RUSKA

DIGITAL PRESSURE GAGE AND PRESSURE CONTROLLER

MODELS 6000C AND 6010C

USER'S MANUAL

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REVISION NOTICE

RELEASE	REV. NO.	DATE	DESCRIPTION
6010-1D01	A	10/8/91	Original Release
6010-1D01	B	4/16/93	Added DVM connections - ECO 17944
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Added Appendix B - Shipping Instructions per ECO 17634.

RELEASE 6010-1D01 Revision D (1/20/94)

Added information for Measure Mode - ECO 18201

WARNING

PRESSURIZED VESSELS AND ASSOCIATED EQUIPMENT ARE POTENTIALLY DANGEROUS. THE APPARATUS DESCRIBED IN THIS MANUAL SHOULD BE OPERATED ONLY BY PERSONNEL TRAINED IN PROCEDURES THAT WILL ASSURE SAFETY TO THEMSELVES, TO SPECTATORS, AND TO THE EQUIPMENT.

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SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

This manual contains operation and routine and preventive maintenance instructions for the Series 6000 Digital Pressure Gage (DPG) manufactured by Ruska Instrument Corporation, Houston, Texas. Because the DPG is available in a wide variety of operational modes and pressure ranges, this manual addresses the DPG in a general fashion and expects the reader to skip over sections or configurations that do not apply to his system.

1.2 GENERAL INFORMATION

The Ruska Series 6000 Digital Pressure Gage (DPG) uses proven fused quartz Bourdon tube technology to provide the fast, precise measurement or control of pressure. Although more than 70 configurations are currently available, the DPG can basically be considered either a measure-only device (Model 6000-xxxx) or a control-or-measure device (Model 6010-xxxx).

Typically, the measure-only model finds applications in research laboratories, wind tunnel testing, power plant testing, and bubbler tank volume accountancy systems. It is also used to monitor barometric pressures, vacuum systems, differential pressure devices, and engine test standards.

The control-or-measure model is commonly used in the calibration and testing of pressure gages, transducers, pressure switches, and production pressure instruments. It is also used to service air data instruments such as altimeters, airspeed indicators, machmeters, and rate of climb indicators and to calibrate engine pressure ratio transducers.

1.3 FEATURES

The following features are standard on all Series 6000 DPG's.

Choice of Configuration: the user selects from over 70 possible combinations to achieve the desired operational mode, pressure range, sensing element medium, and power input. These selections are highlighted in Section 1.4.

Fused Quartz Bourdon Tube Technology: the sensing element makes use of the stability, high elasticity, low hysteresis, and excellent fatigue strength of fused quartz. For an explanation of this technology, see Section 2, "Theory of Operation."

No Mechanical Parts in the Sensing Element: quartz Bourdon tube technology eliminates the need for gear trains, bearings, shafts, and other moving parts that can wear out or introduce hysteresis or deadband into the process.

NIST Traceability: DPG's purchased with the optional Ruska Digital Voltmeter or Interface Panel (Section 1.5) are calibrated against Ruska deadweight gages, which are directly traceable to the National Institute of Standards and Technology in Washington, D.C.

Standard Rack Mount Size: the DPG's standard 19" EIA chassis fits easily into the user's current rack mount system.

1.4 CONFIGURATIONS

The DPG is available as either a measure-only device (Model 6000-xxxx) or a control-or-measure device (Model 6010-xxxx). The features which further define the unit's configuration are listed below.

Operational Mode: absolute, gage, or differential models (Section 1.6) are available for both the measure-only and the measure-or-control models.

Pressure Range: the user selects the pressure range which best suits the application.

Oil or Gas-Filled Sensing Element: gage, differential, and high line differential models (Section 1.6) of the measure-only models can be configured for combinations of oil and gas measurements.

Power Input: depending on the user's line voltage, the DPG is configured to accept 115, 210, 230, or 250 VAC at 50 or 60 Hz.

Major configurations of the DPG are summarized in Figure 1-1.

1.5 OPTIONS

The DPG is not intended to be a stand-alone instrument. Measure-only units (Model 6000-xxxx) produce an analog voltage output which is most easily interpreted by a high-precision digital voltmeter. The Ruska Digital Voltmeter (DVM) offers resolution of 1 part in 100,000, or 5 1/2 digits. These DVM's also provide a parallel BCD output or an optional GPIB interface.

Measure-or-control DPG's (Model 6010-xxxx) are most often used with the Ruska Series 6005 Interface Panel (IFP). A push-button keypad allows the user to enter the desired pressure in one of eight standard units, including %FS. The instrument can also be controlled remotely by way of the GPIB. The IFP is available as either a single or a dual channel device, with up to 8 preprogrammed pressures that are user-selectable.

Other options and accessories are available for the DPG but are not listed here. For more information on these items, contact the Ruska Sales Department.

1.6 DEFINITIONS

Absolute: Absolute models of the DPG measure pressure with respect to true zero pressure (vacuum). Units of measure include psia (pounds per square inch absolute) and HgA (inches of mercury absolute).

Gage: Gage models of the DPG measure pressure with respect to atmospheric pressure. Units of measure include psig (pounds per square inch gage) and kg/cm^2 (kilograms per square centimeter).

Differential: Differential models of the DPG can be used as either an absolute or a gage model without requiring additional tuning. The user provides the desired reference pressure of either vacuum or atmosphere; other reference pressures are not allowed. Units of measure include psid (pounds per square inch differential, where differential implies either an absolute or a gage measurement).

ΔP (Delta P): The term ΔP is used to indicate a difference between two pressures.

High Line Differential: High Line Differential models of the DPG measure ΔP pressure with respect to a high static line pressure. Units of measure include psi.

RUSKA SERIES 6000

Digital Pressure Gage Configurations

Measure Only [Model 6000-xxxx]

Absolute - Different models accommodate pressures between 10 and 150 psia.

Gage - Different models accommodate pressures between 1 and 2500 psig.

Differential - Different models accommodate pressures between 5 and 2500 psid.

High Line Differential (using gas and gas) - Accomodates ΔP between 5 and 500 psi.

High Line Differential (using oil and oil) - Accommodates ΔP between 5 and 500 psi.

Differential (using oil and gas) - Different models accommodate pressures between 5 and 2500 psi.

Measure Or Control [Model 6010-xxxx]

Absolute - Different models accommodate pressures between 10 and 115 psia.

Gage - Different models accommodate pressures between 1 and 2500 psig, and -5 to -15 psig.

Differential - Different models accommodate pressures between 5 and 2500 psid.

Figure 1-1
Ruska Series 6000 Digital Pressure Gage Configurations

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SECTION 2

PRINCIPLES OF OPERATION

2.1 INTRODUCTION

The Series 6000 DPG is available in a wide variety of models and ranges. As was explained in Section 1, the DPG is available as either a measure-only device (Model 6000-xxxx) or a control-or-measure device (Model 6010-xxxx). To create the measure-only version, parts are deleted from both the pneumatics and electronics in the control-or-measure version.

The various ranges are accomplished by using different sensors, different electronics, and different pneumatics. The fact that the DPG can be used for gage, absolute, or differential measurements also increases the number of versions.

This portion of the manual addresses the DPG in a generic fashion and expects the reader to skip over sections or configurations that do not apply to his system.

2.2 SYSTEM OVERVIEW

The DPG is used to accurately measure or control pressure. It is designed to be used with either a high precision digital voltmeter or a Ruska Interface Panel, and thus is not a stand-alone instrument.

The DPG can be broken down into five major sections: the power board, the pneumatics, the sensor, the control board, and the front panel. Figure 2-1 shows a block diagram of a typical DPG. The power board generates all required DC voltages. It also supplies AC to the solenoid valves if the unit is a control-or-measure device. The power board gets its input from an isolation transformer that can be set for 115, 210, 230, or 250 VAC operation.

The pneumatics portion of the DPG has up to four ports to the external world. These are the case reference port, the test port, the supply pressure port, and the supply vacuum port. It also has two internal outputs which connect to the sensor. One line connects to the sensor's reference side, and the other connects to the sensor's quartz Bourdon tube.

The sensor uses these two pressure inputs to create an output which is sent to the control board. In response to this output, the control board sends a current back to the sensor. When pressure measurement is desired, this current is converted to voltage. This voltage may be measured by an external meter and is a representation of the pressure. In control mode, the front panel or the optional Interface Panel generates a voltage which is translated to a current and sent to the sensor, which creates an error signal. In response to this error signal, the control board produces an electrical output which drives a pneumatic servovalve.

The front panel allows the user to switch between measure and control mode and local and remote mode. Two potentiometers generate the control voltage used to command a pressure. A pressure drive switch, which is primarily used for deadband testing, creates a temporary offset voltage which is added to the control voltage.

2.3 POWER BOARD

An isolation transformer selectable for 115, 210, 230, or 250 VAC operation provides input to the power board. The power board then generates all required DC voltages and supplies AC to the solenoid valves if the unit is a control-or-measure device.

In the discussion that follows, reference is made to Drawings 6000B-EEDOC-M, 6010B-EEDOC-HP, and 6010B-EEDOC-LP in Section 8.

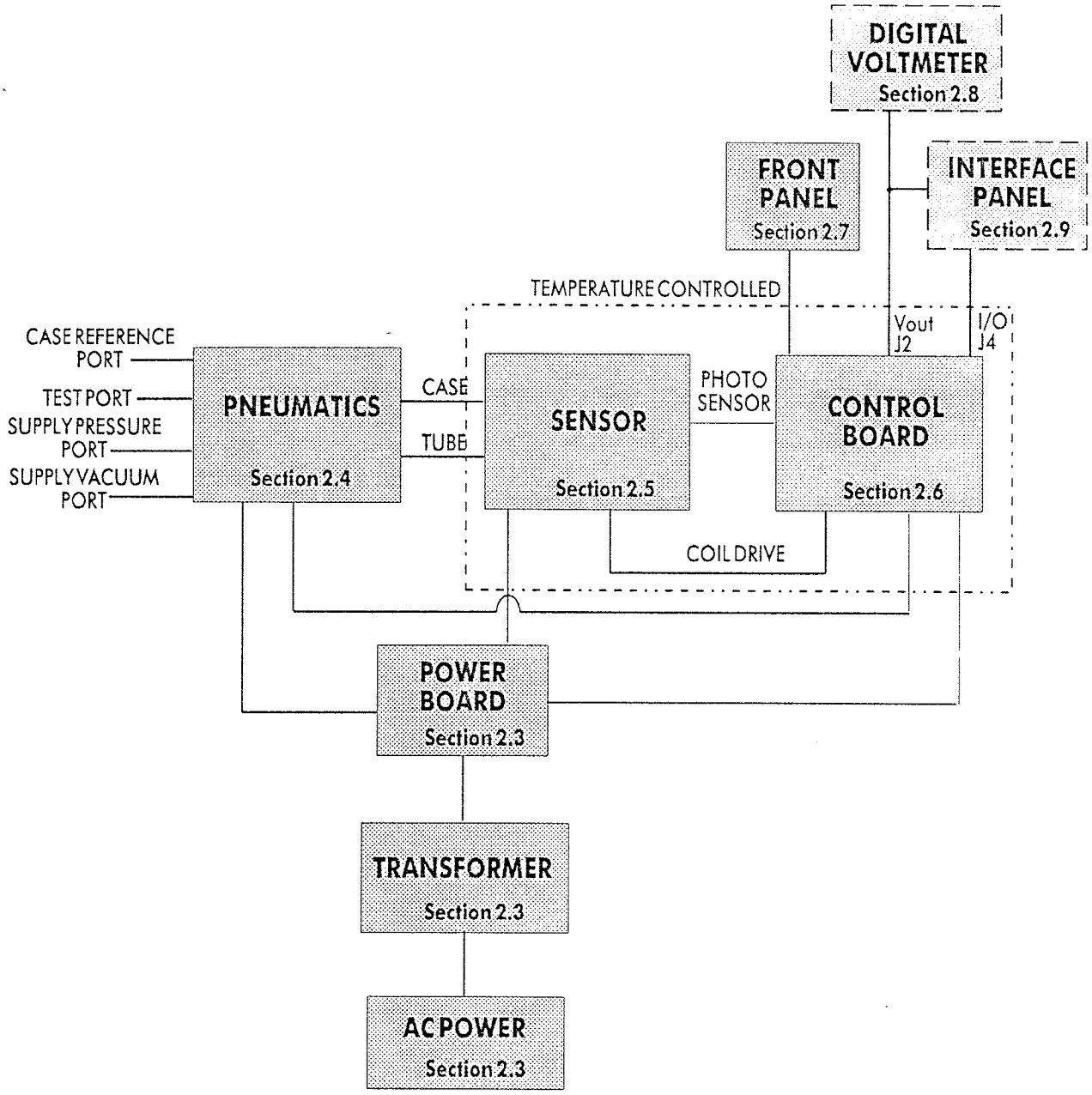

Figure 2-1
DPG Block Diagram

An AD923 power module generates regulated 5 VDC and plus and minus 15 VDC which are used on the control board and to power the sensor light source. Bridge BR1 and regulator U4 create a regulated 12 VDC for relay K1, and bridge BR2 supplies power to a heater which keeps the sensor housing at a constant temperature of 49°C. If the unit is a control-or-measure device, the power board also distributes 110 VAC to enable the isolation solenoid valves (Section 2.4.2).

For high pressure models, transformer T2 provides a modulation signal for the servovalves. In these models, two servovalves having two windings each are used to reduce gas consumption. Diodes D12 and D13 separate the servo drive signal into an increase and a decrease signal. A portion of the drive signal is combined with the modulation signal to drive the fine-control coil windings.

In low pressure models, only one servo valve is used and it only has one winding.

2.4 PNEUMATICS

The pneumatics portion of the DPG varies greatly depending on whether the unit allows for measure-only or measure-or-control mode. The following sections address these cases separately.

2.4.1 MEASURE-ONLY PNEUMATICS

The measure-only pneumatics are very straightforward. Figure 2-2 shows three basic configurations. In all cases, lines from the ports are filtered and relief valves are installed for protection. These lines are then connected to the quartz sensor, where pressure is measured as described in Section 2.5.

2.4.2 MEASURE & CONTROL PNEUMATICS

Unlike the measure-only pneumatics described in the previous section, control pneumatics can vary greatly depending on the pressure mode and range. Figures 2-3 through 2-6 show various configurations. Solenoid valves are used to switch the pneumatics between control and measure applications and to isolate the DPG from the supply lines when the unit is off or in measure mode. The pressure supply port and the test port are filtered as shown in Figures 2-3 through 2-6. Differential pressure regulators are used to control flow through the servovalve. For low pressure units, the differential pressure is typically 1 to 3 psi (7 to 21 kPa). For high pressure units it may be 250 psi (1.72 MPa).

The servovalve regulates the pressure at its output by electrically varying the position of a flapper. The position of the flapper controls the flow from the supply and vacuum sources. The control voltage for the servo valve comes from the control board. The Bourdon sensor is connected to the output of the servo valve.

In control mode, the voltage required for a specific pressure is used to drive the sensor force balance. The output of the sensor is used to drive the servo valve to a point where the pressure balances the offset due to the force balance drive. A variable orifice valve and overshoot valve may be placed in the line between the servovalve output and the test port to control the rate-of-change of pressure and to control overshoot. Voltage on the servo valve may range as high as plus or minus 12 volts when large changes are necessary.

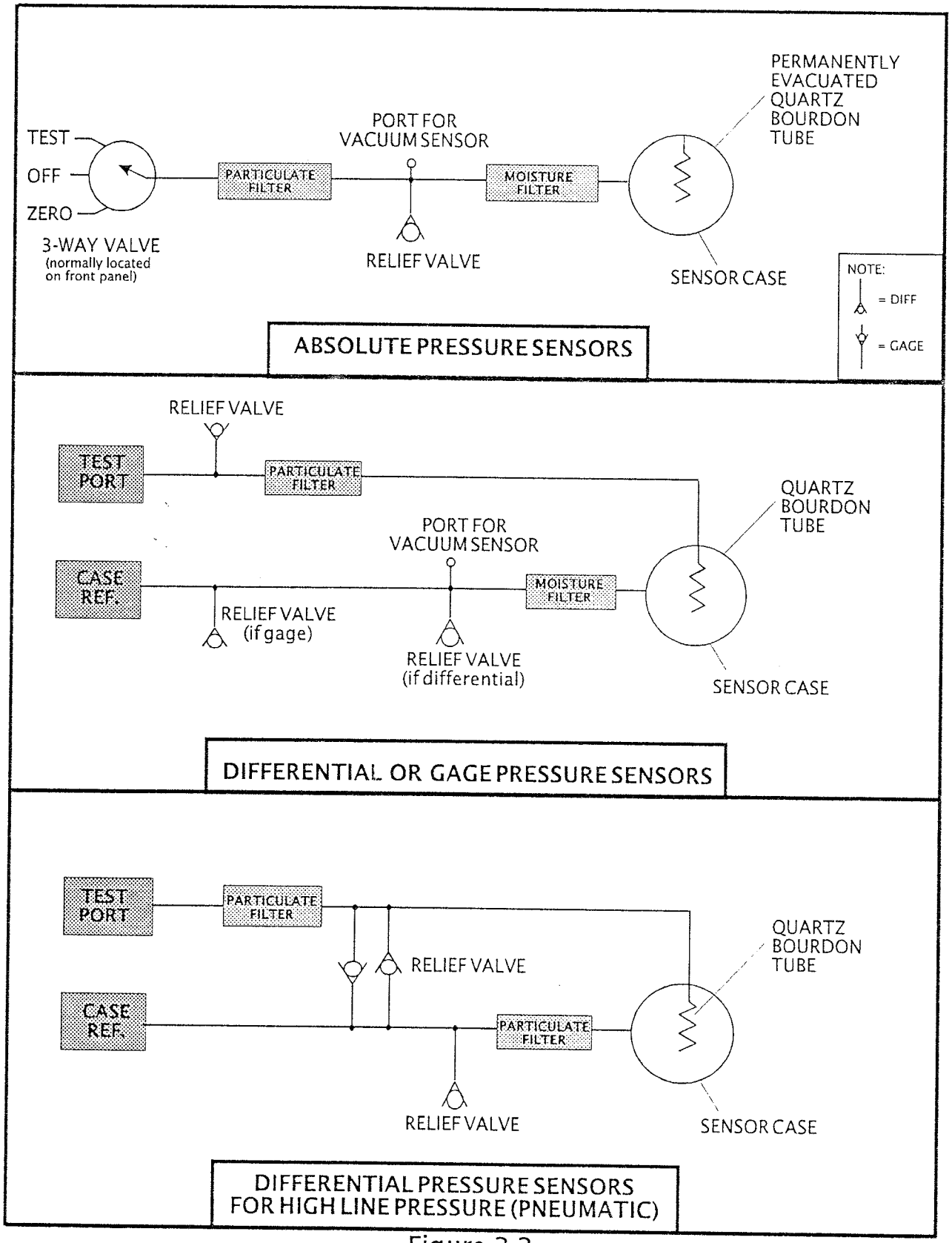

Figure 2-2
Measure Only Pneumatics

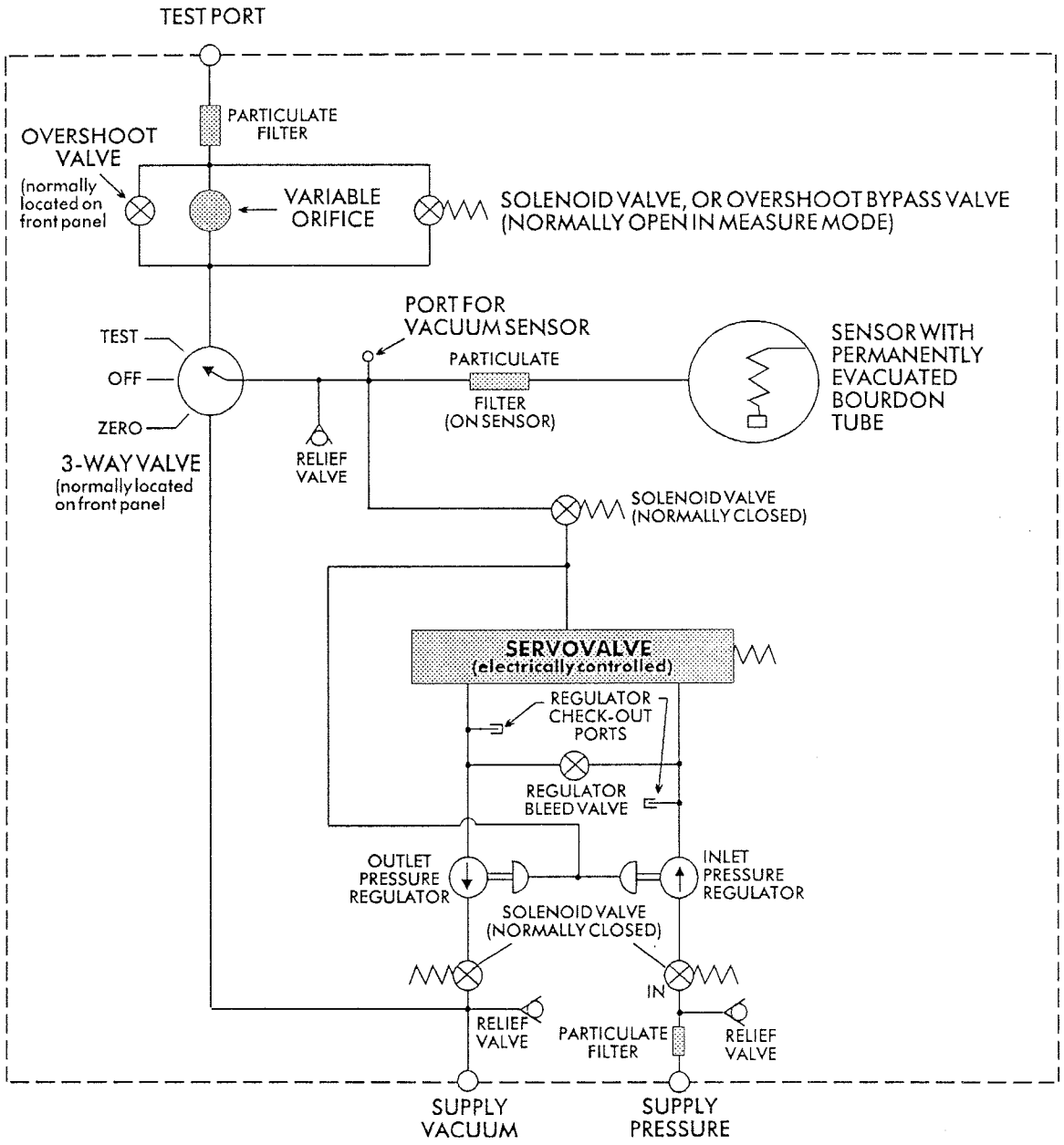

Figure 2-3
Absolute Control Pneumatics
10 TO 115 PSI

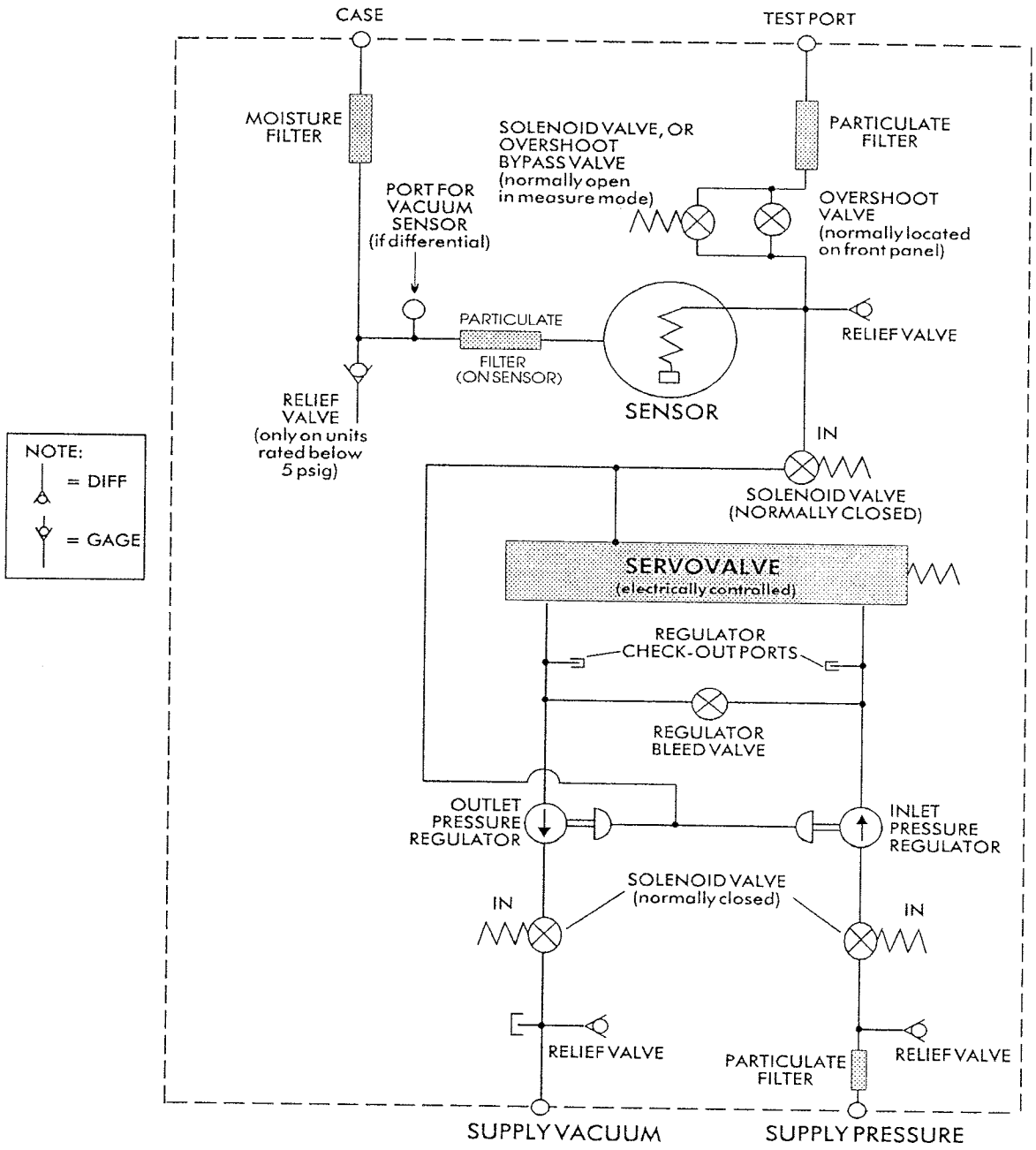

Figure 2-4
Low Pressure Control Pneumatics
Gage Models 1 to 500 PSI Differential Models 100 to 500 PSI

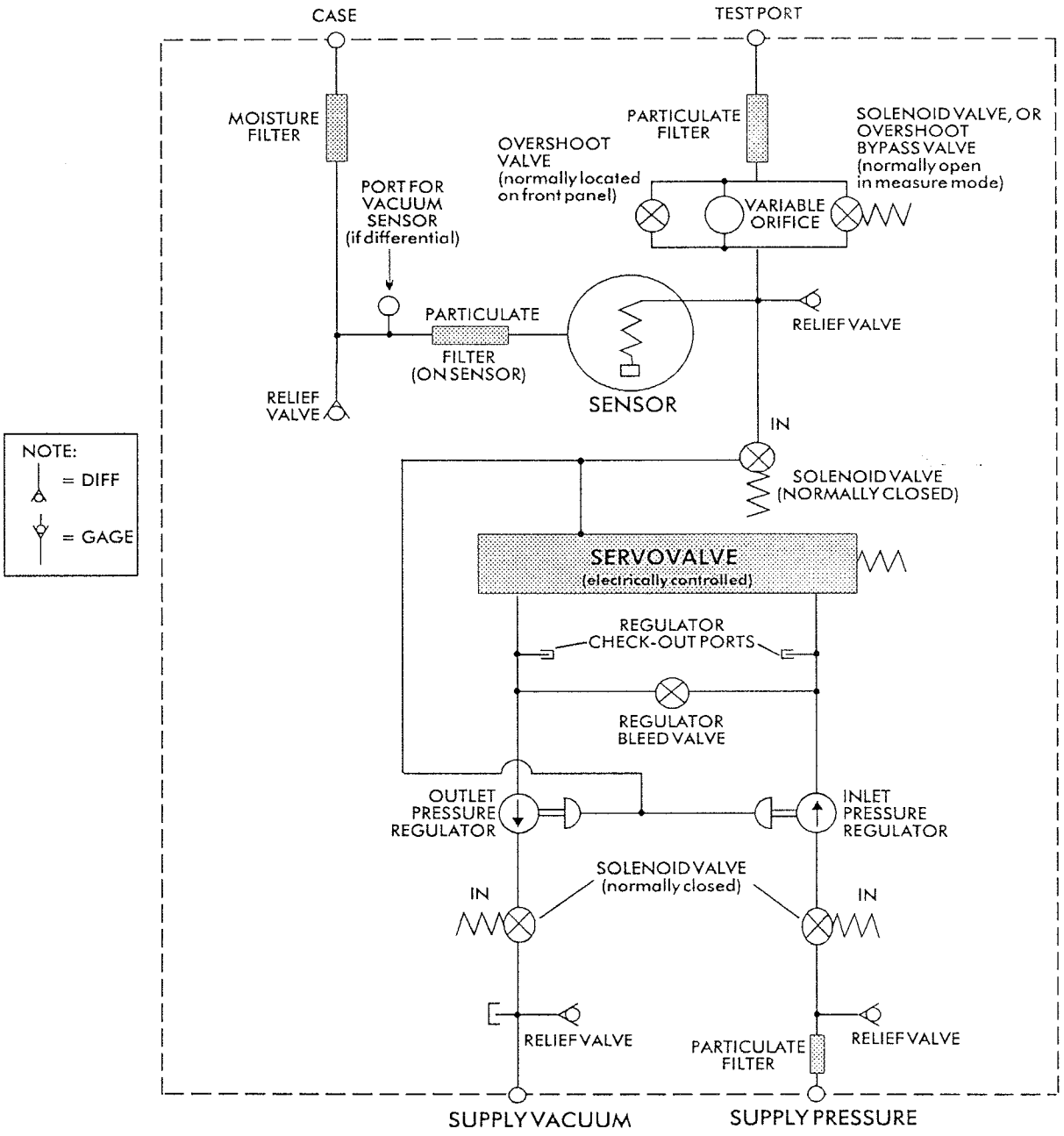

Figure 2-5
Differential Control Pneumatics
5 to 100 psid

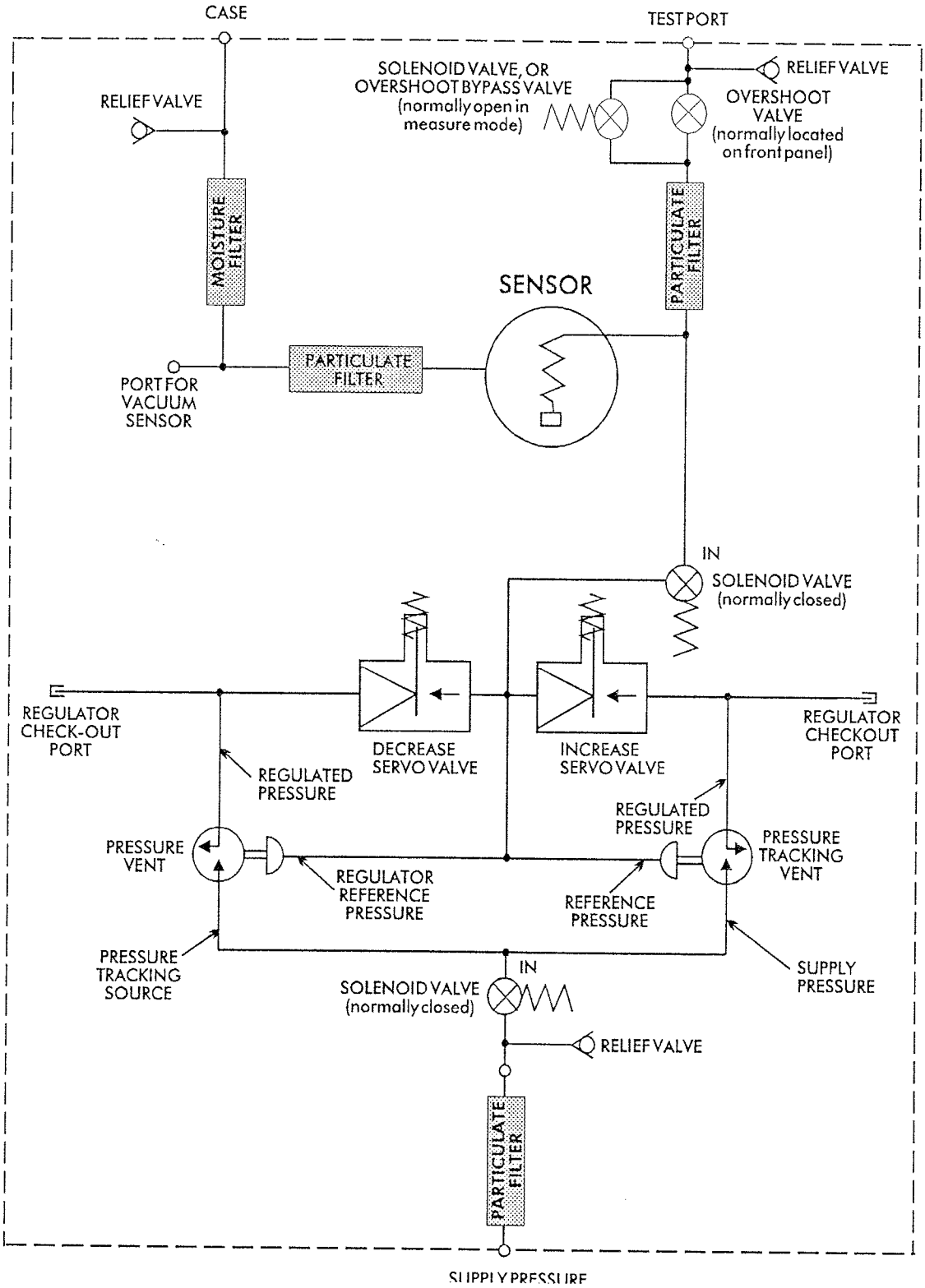

Figure 2-6
High Pressure Control Pneumatics
Gage and Differential 500 to 2500 PSI

2.5 THE SENSOR

The sensor is mounted in a machined aluminum/steel housing that is temperature controlled to approximately 50° Celsius. The sensor consists of a helical quartz tube with a mirror fixed to one end, as shown in Figure 2-7.

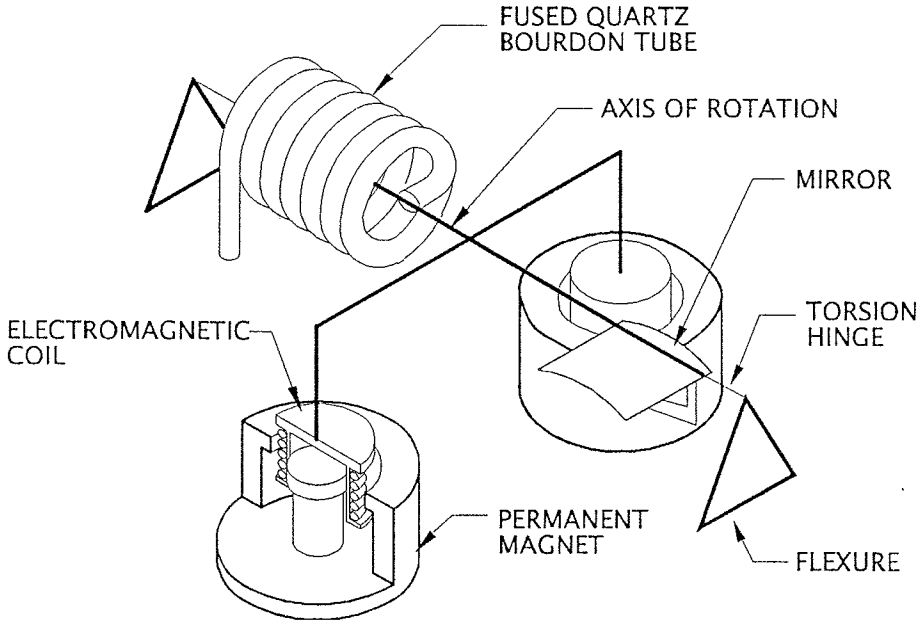

Figure 2-7
Shaft/Magnet Section

A force balance is created by attaching a rigid quartz beam transverse to the axis of the helical tube. Both ends of this beam terminate in an electromagnetic coil, and permanent magnets are placed beneath these coils. As pressure is applied in the tube, the entire apparatus tries to rotate.

At the same time, a lamp assembly directs light through a sapphire window onto the mirror affixed to the helical tube, as shown in Figure 2-8.

The reflected light comes back through the window and strikes two identical photodiodes. If the mirror is in its "zero position," the outputs of the two photodiodes provide sufficient energy in the form of current to maintain the quartz assembly in its zero position; thus, a force balance is created.

If the unit is not balanced, the photodiode outputs are not equal. When this happens, the control board responds by changing the current in the coil assembly until the quartz tube is forced to return to its original position. The amount of current required to do this is proportional to the pressure in the helical tube, with typical driving currents ranging from 2 to 10 milliamps. Thus, the pressure is determined by the amount of current required to return the quartz tube to its zero position.

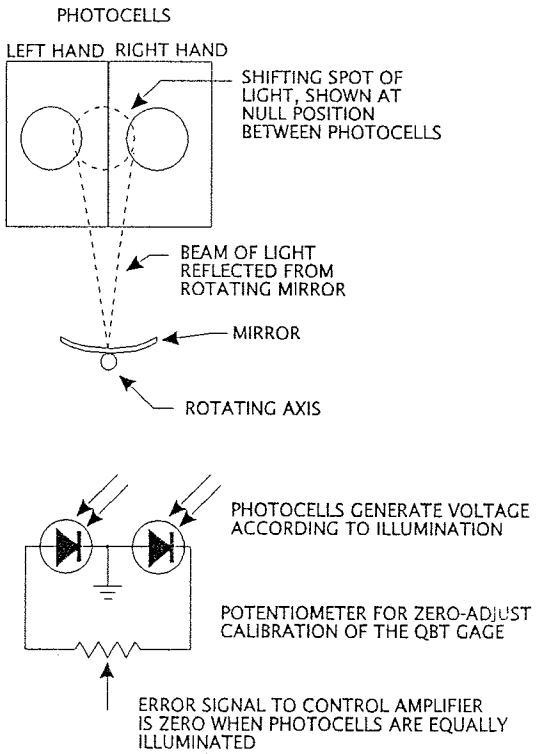

Figure 2-8
Photocell/Lightspot

2.5.1 THE LINEARIZATION TERM

As described in the previous section, the relationship between the pressure being measured and the current required to keep the quartz Bourdon tube in its zero position is the principle behind the operation of DPG's sensing element.

Ideally this current-pressure relationship would be a linear equation of the form

$$I = kP,$$

where I is current, k is a constant of proportionality, and P is pressure.

However, due to certain mechanical characteristics of the helical tube and its supporting structure, this current-pressure relationship is slightly nonlinear. The nonlinear portion of this current-pressure relationship closely follows the form of a second order polynomial, or

$$aP^2 + bP + c,$$

where again P is pressure and a, b, and c are coefficients generated during the calibration procedure as discussed below.

When the user performs a three-point calibration, the DPG's analog correction circuit (Section 2.6) is adjusted based on the zero, mid-point, and full-scale adjustments made by the user. From that point on, the nonlinear term given above is subtracted from the total current-pressure curve to achieve the desired linear current-pressure relationship.

2.5.2 SENSOR CONFIGURATIONS

The four basic configurations of sensors used to measure absolute, gage, and differential pressures are shown in Figure 2-9. For the gage sensor, the inside of the sensor housing is open to the atmosphere. The pressure to be measured is applied to the inside of the quartz tube.

Absolute measurements can be made with the differential sensor by applying vacuum to the sensor housing and the pressure to be measured to the inside of the quartz tube.

For absolute pressure sensors, the quartz tube is evacuated and sealed off permanently. The pressure to be measured is then applied inside the housing external to the quartz tube.

In the case of high line differential sensors, which are used to measure ΔP pressures at high static line pressures, both the quartz tube and the housing are pressurized. The higher pressure is applied to the inside of the quartz tube and the lower pressure is applied inside the housing.

2.6 THE CONTROL BOARD

The control board contains the majority of the DPG's electronics. Throughout the following discussion, reference is made to Drawings 6000B-EEDOC-M, 6010B-EEDOC-HP, and 6010B-EEDOC-LP in Section 8.

An on-board relay (K1) is used to switch the electronics between measure and control modes. These modes may be set by a front panel switch or by the Interface Panel.

Two front panel multi-turn potentiometers are connected to a zener diode reference (D9) to create the local voltage source used to set the pressure in the control mode.

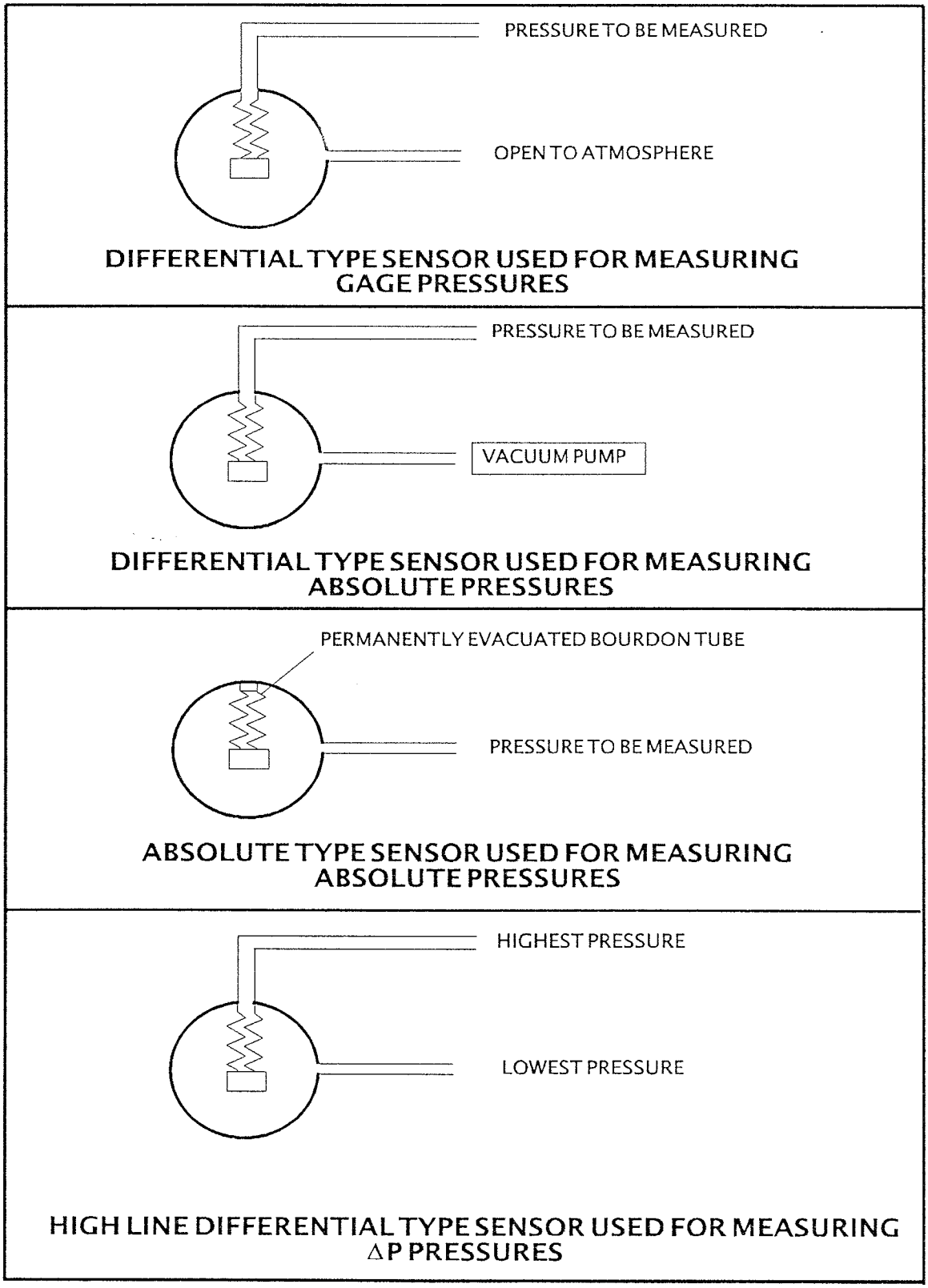

Figure 2-9
Sensor Configurations

An op amp (U10) and two transistors (Q1 and Q2) form a power drive circuit that drives the force balance coil in control mode. The outputs of the sensor's photodiodes are summed and amplified by an op amp (U3A). Its output is an error signal that is integrated by two more op amps (U3B and U3D) which form a compensated integrator. The gain and response characteristics are set independently for measure and control modes.

An op amp (U3C) and two transistors (Q5 and Q6) form a power amplifier which drives the servovalve in control mode and the force balance coils in measure mode. The current through the force balance coils is converted to a voltage at op amp (U1A). The output of this op amp is the raw indication of pressure. A multiplier (U2) is used to square a portion of this output. A switch (S1A) is used to decide to add or subtract the linearization term. An op amp (U1C) sets the final scale factor, and its output is fed to either a high impedance digital voltmeter or to the Interface Panel.

2.7 THE FRONT PANEL

The DPG front panel has a minimum of operator controls. Both the measure and the control versions have an illuminated power switch, an oven indicator lamp, and a recessed zero potentiometer adjustment.

The control version has six additional controls. There are two multi-turn potentiometers for adjusting pressure. A switch selects either control or measure mode. A three position switch allows creating a slight positive or negative pressure change. Another switch controls whether the unit is in local or remote mode. A valve allows adjustment to correct for overshoot.

2.8 THE DIGITAL VOLTMETER

The optional Digital Voltmeter (DVM) is used with measure-only models of the DPG. For more information on the DVM, which is briefly discussed in Section 1.5, contact the Ruska Sales Department.

2.9 THE INTERFACE PANEL

The optional Ruska Interface Panel (IFP) is commonly used with measure-or-control models of the DPG. For more information on the IFP, which is briefly discussed in Section 1.5, contact the Ruska Sales Department.

SECTION 3
ACCURACY AND SPECIFICATIONS

3.0 ACCURACY

Specifications of pressure transducer instrumentation can be divided into three categories: Input Specifications, General Specifications, and Performance Specifications. Each of these categories in turn consists of parameters which are usually specified by minimum and/or maximum numeric limits. Almost all of these parameters can have an effect on what is generally referred to as the instrument's "accuracy". Therefore, the accuracy of any pressure transducer instrumentation can be varied either beneficially or detrimentally by controlling the Input Specifications, operating within the General Specifications, or knowing the actual Performance Specifications.

For example, if Input Specifications have not been met for the line voltage, the unit may not have a catastrophic failure, but errors may be present in the transducer measurement. As another example, if the requirement for the Pressure Source Flow Capacity has not been met, the DPG may not be able to achieve a final steady state controlled pressure within the settling time specification. Finally, if the DPG is commanded to a pressure outside of the Applicable Control Pressure Range, the nonlinearity in the pressure output may be greater than that specified.

Performance Specifications give the user the most flexibility and control over his "accuracy claims". The term accuracy is defined by ISA-S37.1 as either the ratio of the error to the full-scale output (%FS) or the ratio of the error to the reading (%RDG). Note that the definition of accuracy is not the summation of some or even all of the possible error source maximum limits.

The true accuracy of an instrument is relative to the actual error introduced by the calibration transfer standard plus the actual error not eliminated from the instrument's indicated output. Therefore, an instrument's accuracy can be manipulated by introducing more or less actual error through the choice of a calibration standard; or its accuracy can be varied by the elimination of actual errors inherent in the instrument. For example, if an instrument has a known error due to being used in an attitude, or tilt, the %FS zero shift error can be eliminated by rezeroing the instrument in the tilted position. Even %RDG sensitivity shifts can be eliminated mathematically or by controlling the attitude of the instrument during its calibration.

The key to eliminating an error is knowing its source and type along with its polarity and magnitude. Generally, the source is simple to detect and is represented by the specific parameter. The type is usually a function of the instrument's design and manufacturing process. Within a given instrument, an error can be either random or systematic as well as random or systematic within the instrument's population. The user is free to consult Ruska for recommended methods of minimizing error source contributions.

In summation, total error can and should be managed by the control of the three general error sources: Input Specifications, which includes the user's chosen calibration standards; General Specifications, which includes the user's chosen processes; and Performance Specifications, which includes the user's chosen applications for the instrumentation. The parameters and value limits listed in the following specifications indicate the product line's general acceptance limits and are not a report of any unit's specific error contribution. Any parameter exceeding the specified limits should be considered in need of maintenance.

3.1 SPECIFICATIONS

Table 3-1

Input Specifications

Parameter	Value	Applicable Model No.
Line Voltage, (customer specified)	4 selectable values +10% VAC Rms 1. 115 VAC Rms 2. 210 VAC Rms 3. 230 VAC Rms 4. 250 VAC Rms	all
Line Frequency (customer specified)	50 Hz ± 1 Hz 60 Hz ± 1 Hz	
Power Requirement	≤ 100 VA	
Pressure Source Medium	Nitrogen or AIR	all pneumatic units consult factory for hydraulic fluid units
Pressure Source Particle Size Contamination	≤ 50 microns	
Press. Source Max. Moisture Content	-50°C Dew Point	
Press. Source Max. Hydrocarbon Content	30 ppm	
Press. Source Regulated Value	See Table 3-3	6010 only
Press. Source Min. Flow Capacity		
Vacuum Source Min. Flow Capacity	See Table 3-2	all
Vacuum Source Ultimate Vacuum Capability		

Vacuum Note: Ruska recommends and supplies with its vacuum pumps a Vacuum Source Vapor Trap and Vacuum Source Power Loss Back-flow protection.

Table 3-2

Vacuum Source Capacities and Capabilities

Model No.	Supply Capacity	Supply Capability	Reference Capacity	Reference Capability
All Measure-only Units				
6000-151X	≥ 127 L/M	≤ 10 mT *	NA	NA
6000-251X	≥ 127 L/M	≤ 10 mT *	NA	NA
6000-1501X	NA	NA	NA	NA
6000-150X	NA	NA	≥ 127 L/M	≤ 1 mT @ 5 psi FS to ≤ 5 mT @ 20 psi FS
6000-250X	NA	NA	≥ 127 L/M	≤ 5 mT @ 20 psi FS to ≤ 10 mT @ 60 psi
6000-350X	NA	NA	≥ 127 L/M	≤ 10 mT @ 60 psi to ≤ 25 mT @ 100 psi

* mT is an abbreviation for millitorr and is equivalent to a micron of mercury.

Table 3-2 (Continued)

Model No.	Supply Capacity	Supply Capability	Reference Capacity	Reference Capability
6000-154X	NA	NA	≥ 127 L/M	≤ 25 mT @ 100 psi to ≤ 50 mT @ 250 psi
6000-254X	NA	NA	≥ 127 L/M	≤ 50 mT @ 250 psi to ≤ 100 mT @ 500 psi
6000-156X	NA	NA	≥ 127 L/M	≤ 100 mT @ 500 psi to ≤ 200 mT @ 1.000 psi
6000-256X	NA	NA	≥ 127 L/M	≤ 200 mT @ 1,000 psi to ≤ 500 mT @ 2,500 psi
6000-172X	NA	NA	NA	NA
6000-272X	NA	NA	NA	NA
6000-372X	NA	NA	NA	NA
6000-472X	NA	NA	NA	NA
6000-183X	NA	NA	NA	NA
6000-283X	NA	NA	NA	NA
6000-383X	NA	NA	NA	NA
6000-483X	NA	NA	NA	NA
6000-158X	NA	NA	≥ 127 L/M	≤ 1 mT @ 5 psi FS to ≤ 10 mT @ 45 psi
6000-258X	NA	NA	≥ 127 L/M	≤ 10 mT @ 45 psi to ≤ 25 mT @ 135 psi
6000-358X	NA	NA	≥ 127 L/M	≤ 25 mT @ 135 psi to ≤ 50 mT @ 315 psi
6000-458X	NA	NA	≥ 127 L/M	≤ 50 mT @ 315 psi tp ≤ 100 mT @ 500 psi
6000-558X	NA	NA	≥ 127 L/M	≤ 100 mT @ 500 psi to ≤ 200 mT @ 1,000 psi
6000-658X	NA	NA	≥ 127 L/M	≤ 200 mT @ 1,000 psi to ≤ 500 mT @ 2,500 psi
Absolute Pressure Controllers				
6010-161X	≥ 127 L/M	≤ 10 mT	NA	NA
6010-261X	≥ 127 L/M	≤ 10 mT	NA	NA
Gage Pressure Controllers				
6010-1601X	≥ 62 L/M	≤ 100 mT	NA	NA
6010-1600X	≥ 62 L/M	≤ 100 mT	NA	NA
6010-2600X	≥ 62 L/M	≤ 100 mT	NA	NA
6010-1640X	≥ 62 L/M	≤ 100 mT	NA	NA

Table 3-2 (Continued)

Model No.	Supply Capacity	Supply Capability	Reference Capacity	Reference Capability
6010-2640X	≥ 62 L/M	≤ 100 mT	NA	NA
6010-1660X	NA	NA	NA	NA
6010-1680X	NA	NA	NA	NA
6010-1700X	≥ 127 L/M	≤ 100 mT	NA	NA
Differential Pressure Controllers				
6010-160X	≥ 62 L/M	≤ 100 mT	≥ 127 L/M	≤ 1 mT @ 5 psi FS to ≤ 5 mT @ 20 psi FS
6010-260X	≥ 62 L/M	≤ 100 mT	≥ 127 L/M	≤ 5 mT @ 20 psi FS to ≤ 10 mT @ 60 psi
6010-360X	≥ 62 L/M	≤ 100 mT	≥ 127 L/M	≤ 10 mT @ 60 psi to ≤ 25 mT @ 100 psi
6010-164X	≥ 62 L/M	≤ 100 mT	≥ 127 L/M	≤ 25 mT @ 100 psi to ≤ 50 mT @ 250 psi
6010-264X	≥ 62 L/M	≤ 100 mT	≥ 127 L/M	≤ 50 mT @ 250 psi to ≤ 100 mT @ 500 psi
6010-166X	NA	NA	≥ 127 L/M	≤ 100 mT @ 500 psi to ≤ 200 mT @ 1,000 psi
6010-168X	NA	NA	≥ 127 L/M	≤ 200 mT @ 1,000 psi to ≤ 500 mT @ 2,500 psi

Table 3-3

Pressure Source and Pressure Source Capacities

Model Number	Pressure Source	Pressure Source Capacity*
Absolute Pressure Controllers		
6010-161X	FS press + 15 psig ± 5 psig	440 scim
6010-261X	FS press + 15 psig ± 5 psig	1250 scim
Gage Pressure Controllers		
6010-1601X	FS press + 15 psig ± 5 psig	260 scim
6010-1600X	FS press + 15 psig ± 5 psig	420 scim
6010-2600X	FS press + 15 psig ± 5 psig	700 scim
6010-1640X	FS press + 30 psig ± 20 psig	1,600 scim
6010-2640X	FS press + 70 psig ± 20 psig	2,650 scim
6010-1660X	FS press + 125 psig ± 25 psig	4,370 scim
6010-1680X	FS press + 375 psig ± 125 psig	10,500 scim
6010-1700X	+ 15 psig ± 5 psig	440 scim
Differential Pressure Controllers		
6010-160X	FS press + 15 psig ± 5 psig	320 scim
6010-260X	FS press + 15 psig ± 5 psig	480 scim
6010-360X	FS press + 15 psig ± 5 psig	700 scim
6010-164X	FS press + 30 psig ± 20 psig	1,600 scim
6010-264X	FS press + 70 psig ± 20 psig	2,650 scim
6010-166X	FS press +125 psig ± 25 psig	4,370 scim
6010-168X	FS press + 375 psig ± 125 psig	10,500 scim

* **NOTE:** All minimum Flow Capacities are determined by the flow required to charge 60 in^3 to the highest pressure of each model number in 60 seconds plus the maximum steady state flow required to maintain FS pressure. Flows from 0 to this limit must not change the supply pressure set point out of its tolerance limit.

Table 3-4

General Specifications: General Parameters

Parameter	Value	Applicable Model No.
Operating Temperature Range	18° to 28°C	all
Warm Up Period	≤ 4 hrs.*	all
Storage Temperature	0° to 43°C	all
Operating Humidity Range	20% to 60% RH	all
Storage Humidity Range	None[1]	all
Measure Mode Pressure Range	See Table 3-5	all
Transducer Full Scale Pressure Range	See Table 3-5	all
Reference Pressure Range	See Table 3-6	all
Control Mode Pressure Range	See Table 3-7	6010 only
External Pneumatic Load Range	15 ± 5 in^3	6010 only
Output Voltage Range (customer specified)	≤ 11.5000 VDC	all
Output Impedance	> 6 kΩ and < 10 kΩ	all

* See also Section 4.3.1

[1] **NOTE:** If there is any condensation, the DPG must be thoroughly dried before power is applied.

Table 3-5

General Specifications: Custom Full Scale Pressure and Applicable Measurement Range

Model Number	Transducer Full Scale Pressure Range	Measure Mode Range
All Measure-Only Units		
6000-151X	≥ 10 psia and ≤ 50 psia	0 psia to FS psia
6000-251X	> 50 psia and ≤ 150 psia	0 psia to FS psia
6000-1501X	≥ 1 psig and < 5 psig	0 psig to FS psig
6000-150X	≥ 5 psig and ≤ 20 psig	0 psia to FS psig
6000-250X	> 20 psig and ≤ 60 psig	0 psia to FS psig
6000-350X	> 60 psig and ≤ 100 psig	0 psia to FS psig
6000-154X	>100 psig and ≤ 250 psig	0 psia to FS psig
6000-254X	>250 psig and ≤ 500 psig	0 psia to FS psig
6000-156X	>500 psig and ≤ 1000 psig	0 psia to FS psig
6000-256X	>1000 psig and ≤ 2500 psig	0 psia to FS psig
6000-172X	≥ 5 psi ΔP and ≤ 45 psi ΔP	0 psi ΔP to FS psi ΔP

Table 3-5 (Cont.)

Model Number	Transducer Full Scale Pressure Range	Measure Mode Range
6000-272X	>45 psi ΔP and ≤ 135 psi ΔP	0 psi ΔP to FS psi ΔP
6000-372X	>135 psi ΔP and ≤ 315 psi ΔP	0 psi ΔP to FS psi ΔP
6000-472X	>315 psi ΔP and ≤ 500 psi ΔP	0 psi ΔP to FS psi ΔP
6000-183X	≥ 5 psi ΔP and ≤ 45 psi ΔP	0 psi ΔP to FS psi ΔP
6000-283X	> 45 psi ΔP and ≤ 135 psi ΔP	0 psi ΔP to FS psi ΔP
6000-383X	>135 psi ΔP and ≤ 315 psi ΔP	0 psi ΔP to FS psi ΔP
6000-483X	>315 psi ΔP and ≤ 500 psi ΔP	0 psi ΔP to FS psi ΔP
6000-158X	≥ 5 psig and ≤ 45 psig	0 psia to FS psig
6000-258X	> 45 psig and ≤ 135 psig	0 psia to FS psig
6000-358X	>135 psig and ≤ 315 psig	0 psia to FS psig
6000-458X	> 315 psig and ≤ 500 psig	0 psia to FS psig
6000-558X	> 500 psig and ≤ 1000 psig	0 psia to FS psig
6000-658X	> 1000 psig and ≤ 2500 psig	0 psia to FS psig
Absolute Pressure Controllers		
6010-161X	≥ 10 psia and ≤ 50 psia	0 psia to FS psia
6010-261X	> 50 psia and ≤ 115 psia	0 psia to FS psia
Gage Pressure Controllers		
6010-1601X	≥ 1 psig and < 5 psig	0 psig to FS psig
6010-1600X	≥ 5 psig and ≤ 45 psig	0 psig to FS psig
6010-2600X	> 45 psig and ≤ 100 psig	0 psig to FS psig
6010-1660X	> 100 psig and ≤ 250 psig	0 psig to FS psig
6010-2640X	> 250 psig and ≤ 500 psig	0 psig to FS psig
6010-1660X	> 500 psig and ≤ 1000 psig	0 psig to FS psig
6010-1680X	> 1000 psig and ≤ 2500 psig	0 psig to FS psig
6010-1700X	≥ -5psig and ≤ -15 psig	0 psig to FS -psig or ABS vacuum limit
Differential Pressure Controllers		
6010-160X	≥ 5 psig and ≤ 20 psig	0 psia to FS psig
6010-260X	> 20 psig and ≤ 60 psig	0 psia to FS psig
6010-360X	> 60 psig and ≤ 100 psig	0 psia to FS psig
6010-164X	> 100 psig and ≤ 250 psig	0 psia to FS psig
6010-264X	> 250 psig and ≤ 500 psig	0 psia to FS psig
6010-166X	> 500 psig and ≤ 1000 psig	0 psia to FS psig
6010-168X	> 1000 psig and ≤ 2500 psig	0 psia to FS psig

Table 3-6

General Specifications: Applicable Reference Pressures

Model Number	Applicable Reference Pressures
All Measure Only Units	
6000-151X	NA (Factory sealed @ ≤ 0.001 mT
6000-251X	NA (Factory sealed @ ≤ 0.001 mT
6000-1501X	Local atmospheric pressure only
6000-150X	Local atmospheric pressure OR ≤ 500 mT
6000-250X	Local atmospheric pressure OR ≤ 500 mT
6000-350X	Local atmospheric pressure OR ≤ 500 mT
6000-154X	Local atmospheric pressure OR ≤ 500 mT
6000-254X	Local atmospheric pressure OR ≤ 500 mT
6000-156X	Local atmospheric pressure OR ≤ 500 mT
6000-256X	Local atmospheric pressure OR ≤ 500 mT
6000-172X	Local atmospheric pressure TO 3000 psig less FS psi ΔP
6000-272X	Local atmospheric pressure TO 3000 psig less FS psi ΔP
6000-372X	Local atmospheric pressure TO 3000 psig less FS psi ΔP
6000-472X	Local atmospheric pressure TO 3000 psig less FS psi ΔP
6000-183X	Local atmospheric pressure TO 3000 psig less FS psi ΔP
6000-283X	Local atmospheric pressure TO 3000 psig less FS psi ΔP
6000-383X	Local atmospheric pressure TO 3000 psig less FS psi ΔP
6000-483X	Local atmospheric pressure TO 3000 psig less FS psi ΔP
6000-158X	Local atmospheric pressure OR ≤ 500 mT
6000-258X	Local atmospheric pressure OR ≤ 500 mT
6000-358X	Local atmospheric pressure OR ≤ 500 mT
6000-458X	Local atmospheric pressure OR ≤ 500 mT
6000-558X	Local atmospheric pressure OR ≤ 500 mT
6000-658X	Local atmospheric pressure OR ≤ 500 mT
Absolute Pressure Controllers	
6010-161X	NA (Factory sealed @ ≤ 0.001 mT
6010-261X	NA (Factory sealed @ ≤ 0.001 mT
Gage Pressure Controllers	
6010-1601X	Local atmospheric pressure only
6010-1600X	Local atmospheric pressure only
6010-2600X	Local atmospheric pressure only

Table 3-6 (Cont.)

Model Number	Applicable Reference Pressures
6010-1640X	Local atmospheric pressure only
6010-2640X	Local atmospheric pressure only
6010-1660X	Local atmospheric pressure only
6010-1680X	Local atmospheric pressure only
6010-1700X	Local atmospheric pressure only
Differential Pressure Controllers	
6010-160X	Local atmospheric pressure OR ≤ 500 mT
6010-260X	Local atmospheric pressure OR ≤ 500 mT
6010-360X	Local atmospheric pressure OR ≤ 500 mT
6010-164X	Local atmospheric pressure OR ≤ 500 mT
6010-264X	Local atmospheric pressure OR ≤ 500 mT
6010-166X	Local atmospheric pressure OR ≤ 500 mT
6010-168X	Local atmospheric pressure OR ≤ 500 mT

Table 3-7

General Specifications: Applicable Control Pressure Range

Model Number	Applicable Control Pressure Range	
Absolute Pressure Controllers		
6010-161X	from 0.15 psia or 1.000% FS (whichever's greater) to 100.000% FS Abs. press.	
6010-261X	1.000% FS Absolute to 100.000% FS Absolute press.	
Gage Pressure Controllers		
6010-1601X	0.000% FS Gage to 100.000% FS Gage pressure	
6010-1600X	0.000% FS Gage to 100.000% FS Gage pressure	
6010-2600X	0.000% FS Gage to 100.000% FS Gage pressure	
6010-1640X	0.000% FS Gage to 100.000% FS Gage pressure	
6010-2640X	0.000% FS Gage to 100.000% FS Gage pressure	
6010-1660X	10.000% FS Gage to 100.000% FS Gage pressure	
6010-1680X	10.000% FS Gage to 100.000% FS Gage pressure	
6010-1700X	0.000% FS Gage to 100.000% FS Gage or 0.15 psia (whichever's greater Abs. press.)	
Differential Pressure Controllers		
6010-160X	Gage Pressure	0.000% FS Gage to 100.000% FS Gage pressure

Table 3-7

General Specifications: Applicable Control Pressure Range (Cont.)

Model Number	Applicable Control Pressure Range	
	Absolute Pressure	from 0.15 psia or 1.000% FS (whichever's greater) to 100.000% FS Abs. press.
6010-260X	Gage Pressure	0.000% FS Gage to 100.000% FS Gage pressure
	Absolute Pressure	1.000% FSAbsolute to 100.000% FS Absolute pressure
6010-360X	Gage Pressure	0.000% FS Gage to 100.000% FS Gage pressure
	Absolute Pressure	1.000% FSAbsolute to 100.000% FS Absolute pressure
6010-164X	Gage Pressure	0.000% FS Gage to 100.000% FS Gage pressure
	Absolute Pressure	1.000% FSAbsolute to 100.000% FS Absolute pressure
6010-264X	Gage Pressure	0.000% FS Gage to 100.000% FS Gage pressure
	Absolute Pressure	1.000% FSAbsolute to 100.000% FS Absolute pressure
6010-166X	Gage or Abs. Press.	10.000% FS to 100.000% FS pressure
6010-168X	Gage or Abs. Press	10.000% FS to 100.000% FS pressure

Table 3-8

Performance Specifications: General Parameters

Parameter	Value	Applicable Model No.	Note
Maximum Resolution	0.001% FS	All 6000 and 6010	1
Maximum Non-Repeatability	See Table 3-9	See Table 3-9	2, 3
Maximum Non-Linearity	See Table 3-10	See Table 3-10	2, 3
Maximum Hysteresis	< 0.000% FS	all 6000 and 6010	2, 3
Maximum Dead Band	< 0.000% FS	all 6000 and 6010	2, 3
Maximum Offset (zero) Drift	≤ 0.004% / 24 hrs.	All 6000 and 6010	2, 3
Maximum Sensitivity (Span) Drift	See Table 3-11	See Table 3-11	2, 3
Maximum Reference Pressure Zero Shift	See Table 3-12	See Table 3-12	2, 3
Maximum Reference Pressure Sensitivity Shifts	See Table 3-13	See Table 3-13	2, 3
Maximum Line Voltage Zero Shifts	< 0.000% FS	all 6000 and 6010	
Maximum Line Voltage Sensitivity Shift	<0.000% FS	all 6000 and 6010	
Maximum Thermal Zero Shift	≤ ± 0.002% FS	all 6000 and 6010	2, 3, 7
Maximum Thermal Sensitivity Shift	≤ ± 0.007% RDG	all 6000 and 6010	2, 3
Maximum Attitude (tilt) Zero Shift	≤ ± 0.002% FS/Degree	all 6000 and 6010 except Note 4	2, 3, 4
Maximum Attitude (Tilt) Sensitivity Shift	≤ ± 0.002% RDG/Degree	all 6000 and 6010	2, 3

Table 3-8 (Cont.)

Parameter	Value	Applicable Model No.	Note
Maximum Measure Mode Noise	≤ 0.001% FS	all	1, 2, 3, 4, 6
Maximum Control Mode Noise	See Table 3-19	6010 only	1, 2, 4, 6
Measure Mode Band Width	≥ 4 Hz	all	1, 2, 3, 4, 5
Control Mode Band Width	≥ 1 Hz	6010 only	1, 2, 4, 5
Measure Mode Settling Time	See Table 3-14	all	
Control Mode Settling Time	See Table 3-15	6010 only	
Maximum Case Evacuation Time	See Table 3-16	all	
Maximum Measure Mode Leakage Rate	See Table 3-17	all	
Maximum Control Mode Leakage Rate	≤ 0.025 scim/atm	6010 only	
Maximum Measure Mode Overshoot	≤ 0.000% FS	all	
Maximum Control Mode Overshoot	≤ Control Mode Noise	6010 only	
Maximum Control Mode Non-Monotonicity	No limit	6010 only	
Steady State Flow	See Table 3-18	6010 only	

NOTES:

1. This applies to factory test resolution based on a 10.0000 VDC FS output. If ordered direct reading less than 10 VDC the resolution will decrease, also resolution can be slightly increased if ordered with greater than 10 VDC output, up to 11.5 VDC.
2. These values represent the parameter's maximum total effect on the indicated output of the measure mode or the actual pressure output of the control mode. Therefore, the error does not double when used both in the measure and control modes.
3. This value specified is dependent in the case of hydraulic fluid units, upon knowing all head levels and changes in head levels due to temperature or pressure to within 0.1 mm, and applying compensations.
4. The value is ≤ ± 0.012% FS for 6000-183, -283, -383, -483, -158, -258, -358, -458, -558, and -658 hydraulic units.
5. This value has not been thoroughly tested and is subject to change.
6. The actual noise component is a statistically derived value calculated from a random sample of a minimum of 100 instrument output values while the input remains constant. This value is inclusive of the output's measurement standard used. The standard deviation of the sample values time 2.12 is the reported noise level of the output indication of the measure mode, while the standard deviation of the sample values times 1.65 is the reported noise level of the output pressure of the control mode.
7. The value is ≤ ± 0.01% FD for 6000-183, -283, -383, -483, -158, -258, -358, -458, -558, and -658 hydraulic units.

Table 3-9

Non-Repeatability

Model Number	Maximum Non-Repeatability	Model Number	Maximum Non-Repeatability
6010-161X	≤ ± 0.002% FS	6010-250X	≤ ± 0.002% FS
6010-261X	≤ ± 0.003% FS	6010-350X	≤ ± 0.002% FS
6010-1601X	≤ ± 0.003% FS	6010-154X	≤ ± 0.002% FS
6010-1600X	≤ ± 0.002% FS	6000-254X	≤ ± 0.002% FS
6010-2600X	≤ ± 0.002% FS	6000-156X	≤ ± 0.002% FS
6010-1640X	≤ ± 0.002% FS	6000-256X	≤ ± 0.002% FS
6010-2640X	≤ ± 0.002% FS	6000-172X	≤ ± 0.002% FS
6010-1660X	≤ ± 0.002% FS	6000-272X	≤ ± 0.002% FS
6010-1680X	≤ ± 0.002% FS	6000-372X	≤ ± 0.002% FS
6010-1700X	≤ ± 0.002% FS	6000-472X	≤ ± 0.002% FS
6010-160X	≤ ± 0.002% FS	6000-183X	≤ ± 0.002% FS*
6010-260X	≤ ± 0.002% FS	6000-283X	≤ ± 0.002% FS*
6010-360X	≤ ± 0.002% FS	6000-383X	≤ ± 0.002% FS*
6010-164X	≤ ± 0.002% FS	6000-483X	≤ ± 0.002% FS*
6010-264X	≤ ± 0.002% FS	6000-158X	≤ ± 0.002% FS*
6000-166X	≤ ± 0.002% FS	6000-258X	≤ ± 0.002% FS*
6000-168X	≤ ± 0.002% FS	6000-358X	≤ ± 0.002% FS*
6000-151X	≤ ± 0.002% FS	6000-458X	≤ ± 0.002% FS*
6000-251X	≤ ± 0.003% FS	6000-558X	≤ ± 0.002% FS*
6000-1501X	≤ ± 0.003% FS	6000-658X	≤ ± 0.002% FS*
6000-150X	≤ ± 0.002% FS	* Note: The values specified are dependent upon knowing all head levels and changes in head levels due to temperature or pressure to within 0.1 mm.	

Table 3-10

Non-Linearity

Model Number	Maximum Non-Linearity	Model Number	Maximum Non-Linearity
6010-161X	≤ ± 0.001% FS	6000-250X	≤ ± 0.001% FS
6010-261X	≤ ± 0.002% FS	6000-350X	≤ ± 0.001% FS
6010-1601X	≤ ± 0.005% FS	6000-154X	≤ ± 0.001% FS
6010-1600X	≤ ± 0.001% FS	6000-254X	≤ ± 0.001% FS
6010-2600X	≤ ± 0.001% FS	6000-156X	≤ ± 0.001% FS
6010-1640X	≤ ± 0.001% FS	6000-256X	≤ ± 0.001% FS
6010-2640X	≤ ± 0.001% FS	6000-172X	≤ ± 0.002% FS
6010-1660X	≤ ± 0.001% FS	6000-272X	≤ ± 0.002% FS
6010-1680X	≤ ± 0.001% FS	6000-372X	≤ ± 0.002% FS
6010-1700X	≤ ± 0.001% FS	6000-472X	≤ ± 0.002% FS
6010-160X	≤ ± 0.001% FS	6000-183X	≤ ± 0.002% FS*
6010-260X	≤ ± 0.001% FS	6000-283X	≤ ± 0.002% FS*
6010-360X	≤ ± 0.001% FS	6000-383X	≤ ± 0.002% FS*
6010-164X	≤ ± 0.001% FS	6000-483X	≤ ± 0.002% FS*
6010-264X	≤ ± 0.001% FS	6000-158X	≤ ± 0.002% FS*
6010-166X	≤ ± 0.001% FS	6000-258X	≤ ± 0.002% FS*
6010-168X	≤ ± 0.001% FS	6000-358X	≤ ± 0.002% FS*
6000-151X	≤ ± 0.001% FS	6000-458X	≤ ± 0.002% FS*
6000-251X	≤ ± 0.002% FS	6000-558X	≤ ± 0.002% FS*
6000-1501X	≤ ± 0.001% FS	6000-658X	≤ ± 0.002% FS*
6000-150X	≤ ± 0.001% FS	* Note: The values specified are dependent upon knowing all head levels and changes in head levels due to temperature or pressure to within 0.1 mm.	

Table 3-11

Sensitivity Drift

Model Number	Maximum Sensitivity Drift	Model Number	Maximum Sensitivity Drift
6010-161X	≤ ± 0.004% RDG / 180 days	6000-250X	≤ ± 0.004% RDG / 180 days
6010-261X	≤ ± 0.004% RDG / 180 days	6000-350X	≤ ± 0.004% RDG / 180 days
6010-1601X	≤ ± 0.006%RDG / 180 days	6000-154X	≤ ± 0.004% RDG / 180 days
6010-1600X	≤ ± 0.004% RDG / 180 days	6000-254X	≤ ± 0.004% RDG / 180 days
6010-2600X	≤ ± 0.004% RDG / 180 days	6000-156X	≤ ± 0.004% RDG / 180 days
6010-1640X	≤ ± 0.004% RDG / 180 days	6000-256X	≤ ± 0.004% RDG / 180 days
6010-2640X	≤ ± 0.004% RDG / 180 days	6000-172X	≤ ± 0.004% RDG / 180 days
6010-1660X	≤ ± 0.004% RDG / 180 days	6000-272X	≤ ± 0.004% RDG / 180 days
6010-1680X	≤ ± 0.004% RDG / 180 days	6000-372X	≤ ± 0.004% RDG / 180 days
6010-1700X	≤ ± 0.004% RDG / 180 days	6000-472X	≤ ± 0.004% RDG / 180 days
6010-160X	≤ ± 0.004% RDG / 180 days	6000-183X	≤ ± 0.004% RDG / 180 days
6010-260X	≤ ± 0.004% RDG / 180 days	6000-283X	≤ ± 0.004% RDG / 180 days
6010-360X	≤ ± 0.004% RDG / 180 days	6000-383X	≤ ± 0.004% RDG / 180 days
6010-164X	≤ ± 0.004% RDG / 180 days	6000-483X	≤ ± 0.004% RDG / 180 days
6010-264X	≤ ± 0.004% RDG / 180 days	6000-158X	≤ ± 0.004% RDG / 180 days
6010-166X	≤ ± 0.004% RDG / 180 days	6000-258X	≤ ± 0.004% RDG / 180 days
6010-168X	≤ ± 0.004% RDG / 180 days	6000-358X	≤ ± 0.004% RDG / 180 days
6000-151X	≤ ± 0.004% RDG / 180 days	6000-458X	≤ ± 0.004% RDG / 180 days
6000-251X	≤ ± 0.004% RDG / 180 days	6000-558X	≤ ± 0.004% RDG / 180 days
6000-1501X	≤ ± 0.004% RDG / 180 days	6000-658X	≤ ± 0.004% RDG / 180 days
6000-150X	≤ ± 0.004% RDG / 180 days		

Table 3-12

Reference Pressure Zero Shift

Model Number	Maximum Reference Pressure Zero Shift	Model Number	Maximum Reference Pressure Zero Shift
6010-161X	NA	6000-250X	≤ ± 0.010% FS / 30 inHg
6010-261X	NA	6000-350X	≤ ± 0.010% FS / 30 inHg
6010-1601X	NA	6000-154X	≤ ± 0.010% FS / 30 inHg
6010-1600X	NA	6000-254X	≤ ± 0.010% FS / 30 inHg
6010-2600X	NA	6000-156X	≤ ± 0.010% FS / 30 inHg
6010-1640X	NA	6000-256X	≤ ± 0.010% FS / 30 inHg
6010-2640X	NA	6000-172X	≤ ± 0.080% FS / 100 psi
6010-1660X	NA	6000-272X	≤ ± 0.080% FS / 100 psi
6010-1680X	NA	6000-372X	≤ ± 0.080% FS / 100 psi
6010-1700X	NA	6000-472X	≤ ± 0.080% FS / 100 psi
6010-160X	≤ ± 0.010% FS / 30 inHg	6000-183X	≤ ± 0.080% FS / 100 psi
6010-260X	≤ ± 0.010% FS / 30 inHg	6000-283X	≤ ± 0.080% FS / 100 psi
6010-360X	≤ ± 0.010% FS / 30 inHg	6000-383X	≤ ± 0.080% FS /100 psi
6010-164X	≤ ± 0.010% FS / 30 inHg	6000-483X	≤ ± 0.080% FS / 100 psi
6010-264X	≤ ± 0.010% FS / 30 inHg	6000-158X	≤ ± 0.010% FS / 30 inHg
6010-166X	≤ ± 0.010% FS / 30 inHg	6000-258X	≤ ± 0.010% FS / 30 inHg
6010-168X	≤ ± 0.010% FS / 30 inHg	6000-358X	≤ ± 0.010% FS / 30 inHg
6000-151X	NA	6000-458X	≤ ± 0.010% FS / 30 inHg
6000-251X	NA	6000-558X	≤ ± 0.010% FS / 30 inHg
6000-1501X	NA	6000-658X	≤ ± 0.010% FS / 30 inHg
6000-150X	≤ ± 0.010% FS / 30 inHg		

Table 3-13

Reference Pressure Sensitivity Shifts

Model Number	Maximum Reference Pressure Sensitivity Shift	Model Number	Maximum Reference Pressure Sensitivity Shift
6010-161X	NA	6000-250X	≤ ± 0.000% RDG / 30 inHg
6010-261X	NA	6000-350X	≤ ± 0.000% RDG / 30 inHg
6010-1601X		6000-154X	≤ ± 0.000% RDG / 30 inHg
6010-1600X	NA	6000-254X	≤ ± 0.000% RDG / 30 inHg
6010-2600X	NA	6000-156X	≤ ± 0.000% RDG / 30 inHg
6010-1640X	NA	6000-256X	≤ ± 0.000% RDG / 30 inHg
6010-2640X	NA	6000-172X	≤ ± 0.015% RDG / 100 psi
6010-1660X	NA	6000-272X	≤ ± 0.015% RDG / 100 psi
6010-1680X	NA	6000-372X	≤ ± 0.015% RDG / 100 psi
6010-1700X	NA	6000-472X	≤ ± 0.015% RDG / 100 psi
6010-160X	≤ ± 0.000% RDG / 30 inHg	6000-183X	≤ ± 0.080% RDG / 100 psi
6010-260X	≤ ± 0.000% RDG / 30 inHg	6000-283X	≤ ± 0.080% RDG / 100 psi
6010-360X	≤ ± 0.000% RGD / 30 inHg	6000-383X	≤ ± 0.080% RDG / 100 psi
6010-164X	≤ ± 0.000% RDG / 30 inHg	6000-483X	≤ ± 0.080% RDG / 100 psi
6010-264X	≤ ± 0.000% RDG / 30 inHg	6000-158X	≤ ± 0.000% RDG / 30 inHg
6010-166X	≤ ± 0.000% RDG / 30 inHg	6000-258X	≤ ± 0.000% RDG / 30 inHg
6010-168X	≤ ± 0.000% RDG / 30 inHg	6000-358X	≤ ± 0.000% RDG / 30 inHg
6000-151X	NA	6000-458X	≤ ± 0.000% RDG / 30 inHg
6000-251X	NA	6000-558X	≤ ± 0.000% RDG / 30 inHg
6000-1501X	NA	6000-658X	≤ ± 0.000% RDG / 30 inHg
6000-150X	≤ ± 0.000% RDG / 30 inHg		

Table 3-14

Measure Mode Settling Time

Model Number	100% Step	100% Step	10% Step	Ref. Pres. Step
6010-161X	0.01% FS ≤ 10 sec*	0.002% FS ≤ 15 sec*	0.002% FS ≤ 10 sec	NA
6010-261X	0.03% FS ≤ 10 sec*	0.003% FS ≤ 15 sec*	0.003% FS ≤ 10 sec	NA
6010-1601X	0.01% FS ≤ 10 sec	0.003% FS ≤ 15 sec	0.003% FS ≤ 10 sec	NA
6010-1600X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	NA
6010-2600X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	NA
6010-1640X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	NA
6010-2640X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	NA
6010-1660X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	NA
6010-1680X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	NA
6010-1700X	0.01% FS ≤ 10 sec*	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	NA
6010-160X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6010-260X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6010-360X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6010-164X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6010-264X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6010-166X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6010-168X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6000-151X	0.01% FS ≤ 10 sec*	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	NA
6000-251X	0.03% FS ≤ 10 sec*	0.003% FS ≤ 15 sec	0.003% FS ≤ 10 sec	NA
6000-1501X	0.01% FS ≤ 10 sec*	0.003% FS ≤ 15 sec	0.003% FS ≤ 10 sec	NA
6000-150X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6000-250X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6000-350X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6000-154X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6000-254X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6000-156X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6000-256X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6000-172X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.01% FS ≤ 30 min.
6000-272X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.01% FS ≤ 30 min.
6000-372X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.01% FS ≤ 30 min.

* Note: Absolute units verified by largest step possible to ambient pressure.

Table 3-14

Measure Mode Settling Time (Cont.)

Model Number	100% Step	100% Step	10% Step	Ref. Pres. Step
6000-472X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.01% FS ≤ 30 min.
6000-183X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.01% FS ≤ 30 min.
6000-283X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.01% FS ≤ 30 min.
6000-383X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.01% FS ≤ 30 min.
6000-483X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.01% FS ≤ 30 min.
6000-158X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6000-258X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6000-358X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6000-458X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6000-558X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.
6000-658X	0.01% FS ≤ 10 sec	0.002% FS ≤ 15 sec	0.002% FS ≤ 10 sec	0.002% FS ≤ 5 min.

* Note: Absolute units verified by largest step possible to ambient pressure.

Table 3-15
Control Mode Settling Time

Model Number	Gage Pressure to Control Limits	Absolute Pressure to Control Limits
6010-161X①	NA	Low to high ≤ 90 sec to ≤ 0.01% FS High to low ≤ 130 sec to ≤ 0.01% FS
6010-261X①	NA	Low to high ≤ 90 sec to ≤ 0.03% FS High to low ≤ 130 sec to ≤ 0.03% FS
6010-1601X	Bidirectional ≤ 90 sec to ≤ 0.02% FS	NA
6010-1600X	Bidirectional ≤ 90 sec to ≤ 0.01% FS	NA
6010-2600X	Bidirectional ≤ 90 sec to ≤ 0.01% FS	NA
6010-1640X	Bidirectional ≤ 240 sec to ≤ 0.01% FS	NA
6010-2640X	Bidirectional ≤ 240 sec to ≤ 0.01% FS	NA
6010-1660X	Bidirectional ≤ 240 sec to ≤ 0.01% FS	NA
6010-1680X	Bidirectional ≤ 240 sec to ≤ 0.01% FS	NA
6010-1700X①	Bidirectional ≤ 130 sec to ≤ 0.01% FS	NA
6010-160X①	Bidirectional ≤ 90 sec to ≤ 0.01% FS	Low to high ≤ 90 sec to ≤ 0.01% FS High to low ≤ 130 sec to ≤ 0.01% FS
6010-260X①	Bidirectional ≤ 90 sec to ≤ 0.01% FS	Low to high ≤ 90 sec to ≤ 0.01% FS High to low ≤ 130 sec to ≤ 0.01% FS
6010-360X①	Bidirectional ≤ 90 sec to ≤ 0.01% FS	Low to high ≤ 90 sec to ≤ 0.01% FS High to low ≤ 130 sec to ≤ 0.01% FS
6010-164X	Bidirectional ≤ 240 sec to ≤ 0.01% FS	Bidirectional ≤ 240 sec to ≤ 0.01% FS
6010-264X	Bidirectional ≤ 240 sec to ≤ 0.01% FS	Bidirectional ≤ 240 sec to ≤ 0.01% FS
6010-166X	Bidirectional ≤ 240 sec to ≤ 0.01% FS	Bidirectional ≤ 240 sec to ≤ 0.01% FS
6010-168X	Bidirectional ≤ 240 sec to ≤ 0.01% FS	Bidirectional ≤ 240 sec to ≤ 0.01% FS

① Note: When commanded pressure points are equal to or less than the equivalent of 1 psia, an additional 30 seconds of up to 0.03% or 0.01% FS Control Mode Pressure Creep is acceptable if the control mode noise is at a passing level within 30 seconds ot the unit's actual control mode settling time to that pressure point. This specifications does not however, supercede the interface's requirement to send a read light pressure ready signal only upon achieving a pressure that is within the control mode noise tolerance limit.

Table 3-16
Case Evacuation Time

Model Number	Max. Time with ≥ 12 hrs drying time to ≤ 100 mT	Model Number	Max. Time with ≥ 12 hrs drying time to ≤ 100 mT
6010-161X	3 min.*	6000-250X	3 min
6010-261X	3 min*	6000-350X	3 min
6010-1601X	NA	6000-154X	3 min
6010-1600X	NA	6000-254X	3 min
6010-2600X	NA	6000-156X	3 min
6010-1640X	NA	6000-256X	3 min
6010-2640X	NA	6000-172X	NA
6010-1660X	NA	6000-272X	NA
6010-1680X	NA	6000-372X	NA
6010-1700X	NA	6000-472X	NA
6010-160X	3 min	6000-183X	NA
6010-260X	3 min	6000-283X	NA
6010-360X	3 min	6000-383X	NA
6010-164X	3 min	6000-483X	NA
6010-264X	3 min	6000-158X	3 min
6010-166X	3 min	6000-258X	3 min
6010-168X	3 min	6000-358X	3 min
6000-151X	3 min*	6000-458X	3 min
6000-251X	3 min*	6000-558X	3 min
6000-1501X	NA	6000-658X	3 min
6000-150X	3 min		

* using the zeroing position

Table 3-17

Measure Mode Leakage Rate

Model Number	Test Pressure Rate	Reference Pressure Rate
6010-161X	≤ ± 0.0004 scim / atm of exposure	NA
6010-261X	≤ ± 0.0004 scim / atm of exposure	NA
6010-1601X	≤ - 0.0004 scim / atm of exposure	NA
6010-1600X	≤ - 0.0004 scim / atmof exposure	NA
6010-2600X	≤ - 0.0004 scim / atmof exposure	NA
6010-1640X	≤ - 0.0004 scim / atmof exposure	NA
6010-2640X	≤ - 0.0004 scim / atm of exposure	NA
6010-1660X	≤ - 0.0004 scim / atm of exposure	NA
6010-1680X	≤ - 0.0004 scim / atm of exposure	NA
6010-1700X	≤ ± 0.0004 scim / atm of exposure	NA
6010-160X	≤ ± 0.0004 scim / atm of exposure	≤ + 0.0004 scim / atm of exposure
6010-260X	≤ ± 0.0004 scim / atm of exposure	≤ + 0.0004 scim / atm of exposure
6010-360X	≤ ± 0.0004 scim / atm of exposure	≤ + 0.0004 scim / atm of exposure
6010-164X	≤ ± 0.0004 scim / atm of exposure	≤ + 0.0004 scim / atm of exposure
6010-264X	≤ ± 0.0004 scim / atm of exposure	≤ + 0.0004 scim / atm of exposure
6010-166X	≤ ± 0.0004 scim / atm of exposure	≤ + 0.0004 scim / atm of exposure
6010-168X	≤ ± 0.0004 scim / atm of exposure	≤ + 0.0004 scim / atm of exposure
6000-151X	≤ ± 0.0004 scim / atm of exposure	NA
6000-251X	≤ ± 0.0004 scim / atm of exposure	NA
6000-1501X	≤ - 0.0004 scim / atm of exposure	NA
6000-150X	≤ ± 0.0004 scim / atm of exposure	≤ ± 0.0004 scim / atm of exposure
6000-250X	≤ ± 0.0004 scim / atm of exposure	≤ ± 0.0004 scim / atm of exposure
6000-350X	≤ ± 0.0004 scim / atm of exposure	≤ ± 0.0004 scim / atm of exposure
6000-154X	≤ ± 0.0004 scim / atm of exposure	≤ ± 0.0004 scim / atm of exposure
6000-254X	≤ ± 0.0004 scim / atm of exposure	≤ ± 0.0004 scim / atm of exposure
6000-156X	≤ ± 0.0004 scim / atm of exposure	≤ ± 0.0004 scim / atm of exposure
6000-256X	≤ ± 0.0004 scim / atm of exposure	≤ ± 0.0004 scim / atm of exposure
6000-172X	≤ ± 0.0004 scim / atm of exposure	≤ ± 0.0004 scim / atm of exposure
6000-272X	≤ ± 0.0004 scim / atm of exposure	≤ ± 0.0004 scim / atm of exposure
6000-372X	≤ ± 0.0004 scim / atm of exposure	≤ ± 0.0004 scim / atm of exposure
6000-472X	≤ ± 0.0004 scim / atm of exposure	≤ ± 0.0004 scim / atm of exposure

Table 3-17

Measure Mode Leakage Rate (Cont.)

Model Number	Test Pressure Rate	Reference Pressure Rate
6000-183X	No visual fluid leakage per 5 min.	No visual fluid leakage per 5 min.
6000-283X	No visual fluid leakage per 5 min.	No visual fluid leakage per 5 min.
6000-383X	No visual fluid leakage per 5 min.	No visual fluid leakage per 5 min.
6000-483X	No visual fluid leakage per 5 min.	No visual fluid leakage per 5 min.
6000-158X	No visual fluid leakage per 5 min.	≤ + 0.0004 scim / atm of exposure
6000-258X	No visual fluid leakage per 5 min.	≤ + 0.0004 scim / atm of exposure
6000-358X	No visual fluid leakage per 5 min.	≤ + 0.0004 scim / atm of exposure
6000-458X	No visual fluid leakage per 5 min.	≤ + 0.0004 scim / atm of exposure
6000-558X	No visual fluid leakage per 5 min.	≤ + 0.0004 scim / atm of exposure
6000-658X	No visual fluid leakage per 5 min.	≤ + 0.0004 scim / atm of exposure

Note: Measure mode Leakage Rates are toleranced to not produce more than an additional 0.03 in. per minute fall rate to the normal fall rate of the worst case DWG piston and cylinder combination.

Note: All visual fluid leakage rates are verified at the maximum Test pressure and Reference pressure combinations.

Table 3-18
Steady State Flow

Model Number	Steady State Flow
6010-161X	≤ 8.0 SCFH
6010-261X	≤ 27.0 SCFH
6010-1601X	≤ 8.0 SCFH
6010-1600X	≤ 8.0 SCFH
6010-2600X	≤ 10.0 SCFH
6010-1640X	≤ 20.0 SCFH
6010-2640X	≤ 21.0 SCFH
6010-1660X	≤ 10.0 SCFH
6010-1680X	≤ 10.0 SCFH
6010-1700X	≤ 8.0 SCFH
6010-160X	≤ 8.0 SCFH
6010-260X	≤ 8.0 SCFH
6010-360X	≤ 10.0 SCFH
6010-164X	≤ 20.0 SCFH
6010-264X	≤ 21.0 SCFH
6010-166X	≤ 10.0 SCFH
6010-168X	≤ 10.0 SCFH

15-50 A
50-100 A
5-20
20-60
60-100
100-250
250-500
500-1000
1000-2500

Table 3-19
Control Mode Noise

Model Number	Control Mode Noise
6010-161X	≤ 0.001% FS
6010-261X	≤ 0.001% FS
6010-1601X	≤ 0.007% FS
6010-1600X	≤ 0.001% FS
6010-2600X	≤ 0.001% FS
6010-1640X	≤ 0.001% FS
6010-2640X	≤ 0.001% FS
6010-1660X	≤ 0.004% FS
6010-1680X	≤ 0.004% FS
6010-1700X	≤ 0.001% FS
6010-160X	≤ 0.001% FS
6010-260X	≤ 0.001% FS
6010-360X	≤ 0.001% FS
6010-164X	≤ 0.001% FS
6010-264X	≤ 0.001% FS
6010-166X	≤ 0.004% FS
6010-168X	≤ 0.004% FS

SECTION 4

INSTALLATION

4.1 INTRODUCTION

This portion of the manual covers DPG installation. Installing the unit is a relatively simple process of first unpacking the DPG and its accompanying shipping kit (Section 4.2) and then making the necessary electrical and pneumatic connections to its rear panel (Sections 4.3 and 4.4).

NOTE: The DPG should not be subjected to mechanical shocks during installation or use. It should be mounted on a rigid bench or in a sturdy 19" relay rack. Although the ZERO potentiometer will compensate for slight out of level mounting, the DPG should be mounted to within 5° of level.

4.2 UNPACKING THE DPG & SHIPPING KIT

Carefully unpack all components, checking for obvious signs of damage. If necessary, report any shipping damage to the freight agency. Remove masking tape, strings, and packing materials from all components.

4.3 THE REAR PANEL

All electrical and pneumatic connections are made through the rear panel of the DPG (Figure 4-1).

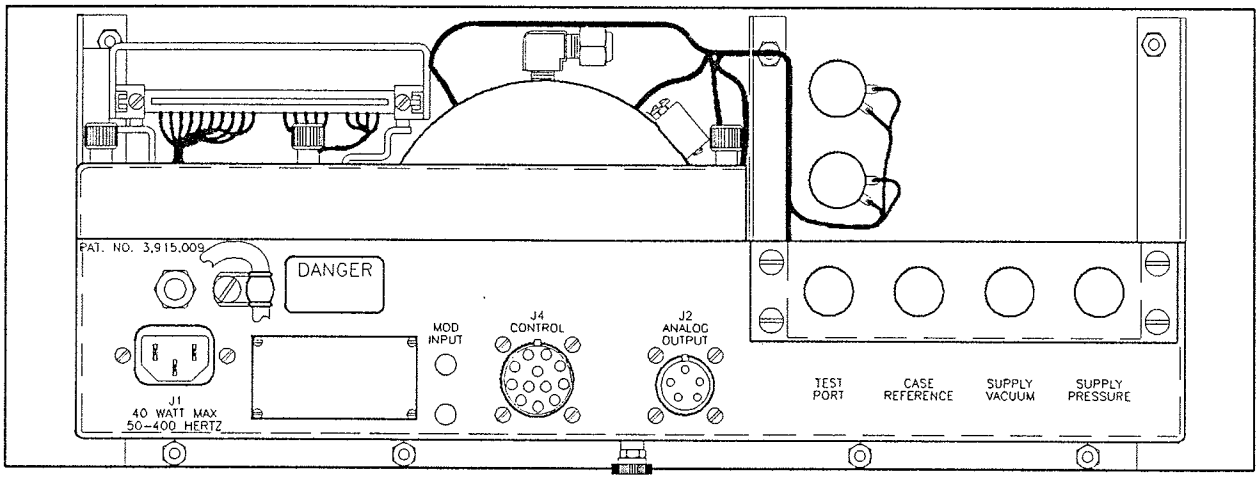

Figure 4-1
Rear Panel

With the exception of the POWER switch and the heater duty cycle lamp, knowledge of the front panel controls is not necessary for installing the DPG. For this reason, a schematic of the front panel is not presented until Section 5.2, where it will be of most use to the operator.

4.4 ELECTRICAL CONNECTIONS

All electrical connections are made through the rear panel of the DPG. The electrical connections are as follows.

- J1 - Power Cord Connection
- J2 Analog Output - MS Connector MS3102A14S-5S
- J4 Control - MS Connector MS3102A18-19P

NOTE: Grounding for the DPG is provided through the power cord.

4.4.1 CONNECTING THE POWER CORD

Plug the electrical power cord supplied with the DPG into an appropriate receptacle. If necessary, consult the specifications on input power requirements listed in Table 3-1. Next turn on the DPG by pushing the POWER switch on the front panel. After the heater duty cycle lamp on the front panel begins to turn off and on (0 to 2 hours after power up), allow an additional two hours for the DPG to stabilize at its operating temperature.

4.4.2 CONNECTING THE DIGITAL VOLTMETER

Connector J2 provides an analog output for the optional RUSKA Digital Voltmeter (Section 1.5). If a voltmeter other than the Ruska DVM is used, it must have the following characteristics.

- A common mode rejection ratio (CMRR) of 140 dB or greater
- A range of 0-10 VDC
- An input impedance of 10 MΩ or greater
- An operating temperature range of 18 to 28°C

A 5 1/2 digit voltmeter can provide a resolution of 0.001% of the DPG's full scale. Likewise, a 4 1/2 digit voltmeter can produce a resolution 0.01%FS.

If a Ruska DVM will not be used, connect the cable provided for J2 to the digital voltmeter as follows.

1. Connect the red wire (Pin A of J2) to the voltmeter HIGH terminal.
2. Connect the white wire (Pin B of J2) to the voltmeter LOW terminal.
3. Connect the wire shield (Pin C of J2) to the voltmeter GUARD terminal. If the voltmeter does not have a Guard terminal, connect the wire shield and the white wire to the LOW terminal. If the voltmeter has a GUARD terminal, do not connect a jumper between the LOW and GUARD terminals.

4. If the voltmeter requires a connection to the analog common of the source, connect the black wire (Pin D of J2) to the analog common terminal of the voltmeter. If the voltmeter does not require such a connection, cut and insulate the black wire.

4.4.2.1 Digital Voltmeter Connections

Refer to Figure 4-2 for Digital Voltmeter connections for Series 6000 DPG's.

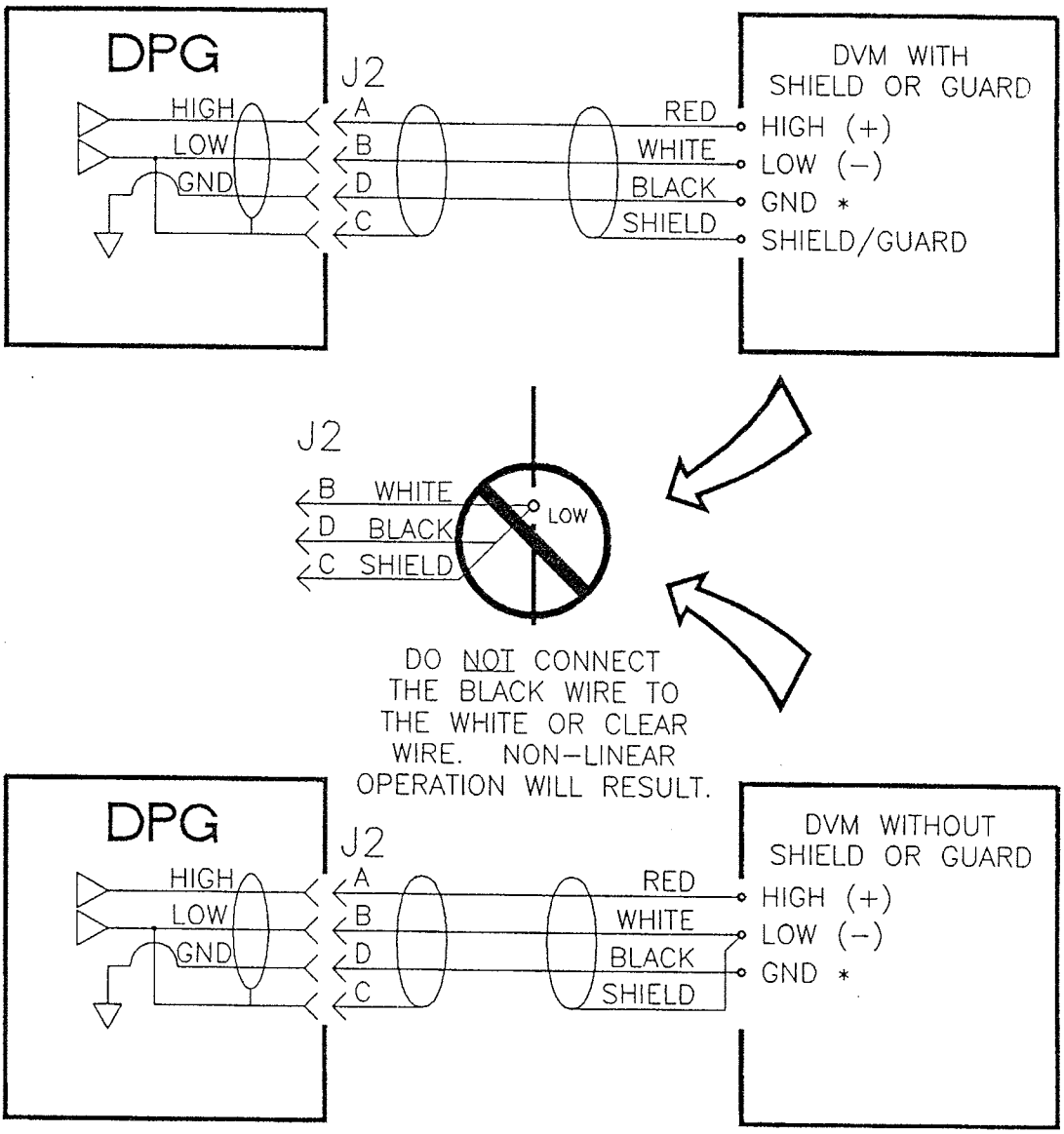

FIGURE 4-2
SERIES 6000 DPG — DIGITAL VOLTMETER CONNECTIONS

4.4.3 CONNECTING THE INTERFACE PANEL

When the optional RUSKA Interface Panel is used (Section 1.5), connector J2 provides the analog output, and connector J4 provides remote I/O.

4.5 PNEUMATIC CONNECTIONS

NOTE: Once the DPG is installed, it is recommended that the user review the troubleshooting checklist mentioned in Section 7.1, "Preventive Maintenance."

All pneumatic connections are also made through the rear manifold of the DPG. The four pneumatic ports are listed below.

- Test Port
- Case Reference Port (not on Absolute models)
- Supply Vacuum Port (not on measure-only models)
- Supply Pressure Port(not on measure-only models)

These ports are tapped for 1/4" NPT female fittings.

NOTE: To install High Line Differential* models of the DPG, consult Section 6.

4.5.1 CONNECTING THE TEST PORT

Connect the device under test to the TEST PORT. For pneumatic measurements, make sure that the gas being tested meets the requirements for medium, moisture content, and hydrocarbon content listed in Table 3-1.

4.5.2 CONNECTING THE CASE REFERENCE PORT

NOTE: Absolute* models of the DPG do not have this port.

4.5.2.1 Absolute Measurements

If a differential DPG* is being used to measure absolute pressures, a vacuum pump must be used to create a reference vacuum in the sensor case. To do this, connect the vacuum pump to the port labeled CASE REF. A two-stage vacuum pump which meets the specifications for Reference Capacities listed in Table 3-2 is normally used.

Pumps smaller than those listed in the specification can be used, but there will be a corresponding increase in the time required to establish the vacuum reference.

If the pump being used cannot achieve the ultimate Vacuum Reference Capability listed in Table 3-2, monitor the reference vacuum with a vacuum sensor, and make the following

* Definitions for absolute, gage, differential, and ΔP high line differential are provided in Section 1.6

correction to the system pressure reading. To obtain the actual system pressure, add the amount shown on the vacuum sensor readout to the value indicated by the Digital Voltmeter or Interface Panel.

NOTE: If a differential DPG* is being used to measure absolute pressures, the tubing connected to the CASE REF port should be 1/4" ID minimum. If larger tubing is used, vacuum will be achieved more quickly.

4.5.2.2 Gage Measurements

If a differential DPG* is being used to measure gage pressures, both the CASE REF port on the DPG and the reference port on the device under test should be open to ambient. If necessary, consult the Applicable Reference Pressures listed in Table 3-6. For accurate measurements, the device under test should also be placed at the same elevation as the DPG.

4.5.3 CONNECTING THE SUPPLY VACUUM

NOTE: Measure-only models of the DPG do not have this port.

4.5.3.1 Differential Measurements

If a differential DPG* is being used, connect a vacuum pump to the SUPPLY VAC port. This pump is used in CONTROL mode to supply vacuum to the servovalve. A vacuum pump which meets the specifications for Vacuum Supply Capacities listed in Table 3-2 is normally used.

4.5.4 CONNECTING THE SUPPLY PRESSURE

NOTE: Measure-only models of the DPG do not have this port.

Connect the SUPPLY PRESS port to a regulated gas supply which meets the requirements for medium, moisture content, and hydrocarbon content listed in Table 3-1. To select the Supply Pressure Value, consult Table 3-3.

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* Definitions for absolute, gage, differential, and ΔP high line differential are provided in Section 1.6

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SECTION 5
OPERATION

5.1 INTRODUCTION

Section 5 assumes that the DPG has been installed according to Section 4. This portion of the manual presents the front panel controls (Section 5.2) and provides instructions for operating the DPG (Sections 5.3 through 5.7). Important precautions are listed in Section 5.3. The daily process of zeroing the unit is described in Section 5.4, and Sections 5.5 and 5.6 describe measuring and controlling pressure. Finally Section 5.7 provides a means of correcting for pressure gradients.

5.2 FRONT PANEL CONTROLS

The DPG's front panel controls are shown in Figure 5-1. Not all DPG's will have all of the controls shown in this figure.

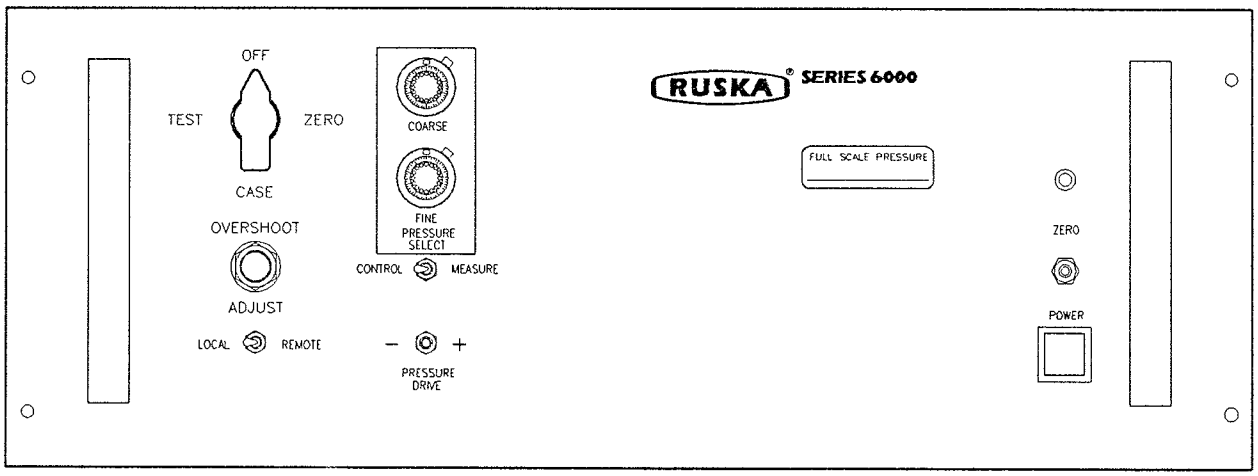

Figure 5-1
Front Panel Controls

POWER switch — turns the DPG on or off. Once the DPG is on, it is designed to be left on continuously.

CIRCUIT BREAKER (not shown) — located on rear panel above power cord connector.

ZERO potentiometer — A small screwdriver should be used to zero the DPG (Section 5) each day it is used or any time it is tilted or relocated.

Heater Duty Cycle Lamp — indicates when the heater for the quartz Bourdon tube assembly turns on. It is perfectly normal for this this lamp to turn off and on during operation.

PRESSURE SELECT, COARSE — Dial approximate desired pressure in CONTROL mode while observing Digital Voltmeter Readout. Dial numerals are for reference only.

PRESSURE SELECT, FINE — Dial exact desired pressure. This control may need to be readjusted slightly as pressure comes to exact level.

LOCAL/REMOTE SWITCH -- Select either LOCAL or REMOTE mode of operation.

Local CONTROL/MEASURE switch — configures the unit to either CONTROL or MEASURE pressure.

PRESSURE DRIVE SWITCH -- When the DPG is in CONTROL mode, this switch can be used to increase or decrease pressure around a given pressure. When the switch is actuated, system pressure will change accordingly. When the switch is released, system pressure will return to the original pressure. Operating this switch in the (+) and then the (-) direction and taking readings on the device being tested each time enables the operator to determine the dead band or hysteresis of the device at any pressure point.

3-WAY VALVE -- This valve is provided as a convenience in switching the user's supply vacuum pump to the internal transducer for zeroing the unit. It is used on absolute models only.

OVERSHOOT VALVE -- This valve limits the rate of flow to the output test port. It is used to adjust the system pneumatics to eliminate overshoot at the device under test.

5.3 CAUTIONS

1. The test port pressure should not exceed 110% of the sensor's full scale rating when using the DPG to measure pressure. Any excess pressure will be vented through a relief valve.
2. Always operate the DPG in a vibration-free location.
3. Care should be taken when checking inside the DPG. Touching electrical power wires inside the unit could cause electrical shock.
4. When the system is not in use for an extended period of time, but is not to be powered down, all ports should be capped to keep the pneumatic system dry.

5.4 ZEROING

It is recommended that the DPG be zeroed on a daily basis, but the zeroing interval may be altered by comparing the magnitude of Zero Drift to the user's allowable tolerance. Instructions for zeroing gage, differential, and absolute DPG's are given in the sections that follow. To zero a high line differential DPG, consult Section 6.

5.4.1 GAGE DPG'S

1. Configure the DPG the pressure measurement.
2. Make sure that the CASE REF port is open to atmosphere.
3. Open the TEST Port to atmosphere.
4. Use a small screwdriver to adjust ZERO potentiometer until the Interface Panel or Digital Voltmeter displays 0.000 %FS . If the potentiometer does not have enough travel to zero the gage, it is possible that the gage is not level or that the photocells need adjusting. If necessary, see Section 7, "Maintenance," for instructions.
5. The DPG is now ready for use.

5.4.2 DIFFERENTIAL DPG'S

5.4.2.1 GAGE Mode

1. Configure the DPG for pressure measurement.
2. Open a bypass between the TEST and CASE REF ports so that they are at the same pressure.
3. Use a small screwdriver to adjust the ZERO potentiometer until the Interface Panel or Digital Voltmeter displays 0.000 %FS. If the potentiometer does not have enough travel to zero the gage, it is possible that the gage is not level or that the photocells need adjusting. If necessary, see Section 7, "Maintenance," for instructions.
4. Close the bypass valve.
5. The DPG is now ready for use.

5.4.2.2 ABSOLUTE Mode

1. Configure the DPG for pressure measurement.
2. Apply a hard vacuum (below 100 microns) to both the TEST and CASE REF ports. Make sure that both ports have the same hard vacuum for a minimum of 5 minutes.
3. Use a small screwdriver to adjust the ZERO potentiometer until the Interface Panel or Digital Voltmeter displays 0.000 %FS. If the potentiometer does not have enough travel to zero the gage, it is possible that the gage is not level or that the photocells need adjusting. If necessary, see Section 7, "Maintenance," for instructions.
4. While keeping the CASE REF port at vacuum, isolate the TEST port from the CASE REF port. Next connect the TEST port to the test pressure, or open it to atmosphere.
5. The DPG is now ready for use.

5.4.3 ABSOLUTE DPG'S

1. Install a vacuum sensor in the fitting provided near the sensor.
2. Configure the DPG for pressure measurement.

3. Connect a vacuum pump to SUPPLY VAC and turn the 3-way valve on the front panel to zero. Pump until the vacuum gage attached to the Ruska sensor reads 100 microns or less and is relatively stable. A two-stage vacuum pump with a capacity of 50 to 150 liters per minute and an ultimate vacuum of 5 microns or better is usually used for this purpose. Smaller pumps can be used with a corresponding increase in time required. Tubing with a 1/2" OD is normally used for this. If larger tubing is used, vacuum will be achieved more quickly.

4. After the pump has pumped the sensor down to 100 microns or less, use a small screwdriver to adjust the ZERO potentiometer until the Interface Panel or Digital Voltmeter reads a pressure equivalent to that displayed by the vacuum sensor. For example, if the vacuum sensor reads 100 microns and the DPG is calibrated in psia, adjust the ZERO potentiometer until the reading is 0.002 psia. If the vacuum sensor reads 100 microns and the DPG is calibrated in inches of mercury absolute, adjust the ZERO potentiometer until the reading 0.004 inches of mercury absolute. For convenience in converting, 1 micron of mercury equals 39.3×10^{-6} inches of mercury and 19.3×10^{-6} psi.

   If the potentiometer does not have enough travel to zero the gage, it is possible that the gage is not level or that the photocells need adjusting. If necessary, see Section 7, "Maintenance," for instructions.

5. Return the 3-way valve on the front panel to the TEST position.

6. The DPG is now ready to use.

Note: When not in use, it is recommended to store with the 3-way valve on the front panel set to the OFF position, (straight up and down).

5.5 LOCALLY MEASURING PRESSURE

After the DPG has been installed as described in the preceding sections, verify the following.

1. The cautions listed in Section 5.3 have been observed.
2. The DPG has been allowed to warm up according to Table 3-4.
3. The medium being used to pressurize the system meets the requirements listed in Table 3-1.
4. The DPG has been zeroed according to Section 5.4.

Instructions for locally measuring pressure with a gage, differential, or absolute DPG are given below. Remote instructions are provided in the Interface Panel User's Manual. To measure pressure with a high line differential DPG, consult Section 6.

5.5.1 GAGE DPG'S

1. Make sure that the DPG is in MEASURE mode.
2. As pressure is admitted into the TEST PORT, the Digital Voltmeter or Interface Panel readout will change accordingly.

5.5.2 DIFFERENTIAL DPG'S

1. Make sure that the DPG is in MEASURE mode.

2. As pressure is admitted into the TEST PORT, the Digital Voltmeter or Interface Panel readout will change accordingly.
3. Pressure and vacuum surges in the CASE REF port should be avoided. The pressure inside the Bourdon tube can safely reach full scale in three seconds. If vacuum reference pressures are being used on the CASE REF. port, take at least three seconds to admit atmospheric pressure into this port.

5.5.3 ABSOLUTE DPG'S

1. Make sure that the DPG is in MEASURE mode.
2. Set the CASE 3-way valve on the front panel to TEST.
3. As pressure is admitted into the TEST PORT, the Digital Voltmeter or Interface Panel readout will change accordingly.
4. Pressure and vacuum surges in the TEST PORT should be avoided. The pressure inside the Bourdon tube can safely reach full scale in three seconds.

5.6 LOCALLY CONTROLLING PRESSURE

After the DPG has been installed as described in the preceding sections, verify the following:

1. The cautions listed in Section 5.3 have been observed.
2. The DPG has been allowed to warm up according to Table 3-4.
3. The DPG has been zeroed according to Section 5.4.
4. The medium being used to pressurize the system meets the requirements listed in Table 3-1.
5. The vacuum pump(s) are on.
6. The supply pressure meets the requirements listed in Table 3-3.
7. The supply pressure is on and regulated down to the pressure list in Table 3-3.

Instructions for locally controlling pressure with a gage, differential, or absolute DPG are given below. Remote instructions are provided in the Interface Panel User's Manual.

5.6.1 GAGE DPG'S

1. Make sure that the DPG is in CONTROL mode.
2. Using the COARSE and FINE PRESSURE SELECT dials found on the front panel of the DPG, set the Digital Voltmeter or Interface Panel readout to the desired pressure. As the system pressure approaches the desired pressure, the FINE PRESSURE SELECT dial may need to be reset slightly.
3. When the readout of the device under test stops traversing, it can be assumed that the DPG has stabilized system pressure.

5.6.2 DIFFERENTIAL DPG'S

1. Make sure that the DPG is in CONTROL mode.

2. Using the COARSE and FINE PRESSURE SELECT dials found on the front panel of the DPG, set the Digital Voltmeter or Interface Panel readout to the desired pressure. As the system pressure approaches the desired pressure, the FINE PRESSURE SELECT dial may need to be reset slightly.
3. When the readout of the device under test stops traversing, it can be assumed that the DPG has stabilized system pressure.

5.6.3 ABSOLUTE DPG'S

1. Set the 3-way valve on the front panel to TEST.
2. Make sure that the DPG is in CONTROL mode.
3. Using the COARSE and FINE PRESSURE SELECT dials, set the Digital Voltmeter or Interface Panel readout to the desired pressure. As the system pressure approaches the desired pressure, the FINE PRESSURE SELECT dial may need to be reset slightly.
4. When the readout of the device under test stops traversing, it can be assumed that the DPG has stabilized system pressure.

5.7 CORRECTION FOR PRESSURE GRADIENTS

Due to the fact that pressurized fluids (gas or liquid) have quantifiable densities (and therefore mass) one must consider the pressure gradients which arise from the influence of gravity on that mass.

The pneumatic reference plane for the DPG has been chosen to be at the center of the pressure sensor, which is approximately 3.33" from the bottom edge of the DPG front panel. Therefore all pressures measured or controlled by the DPG are known at this reference plane. The actual pressure at the system test port may be calculated from the knowledge of the physics of fluid columns.

5.7.1 GAGE MODE OPERATIONS

When performing gage mode operations the case reference is open to ambient through the Case Reference Port. The ultimate concern is to know what the actual pressure is at the device under test (DUT). If the DUT is not in the same reference plane as the DPG test port then corrections as exemplified below must be performed.

The pressure gradient Pg is mathematically described as

$$Pg = \delta \times K \times (\pm h)$$

where:

δ = density of fluid (kg/cm^3),

K = ratio of standard gravity to local gravity, and

h = vertical distance between the two reference planes (cm)

Due to the significant compressibility properties of gas the density will vary as a function of pressure. This relationship is given graphically in Figures 5-2 through 5-5. The K factor in the

above relationship may be virtually considered as one (1). Doing so will not introduce significant error into the calculation. Note that the vertical dimension h has a sign associated with it. In this application we are interested in knowing what the pressure is at the device under test. Therefore, dimensions which are above the DPG test port have a negative sign. Conversely, dimensions which are below the device under test will have positive sign.

As an example, we will compute the actual pressure at the device under test when the DPG is generating a pressure of 2,000 psi (13.7895 MPa). We can assume for this example that the DUT is 8 inches (20.32 cm) below the DPG test port. Therefore, the vertical distance h is +8 inches (+ 20.32 cm). To begin, convert psi to MPa and kg/cm^2:

$$\begin{aligned} 2000 \text{ psi} &= 13.7895 \text{ MPa} \quad (1 \text{ psi} = 0.070307 \text{ kg/cm}^2) \\ &= 140.613919 \text{ kg/cm}^2 \end{aligned}$$

Next this pressure is used to obtain δ

from the density chart: $\delta \cong 147 \text{ kg/m}^3 = 147 \times 10^{-6} \text{ kg/cm}^3$

Then, the pressure gradient is found to be

$$\begin{aligned} Pg &= \delta \times h \\ &= (147 \times 10^{-6}) \times (+20.32) \\ &= 0.00298704 \text{ kg/cm}^2. \end{aligned}$$

Hence, the pressure at the device under test will be greater than the pressure at the system reference plane by 0.00298704 kg/cm^2, or the pressure at the DUT is

$$\begin{aligned} &140.613919 + 0.00298704 \\ &= 140.616906 \text{ kg/cm}^2 \\ &= 2000.042486 \text{ psi}. \end{aligned}$$

From the above example, it can be seen that significant errors can be realized if these corrections are not considered. Therefore, if the requirement is to generate exactly 2,000 units at the device under test then the correction can be made by commanding the DPG to generate a pressure less than the amount of the correction, or 1999.958 units.

Equations for approximating d when the units of measure are psi are given in Figures 5-4 and 5-5.

5.7.2 ABSOLUTE OPERATIONS

When performing absolute operations, the reference plane is moved to the center of the pressure sensor of the DPG. You must now calculate corrections for pressure gradients from the DPG in use to the system test port.

The case reference is no longer ambient, but has been changed to approximately 100 microns. The vacuum causes a physical distortion in the case of the sensor. This distortion will result in a shift in the zero setting of the sensor. This zero shift has been determined and is recorded in

the test report for each DPG; see TST-100 in Appendix A. The amount given for Ref. Prs. Zero Polarity on each test report TST-100 is the amount of zero shift due to the case effect. To compensate for this effect, set the zero potentiometer for the DPG in use to the opposite of the amount given in TST-100 for Ref. Prs. Zero Polarity.

5.8 SPECIAL CONSIDERATIONS FOR 1 PSI 6010

The 1 PSI version of the DPG requires special handling to assure the full performance of the instrument. The unit is only available in a gauge pressure version. Thus, it is sensitive to atmospheric changes. To realize just how sensitive it is, consider that a change in the least significant digit at 1 psi full scale corresponds to approximately 2 microns of pressure change. The reference side must be very carefully controlled or changes due to wind, air handlers, doors shutting, etc. will cause major variations. The DPG tracks these changes but it may not track in the same way as the other instrument. To control these changes, it is recommended that the references of all relevant devices be tied to the reference of the DPG. This in turn should be connected to a tank with a volume of 200 in^3 or better. The tank should be vented to the atmosphere through a bleeder valve at the other end of the tank. The entire reference assembly should be shielded from rapid fluctuations in air temperature and flow. The vent valve should be set experimentally. In an environment with no temperature changes, it would be closed. In an environment with no pressure pressure fluctuations it would be wide open. The heater on the DPG will cause some temperature variations. Thus the appropriate setting varies but a good compromise can be found. To observe the variations, connect the reference as discussed and open the test port to the atmosphere. In measure mode, the DPG will indicate the variations. A good filter may be usable in place of the valve if it provides approximately the correct restriction of air flow.

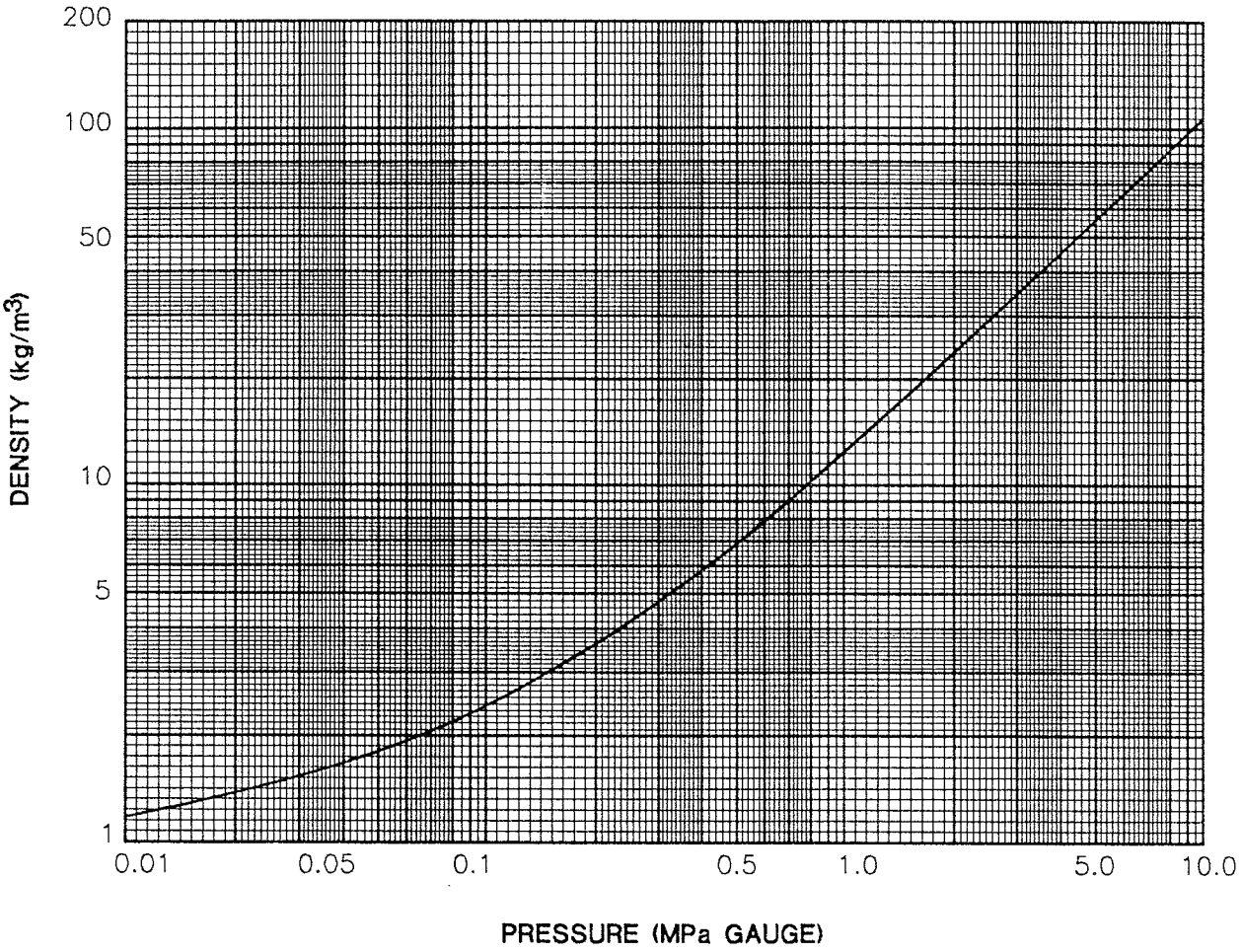

Figure 5-2
Nitrogen Density at 25°C
(SI Units to 10 MPa)

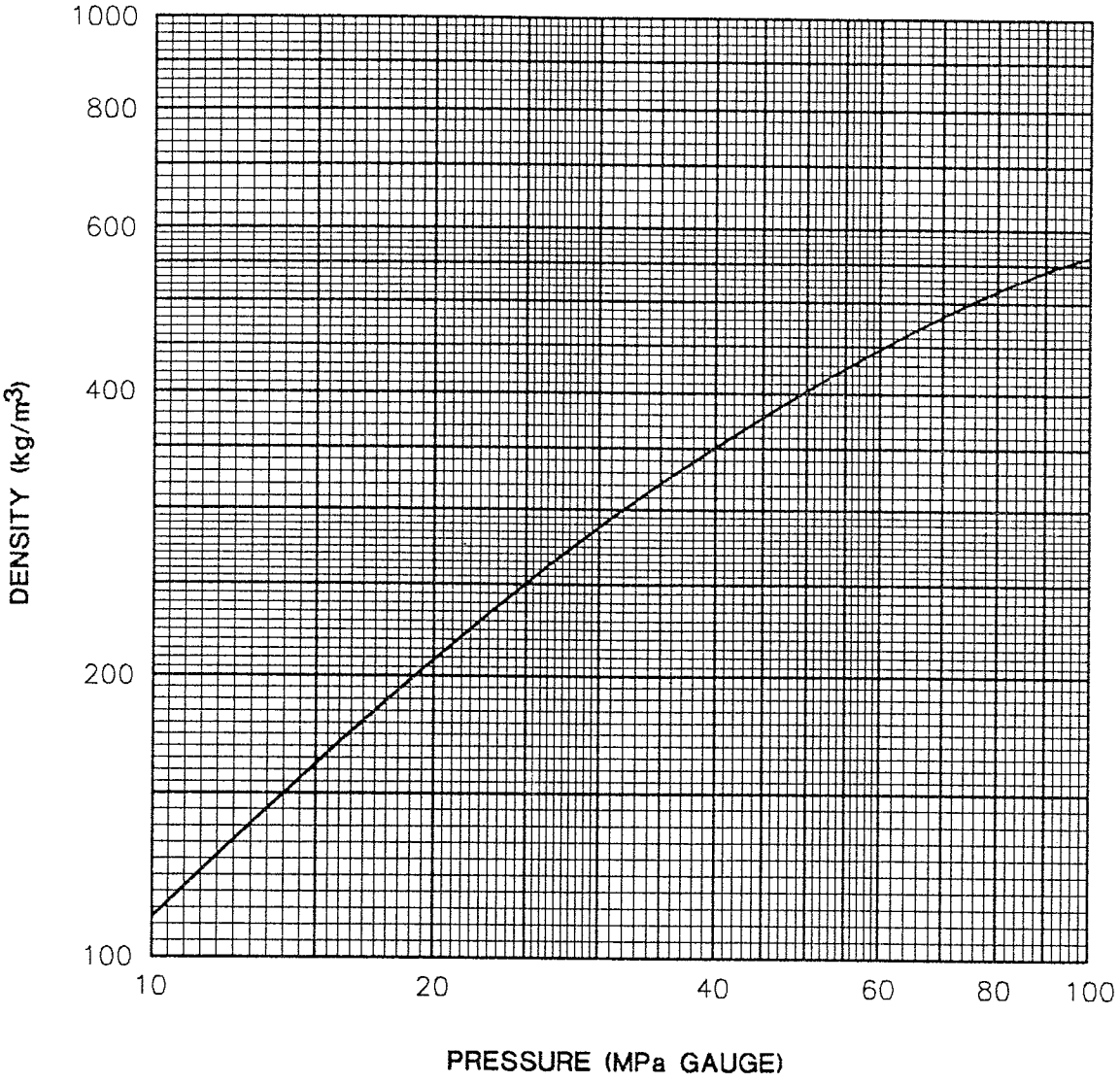

Figure 5-3
Nitrogen Density at 25°C
(SI Units: 10 MPa to 100 MPa)

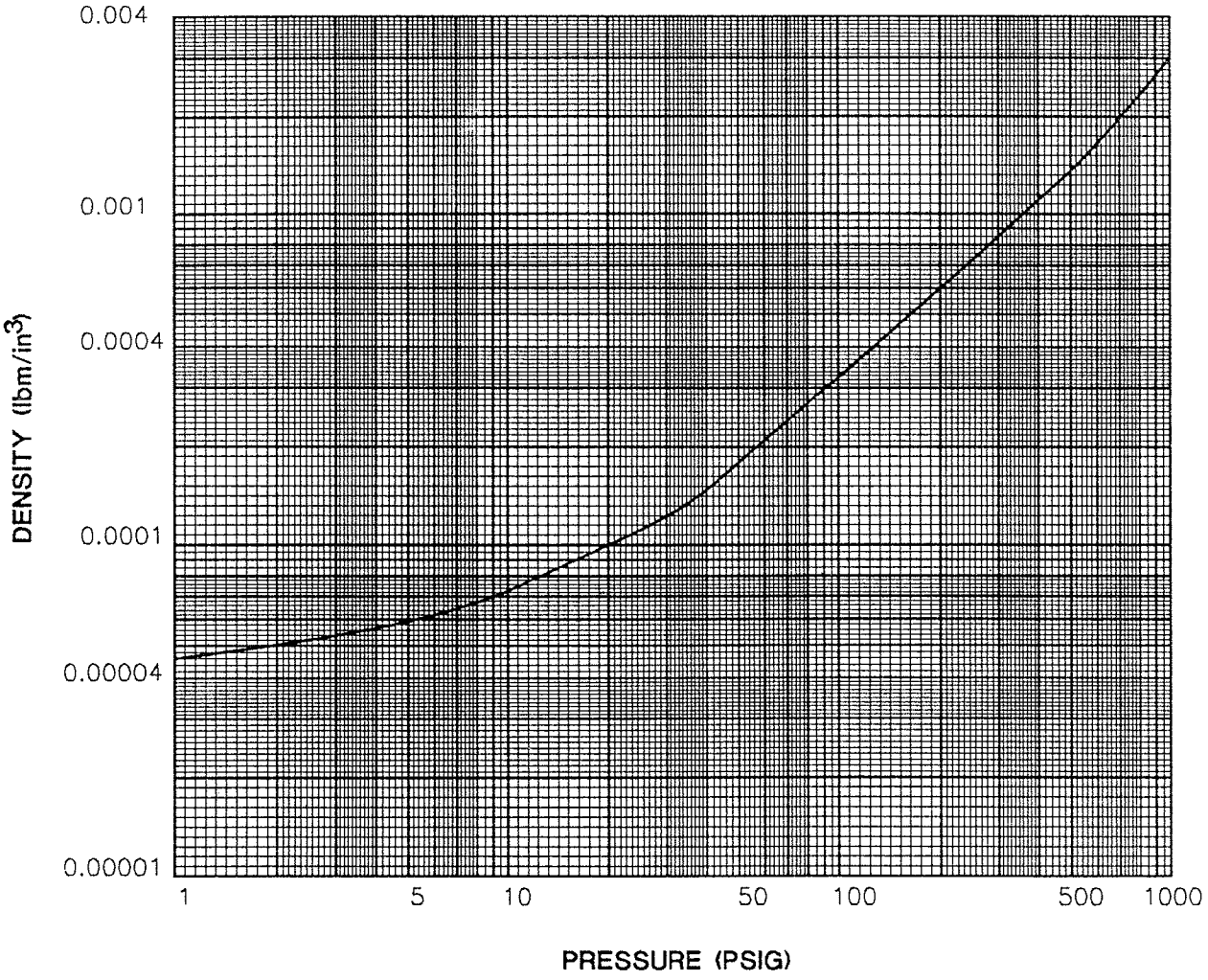

Figure 5-4
Nitrogen Density at 25°C
(English Units to 1000 PSIG)

To approximate the density of nitrogen at pressures between 0 and 1000 psig, use the above chart or the following equation:

$$\text{DENSITY (lbm/in}^3) \cong (3 \times 10^{-6})\ (P + 14.7),$$

where P = pressure in psig.

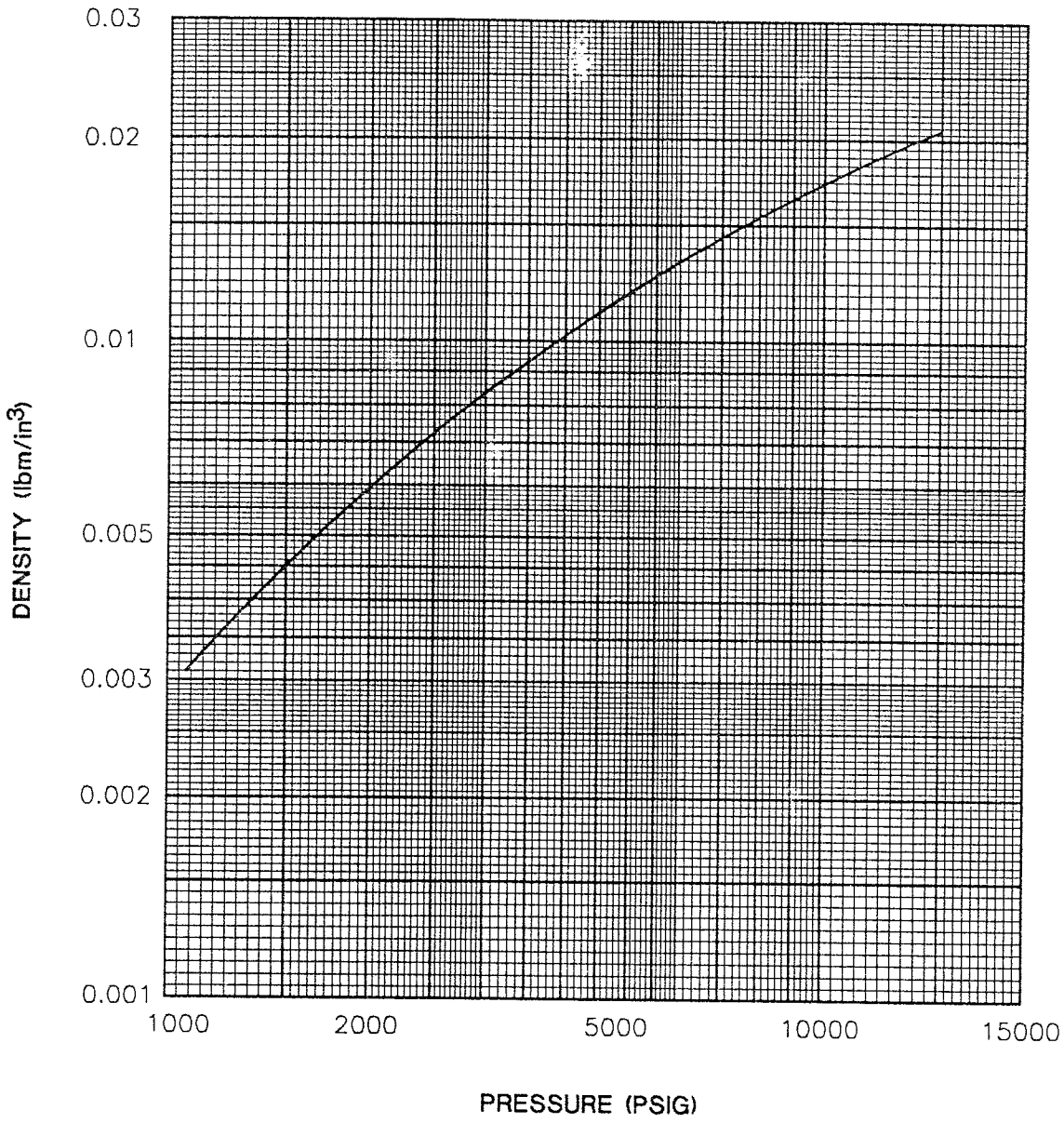

Figure 5-5
Nitrogen Density at 25°C
(English Units: 1,000 psig to 15,000 psig)

To approximate the density of nitrogen at pressures between 1,000 and 15,000 psig, use the above chart or the following equation:

$$\text{DENSITY (lbm/in}^3) \cong (0.27467 \times 10^{-5})\, P - (0.94608 \times 10^{-10})\, P^2,$$

where P = pressure in psig.

SECTION 6

THE HIGH LINE DIFFERENTIAL DPG WITH SILICON OIL-FILLED BOURDON TUBE AND CASE

For Models 6000-183C, -283C, -383C, and -483C, High Line Differential Oil-filled units, refer to the 6000-1D05 User's Manual.

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SECTION 7

MAINTENANCE

Maintenance is divided into preventive maintenance and calibration. The unit is designed to be nearly maintenance free.

7.1 PREVENTIVE MAINTENANCE

The DPG should be kept clean and completely assembled at all times. Operating without the sensor cover will reduce accuracy, due to loss of temperature control. The unit should be zeroed on a daily basis. To do this, consult Section 5.4.

The DPG contains a moisture filter (Ruska P/N 24-631) which must be replaced on a regular basis. This filter is normally replaced at the same time a calibration is performed (spare filters are initially supplied with the instrument). The filter is similar to those used in air-conditioning systems and should be available locally. To replace the filter simply unscrew the fitting at each end and insert the new filter.

To aid in determining if a problem exists with the DPG and to aid Ruska in helping to diagnose the problem, a troubleshooting checklist has been included at the end of this section. This checklist should be filled out upon receipt of the DPG. It should then be updated on a yearly basis or when a problem is thought to exist. Comparison of the data will help to identify if a problem exists and the source of the problem.

7.2 CALIBRATION

Calibration of the DPG is recommended every 90 to 180 days. The following procedure explains how to perform the calibration.

NOTE: For negative PSIG units, it may require two standards to generate FD pressure.

7.2.1 MEASURE ONLY UNITS

1. Insure that the unit is at operation temperature of approximately 49°C.
2. Apply zero pressure to the unit by following the directions in Section 5.4.
3. Remove the top oven-cover plate and the cut-out access insulation plate.
4. Connect the test jumper from TPD to TPA and switch SW2 to the Setup position.
5. Adjust the unit's Front Panel Zero Pot until the pressure readout indicates 0.0000 VDC ± 0.0010 VDC.
6. Move the test jumper from TPA and connect it to TPB.
7. The pressure readout should indicate 0.0000 VDC ± 0.0001 VDC.

NOTE: If this reading is off by more than ± 0.0001 VDC, adjustments to R31 will be required. Adjust R31 until the pressure readout indicates 0.0000 VDC ± 0.0001 VDC with the test jumper connected from TPD to TPB.

---

8. Move the test jumper from TPB back to TPA.

9. Apply Full Scale pressure to the unit's test port.
10. Adjust the unit's Front Panel Zero Pot until the pressure readout indicates a voltage equivalent to Full Scale pressure, (i.e. +10.0000 VDC ± 0.0010 VDC.
11. Move the test jumper from TPA and connect it to TPB.
12. The pressure readout should indicate 0.0000 VDC, ± 0.0001 VDC.

NOTE: If the reading is off by more than ± 0.0001 VDC, adjustments to R24 will be required. Adjust R24 until the pressure readout indicated 0.0000 VDC, ± 0.0001 VDC with the test jumper connected from TPD to TPB.

13, Move the test jumper from TPB back to TPA.
14. Switch SW2 back to the operate position.

NOTE: The pressure readout may temporarily indicate a large negative voltage until the integrator section of the nulling circuit has discharged from saturation.

---

15. Apply a near zero pressure (i.e. a pressure < 0.1% FS) and readjust the zero potentiometer (accessed through the front panel) until the output agrees with the applied pressure.
16. Apply a pressure within 1% of Full Scale, and adjust P_{max} (R23) until the output agrees with the applied pressure.
17. Apply a pressure within 1% of one half Full Scale, and adjust P_{mid} (R28) until the output agrees with the applied pressure.

NOTE: If R28 will not correctly adjust the output, change the position of SW1 and try again. The position of SW1 indicates the direction of linearity correction applied to the signal and should not change over the life of a particular sensor, therefore, once it is set for the proper polarity, SW1 should not require change.

---

18. The correctness of output should be verified at two or more pressure points between the three adjustment pressures.
19. Reinstall the cut-out access insulation piece and top oven-cover plate.
20. Calibration and adjustments are complete.

7.2.2 CONTROL UNITS

NOTE: The uncertainty of the final calibration must include the uncertainty of the standard being used.

---

1. Insure that the unit is at operation temperature of approximately 49° C and that it is in local mode and Measure mode.
2. Apply zero pressure to unit by following the directions in Section 5.4.
3. Remove the top oven cover plate and the cut-out access insulation plate.
4. Connect a jumper from TPD to TPA.
5. Switch SW2 to the Setup position (toward rear).

6. Dial the front panel COURSE and FINE control potentiometers until the pressure readout indicates 0.0000 VDC ± 0.0010 VDC.
7. Move the jumper from TPA and connect it to TPB.
8. The pressure readout should indicate 0.0000 VDC ± 0.0001 VDC.

NOTE: If the reading is off by more than ± 0.0001 VDC, adjustments to R31 will be required. Adjust R31 until the pressure readout indicates 0.0000 VDC ± 0.0001 VDC with the jumper connected from TPD to TPB.

---

9. Move the jumper from TPB back to TPA.
10. Dial the front panel COURSE and FINE control potentiometers until the pressure readout indicates a voltage equivalent to Full Scale pressure, ± 0.0010 VDC.
11. Move the jumper from TPA and connect it to TPB.
12. The pressure readout should indicate 0.0000VDC ± 0.0001 VDC.

NOTE: If the reading is off by more than ± 0.0001 VDC, adjustments to R24 will be required. Adjust R24 until the pressure readout indicates 0.0000 VDC ± 0.0001 VDC with the jumper connected from TPD to TPB, then move the jumper from TPB and connect it to TPA.

---

13. Move the jumper from TPB back to TPA.
14. Switch SW2 back to the operate position.

NOTE: The pressure readout may temporarily indicate a large negative voltage unegative voltag the integrator section of the nulling circuit has discharged from saturation.

---

15. Apply a near zero pressure (i.e. a pressure < 0.1% FS) and adjust the zero potentiometer (accessed through the front panel) until the output agrees with the applied pressure.
16. Apply a pressure within 1% of Full Scale, and adjust Pmax (R23) until the output agrees with the applied pressure.
17. Apply a pressure within 1% of one half Full Scale, and adjust Pmid (R28) until the output agrees with the applied pressure.

NOTE: If R28 will not correctly adjust the output, change the position of SW1 and try again. The position of SW1 indicates the direction of linearity correction applied to the signal and should not change over the life of a particular sensor, therefore, once it is set for the proper polarity SW1 should not require change.

---

18. The correctness of output should be verified at two or more pressure points between the three adjustment pressures.
19. Reinstall the cut-out access insulation piece and top oven-cover plate.
20. Calibration and adjustments are complete.

I. DPG TROUBLESHOOTING CHECKLIST --- INITIAL DATA

A. Power Supplies

1. +15V @ TP17 ref to TP15 _____ to nearest millivolt.
2. -15V @ TP12 ref to TP15 _____ to nearest millivolt.
3. + 5V @ TP14 ref to TP13 _____ to nearest millivolt.
4. +12 V @ TP16 ref to TP18 _____ to nearest millivolt.

B. Tilt Sensitivity Recorded in cts/degree

1. Record zero ct. with unit level (polarity important!) _____ ct. level
2. Record zero ct. with approx. 2° front to rear rotation _____ ct. tilted _____°
   a. Front to rear rotation because of many console mounted instruments.
   b. 1 count = 100 micro volts or 0.0001 volts.
   c. 2° Rotation = approx. 1/2 inch tilt from front to rear 1° is approximately 1/4 inch or diameter of a pencil.

C. Zero Potentiometer Adjustment Range

1. Most positive reading _____ ct.
2. Most negative reading _____ ct.
3. Total Potentiometer span _____ ct.

D. Sensor Temperature Control

1. Record sensor temperature _____ ° _____
2. Record duty cycle
   a. ON time _____ sec.
   b. OFF time _____ sec.
   c. Total time _____ sec.

II. MEASURE MODE PROBLEMS

☐ A. Zero Drift - Record Rate _____ ct / 24 hrs.

☐ 1. Diff. Gages - Confirm that the test port and ref. port are vented in the same area.

☐ 2. Absolute Gages - Confirm Vac. is stable and calculate approx. ct. for 100 µHg vac _____

☐ 3. Over a period of 2 or 3 days record zero potentiometer span, supply voltages, and sensor temperature control in the same manner as described on the previous page.

☐ 4. If everything looks good on a Diff. DDR after 2 to 3 days or they suspect sensor contamination, apply a vac to the test port and case ref. and compare the drift rate.

☐ a. If problem goes away vent back to atm and re-record drift rate.

☐ B. Zero Stability (Noise) - Record approx. counts unstable ± _____ct.

☐ 1. Check for excessive chassis vibrations, high and low frequencies.

☐ 2. Check DVM high, low and shield are good from the printed circuit board to the readout.

☐ 3. Check DVM for stability with a stable voltage source to 100 μvolts.

☐ 4. Check noise level on the DDR output with oscilloscope if available.

☐ C. Repeatability - Record approx. magnitude of non-repeatability ± _____ ct.

☐ 1. While at zero pressure or near zero on an absolute gage (100 μHg vac or less) use the pressure drive switch, if available, and rotate the element until the output is near the Full Scale value of the instrument. Then note the magnitude of nonrepeatability after 30 to 60 sec.

a. If the gage is a measure only the same test can be run by using an analog ohm meter across the coils starting on the highest range and moving down until the gages output go higher than the Full Scale volts.

1. Coils are between TPC and TP8.

☐ D. Leaks - Test Ports and Reference Ports

☐ 1. Eliminate any external plumbing.

☐ 2. Check Relief Valve - using soap and water.

☐ 3. Check all fittings on the test port line to the sensor and if it's a controller the solenoid separates the control and measure piping.

☐ 4. Reference ports with vac leaks - try to locate leak in piping with freon before going to feed thru's or cap.

☐ E. Linearity

1. Run and record 5 points, check readings in Operate at TP3 and TP6.

a.

ZERO	_____	TP6	_____	TP3
100%	_____	TP6	_____	TP3
50%	_____	TP6	_____	TP3
80%	_____	TP6	_____	TP3
20%	_____	TP6	_____	TP3

☐ F. Full Scale Span Changes - Record span change and over what time period. _____

☐ 1. Check for span changes in the readout (DVM or IFP).

☐ 2. While at F.S. pressure use the pressure drive switch or ohm meter as described in the repeatability checkout to check the full scale repeatability of the instrument.

III CONTROL MODE PROBLEMS

☐ A. Operation and Set Up

- ☐ 1. Confirm a minimum pressure supply and vac supply, also some external volume of 10 to 20 in^3.
- ☐ 2. Confirm test port is not vented or blocked.
- ☐ 3. Confirm in the local control mode voltage across the coils and adjustment available with the coarse and fine control pots.
- ☐ 4. Confirm proper operation of the servo valve volts at TP24, in CONTROL mode.

☐ B. Slew Rates

- ☐ 1. Inquire about the volume and configuration of the volume being controlled into.
- ☐ 2. Inquire about the pressure points trying to be reached and possibilities of leaks.
- ☐ 3. Confirm that the VOV valve and the overshoot valve have not been altered.
- ☐ 4. Measure Increase and Decrease Regulator differentials at the checkout ports and minimum and maxmum control pressure points.
- ☐ 5. While controlling from one pressure point to another, check the point at which the servo valve comes out of saturation at TP24.

☐ C. Overshoot

- ☐ 1. Confirm Volume controlled into
- ☐ 2. Confirm VOV and overshoot valve settings.
- ☐ 3. Confirm element is not sticking by tapping on the front of the DDR as it is approaching the desired pressure point.

☐ D. Stability Noise

- ☐ 1. Again inquire about the volume and the configuration of the volume being controlled into.
- ☐ 2. Also inquire where in the system the pressure is not stable and how it is monitored.
- ☐ 3. Check for vibrations in control mode not present in measure mode.

☐ E. Repeatability

- ☐ 1. With a transducer of approximately equal resolution if available, try approaching a pressure point from both directions and record the non-repeatability.
- ☐ 2. Confirm Repeatability in measure mode.

☐ F. Relative Accuracy Compared to Measure Mode.

☐ 1. If possible use another pressure gage of approximately the same resolution in measure mode at the questionable point along with the questionable gage in measure mode. Record readings from both gages then control to the same reading taken from the questionable gage. The monitor gage should read the same as when both gages were in measure mode +/- tolerances.

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SECTION 8
DRAWINGS AND BILLS OF MATERIAL

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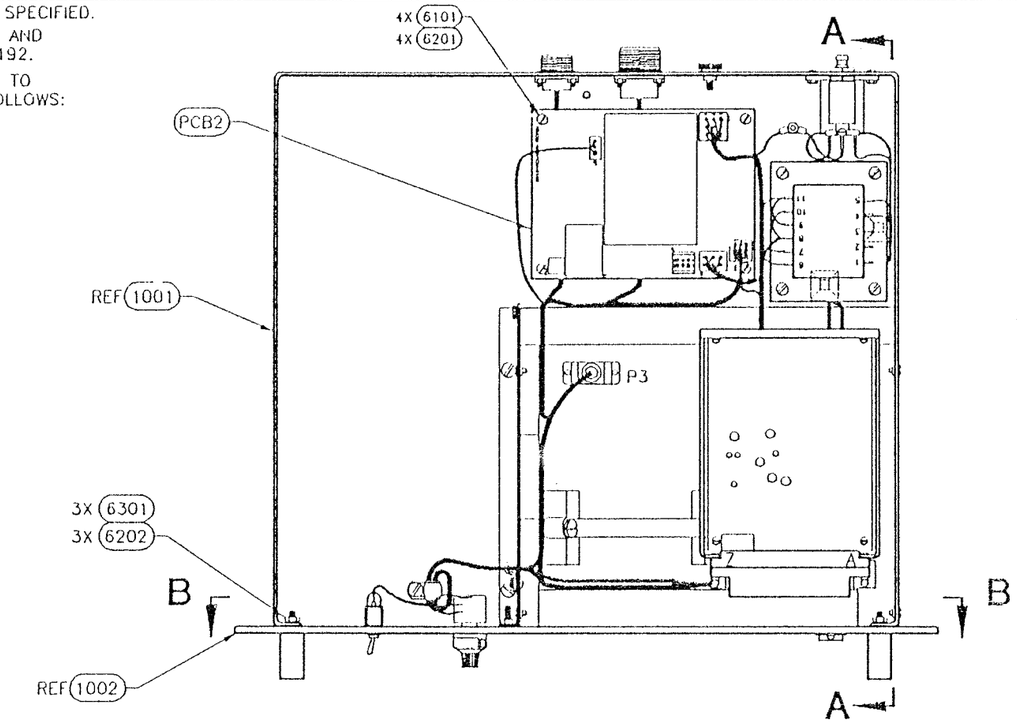
NOTES : UNLESS OTHERWISE SPECIFIED.

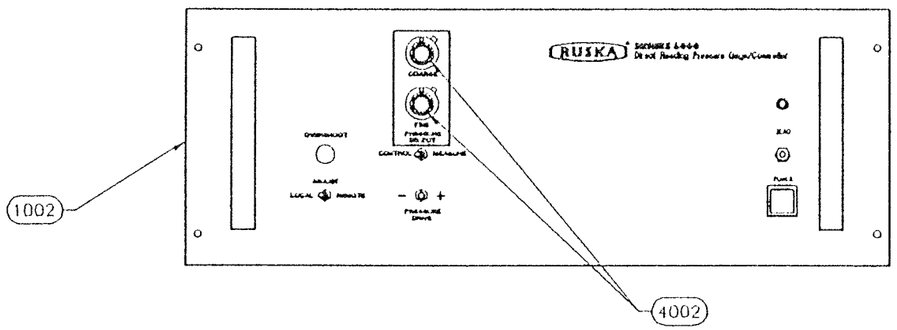
1. FABRICATION TOLERANCES AND PRACTICES PER RIC ER-192.

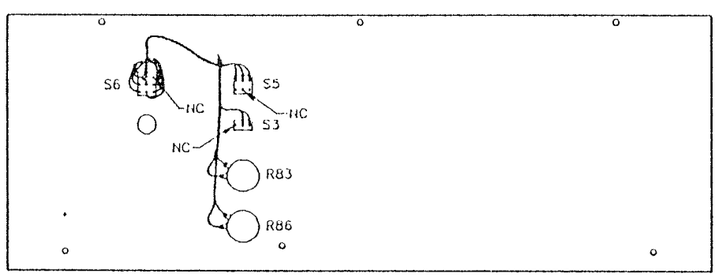
APPLICABLE DOCUMENTS TO THIS DRAWING ARE AS FOLLOWS:

6000-126C

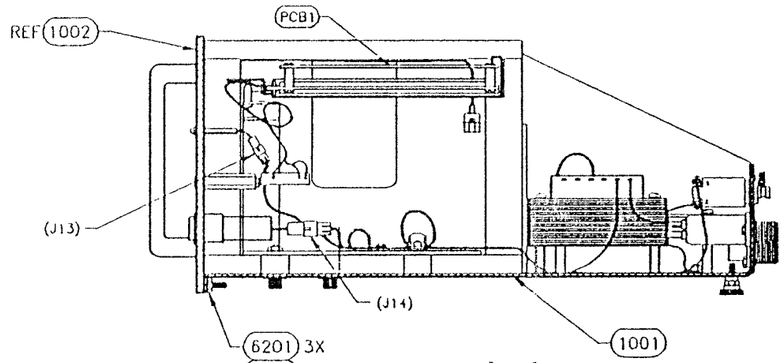
REVISION RECORD				
LTR	DESCRIPTION	BY	DATE	APP
A	RELEASED ER 7501	JH	4/28/81	JH
B	REVISED ECO 16404	PE	01/04/82	JH
C	REVISED ECO 17453	JH		







SECTION B-B



SECTION A-A
ROTATED 90° CW

(XXXX) COMPUTER ITEM SEQUENCE NUMBERS USED

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMALS: .X ± .020, .XX ± .020, .XXX ± .010, .XXXX ± .005
ANGULAR ± 2°
FRACTIONAL ± 1/32

	NAME	DATE
DRAWN	JEFF HAWKS	12/6/80
CHECK	PAT EDWARDS	1/26/81
PROJECT ENGR	JEFF HAWKS	1/26/81
QUALITY		
MFG ENGR SUPV		
MFG ENGR		
MFG		

FSCM NO.	98116
	RUSKA® INSTRUMENT CORPORATION HOUSTON, TEXAS
TITLE	CHASSIS ASSY, DIGITAL PRESSURE GAGE
SIZE	D
DRAWING NO.	6000-126B
REV	C
SCALE	1/2
FILE NO.	002053C1.DWG
SHEET	1 OF 1

BILL OF MATERIAL
6010-PCA-1L
PCA, DPG CONTROL BOARD, LOW PRESSURE

SEQ. NO.	COMPONENT ITEM NO.	DESCRIPTION	QTY.	UM
C001	10-260	CAP CE 1. MF 50V.10% R	1.000	EA
C002	10-128	CAP CE .1 MF 50V 10% R	1.000	EA
C005	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C006	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C007	10-128	CAP CE .1 MF 50V 10% R	1.000	EA
C008	10-128	CAP CE .1 MF 50V 10% R	1.000	EA
C009	10-57`	CAP MF .001 1000VDC ISCAD	1.000	EA
C010	10-260	CAP CE 1. MF 50V.10% R	1.000	EA
C011	10-57`	CAP MF .001 1000VDC ISCAD	1.000	EA
C012	10-128	CAP CE .1 MF 50V 10% R	1.000	EA
C013	10-128	CAP CE .1 MF 50V 10% R	1.000	EA
C014	10-128	CAP CE .1 MF 50V 10% R	1.000	EA
C015	10-117	CAP DT 4.7 MF 20V 20% R	1.000	EA
C016	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C017	10-117	CAP DT 4.7 MF 20V 20% R	1.000	EA
C018	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C019	10-165	CAP MF 1.0 50V 10% F141	1.000	EA
C020	10-166	CAP MF 2.0 50V 10% F141	1.000	EA
C021	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C023	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C025	10-128	CAP CE .1 MF 50V 10% R	1.000	EA
C026	10-128	CAP CE .1 MF 50V 10% R	1.000	EA
C028	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C029	10-117	CAP DT 4.7 MF 20V 20% R	1.000	EA
C030	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C031	10-260	CAP CE 1. MF 50V.10% R	1.000	EA
C036	10-260	CAP CE 1. MF 50V.10% R	1.000	EA
D001	19-233	DIO RECT 1N4002	1.000	EA
D002	19-234	SUPPRESSOR TVS515 TRANSIENT	1.000	EA
D003	19-234	SUPPRESSOR TVS515 TRANSIENT	1.000	EA
D004	19-228	SUPPRESSOR TVS505	1.000	EA
D005	19-228	SUPPRESSOR TVS505	1.000	EA
D006	19-228	SUPPRESSOR TVS505	1.000	EA
D009	19-249	DIODE,REF,ZENER,6.2V,1N829A	1.000	EA
K001	66-818	RLY 6PDT 12VDC TF154-6C 5AMP OK 4AUG80	1.000	EA
Q001	86-515	XSTR 2N2907	1.000	EA
Q002	86-516	XSTR 2N2222	1.000	EA
Q003	86-538	XSTR,MOSFET 2N7000	1.000	EA
Q004	86-538	XSTR,MOSFET 2N7000	1.000	EA
Q005	86-515	XSTR 2N2907	1.000	EA
Q006	86-516	XSTR 2N2222	1.000	EA
R001	67-430	RES MF 100K .10W1.00%RN55C	1.000	EA
R002	67-10028	RES CC 270 OHM .25W5.00%RC07	1.000	EA

R003	67-10028	RES CC 270 OHM .25W5.00%RC07	1.000	EA
R004	67-399-20	RES CC 20K .25W5.00%RC07	1.000	EA
R005	94-334	WIRE,BUSS 22AWG SOFT DRAWN	1.000	FT
R006	94-334	WIRE,BUSS 22AWG SOFT DRAWN	1.000	FT
R008	94-334	WIRE,BUSS 22AWG SOFT DRAWN	1.000	FT
R009	67-10014	RES CC 10 .25W5.00%RC07 ALLEN BRADLEY	1.000	EA
R010	67-000-3	RES SEL S102K	1.000	EA
R011	67-000-3	RES SEL S102K	1.000	EA
R012	67-000-3	RES SEL S102K	1.000	EA
R013	67-000-3	RES SEL S102K	1.000	EA
R014	67-000-3	RES SEL S102K	1.000	EA
R015	67-000-3	RES SEL S102K	1.000	EA
R016	67-000-3	RES SEL S102K	1.000	EA
R017	67-40039	RES BM 100K .6W 1.0% S102K VISHAY	1.000	EA
R018	67-10025	RES MF 95.3K .12W1.00% RN55D	1.000	EA
R019	67-401	RES MF 1.5K .10W1.00%RN55C	1.000	EA
R020	67-430	RES MF 100K .10W1.00%RN55C	1.000	EA
R021	67-401	RES MF 1.5K .10W1.00%RN55C	1.000	EA
R022	67-40039	RES BM 100K .6W 1.0% S102K VISHAY	1.000	EA
R023	62-234-501	POT CE 500 OHM 20TURN PC MOUNT	1.000	EA
R024	62-234-103	POT CE 10K OHM 20TURN PC MOUNT	1.000	EA
R025	67-430	RES MF 100K .10W1.00%RN55C	1.000	EA
R026	67-430	RES MF 100K .10W1.00%RN55C	1.000	EA
R027	67-469	RES MF 100 .10W1.00%RN55C	1.000	EA
R028	62-234-501	POT CE 500 OHM 20TURN PC MOUNT	1.000	EA
R029	67-433	RES MF 7.5K .10W1.00%RN55C	1.000	EA
R030	67-433	RES MF 7.5K .10W1.00%RN55C	1.000	EA
R031	62-234-502	POT CE 5K OHM 20TURN PC MOUNT	1.000	EA
R032	67-430	RES MF 100K .10W1.00%RN55C	1.000	EA
R033	62-234-502	POT CE 5K OHM 20TURN PC MOUNT	1.000	EA
R034	67-469	RES MF 100 .10W1.00%RN55C	1.000	EA
R035	94-334	WIRE,BUSS 22AWG SOFT DRAWN	1.000	FT
R036	67-399-10	RES CC 10K .25W5.00%RC07	1.000	EA
R037	67-399-10	RES CC 10K .25W5.00%RC07	1.000	EA
R038	67-405-3-3	RES CC 3.3M .25W5.00%RC07	1.000	EA
R039	67-20036	RES MF 174K .10W1.00%RN55C	1.000	EA
R040	67-436	RES MF 2K .10W1.00%RN55C	1.000	EA
R041	62-234-503	POT CE 50K OHM 20TURN PC MOUNT	1.000	EA
R042	94-334	WIRE,BUSS 22AWG SOFT DRAWN ALPHA 298	1.000	FT
R043	94-334	WIRE,BUSS 22AWG SOFT DRAWN ALPHA 298	1.000	FT
R044	67-425	RES MF 10K .10W1.00%RN55C	1.000	EA
R045	67-10028	RES CC 270 OHM .25W5.00%RC07	1.000	EA
R046	67-10028	RES CC 270 OHM .25W5.00%RC07	1.000	EA
R047	67-425	RES MF 10K .10W1.00%RN55C	1.000	EA
R048	67-435	RES MF 1K .10W1.00%RN55C	1.000	EA
R049	62-234-500	POT CE 50 OHM 20TURN PC MOUNT	1.000	EA
R050	67-450	RES MF 499K .10W1.00%RN55C	1.000	EA
R051	67-426	RES MF 5.9K .10W1.00%RN55C	1.000	EA
R052	62-234-103	POT CE 10K OHM 20TURN PC MOUNT	1.000	EA
R053	67-000-3	RES SEL S102K	1.000	EA
R055	62-234-504	POT CE 500KOHM 20TURN PC MOUNT	1.000	EA

R056	62-234-504	POT CE 500KOHM 20TURN PC MOUNT	1.000	EA
R058	94-334	WIRE,BUSS 22AWG SOFT DRAWN	1.000	FT
R059	67-435	RES MF 1K .10W1.00%RN55C	1.000	EA
R060	67-444	RES MF 4.02K .10W1.00%RN55C	1.000	EA
R061	67-399-10	RES CC 10K .25W5.00%RC07	1.000	EA
R062	67-399-10	RES CC 10K .25W5.00%RC07	1.000	EA
R063	67-435	RES MF 1K .10W1.00%RN55C	1.000	EA
R064	67-426	RES MF 5.9K .10W1.00%RN55C	1.000	EA
R065	67-40028	RES BM 2K .6W 1.0% S102K VISHAY	1.000	EA
R066	67-40028	RES BM 2K .6W 1.0% S102K VISHAY	1.000	EA
R067	94-334	WIRE,BUSS 22AWG SOFT DRAWN	1.000	FT
R068	67-433	RES MF 7.5K .10W1.00%RN55C	1.000	EA
R069	67-423	RES MF 511 .10W1.00%RN55C	1.000	EA
R070	67-433	RES MF 7.5K .10W1.00%RN55C	1.000	EA
R071	67-399-10	RES CC 10K .25W5.00%RC07	1.000	EA
R072	67-399-10	RES CC 10K .25W5.00%RC07	1.000	EA
R073	67-399-10	RES CC 10K .25W5.00%RC07	1.000	EA
R074	67-465	RES MF 34.8K .10W1.00%RN55C	1.000	EA
R075	67-425	RES MF 10K .10W1.00%RN55C	1.000	EA
R076	67-432	RES MF 200K .10W1.00%RN55C	1.000	EA
R077	94-334	WIRE,BUSS 22AWG SOFT DRAWN	1.000	FT
R078	67-000-3	RES SEL S102K	1.000	EA
R079	67-430	RES MF 100K .10W1.00%RN55C	1.000	EA
R080	62-234-104	POT CE 100KOHM 20TURN PC MOUNT	1.000	EA
R081	67-430	RES MF 100K .10W1.00%RN55C	1.000	EA
R082	67-10009	RES CC 2K .25W5.00%RC07	1.000	EA
R105	67-425	RES MF 10K .10W1.00%RN55C	1.000	EA
R107	67-432	RES MF 200K .10W1.00%RN55C	1.000	EA
SW01	80-694	SWITCH SLIDE PC MOUNT	1.000	EA
SW02	80-695	SWITCH TOGGLE DPDT PC MOUNT	1.000	EA
U001	35-284	IC QUAD OP AMP OP400FY	1.000	EA
U002	2-704	AMPL,MULTIPLIER,IC AD532KH	1.000	EA
U003	35-284	IC QUAD OP AMP OP400FY	1.000	EA
0001	74-865	HLD-DN SPNG 6PDT R10-TYPE	1.000	EA
0002	74-854	SKT RELAY 6PDT PC MNT R10 TYPE	1.000	EA
0003	14-527	VERT HEDR SGL ROW.025SQX.318H	1.000	EA
0004	6010-PWB-1	PC BOARD, DPG CONTROL	1.000	EA
0005	37-676	JUMPER,TEST POINTS .025"SQR,6"	1.000	EA
0007	75-255	SPCR .250HX .50LX.138-32AL	4.000	EA
0008	71-106-501	RHMS 6-32 X 5/16SS	8.000	EA
0009	91-217	WIL 0.150X0.295X.021 (#6) SS	8.000	EA
0010	6010-46-003	CUSTOMER SERVICE COVER SILKSCR	1.000	EA

BILL OF MATERIAL
6010-PCA-1H
PCA, DPG CONTROL BOARD, HIGH PRESSURE

SEQ. NO.	COMPONENT ITEM NO.	DESCRIPTION	QTY.	UM
	6010-PCA-1	PCA, DPG CONTROL BD, BASE	1.000	EA
	6010B-EEDOC-HP	SERVICE DIAGRAM,DPG	1.000	EA
D007	19-216	DIO 1N914A/B	1.000	EA
D008	19-216	DIO 1N914A/B	1.000	EA
R107	67-432	RES MF 200K .10W1.00%RN55C	1.000	EA

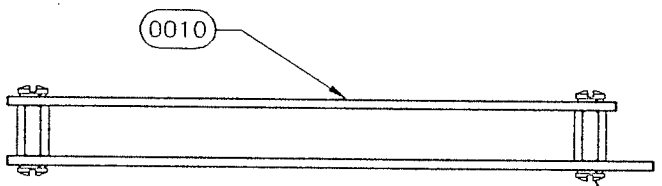
BILL OF MATERIAL
6010-PCA-1M

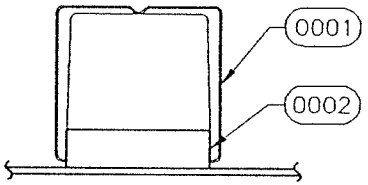
SEQ. NO.	COMPONENT ITEM NO.	DESCRIPTION	QTY.	UM
C007	10-128	CAP CE .1 MF 50V 10% R	1.000	EA
C008	10-128	CAP CE .1 MF 50V 10% R	1.000	EA
C009	`10-57	CAP MF .001 1000VDC ISCAD	1.000	EA
C011	`10-57	CAP MF .001 1000VDC ISCAD	1.000	EA
C012	10-128	CAP CE .1 MF 50V 10% R	1.000	EA
C013	10-128	CAP CE .1 MF 50V 10% R	1.000	EA
C014	10-128	CAP CE .1 MF 50V 10% R	1.000	EA
C015	10-117	CAP DT 4.7 MF 20V 20% R	1.000	EA
C016	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C017	10-117	CAP DT 4.7 MF 20V 20% R	1.000	EA
C018	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C019	10-165	CAP MF 1.0 50V 10% F141	1.000	EA
C020	10-166	CAP MF 2.0 50V 10% F141	1.000	EA
C021	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C023	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C025	10-128	CAP CE .1 MF 50V 10% R	1.000	EA
C026	10-128	CAP CE .1 MF 50V 10% R	1.000	EA
C028	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C029	10-117	CAP DT 4.7 MF 20V 20% R	1.000	EA
C030	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C031	10-260	CAP CE 1. MF 50V.10% R	1.000	EA
C036	10-260	CAP CE 1. MF 50V.10% R	1.000	EA
D002	19-234	SUPPRESSOR TVS515 TRANSIENT	1.000	EA
D003	19-234	SUPPRESSOR TVS515 TRANSIENT	1.000	EA
D006	19-228	SUPPRESSOR TVS505	1.000	EA
Q005	86-515	XSTR 2N2907	1.000	EA
Q006	86-516	XSTR 2N2222	1.000	EA
R008	94-334	WIRE,BUSS 22AWG SOFT DRAWN	1.000	FT
R009	67-10014	RES CC 10 .25W5.00%RC07	1.000	EA
R010	67-000-3	RES SEL S102K	1.000	EA
R011	67-000-3	RES SEL S102K	1.000	EA
R012	67-000-3	RES SEL S102K	1.000	EA
R013	67-000-3	RES SEL S102K	1.000	EA
R014	67-000-3	RES SEL S102K	1.000	EA
R015	67-000-3	RES SEL S102K	1.000	EA
R016	67-000-3	RES SEL S102K	1.000	EA
R017	67-40039	RES BM 100K .6W 1.0% S102K	1.000	EA
R018	67-10025	RES MF 95.3K .12W1.00% RN55D	1.000	EA
R019	67-401	RES MF 1.5K .10W1.00%RN55C	1.000	EA
R020	67-430	RES MF 100K .10W1.00%RN55C	1.000	EA
R021	67-401	RES MF 1.5K .10W1.00%RN55C	1.000	EA
R022	67-40039	RES BM 100K .6W 1.0% S102K	1.000	EA
R023	62-234-501	POT CE 500 OHM 20TURN PC MOUNT	1.000	EA

SEQ. NO.	COMPONENT ITEM NO.	DESCRIPTION	QTY.	UM
R024	62-234-103	POT CE 10K OHM 20TURN PC MOUNT	1.000	EA
R025	67-430	RES MF 100K .10W1.00%RN55C	1.000	EA
R026	67-430	RES MF 100K .10W1.00%RN55C	1.000	EA
R027	67-469	RES MF 100 .10W1.00%RN55C	1.000	EA
R028	62-234-501	POT CE 500 OHM 20TURN PC MOUNT	1.000	EA
R029	67-433	RES MF 7.5K .10W1.00%RN55C	1.000	EA
R030	67-433	RES MF 7.5K .10W1.00%RN55C	1.000	EA
R031	62-234-502	POT CE 5K OHM 20TURN PC MOUNT	1.000	EA
R032	67-430	RES MF 100K .10W1.00%RN55C	1.000	EA
R033	62-234-504	POT CE 500KOHM 20TURN PC MOUNT	1.000	EA
R035	94-334	WIRE,BUSS 22AWG SOFT DRAWN	1.000	FT
R036	67-10028	RES CC 270 OHM .25W5.00%RC07	1.000	EA
R039	67-20036	RES MF 174K .10W1.00%RN55C	1.000	EA
R040	67-436	RES MF 2K .10W1.00%RN55C	1.000	EA
R041	62-234-503	POT CE 50K OHM 20TURN PC MOUNT	1.000	EA
R042	94-334	WIRE,BUSS 22AWG SOFT DRAWN	1.000	FT
R043	94-334	WIRE,BUSS 22AWG SOFT DRAWN	1.000	FT
R044	67-425	RES MF 10K .10W1.00%RN55C	1.000	EA
R045	67-10028	RES CC 270 OHM .25W5.00%RC07	1.000	EA
R046	67-10028	RES CC 270 OHM .25W5.00%RC07	1.000	EA
R047	67-425	RES MF 10K .10W1.00%RN55C	1.000	EA
R048	67-435	RES MF 1K .10W1.00%RN55C	1.000	EA
R049	62-234-500	POT CE 50 OHM 20TURN PC MOUNT	1.000	EA
R050	67-450	RES MF 499K .10W1.00%RN55C	1.000	EA
R051	67-426	RES MF 5.9K .10W1.00%RN55C	1.000	EA
R053	67-000-3	RES SEL S102K	1.000	EA
R056	62-234-504	POT CE 500KOHM 20TURN PC MOUNT	1.000	EA
R058	94-334	WIRE,BUSS 22AWG SOFT DRAWN	1.000	FT
R059	67-435	RES MF 1K .10W1.00%RN55C	1.000	EA
R060	67-444	RES MF 4.02K .10W1.00%RN55C	1.000	EA
R061	67-399-10	RES CC 10K .25W5.00%RC07	1.000	EA
R064	67-426	RES MF 5.9K .10W1.00%RN55C	1.000	EA
R065	67-40028	RES BM 2K .6W 1.0% S102K VISHAY	1.000	EA
R066	67-40028	RES BM 2K .6W 1.0% S102K VISHAY	1.000	EA
R067	94-334	WIRE,BUSS 22AWG SOFT DRAWN	1.000	FT
R068	67-433	RES MF 7.5K .10W1.00%RN55C	1.000	EA
R069	67-423	RES MF 511 .10W1.00%RN55C	1.000	EA
R070	67-433	RES MF 7.5K .10W1.00%RN55C	1.000	EA
R077	94-334	WIRE,BUSS 22AWG SOFT DRAWN	1.000	FT
R078	67-000-3	RES SEL S102K	1.000	EA
SW01	80-694	SWITCH SLIDE PC MOUNT	1.000	EA
SW02	80-695	SWITCH TOGGLE DPDT PC MOUNT	1.000	EA
U001	35-284	IC QUAD OP AMP OP400FY	1.000	EA
U002	2-704	AMPL,MULTIPLIER,IC AD532KH	1.000	EA
U003	35-284	IC QUAD OP AMP OP400FY	1.000	EA
0003	14-527	VERT HEDR SGL ROW.025SQX.318H	1.000	EA
0004	6010-PWB-1	PC BOARD, DPG CONTROL	1.000	EA
0005	37-676	JUMPER,TEST POINTS .025"SQR,6"	1.000	EA
0007	75-255	SPCR .250HX .50LX.138-32AL	4.000	EA

SEQ. NO.	COMPONENT ITEM NO.	DESCRIPTION	QTY.	UM
0008	71-106-501	RHMS 6-32 X 5/16SS	8.000	EA
0009	91-217	WIL 0.150X0.295X.021 (#6) SS	8.000	EA
0010	6010-46-005	COVER,CUST. SRVC.,SLKSCRD,MEAS	1.000	EA

REVISION RE					
ZONE	LTR	DESCRIPTION	BY	DATE	APVD
	A	RELEASED DR 7501	JH	5/6/91	JH
	B	REVISED PER ECO 17414	PE	11/4/91	JH
	C	REVISED PER ECO 17048	PE	11/13/91	JH
	D	REVISED PER ECO 16878	PE	3/30/92	JH
	E	REVISED PER ECO 17449	JH		



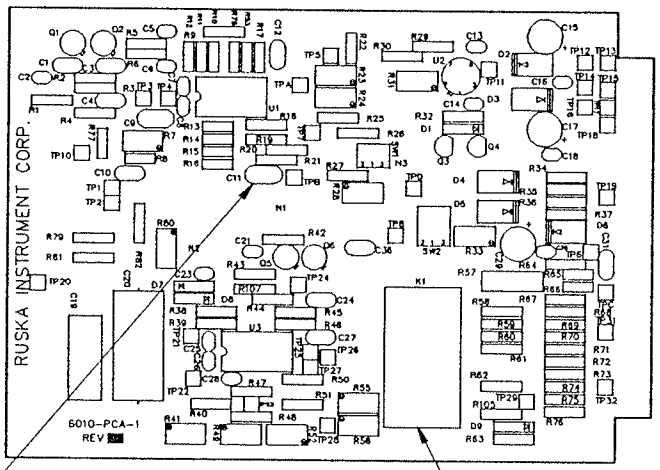


DETAIL A

0009 8X
0008 8X
0007 4X

Parts to be mounted on "Solder Side"

TP1–8, TP10–29, TP31, TP32, TPA, TPB, TPC, TPD, SW1, SW2, R23, R24, R28, R31, R33, R41, R49, R52, R55, R56, R80



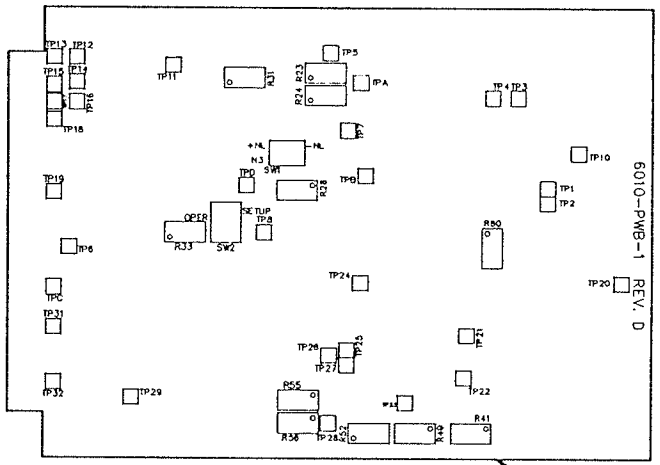
0004

Component Holes

Feedthru Holes

COMPONENT SIDE

SEE DETAIL A



SOLDER SIDE
(COVER DELETED FOR CLARITY)

0004 REF

(XXXX) COMPUTER ITEM SEQUENCE NUMBERS USED

3 INSTALL TEST LEAD ITEM 0005 BETWEEN TPA AND TPD AFTER INSTALLING ITEM 10.

2. ALL COMPONENTS WITH DESIGNATOR "TP" TO BE TRIMMED FROM ITEM 0003

1. FABRICATION TOLERANCES AND PRACTICES PER RIC ER–192.

NOTES: UNLESS OTHERWISE SPECIFIED.

FINISH

MATERIAL SPEC (RIC NO.)

MATERIAL DESCRIPTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES
TOLERANCES

DECIMALS	ANGULAR
.X ± .030	± 0.5°
.XX ± .020	FRACTIONAL
.XXX ± .010	± 1/32
.XXXX ± .005	

		DATE
DRAWN	J.HARRIS	10/08/90
CHECKED	PAT EDWARDS	5/6/91
PROJECT ENGR	JEFF HARRIS	5/6/91
MGR QUALITY	J. VAINASK	5/6/91
MGR ENGRG SVCS	K.HARRIS	5/6/91
VP ENGRG	J.HINDS	5/6/91
VP MFG	S.LAUGHMAN	5/13/91

FSCM NO. 96116

RUSKA® INSTRUMENT CORPORATION HOUSTON, TEXAS

TITLE

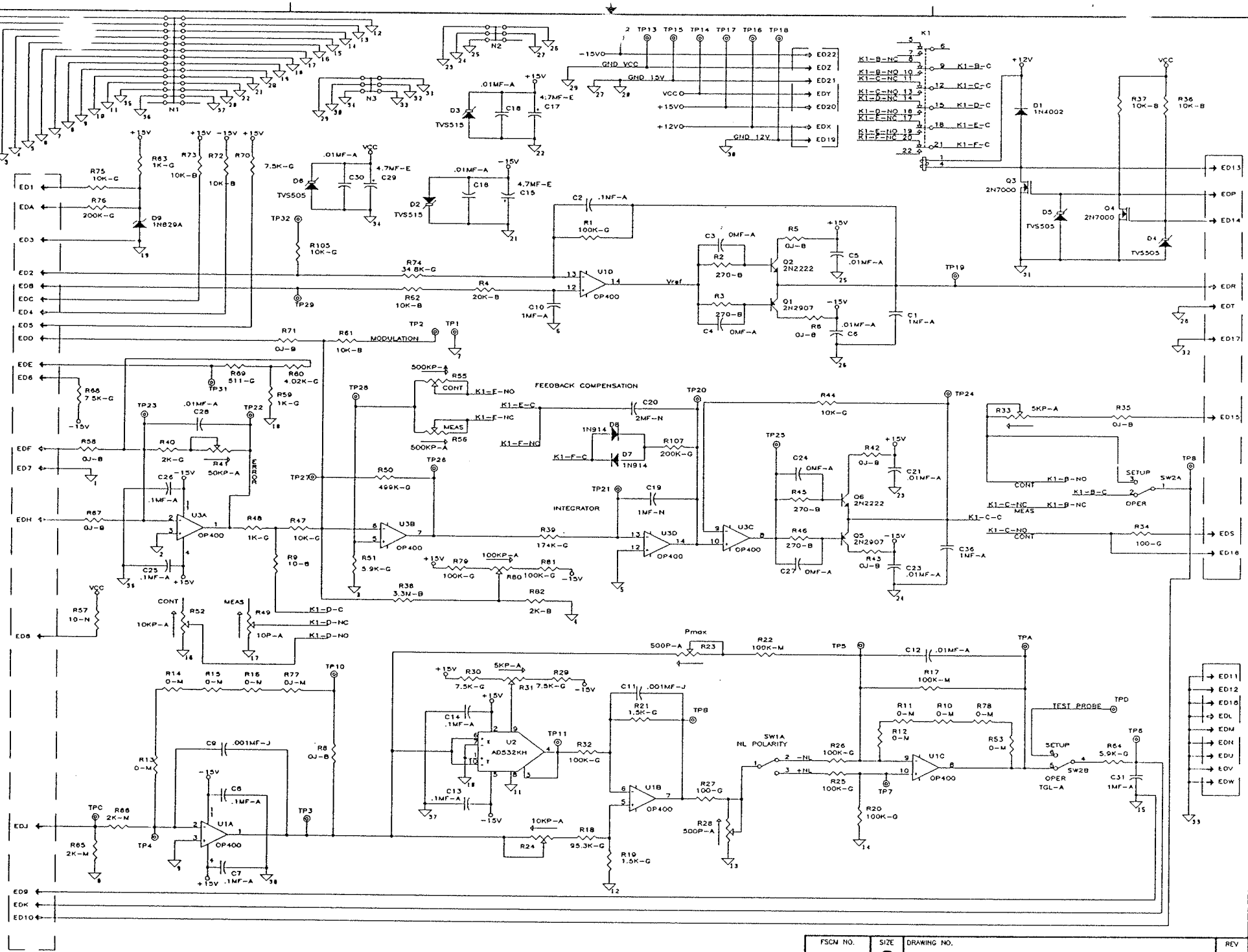
PCB ASSEMBLY, DPG CONTROLLER

SIZE	DRAWING NO.	REV
C	6010–PCA–1	E

SCALE 1/1 FILE NO. 001498E1.DWG SHEET 1 OF 2

4 3 2 1

D C B A



FSCN NO.	SIZE	DRAWING NO.	REV
96116	C	6010-PCA-1	E
SCALE 1/1	PLOT SCALE E/1=1	PLNR 10000	FILE NO. 00149BE2 DWG	SHEET 2

4 3 2 1

BILL OF MATERIAL
6010-PCA-2L
PCA, DPG POWER BOARD, LOW PRESSURE

SEQ. NO.	COMPONENT ITEM NO.	DESCRIPTION	QTY.	UM
	6010-PCA-2	PCA, DPG POWER BD, BASE	1.000	EA
BR01	65-842	RECT,BRDG 6.0A100PIV	1.000	EA
BR02	65-842	RECT,BRDG 6.0A100PIV	1.000	EA
C032	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C033	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C034	10-123	CAP DT 68. MF 15V 20% R	1.000	EA
C035	10-272	CAP ELEC 2200MF 25V RADIAL	1.000	EA
J007	14-459	CONN HSG MOLEX RCPT 9CKT .093	1.000	EA
J008	14-1114	CONN HSG MOLEX RCPT 4CKT .062	1.000	EA
J009	14-461	CONN HSG MOLEX RCPT 3CKT .062	1.000	EA
J010	14-459	CONN HSG MOLEX RCPT 9CKT .093	1.000	EA
K002	66-894	RLY SS 120 VAC SPNO PC MOUNT	1.000	EA
PS01	62-203	PWR SPLY, 5VDC & +/-15VDC	1.000	EA
P006	14-1115	CONN HSG MOLEX PLUG 6CKT .093	1.000	EA
P011	14-491	CONN HSG MOLEX PLUG 9CKT .062	1.000	EA
Q007	86-504	RECT GE-C106B1 SCR	1.000	EA
R084	67-265	RES CC 100K .50W5.00%RC20	1.000	EA
R085	10-159	VARISTOR GE V130LA20A	1.000	EA
R089	67-409	RES CC 33K .50W5.00%RC20	1.000	EA
U004	90-913	IC POS 12YREG LM340-12 1.5A	1.000	EA
0001	14-487	SKT CNTKS MOLEX .093 PC TAIL	18.000	EA
0002	14-677	SKT CNTKS MOLEX .062 PC TAIL	7.000	EA
0003	14-451	PIN CNTKS MOLEX .093 PC TAIL	6.000	EA
0004	14-452	PIN CNTKS MOLEX .062 PC TAIL	9.000	EA
0005	32-173	HEATSINK, CLIP-ON SOLDERABLE	2.000	EA
0006	6010-PWB-2	PC BOARD, DPG POWER SZ C,	1.000	EA
0007	14-551	SHUNT PLUG 2SKT .025SQ .1CNTRS	1.000	EA
0008	35-511	TERM SUBMIN BLUE TEFLON	7.000	EA
0009	14-528	HDR 2ROW ST BERGSTIK 72PIN SQ	1.000	EA
	6010B-EEDOC-LP	SERVICE DIAGRAM, DPG	1.000	EA
D012	94-334	WIRE, BUSS 22AWG SOFT DRAWN ALPHA 298	0.100	FT

BILL OF MATERIAL
6010-PCA-2H
PCA, DPG POWER BOARD, HI PRESSURE

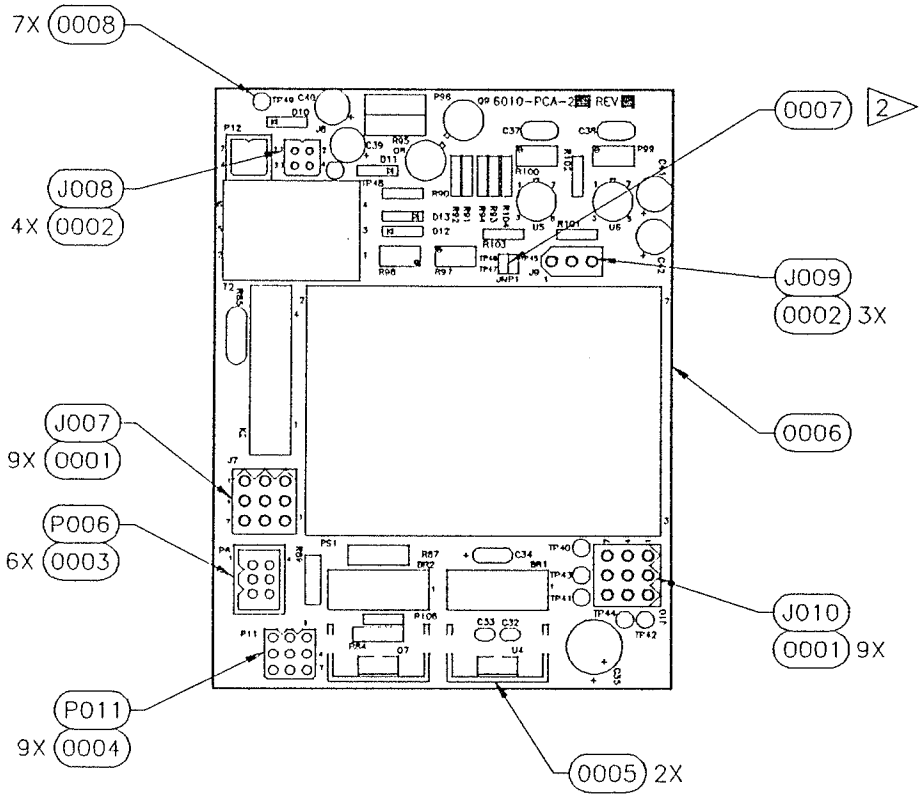
SEQ. NO.	COMPONENT ITEM NO.	DESCRIPTION	QTY.	UM
	6010-PCA-2	PCA, DPG POWER BD, BASE	1.000	EA
BR01	65-842	RECT,BRDG 6.0A100PIV	1.000	EA
BR02	65-842	RECT,BRDG 6.0A100PIV	1.000	EA
C032	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C033	10-257	CAP CE .01 MF 50V 10% R	1.000	EA
C034	10-123	CAP DT 68. MF 15V 20% R	1.000	EA
C035	10-272	CAP ELEC 2200MF 25V RADIAL	1.000	EA
J007	14-459	CONN HSG MOLEX RCPT 9CKT .093	1.000	EA
J008	14-1114	CONN HSG MOLEX RCPT 4CKT .062	1.000	EA
J009	14-461	CONN HSG MOLEX RCPT 3CKT .062	1.000	EA
J010	14-459	CONN HSG MOLEX RCPT 9CKT .093	1.000	EA
K002	66-894	RLY SS 120 VAC SPNO PC MOUNT	1.000	EA
PS01	62-203	PWR SPLY, 5VDC & +/-15VDC	1.000	EA
P006	14-1115	CONN HSG MOLEX PLUG 6CKT .093	1.000	EA
P011	14-491	CONN HSG MOLEX PLUG 9CKT .062	1.000	EA
Q007	86-504	RECT GE-C106B1 SCR	1.000	EA
R084	67-265	RES CC 100K .50W5.00%RC20	1.000	EA
R085	10-159	VARISTOR GE V130LA20A	1.000	EA
R089	67-409	RES CC 33K .50W5.00%RC20	1.000	EA
R106	94-334	WIRE, BUSS 22AWG SOFT DRAWN ALPHA 298	0.100	FT
U004	90-913	IC POS 12YREG LM340-12 1.5A	1.000	EA
0001	14-487	SKT CNTKS MOLEX .093 PC TAIL	18.000	EA
0002	14-677	SKT CNTKS MOLEX .062 PC TAIL	7.000	EA
0003	14-451	PIN CNTKS MOLEX .093 PC TAIL	6.000	EA
0004	14-452	PIN CNTKS MOLEX .062 PC TAIL	9.000	EA
0005	32-173	HEATSINK, CLIP-ON SOLDERABLE	2.000	EA
0006	6010-PWB-2	PC BOARD, DPG POWER SZ C,	1.000	EA
0007	14-551	SHUNT PLUG 2SKT .025SQ .1CNTRS	1.000	EA
0008	35-511	TERM SUBMIN BLUE TEFLON	7.000	EA
0009	14-528	HDR 2ROW ST BERGSTIK 72PIN SQ	1.000	EA
	6010B-EEDOC-HP	SERVICE DIAGRAM, DPG	1.000	EA
C037	10-57`	CAP MF .001 1000VDC ISCAD	1.000	EA
C038	10-57`	CAP MF .001 1000VDC ISCAD	1.000	EA
C039	10-119	CAP DT 15. MF 15V 20% R	1.000	EA
C040	10-119	CAP DT 15. MF 15V 20% R	1.000	EA
C041	10-119	CAP DT 15. MF 15V 20% R	1.000	EA
C042	10-119	CAP DT 15. MF 15V 20% R	1.000	EA
D010	19-214	DIO 1N645	1.000	EA
D011	19-214	DIO 1N645	1.000	EA
D012	19-214	DIO 1N645	1.000	EA
D013	19-214	DIO 1N645	1.000	EA
P012	14-1113	CONN HSG MOLEX PLUG 4 CKT .062	1.000	EA
Q008	86-508	XSTR, NPN-GE ECG101	1.000	EA

SEQ. NO.	COMPONENT ITEM NO.	DESCRIPTION	QTY.	UM
Q009	86-509	XSTR-PNP-GE ECG100	1.000	EA
R090	67-10014	RES CC 10 .25W5.00% RC07 ALLEN BRADLEY	1.000	EA
R091	67-425	RDS MF 10K .10W1.00% RN55C	1.000	EA
R092	67-425	RDS MF 10K .10W1.00% RN55C	1.000	EA
R093	67-425	RDS MF 10K .10W1.00% RN55C	1.000	EA
R094	67-425	RDS MF 10K .10W1.00% RN55C	1.000	EA
R095	67-373	RES WW 20 3.00W1.00% RS2B	1.000	EA
R096	67-373	RES WW 20 3.00W1.00% RS2B	1.000	EA
R097	62-234-502	POT CE 5K OHM 20 TURN PC MOUNT	1.000	EA
R098	62-234-502	POT CE 5K OHM 20 TURN PC MOUNT	1.000	EA
R099	62-234-104	POT CE 100KOHM 2O TURN PC MOUNT	1.000	EA
R100	62-234-104	POT CE 100KOHM 2O TURN PC MOUNT	1.000	EA
R101	67-399-10	RES CC 10K .25W5.00% RC07	1.000	EA
R102	67-399-10	RES CC 10K .25W5.00% RC07	1.000	EA
R103	67-399-10	RES CC 10K .25W5.00% RC07	1.000	EA
R104	67-399-10	RES CC 10K .25W5.00% RC07	1.000	EA
T002	86-473	TRFR STEP DWN 6.3V 14A PC12-70 SIGNAL	1.000	EA
U005	35-486	IC ADOP07DH OP AMP	1.000	EA
U006	35-486	IC ADOP07DH OP AMP	1.000	EA
0004	14-452	PIN CNTKS MOLEX .062 PC TAIL	4.000	EA

BILL OF MATERIAL
6010-PCA-2M

SEQ. NO.	COMPONENT ITEM NO.	DESCRIPTION	QTY.	UM
BR02	65-842	RECT,BRDG 6.0A100PIV	1.000	EA
J010	14-459	CONN HSG MOLEX RCPT 9CKT .093	1.000	EA
PS01	62-203	PWR SPLY, 5VDC & +/-15VDC	1.000	EA
P006	14-1115	CONN HSG MOLEX PLUG 6CKT .093	1.000	EA
P011	14-491	CONN HSG MOLEX PLUG 9CKT .062	1.000	EA
Q007	86-504	RECT GE-C106B1 SCR	1.000	EA
R084	67-265	RES CC 100K .50W5.00%RC20	1.000	EA
R089	67-409	RES CC 33K .50W5.00%RC20	1.000	EA
R106	94-334	WIRE,BUSS 22AWG SOFT DRAWN	0.100	FT
0001	14-487	SKT CNTKS MOLEX .093 PC TAIL	9.000	EA
0003	14-451	PIN CNTKS MOLEX .093 PC TAIL	6.000	EA
0004	14-452	PIN CNTKS MOLEX .062 PC TAIL	9.000	EA
0005	32-173	HEATSINK, CLIP-ON SOLDERABLE	1.000	EA
0006	6010-PWB-2	PC BOARD, DPG POWER	1.000	EA
0008	35-511	TERM SUBMIN BLUE TEFLON	5.000	EA

REVISION					
ZONE	LTR	DESCRIPTION	BY	DATE	APVD
	A	RELEASED DR 7501	JH	05/06/91	JH
	B	REVISED ECO 17451	JH		



XXXX COMPUTER ITEM SEQUENCE NUMBERS USED

3. COMPONENT WITH DESIGNATOR "JMP1" TO BE TRIMMED FROM ITEM 0009

2 INSTALL ITEM 0007 BETWEEN TP46 AND TP47.

1. FABRICATION TOLERANCES AND PRACTICES PER RIC ER-192.

NOTES: UNLESS OTHERWISE SPECIFIED.

FINISH

MATERIAL SPEC (RIC NO.)

MATERIAL DESCRIPTION

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES

DECIMALS	ANGULAR
.X ± .030	± 0.5°
.XX ± .020	FRACTIONAL
.XXX ± .010	± 1/32
.XXXX ± .005	

		DATE
DRAWN	J.HARRIS	10/09/90
CHECKED	P. EDWARDS	05/06/91
PROJECT ENGR	J.HARRIS	05/06/91
MGR QUALITY	J. VAINASK	05/08/91
MGR ENGRG SVCS	K.HARRIS	05/06/91
VP ENGRG	J. HINDS	05/14/91
VP MFG	S. LAUGHNAN	05/13/91

FSCM NO. 96116

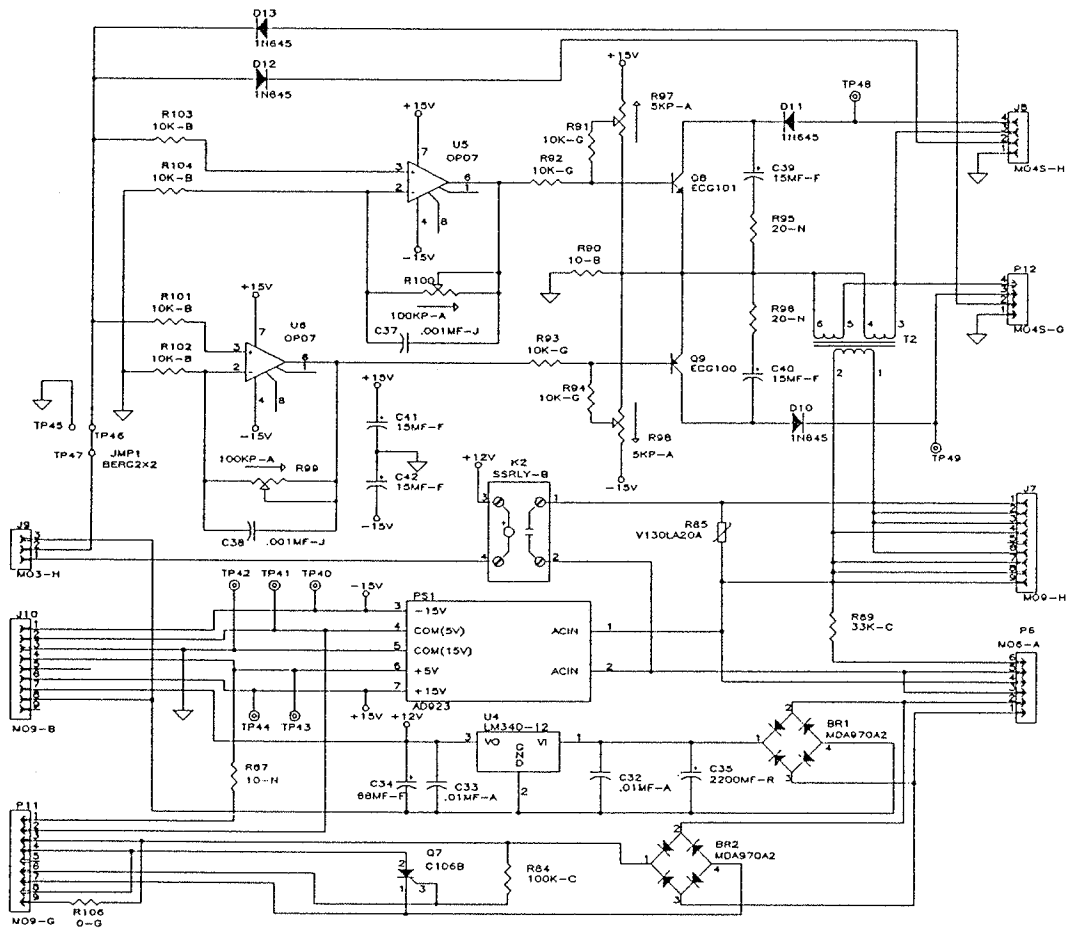
RUSKA® INSTRUMENT CORPORATION HOUSTON, TEXAS

TITLE
PCB ASSEMBLY DPG POWER

NEXT ASSY
6010-126G

SIZE C | DRAWING NO. 6010-PCA-2 | REV B

SCALE 1/1 | FILE NO. 001500B1.DWG | SHEET 1 OF 2



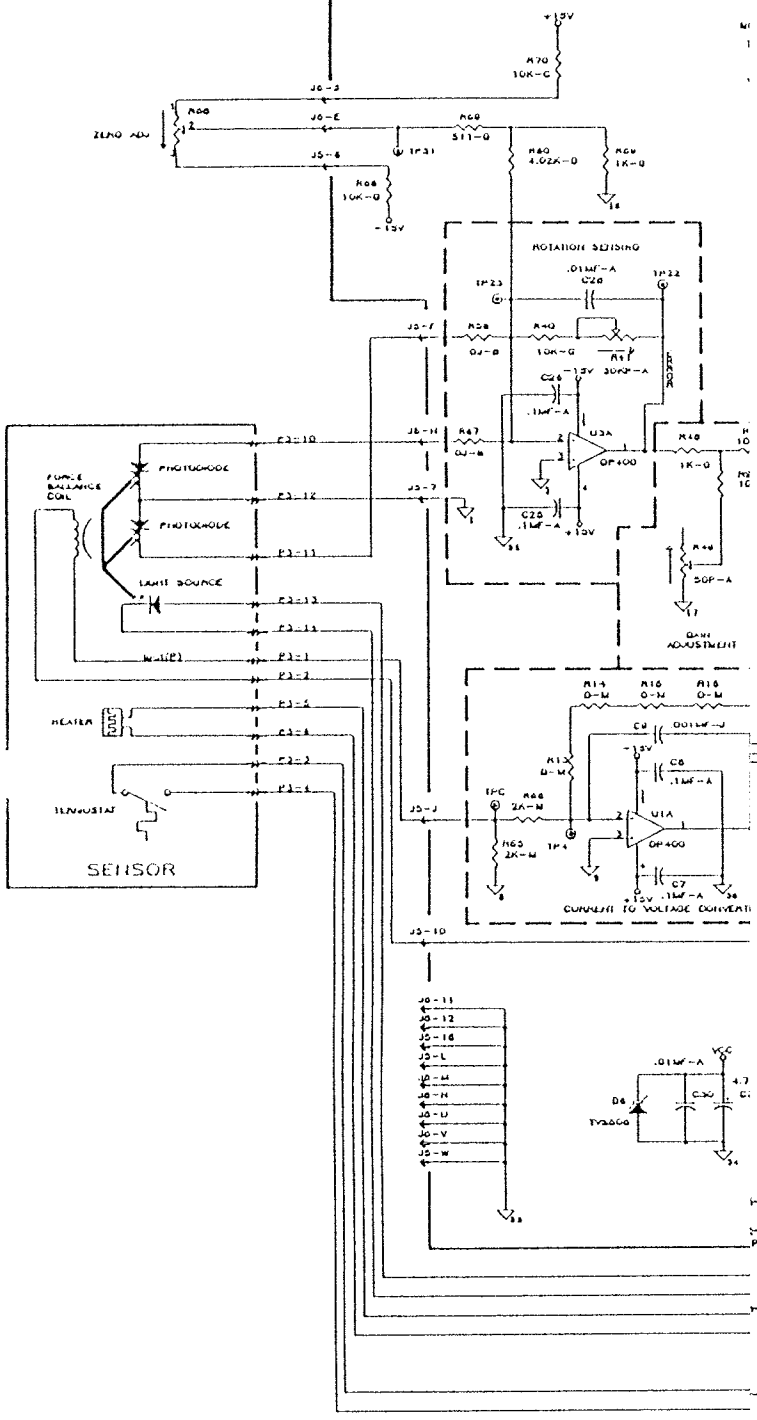
POWER
BOARD

FSCN NO.	SIZE	DRAWING NO.	REV
96116	C	6010-PCA-2	B
SCALE 1/1	PLOT SCALE E/1=1	PLNR 10000	FILE NO. 001500B2 DWG	SHEET 2

NOTES: UNLESS OTHERWISE SPECIFIED.

1. FABRICATION TOLERANCES AND PRACTICES PER ER-192.

REVISION RECORD				
LTR	DESCRIPTION	BY	DATE	APVD
A	RELEASED ECN 7501	VP	91/04/30	JBM
B	ECO 16404	MWK		



FSCM NO. 96116	RUSKA® INSTRUMENT CORPORATION HOUSTON, TEXAS		
TITLE	SERVICE DIAGRAM, DIGITAL PRESSURE GAGE-MEASUREMENT		
SIZE D	DRAWING NO. 6010B-EEDOC-M	REV B	
SCALE 1/1	FILE NO. 00191981.DWG	SHEET 1 OF 1	

NOTES: UNLESS OTHERWISE SPECIFIED.

1. FABRICATION TOLERANCES AND PRACTICES PER RIC ER-192.

REVISION RECORD				
LTR	DESCRIPTION	BY	DATE	APVD
A	RELEASED ECN 7501	VP	91/04/30	JBH
B	ECO 18604	MPK	92/21/01	JBH
C	ECO 18675	JH	92/08/01	JBH
D	REVISED ECO 17650	JH		

SENSOR

CONTROL BOARD

POWER BOARD

TO INTERFACE PANEL

MATERIAL SPEC (RIC NO.)

MATERIAL DESCRIPTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

TOLERANCES

DECIMALS	ANGULAR
X ± .030	± 2°
XX ± .020	FRACTIONAL
XXX ± .010	± 1/32
XXXX ± .005	

		DATE
DRAWN	V POTEET	4/30/91
CHECKED	K HARRIS	4/30/91
PROJECT ENGR	J HARRIS	4/30/91
QUALITY	G STOCKER	4/30/91
MFG ENGRG SVCS	K HARRIS	4/30/91
MFG ENGRG	J HINDS	4/30/91
MFG	S LAUGHMAN	4/30/91

FSCM NO 96116

RUSKA® INSTRUMENT CORPORATION HOUSTON, TEXAS

TITLE

SERVICE DIAGRAM, DIGITAL PRESSURE GAGE-HIGH PRESSURE

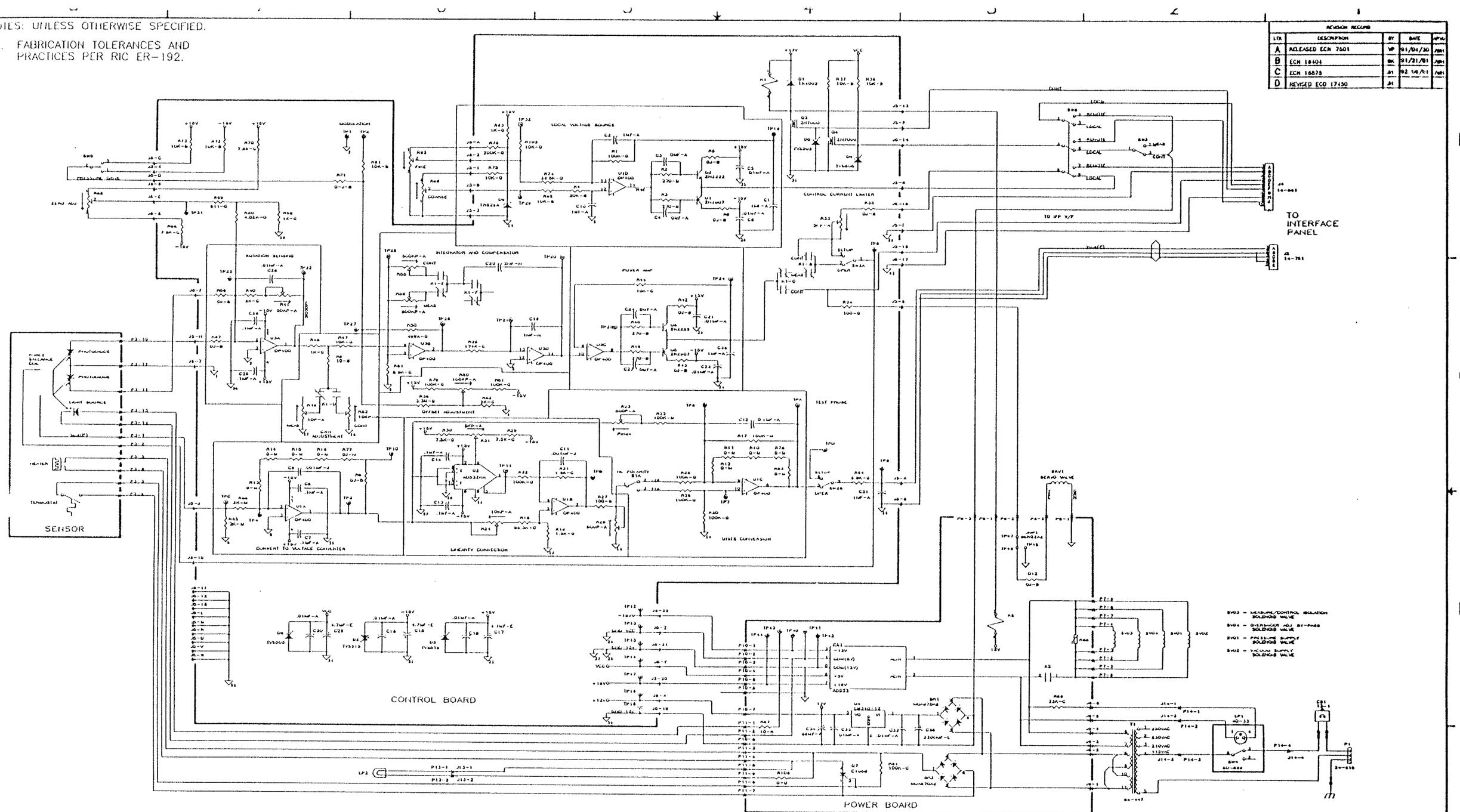
SIZE	DRAWING NO.	REV
D	6010B-EEDOC-HP	D

SCALE 1/1 FILE NO. 00191801.DWG SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED.

1. FABRICATION TOLERANCES AND PRACTICES PER RIC ER-192.

REVISION RECORD				
LTR	DESCRIPTION	BY	DATE	APVD
A	RELEASED ECN 7601	VP	91/04/30	MH
B	ECN 16404	BK	91/21/91	MH
C	ECN 16873	JH	92.10/91	MH
D	REVISED ECO 17450	JH		



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MATERIAL SPEC (RIC NO)

MATERIAL DESCRIPTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMALS: .x ± .030; .xx ± .020; .xxx ± .010; .xxxx ± .005
ANGULAR ± 2°
FRACTIONAL ± 1/32

DRAWN	V. POTEET	91/04/30
CHECKED	K HARRIS	91/04/30
PROJECT ENGR	J HARRIS	91/04/30
QUALITY	G STOCKER	91/04/30
MFG ENGRG SVCS	K HARRIS	91/04/30
MP ENGRG	J HINDS	91/04/30
MP MFG	S LAUGHMAN	91/04/30

FSCM NO 96116

RUSKA® INSTRUMENT CORPORATION HOUSTON, TEXAS

TITLE: SERVICE DIAGRAM, LOW PRESSURE-DIGITAL PRESSURE GAGE

SIZE	DRAWING NO.	REV
D	6010B-EEDOC-LP	D

SCALE NONE | FILE NO. 001917D1.DWG | SHEET 1 OF 1

APPENDIX A
TEST REPORT

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INDEX