Model 200L

Instruction Manual
Single Dilution Probe Controller
Part Number 10519
20Dec2007

CE

The 220V option complies with 89/336/EEC directive for electromagnetic compatibility.

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Thermo Fisher Scientific
Air Quality Instruments
27 Forge Parkway
Franklin, MA 02038
1-508-520-0430
www.thermo.com/aqi

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CHAPTER 1
INTRODUCTION

Thermo Environmental Instruments is pleased to provide the Model 200L Single Dilution Probe Controller. We are committed to the manufacture of instruments exhibiting high standards of quality, performance, and workmanship. TEI service and support personnel are available to provide assistance with any questions or problems that may arise in the use of this controller.

The Model 200L Single Dilution Probe Controller allows configurations for systems requiring the need for various dilutions. With an external source of high pressured air and calibration cylinders, the dilution controller provides the necessary means of delivering different dilution ratios in conjunction with one dilution probe. The controller is based on the engineering design and selection of complete components having complimentary specifications which result in a simple to operate, easy to adapt, high accuracy, and low maintenance.

PRINCIPLE OF OPERATION

The Model 200L Single Dilution Probe Controller is utilized in conjunction with various dilution probe configurations. The dilution probe provides the means of the actual dilution process. The dilution probe is where the actual dilution process occurs. The Model 200L Single Dilution Probe Controller is designed to measure stack effluents by mixing the exhaust gases with pressurized regulated zero air at a known dilution ratio. This method meets the requirements pertained in the E.P.A. CFR Title 40, Part 60. A critical orifice is affixed to the probe which draws the sample or span gas through to mix with the pressure being delivered from the instrument's controller unit. The critical orifice selection determines which dilution setting is necessary to meet the customer's requirements. Ratios of 50:1, 100:1, 150:1, and 200:1 are the most common used configurations for combustion or other various sample monitoring. The controller allows the user to set the dilution ratio according to the customer's dilution settings by means of measuring combustion emissions or other sample gases. A relay board is used to switch the flow streams for calibration gases. A front panel rotary switch is utilized in order to switch from calibration gas streams 1 through 5, manually or externally from a data acquisition system. The Model 200L Single Dilution Probe Controller provides for a variety of dilution system requirements

The dilution ratio is calculated to decrease the water moisture in the sample gas to a percent at which the water moisture remains suspended. The use of dry instrument air for dilution ratios in the order of 100:1 results in a sample that is 99 percent clean and dry zero air. This is an excellent sample for analyses with ambient air analyzers. High accuracy and freedom from interferences is assured.

SPECIFICATIONS

Operating temperature	5^{o} C to 45^{o} C
Power Requirements	115/230 Volts ±10%, single -phase, 50/60 Hz, 90 Watts
Remote Inputs	Ability to control zero, and 1 to 5 span ports.
Output Contacts	Zero, and up to 5 spans.
Physical Dimensions	17" W x 7" H x 23" D
Weight	29 lbs.

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CHAPTER 2
INSTALLATION

The installation of the Model 200L Single Dilution Probe Controller includes unpacking the controller, connecting conditioning lines to the controller, and initial installation.

LIFTING

A procedure appropriate to lifting a heavy object should be used when lifting the controller. This procedure consists of bending at the knees while keeping your back straight and upright. The controller should be grasped at the bottom, in the front and at the rear of the unit. Do not attempt to lift the controller by the cover or other external fittings. While one person may lift the unit, it is desirable to have two persons lifting, one by grasping the bottom in the front and the other by grasping the bottom in the rear.

UNPACKING

The Model 200L Single Dilution Probe Controller is shipped complete in one container. If, upon receipt of the controller, there is obvious damage to the shipping container, notify the carrier immediately and hold for inspection. The carrier, and not Thermo Environmental Instruments Inc., is responsible for any damage incurred during shipment. Follow the procedure below to unpack and inspect the controller.

1. Remove the controller from the shipping container and set on a table or bench that allows easy access to both the front (Figure 2-1) and rear (Figure 2-2) of the instrument.
2. Remove the controller cover to expose the internal components.
3. Remove any internal packing material.
4. Check for possible damage during shipment.
5. Check all connectors and printed circuit boards to see if they are firmly attached.
6. Re-install the controller cover.

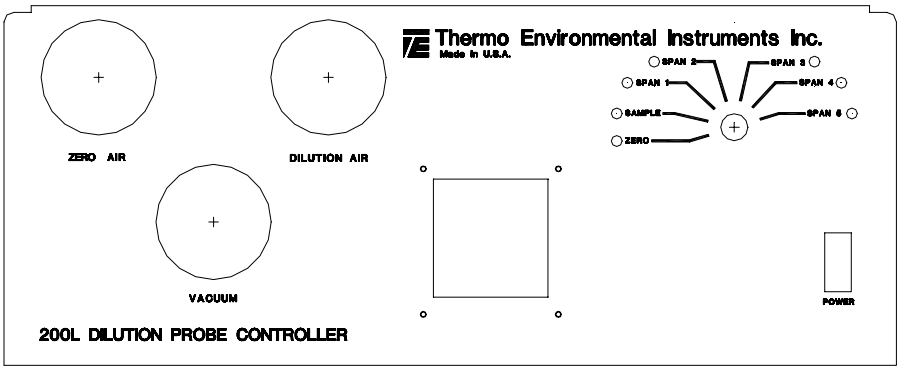

Figure 2-1. Model 200L Front Panel

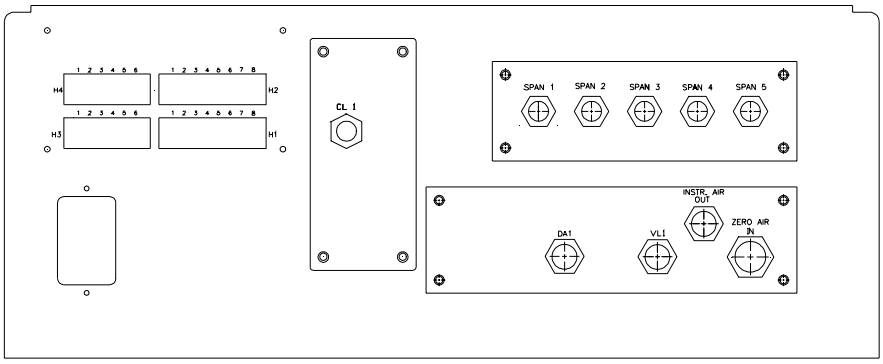

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Figure 2-2 Model 200L Single Rear Panel

INSTALLATION PROCEDURE

Before connecting any power or lines to the rear of the controller, refer to Figure 2-2 and to the system documentation, if supplied, for any details which may not be included in this manual. Check the Purchase Order packing slip to ensure that the unit was ordered for the right configuration. If any of the information is incorrect, contact the Sales Representative from which the unit was purchased or call a Sales Representative at Thermo Environmental Instruments at 508-520-0430. Information in the system's documentation will refer to more detailed wire connections and plumbing diagrams. System documentation will be issued if the unit is supplied as a component of a larger systems.

Before powering up of the Model 200L Single Dilution Probe Controller, make sure the proper transformer configuration is correct for the proper outlet. Identify the rear panel for appropriate outlet labeling. The transformer is marked accordingly to identify if the transformer is for 110 AC or 220 AC. The cover will need to be removed to identify the label on the transformer.

SYSTEM PLUMBING CONNECTIONS

Connecting the various lines to the rear panel of the Model 200L Single Dilution Probe Controller is illustrated in Figure 2-3. If the unit was purchased with a system, please refer to those appropriate documentation for proper connections. All tubing connected to the controller is ¼" Teflon® tubing. When the proper configuration complete and checked, the startup procedure can be performed.

STARTUP PROCEDURE

1. Connect the power cord to the rear of the unit and turn the power ON.
2. Check to make sure the power switch light is ON.
3. Monitor the indicator lights. Switch the selector switch from various positions to check if all the LEDs are turning ON properly.
4. While moving the switch, listen for the solenoid valves to click into position and observe that the appropriate LEDs turn ON in turn.

The Model 200L Single Dilution Probe Controller is now ready to be installed either in a rack assembly or for test bench purposes. With the unit placed in a secured location, the lines to the unit can be connected. Figure 2-3 illustrates a common connection to a rack system for a Model 200L Single Dilution Probe Controller. Four major plumbing connection lines, and the system plumbing configuration, are critical to the operation of the controller. The four major plumbing lines are Diluted Air (DA), Diluted Sample (DS), Vacuum Line (VL), and Calibration Line (CL).

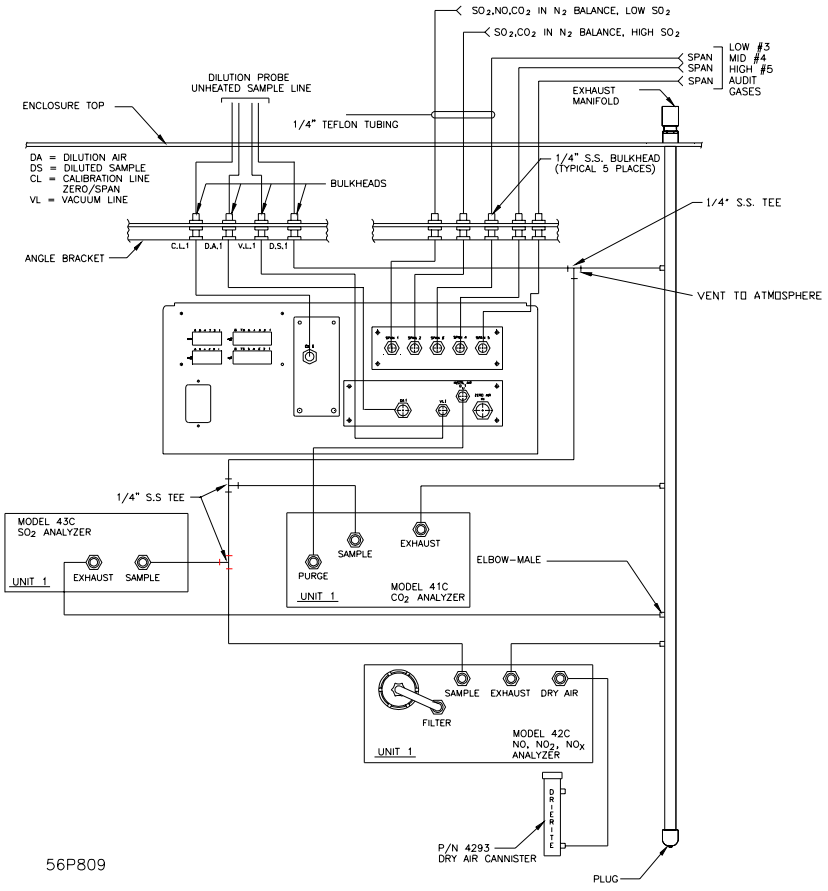


Figure 2-3. Typical Single Probe Controller System Line Connections

The connection lines from the dilution controller to the dilution sample probe should be properly labeled and connected to the correct port fitting. A pressure of 60 to 80 psig of clean zero air is supplied to the high pressure air inlet port. The air inlet is then reduced to approximately 40 psig by a dilution air regulator. The desired dilution ratio is determined after reviewing the application data. This dilution air is delivered to the sample probe. A high performance venturi in the probe provides the vacuum that draws the sample through the critical orifice. This sample is mixed with the dilution air and transported through the sample transport bundle to the selected instruments for analysis. Figure 2-4 shows the stack probe installation and connection details.

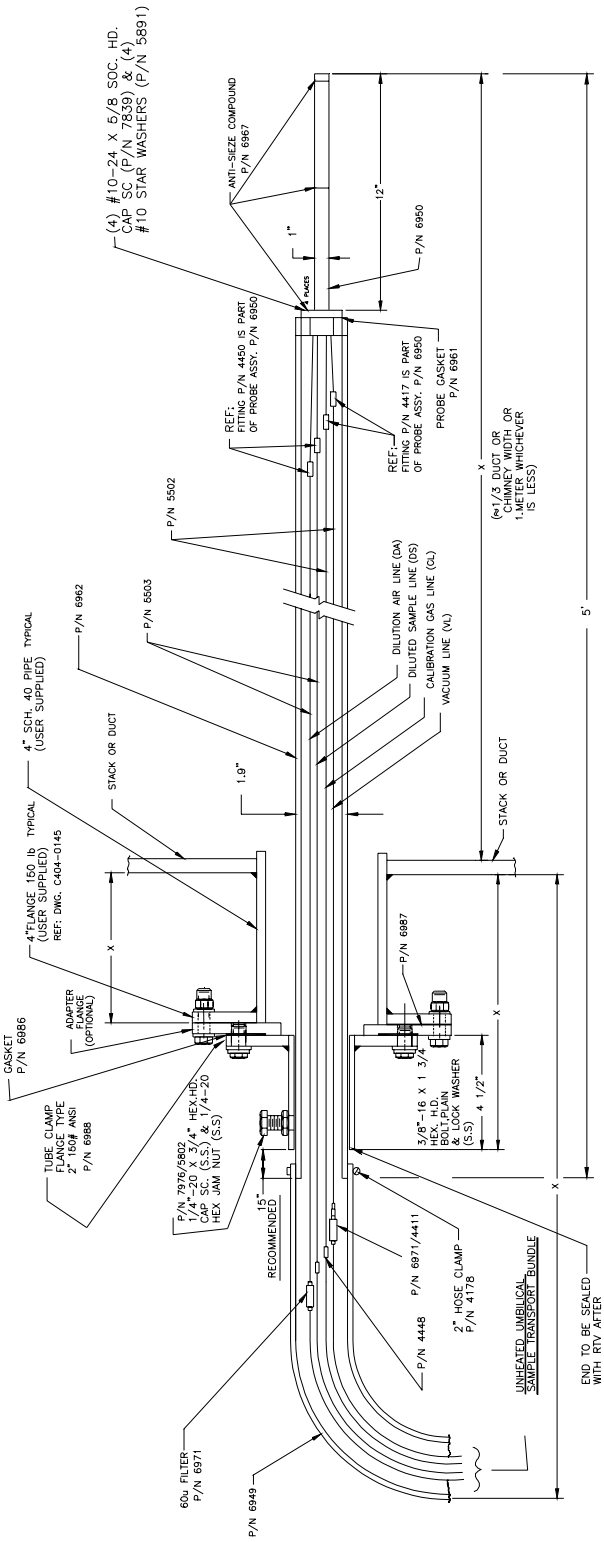


Figure 2-4. Dilution Probe

The sonic orifice uses a quartz wool to prevent sample particulates to enter the critical flow passage. The quartz wool acts as a particulate filter (Figure 2-5). The quartz wool is periodically changed every three months for continuous monitoring. The quartz wool is placed into the end of the orifice against a glass frit. The glass critical orifice is attached to the dilution nozzle/heat exchanger section with a graphite ferrule and nut. The mantel section is carefully threaded onto the dilution nozzle/heat exchanger.

CAUTION: This is a very fine threaded section and requires anti-seize compound on the threads since this section will be located in the zone of the source. Also, caution should be observed when unthreading this unit to prevent breaking the glass critical orifice.

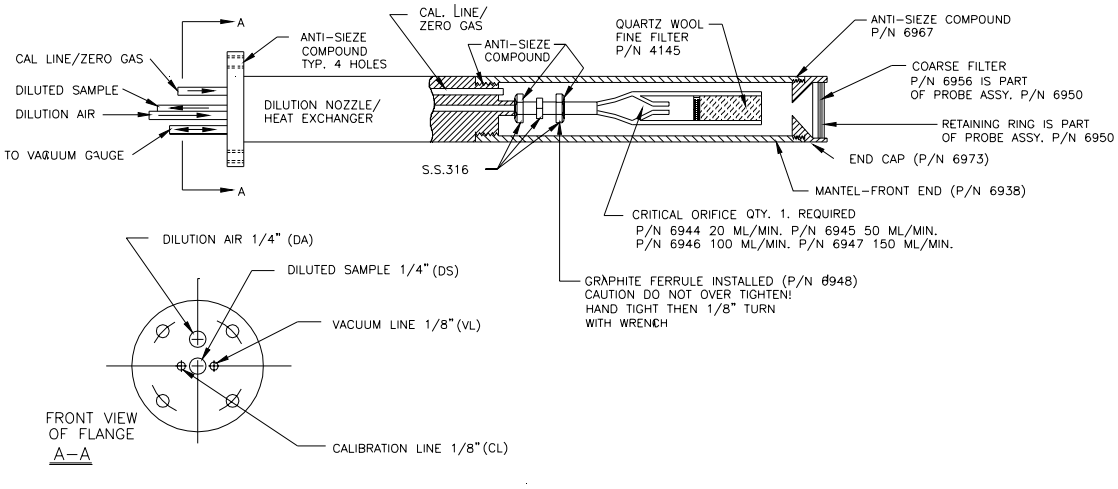


Figure 2-5. Sonic Orifice Assembly

CHAPTER 3
OPERATION

In order to fully understand the operation of the Model 200L Single Dilution Probe Controller, a general knowledge of the electronics, flow, and subassemblies is recommended. A better understanding of the components themselves will allow the user to correctly change parts or subassemblies more efficiently.

ELECTRONICS

The relay and switch boards are the primary active electronic circuit boards mounted in the controller unit. A DC voltage of +24 is utilized from the relay board to activate the solenoid valves. The position of the rotary switch on the front panel determines which solenoid valve or valves are activated in order to allow air or gas flow through the Model 200L Single Dilution Probe Controller. The rear terminal board delivers dry contact status output which can be connected to a data acquisition unit. The controller can be activated remotely by a data acquisition unit or by solid state relay configurations.

RELAY BOARD

The relay board supplies +24 Volts to the solenoid valves, depending upon the position of the switch. The relay board is part of the regulator-relay board assembly (Figure 3-1). Three ribbon cables are attached to the relay board. One of the cable assemblies is connected to the switch board assembly and the other two are connected to the rear terminal board. The relay board controls the position of the valves and provides solid state contacts to the rear connector board. The voltage from the transformer delivers approximately +20 Volts AC, which is than converted to +24 Volts DC by four diodes (see appendix B for relay board schematic for details). The +24 Volts DC goes through the relay board and is delivered to the Switch Board Assembly. The switch from the switch board assembly directs the +24 Volts DC to the appropriate solid state relay. A ¼ amp fuse is used for safety prevention of surge current while the unit is in the sample mode.

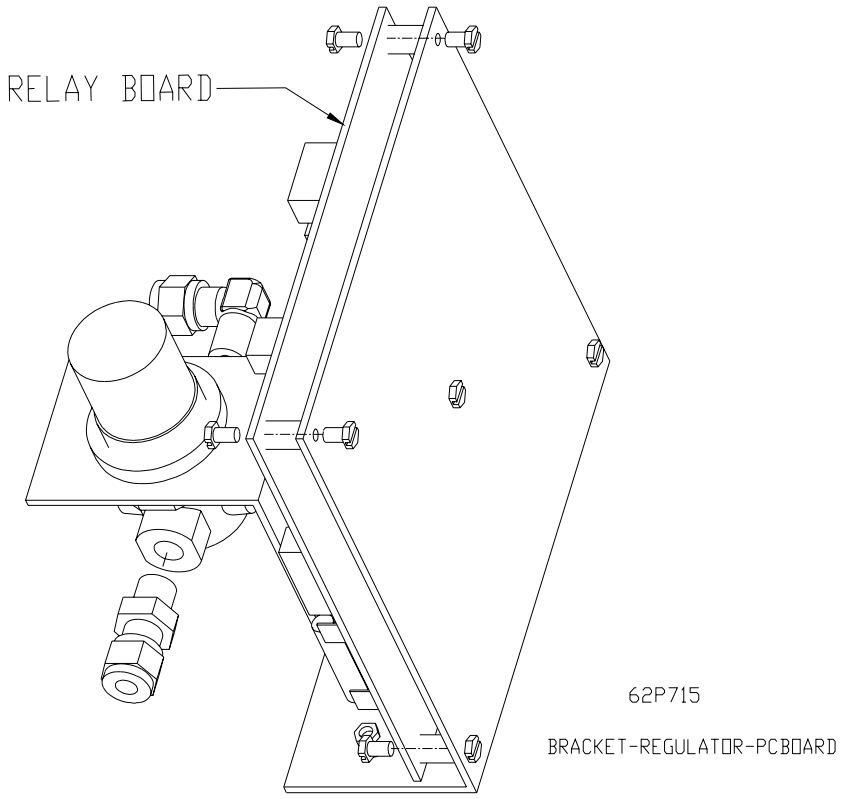


Figure 3-1. Relay Board Assembly

SWITCH BOARD

A rotary switch allows the path for the +24 Volts DC to the solid state relays from the relay board Assembly. The rotary switch, behind the switch board assembly shown in Figure 3-2, uses two adjustable locking washers to select from zero, sample, and 5 span valves.

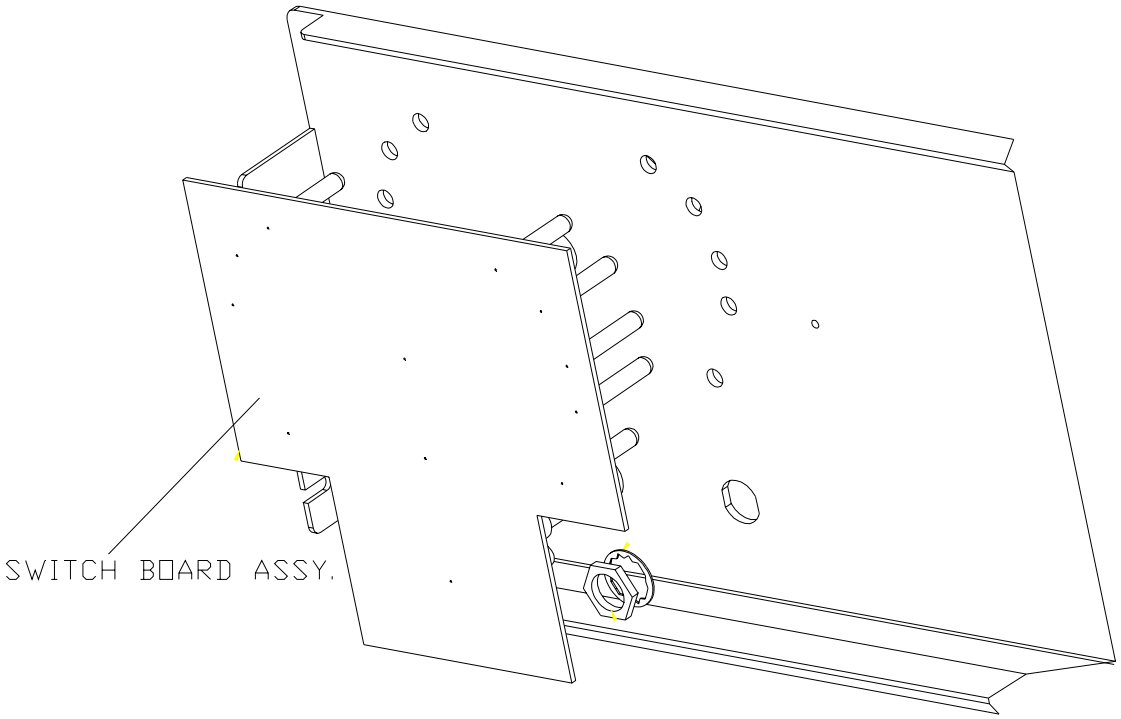


Figure 3-2. Switch Board Assembly

REAR TERMINAL BOARD

The rear terminal board provides the necessary means to deliver status contact for zero, sample, and 5 span valves (Figure 3-3). A constant +24 Volts DC is present from the Rear Terminal Board for remote activation from a data acquisition system or relay contact configurations. In order to activate for zero, or the 5 span valves, +24 Volts DC is delivered to the appropriate terminal connection from a dry contact closed state. All valves are in the de-energized state, with both lines to the solenoid valve at a zero volt potential.

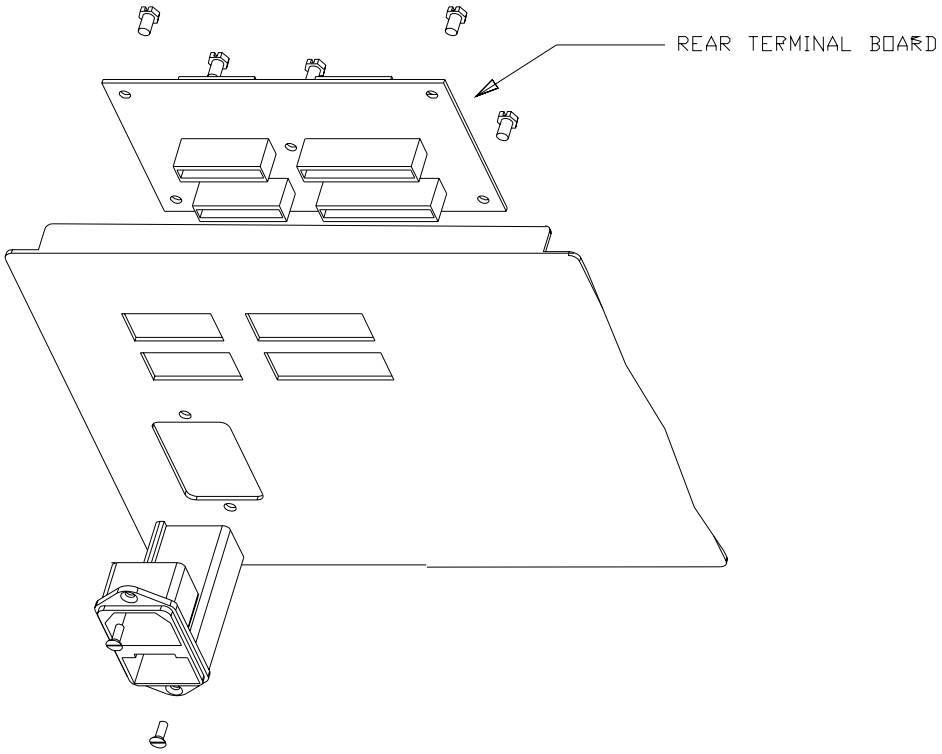
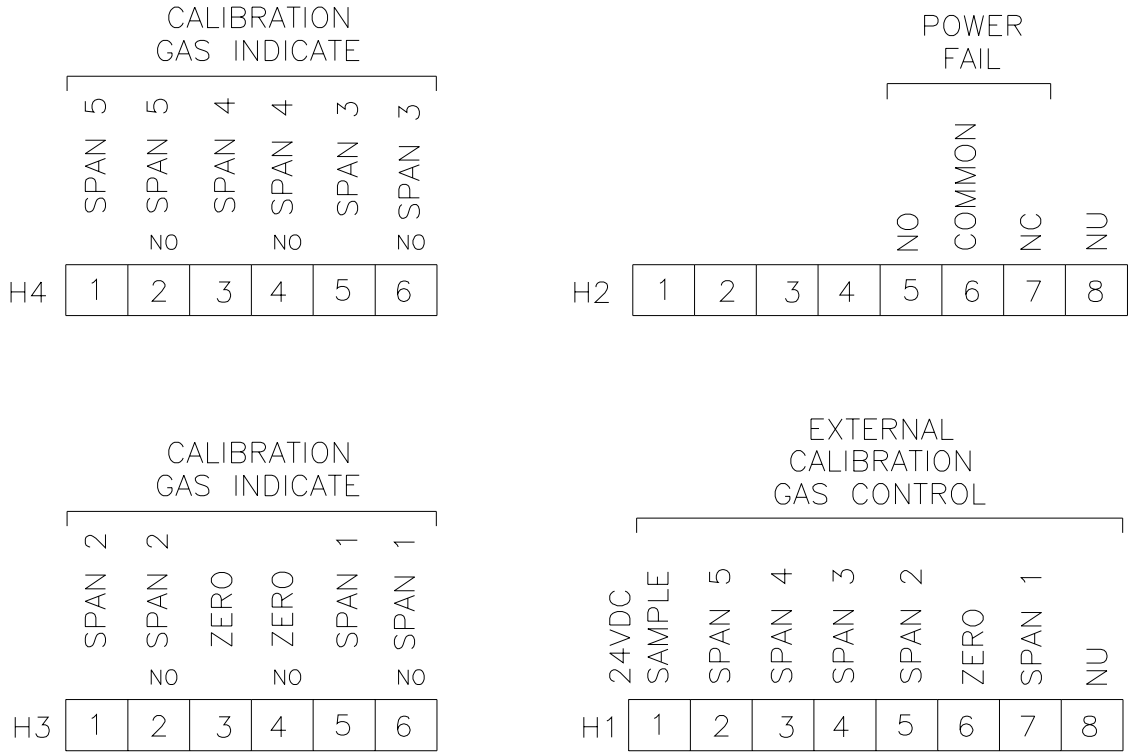


Figure 3-3. Rear Terminal Board

Two ribbon cables are connected from the rear terminal board to the relay board assembly. J9 from the relay board provides the status contacts for zero air and one to five span gas valves. The connections for the status and remote activation are illustrated in Figure 3-4



* NU = Not Used.
* NO = Normally Open.
* NC = Normally Closed

Figure 3-4. Rear Terminal Status and Remote Activation

GAUGES

Three gauges are affixed to the front panel of the Model 200L Single Dilution Probe Controller. These are vacuum, dilution air, and zero air (Figure 3-5). The dilution air gauge should read from 30 to 45 psig with a dilution orifice setting of 100:1. A leak check should be performed if this pressure is below 30 psig,. The vacuum gauge should read from 17 to 22 inches Hg at sea level. The zero air gauge should be set to 20 psig. Refer to the troubleshooting section for leak checking the instrument. The vacuum gauge corresponds to the setting of the high pressure air adjustment for the selection of the dilution orifice.

The span/zero rotometer, shown in Figure 2-1, should read 2.5 SCFH to indicated excess flow of calibration gasses to the monitoring system.

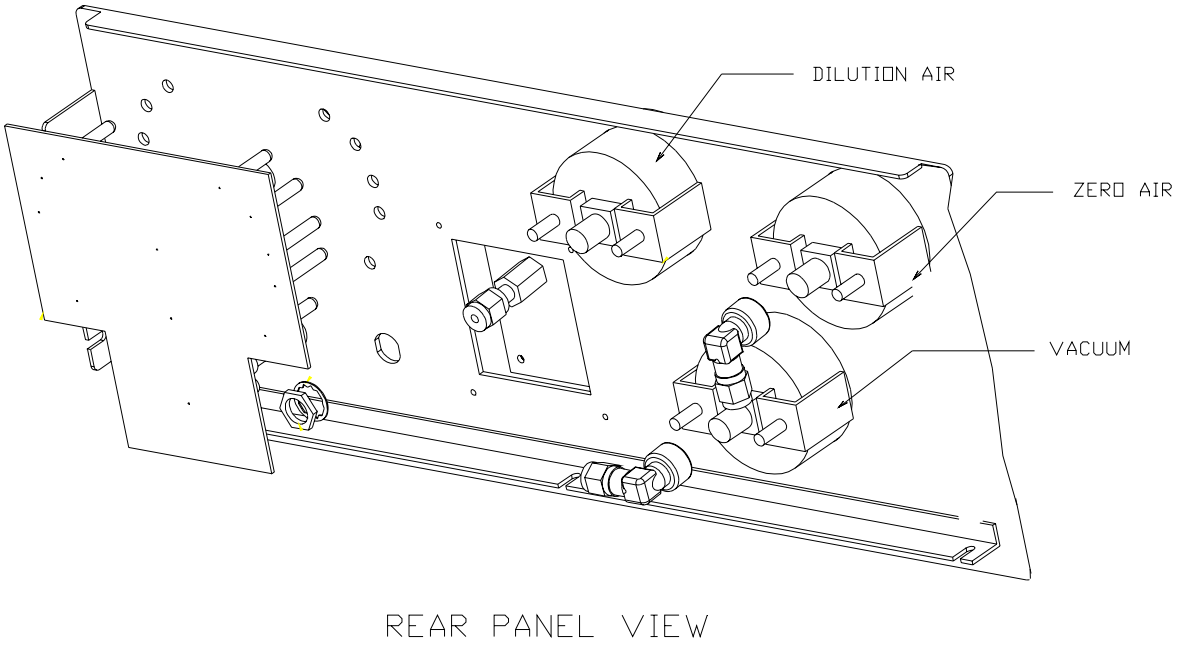


Figure 3-5. Gauge Locations

FLOW DESCRIPTION

Flow path of the air and gas streams are the primary function of the Model 200L Single Dilution Probe Controller. The controller is utilized in conjunction with one dilution probe. The configuration will be determined by site application and the customer's request or requirements. Figure 3-6 is a flow diagram.

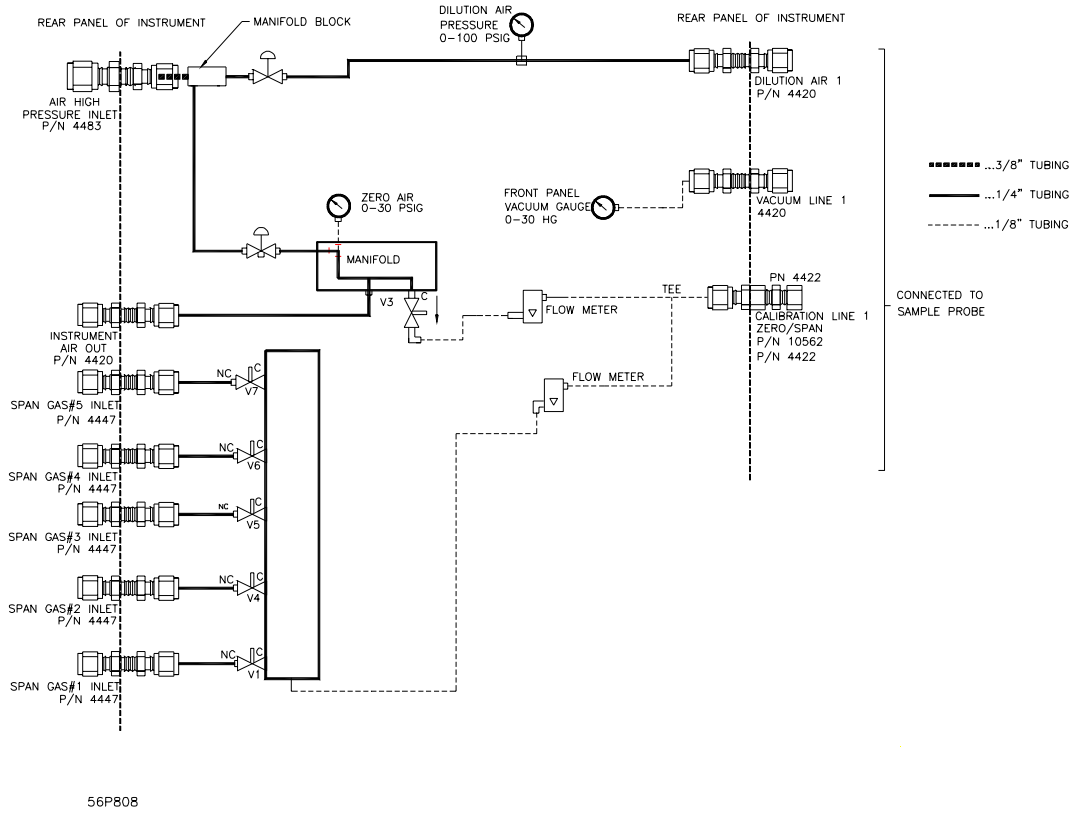
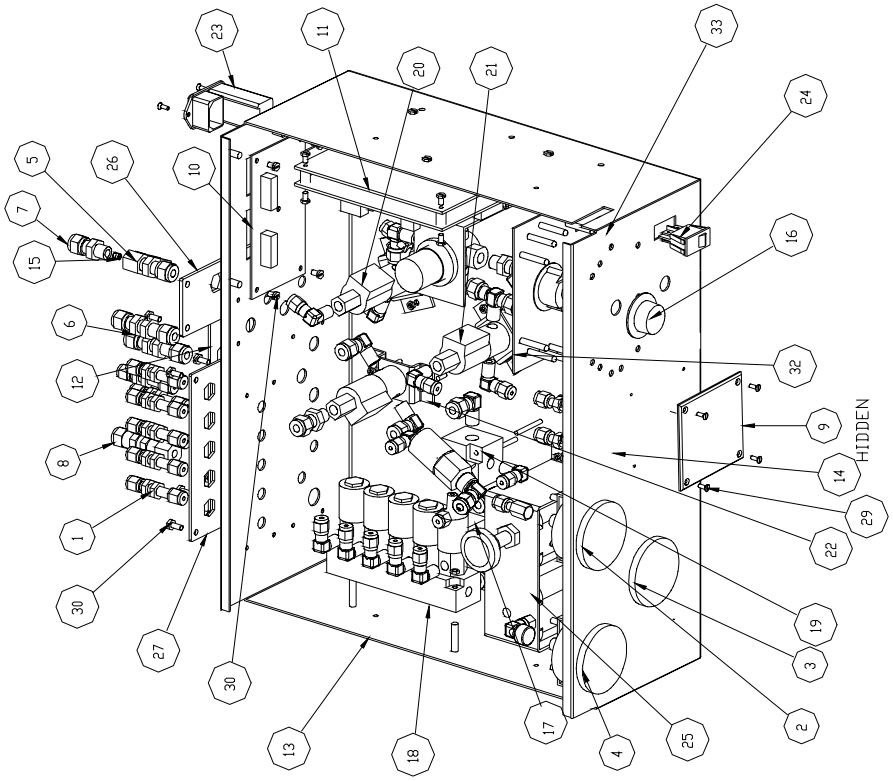


Figure 3-6. Plumbing Diagram

The flow diagram illustrates a standard single configuration. Some controllers may not follow the standard configuration, depending upon customer requirements. If this is the case, refer to the system documentation or attached addendum.

SUBASSEMBLIES

The subassemblies shown in Figure 3-7 are available from Thermo Environmental Spare Parts Department. The subassemblies allow the customer to replace inoperable parts and troubleshoot efficiently.



NO.	DESCRIPTION	DWG. NO.	P/N	QTY.
1	1/4-BULKHEAD		4447	15
2	100-PSI-GAUGE-ASSY		6963	1
3	30-IN-HG-VACUUM-GAUGE-ASSY		4546	1
4	30-PSI-GAUGE-ASSY		8105	1
5	4BCF2-BULKHEAD-MACHINED		10562	1
6	4BU-BULKHEAD BRASS		4420	3
7	4CM2-CONNECTOR		4422	1
8	6BU-BULKHEAD S.S		4483	1
9	BEZEL-FLOWMETER		8574	1
10	BOARD-REAR-PANEL ASSY		14670	1
11	BRACKET-REGULATOR-PCBOARD	C62P715		1
12	BULKHEAD-RETAINER		10517	1
13	CASE-BOTTOM-200-NEWDESIGN	D62P612		1
14	FLOWMETER-DWYER ASSY	C62P717	10574	1
15	FRIT-200		10539	1
16	KNOB		4708	1
17	MANIFOLD-HIGH-PRESSURE-AIR ASSY	C62P720	10512	1
18	MANIFOLD-VALVE ASSY	C62P718	10521	1
19	MANIFOLD-ZERO-AIR ASSY	C56P716		1
20	NO-12-VALVE-ASSY	C62P723	10575	1
21	NO-13-VALVE-ASSY	C62P724	10576	1
22	NO-8-VALVE-ASSY	C62P721	10525	1
23	POWER-RECEPTICAL		11289	1
24	POWER-SWITCH		12118	1
25	REGULATOR ASSY	C62P716	10510	1
26	RETAINER-BULKHEAD	B62P615	10518	1
27	RETAINER-BULKHEAD-MANIFOLD	B62P622	10517	1
28				
29	SCREW-440-25-FLAT		7860	6
30	SCREW-SEMS-632--25		8457	16
32	SWITCH-BOARD ASSY DUAL		14674	1
32	SWITCH-BOARD ASSY. SINGLE		14669	1
33	TRANSFORMER-200 110VAC		10535	1
34				

Figure 3-7. Case Bottom Assembly Layout

CHAPTER 4
CALIBRATION

This chapter describes the procedure for performing the multipoint calibration with the Model 200L Single Dilution Probe Controller using the Model 42C and NO as an example. Although the Model 42C is used in this example, a variety of instruments can be used to check the performance of the Model 200L Single Dilution Probe Controller. The instrument used for the performance test should be calibrated prior to setting up with the Model 200L Single Dilution Probe Controller.

Before any calibration, the line connections between the Model 200L Single Dilution Probe Controller and the sonic orifice probe should be properly connected and verified. Refer to figure 3-6 for a typical single probe controller connected to a sonic orifice probe.

A cylinder of NO in nitrogen (N_2) containing an appropriate concentration (80 percent of system full scale range) of NO. The assay of the cylinder should be traceable either to a National Institute of Standards and Technology (NIST) NO in Air Standard Reference Material (SRM) or an NIST/EPA approved gas manufacturer's Certified Reference Material (CRM). A recommended protocol for certifying NO gas cylinders against a NO, SRM or CRM is given in the Quality Assurance Handbook. The NO gas cylinder should be recertified on a regular basis determined by the local quality control program.

DILUTION PROBE

There are four lines to the dilution probe. The lines are dilution air, calibration line, diluted sample, and vacuum line. The dilution air line delivers high pressure zero air to the probe. The probe utilizes this pressurized air for diluting with the sample. The calibration line is used to deliver either zero air or span gas to the probe. The dilution controller selects the zero air or the span gas that flows through the calibration line to the probe.

PROBE TECHNIQUE

Dilution probe technology may be generically defined as a sampling technique whereby a small continuous sample is filtered and diluted at stack temperature prior to transport to a set of analyzers. A preferred way to do this is with an in-stack venturi, in which preheated instrument air extracts the sample, dilutes it, and transports it under pressure to the remote analyzers.

Potential advantages of the technique, as contrasted to more conventional extractive systems include:

1. Long filter life due to a low sampling rate.

2. Elimination of heated probe and sample lines by lowering the dew point below the coldest expected ambient temperature.

3. Elimination of all valving and electric utilities at the probe location.

4. Fail-safe sampling whereby analyzers are intrinsically protected from any condensates.

5. All parts of the systems can be checked using calibration gases.

6. Conventional ambient-level analyzers (which may already be in use at the site) are used, reducing training time for operators.

DILUTION CALCULATIONS

Calculations are performed in conjunction with a gas analyzer or rack of no more than five analyzers. It is important that the information pertaining to the critical orifice used in the dilution probe is accurate. If the orifice in the dilution probe is in question, the probe should be inspected to determine the sonic orifice that is in use. Refer to Table 4-1 for specific data for the size of the critical orifice.

Table 4-1. Pyrex Critical Orifice Sizes

Orifice Size	Nominal Dilution Ratio	P/N
20 mil/min	200:1	6944
50 mil/min	100:1	6945
100 mil/min	50:1	6946
150 mil/min	20:1	6947

After the appropriate critical orifice is determined, the adjustment for the Model 200L Single Dilution Probe Controller can be made.

Connect the analyzer unit to the diluted sample from the probe. Be sure that the gas is vented to the atmosphere. If the gas bottle is connected to the Span 1 port, turn the selector switch to the Span 1 position. Adjust the dilution air pressure to 40.0 psig. If a dilution ratio of 100:1 has been selected, the concentration of the diluted sample can be determined. Take the concentration value of the bottle and divide it by the ratio. For example, if the value of the bottle for NO is 500 PPM, the reading on the instrument should be 5 ppm (i.e., the concentration should be between 4.80 to 5.20 ppm) before adjusting the instrument calibration. If the reading is not within 4 percent of this value, the dilution air pressure needs to be adjusted for the appropriate value.

The dilution air is adjusted to mix the right amount of air with the gas in order to achieve the correct dilution ratio. Adjusting the dilution air regulator clockwise will introduce more air to the probe, thus increasing the dilution ratio. Adjusting the dilution air regulator counter-clockwise will reduce the amount of air introduced to the probe, thus decreasing the dilution ratio. Before adjusting the dilution air regulator, wait for the flow of the air and gas to settle to a stable reading. This will take approximately 5 minutes, but it can take longer with sample line lengths over 200 feet (61 meters). The dilution ratio may swing in either direction from the previous adjustment before actually stabilizing. Care should be taken when adjusting the dilution air regulator. It is better to adjust the dilution air regulator a little rather than in quarter-turns increments, especially if the readings are near the expected value. Once the right amount of dilution air to the probe has been achieved, the dilution air regulator should be fixed by tightening the locking nut of the dilution air regulator to keep vibrations from changing the adjustment. The controller should not have to be readjusted unless a different sonic orifice is used in place of the original, or when routine maintenance has been performed on the sample probe.

CHAPTER 5

PREVENTIVE MAINTENANCE

This chapter describes the periodic maintenance procedures that should be performed on the Model 200L Single Dilution Probe Controller to ensure proper, uninterrupted operation. For example, the precision orifices and gauges should be checked. This chapter also explains how to replace the Model 200L Single Dilution Probe Controller subassemblies. It is recommended that the individual be familiar with the subassemblies before attempting to disassemble or repair the controller unit.

SAFETY PRECAUTIONS

Some internal components may be damaged by the discharge of static electricity. To avoid damaging internal components, follow these precautions when performing any service procedure:

- Wear an antistatic wrist strap that is properly connected to earth ground (note that when the analyzer is unplugged, the chassis is not at earth ground).
- If an antistatic wrist strap is not available, be sure to touch a grounded metal object before touching any internal components.
- Carefully observe the instructions in each procedure.
- Remove the power cord from the unit when any of the assemblies are replaced.

REPLACEMENT PARTS LIST

It is recommended that the spare parts in Table 5-1 be kept on-site for quick repair in case of unexpected failures. Refer to Figure 3-7 to identify their locations.

Table 5-1. Replacement Parts

P/N	Description	Quantity
10546	Span Solenoid Valve	5
10539	Precision Orifice	1
6984	Dilution Air Regulator	1
4546	Vacuum Gauge 30 in of HG	1
8105	Pressure Gauge 30 psig	1
4495	Flow Meter 2.5 LPM	2
7368	Solenoid valve, 24volt, 3-Way	1
7916	Fuse, ¼ amp, slo blo	1
4511	Fuse, 1 amp, 100 volt, slo blo	2
11912	Fuse, ½ amp, 250 volt (220 option)	2

RELAY BOARD REPLACEMENT (Figure 3-1)

Equipment required:
- New Relay Board Assy. (Part No. 14672)
- Nut Driver or Adjustable Wrench
- Flat Tip Screwdriver

Slide the unit from the rack cabinet, so the cover can be taken off. Remove the four screws that hold the cover above the unit. The relay board and switch board assemblies are now accessible. Remove the unit and locate the relay board assembly. Remove the two screws holding down the relay board bracket. Remove any cables, connectors. and lines that will prevent the bracket from moving. Remove the fitting lines to the regulator. Once the assembly is removed from the case, the five screws can be removed from the relay board. Replace the relay board with a new board and secure this board with the five screws that held the old relay board. Install the assembly by reversing the order in which it was removed. Connect the appropriate connectors to the numbered locations on the relay board. Apply power to the unit and make sure the relay board is working properly by switching all the selection points.

SWITCH BOARD REPLACEMENT (Figure 3-2)

Equipment required:
- New Switch Board Assy. (Part No.14669)
- Nut Driver or Adjustable Wrench
- Flat Tip Screwdriver

Slide the unit from the rack cabinet, and remove the cover so that the switch board assemblies are accessible. Remove the four screws that hold the cover above the unit. Remove the unit and locate the switch board assembly. Remove the selector knob from the front of the unit by removing the two Allen set screws. With an adjustable wrench, remove the nut from the switch. Remove the screw that holds the bottom of the switch board assembly from the inside of the controller unit. Remove any connector or wiring to the switch board, and then remove the assembly from the case. Replace the assembly in the reverse order from which it was taken out. Reconnect any cables and wiring to the switch board. Apply power to the unit and make sure the switch board is working properly by switching all the selection points.

PRECISION ORIFICE CHECK

The precision orifice allows a certain amount of flow for the zero and span gas to the dilution probe. The flow must be enough for the critical orifice to draw from while providing a reasonable lag time through the sample line.

SPAN SOLENOID VALVE CHECK

The valves can be checked by using air flow applied to the common port of the valve. Use the plumbing diagram associated with the type of controller supplied with the instrument. Figure 5-1 shows the components of the span valve manifold assembly.

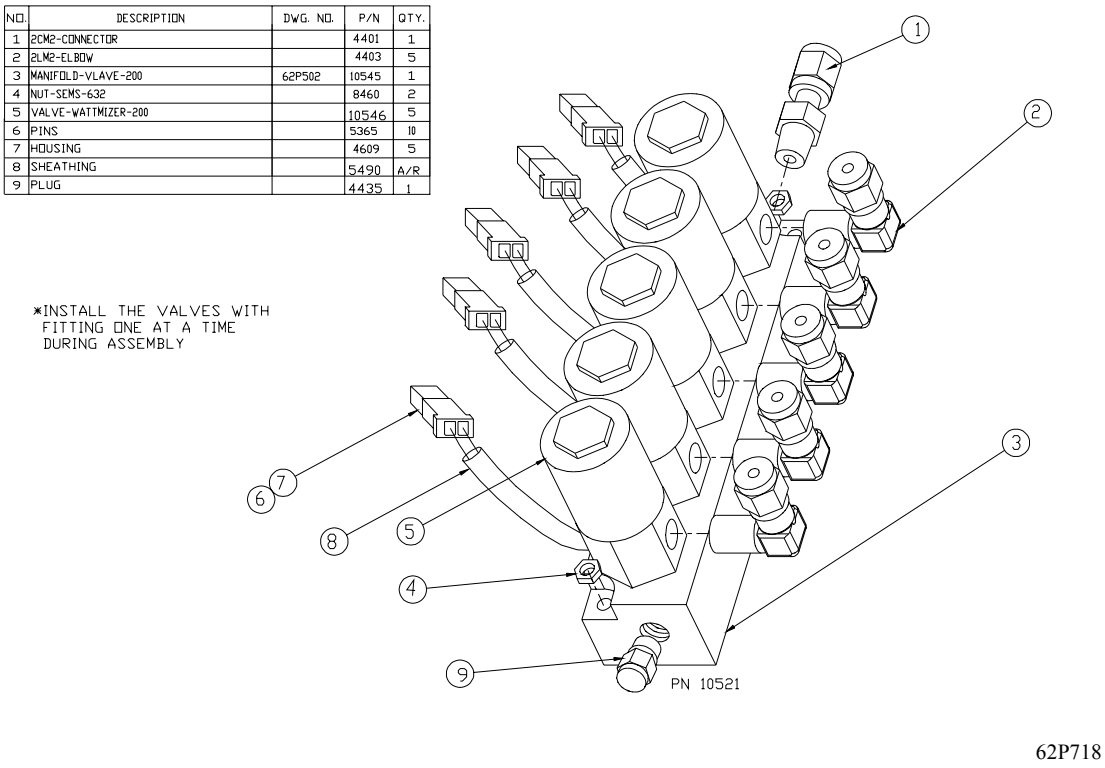


Figure 5-1. Span Valve Manifold Assembly

FLOW LEAK CHECKING

This procedure enables the user to thoroughly check the controller for leaks. Leak checking should only be conducted if the Model 200L Single Dilution Probe Controller is suspected of performance calibration errors. Leak checking the controller ensures that the unit does not produce erroneous readings on the gas analyzer. A leak check is performed at the factory to ensure the proper operations before shipping to the customer.

Leak check the lines to the dilution probe (see Figure 2-5) before checking for leaks in the controller. This is done by disconnecting the umbilical line between the controller and the dilution probe, and attaching a pressure gauge to the end of the line that was attached to the probe. Connect a shut off valve and pressure gauge to the end of the line, which was connected to the controller. Apply approximately 50 psig of pressure through the line, and then shut off the valve to keep the pressure suspended in the line. Wait for about two minutes and monitor the pressure reading to see if it drops. If the valve was shut off at 50 psig and stays at 48 psig for two minutes, the line has no leaks. If the pressure drops below 48 psig and continues to fall, the line either needs to be replaced or the fittings are not tight. All four lines to the probe should be checked in this matter before checking the controller for leaks.

Leak checking the controller requires zero air and a bottle of leak detection solution. Cap off any potential ports, which will allow pressurized air to escape, for example the instrument air out. Pressurize the unit with 50 psig and monitor for any leaks with the leak detection solution at all the fittings (the dilution air regulator has a bleeder valve, so an air flow sound is normal). If the leak detection solution bubbles at any fittings points, reconnect or replace the fitting. Once the Model 200L Single Dilution Probe Controller is leak checked, the controller can be put back into service.

SERVICE LOCATIONS

For additional assistance, Environmental Instruments Division has service available from exclusive distributors worldwide. Contact one of the phone numbers below for product support and technical information.

866-282-0430 Toll Free
508-520-0430 International

CHAPTER 6

TROUBLESHOOTING

The Model 200L Single Dilution Probe Controller has been designed to achieve a high level of reliability. Only premium components are used, thus complete failure is rare. In the event of problems or failure, the troubleshooting guidelines presented in this chapter should be helpful in isolating the fault(s). The Service Department at Thermo Environmental can be consulted in the event of problems at (508) 520-0430. In any correspondence with the factory, please note the serial number of the controller unit.

CAUTION: Some internal components can be damaged by small amounts of static electricity. A properly grounded antistatic wrist strap must be worn while handling any internal component.

TROUBLESHOOTING GUIDE

MALFUNCTION	POSSIBLE CAUSE	ACTION
Does not start up	No power	Check that the unit is plugged into the power source (115 or 220 VAC)
		Check unit fuse
	Power supply	Check that the voltage from the transformer is approximately 20 AC.
	Electronics defective	Check that all boards and connectors are seated properly
		Isolate and replace the assembly board that is not working correctly

MALFUNCTION	POSSIBLE CAUSE	ACTION
Fails calibration due to external components	Concentration bottles are listed incorrectly	Replace the bottles
	Zero air system	Check plant instrument air or compressor system
	Solenoid valves are not switching	Replace the valves
Valve will not switch	Isolate If it is the Relay board Assy. or Switch Board Assy.	Replace the defective Board Assembly

Appendix A
Warranty

Seller warrants that the Products will operate or perform substantially in conformance with Seller's published specifications and be free from defects in material and workmanship, when subjected to normal, proper and intended usage by properly trained personnel, for the period of time set forth in the product documentation, published specifications or package inserts. If a period of time is not specified in Seller's product documentation, published specifications or package inserts, the warranty period shall be one (1) year from the date of shipment to Buyer for equipment and ninety (90) days for all other products (the "Warranty Period"). Seller agrees during the Warranty Period, to repair or replace, at Seller's option, defective Products so as to cause the same to operate in substantial conformance with said published specifications; provided that (a) Buyer shall promptly notify Seller in writing upon the discovery of any defect, which notice shall include the product model and serial number (if applicable) and details of the warranty claim; (b) after Seller's review, Seller will provide Buyer with service data and/or a Return Material Authorization ("RMA"), which may include biohazard decontamination procedures and other product-specific handling instructions; and (c) then, if applicable, Buyer may return the defective Products to Seller with all costs prepaid by Buyer. Replacement parts may be new or refurbished, at the election of Seller. All replaced parts shall become the property of Seller. Shipment to Buyer of repaired or replacement Products shall be made in accordance with the Delivery provisions of the Seller's Terms and Conditions of Sale. Consumables, including but not limited to lamps, fuses, batteries, bulbs and other such expendable items, are expressly excluded from the warranty under this warranty.

Notwithstanding the foregoing, Products supplied by Seller that are obtained by Seller from an original manufacturer or third party supplier are not warranted by Seller, but Seller agrees to assign to Buyer any warranty rights in such Product that Seller may have from the original manufacturer or third party supplier, to the extent such assignment is allowed by such original manufacturer or third party supplier.

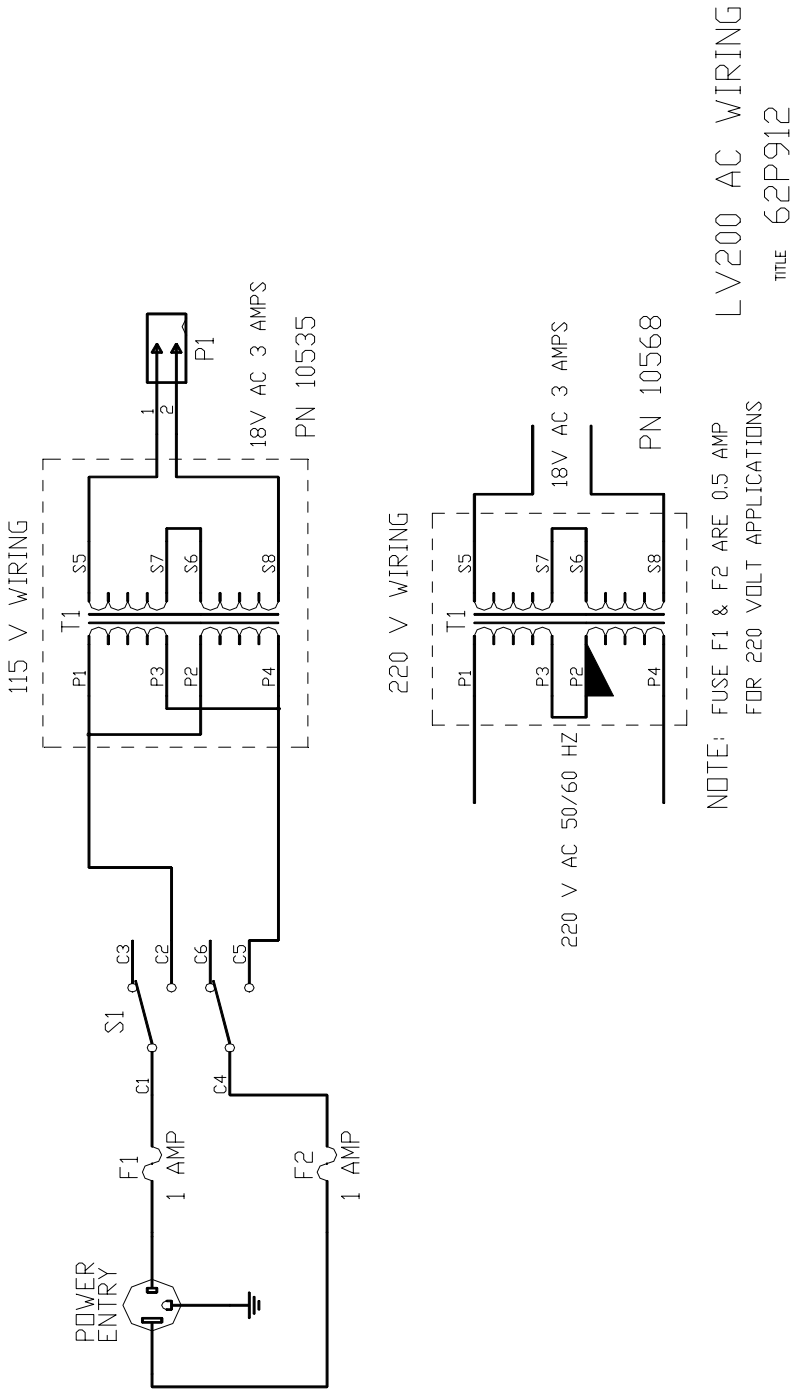
In no event shall Seller have any obligation to make repairs, replacements or corrections required, in whole or in part, as the result of (i) normal wear and tear, (ii) accident, disaster or event of force majeure, (iii) misuse, fault or negligence of or by Buyer, (iv) use of the Products in a manner for which

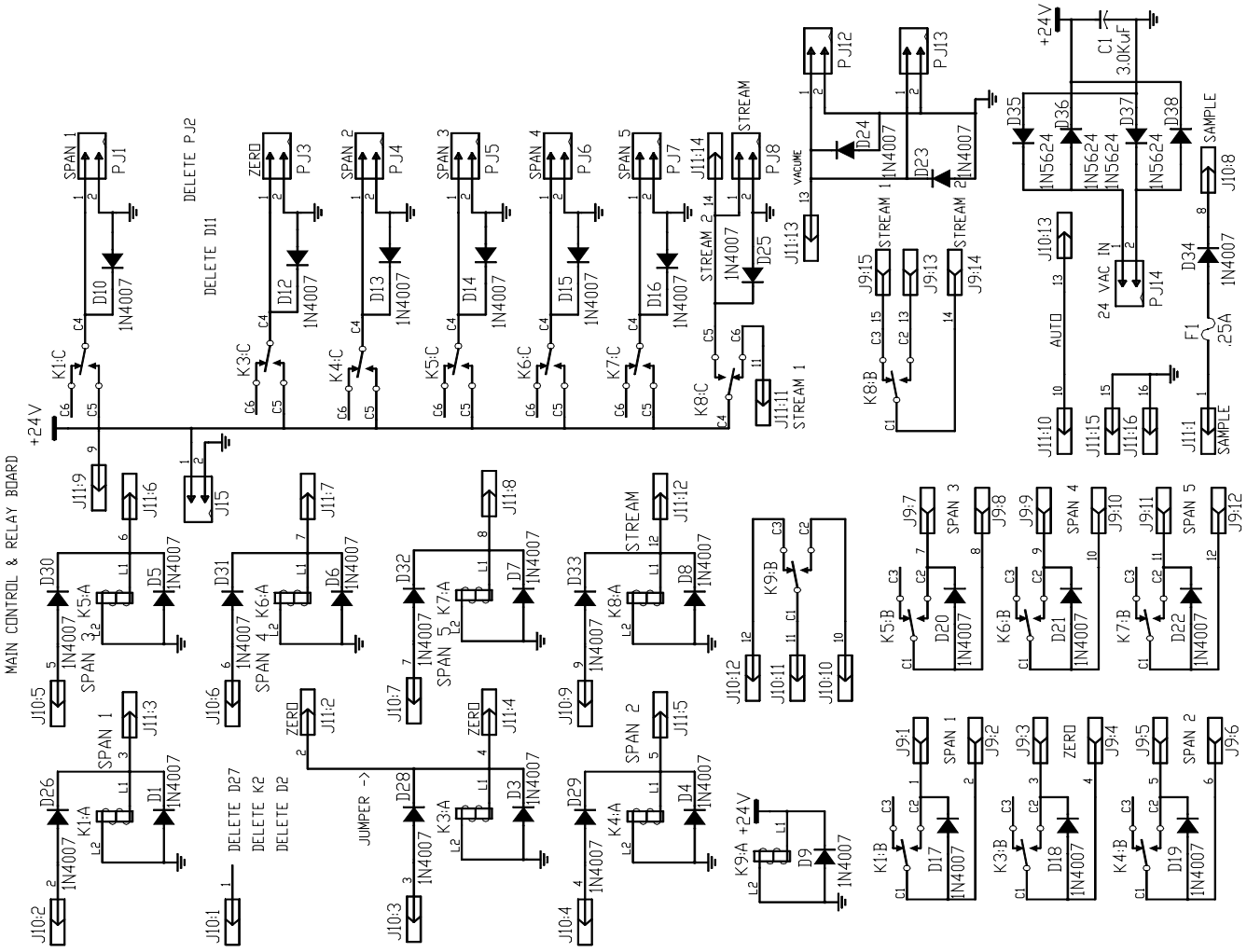
they were not designed, (v) causes external to the Products such as, but not limited to, power failure or electrical power surges, (vi) improper storage and handling of the Products or (vii) use of the Products in combination with equipment or software not supplied by Seller. If Seller determines that Products for which Buyer has requested warranty services are not covered by the warranty hereunder, Buyer shall pay or reimburse Seller for all costs of investigating and responding to such request at Seller's then prevailing time and materials rates. If Seller provides repair services or replacement parts that are not covered by the warranty provided in this warranty, Buyer shall pay Seller therefor at Seller's then prevailing time and materials rates. ANY INSTALLATION, MAINTENANCE, REPAIR, SERVICE, RELOCATION OR ALTERATION TO OR OF, OR OTHER TAMPERING WITH, THE PRODUCTS PERFORMED BY ANY PERSON OR ENTITY OTHER THAN SELLER WITHOUT SELLER'S PRIOR WRITTEN APPROVAL, OR ANY USE OF REPLACEMENT PARTS NOT SUPPLIED BY SELLER, SHALL IMMEDIATELY VOID AND CANCEL ALL WARRANTIES WITH RESPECT TO THE AFFECTED PRODUCTS.

THE OBLIGATIONS CREATED BY THIS WARRANTY STATEMENT TO REPAIR OR REPLACE A DEFECTIVE PRODUCT SHALL BE THE SOLE REMEDY OF BUYER IN THE EVENT OF A DEFECTIVE PRODUCT. EXCEPT AS EXPRESSLY PROVIDED IN THIS WARRANTY STATEMENT, SELLER DISCLAIMS ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, ORAL OR WRITTEN, WITH RESPECT TO THE PRODUCTS, INCLUDING WITHOUT LIMITATION ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE PRODUCTS ARE ERROR-FREE OR WILL ACCOMPLISH ANY PARTICULAR RESULT.

APPENDIX B

SCHEMATICS

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DELETE D11
DELETE D27
DELETE K2
DELETE D2
JUMPER ->
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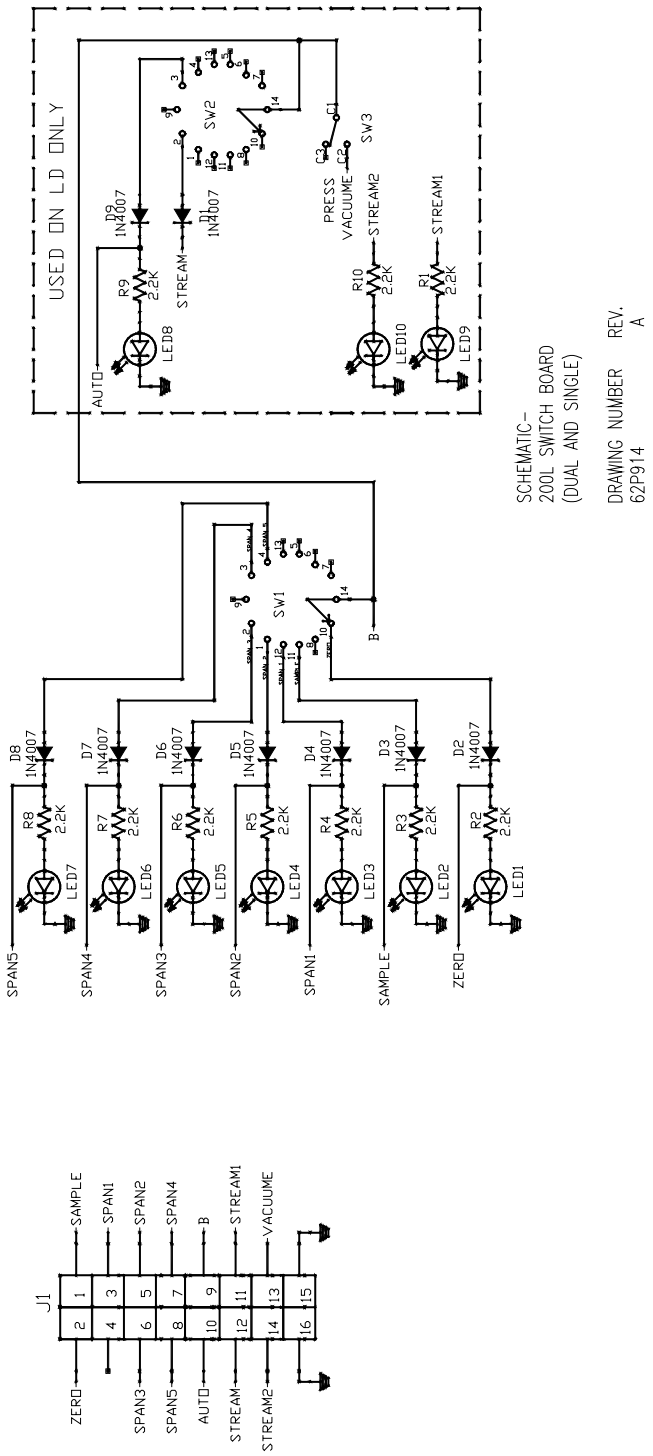
SPAN 2
SPAN 3
SPAN 4
SPAN 5
ZERO
STREAM
STREAM 1
STREAM 2
VACUME
AUTO
24 VAC IN
SAMPLE
F1
.25A
C1
3.0KuF
1N4007
1N5624


USED ON LD ONLY
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R9
2.2K
D9
1N4007
STREAM
D11
1N4007
Sw2
PRESS
VACUUME
STREAM2
STREAM1
Sw3
R10
2.2K
LED10
R1
2.2K
LED9
Sw1
B
D8
1N4007
R8
2.2K
LED7
SPAN5
D7
1N4007
R7
2.2K
LED6
SPAN4
D6
1N4007
R6
2.2K
LED5
SPAN3
D5
1N4007
R5
2.2K
LED4
SPAN2
D4
1N4007
R4
2.2K
LED3
SPAN1
D3
1N4007
R3
2.2K
LED2
SAMPLE
D2
1N4007
R2
2.2K
LED1
ZERO
SCHEMATIC–
200L SWITCH BOARD
(DUAL AND SINGLE)
DRAWING NUMBER REV.
62P914 A
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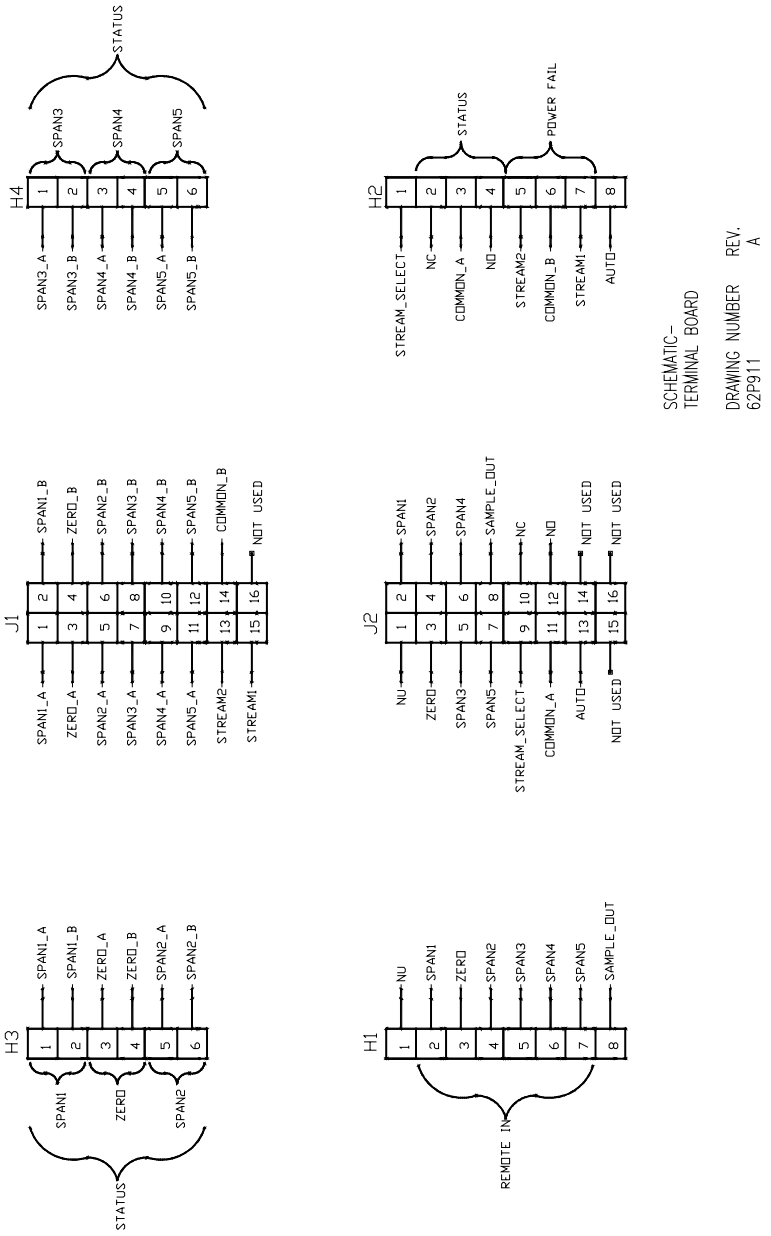
SPAN1
SPAN2
SPAN4
B
STREAM1
VACUUME
ZERO
SPAN3
SPAN5
AUTO
STREAM
STREAM2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SPAN5_B
H2
STATUS
POWER FAIL
STREAM_SELECT
NC
COMMON_A
NO
STREAM2
COMMON_B
STREAM1
AUTO
J1
SPAN1_A
ZERO_A
SPAN2_A
SPAN3_A
SPAN4_A
SPAN5_A
STREAM2
STREAM1
SPAN1_B
ZERO_B
SPAN2_B
SPAN3_B
SPAN4_B
SPAN5_B
COMMON_B
NOT USED
J2
NU
ZERO
SPAN3
SPAN5
STREAM_SELECT
COMMON_A
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SPAN1
SPAN2
SPAN4
SAMPLE_OUT
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NO
NOT USED
NOT USED
H3
SPAN1
ZERO
SPAN2
STATUS
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SPAN1_B
ZERO_A
ZERO_B
SPAN2_A
SPAN2_B
H1
REMOTE IN
NU
SPAN1
ZERO
SPAN2
SPAN3
SPAN4
SPAN5
SAMPLE_OUT
SCHEMATIC–
TERMINAL BOARD
DRAWING NUMBER
62P911
REV.
A