STATIC LEVEL MONITORING SYSTEM

Model 621A

Operating Manual

6/09

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1.0 INTRODUCTION

Electrostatics is the oldest form of electrical phenomena known, but probably the least understood and the most difficult to control. Static electricity occurs because a material has a surplus (-) or a deficiency of electrons (+). Static electricity is generated by the separation of materials such as pulverized material passing through chutes or pneumatic conveyers, power or conveyer belts in motion, motion of all sorts that involve changes in the relative position of contacting surfaces, usually of dissimilar substances, liquid or solid, one of which is usually a poor conductor of electricity. In general, the lower the electrical conductivity of the material and ambient relative humidity, the greater the static charge generation.

The generation of static charge cannot be prevented absolutely because its intrinsic origins are present at every interface. It is often the ignition source for an ignitable mixture in many unexplained explosions or flash fires. The problem is particularly acute in size reduction operations such as milling or pulverizing, the movement of particles through conveyers and pipes, and the high speed processing of sheet and roll material. The resultant materials are often highly charged and potentially dangerous or disruptive to the manufacturing process.

The development of electrical charges may, in itself not be a potential explosion hazard. There must be a discharge or sudden recombination of separated positive and negative charges. In order for static electricity to be a source of ignition, four conditions must be fulfilled:

1. There must be a source of static electric generation.
2. There must be a means of accumulating charge and maintaining a sufficient difference of electrical potential.
3. There must be a spark discharge of sufficient energy.
4. The spark must occur in an ignitable mixture.

The ignitable mixture could be from fumes emanating from a solvent used in the process or, as in many situations, from the dust cloud developed from the material itself.

Operations where the above conditions can exist are hammer mills; storage or transporting facilities such as tanks, hoppers, grain elevators, tankers and barges; compounding and calendering of plastics; chemical and petrochemical plants, and fueling facilities.

The ability of a spark to produce ignition is governed largely by its energy, which will be some fraction of the total stored energy. The energy in a static discharge is expressed as

$$E = \tfrac{1}{2}CV^2 \text{ Joules}$$

where C is the capacitance in Farads and V is the potential difference in Volts. The magnitude of electrostatic voltage encountered in industry can range anywhere from a few volts to several hundred thousand volts. The capacitance of an object depends upon its physical dimensions and its proximity to adjacent objects. Generally, the capacitance of pieces of machinery is estimated to range from 100 to more than 1000 pf. The capacitance of the human body generally ranges between 100 to 300 pf. Tests (NFPA 77 – Static Electricity) have shown that saturated hydrocarbon gases and vapors require approximately 0.25 milliJoules (mJ) of stored energy for spark ignition of optimum mixtures with air. In normal industrial environments, minimum voltages of approximately several thousand (1.5–5kV) would be required. Many industrial standards limit the maximum voltage to 500–4000 Volts.

For dust clouds the minimum ignition energy ranges from approximately 10 to over 100 mJ for many common foodstuffs and resins. In normal industrial environments, voltages ranging from under 5kV to over 20kV would be required.

In practically every situation the capacitance of a system is fixed which means that the ignition energy is a function of the voltage generated. The voltage levels are a function of several factors, but for a given material, the lower the humidity, the higher the voltage generated. In most industrial operations the voltage levels generated by a material cannot be totally controlled. However, it is possible to monitor the electrostatic voltage level, and when dangerous levels are reached an alarm and/or a countermeasure can be activated.

Another critical area affected by static charge build-up is in the manufacture of material using high speed machinery such as fabric, nonwoven and plastic webs, extruding and calendering processes, slitting and rewinding operations, paper handling, printing, etc. In many of these processes, the build-up of static charge can be controlled locally by passive, electronic or nuclear ionization. However, when ionizer performance deteriorates (dirt build-up on the ionizer points) or fails, costly machine downtime caused by static electricity can occur.

Finally, many electronic devices are highly susceptible to electrostatic discharge. Exposure to an ESD event can damage or destroy electronic equipment. Many devices today are sensitive to static discharges less than 200 Volts and new technology devices being sensitive to less than 30 Volts. Many automatic handling machines will generate static charges in excess of these levels resulting in decreased product reliability.

The Model 621A Static Level Monitor is specifically designed to monitor the static charge build-up and to activate alarm(s) or countermeasure(s) when the level exceeds a preset threshold. Recorder outputs of 4-20mA and ±1.0V full scale provide optional remote monitoring, recording or computer logging (A/D converter required).

2.0 EQUIPMENT DESCRIPTION

2.1 General

The Model 621A shown in Figure 2.1-1 is a single channel static level monitor that consists of a control unit and a remote sensor. The system can be configured to meet most user applications. The standard Model 621A is designed for use in non-hazardous locations.

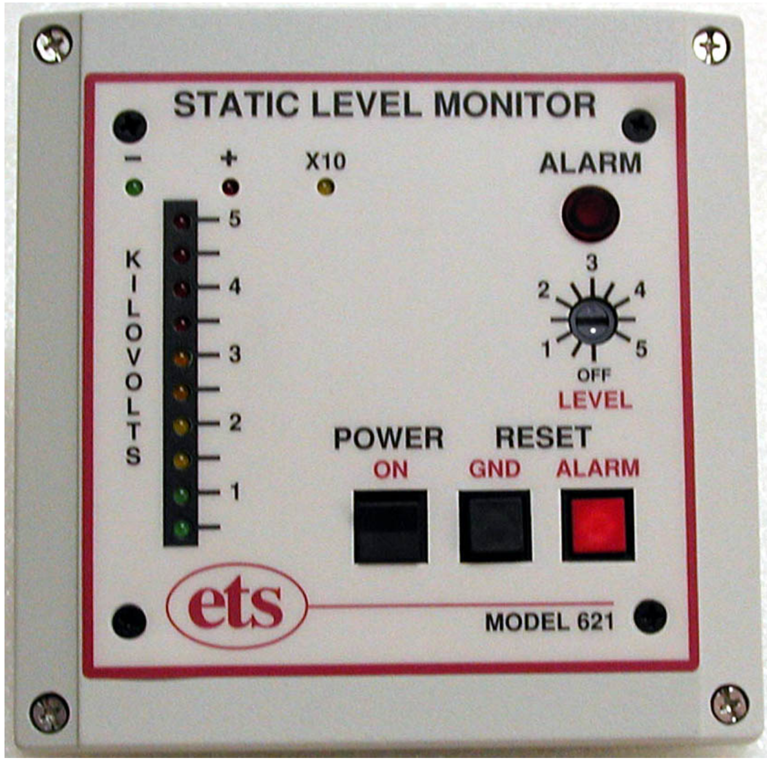


Figure 2.1-1: Standard Model 621A

For Class I, II or III applications where intrinsically safe apparatus has been approved, the Model 621A can be made intrinsically safe. The standard sensor is fitted with a 1/8" NPT tapped and plugged hole as shown in Figure 2.1-2 for those applications that permit an air purge. In certain applications where an explosion-proof sensor housing incorporating a threaded Teflon insert is permitted, then an optional explosion-proof housing can be provided for custom designed systems.

Figure 2.1-2: Standard Charged Plate Detector Sensor

Where high sensitivity in a clean environment is required, such as electronic assembly operations, the Model 621A is available with an open detector sensor shown in Figure 2.1-3 that increases the basic system sensitivity by a factor of 10 or a modified standard system with closer sensor-object spacing that also increases the sensitivity by a factor of 10.

Figure 2.1-3: High Sensitivity Open Detector Sensor

A 3” or 6” (7.62 or 15.25 cm) diameter detector plate, as shown in Figure 2.1.4, can be added to the standard sensor to convert the Model 621A into a Charged Plate Monitor for monitoring ionizer balance. In this configuration the system is calibrated for a sensitivity of 50/500 V applied directly on the detector plate.

Figure 2.1.4: Charge Plate Monitor sensor

2.1.1 Control Unit

The control unit is housed in a cast aluminum housing with a powder coat finish, 5.375"W x 5.5”H x 2.875”D (13.65 x 14.0 x 7.30 cm) with three ½”

NPT access ports for bringing out the power, sensor and recorder and alarm signals. Connections can also be made via ½" conduit or by cables secured by compression fittings.

The control unit contains the system power supply, LED bargraph, alarm threshold selector, alarm LED indicator, and power and reset switches.

The power supply is designed to operate from either 115 or 230 VAC, 50-60 Hz. A jumper change on the printed circuit board is required to change the incoming line voltage. Power to the Model 621A is controlled by an **ON/OFF** rocker switch located on the front panel. The power supply converts the line voltage to +15 and –15 DC operating voltages. Table 1 lists the voltage and current characteristics of the power and signal lines going to the sensor for applications where intrinsically safe barriers are required.

Table 1

LINE	VOLTAGE	MAX I	SC I	CAP
PWR	-15v	9 ma	50 ma	.47 µf
PWR	+15v	9 ma	50 ma	.47 µf
GND	0	0	0	0
SIG	±15v	1.5 ma	1.5 ma	.47pf

A 10-point LED bargraph display is used to display the magnitude and single point LEDs are used to display the polarity and the **X10 RANGE** multiplier of the measured electrostatic voltage. The standard Model 621A is calibrated for 0 to ±5 kV, autoranging to 0 to ±50kV in 500V and 5000V increments respectively, at a sensor-object spacing of 2 inches.

The high sensitivity version of the Model 621A is calibrated for 0 to ±500 Volts, autoranging to 0 to ±5000V in 50 and 500V increments, respectively, at a sensor-object spacing of 1 inch. Additional modifications can increase the sensitivity to 50 and 500V with 5 and 50V resolution at closer sensor to object spacing.

The alarm function operates in either the **x1** or **x10** range as selected by an internal slide switch. A user adjustable selector switch is located on the front panel to select alarm thresholds in 10% increments (500, 1000, 1500 volts, etc.). When the measured voltage exceeds the threshold a red **ALARM** LED on the front panel lights and remains lit until the **RESET** button is depressed. The **RESET** button resets the alarm circuit and the black GND push button momentarily grounds the isolated charged plate detector. The alarm also activates a Form-C relay with NO and NC contacts to activate a remote alarm signal or a countermeasure. The relay can switch up to 10 Amps at 30 volts DC or 10 Amps at 115-230 VAC.

Two recorder output signals are available: A 0 to ±1V signal corresponding to the full measurement range of the unit, i.e., 0 - ±50 kV and, a 4-20ma signal corresponding to –50 to +50kV. These signals can be used to with a strip chart recorder or linked to a computer to signify an alarm event.

2.1.2 Sensor

The sensor assembly consists of a chopper stabilized electrostatic sensor mounted in a cast aluminum ½" NPT electrical conduit elbow fitting. A charged plate detection system is used to isolate the sensor from outside contaminants found in most industrial environments. The standard detector is a 1" (25.4 mm) diameter stainless steel disc mounted in a Teflon housing having a capacitance of 16 pf. Other detector configurations are available to adapt the Model 621A sensor to virtually any application.

A 20-foot (6m), 5-conductor, shielded, PVC jacketed signal cable is used to connect the sensor to the control unit. The cable is connected to the control unit through a screw terminal block and connects to the sensor via a 5-pin locking DIN connector. Cable lengths up to 100 feet are available as an option.

The sensor is mounted using a 1-inch (25mm) long, ¼-20 threaded stud and a vibration-proof locking nut. Custom mounting configurations are also available.

3.0 INSTALLATION

The Model 621A Static Level Monitoring System is a precision measuring instrument. The sensor should be installed on a vibration-free surface and the control unit away from excessive dusty or damp locations. If the system must be installed in a harsh environment, contact ETS for custom enclosure configurations and pressurized fittings.

3.1 Control Unit

The control unit should be mounted on a flat surface that is at least 6 inches (150mm) square. Figure 3.1-1 also shows the mounting dimensions required to mount the basic control unit using four (4), #8 screws.

The standard Monitor comes equipped with a 6-foot (1.8m) power cord for connection to a standard North American grounded 115VAC outlet. The user may elect to hard wire the system to the power source. Both the power cord and the 20-foot (6m) sensor cable are hard wired to the unit via plug-in screw terminal blocks located inside the control unit. The system is fused internally with a 5x20mm 2 Amp, 250 Volt fuse. **Note: do not remove the 4 black nylon screws.**

All power and signal connections are made to the terminal blocks as shown in Figure 3.1-1. Standard connections are through cable strain relief fittings, but the enclosure also allows for direct installation of ½" (12mm) conduit.

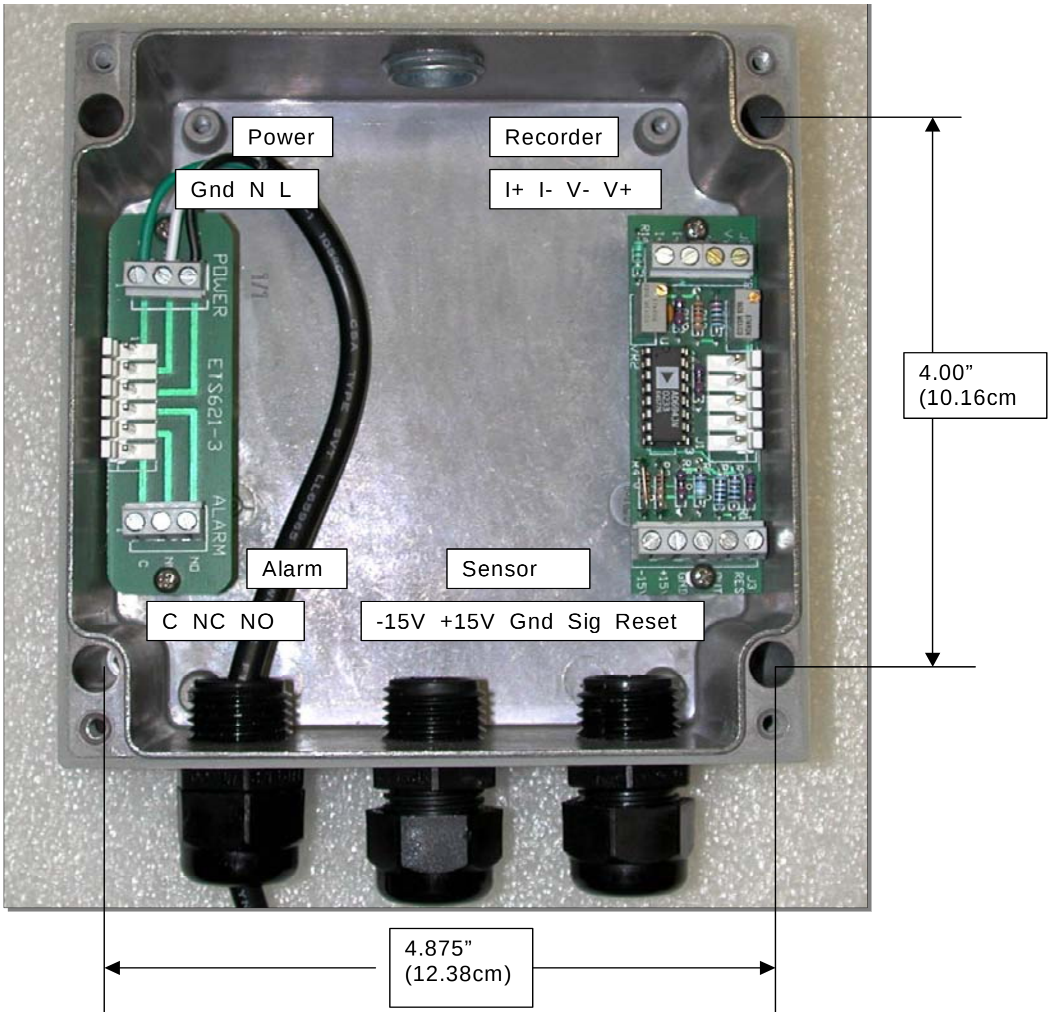


Figure 3.1-1: Power and signal connections

All power and signal connections are made to the terminal blocks.

The Model 621A is normally wired for 115VAC unless 230VAC is specified at the time of order. If it is necessary to change the line voltage in the field, the jumpers on the PC board must be changed as shown in Figure 3.1-2. The fuse must also be changed to a 3AG, 250 V, 1/8 Amp. To access the fuse, remove the front section of the control unit as described above. Be very careful since the electronics are mounted to this section.

To connect the Recorder Output and/or the Alarm output remove one or both of the hole plugs on the bottom of the control unit and install the necessary ½" NPT compression fittings. Connect the wires to the appropriate barrier strip as shown in Figure 3.1-1.

Note 1: Sensor cable color code is as follows:
-15V - **G**reen; +15V - **R**ed; Gnd & Shield - **B**lack & Shield; Signal - **W**hite; Reset - **Y**ellow

Note 2: When connecting the sensor to the control unit via conduit a T-junction housing is provided. The housing can be attached to the sensor using either the end or middle ½ “ NPT fittings. Follow the same wiring code as above, except, the Black ground wire and cable shield are connected to separate terminals in the junction box.

The alarm range is normally set at the factory to the **x1** Range. If specified, it will be set to the **x10** Range. However, if the application requires changing to the other range in the field it will be necessary to open the unit and reposition the alarm range select slide switch. Follow the directions above for opening the unit to change the fuse. On the bottom side of the PC board there is a miniature slide switch. Move it to the opposite position. This will switch the alarm threshold selector switch to the other range.

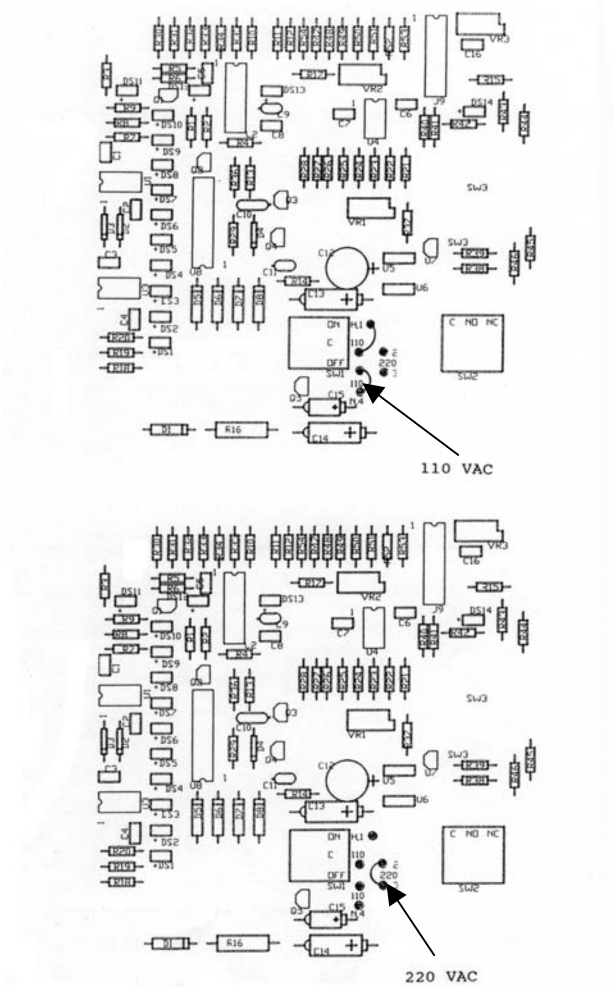


Figure 3.1-2: 115/230VAC Jumper change

3.2 Sensor

The sensor is installed using the ¼-20 x 1” (25mm) stud attached to the top of the housing. The sensing element is sensitive to excessive vibration and shock. A vibration-free location should be used. If this is not possible then the sensor should be mounted using shock and vibration absorbing devices or material. Figure 3.2-1 shows the sensor mounting configuration.

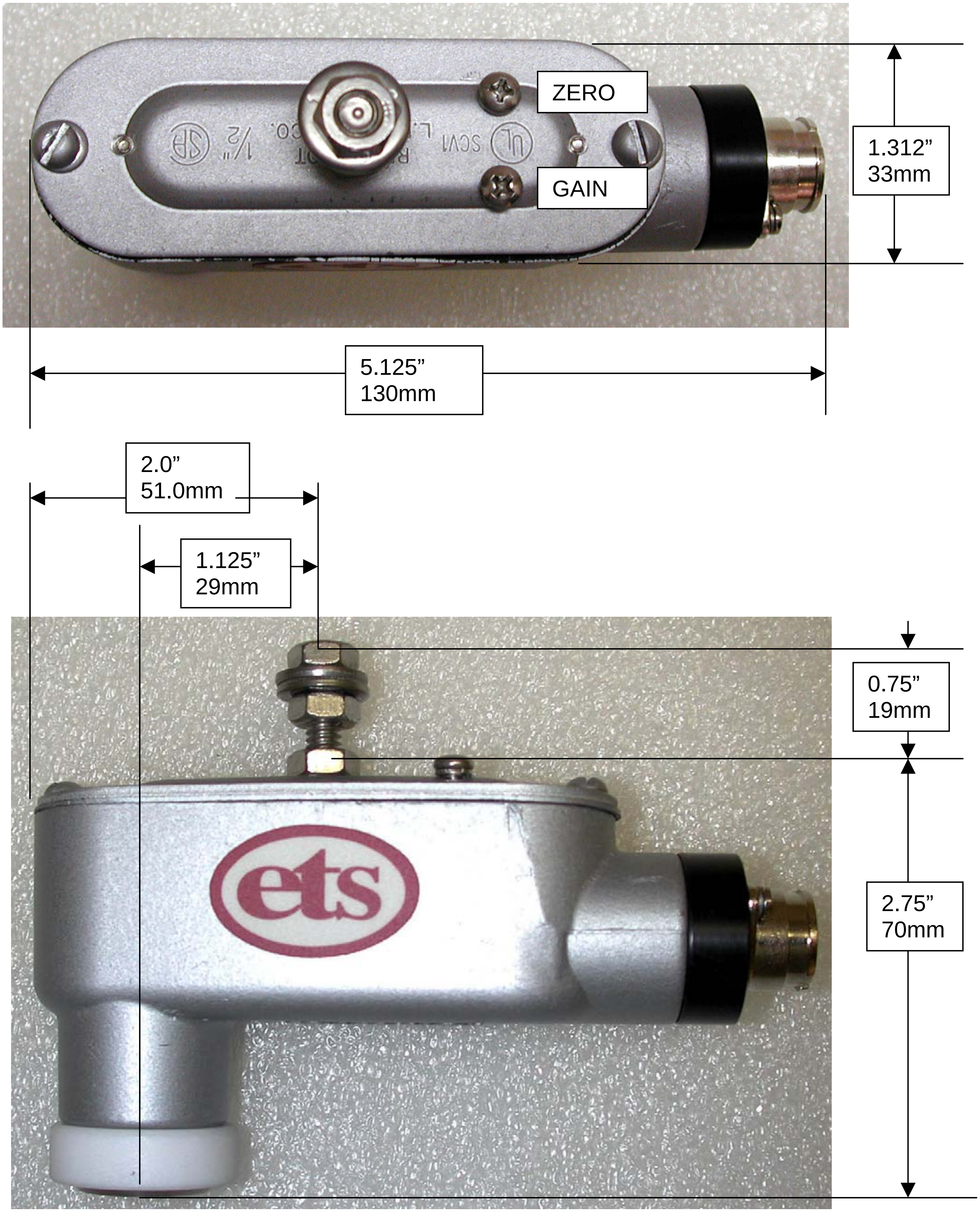


Figure 3.2-1: Sensor Mounting and ZERO/GAIN Adj.

The sensor electronics has internal Gain and Zero Adjust potentiometers that are also shown in Figure 3.2-1. The two 6-32 screws located on the top of the sensor housing allow access to these adjustments.

The standard sensor is supplied with a 5-pin locking DIN connector. However, the sensor can be hard-wired directly to the control unit via a ½" conduit or compression fittings. This configuration should be specified at time of order since a T-junction housing is incorporated onto the sensor housing to provide a terminal block interface; otherwise, the sensor must be returned to ETS for retrofit.

The calibrated mounting distance of the standard sensor from the surface being measured is 2.0 inches (51mm). For the high sensitivity sensors it is 1.0 inch (25.4mm) The surface to be monitored must be in free air. If it is against a grounded surface, the electrostatic field will be suppressed and no significant measurements will be obtained, even though the surface may be charged. A clear field of view of at least 6 inches is also required to maintain system calibration.

Grounded objects within this area will also distort the electrostatic field resulting in a lower measured signal. If a totally clear field of view is not possible then the system should be recalibrated after installation. This requires a high voltage power source of at least 1000 Volts, such as the ETS Model 208B battery powered Charging Source, a 6 inch (150mm) square metal plate and an insulated surface.

Figure 3.2-2 shows a typical calibration set-up for a moving web. Turn on the system. Allow 5 minutes for warm-up. Set the HVPS to the desired level, then turn it off. Depress the **GND** button. The bargraph should read 0. Apply the high voltage to the isolated metal plate. Observe the reading on the LED bargraph display. Adjust the sensor-surface spacing so that the display indicates the applied voltage. If this is not possible, then some convenient multiple of the scale. Depress the **GND** button and recheck the measurement. Readjust if necessary. **NOTE: Always turn off the HVPS before starting a calibration**. Do not use the Gain Adjust in the sensor. This adjustment should only be used for the system recalibration per specification.

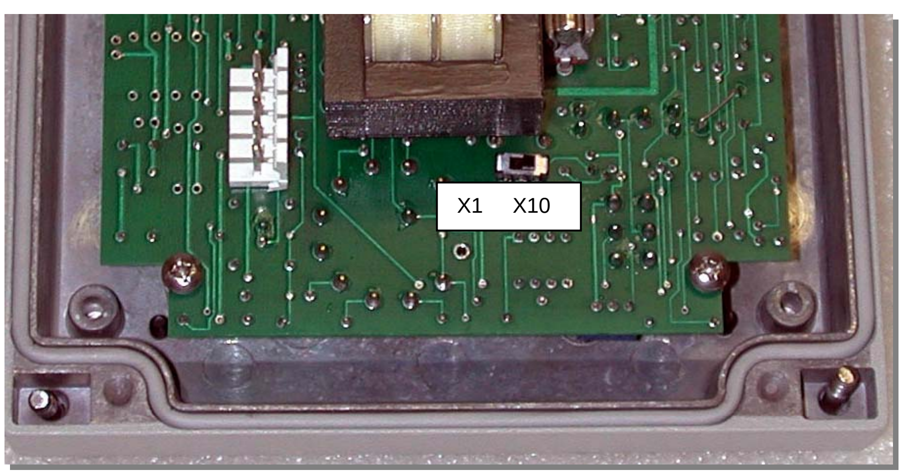


Figure 3.2-1: Standard sensor configuration

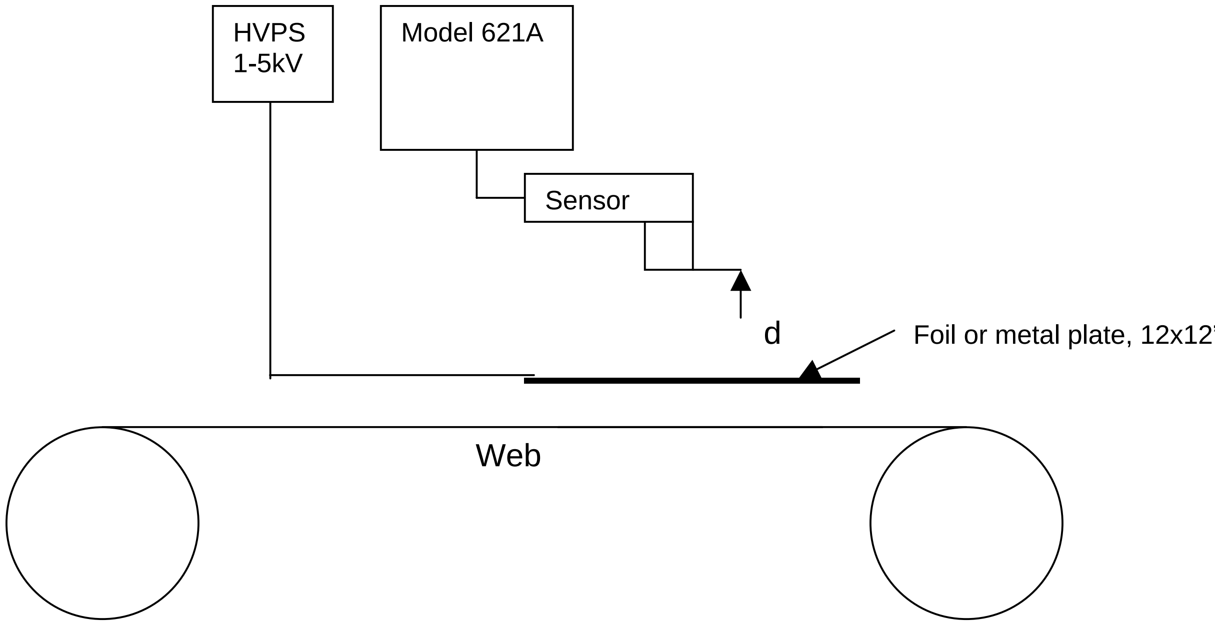


Figure 3.2.2: Calibration Set-Up for Moving Web Installation

3.3 Non-hazardous Location Installation

The standard Model 621A Monitoring System is designed for use in non-hazardous locations. The sensor is sufficiently sealed to protect the internal components from normal dust and dirt. The high-sensitivity, open view sensor utilizes an exposed sensor and therefore, must be used in a clean environment. If this system must be used in a moderately dirty environment then an air purge may be used. A slight positive pressure will prevent suspended contaminants from entering the sensor housing. However, this will not protect the sensor from blowing dust.

The control unit is housed in a sealed polycarbonate enclosure. If necessary, an air purge fitting can be installed onto the enclosure to provide positive pressure.

3.4 Hazardous Location Installation

The Model 621A Sensor can be configured for use in hazardous locations. Either air purge, intrinsically safe barriers, or with certain configurations, an explosion-proof housing can be used, depending upon the governing safety requirements. The control unit is normally not installed in the hazardous location, but air purge or explosion-proof housings can be supplied if required. **All hazardous location installations are the responsibility of the user.**

3.4.1 Air Purge

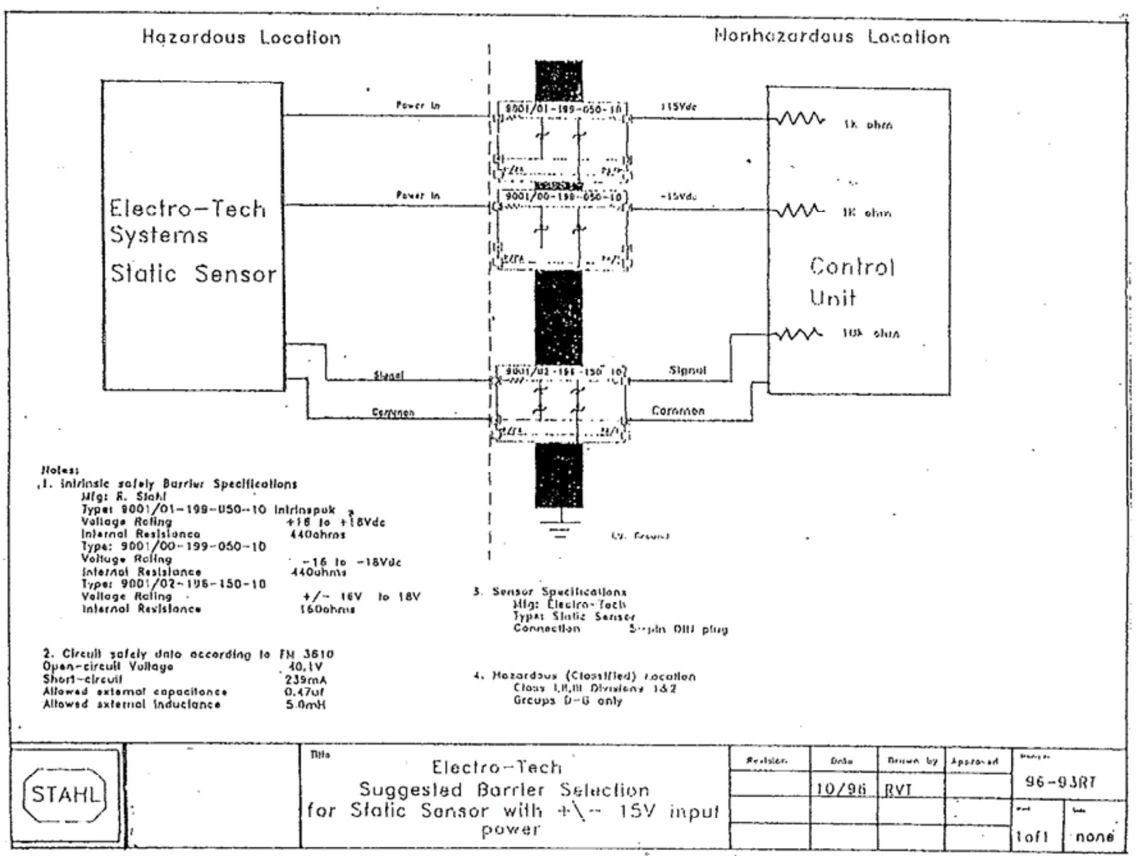
In those applications where an air purge is permitted, the user need only to install the appropriate 1/8” NPT fitting to the connection provided on the sensor.

Facility air at approximately 2 psi is sufficient to keep dust, dirt and harmful vapors from building up in the sensor housing. In many applications the use of an inert gas such as dry nitrogen may be required.

3.4.2 Intrinsically Safe Barrier

The standard sensor can be used in Class I, II or III hazardous locations where intrinsically safe apparatus has been approved and the appropriate intrinsically safe barriers have been installed. Intrinsically safe barriers limit the maximum current to the sensor so that a worst-case scenario (shorted power and signal leads) will not produce sufficient energy to support ignition of an optimum mixture of the product and air.

Intrinsically safe barriers from R. Stahl, Inc. are satisfactory for use. Each power, signal and ground lead requires its own barrier. **Installation of intrinsically safe barriers are the responsibility of the user.** Figure 3.4-1 shows the installation of the recommended barriers and the applicable safety data.



Stahl, Inc. Contact Information:
45 Northwestern R.
Salem, NH 03079
PH: 603-870-9500
Web: www.rstahl.com

Figure 3.4-1: Intrinsic Barrier Data Sheet

3.5 Explosion-Proof Enclosures

The Model 621A sensor can be mounted in a rated explosion-proof housing. However, the Teflon isolation core may not meet certain explosion-proof housing specifications. With this type of installation the sensor cable must be run through rated conduit to the sensor. Contact ETS for additional information on a custom designed explosion-proof system. **It is the responsibility of the user to determine if an explosion-proof housing meets all the safety requirements of the specific application.**

4.0 OPERATION

The Model 621A Static Level Monitoring System is designed to operate with minimum operator control.

To operate, turn on the **POWER**. Allow a few minutes for the system to warm up. Depress the **GND** and **ALARM RESET** buttons. With the process to be monitored shut down, the LED bargraph on the control unit should read 0 (ideally, no LED's lit), however, the polarity LEDs will read either + or -. The **x10** range LED and the **ALARM** LED should be off. If the alarm function is to be used, select the desired threshold level by rotating the **LEVEL** adjust control. Each increment on the control corresponds to an increment on the bargraph display. If the alarm threshold must be changed to the other range, follow the instructions in Section 3.1.

If the **ALARM** threshold is exceeded, the large red **ALARM** LED on the control unit will light and remain lit until it is reset by the operator depressing the **RESET button**. In addition, the alarm relay will be activated and control whatever signal device or countermeasure installed by the user.

The black **GND** momentary pushbutton is located next to the **RESET** button. This button provides a means to ground the isolated, .875" (22mm) diameter detector plate installed on the white Teflon insulator. It normally should be pressed just prior to starting the machinery or industrial process. **NOTE: Pressing this button while a static charge is present establishes a new zero point which is at the level just prior to the detector plate being grounded. To check the calibration when the process cannot be stopped then place a grounded plate in front of, but not touching, the sensor before depressing the GND button.**

The Model 621A provides both ±1.0 Volt and 4-20 mA signals, corresponding to full scale (±50kV for standard system) for connection to a recorder or data logger. Using an A/D converter will enable the unit to be connected to a computer. The voltage signal requires a minimum 10 kOhm input resistance.

5.0 MAINTENANCE, CALIBRATION AND REPAIR

The Model 621A Static Level Monitor requires very little attention if it has been installed properly and protected from excessive contamination (dust, dirt, harmful vapors, solvents, etc.). The most vulnerable part of the system is the sensor. The chopper stabilized sensing element is susceptible to damage when exposed to excessive shock or vibration. A sensor failure is usually indicated by the LED bargraph locked onto a reading, continuously flashing with no static field present, or not responding to a static field at all.

If the system does respond to a static field signal, but the zero has shifted over time by 2–3 digits, the **Zero** adjust control on the sensor can be readjusted. To readjust the zero, remove the 6-32 screw covering the potentiometer. Depress the **GND** button on the control unit. Insert a very small flat blade screwdriver (1/8” or 3mm) into the hole and carefully rotate the pot until the bargraph reads 0. This occurs when the polarity lights switch between + and – with equal back and forth adjustment. At the completion of this procedure, replace the 6-32 screw.

If the system still fails to operate properly, the sensor and/or the complete system may have to be returned to ETS for service. It is strongly recommended that ETS be contacted if improper system operation is suspected. **Do not return this or any unit to ETS without first obtaining a Return Material Authorization number (RMA). Call 215-887-2196.**

The calibration of the system can be checked by following the procedure outlined in Section 3.2. If the installation warrants, the system can be sent back to ETS for periodic recalibration.

6.0 WARRANTY

Electro-Tech Systems, Inc. warrants its equipment, accessories and parts of its manufacture to be and remain free from defects in material and workmanship for a period of one (1) year from date of invoice. ETS will, at it's discretion, either replace or repair without charge, F.O.B. Glenside, similar equipment or a similar part to replace any equipment or part of its manufacture which, within the above stated time, is proved to have been defective at the time it was sold. All equipment claimed defective must be returned properly identified to the Seller (or presented to one of its agents for inspection). This warranty only applies to equipment operated in accordance with Seller's operating instructions.

Seller's warranty with respect to those parts of the equipment that are purchased from other manufacturers shall be subject only to that manufacturer's warranty.

The Seller's liability hereunder is expressly limited to repairing or replacing any parts of the equipment manufactured by the manufacturer and found to have been defective. The Seller shall not be liable for damage resulting or claimed to result from any cause whatsoever.

This warranty becomes null and void should the equipment, or any part thereof, be abused or modified by the customer of if used in any application other than that for which it was intended. This warranty to replace or repair is the only warranty, either expressed or implied or provided by law, and is in lieu of all other warranties. The Seller denies any other promise, guarantee, or warranty with respect to the equipment or accessories and, in particular, as to its or their suitability for the purposes of the buyer or its or their performance, either quantitatively or qualitatively or as to the products which it may produce. The buyer is expected to expressly waive rights to any warranty other than that stated herein.

ETS must be notified before any equipment is returned for repair. ETS will issue an RMA (Return Material Authorization) number for return of equipment.

Equipment should be shipped prepaid and insured in the original packaging. If the original packaging is not available, the equipment must be packed in a sufficiently large box (or boxes if applicable) of double wall construction with substantial packing around all sides. The RMA number, description of the problem along with the contact name and telephone number must be included in formal paperwork and enclosed with the instrument. Round trip freight and related charges are the owner's responsibility.

WARNING:

WOODEN CRATES MUST NOT BE USED. PACKAGING OF DELICATE INSTRUMENTS IN WOODEN CRATES SUBSTANTIALLY INCREASES THE CONTENT'S SUSCEPTIBILITY TO SHOCK DAMAGE. DO NOT PLACE INSTRUMENTS OR ACCESSORIES INSIDE OTHER INSTRUMENTS OR CHAMBERS. ELECTRO-TECH SYSTEMS, INC. WILL NOT ASSUME RESPONSIBILITY FOR ADDITIONAL COST OF REPAIR DUE TO DAMAGE INCURRED DURING SHIPMENT BECAUSE OF POOR PACKAGING.