.....	17
E. Dampening	18
5. SENSOR REMOVAL/REINSTALLATION (w/ Insertion Adapter Kit).....	19
6. TROUBLESHOOTING	20
7. TECHNICAL SUPPORT	21
8. TECHNICAL DIAGRAMS	22
A. Model 978-C Suspended Solids Monitor	22
Model 978-C Circuit Diagram (AC Power).....	22
Model 978-C Circuit Board Component Layout (AC Power)	23
Model 978-C Circuit Diagram (Optional DC Power)	24
Model 978-C Circuit Board Component Layout (Optional DC Power).....	25
B. Model 220 Alarm (Optional).....	26
Model 220 Alarm Board Circuit Diagram	26
Model 220 Alarm Board Component Layout	27
C: Pipe Insertion Assembly Dimensions and Materials.....	28
9. WARRANTY.....	29

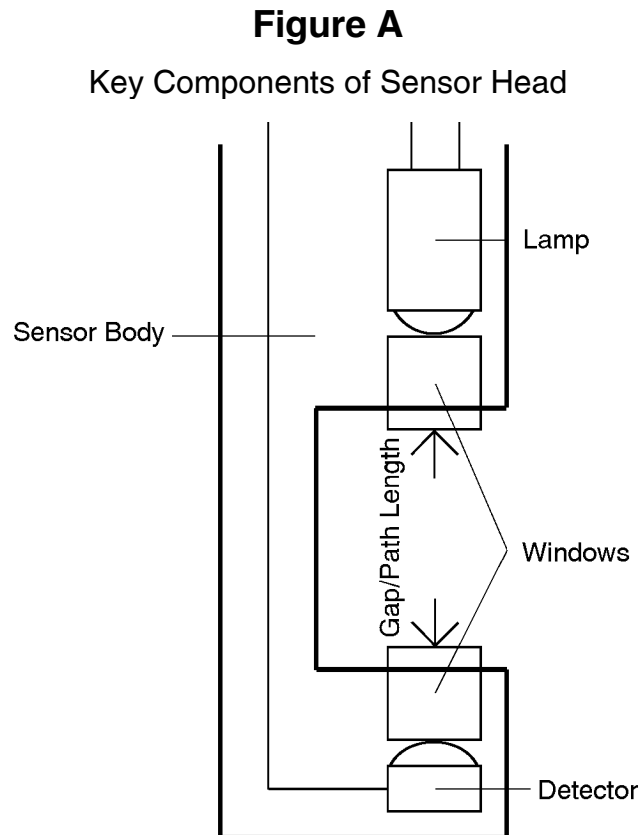
1. PRINCIPLE OF OPERATION

A prefocused incandescent lamp directs an intense beam of light through the process fluid. The particulate in the fluid absorbs the light in proportion to its concentration. The remaining light is detected by a silicon detector that generates a current signal proportional to the particulate concentration. The electronic signal converter then amplifies and scales the current signal to provide a linear readout on a digital meter and an isolated output signal.

The instrument is "peaked" to operate in the near-infrared radiant (NIR) energy spectrum to eliminate errors due to visible colors in the particulate and the process liquid.

Key components of the sensing head are shown in **Figure A** below. The sensing head has been hydrodynamically designed to eliminate problems such as plugging, solids separation and dewatering of pulp stock.

The sensor's unique design reduces the effects of stray light and moderate window obscuration. It utilizes an optimum optical path length so that a linear response is provided over a wide dynamic range of suspended solids concentrations.



2. INSTALLATION

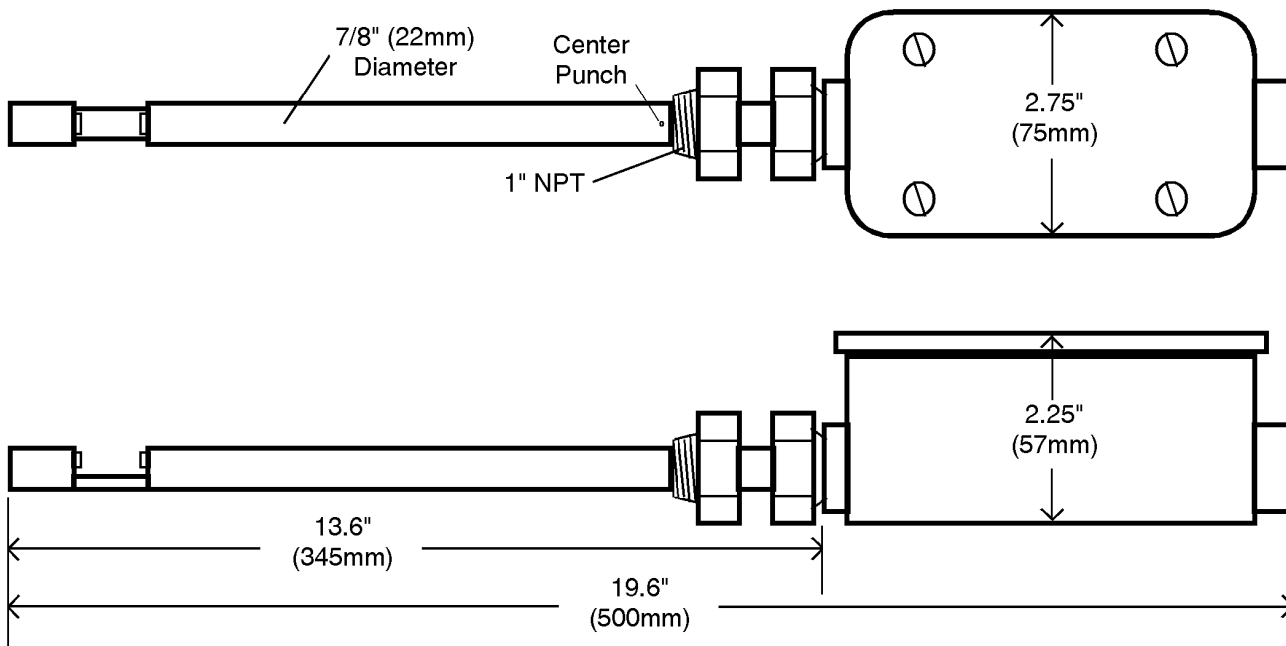
A. Insertion-Type Sensor

Dimensions

Figure B below shows the dimensions of the insertion-type sensor.

Figure B

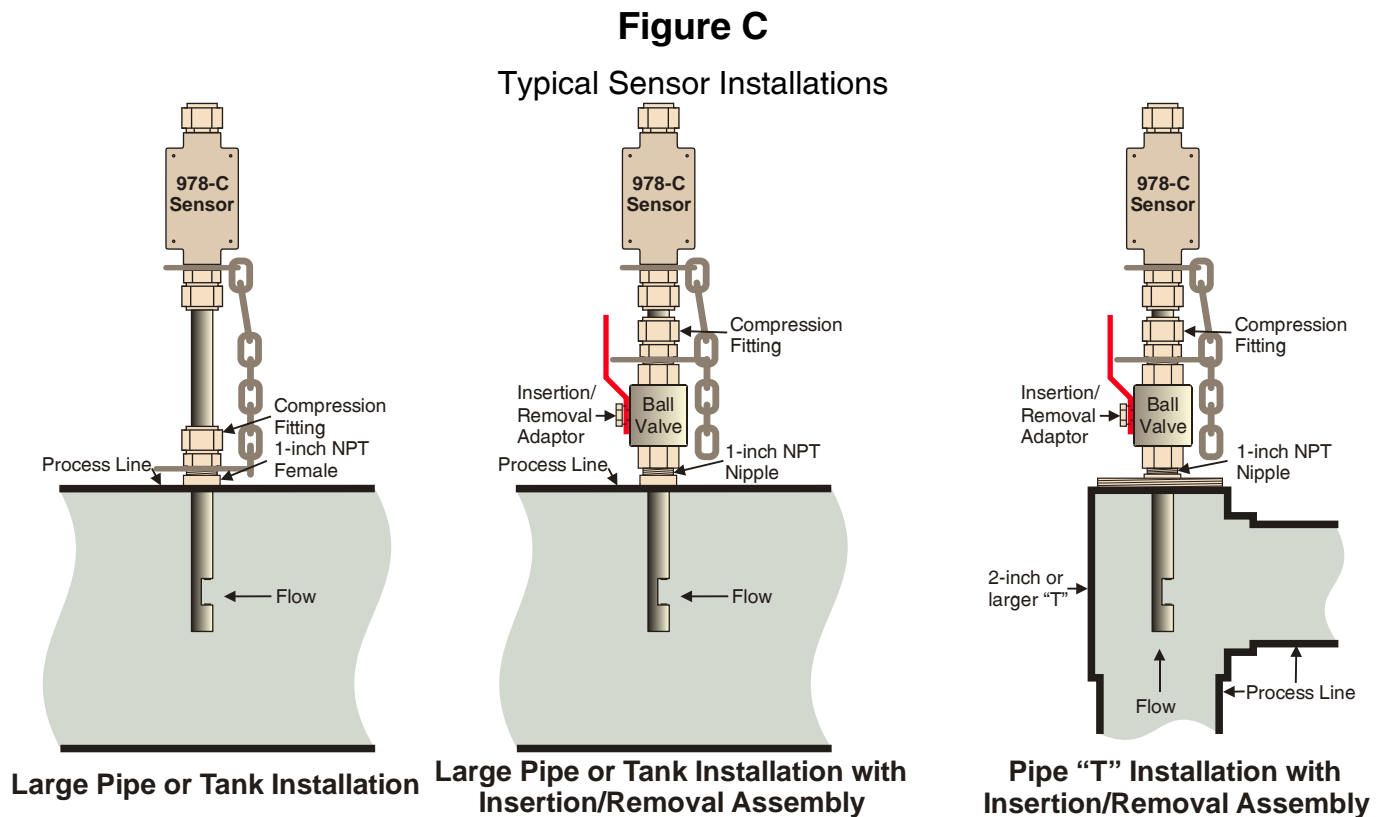
Insertion-Type Sensor Dimensions



Line Size: There are no restrictions on the maximum pipe diameter into which the sensor can be installed. However, if a 2-inch or smaller line is to be monitored, install a 2-inch or larger "T" to prevent the sensor from blocking the line. See Figure C on page 3 for drawings of typical installations.

Installation

Figure C below shows some typical insertion-type sensor installations.



Transparent Lines: If the sensor is to be used in a transparent (e.g., glass, PVC, acrylic, etc.) process or sample line, the pipe must not be exposed to direct sunlight or comparably intense light. Transparent lines exposed to direct sunlight must be wrapped with tape to prevent ambient light from entering the pipe and affecting the readings. Wrap the pipe five (5) pipe diameters from the sensor. **Black PVC electrical tape will not block light sufficiently.** Use an aluminum tape or wrap any tape over a metallic foil.

Temperature: The sensor should not be exposed to a process temperature that is below -10°C or greater than 110°C .

Pressure: The sensor should not be used where the process pressure is greater than 150 psig (10 BAR). A safety chain is provided and **MUST** be used (see Insertion below).

Entrained Gas: Gas bubbles in suspension can cause errors, so care should be taken to locate the sensor upstream of anything that could create a pressure drop (orifice plates, valves, pumps, etc.) and cause the dissolved gases to come out of solution.

Mounting (without pipe insertion adapter): While any position on the periphery of the process pipe may be used to install the sensor, a position above the horizontal plane is recommended, particularly if the sensor is to be removed frequently. The sensor may either be installed through a "T" or a weldment that has been installed on the process pipe. The "T" or weldment must provide a 1" NPT female thread. After mounting the "T" or weldment, thread the male Swagelok fitting supplied with the instrument into the "T" or weldment. Be sure that the

large washer, with one end of the safety chain fastened to it, is captured between the Swagelok fitting and the process pipe.

Mounting (with pipe insertion adapter): While any position on the periphery of the process pipe may be used to install the sensor, a position above the horizontal plane is recommended, particularly if the sensor is to be removed frequently. The sensor may either be installed through a "T" or a weldment that has been installed on the process pipe. The "T" or weldment must provide a 1-1/2" NPT male thread. After mounting the "T" or weldment, thread the ball valve supplied with the instrument into the "T" or weldment.

Insertion

An insertion depth between 1" and 4" is suggested. If the process pipe is empty or filled with a clean fluid, position the sensor at a depth where a minimum reading is obtained on the meter. This is to ensure that any internally reflected light from the process piping can be zeroed out. If the solids are small in size and not likely to cling or wrap around the metal bar separating the light source and detector, rotate the sensor so that the small center punch, located below the junction box, is facing upstream. On other applications, such as heavy slurries, paper pulp, etc. position the center punch mark so that it is at right angles to the flow. In other words, if the process pipe is horizontal and the sensor is inserted into the top of the pipe, the center punch should be facing at a right angle to the direction of flow (i.e., not upstream or downstream). This permits a "scrubbing" action on the windows and helps eliminate any build-up on the sensor. When the sensor has been positioned satisfactorily, firmly tighten the Swagelok fitting so that the sensor cannot be pulled out or rotate. Make sure that the large washer which is holding one end of the safety chain is captured between the Swagelok fitting and the process pipe.

AFTER PROPERLY INSTALLING THE SENSOR AND BEFORE THE LINE IS PRESSURIZED, TAKE ALL THE SLACK OUT OF THE SAFETY CHAIN BY MOVING THE "CLIP" TYPE LINK UNTIL THE SAFETY CHAIN IS TAUT.

Junction Box: Route the cable from the electronic signal converter through the sealing gland and tighten it to assure a moisture-tight seal. Make the wire connections as shown in Figure G on page 10 and reinstall the cover and gasket to assure a weather-tight seal. It is important that the inside of the junction box be kept dry at all times. If the junction box is positioned so that it is difficult to make the wire connections, the box may be rotated by loosening the Swagelok fitting located directly under the box.

NOTE: Do not rotate the box more that 180 degrees in either direction or the internal wiring may be damaged. Be sure to retighten the Swagelok fitting.

Removal

Should it ever become necessary or desired to remove the sensor from the process line, please follow the steps below.

If the sensor has been installed without the pipe insertion adapter and ball valve, the process line will have to be depressurized and probably drained. The sensor may then be safely removed by disconnecting the safety chain and loosening the Swagelok fitting.

If the sensor has been installed using the pipe insertion adapter and ball valve, and it is not possible or practical to depressurize the line, **extreme care** must be taken to assure that the sensor is not "blown out" by the process pressure when the Swagelok fitting is loosened. Follow these steps:

1. Loosen the safety chain one or two links by moving the "clip" towards the process pipe.
2. Loosen the Swagelok fitting sufficiently to permit pulling the sensor out to the new limit of the safety chain.
3. Retighten the Swagelok fitting and repeat steps 1 through 3 until the sensor is clear of the ball valve.
4. Close valve and withdraw sensor completely.

NOTE: NEVER STAND IN FRONT OF THE SENSOR WHILE ATTEMPTING TO REMOVE IT FROM A PIPE THAT IS UNDER PRESSURE.

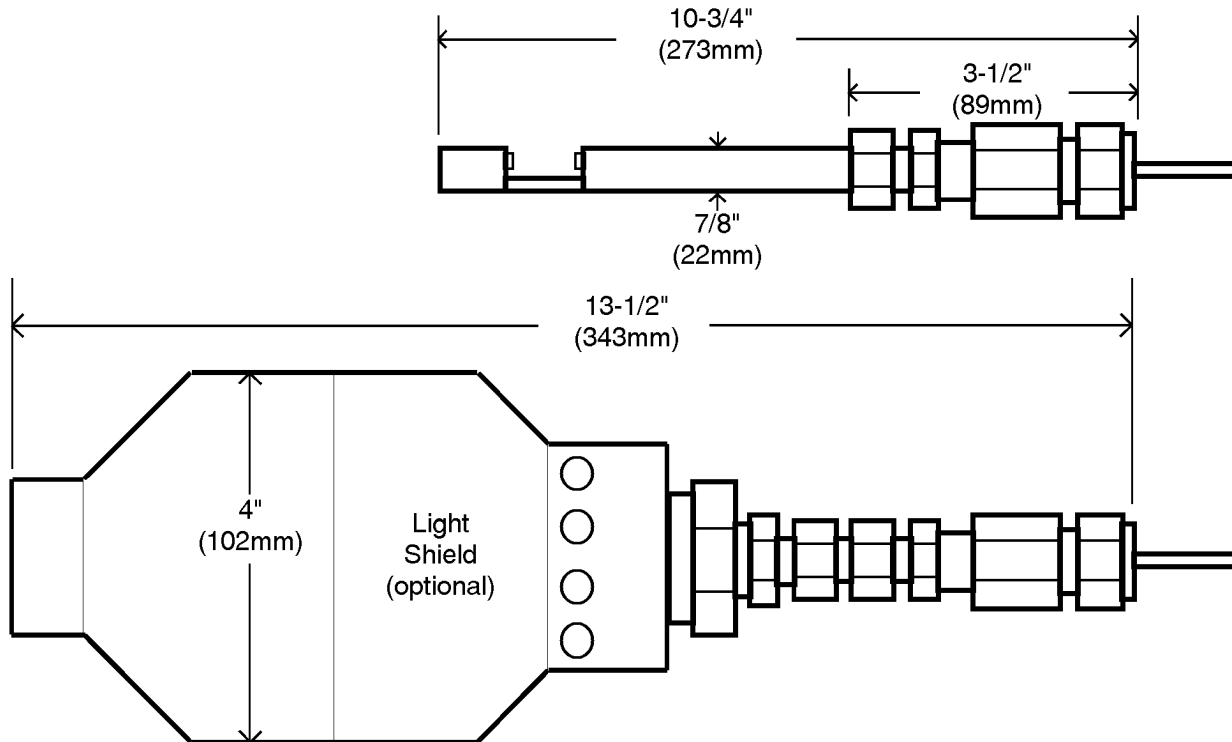
B. Submersible-Type Sensor

Dimensions

Figure D below shows the dimensions of the submersible-type sensor.

Figure D

Submersible-Type Sensor Dimensions



Installation

The sensor may be installed in tanks, clarifiers, streams, lakes, etc. by using any suitable support, or it may simply be suspended using the connecting cable.

Ambient Light Effects: If the sensor is to be installed where it could be affected by ambient light (near the surface, in clear liquids, or in direct sunlight), the optional light shield should be used.

Temperature: The sensor should not be exposed to a process temperature that is below -10°C or greater than 60°C .

Pressure: The sensor should not be exposed to pressures greater than 50 psig (115 feet of water). Sensors capable of handling higher pressures are available on special order.

Entrained Gas: Gas bubbles in suspension appear as particulate, so care should be taken to locate the sensor where there are no bubbles.

C. Electronic Signal Converter

Dimensions

See Figure E below for panel/wall mount enclosure dimensions and Figure F on page 8 for the NEMA 4X (watertight) enclosure mounting dimensions.

Environment: The panel/wall mount enclosure must be situated in a dry area. The NEMA 4X enclosure is suitable for wall or pipe mounting and relatively harsh or damp atmospheres. Ambient temperatures should be between 0°C and 50°C.

Figure E

Panel Mount Enclosure Dimensions

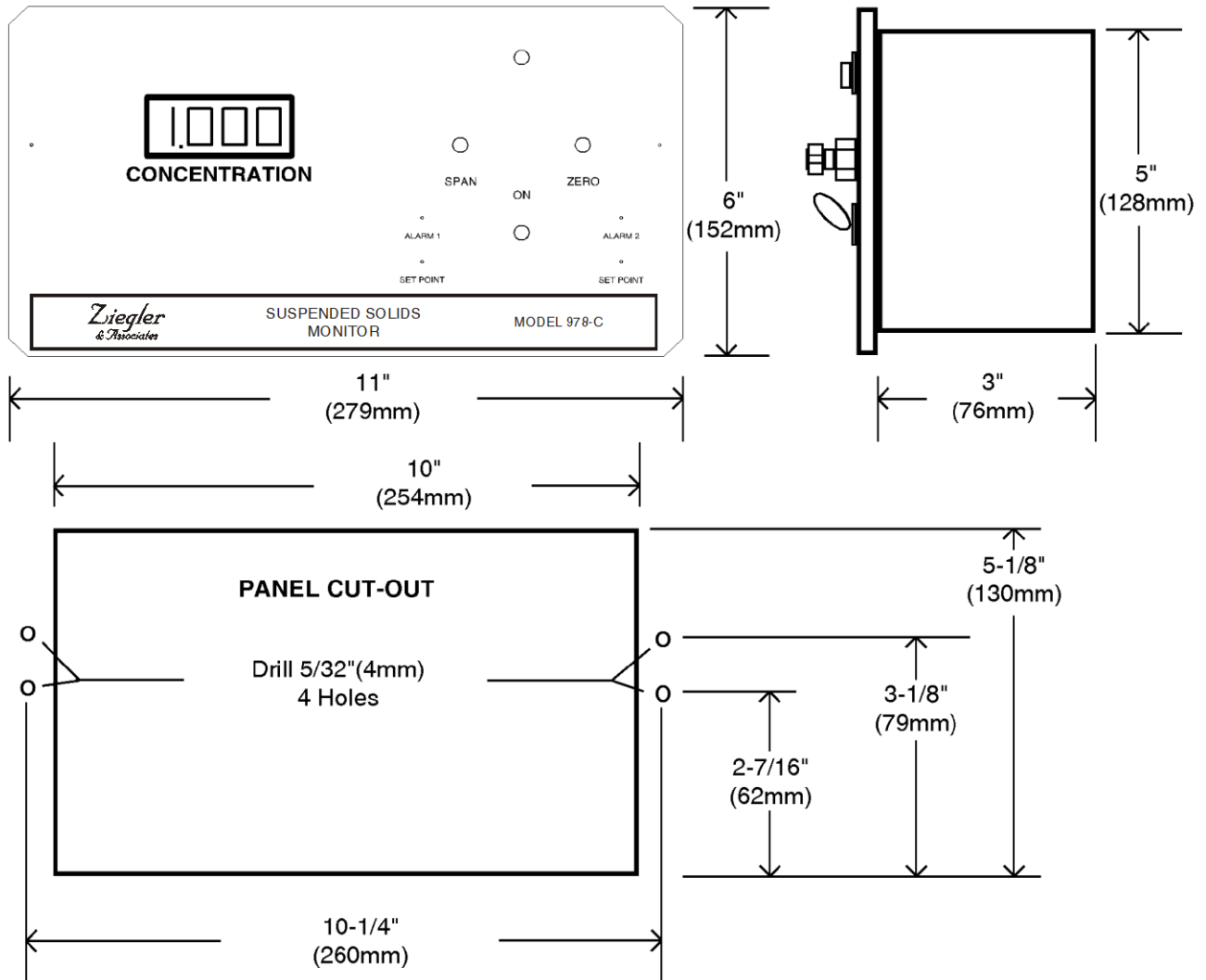
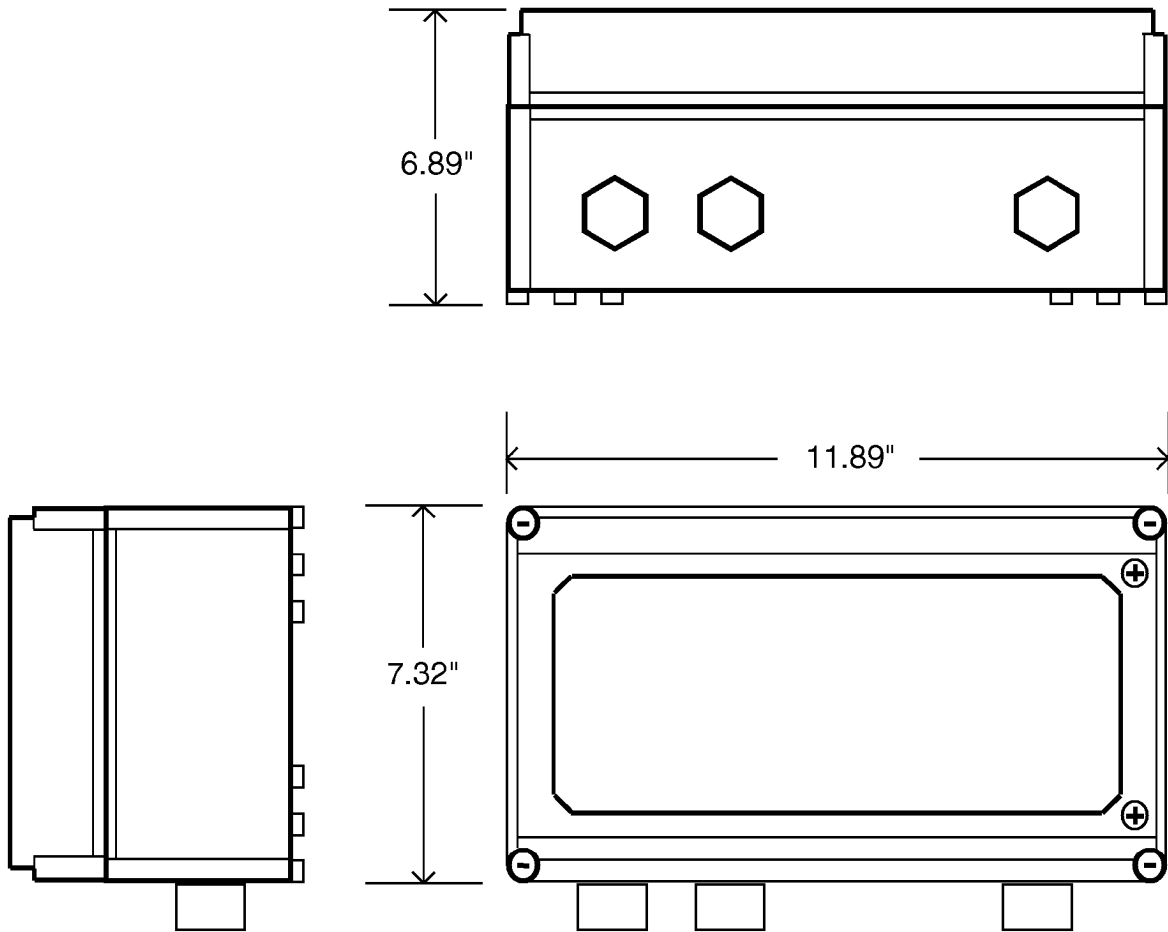


Figure F

NEMA 4X Enclosure Dimensions



3. WIRING

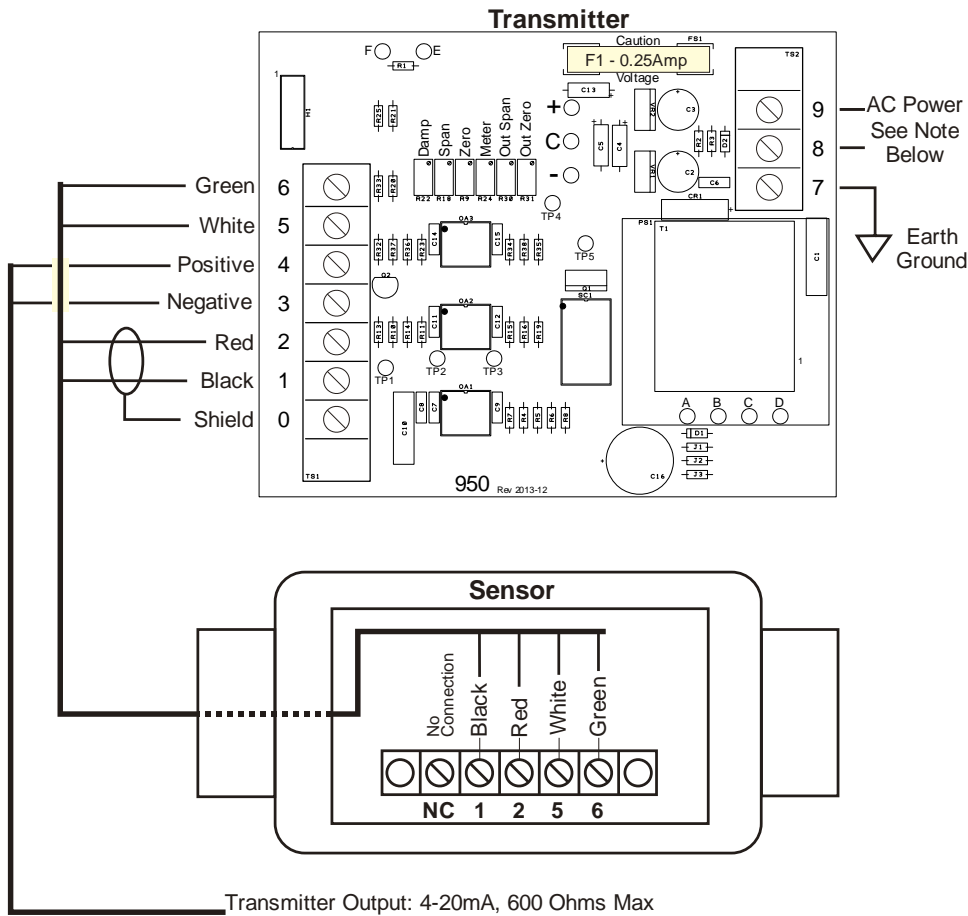
A. General

1. All wires should be routed away from potential RF (radio frequency) sources and large inductive loads.
2. All wiring connections at the sensor and the electronic signal converter must go through the sealing glands, and the glands must be tightened sufficiently to keep moisture out. Unused holes in the enclosure should also be sealed.
3. Assure that the interconnecting cable between the sensor and the signal converter is correctly installed (see **Figure G** on page 10), and all terminals are tightened. Use only the cable supplied with the instrument. Standard cable length is 25 feet. Optional lengths up to 1000 feet are available.
4. Before connecting the main power at terminals 7, 8, and 9, be sure that the supplied voltage matches the jumper configuration as shown in
5. Wire the transmitter output with a shielded twisted pair to terminals 3 and 4, and ground the shield **AT ONE END ONLY**.

NOTE: RFI (Radio Frequency Interference) and large inductive loads such as motors, solenoid valves and large switches can affect the operation of the instrument. Therefore, both the sensor and the electronic signal converter should be properly grounded to eliminate the effects of RFI. If the instrument is mounted in the vicinity of any large inductive loads, all interconnecting cable should be installed in conduit that does not contain power cables.

B. Wiring Diagram

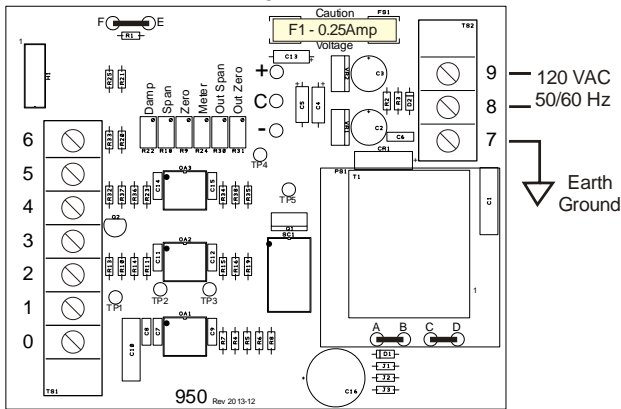
Figure G
Wiring Diagram



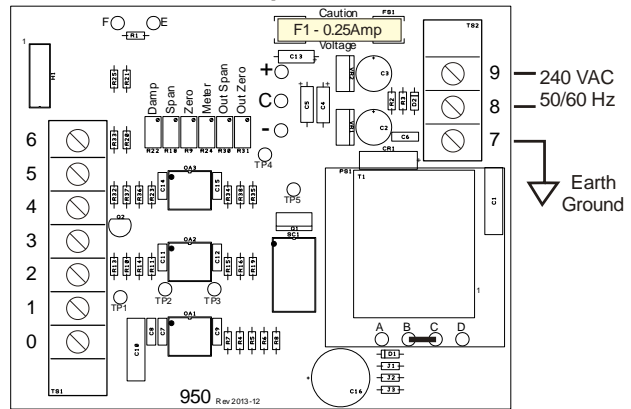
Transmitter Output: 4-20mA, 600 Ohms Max
Optional Outputs: 0-5 Volts, 0-10 Volts etc.

Note: Before connecting the AC power supply, be sure that jumpers A, B, C, D, E & F are connected as shown below.

120 VAC Operation



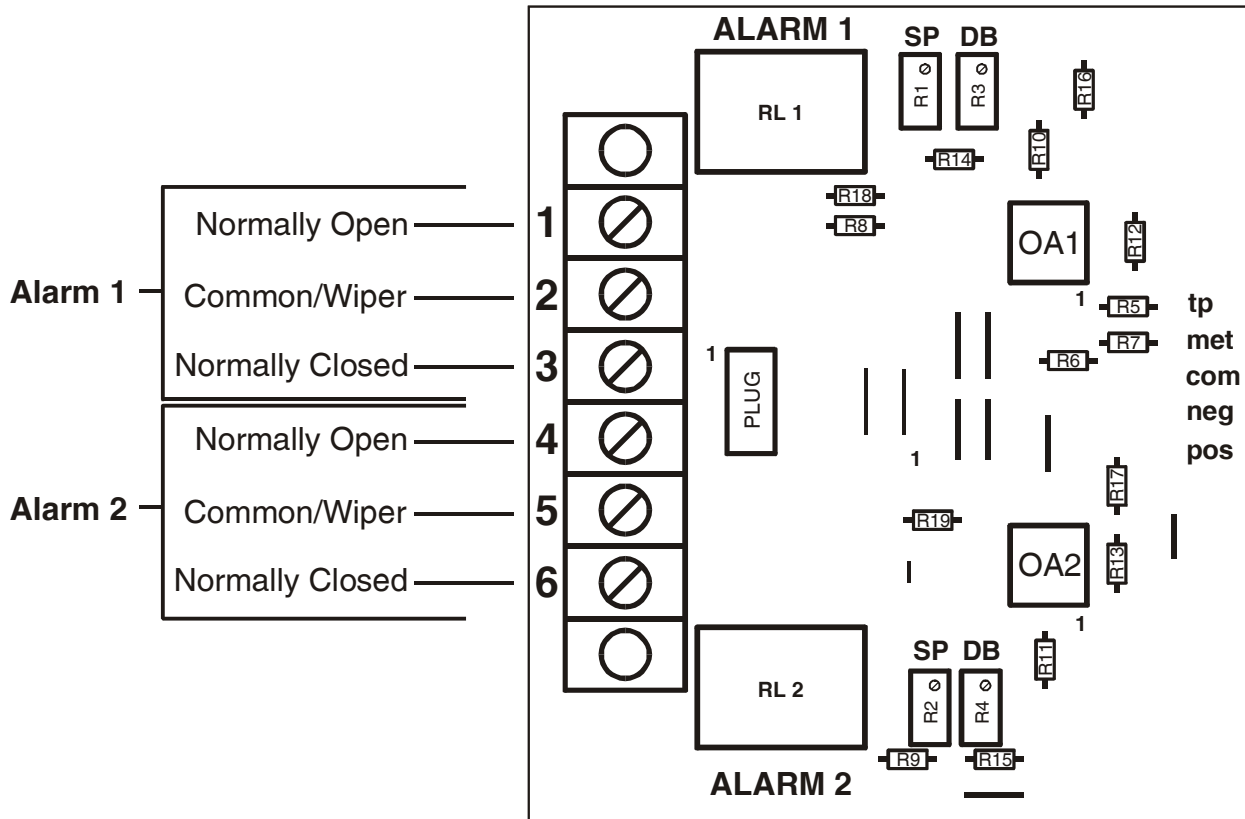
240 VAC Operation



DC Power Connections (Optional)

For units equipped with 12-volt or 24-volt DC-powered operation, make all connections as above, except for power connections. Connect **12/24 VDC Positive (+)** to terminal 9 and **12/24 VDC Negative (-)** to terminal 8. The jumpers are factory set and do not need adjustment. Be sure that there is a good **earth ground to terminal 7**.

C. Alarm Unit Connections and Adjustments (Optional)



1. Alarm Contact Ratings: 10 Amps @ 120 VAC
2. All adjustments are "clockwise increase"
3. Both alarm trip points are adjustable over the full output range.
4. Alarm trip dead band (DB) adjustments provide a dead band (differential between on and off) of either alarm trip from 0 to 10% of span.

* SP = Alarm trip setpoint adjustment

* DB = Dead band adjustment

4. CALIBRATION

A. General

The Model 978-C has been factory calibrated using distilled water and an electronic current source. The instrument may easily be recalibrated by mixing solids with distilled water. First, the zero point is established using distilled water. If it is desired to elevate the zero to say 5% (solids), then a 5% (solids) sample is used for the zero point. The span is set by adjusting the instrument to correspond to a known gravimetric sample. A known gravimetric sample can be made by mixing 1 gram of dry solids from the process with 1 liter of distilled water. This will yield a 1000 ppm (parts per million) mixture (using 2 grams will yield 2000 ppm, and so on). Only the zero and one other point need be established. Prior to checking or changing calibration, the instrument must be turned on and warmed up for at least 15 minutes. Make sure the front panel is on the signal converter and the cover is on the sensor junction box prior to taking any readings or making any adjustments.

The adjustments for calibrating the instrument are located on the front panel of the instrument and on the main circuit board inside the transmitter enclosure. When calibrating, first use the "ZERO" and "SPAN" adjustments on the panel. If the panel adjustments do not allow calibration for the desired range, use the "Zero" and "Span" adjustments on the circuit board for additional range. Depending on the darkness of the solids, the response can be somewhat non-linear. Dark solids tend to give a more linear response than light solids. Figure H on page 13 shows the Model 950 response curve for Brewer's Yeast. The Brewer's Yeast graph covers a measurement span of 0 to 16% (0 to 160,000 ppm); however, on most applications the area of interest is much less, and the curve is usually "flat" (linear) for smaller segments. Calibrating the instrument over a smaller concentration range will result in more accurate readings in that range.

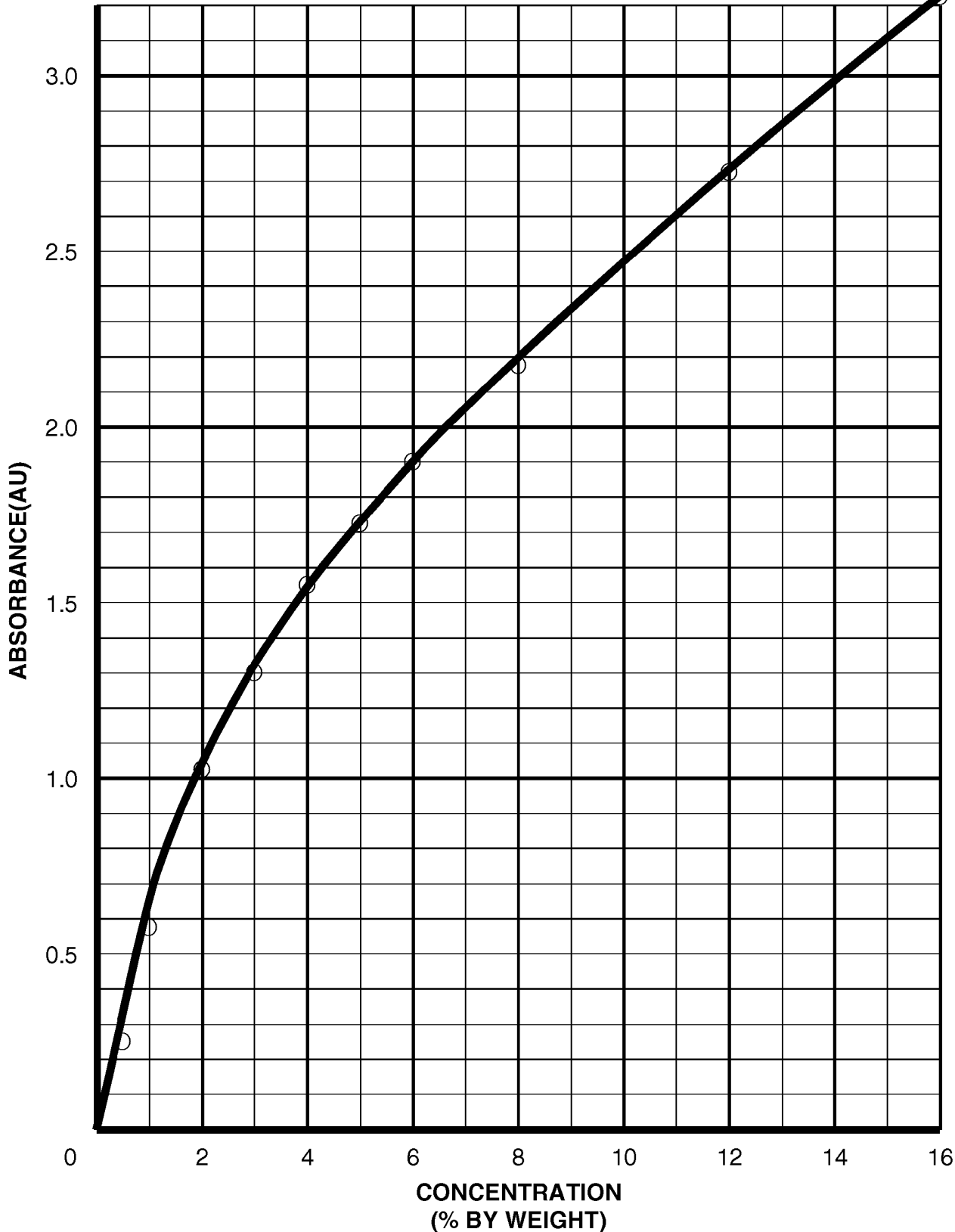
Unless instructed otherwise, the instrument has been factory calibrated as follows:

Range	Absorbance Units
Minimum	0.5
Maximum	4.0
Pre Set	2.0

RESPONSE CURVE

Figure H

978-C Response Characteristics to Brewer's Yeast

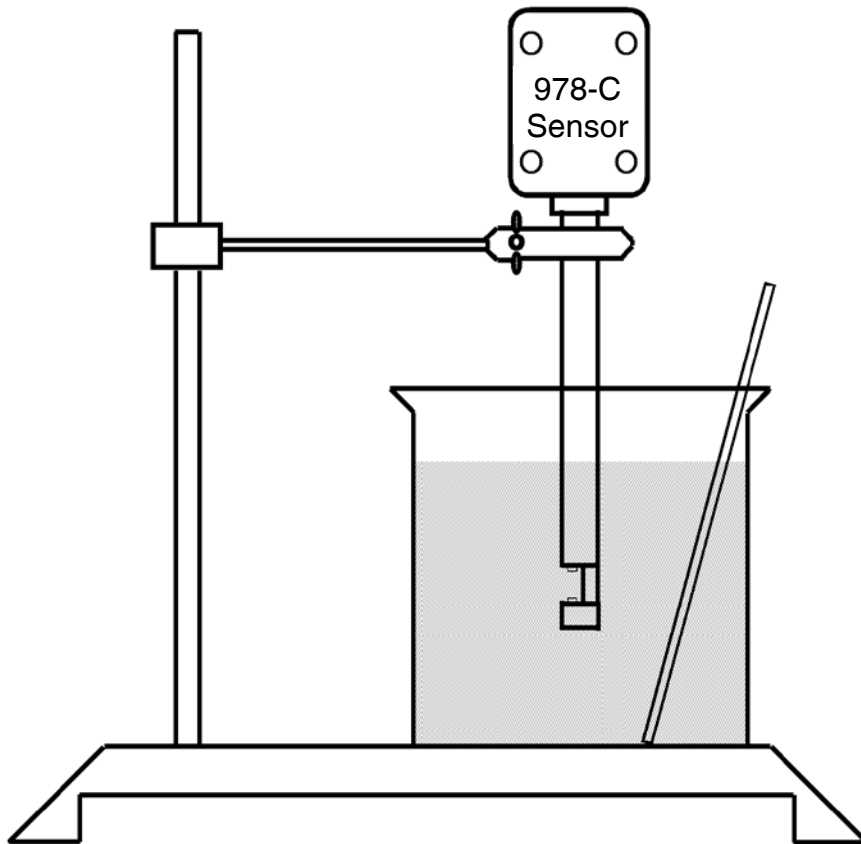


B. Laboratory

This method is normally used on new instruments prior to their installation or on instruments that have been completely removed from the process. Laboratory calibration will require the apparatus as shown in **Figure I** below. The instrument must be wired according to the wiring instructions. During calibration, care must be taken to eliminate bright natural light from the sample and sensor tip. Care should also be taken to place the sensor in the middle of the sample chamber to avoid internally reflected light.

Figure I

Laboratory Apparatus



The calibration is a two-step procedure. Samples at each end of the desired range should be available.

In most instances, the zero point is established using clean water. For the upscale value, a sample of the product near the normal operating concentration will be required. If a sample of the normal concentration is not available, any sample of known value will suffice. For example, if 15% pulp is not available for a 15% operating range, use a 10% sample and set the instrument span so that the meter reads 10%.

The calibration procedure is as follows:

- a.** Place the sensor in the clean water sample and set the ZERO on the front panel to read 0 on the indicator.*
- b.** Next, place the sensor in a sample that is near the operating concentration of the process and set the SPAN to read the sample value.
- c.** Repeat steps **a.** and **b.** above to check the calibration. If the calibration is off, make the necessary adjustments.

* **NOTE:** For certain applications, an offset zero may be used to provide better accuracy over a narrower concentration range. If calibrating with an offset zero, choose two samples of known concentration that are in the operating range where best accuracy is needed. One sample should be at the low end of the range and the other sample should be at the high end of the range. Calibrate the instrument using the procedure below:

- a.** Place the sensor in the low concentration sample and set the ZERO on the front panel to read the low sample value.
- b.** Next, place the sensor in the high concentration sample and set the SPAN to read the high sample value.
- c.** Repeat steps **a.** and **b.** above to check the calibration. If the calibration is off, make the necessary adjustments. If the offset zero is large, you may have to repeat steps **a.** & **b.** several times.

C. In-Line

The instrument may be calibrated without removing the sensor from the line, provided that accurate laboratory equipment is available and a representative sample of the process liquid can be taken.

1. If the meter is reading off-scale, adjust the ZERO pot on the front panel until the reading is back on scale.
2. Take a grab sample and simultaneously note meter reading.
3. Determine the value of the sample's solids concentration in ppm or % solids.
4. After the concentration has been determined, note the present instrument reading and adjust the ZERO pot to correct.

EXAMPLE

Meter reading when sample taken	=	2.50 %
Lab test value	=	2.25 %
Difference (reads 0.25 too high)	=	0.25 %
Present meter reading	=	4.00 %
Subtract	=	0.25 %
Set meter (by adjusting ZERO pot on Panel) to read		3.75 %

In rare instances where there is insufficient "travel" in the ZERO pot to reach the desired setting, adjust the coarse zero pot on the main circuit board. See **Figure G** on page 10.

After the calibration adjustments have been made, tighten the lock nuts on the ZERO and SPAN pots.

D. Output

The instrument is supplied with either a millivolt (mV) or a milliamp (mA) isolated output, which corresponds to the 0-2, 20, 200 or 2000 meter reading. The output is usually specified by the customer at the time of purchase; however, if an output has not been specified, a 4-20 mA output will be provided. The output is factory set and should not require resetting. To change or reset the output, please follow these instructions:

The adjustments for the output ZERO and SPAN setting are located on the electronic converter circuit board and are marked "Z" and "S" (see **Figure G** on page 10). After removing the front panel (dust-tight enclosure) from the converter, connect a suitable ammeter to terminals **#3 (-)** and **#4 (+)**. Set the meter to "zero" by turning the "ZERO" pot located on the **front panel**, then adjust the "Z" pot on the **circuit board** until the ammeter reads 4 mA. Next, adjust the "ZERO" pot on the **front panel** until the meter reads full scale (1999). Then adjust the "S" pot on the **circuit board** until the ammeter reads 20 mA.

NOTE: There is a small amount of interaction between these adjustments, so both the "0" and "1999" (4-20mA) points should be rechecked.

If the instrument is being "checked out" in the lab, the following procedure is recommended:

With the sensor immersed in a clear sample and the meter reading "0", adjust the "Z" pot until the ammeter reads 4 mA. Next, place the sensor in a mixture that is equivalent to the full scale concentration so that the meter reads full scale (1999), and adjust the "S" pot until the ammeter reads 20 mA.

E. Dampening

If the meter indication appears particularly "noisy", it can be dampened using the "D" adjustment on the signal converter circuit board (see **Figure G** on page 10). Turning the adjustment clockwise increases dampening.

5. SENSOR REMOVAL/REINSTALLATION (w/ Insertion Adapter Kit)

Sensor Removal (when installed with insertion adapter kit): DO NOT ATTEMPT TO REMOVE THE SENSOR WHEN THE LINE IS FILLED OR UNDER PRESSURE IF THE PROCESS FLUID IS ACIDIC, CORROSIVE, OR AT ELEVATED PRESSURES OR TEMPERATURES!

To remove the sensor from a pressurized line, it is recommended to first depressurize the line and drain it. If this is not possible, then **EXTREME CARE** must be taken to assure that the sensor is not "blown out" by the process pressure when the Swagelok fitting is loosened.

1. Loosen safety chain one or two links by moving the "clip".
2. Loosen the Swagelok fitting enough to permit pulling the sensor out to the new limit of the safety chain.
3. Retighten Swagelok fitting and repeat steps 1 through 2 until the sensor is clear of the ball valve.
4. Close valve.

Sensor Reinstallation: As with the removal of the sensor, reinstallation should never be attempted when the process fluid is highly acidic or corrosive, or at elevated temperatures or pressures. **It is HIGHLY recommended that the process line be depressurized and drained before reinserting the sensor.** If this is absolutely impossible or very impractical, use the following method:

With the ball valve in the "closed" position and the Swagelok tightening gland slightly loosened, insert the sensor into the Swagelok fitting until it stops against the closed portion of the ball. Reconnect the safety chain and remove all slack using the "clip" connector on the chain. **(NOTE: The large washers that are connected to the safety chain must be "captured" between the Swagelok fittings -- one on the valve and on the other on the sensor).** Tighten the Swagelok fitting to a "snug" position, then insert the probe further while containing most of the liquid. While standing to the side of the sensor, **SLOWLY** open the ball valve to permit the liquid to reach the outer Swagelok fitting. When the valve is completely open, insert the sensor to its original position and retighten the Swagelok fitting until it stops leaking. Finally, retighten the safety chain to remove all slack, using the "clip" connector on the chain.

6. TROUBLESHOOTING

Problem	Possible Causes	Check/Remedy
Meter indication is blank	No power Blown fuse No power to instrument Panel plug installed incorrectly Faulty transmitter/indicating meter	Check power light. Check fuse. Check for proper voltage on terminals 8 & 9. Make sure red dot on plug aligns with red dot on main circuit board. Refer to supplier.
Meter will not zero	Too much absorbed light Poor sensor connections or incorrect wiring Sensor leads not insulated from body of sensor or conduit Wet connection in converter or sensor housings No power to sensor Faulty sensor lamp or defective sensor/transmitter	Remove sensor and place in clean water. If the meter does not zero then try adjusting Zero (R9) on the main circuit board. Check connections and wiring. Check sensor wires. Look for water or condensate on connections. Voltage should be between 11 & 26 VDC across terminals 5 and 6 on the main circuit board. Also, there should be between 11 & 26 VDC across terminals 5 and 6 of the circuit board at the sensor. If the proper voltage (11-26 VDC) is on terminals 5 and 6 at the sensor and the lamp in the sensor is not on, then the lamp, lamp wiring or sensor circuit board has failed.
No response (indication does not change and indication is high)	Faulty sensor lamp	Check to see if sensor lamp is on. If lamp is off, check voltage across terminals 5 & 6 in sensor. If the proper voltage (11-26 VDC) is on terminals 5 and 6 and the lamp in the sensor is not on, then the lamp, lamp wiring or sensor circuit board has failed.
Unstable reading	Insufficient dampening Air bubbles or very large particles in process line RFI pickup Heavy Inductive loads	Increase dampening. Take sample and check for bubbles or large particles. If present, relocate sensor. Earth ground instrument properly. Mount instrument away from power cables. Put cables in conduit.
Reading does not agree with lab results	Improper calibration Lab procedure error Lab instrument error Defective sensor/transmitter	Recalibrate instrument. Check procedure. Check instrument. Refer to supplier.
Readings drift with time	Converter not warmed up Sensor/converter connections wet Deposit build-up on sensor	Warm up converter for 5 minutes. Look for water or condensate on connections. Dry connections with hair dryer. Remove sensor and clean.
Negative readings or negative output	Improper calibration	Recalibrate instrument.

7. TECHNICAL SUPPORT

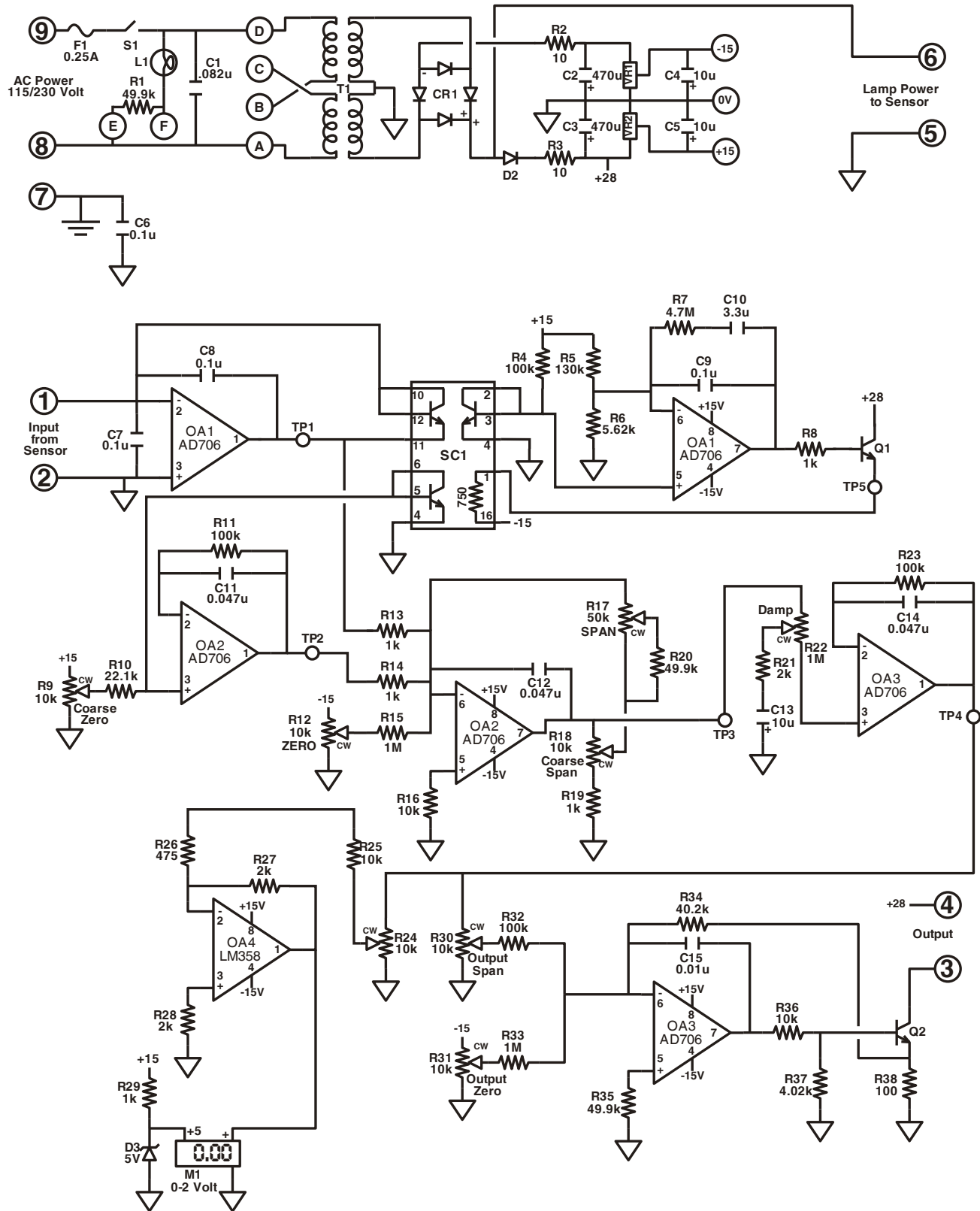
If technical support is required, please contact us at the phone number on the front cover, and be prepared to supply the following information:

- _____ **Serial Number** (inside signal converter)
- _____ **Light Gap/Path Length** (0.25cm/1.0cm/2.5cm/special)
- _____ **Sensor Type** (Submersible/Insertion)
- _____ **Date Purchased**
- _____ **Output** (Current/Voltage)
- _____ **Power** (110VAC/220VAC/12VDC/24VDC)
- _____ **Process Temperature**
- _____ **Process Pressure**
- _____ **Process Solid** (Sand/Pulp/Yeast)
- _____ **Process Liquid** (Water/Oil/Alcohol)
- _____ **Process Solid Concentration**
- _____ **Process Piping Material** (ABS/Stainless)
- _____ **Process Piping Size**
- _____ **Anything else you feel is important**

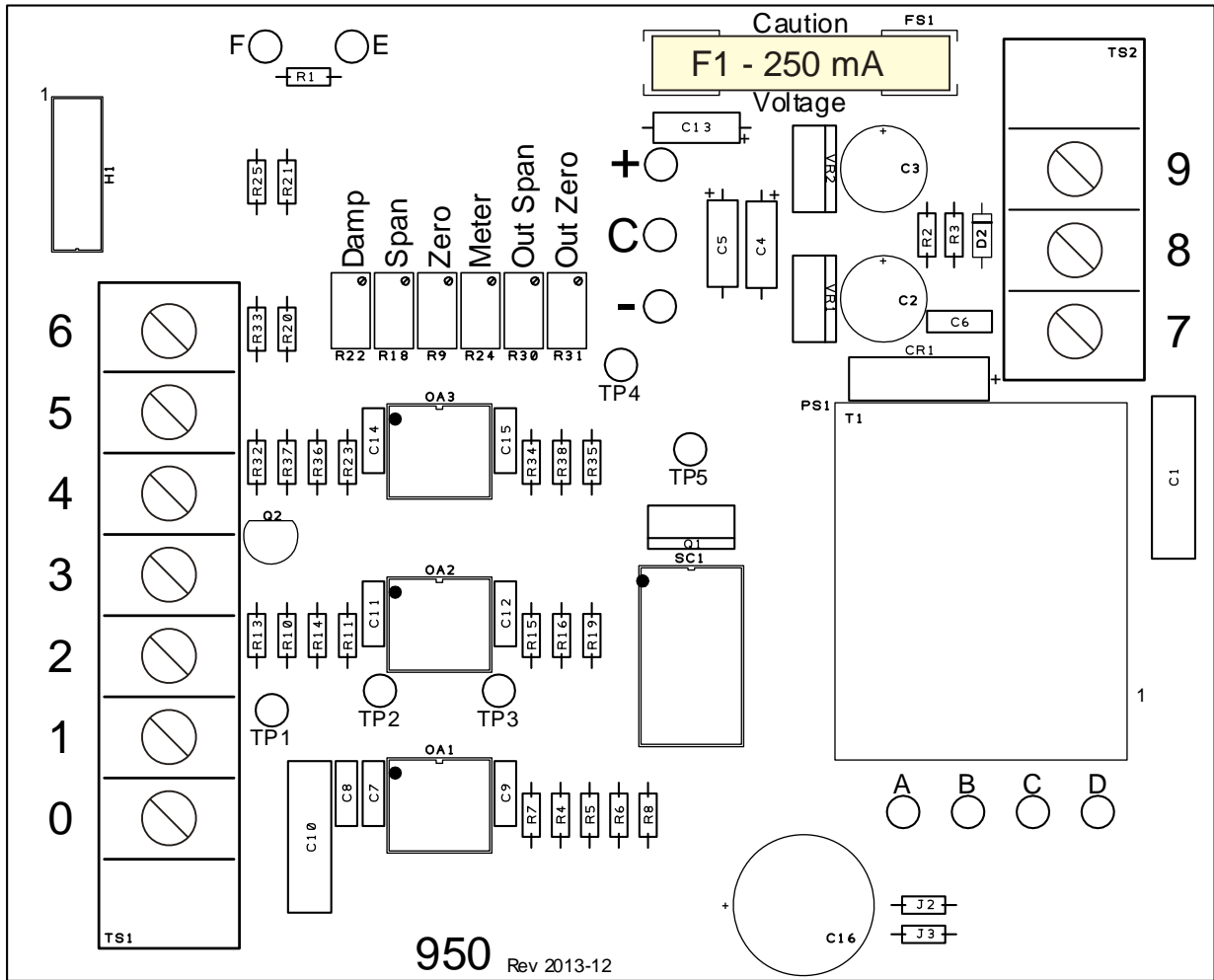
8. TECHNICAL DIAGRAMS

A. Model 978-C Suspended Solids Monitor

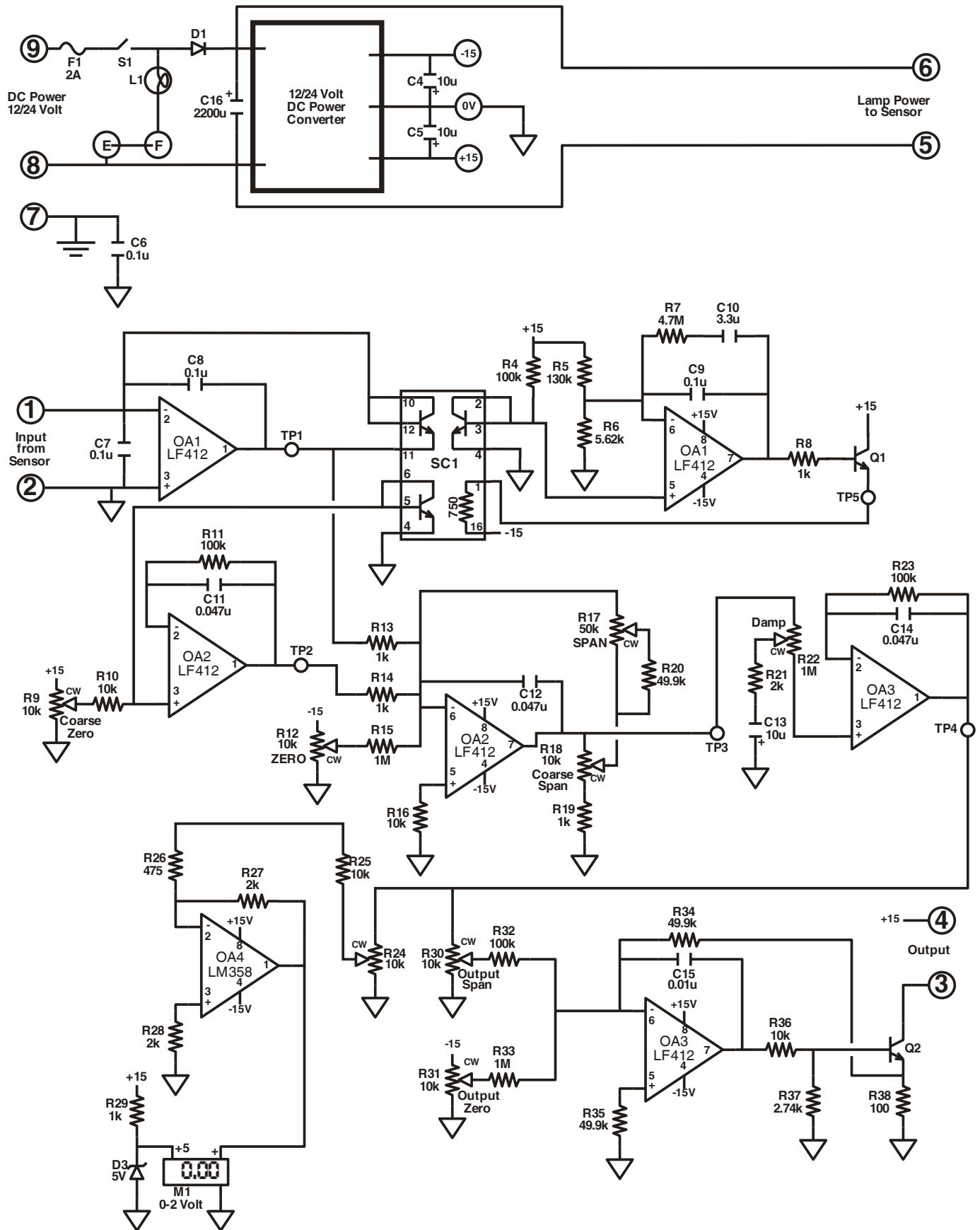
Model 978-C Circuit Diagram (AC Power)



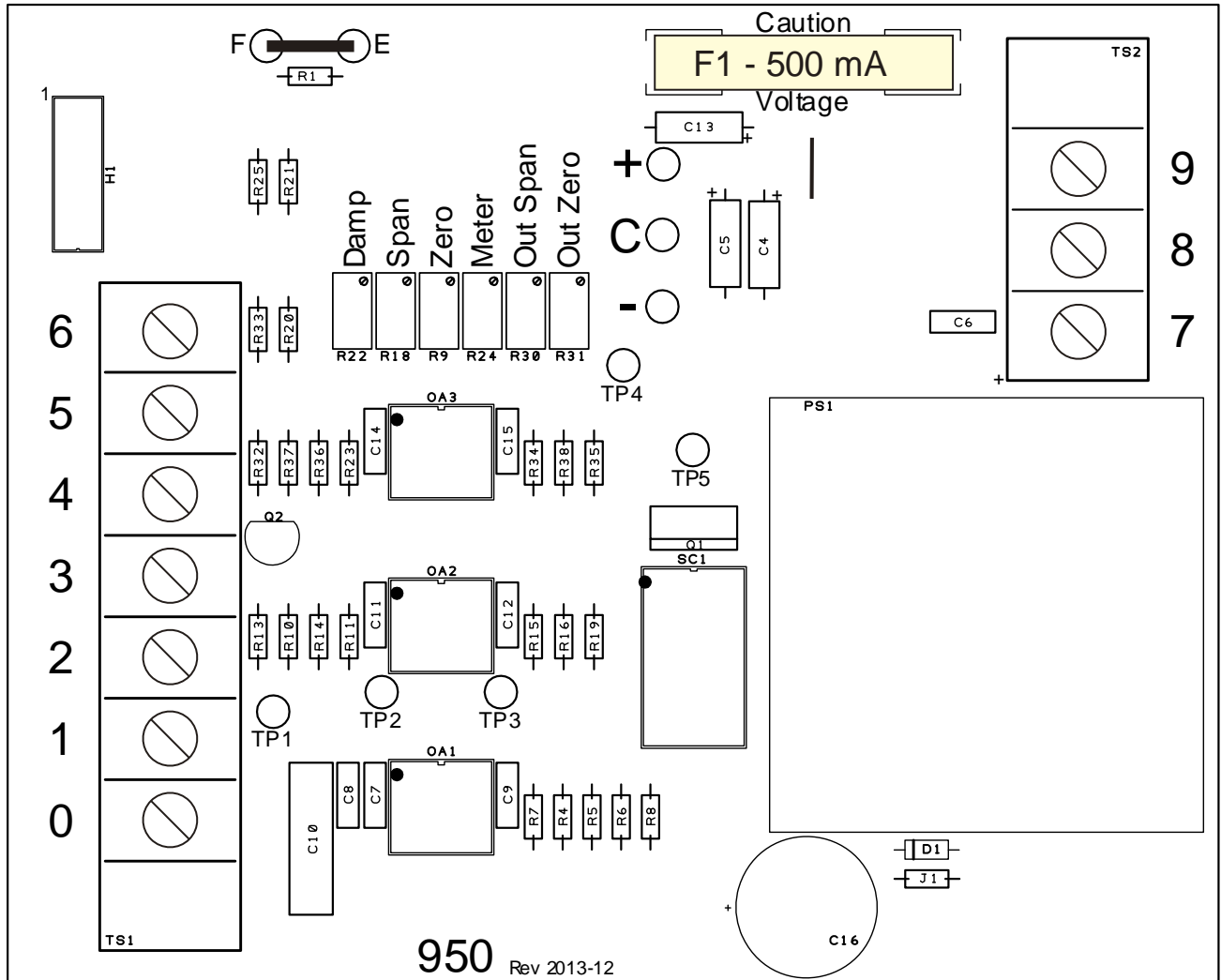
Model 978-C Circuit Board Component Layout (AC Power)



Model 978-C Circuit Diagram (Optional DC Power)

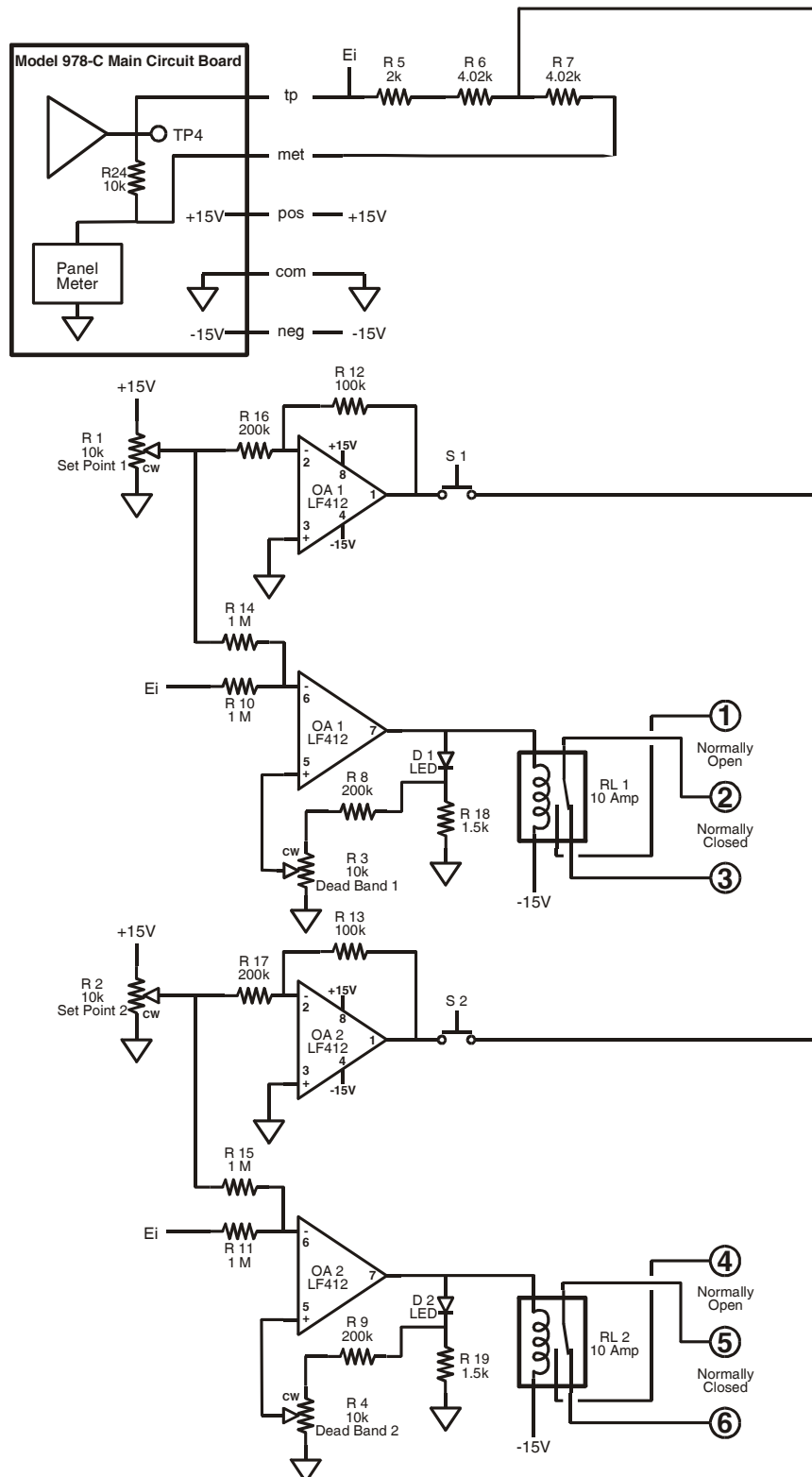


Model 978-C Circuit Board Component Layout (Optional DC Power)

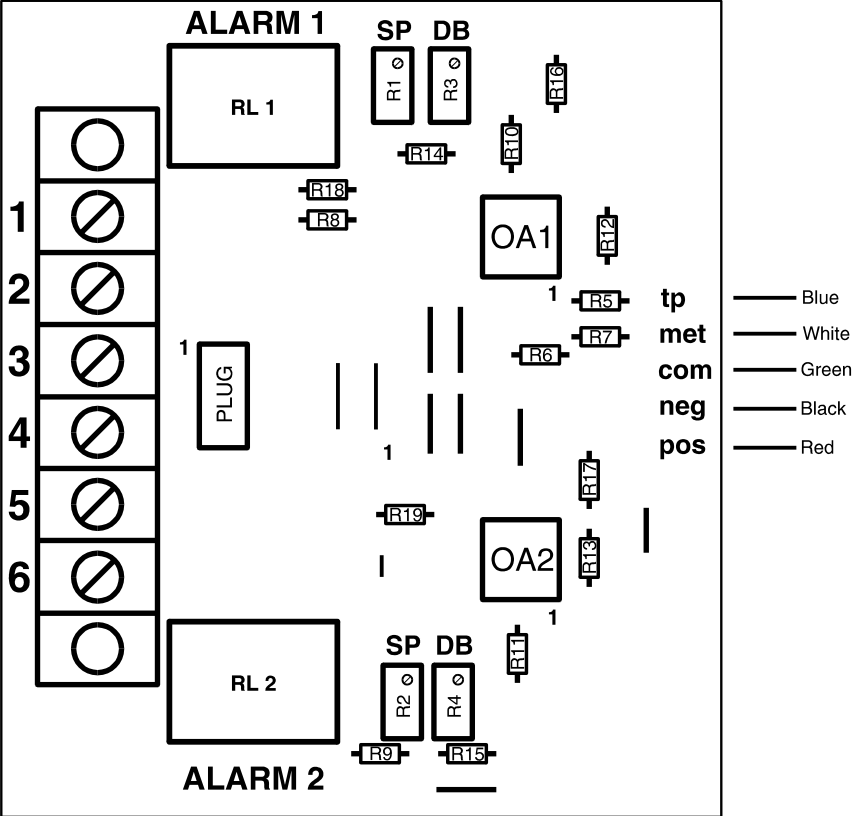


B. Model 220 Alarm (Optional)

Model 220 Alarm Board Circuit Diagram

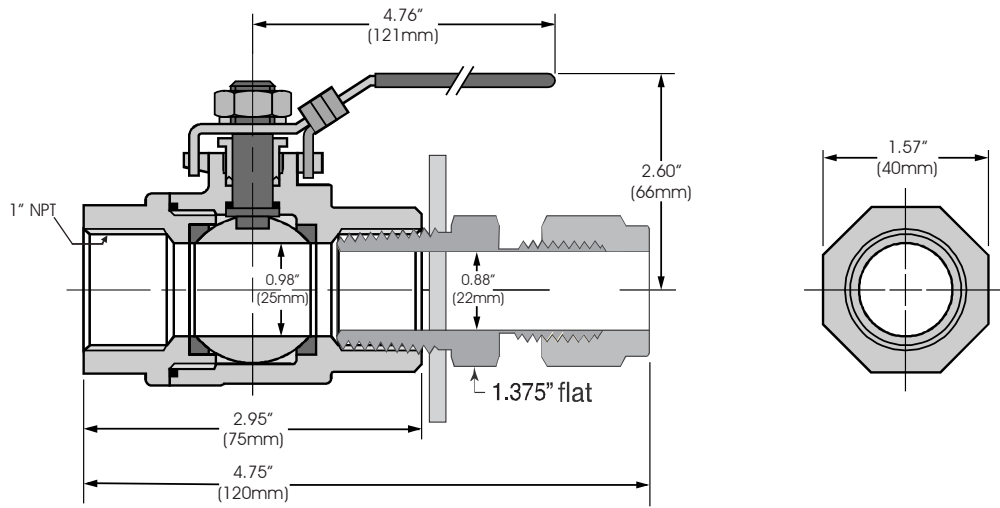


Model 220 Alarm Board Component Layout

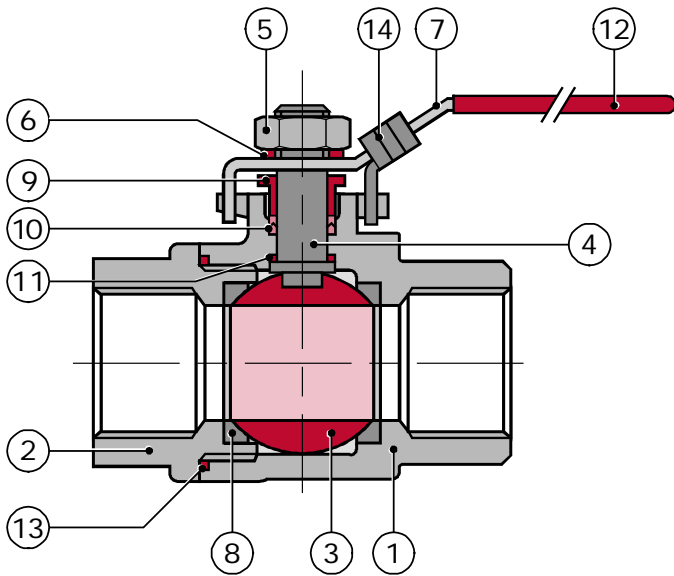


C: Pipe Insertion Assembly Dimensions and Materials

Dimensions:



Materials:



No.	Part	Material	Qty.
1	Body	ASTM A351 Gr. CF8M	1
2	End Cap	ASTM A351 Gr. CF8M	1
3	Ball	AISI 316	1
4	Stem	AISI 316	1
5	Stem Nut	AISI 304	1
6	Stem Washer	AISI 304	1
7	Handle	AISI 304	1
8	Seat	PTFE	2
9	Gland Nut	AISI 304	1
10	Stem Packing	PTFE	1
11	Thrust Washer	PTFE	1
12	Handle Sleeve	Vinyl	1
13	Joint Gasket	PTFE	1
14	Locking Device	AISI 304	1

9. WARRANTY

Ziegler & Associates' products are warranted to be free from defects in material and workmanship for a period of one (1) year from the date of shipment. The final determination as to whether the product has failed due to defects in materials or workmanship rests solely with Ziegler & Associates. Products that have been proven to be defective in workmanship or materials will be repaired or replaced at Ziegler & Associates' facility at no charge to the buyer. Defective instruments must be returned to Ziegler & Associates freight prepaid. **THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE GIVEN IN CONNECTION WITH THE SALE OF ANY ZIEGLER & ASSOCIATES PRODUCT(S).** In no event shall Ziegler & Associates be liable for consequential, incidental or special damages. The buyer's sole and exclusive remedy and the limit of Ziegler & Associates' liability for any loss whatsoever, shall not exceed the purchase price paid by the purchaser for the product or equipment to which a claim is made.

