

TECHNICAL MANUAL

DIGI-PAK 270 Ion Pump Power Supply

Part No. 624754 Rev. A

PERKIN ELMER

Physical Electronics Division
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OPERATOR SAFETY SUMMARY

All PHI components have been designed to assure operator safety. However, like all other sophisticated instruments, continual operator safety is dependent on the proper use.

LISTED BELOW ARE WARNINGS APPLICABLE TO THIS EQUIPMENT. ALL PERSONNEL INVOLVED IN THE OPERATION AND MAINTENANCE OF THIS EQUIPMENT MUST FULLY UNDERSTAND THE WARNINGS AND THE PROCEDURES BY WHICH THE HAZARD IS TO BE REDUCED OR ELIMINATED.

WARNING

THE PRODUCT(S) COVERED IN THIS MANUAL HAS BEEN DESIGNED TO FUNCTION SAFELY WITH THE REQUIRED DEGREE OF PRECISION WHEN USED IN THE PRESCRIBED MANNER.

IT IS NOT RECOMMENDED THAT THIS EQUIPMENT BE MODIFIED FOR ANY NON-STANDARD APPLICATION SINCE HAZARDOUS CONDITIONS MAY RESULT. DUE TO THE FACT THAT PHYSICAL ELECTRONICS DIVISION OF PERKIN-ELMER HAS NO CONTROL OVER CUSTOMER MODIFICATIONS TO PHI PRODUCTS SHIPPED, IT DISCLAIMS ANY RESPONSIBILITY FOR ANY MALFUNCTIONS OR ACCIDENTS THAT MAY RESULT!

WARNING

115/230 VAC OPERATION ONLY

THE SERIES 270 DIGI-PAK COVERED IN THIS MANUAL HAS BEEN DESIGNED TO OPERATE FROM EITHER NOMINAL 115 VOLT OR NOMINAL 230 VOLT, 50 OR 60 HZ AC POWER BY SELECTION OF EITHER THE 115V OR 230V INPUT LINE CORD. UNDER NO CIRCUMSTANCES SHOULD THIS UNIT BE CONNECTED TO ANY OTHER INPUT POWER SOURCE THAN ONE SPECIFIED FOR THE LINE CORD BEING USED. SEVERE DAMAGE TO EITHER PERSONNEL OR EQUIPMENT MAY RESULT.

DANGER ELECTRICAL SHOCK HAZARD

HIGH VOLTAGES ARE PRESENT IN THE SYSTEM WHEN THE SYSTEM POWER INPUT LINES ARE CONNECTED. DISCONNECT INPUT POWER AT THE WALL BEFORE MAKING ANY ADJUSTMENTS. REFER SERVICING TO PERSONNEL WHO HAVE BEEN TRAINED AND HAVE WORKING EXPERIENCE WITH VOLTAGES IN EXCESS OF 50 VOLTS.

ALL ELECTRICAL CABLES ASSOCIATED WITH VARIOUS UNITS INCLUDED IN A SYSTEM ARE WELL SHIELDED. HOWEVER, CARE MUST BE TAKEN NEVER TO COME IN CONTACT WITH ANY ASSOCIATED TERMINALS WHEN THE POWER IS ON. SOME OF THESE LEADS CARRY POTENTIALLY LETHAL HIGH VOLTAGES. OTHER LEADS MAY CARRY SUFFICIENT RF POWER TO INFLICT SEVERE BURNS.

RF INTERFERENCE

THIS EQUIPMENT GENERATES, USES, AND CAN RADIATE RADIO-FREQUENCY ENERGY, AND IF NOT INSTALLED AND USED IN ACCORDANCE WITH THE INSTRUCTION MANUAL, MAY CAUSE INTERFERENCE TO RADIO COMMUNICATIONS. OPERATION OF THIS EQUIPMENT IN A RESIDENTIAL AREA IS LIKELY TO CAUSE INTERFERENCE IN WHICH CASE THE USER AT HIS OWN EXPENSE WILL BE REQUIRED TO TAKE WHATEVER MEASURES MAY BE REQUIRED TO CORRECT THE INTERFERENCE.

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SECTION I INTRODUCTION

1.0 GENERAL INFORMATION

This manual is intended to assist personnel in the installation, operation, and understanding of the PHI Series 270 DIGI-PAK Ion Pump Power Supplies which includes P/N's 222-0272 and 222-0275.

Two versions of the DIGI-PAK 270 Ion Pump Power Supply exist: a positive polarity version (P/N 222-0272) and a negative polarity version (P/N 222-0275). The information contained within this manual covers both versions.

The manual is divided into five sections. Section I contains a brief description and the specifications of the DIGI-PAKs. Section II describes installation, Section III explains operation, and Section IV briefly outlines how the various components function together. Maintenance and calibration procedures are discussed in Section V.

1.1 GENERAL DESCRIPTION

DIGI-PAK 270 units are compact high voltage power supplies designed to directly start, operate, and monitor the operation of ion pumps up to 60 liters/second capacity after normal turbo roughing has been performed. These power supplies can also be used to operate and monitor much larger ion pumps after they have been started by a higher current power supply.

The Series 270 DIGI-PAK provides a number of features for safe and convenient control and monitoring of ion pumps. These include both local and remote digital readout of pump voltage and current, both visual and electrical status indication when High Voltage is ON and control of the High Voltage output from the front panel as well as remotely both from the ion pump and from other customer provided interlocks. In addition, the DIGI-PAK 270 provides a user-programmable digital setpoint which can be used to operate alarms and turn external equipment ON and OFF as a function of system vacuum levels and pump current.

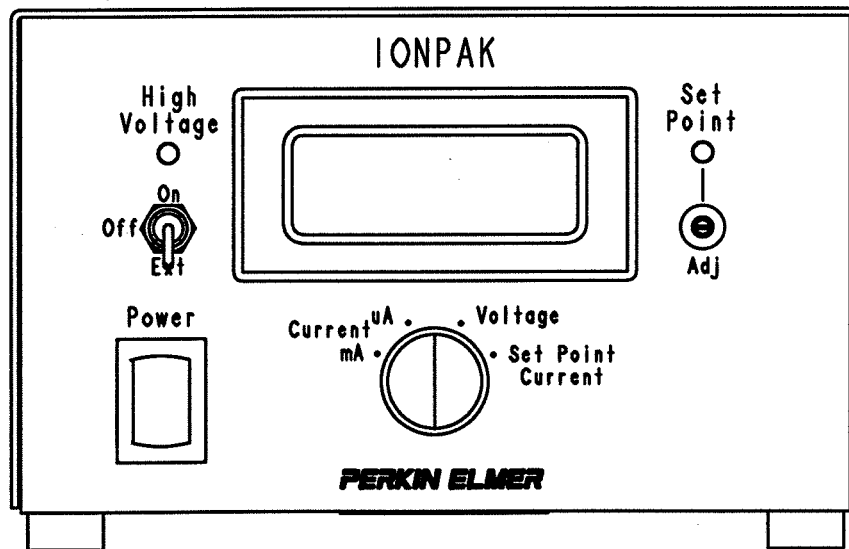


Figure 1 - 1. The PHI DIGI-PAK 270 Power Supply.

Section I - Introduction

The DIGI-PAK 270 is designed and built to allow continuous operation into any type pump condition ranging from an open circuit to a dead short without damage to the supply.

Power Source

The DIGI-PAK 270 is designed to be powered directly from either a 115 or 230 volt, 50 or 60 Hz, single phase power line. The input voltage is automatically connected for the correct voltage range by either the 115 volt or 230 volt power cord when it is connected to the Power Input connector, J1. A power cord is NOT included with the standard DIGI-PAK 270 unit and should be ordered separately. Two standard line cords are available for the DIGI-PAK: PHI P/N 623928 is for operation on line voltages ranging between 100 to 125 volts and PHI P/N 623929 for operation on line voltages between 200 to 250 volts.

- P/N 623928 has a standard molded NEMA 5-15, 120 volt grounded plug marked with a RED label and WHITE lettering which reads "100 - 120 VAC";
- P/N 623929 does not include a molded plug. This power cord is provided with the conductors pre-stripped which allows customers to install a suitable plug to correspond with the outlets at their particular site. This cord is marked with a YELLOW label with black lettering which reads "200 - 250 VAC".

Before attempting to use the Series 270 ion pump power supply, always check to confirm that you have the correct line cord for your input voltage. Refer to Section III (Table 3-1, page 15) for input power connections.

Starting an ion pump with the Series 270 power supply operating from 120 VAC will draw approximately .25 amps (maximum). Starting an ion pump with the Series 270 power supply operating from 240 VAC will draw approximately .125 amps (maximum).

All DIGI-PAK models are designed to limit the total power delivered to the ion pump to a maximum of 12 watts @ 60 Hz (16 watts @ 50 Hz). All PHI ion pumps 11 l/s or larger can safely dissipate 12 watts indefinitely, so there is no way they can be overheated by the power supply under any vacuum conditions. Smaller pumps, and even 11 l/s units operating on 50 Hz, can also be safely

operated, but it is up to the operator to manually shut down the supply if the pump is NOT able to start before it overheats.

Readout

The Series 270 power supplies are provided with a digital readout which displays pump voltage and current, and is used for adjusting the setpoint. It displays voltage from a range of 0.00 to 6.00 kV, and pump current from 0.0 to 200.0 microamps or from 0.00 to 10.00 milliamps.

Analog Output

A 15 pin Sub D jack, J2, is located on the rear panel of the DIGI-PAK. This jack provides analog output signals to monitor voltage and current as well as the setpoint output and remote high voltage interlock control.

Setpoint

The Series 270 power supplies are also provided with a user-adjustable setpoint. The setpoint provides a set of SPDT relay contacts which are energized whenever the supply is operating and the pump current is below the setpoint value. The setpoint can be adjusted to any value current up to 2 mA and is usually set to discharge current corresponding to a desired pressure level inside the ion pump. When the current increases above the setpoint value due to higher pressure or the supply loses power or is turned off, the relay is de-energized.

NOTE:

When the high voltage relay is opened, the setpoint relay must also be de-energized since there is no pump current to prove system pressure is low enough.

Safe-conn High Voltage Interlock

When operated with PE Safe-conn safety interlocked pumps and cables, the Series 270 pump supply will also automatically shutdown whenever the HV cable is disconnected at either the supply end or the pump end. In this way, personnel are provided additional protection from possible shock hazards.

The high voltage output can be controlled in two ways: either from the front panel, or by a remote interlock switch.

**1.2 ELECTRICAL SPECIFICATIONS -
MODELS 222-0272**

1.2.0 Input Power

Voltage: 100 - 125 VAC,
200 - 250 VAC.

Starting Current: .25 Amp (maximum)
@ 115 VAC, 60 Hz;
.160 Amp (maximum)
@ 230 VAC, 50 Hz.

Frequency: 50/60 Hz.

1.2.1 High Voltage Output

Open Circuit
Voltage: +5.6 kV (no load).

Short Circuit
Current: 8.6 mA @ 60 Hz.,
10.5 mA @ 50 Hz.

1.2.2 Analog Outputs (Buffered)

The analog outputs can be used as either voltage or current sources. In voltage mode, use a 0 - 10 volt DVM of 100 kohms or greater input impedance. In current mode, use a 0-1 mA current meter of 10 ohms or less input impedance.

Ranges: $V_{Mon} = 0$ to 6 VDC,
 $I_{Mon} = 0$ to 10 VDC.

Output
Impedance: 1 kohm, $\pm 1\%$.

Monitor
Scale Factors: $V_{Mon} = 1V/kV$,
 $I_{Mon} = 1V/mA$.

1.2.3 Setpoint

User adjustable: 40 microamps to
1.999 milliamps.

1.2.4 Readout

I_{High} : 0.00 to 10.00 mA.
 I_{Low} : 0.00 to 199.9 μ A.
 V_{Out} : 0.00 to 6.00 kV.
 I_{Setpt} : .040 to 1.999 mA.

1.2.5 Auxillary Power Out

+5 VDC @ 50 mA (maximum).
+15 VDC @ 15 mA (maximum).
-15 VDC @ 15 mA (maximum).

1.2.6 Status

High Voltage
Status Out: 12 VDC, 50 mA
(maximum).

Setpoint Logic
Level Out: 5 VDC, 4 mA
(maximum).

Setpoint
Contacts: SPDT (1 FORM C),
2 A @ 250 VAC,
0.5 A @ 30 VDC.

Section I - Introduction

1.3 ELECTRICAL SPECIFICATIONS - MODELS 222-0275

1.3.0 Input Power

Voltage:	100 - 125 VAC, 200 - 250 VAC.
Starting Current:	.25 Amp (maximum) @ 115 VAC, 60 Hz; .160 Amp (maximum) @ 230 VAC, 50 Hz.
Frequency:	50/60 Hz.

1.3.1 High Voltage Output

Open Circuit Voltage:	-5.6 kV (no load).
Short Circuit Current:	8.6 mA @ 60 Hz, 10.5 mA @ 50 Hz.

1.3.2 Analog Outputs (Buffered)

The analog outputs can be used as either voltage or current sources. In voltage mode, use a 0 - 10 volt DVM of 100 Kohms or greater input impedance. In current mode, use a 0-1 mA current meter of 10 ohms or less input impedance.

Ranges:	$V_{Mon} = 0 \text{ to } 6 \text{ VDC},$ $I_{Mon} = 0 \text{ to } 10 \text{ VDC}.$
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Output Impedance:	1 kohm, $\pm 1\%$.
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Monitor Scale Factors:	$V_{Mon} = 1\text{V}/1\text{kV},$ $I_{Mon} = 1\text{V}/\text{mA}.$
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1.3.3 Setpoint

User adjustable:	40 microamps to 1.999 milliamps.
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1.3.4 Readout

I_{High} :	0.00 to 10.00 mA.
I_{Low} :	0.00 to 199.9 μA .
V_{Out} :	0.00 to 6.00 kV.
I_{Setpt} :	.040 to 1.999 mA.

1.3.5 Auxillary Power Out

+5 VDC @ 50 mA (maximum).
+15 VDC @ 15 mA (maximum).
-15 VDC @ 15 mA (maximum).

1.3.6 Status

High Voltage Status Out:	12 VDC, 50 mA (maximum).
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Setpoint Logic Level Out:	5 VDC, 4 mA (maximum).
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Setpoint Contacts:	SPDT (1 FORM C), 2 A @ 250 VAC, 0.5 A @ 30 VDC.
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1.4 MECHANICAL SPECIFICATIONS

1.5 ENVIRONMENTAL SPECIFICATIONS

1.4.0 Physical

Chassis
 Dimensions: Width = 5.63"
 (14.3 cm)
 Height = 3.60"
 (9.1 cm)
 Depth = 9.18"
 (23.3 cm)

Net Weight: 8 lbs. (3.7 kg).

Operating Temperature
 Range: 0° to 50° C.

Storage Temperature
 Range: -10° to 50° C.

Relative Humidity: 80% @ 30° C
 (non-condensing).

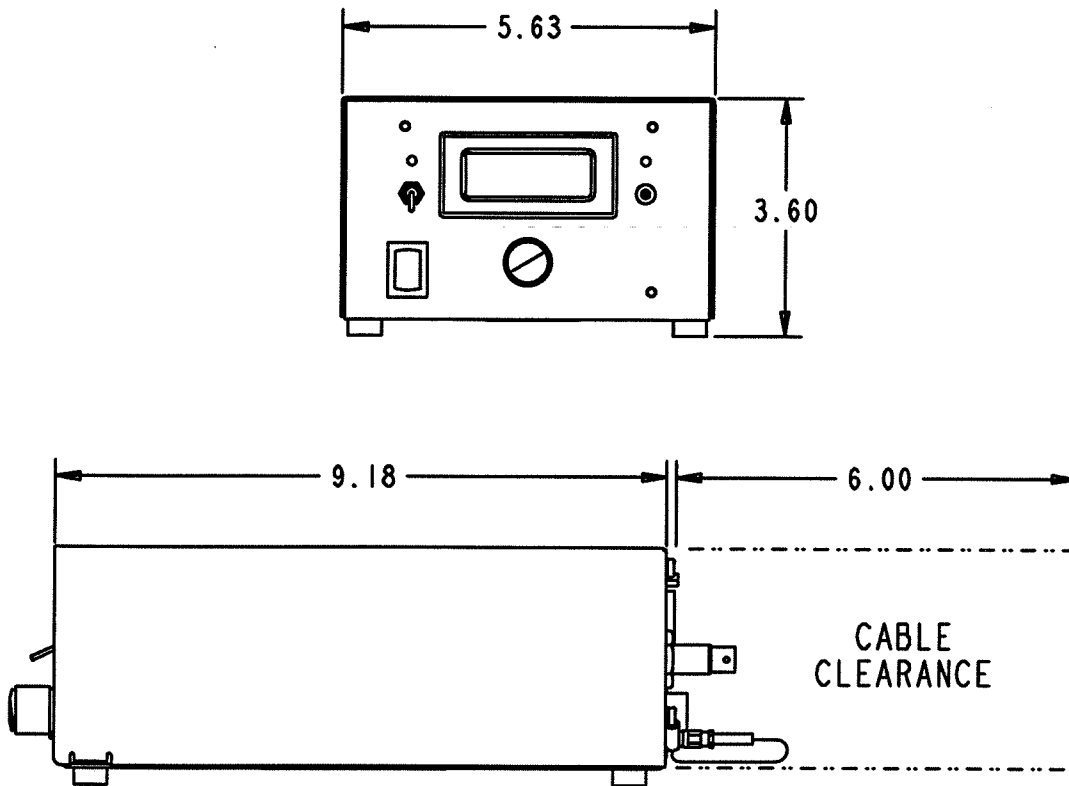


Figure 1-2. Dimensions of the DIGI-PAK 270 Chassis.

Section I - Introduction

SECTION II

INITIAL CHECKOUT AND INSTALLATION

2.0 GENERAL INFORMATION

The PHI DIGI-PAK 270 ion pump power supplies are designed to be used in either a table top or rack-mounted configuration.

2.1 INSTALLATION PLANNING

Table Top

The DIGI-PAK 270 ion pump power supply is shipped ready for use as a table top or bench-mounted unit. The power supply is provided with four (4) rubber feet to protect the mounting surface and prevents it from easily moving around.

Rack Mounting

DIGI-PAK 270 power supplies can be installed in standard 19 inch electronic racks using the optional rack

mounting kit (P/N 624543) as shown in Figures 2-3 and 2-4. The rack mount shelf has adequate space to mount up to three controls. Once mounted in the rack, a DIGI-PAK 270 occupies a height of only 3.5 inches. The electronics rack comes with two removable blank panels to cover front portions of the rack which will not be used for mounting additional power supplies.

To install a DIGI-PAK 270 power supply on the rack shelf, unscrew the four (4) rubber feet on the bottom of the supply, position the DIGI-PAK, and secure it with the four flat head screws which fit into the holes where the feet were attached. Allow enough space at the rear of the control to connect the cable(s) to the Series 270 when planning the installation of the unit. For proper operation, the ambient temperature must be kept between 0° C and 50° C, and relative humidity should be <80% non-condensing. The maximum power draw is 30 VA.

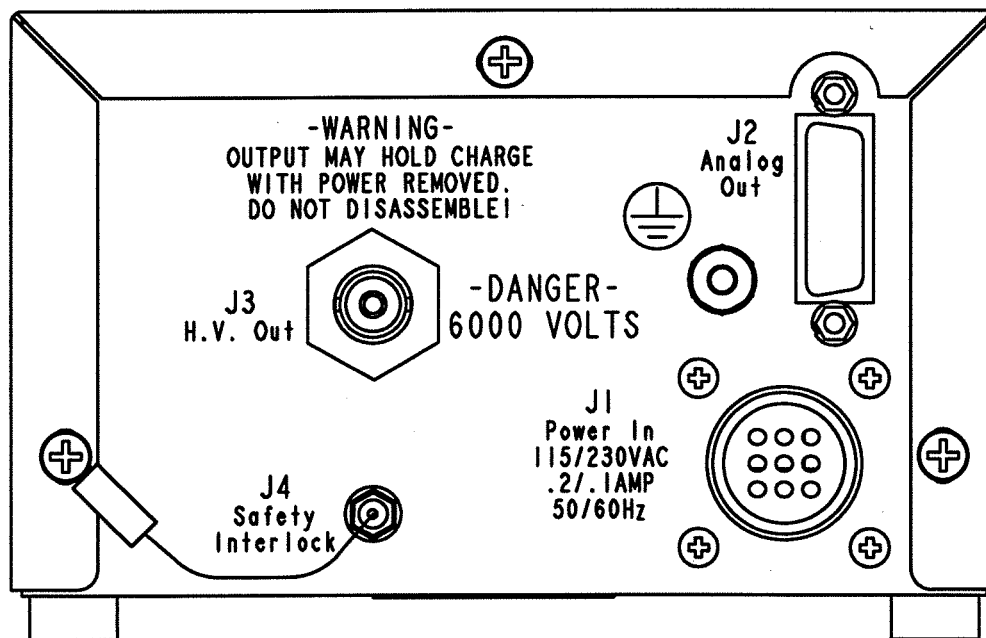


Figure 2 - 1. Diagram of the PHI DIGI-PAK 270 Ion Pump Power Supply Connections.

Section II - Initial Checkout & Installation

2.2 RECEIVING AND UNPACKING

Upon receiving your DIGI-PAK 270 Ion Pump Power Supply unit, a visual inspection should be performed to insure that no damage occurred during shipping. If damage did occur, contact the shipping carrier immediately.

WARNING

VOLTAGES AS HIGH AS 7000 VOLTS MAY BE PRESENT IN THE DIGI-PAK. SERVICE SHOULD ALWAYS BE PERFORMED BY QUALIFIED PERSONNEL. DO NOT DISCONNECT THE POWER SUPPLY FROM THE ION PUMP WHILE POWER IS CONNECTED TO THE UNIT. AFTER REMOVING THE POWER FROM THE UNIT, ALLOW A MINIMUM OF ONE MINUTE BEFORE DISCONNECTING THE POWER SUPPLY FROM THE ION PUMP. DO NOT OPERATE THE CONTROL WITHOUT A PROPER ELECTRICAL GROUND. DO NOT OPERATE THE UNIT NEAR WATER. THE UNIT MAY BE DAMAGED AND ITS SAFETY REDUCED, IF IT IS OPERATED OUTSIDE THE SPECIFICATIONS.

2.3 INPUT POWER CONNECTION

Before attempting to use the DIGI-PAK, confirm that you have the correct line cord for the selected input voltage. The 100 - 125 volt (AC) range requires the low voltage cord which is normally provided with a molded, standard NEMA 5-15, grounded 120 volt plug and a red label. Operation of the DIGI-PAK with the 200 - 250 volt (AC) range requires the usage of the high voltage cord. This cord, which is marked with a yellow label, is normally provided with the conductors stripped and tinned for connection to a suitable, molded plug to mate with the locally available outlets.

NOTE:

Power cords purchased with the DIGI-PAK are supplied with three conductors: blue, brown and green/yellow. The blue and brown conductors are both designated for incoming power, and the green conductor with the yellow stripe serves as the safety ground connection to the chassis and as the high voltage return.

WARNING

NEVER APPLY A VOLTAGE GREATER THAN 125 VAC TO THE DIGI-PAK WHEN USING A LINE CORD WIRED FOR 115 VOLT OPERATION. THE DIGI-PAK UNIT WILL BE DAMAGED AND DANGEROUS VOLTAGES MAY BE GENERATED.

2.4 CABLE CONNECTIONS

Refer to Figure 2-1 for the location of the following connections on the rear of the DIGI-PAK 270 Ion Pump Power Supply.

Connector:	Purpose:
J1	Power Input
J2	Interface
J3	High Voltage Output
J4	High Voltage Interlock

The DIGI-PAK Power Supply is not shipped with mating connectors. The following list describes the connector designation on the end panels of the DIGI-PAK, the corresponding number of pins on the connector, the type of connector used, and the vendor part number (with a corresponding part number for the mating connector).

Connector:	Pins:	Type:	Part #(s)
J1	9	Male	AMP MultiMate chassis receptacle # 206705-1. Mates with cord connector # 206708-1.
J2	15	Female	Sub-D mates with Amphenol DA15P.
J3	1	Female	Standard: 10kV coax jack, mates with Kings type 1065 cable plug. Optional: Fischer D105A049 mates with S105A049.
J4	2	Female	Safe-conn Interlock mates with Amphenol #27-1.

2.5 INSTALLATION PROCEDURE

Interconnecting cables and connectors for the DIGI-PAK 270 power supply are not provided with the base unit, and must be purchased separately, based on the requirements of the specific installation. If you have any questions, please contact your PHI customer service representative.

To install the DIGI-PAK 270, perform the following steps:

1. Carefully unpack and remove the unit from its shipping container, check for any physical signs of damage. Prior to connecting any cables, be sure both the Power and HV Enable switches are in the OFF position.
2. Review your installation to confirm you have all of the cables you will need and that they are long enough to reach the planned location for the supply.
3. First you will need a power cord, either PHI P/N 623928 for 115 volt operation or P/N 623929 for 230 volt operation. The 230 volt power cord is shipped with the leads stripped and tinned for installation of a suitable connector that will mate with the power receptacles at your site.
4. You will also need a suitable HV output cable to connect the control to your pump. A wide variety of lengths and styles are available both with and without the Safe-conn safety interlock feature.
5. In addition, if you plan to interface the setpoints, the analog monitor outputs, or the remote HV interlock and control with other equipment at your site, you will need a suitable cable that will connect the 15 pin Interface Jack (J2) with your equipment.
6. The chassis of the 270 series power supply is tied to earth ground and to the frame of the ion pump through the third green/yellow wire in the power cord. However, depending on local practices and regulations, you may also wish to use an additional auxiliary grounding lead to tie the chassis of the 270 directly to a safety earth ground point. A ground stud is provided on the rear of the supply for such connections.

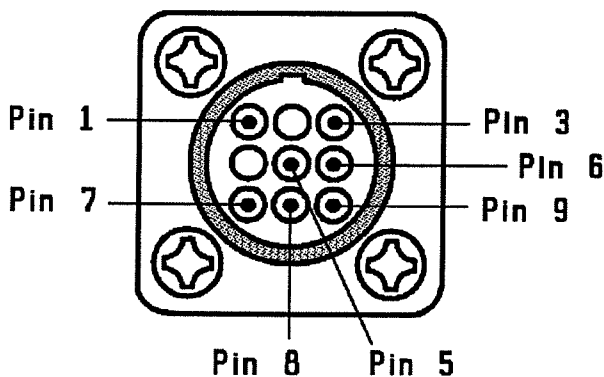


Figure 2-2. Configuration of 9-pin connector J1 located on the rear panel of the DIGI-PAK chassis.

Section II - Initial Checkout & Installation

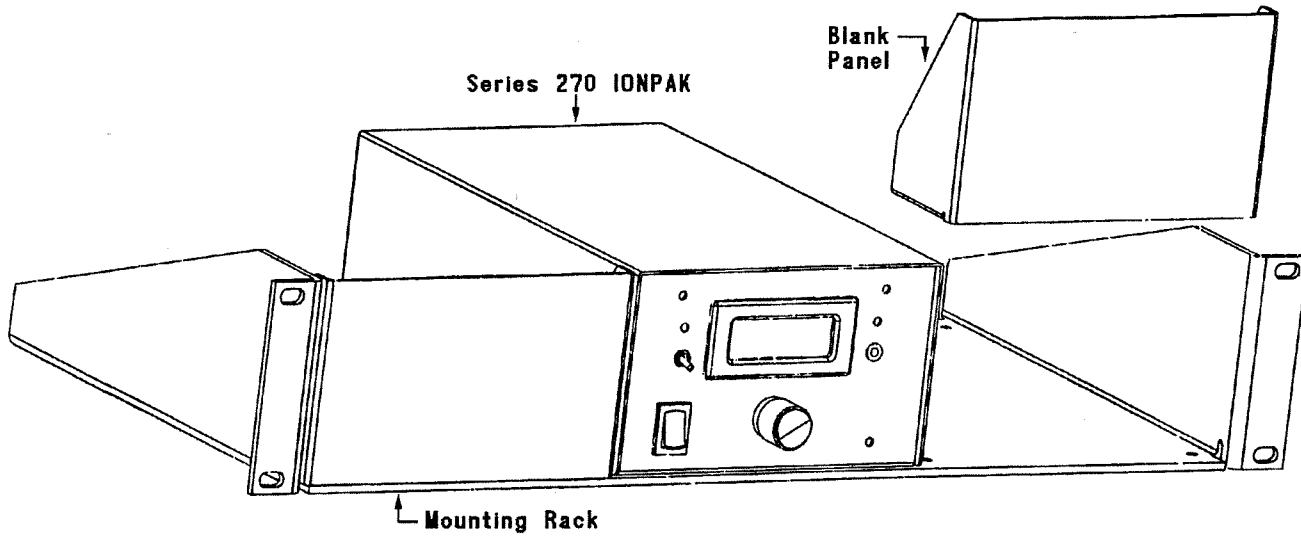


Figure 2-3. Front View of a Rack-Mounted DIGI-PAK 270 Power Supply.

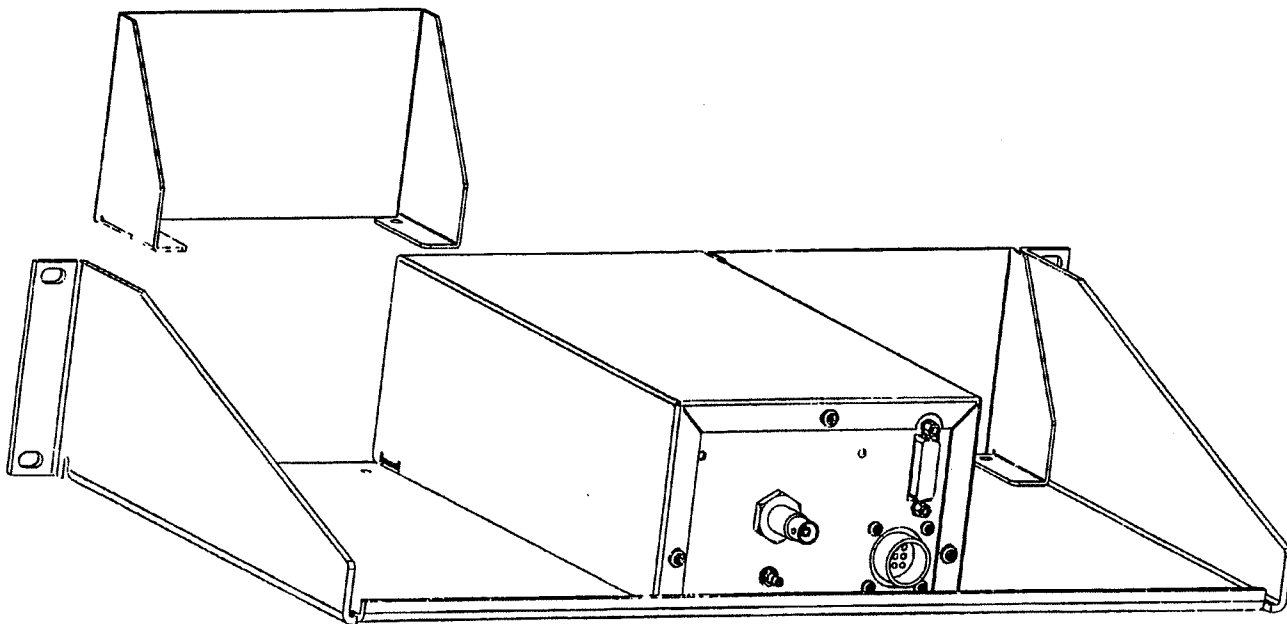


Figure 2-4. Rear View of a Rack-Mounted DIGI-PAK 270 Power Supply.

Section II - Initial Checkout & Installation

7. If you plan to rack mount your power supply, refer to the instructions on page 5 for removing the table top feet and fastening the supply to the rack. You can mount either 1, 2 or 3 units in any position on the rack shelf.
8. Begin cabling by checking that the pump end of the High Voltage output cable and the connector on the ion pump are clean and undamaged. If the DIGI-PAK Power Supply unit has been stored for a while, or the ion pump to be used in conjunction with the DIGI-PAK has not been used for some time, clean the mating connectors on both the DIGI-PAK unit and the ion pump. This will minimize the chance of any arcing between the connectors when power is applied to the DIGI-PAK and the ion pump. Connect the High Voltage cable securely to the ion pump, making sure to tighten the outer collar of the coaxial connector unit until it is fully seated. Check the control end of the High Voltage cable and connect it to the High Voltage output connector J3.
9. If you are not using a Safe-conn safety interlock cable, put the shorting plug over the Safe-conn jack, J4.
10. If you are using an auxiliary ground connection, run it from the threaded stud on the rear panel to a suitable ground point.
11. Connect the Interface cable (if used) to J2, securing it with the jackscrews that are provided.
12. Confirm that you have the correct power line cord for your site. Double check to insure that the power supply is switched OFF, and connect the line cord to a suitable source of 50 Hz or 60 Hz AC power.

Section II - Initial Checkout & Installation

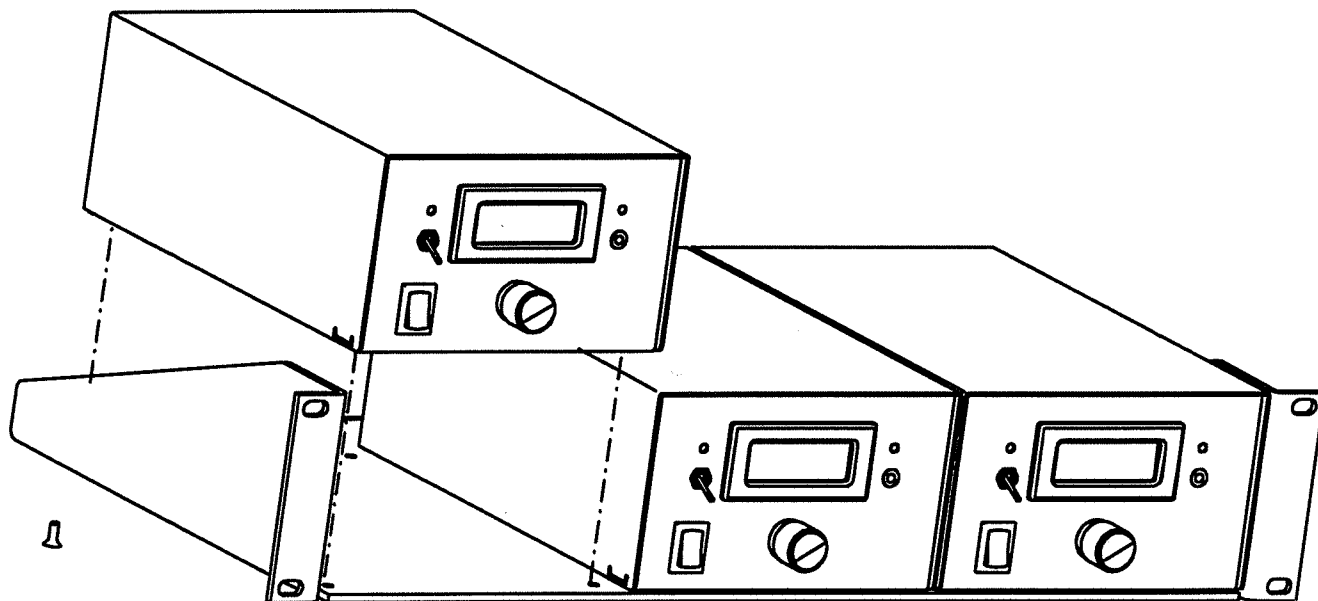


Figure 2-5. Front View of Multiple, Rack-Mounted DIGI-PAK 270 Power Supplies.

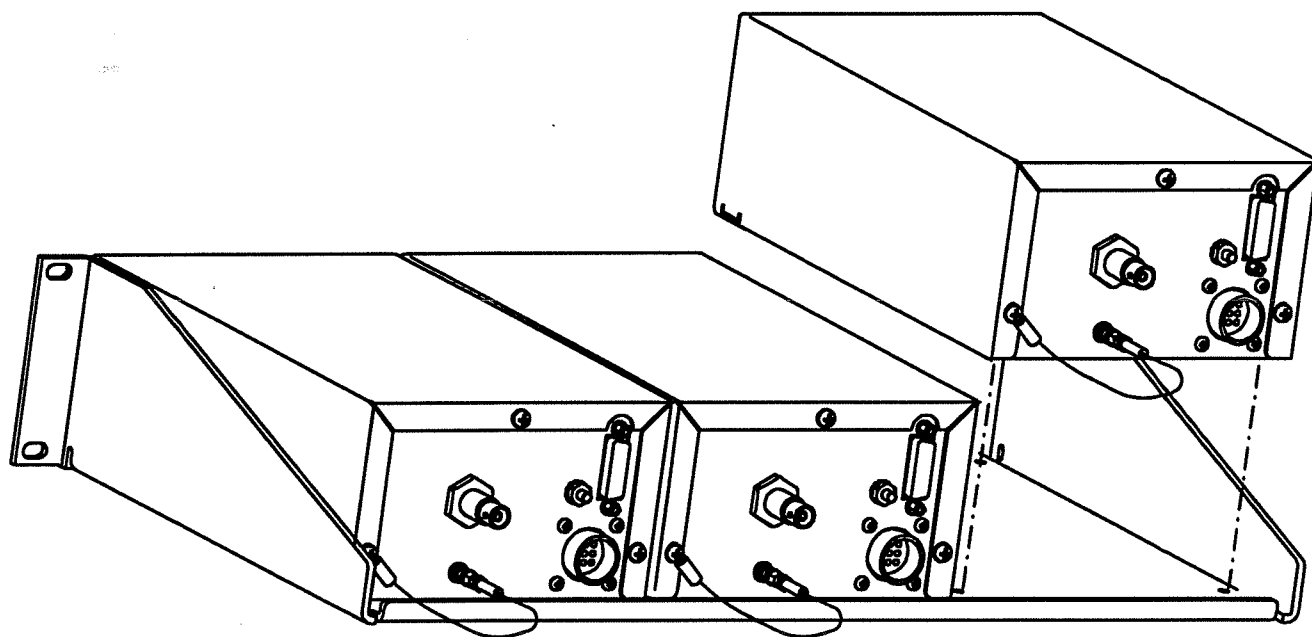


Figure 2-6. Rear View of Multiple, Rack-Mounted DIGI-PAK 270 Power Supplies.

SECTION III OPERATION

3.0 GENERAL INFORMATION

This section of the manual provides an overview of the functions contained within the DIGI-PAK and discusses operating procedures for the unit. Refer to the appropriate system manual for use of the DIGI-PAK within the system.

3.1 INDICATORS AND CONTROLS

3.1.0 Indicators

The Series 270 DIGI-PAK is provided with a 2000 count LED digital display and two red LED indicators.

The digital display indicates either a) the voltage or current being fed to the ion pump, or b) the amount of output current below which the Set Point relay will be energized. The display also functions as a pilot light and indicates when main power to the supply is ON.

High Voltage LED

The High Voltage LED on the front left side of the supply is lit whenever the high voltage section of the DIGI-PAK 270 is energized and delivering power to the ion pump. In order for the High Voltage circuit to be energized, the following conditions must be met:

- the Safe-conn safety interlock circuit must be completed, and
- either the HV switch must be in the ON (up) position, or the HV switch must be in the EXT (down) position and the External HV control circuit must be closed which connects Pin 8 (+) to Pin 14 (+) on the Analog Output/Interface connector, J2.

Set Point LED

The Set Point LED on the front right side of the power supply is lit whenever the Setpoint relay is energized. The Setpoint relay can be energized only if the High Voltage output circuit is energized and the output current falls below the Setpoint value which represents an acceptable vacuum level within the vacuum chamber.

If the output current to the ion pump is greater than the Setpoint value, the High Voltage is OFF, or the power supply is not powered up, the relay will not be energized. In the normal de-energized (up-to-air) state, the COM relay contact connects to the NC (Normally Closed) output. In the energized (pumping at good vacuum) state, COM connects to the NO (Normally Open) output.

INDICATOR:

FUNCTION:

HIGH VOLTAGE

LED is illuminated when the High Voltage section is enabled.

SETPOINT

LED is illuminated when the setpoint relay is energized.

3.1.1 Controls

There are three operating switches and a recessed adjustment potentiometer on the front of the DIGI-PAK 270 Ion Pump Power Supply.

Power

The Power rocker switch is located in the lower left corner of the unit and switches both sides of the incoming AC power line. Note that it is provided with a bright colored skirt which is exposed when switched to the ON position.

High Voltage

Located directly above the Power switch is the High Voltage toggle switch which has three positions: OFF, ON, and EXT (EXTERNAL). In the OFF position, High Voltage cannot come ON, and in the ON position, High Voltage will come on only if the Safe-conn safety interlock condition is satisfied. In the EXT position, the High Voltage can be externally controlled by an isolated set of contacts completing a 12VDC circuit carrying 50 mA.

Section III - Operation

Display Selector Switch

In the center of the unit is a 4 position rotary display selector switch. In the first (furthest to the left) position, it displays output current from 0.00 mA to the maximum output of 11 mA @ 50 Hz (with high line voltage). In the second position, it reads output current ranging from 0.00 to 199.0 microamps and in the third position, it reads output voltage from 0.0 to 6.00 kV. In the last position, it reads the current setpoint value from 40 to 1999 microamps.

Setpoint

The Setpoint adjustment is located on the front right side of the DIGI-PAK 270 power supply and is recessed to prevent changing the setpoint accidentally. Setpoint adjustments are made via a 20 turn potentiometer which can be adjusted with a small straight blade screw driver or adjustment tool.

There are two ways to adjust the setpoint. If the desired current (I) value is known, the selector switch is rotated clockwise (CW) to the Set Point Current position and the potentiometer adjusted until the desired value is obtained. This can be accomplished without the High Voltage being turned on. If the system is operating at the actual vacuum pressure that is desired, then the Set Point can simply be adjusted until the Set Point LED switches. In using this technique, bear in mind that the Setpoint circuit within the power supply incorporates a small amount of hysteresis.

3.2 OPERATING PROCEDURE

3.2.0 Ion Pump Operation

Before operating any ion pump, ensure that it has been installed using the instructions supplied with the ion pump. The DIGI-PAK 270 Ion Pump Power Supply should be installed in accordance with the installation procedures described in Section 2 of this manual.

1. Incoming AC power to the DIGI-PAK must be OFF.
2. Connect all cables as outlined in Section 2. Confirm that the power cord is correct for the AC line voltage available. For 115 VAC, the cord with the RED label ties pin 5 to 8 and pin 6 to 9. For 230 VAC, the cord with the YELLOW label ties pin 5 to 9 and leaves 6 and 8 open.
3. Rough down the system to the recommended starting pressure for the ion pump.
4. Check that the High Voltage switch is in the OFF position and turn the Power switch ON. The digital display should light, but both of the LED indicators should be dark. The current and voltage readings should be at zero (0). In the Set Point position, the display will show the current value below which the setpoint relay will be energized.

If you wish to adjust the setpoint current value, you may do so without applying power to the pump. Rotate the selector switch clockwise (CW) to the Set Point Current position and the meter will display the Setpoint Value. It can be adjusted between 40 microamps and 2 milliamps with a small slotted screw driver through the access hole to the right of the display marked ADJ.

**TABLE 3-1
INPUT LINE CORD CONNECTIONS**

J1 PIN NUMBER:	DESCRIPTION	CONNECTIONS:	
		115V INPUT	230V INPUT
1	CHASSIS SAFETY GROUND	Case & High Voltage Return	
2	NOT USED		
3	LINE L1	3	3
4	NOT USED		
5	VOLTAGE SELECT	8	9
6	VOLTAGE SELECT	9	Not Connected
7	LINE L2	7	7
8	VOLTAGE SELECT	5	Not Connected
9	VOLTAGE SELECT	6	5

Pin 1 is the chassis safety ground and is always tied to the Green/Yellow ground lead.

Pins 3 and 7 are the incoming power leads.

Pins 5, 6, 8, and 9 are the voltage strapping terminals:

For 115 volt operation, tie pin 5 to pin 8, and pin 6 to pin 9.

For 230 volt operation, tie pin 5 to pin 9, and leave pin 6 and pin 8 open.

5. After the vacuum system has reached the recommended starting pressure of the ion pump, you may start the ion pump by switching the HV toggle switch on the front left side of the power supply up to the ON position. The LED above the switch will light, indicating power is being applied to the HV section of the power supply and the digital display will indicate the voltage or current being fed to the pump.

6. When power is first applied, an ion pump may draw up to 10 ma of current from the power supply and draw the output voltage down to a few hundred volts. This is perfectly normal and will not damage either the pump or the power supply. When the pump starts, the current will fall off and the voltage will quickly rise to a normal value.

The time it takes a pump to start is a function of its size, the vacuum pressure within the chamber and how much water vapor is contained within the chamber. On larger ion pumps and pumps which contain a high level of moisture or are not well roughed out, starting can take many minutes or in some cases even several hours. This is normal with a power-limited pump supply and is no cause for concern.

7. After the pump is started, an approximate indication of system pressure may be obtained by monitoring the pump current on the digital display. (Table 3-2 lists various pump sizes and the approximate corresponding scale factors.)

**TABLE 3-2
PUMP SIZE V.S. SCALE FACTORS**

PUMP SIZE (LPS)	SCALE FACTOR
2	75 A/Torr*
11	200 A/Torr*
30	500 A/Torr*
60	1,000 A/Torr*
120	2,000 A/Torr*
220	3,500 A/Torr*
400	6,500 A/Torr*

*Scale factors listed above are approximate values for each pump in the 1×10^{-6} Torr to 1×10^{-10} Torr pressure range. These numbers are not intended as absolute values and are shown here only as a matter of reference.

**TABLE 3-3
ANALOG OUTPUT & INTERFACE CONNECTIONS**

J2 PIN NUMBER:	DESCRIPTION	
1	Setpoint Com contact	2 amp, 250 VAC
2	Setpoint NC contact	2 amp, 250 VAC
3	+5 VDC Return (Dig Gnd.)	5 VDC
4	±15 Common (Analog Gnd.)	
5	-15 VDC Out	15 mA (maximum)
6	+15 VDC Out	15 mA (maximum)
7	+5 VDC Out	50 mA (maximum)
8	High Voltage Enable Input	50 mA drive @ +12 VDC
9	High Voltage Enable Status Out (+)	12 VDC, 50 mA (maximum)
10	V _{MON}	1 V/kV, 1 kohm impedance
11	High Voltage Enable Status Out (-)	12 VDC, 50 mA (maximum)
12	I _{MON}	1 V/kV, 1 kohm impedance
13	Setpoint Logic Level Out	1 V/kV, 1 kohm impedance
14	V unregulated (High Voltage Enable Output)	
15	Setpoint NO contact	2 amp, 250 VAC

SECTION IV

THEORY OF OPERATION

4.0 GENERAL VACUUM INFORMATION

The information included in this section provides a brief introduction to the principles of operation behind an ion pump as well as a brief explanation of the operation of the DIGI-PAK 270 Ion Pump Power Supply. This information is provided to assist you in understanding the role the DIGI-PAK 270 plays in the overall vacuum system.

4.1 GENERAL VACUUM PRINCIPLES

In order for any pump to function, a lower molecular density must exist in itself than exists anywhere else in the system. In the case of the ion pump, the lower molecular density (pressure) is created by trapping and burial mechanisms (refer to Figure 4-1).

The first step in reducing the pressure in a vacuum system to a few microns is usually accomplished by means of a sorption pump or other roughing device. Then a voltage is applied between the cathodes and the ring-shaped

anodes of the ion pump. Electrons, which are generated by cold cathode emission and accelerated toward the anodes, are caused to oscillate and spiral in the anode space by the magnetic field. This increased path length increases the probability of the electrons colliding with gas molecules.

The positive ions formed in the collisions bombard the cathodes, ejecting cathode atoms. These titanium atoms, which are uncharged and therefore unaffected by the electrical and magnetic field, are deposited chiefly on the anode surfaces. In this way a continuously replenished film of cathode material is formed on the anodes. Chemically active neutral gas atoms, such as N_2 , O_2 , and H_2 , which are present in the discharge region, combine with the reactive titanium metal atoms and are thus removed (pumped) from the system.

The pumping mechanism for inert gases is that of burial in the pump surfaces. When inert gases are ionized, they are accelerated toward the cathode. Upon impact, they either penetrate several atomic layers and become trapped within the cathode lattice atoms, and may be re-emitted if

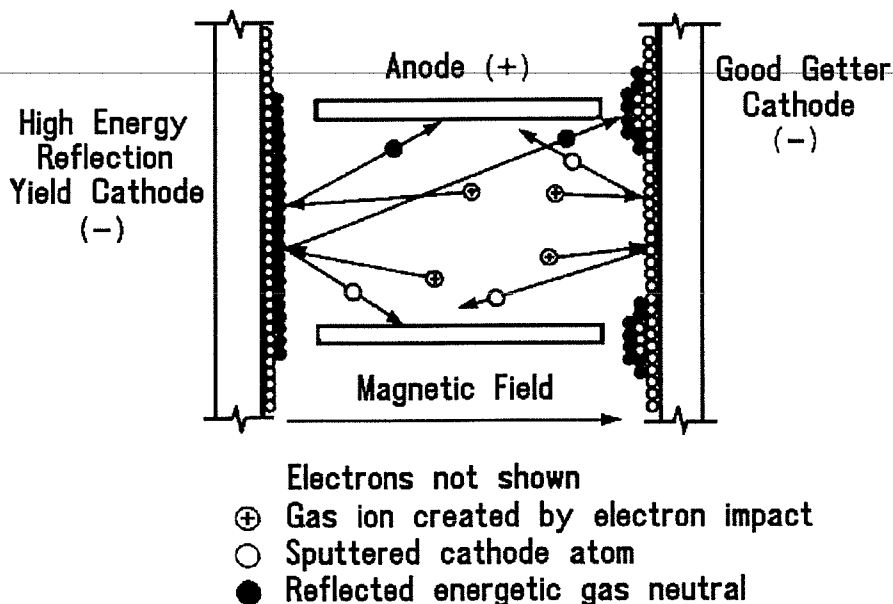


Figure 4 - 1. Ion Pump Trapping and Burial Mechanism.

Section IV - Theory of Operation

the entrapping lattice atoms are sputtered away; or reflect as energetic neutrals and become embedded and trapped in the pump surfaces that see little or no sputtering, such as the anode surfaces and the cathode surfaces around the periphery of the Penning cells. Typically, the pumping speed for inert gases is an order of magnitude lower than for the active gases. Perkin-Elmer DI pumps are designed to dramatically increase inert gas pumping speed by increasing the production of energetic neutrals. This design also eliminates argon instability.

The magnetic field (see Figure 4 -2) directly affects the pumping speed of the pump. All Perkin-Elmer pumps use a Barium Ferrite or Strontium Ferrite (Ceramic Grade 8) magnet. This material exhibits a reversible field loss of +0.2% per C° and an irreversible field loss of 7% at 350°C. This loss is noncumulative. (Subsequent bakeouts to 350°C will not cause an additional irreversible loss.) Under no circumstances should the magnet temperature be brought above 350° C. Above 85° C the pumping speed of the pump will decline with temperature.

4.2 DIGI-PAK GENERAL INFORMATION

The DIGI-PAK is a high voltage power supply designed to reliably power ion pumps under all vacuum conditions. It will operate continuously into any load from an open circuit to dead short and contains no user serviceable parts.

4.3 DIGI-PAK GENERAL DESCRIPTION

The DIGI-PAK is comprised internally of three sections: the Power Supply/Interface board, the Display board and the High Voltage board. High voltage is achieved through a modified voltage doubler, while the unique pump starting and power limiting characteristics, and short circuit protection are provided through a proprietary transformer/rectifier design.

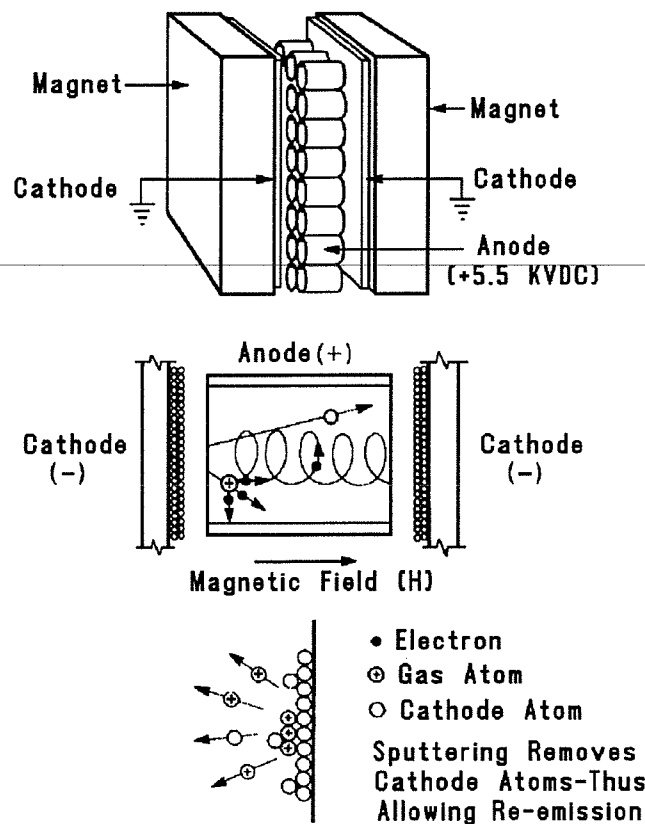


Figure 4 - 2. Cross Section of Diode Sputter Ion.

4.4 POLARITY

DIGI-PAK 270 Ion Pump Power Supplies are built and shipped from the factory configured with either a positive polarity or a negative polarity high voltage output. DIGI-PAK 270 Ion Pump Power Supplies shipped from the factory cannot be converted from one polarity to the other.

CAUTION

ALL EQUIPMENT MUST BE DE-ENERGIZED BEFORE REMOVAL FROM THE SYSTEM. SERVICE MUST BE PERFORMED BY QUALIFIED SERVICE PERSONNEL ONLY. THERE ARE NO USER SERVICEABLE PARTS IN THIS UNIT.

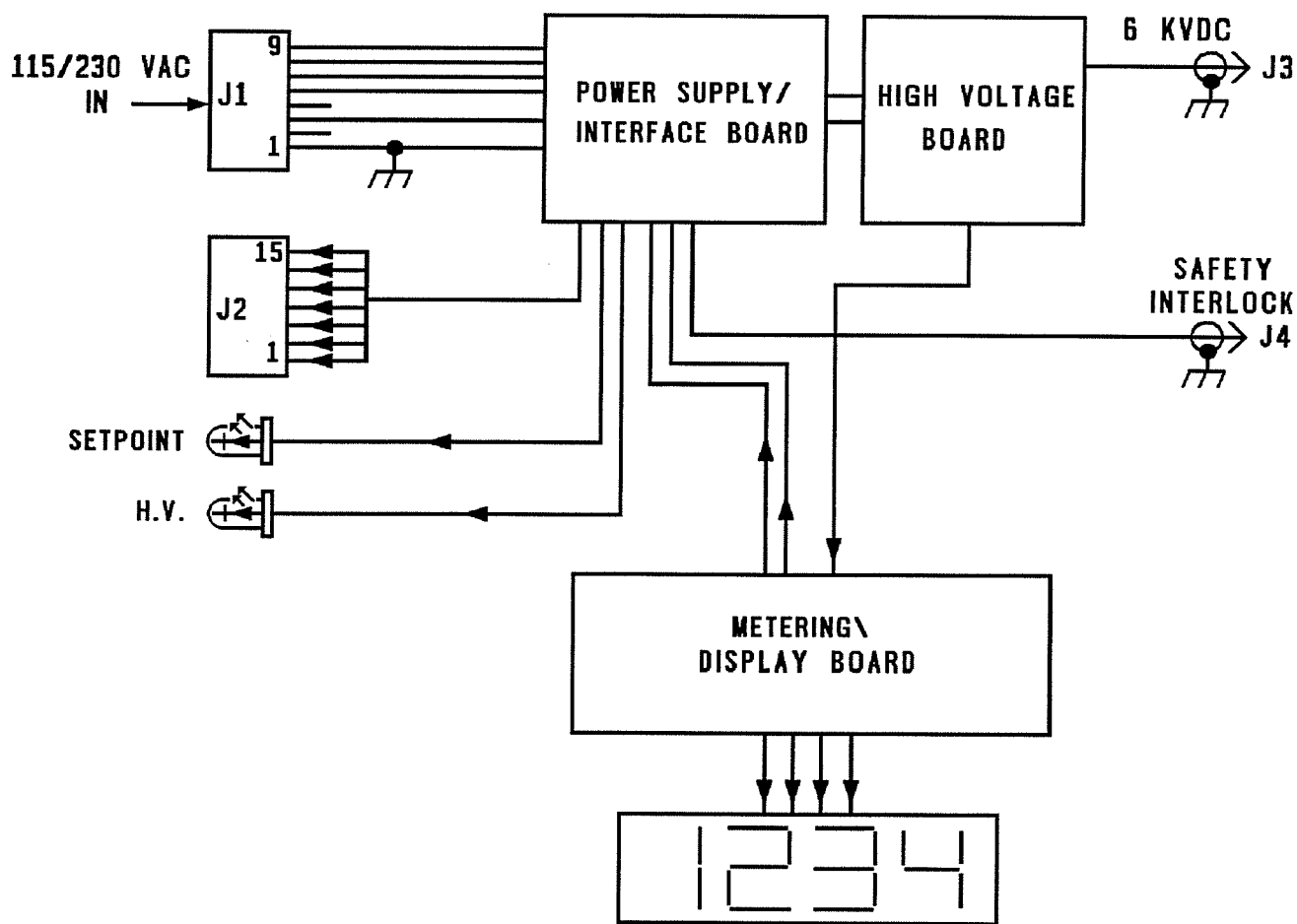


Figure 4 - 3. Functional Diagram of the DIGI-PAK 270.

Section IV - Theory of Operation

SECTION V

CALIBRATION AND MAINTENANCE

5.0 GENERAL INFORMATION

The DIGI-PAK 270 Ion Pump Power Supply has been designed and engineered to provide years of maintenance free use. However, in the event the power supply fails or is suspected of faulty operation, a few operational checks can be performed. These checks are divided into two categories: basic operator checks and an equipment check. Both categories are discussed in the paragraphs to follow.

CAUTION

IF AN OPERATIONAL CHECK INDICATES THAT A PROBLEM EXISTS WITH THE POWER SUPPLY, IMMEDIATELY REMOVE THE UNIT FROM ON-LINE USE. NEVER ATTEMPT TO DISASSEMBLE THE UNIT FOR REPAIR OR ANY OTHER PURPOSE. IF THE DIGI-PAK POWER SUPPLY REQUIRES SERVICE OF ANY TYPE, REFER THE PROBLEM TO A QUALIFIED SERVICE REPRESENTATIVE.

5.1 TEST EQUIPMENT

No regularly scheduled calibration is required for normal operation of the PHI DIGI-PAK 270, therefore, no test equipment is needed. However, in the event of a power supply failure, the following procedures require the use of a digital multimeter. The multimeter used must have an input impedance of ≥ 20 ohms/volt.

5.2 BASIC OPERATIONAL CHECKS

If the DIGI-PAK is suspected of faulty operation, make the following basic checks before performing the more detailed equipment check.

Basic operational checks use no special instruments other than a standard digital multimeter. Make the following checks on the power supply.

1. If the digital display on the DIGI-PAK 270 does not light after the unit has been connected to both the ion pump and the AC power source, and the Power switch has been turned ON, verify the following:
 - A. Check that the line voltage power cord is securely connected to the site's power source and that the power cord is the correct type for the voltage available.
 - B. Check that the line voltage power cord is securely connected to the power cord receptacle on the rear chassis of the DIGI-PAK 270 Power Supply.
 - C. Check that the line voltage supply source is operational and supplying AC power.
 - D. If all of the above steps are completed and the DIGI-PAK 270 supply does not function, the unit needs to be repaired. Refer to Section 5.6.
2. If the digital display lights, next check to confirm that the HV relay closes and the LED comes ON when the HV switch is turned to the ON position. If the LED does not light, check to see if the Safe-conn safety interlock circuit is being completed either through the interlock cable to the ion pump or, if needed, by plugging the by-pass shorting jumper into connector J4.

If the HV LED comes ON, check the unit's digital display to see if the unit registers a power output. First read the output voltage. The unit's output voltage varies with the load. If the output voltage is in the range of 4500 to 6000 volts and the current is not over 1 milliamp, the unit is working correctly and the pump should be operating.

Section V - Calibration and Maintenance

If the voltage is between 400 and 1500 volts, and high current is indicated, the ion pump probably has not started.

If the voltage reading is less than 300 volts with 8 to 10 milliamps of current when connected to the pump but is reading a normal level when disconnected, there is probably a short circuit in either the ion pump or the HIGH VOLTAGE cable.

If the HIGH VOLTAGE LED comes ON but the supply has no high voltage output even when disconnected from the load (ion pump), the power supply needs repair.

If the HIGH VOLTAGE LED is lit and the DIGI-PAK's output is >1500 Volts, the ion pump should be pumping. If you suspect the ion pump of not operating properly, remove the AC power plug from the rear panel of the DIGI-PAK, and remove the DIGI-PAK connection from the ion pump. Use a DVM to measure the resistance between the ion pump connection and the ion pump chassis. A resistance of >10 Megohms means that the ion pump itself should be operational and a problem may exist with the DIGI-PAK Power Supply. If the pump resistance measures <10 Megohms, a problem exists with the ion pump.

By comparing the pump current with the scale factor for the ion pump being used, a rough indication of approximate system vacuum can be obtained.

5.3 VACUUM SYSTEM TROUBLE-SHOOTING

5.3.0 Basic Operator Checks

1. Check that the power supply is securely connected to the ion pump.
2. Check that the site power source is delivering the proper level of AC power required.
3. Check that the high voltage connector that connects the power supply to the ion pump has not been damaged.

5.3.1 Pump Loading

If during testing, high current readings are always being obtained, it is possible that one of the following conditions has developed:

1. Water vapor in the vacuum system may have overloaded the pump. If this is the case, bake out the system at a minimum temperature of 150° C for eight (8) hours. The system should be baked out using a higher output ion pump power supply or should be pumped on by an auxiliary pump.

CAUTION

DO NOT BAKE THE POWER SUPPLY WITH THE SYSTEM. EXPOSURE TO TEMPERATURES ABOVE 50° C WILL DAMAGE THE UNIT.

2. Pressure in the system is too high when an attempt is made to start the ion pump. If this is the case, pump down the system to an acceptable level and then restart the ion pump.
3. Outgasing from some system component is inhibiting proper operations. Find the source of the outgasing and either remove the component, or follow the bakeout sequence outlined in step 1 above.
4. A leak has developed in the system. Locate the source of the leak.
5. One of the vacuum system components has failed. Locate and remove the failed component.
6. The ion pump itself is not functioning properly. Either repair or replace the ion pump.
7. The ion pump power supply is malfunctioning.

If the above checks indicate that the system is clean and that vacuum is leak-free, try removing and replacing the DIGI-PAK 270 Ion Pump Power Supply with a second unit of the same polarity. For information on returning a defective DIGI-PAK unit, refer to Section 5.5 below.

5.4 FIELD CHECKOUT PROCEDURE

5.4.0 Equipment Checks

The equipment check should be performed if you suspect that the power supply is not functioning properly. Before this check is made, the Basic Operator Checks (Section 5.3.0) previously discussed should be performed. Note that the purpose of the equipment check is to monitor the amount of current being used by the ion pump.

NOTE

There are no user serviceable parts or adjustments inside the DIGI-PAK 270 Ion Pump Power Supply.

DIGI-PAK ion pump supplies are designed to withstand continuous overloads up to and including a short circuit. The units include no provisions for any type of field adjustment or user serviceable parts. The unit is provided with internal fuses to protect the supply against fire or damage in case an internal component shorts out. MOV overload protectors are also incorporated into all DIGI-PAKs to help reduce both internal equipment damage and hazardous voltage damage if 230 volts is accidentally applied to a unit configured for 115 volts.

If one of the internal fuses blows, there will be other component damage which must be identified and corrected. Therefore, inspection and retesting are required after replacing the fuses and any other damaged components prior to placing the unit back into service.

1. If the DIGI-PAK does not appear to operate correctly on the ion pump, it can be operated open circuit as a final test.

CAUTION

EXERCISE EXTREME CAUTION WHEN OPERATING THE DIGI-PAK 270 DISCONNECTED FROM THE PUMP. LETHAL VOLTAGES ARE PRESENT AT THE HIGH VOLTAGE OUTPUT CONNECTOR (J3) AND INTERNAL TO THE DIGI-PAK.

Section V - Calibration and Maintenance

To test the DIGI-PAK off of the ion pump, disconnect the 115/230 VAC power input from the PHI DIGI-PAK unit. Allow the unit to discharge for one minute prior to disconnecting from the ion pump.

2. Once the DIGI-PAK Power Supply has discharged, disconnect the DIGI-PAK unit from the ion pump. Apply AC power to the J1 input of the unit.

CAUTION

It is important to note that the DIGI-PAK is now operating in an open circuit mode.

3. With the HV turned OFF, carefully check the internal power supply voltages at the test pins on J2 at the rear of the DIGI-PAK unit. Measure the +5 VDC logic supply between pin 7 and pin 3. It should be between 4.5 and 5.5 VDC. Measure the ± 15 Volt supplies: +15 volts between pins 6 and 4, and -15 volts between pins 5 and 4. They should both measure between 14.5 and 15.5 VDC. If any of the supplies are not within their specified values, the unit needs to be repaired. Refer to Section 5.5 for instructions on returning defective units.

4. If the internal supply voltages are within specifications, install the Safe-conn by-pass shorting jumper on J4 and switch the HV switch to ON. The high voltage enable relay should close and the High Voltage LED should light. Less than 10 microamps leakage current should be indicated on the digital display. If the LED is not lit or if greater than 10 microamps of leakage current is indicated, return the unit for repair.

5.5 RETURNING DEFECTIVE UNITS

If the PHI DIGI-PAK 270 Ion Pump Power Supply unit must be returned for inspection and/or repair, authorization must be obtained from Perkin Elmer prior to shipment. Contact Physical Electronics Customer Service at (612) 828-6100.

Repackage the power supply using the original packing materials if they are available. If these are not available, pack the power supply in a suitable, heavy-duty shipping container.

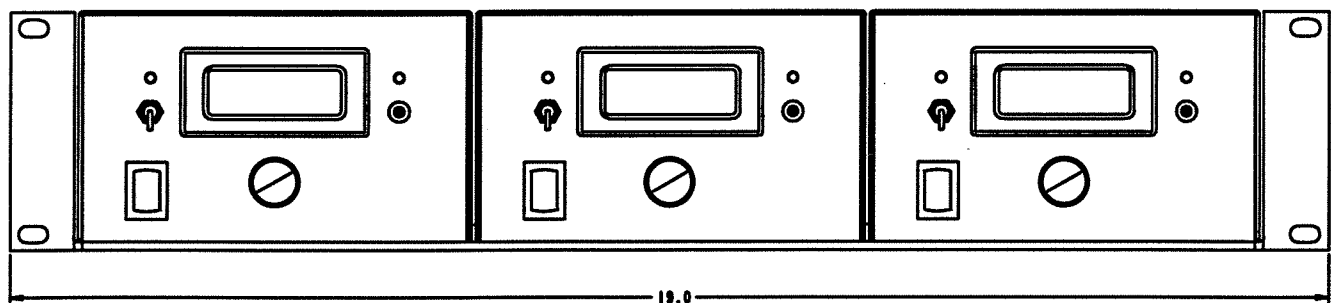


Figure 5-1. Diagram of three DIGI-PAK 270 Power Supply units mounted in a Single (19") Electronics Rack.

Limited Warranty

Except as otherwise provided herein, the Seller warrants to Buyer that the equipment sold hereunder, whether it is new equipment or remanufactured (reconditioned) equipment, is, at the time of shipment to Buyer from Seller, free from defects in material and workmanship. As Buyer's sole exclusive remedy under this warranty Seller agrees either to repair or replace, at Seller's sole option and free of part charge to Buyer, any part or parts of such equipment which, under proper and normal conditions of use prove to be defective within twelve (12) months from the date of receipt by the Buyer. Warranty period for equipment requiring installation by Seller will commence on completion of standard installation services. If customer delays installation beyond forty-five (45) days after delivery, the warranty period will commence to run forty-five (45) days after delivery. After installation, any realignment, readjustment, recleaning or recalibration, provided it does not relate to a proven defect in material or workmanship, shall be performed only at Seller's then current rates for service.

Exclusions and Limitations

It is recognized that some parts by their nature (expendable items) may not function for one full year; therefore, excluded from the foregoing warranty are filaments, anodes, cathodes, multipliers, retard grids, special ceramics, ionizers, along with other such parts mentioned in the applicable operating manual.

The foregoing warranty excludes certain major items or accessories specifically indicated on applicable price lists or quotations, as to which Seller passes to Buyer whatever warranty is provided to Seller by the manufacturer or the specific warranty indicated by the price list or quotation.

This warranty does not cover loss, damage, or defects resulting from transportation to the Buyer's facility, improper or inadequate maintenance by Buyer, buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the equipment or improper site preparation and maintenance.

Product Service

All claims must be brought to the attention of Seller within thirty (30) days of the failure to perform.

Seller at his option may require the product to be returned to the factory, transportation prepaid, for repair.

Refund of Purchase Price

In lieu of the foregoing, Seller may at any time elect, in its sole discretion, to discharge its warranty by accepting the return of such equipment and refunding any portion of the purchase price paid by Buyer.

Software and Firmware Products

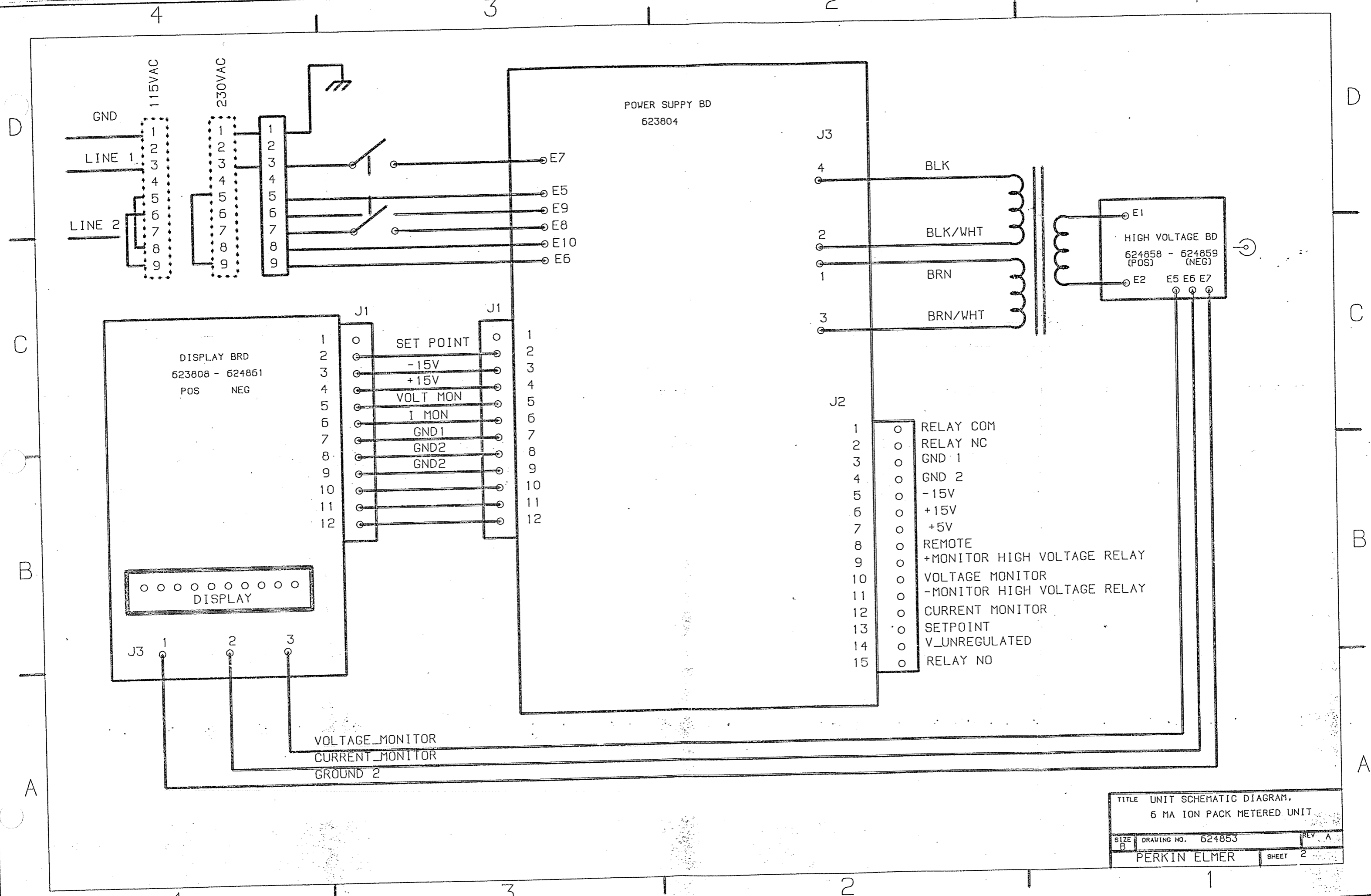
The sole exclusive warranty applicable to software and firmware products provided by Seller for use with a processor will be as follows: Seller warrants that such software and firmware will conform to Seller's program manuals current at the time of shipment to Buyer when properly installed on that processor. Seller does not warrant that the operation of the processor software or firmware will be uninterrupted or error-free.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. SELLER EXPRESSLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Part No.: 617281

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TITLE UNIT SCHEMATIC DIAGRAM.
 6 MA ION PACK METERED UNIT

SIZE B	DRAWING NO. 624853	REV A
PERKIN ELMER		SHEET 2