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# SERIES 303

# VACUUM PROCESS

# CONTROLLER

# INSTRUCTION MANUAL

GRANVILLE-PHILLIPS



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# SERIES 303
# VACUUM PROCESS CONTROLLER

# INSTRUCTION MANUAL

THIS MANUAL IS FOR USE ONLY WITH SERIES 303
VACUUM PROCESS CONTROLLERS WITH THE
FOLLOWING PART NUMBERS:

| BASIC UNITS | | OPTIONS | |
|---|---|---|---|
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| 303002 | 303008 | 303014 | 303018 |
| 303003 | 303009 | 303015 | 303019 |
| | | 303016 | 303020 |

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INSTRUCTION MANUAL P/N 303035-101

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**SAFETY PAYS!**

**THINK BEFORE YOU ACT!**

**UNDERSTAND WHAT YOU ARE GOING TO DO BEFORE YOU DO IT!**

Read this instruction manual carefully before installing, using, or servicing this equipment. If there are any doubts about how to use this equipment safely, contact the Granville-Phillips Product Manager for the 303 Vacuum Process Controller (VPC) at 5675 East Arapahoe Avenue, Boulder, Colorado 80303, U.S.A., Telex 045 791 GPVAC Bldr, or Telephone (303) 443-7660.

**WARNING**

Voltages as high as 800V peak are present in the controller, on the cable, and at the IG tube during degas. If a current-worthy common ground is not present between the vacuum chamber and the controller chassis, this voltage under some conditions appears between these surfaces. This can be very dangerous! Check the grounds! Always turn off the power to the controller before connecting any cable to the controller or to the IG tube. Do not operate the controller ungrounded or near water. The VPC is intended for use only in a clean, dry laboratory environment. Operation in other environments may cause damage to the controller and reduce the effectiveness of the safety features.

**WARNING**

Danger of injury to personnel and damage to equipment exists on all vacuum systems that incorporate gas sources or involve processes capable of pressurizing the system above the limits it can safely withstand.

For example, danger of explosion in a vacuum system exists during backfilling from pressurized gas cylinders because many vacuum devices such as ionization gauge tubes, glass windows, glass bell jars, etc., are not designed to be pressurized.

Install suitable devices that will limit the pressure from external gas sources to the level that the vacuum system can safely withstand. In addition, install suitable pressure relief valves or rupture disks that will release pressure at a level considerably below that pressure which the system can safely withstand.

Suppliers of pressure relief valves and pressure relief discs are listed in Thomas Register under the respective headings "Valves, Relief" and "Discs, Rupture".

**WARNING**

303 Vacuum Process Controllers are intended for use only on vacuum systems which have suitable devices installed that will limit the pressure from external gas sources to the level the system can safely withstand and which also have suitable pressure relief valves or rupture discs installed. Confirm that these safety devices are properly installed before installing the VPC. In addition, check that (l) the proper gas cylinders are installed, (2) gas cylinder valve positions are correct on manual systems, and (3) the automation is correct on automated systems.



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## WARNING

It is the installer's responsibility to ensure that the automatic signals provided by the process control option are always used in a safe manner. To help ensure safety of personnel and equipment, and to provide for manual operation and maintenance of the equipment, switches must be installed such that all equipment subject to automatic process control can be operated manually as well. Figure 2-6 illustrates typical connections.

Carefully check manual operation of the system and the programming before switching it to automatic operation. Where an equipment malfunction could cause a hazardous situation, always provide for fail-safe operation. As an example, in an automatic backfill operation where a malfunction might cause high internal pressures, provide an appropriate pressure relief device.

## WARNING

Operation of the VPC with the line voltage selector card improperly set can cause damage to the VPC and injury to personnel.

## WARNING

Do not attach cables to glass gauge pins while the gauge is under vacuum. Accidental bending of the pins-may cause the glass to break and implode. Cables once installed should be secured to the system to provide strain relief for the gauge tube pins.

## WARNING

The fumes from trichloroethylene, perchloroethylene, toluene, and acetone can be dangerous to health if inhaled. They should be used only in well ventilated areas exhausted to the outdoors. Acetone and toluene are highly flammable and should not be used near an open flame or energized electrical equipment.



**All conductors in, on, or around a vacuum system that are exposed to potential high voltage electrical discharges must either be sheilded so as to prevent human contact, or be connected to earth ground for safe operation.**



**When high voltage is present in any vacuum system, a life threatening electrical shock hazard may exist unless all exposed conductors are maintained at earth ground. The power cord of this product should be connected only to a properly grounded outlet. However, grounding this product does not guarantee that other components of the vacuum system are maintained at earth ground.**
**This hazard is not peculiar to this product.**



**Be aware that an electrical discharge through a gas may couple dangerous high voltage directly to an ungrounded conductor almost as effectively as would a copper wire connection. A person may be seriously injured or even killed by merely touching an exposed ungrounded conductor at high potential.**
**This hazard is not peculiar to this product.**



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Under certain conditions, dangerous high voltage can be coupled directly to an ungrounded conductor through a gas almost as effectively as through a copper wire conection. This hazard, which is not peculiar to this product, is a consequence of the ability of an electric current to flow through a gas under certain circumstances. A person may be seriously injured, or even killed by merely touching an exposed ungrounded conductor at high potential.

**WHEN HIGH VOLTAGE IS PRESENT, ALL EXPOSED CONDUCTORS OF A VACUUM SYSTEM MUST BE MAINTAINED AT EARTH GROUND.**

- All vacuum components, such as gauges, valves, etc., or parts thereof, that are electrically insulated from the main vacuum system must be reliably connected to an earth ground, or shielded to positively prevent human contact.

- All components utilizing vacuum connections, such as quick connects, taped threads, plastic, glass, rubber tubing, etc., must be reliably grounded.

  ***For example, a metal gauge envelope that is not reliably grounded through its vacuum connector may be grounded by using a metal hose clamp on the gauge, connected by a 12 awg copper wire to the grounded vacuum chamber.***

- High voltage can couple through a gas to the internal electrodes of a gauge. Do not touch the exposed pins on any gauge installed on a vacuum system where high voltage is present.

This hazard is not peculiar to this product. It is a characteristic of all vacuum systems having equipment installed that is capable of producing high voltage within the vacuum environment. Check all of your vacuum systems periodically for proper grounding of all exposed conductors.



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## INTRODUCTION

This manual provides the instructions for operation and maintenance of the Series 303 Vacuum Process Controller (VPC) and the options which are available for either factory installation or installation by the user. The operation and maintenance instructions are presented in six chapters.

Chapter 1 contains a general description of the VPC and options.

Chapter 2 describes and illustrates the procedures necessary to install the VPC and options to make them completely operable.

Chapter 3 describes and illustrates the operating controls and indicators. This chapter also contains operating procedures for all modes of operation.

Chapter 4 provides descriptive theory of operation information at a functional block diagram level for the VPC and the option boards.

Chapter 5 contains general procedures for isolating a malfunction to a replaceable circuit board level. Removal and replacement instructions are provided in this chapter.

Chapter 6 contains a list of parts and assemblies which are field replaceable. These are useful components for on-site maintenance of the VPC.

It is strongly recommended that the user read and understand all chapters of this manual prior to placing the VPC in operation. The operation procedures in Chapter 3 which pertain to the individual user's configuration should be thoroughly understood.



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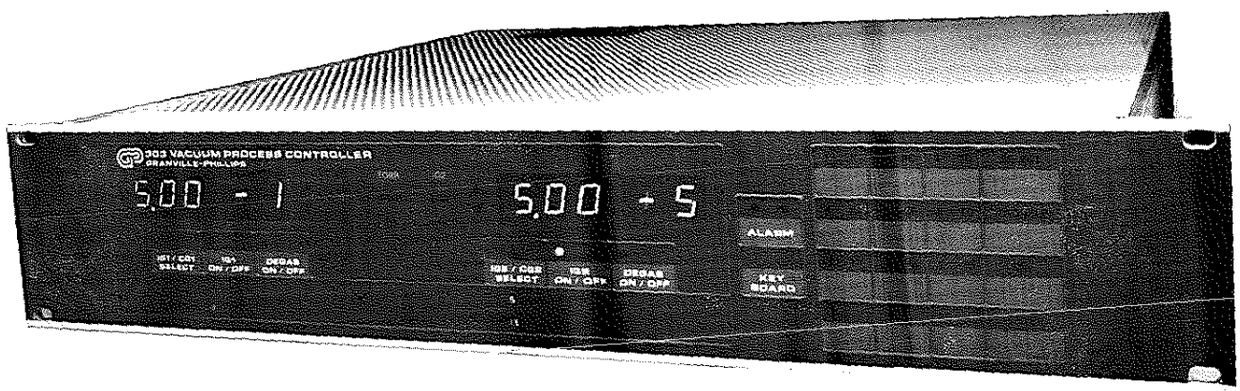



Figure 1-1. Series 303 Vacuum Process Controller

01



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# CHAPTER 1
# GENERAL DESCRIPTION

## 1-1. EQUIPMENT DESCRIPTION

The Series 303 Vacuum Process Controller (VPC) illustrated in Figure 1-1, is a programmable, microprocessor controlled vacuum system controller. The basic VPC operates two ionization gauge tubes over the range from $5 \times 10^{-11}$ to $1 \times 10^{-1}$ Torr. There are two basic VPC models; VPCA and VPCB. VPCA sequentially operates two ionization gauge tubes, while VPCB is configured to simultaneously operate two ionization gauge tubes.

Both VPCA and VPCB front-panel controls and indicators are identical and allow the operator to program gauge tube sensitivity, electron bombardment degas power, degas time duration, gauge tube filament overpressure trip, direction/rate of change arrows, two-or-three-digit pressure readout, and security of programs against change. Also a control is provided for maximum emission current selection and indicators for leak testing and gauge tube filament circuit deterioration warning.

## 1-2. VPC OPTIONS

The operational capability of a basic VPC can be upgraded by the installation of plug-in option cards. A VPCA or VPCB can be ordered with the desired options installed or the user may order and easily install the desired plug-in options. Eight card slots are provided for installation of the option cards. Installation procedures for the option cards are provided in Chapter 2.

## 1-3. CONVECTRON GAUGE OPTION

This option permits two Granville-Phillips Series 275 Convectron Gauges to be simultaneously operated to provide digital pressure measurements from $1 \times 10^{-3}$ to 999 Torr of air, $N_2$ or Ar. Pressure of other gases may be measured with the use of conversion charts (refer to Figures 3-5 through 3-10). Use of this option in conjunction with an ionization gauge tube, allows the system to be monitored from atmospheric pressure down to the pressure at which the ionization gauge tube is automatically turned on.

## 1-4. PROCESS CONTROL OPTION

Process control option cards allow the operator to control system process equipment from as many as 12 process control channels. Each process control card contains four single pole, double throw relays. Up to three cards may be installed in the VPC to obtain 12 relays operating on the process control channels. The channels may be assigned in any order to any ionization gauge or Convectron gauge tube and the pressure set point programmed to any pressure within the tube's range. Additionally, time delay, time duration, hysteresis, and an audible alarm can be programmed for each channel.

## 1-5. EXTERNAL ENABLE OPTION

The external enable option allows for the activation or deactivation of each process control channel with externally generated signals from the user's equipment.

## 1-6. RS232C OPTION

This option provides for two-way communication between the VPC and a computer via a standard EIA RS232C serial interface. Functions and displays provided by the VPC front-panel may be controlled and displayed by a computer. The only functions not implemented are those which change the displayed information, i.e., (F8-10, F17-20, etc.).



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## 1-7. IEEE 488 OPTION

This option provides for two-way communication between the VPC and a computer via a standard IEEE 488 parallel addressable interface. Functions and displays provided by the VPC front panel may be controlled and displayed by a computer. The only functions not implemented are those which change the displayed information, i.e., (F8, 10. 17-20, etc.).

## 1-8. BCD OPTION

The BCD option provides parallel binary coded decimal pressure and status information to a remote device with a compatible interface. Up to two option cards can be installed.

## 1-9. ANALOG OUTPUT OPTION

This option provides an analog output voltage corresponding to the pressure measured by any two of the four possible gauges. The voltage is linearly proportional to the pressure in each decade of pressure over the pressure range of the ionization gauge or Convectron gauge tube. There are two outputs per card and the capability exists to install two cards.

## 1-10. ELECTROMETER B OPTION

A VPCA unit may be configured to a VCPB unit by the installation of an Electrometer B option board. The Electrometer A board is removed and the Electrometer B board installed. This will allow simultaneous operation of two ionization gauge tubes.



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## 1-11. VPC SPECIFICATIONS

Table 1-1 lists the specifications applicable to the basic VPC (A and B). The specifications applicable to the individual option cards are listed in Table 1-2.

Table 1-1. Basic VPC Specifications

| Characteristics | Specifications |
|---|---|
| Electrical Voltage | 90-110/105-125/195-235/210-250 Vac rear panel selectable |
| Frequency | 50 Hz or 60 Hz |
| Power | 450W (maximum) |
| Environmental operating temperature | 0 to 40°C (32 to 104°F). Warranted specifications given at 25°C ± 5°C. |
| Physical dimensions | |
| Width | 19 inches (48.3 cm) |
| Height | 3.5 inches (8.9 cm) |
| Depth | 18.0 inches (45.7 cm) with cables |
| Weight | 25 pounds (11.6 kg) |
| Gauge type | Bayard-Alpert type, or equivalent, ionization gauge |

The following performance specifications are for the ionization gauge controller only. Actual system capabilities and specifications will be dependent on the transducer used and on gas composition. Unless otherwise specified, the following specifications are for a sensitivity setting of 10/Torr, 7.5/mbar, or .075/Pa and a maximum emission current of 10 mA.

| | |
|---|---|
| Pressure range | $5 \times 10^{-11}$ to $1 \times 10^{-1}$ Torr<br>$7 \times 10^{-11}$ to $1.3 \times 10^{-1}$ mbar<br>$7 \times 10^{-9}$ to 13 Pa |
| Gas type | Direct reading for air, $N_2$ or Ar. By altering the tube sensitivity in the $N_2$ mode, other gas types can be measured directly. |
| Accuracy of electronic measurement | Typically ± 2% of pressure reading over the range $10^{-9}$ to $10^{-3}$ Torr (mbar) or $10^{-7}$ to $10^{-1}$ Pa. |



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Table 1-1 Basic VPC Specifications (Cont.)

| Characteristics | Specifications |
|---|---|
| Resolution of ionization gauge (IG) readout | ± 0.1% of full scale in each decade, over the range (IG) readout $10^{-3}$ to $10^{-9}$ Torr (mbar) or $10^{-1}$ to $10^{-7}$ Pa.<br>± 1% of full scale in the $10^{-10}$ Torr (mbar) or $10^{-8}$ Pa range.<br>± 10% of full scale in the $10^{-11}$ Torr (mbar) or $10^{-9}$ Pa range. |
| Display update time | 0.5 second maximum for all ranges |
| Programmable IG tube sensitivities | 0.1 to 99.9/Torr<br>0.1 to 99.9/mbar<br>0.001 to 0.999/Pa<br>Factory set at 10/Torr |
| Emission current | User programmable to maximum values of 1, 2, 4 or 10 mA. Factory set at 4 mA. Controller selects one of the following constant emission currents, subject to the maximum value programmed, to optimize performance at a given pressure 0.01, 0.02, 0.04, 0.1, 0.2, 0.4, 1, 2, 4, 10 mA. The emission can be fixed to the selected maximum value. This will limit pressure measurement range (see Table 3-6). |
| Collector potential | Zero V referenced to system ground |
| Grid potential | 180 ± 10 Vdc referenced to system ground (adjustable) |
| Filament voltage | 2.0 to 8.5 Vac rms |
| Filament current | 6.0 A rms (maximum) |
| Filament bias | 30 ± 4 Vdc referenced to system ground |
| DEGAS | |
| Power | Electron bombardment. 5 to 80 watts, programmable in 5 watt steps. Power can be displayed during degas. |
| Pressure | Must be less than 5 x $10^{-5}$ Torr. Approximate pressure can be displayed during degas. |



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Table 1-1. Basic VPC Specifications (Cont.)

| Characteristics | Specifications |
|---|---|
| Time | Programmable from 1 to 999 minutes, in one minute steps, or manually or remotely timed. Degas time remaining can be displayed. |
| Start | Soft start - Start manually or with remote signal:<br>1) 15 seconds at approximately 0.25 programmed full power.<br>2) 15 seconds at approximately 0.5 programmed full power.<br>3) Full power. |
| Stop | 1) Manually or remotely timed: Full power to zero when stopped.<br>2) Programmably timed: (DT = degas time)<br>a) Step down to approximately 0.5 of full power at t = 0.5 x DT.<br>b) Step down to approximately 0.25 of full power at t = 0.75 x DT.<br>c) Step down to 0 power at t = DT. |
| Grid potential | 500 Vdc effective. Measured with respect to filament. |
| Emission | 10 to 160 mA. |
| REMOTE INPUTS | |
| Input functions | IGl On/Off, IG2 On/Off<br>Degas 1 On/Off, Degas 2 On/Off |
| Current | 1 mA to ground |
| FILAMENT STATUS RELAY | |
| Contact form | Single pole, double throw |
| Contact rating | 4A at 125 Vac resistive load or 30 Vdc<br>2A at 250 Vac resistive load |



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Table 1-2. Option Specifications

| Option Name/Characteristics | Specifications |
|---|---|
| **275 CONVECTRON GAUGE** | |
| Pressure range | $1 \times 10^{-3}$ to 999 Torr<br>$1 \times 10^{-3}$ to $1.33 \times 10^{3}$ mbar<br>$1 \times 10^{-1}$ to $1.33 \times 10^{5}$ Pa<br><br>Direct reading in six decade ranges for air, $N_2$ or Ar. |
| IG tube filament control | Can be programmed to automatically turn on or off the filament of associated IG tube. |
| **PROCESS CONTROL** | |
| Number of channels | 12 (maximum). Each option card provides relay control for four channels. |
| Pressure range | Selectable within:<br>$5 \times 10^{-11}$ to 999 Torr<br>$7 \times 10^{-11}$ to $1.33 \times 10^{3}$ mbar<br>$7 \times 10^{-9}$ to $1.33 \times 10^{5}$ Pa |
| Time delay | Programmable, in one second steps, to delay channel activation for up to 999 seconds after channel has been enabled and reached its pressure set point. |
| Time duration | Programmable, in one minute steps, to deactivate a channel within 999 minutes after it activates. |
| Hysteresis | Programmable, in 1% steps, from zero to 999%. |
| Output relays | Four per option card (three cards maximum). |
| Contact rating | 4A maximum, 125 Vac or 30 Vdc resistive load;<br>2A maximum, 250 Vac resistive load. |
| Contact style | Single pole, double throw. |



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Table 1-2. Option Specifications (Cont.)

| Option Name/Characteristics | Specifications |
|---|---|
| EXTERNAL ENABLE | |
| Input/Outputs | 12 inputs/12 outputs. One pair for each process control channel. Must be used with process control option. |
| Input/Enable Signal | TTL, active low, or contact closure to option ground. 5V open circuits, 1.2 mA short circuit. |
| Output format | TTL, active low. 15 mA source. 24 mA sink. |
| BCD | |
| Output | One per card. (Maximum of two cards.) Card assignable to either display; each card can output IG, CG, or automatically switch from CG to IG pressure when IG is activated. |
| Logic format | 8421 positive-true, parallel. |
| Number of digits | Three significant, 1 1/2 digit exponent, exponent sign (18 bits). |
| Control outputs | IG/CG tube data (1 bit), data valid (1 bit), degas status (1 bit). |
| Output drivers | Latched, parallel, 5V TTL or CMOS. 6 mA source, 6 mA sink current for data lines. 8 mA sink current for data update pulse. |
| Control inputs | Hold parallel data, prevent data update. Disable data output lines to high impedance. |
| ANALOG OUTPUT | |
| Number of outputs | Two per card. (Maximum of two cards.) Each card may be assigned to any gauge or gauge pair. |
| Output voltage | 0 to 7.0 Vdc (0.5V/decade), (3.77 V for 000 on Convectron) linearly proportional pressure. Source impedance 100 ohms. |
| Pressure range | $5 \times 10^{-11}$ to 999 Torr<br>$7 \times 10^{-11}$ to $1.33 \times 10^{3}$ mbar<br>$7 \times 10^{-9}$ to $1.33 \times 10^{5}$ Pa |



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## 1-12. INPUT/OUTPUT CONNECTIONS

The VPC input and output connectors are located on the rear panel of the controller (refer to Figure 1-2). Table 1-3 identifies the connectors, referenced to Figure 1-2. Also identified are the fuses, circuit breakers and switch associated with the VPC power system.

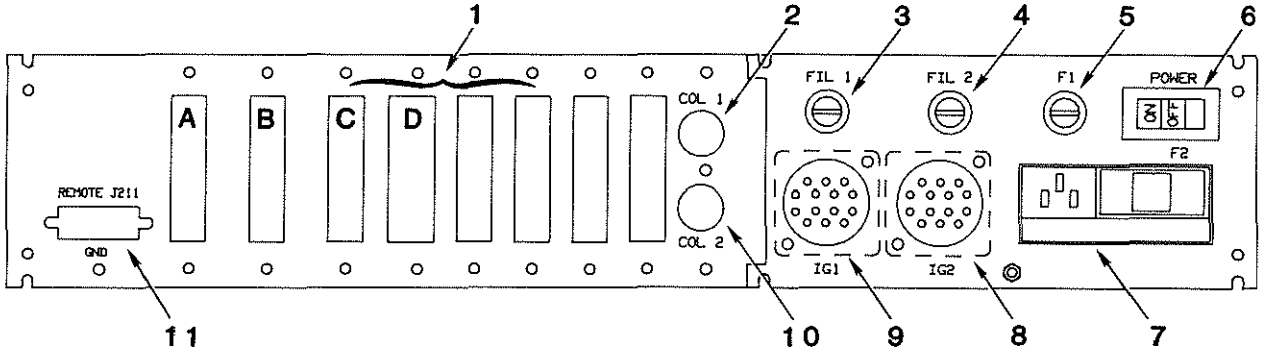



Figure 1-2. VPC Rear Panel Connectors

Table 1-3. VPC Rear Panel Components

| Index | Reference | Use |
|---|---|---|
| 1 | | Eight slots for option cards. The A, B, and C slots are for the process control option cards. |
| 2 | COL1 | Connector for IG1 collector. |
| 8 | IG2 | Connector for IG2. |
| 9 | IG1 | Connector for IG1. |
| 10 | COL2 | Connector for IG2 collector. |
| 11 | J211 | Input/Output connector for remote control of IG On/Off, Degas On/Off, and Filament Status Output. |
| Power System Components | | |
| 3 | FIL1 | Fuse for IG1 filament. |
| 4 | FIL2 | Fuse for IG2 filament. |
| 5 | F1 | Degas power fuse. |
| 6 | Power | On/Off ac power switch. |
| 7 | F2 | Line fuse and line voltage selector module. |



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## 1-13. MODEL DESIGNATIONS

The different configurations of the VPC and specific options available are listed in Tables 1-4 and 1-5, respectively.

Table 1-4. VPC Configurations

| Configuration | Catalog/Part Number | | |
|---|---|---|---|
| | 120* VAC | 240** VAC | 100* VAC |
| VPC A (sequential IG) | 303001 | 303002 | 303003 |
| VPC B (simultaneous IG) | 303007 | 303008 | 303009 |

* Includes 8-foot power cord with NEMA plug.
** Includes 2.5-meter power cord with CEE plug.

Table 1-5. VPC Options

| | Catalog Part Number | Remarks |
|---|---|---|
| Convectron Gauge | 303013 | Requires one Convectron gauge cable assembly and two Convectron gauge tubes. |
| Process Control | 303014 | Four channels per card, up to four cards. |
| External Enable | 303015 | Must be used with process control option. |
| RS232C | 303016 | Half duplex, bidirectional computer interface. |
| BCD | 303017 | Each display requires one card for simultaneous data output. |
| IEEE 488 | 303020 | Parallel, addressable, bidirectional computer interface. |
| Analog Output | 303018 | Two outputs per card, up to two cards. |
| Electrometer B | 303019 | Replaces Electrometer A card for simultaneous IG data display. |



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# NOTES



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# CHAPTER 2
# INSTALLATION

## 2-1. GENERAL INSTALLATION INSTRUCTIONS

The following procedures should be followed to install and apply power to your system for the first time. If the system fails to power-up when power is applied, refer to Chapter 5 for troubleshooting and maintenance procedures.

## 2-2. LINE VOLTAGE SETTING

Verify that the line voltage selector card displays the line voltage value of the available local ac line voltage. If the card does not display the correct line voltage value as shown in Table 2-1, perform the following procedure (refer to Figure 2-1).

Table 2-1. Line Voltage Selector Setting

| Line Voltage (Vac) | Selector Card Setting | Fuse F2 Type |
|---|---|---|
| 90-110 | 100 | 3ASB |
| 105-125 | 120 | 3ASB |
| 195-235 | 220 | 1.5ASB |
| 210-250 | 240 | 1.5ASB |

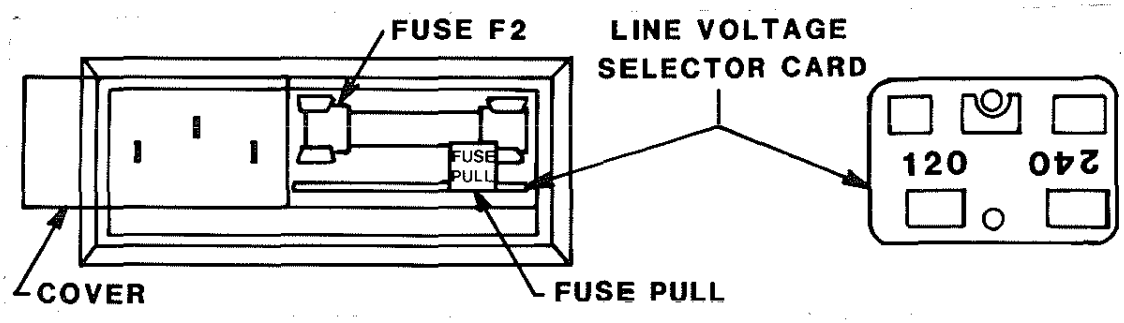



Figure 2-1. Line Voltage Selector Feature.

a. On the rear panel (lower right), slide the cover over fuse F2 to the left.

b. Remove fuse F2 by pulling the fuse extractor tab FUSE PULL outward and to the left. Leave the extractor tab in the full-left position.

c. Use a pointed tool or small wire hook to extract the line selector card from its holder. Pull card straight out.

d. Reinsert the card such that the correct line voltage (refer to Table 2-1) is readable from the rear of the VPC.



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**WARNING**

Operation of the VPC with the line voltage selector card improperly set can cause damage to the VPC and injury to personnel.

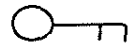
e. Verify that fuse F2 is the correct value as shown in table 2-1. Install fuse F2 in fuse holder and position fuse extractor tab FUSE PULL to the righthand position.

f. Slide the cover to the right over fuse F2.

## 2-3. SETTING SECURITY CODE

The VPC is factory-programmed to operate without entering a security code. If it is desired to protect the stored parameters from unauthorized changes, a security code can be entered from the front panel. This will allow changing parameters only after entering the security code. There are 2 ways to change the security code. If the security code is known, or the unit is unsecured, perform the following procedures:

a. Enter the programming mode by depressing the KEYBOARD key.

b. Depress the security key. 

c. If the key changes from red to green jump to step e. If it blinks red continue.

d. Enter the security code from 1 to 254 followed by the ENTER key.

e. With the security key green, depress the key again to change to a new security code. The key will blink green.

f. Enter the new security code from 0 to 255 followed by the ENTER key.

**Note**

A code of 255 defeats the security feature and program change can be made without entering a security code. A code of 0 provides total program security.

Keep a record of the security code written down for future reference.

If you need to reprogram the security code for servicing or because you cannot remember the present code, there is a second way to reprogram the code by pushing a switch on the upper right hand corner of the CPU board, (as viewed from the front of the 303) (see Fig. 2-2). To use this push button switch, perform the following procedures.

a. Remove the 303 from where it's mounted and set it on a flat surface.

**CAUTION**

Most of the printed circuit boards contain static sensitive devices. Use of conductive workstation and wrist strap is recommended to eliminate buildup of static electricity.

b. Remove the top cover of the VPC.



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**WARNING**

Voltages as high as 800V peak are present in the controller. Do not touch any components in the power supply section of the 303.

c. Turn the 303 power on, and depress the push button switch on the CPU board. See Fig. 2-2 for location.

d. Enter the security code from 0 to 255 followed by the ENTER key.

e. Remove power from the 303 and re-install the top cover.

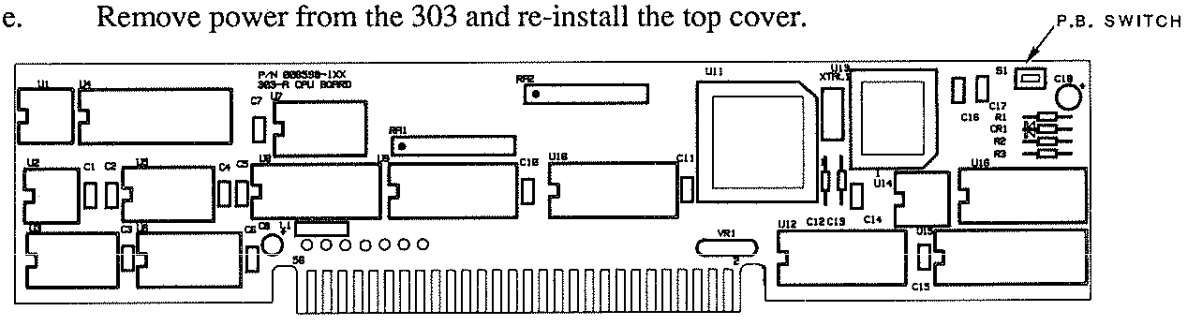



Fig. 2-2 Security Code Push Button

## 2-4. OPTION CARDS

If the VPC has been ordered with process control, BCD, RS232C, IEEE 488, or analog output options installed, the option cards must be configured for the specific requirements of the user prior to installation of the VPC and operational use. Table 2-2 lists the option cards, option slots in which the cards are installed, and a paragraph reference where appropriate installation information is provided. Refer to Figure 1-2 for identification of option slots A, B, C, and D.

Table 2-2. Option Card Installation

| Option Card | Cards Allowed | Card Slot Location | Installation Information |
|---|---|---|---|
| Process Control | 3 | A, B, or C | Para. 2-17 |
| BCD | 2 | Any Slot except D | Para. 2-21 |
| RS232C<br>or IEEE 488 | 1<br>1 | D<br>D | Para. 2-20<br>Para. 2-24 |
| Convectron Gauge | 1 | Any Slot except D | Para. 2-15 |
| External Enable | 1 | Any Slot except D | Para. 2-19 |
| Analog Output | 2 | Any Slot except D | Para. 2-23 |



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Option cards which have been ordered to modify and upgrade the operation of a basic VPC should be configured for specific user requirements prior to installation.

## 2-5. INSTALLATION OF VPC

The VPC is designed to be mounted in a standard 19-inch (48.3 cm) relay rack. Use mounting hardware furnished to secure the unit to the rack.

**CAUTION**

Adequate ventilation must be provided above and below the unit. Recommended spacing is 1.5 inches minimum. Do not mount the controller above other heat generating equipment.

## 2.6. PROTECTION OF CONTROLLER FROM DC AND RF VOLTAGES

The VPC is constructed to withstand most tube element shorts. Grid to filament or grid to collector shorts during degas may damage the VPC. Input protection is provided to protect the electrometer from high energy discharges. However, it is necessary to shield the ionization tube whenever the VPC is used in systems where high-voltage arcs may be present. This shielding can include baffles or fine screening in the tube inlet. If the energy is external to the system, an additional rf shield around the tube is required. Contact Granville-Phillips Application Engineers for assistance in remedying difficult shielding problems.

The use of a high frequency spark coil for leak testing glass systems can cause damage to the controller. Always disconnect the cables from the gauge prior to leak testing with a spark coil.

## 2-7. IONIZATION GAUGE TYPES AND MOUNTING

The VPC is designed to operate one or two Bayard-Alpert or equivalent ionization gauge tubes. It is recommended that a coated iridium filament type gauge be used if the automatic filament turn on feature is to be utilized. Iridium filaments provide a longer operating life during operation in the higher pressure ranges.

The specifications of the ionization gauge to be used should be compared with the VPC specifications in Table 1-1. Particular attention should be given to gauge sensitivity, grid bias potential, filament bias potential and degas power specifications. The VPC can be programmed to accommodate a full range of gauge sensitivities (refer to paragraph 3-45) and degas power levels (refer to paragraph 3-33). The grid potential is adjustable by a potentiometer on the power board (refer to paragraph 5-9).

Consideration should be given to where the gauge is connected to the system. If placed near the pump, the pressure in the gauge may be considerably lower than in the remainder of the system. If placed near a gas inlet or source of contamination, the pressure in the tube may be considerably higher than in the remainder of the system.

If an unshielded gauge is placed near an electron beam evaporation source or used in a sputtering system, spurious electrons or ions may completely disturb the measurement. Screens or other shielding should be placed between the gauge and the system if spurious charged particles are present. Consideration should also be given to electrostatic shielding of glass tubulated gauges when measuring pressures near their x-ray limits.



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## 2-8. IONIZATION GAUGE CABLES

**WARNING**

Do not attach cables to glass gauge pins while the gauge is under vacuum. Accidental bending of the pins may cause the glass to break and implode. Cables, once installed, should be secured to the system to provide strain relief for the gauge tube pins.

Ionization gauges are safe for use only if all exposed conductors on this gauge **and** on controller **and** on vacuum system are grounded.

Figure 2-3 shows the configuration the tube elements must have if the tube is to mate directly to a standard cable assembly. These cables are designed to be used with gauges similar to the series 274 tubulated gauges, with either single or dual filaments. If one of these cables is to be used, connect the tube to the 7 contact connector. Plug the plastic collector socket on the collector pin at the opposite end of the tube.

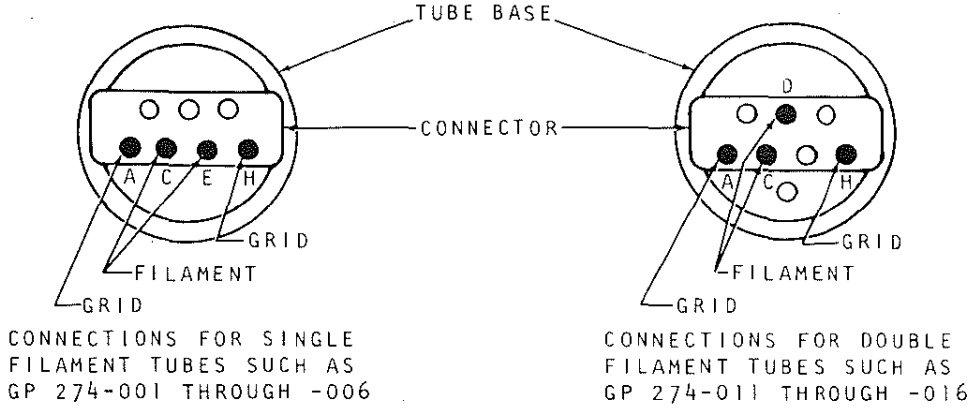



Figure 2-3. Standard Tube Base Configurations

Prior to connecting the cables to the gauge tubes and the VPC, ensure that a strain relief is provided for each cable assembly such that the glass envelope of each tube will not break due to pin movement. On the VPC, the connectors for the gauge tubes are located on the rear panel. Refer to Figure 1-2.



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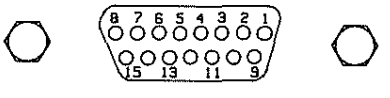
## 2-9. REMOTE CONTROL INPUT/OUTPUT CONNECTIONS

The basic VPCs have input connections available for the remote control of the IG ON/OFF and DEGAS ON/OFF functions for both of the ionization gauges. These inputs can be used to activate the ionization gauge(s) from external signals derived from the user's system. Relay contacts are also provided that indicate the status of each ionization gauge filament (FIL STATUS). The relay is energized to indicate that a particular ionization gauge is on. Refer to the specifications in Table 1-1 for the relay contact ratings and to paragraph 3-11 for the operational characteristics of this feature.

The pin connections for J211 are given in Table 2-3. Refer to Figure 1-2 to locate the connector on the rear panel.

Table 2-3. Remote Control Connections

| Pin No. J211 | Function | Notes |
|---|---|---|
| 8 | IGl ON/OFF (Input) | 1 mA to ground.<br>Toggles On and Off. |
| 12 | Ground | |
| 15 | IG2 ON/OFF (Input) | 1 mA to ground.<br>Toggles On and Off. |
| 13 | Ground | |
| 7 | Degas 1 ON/OFF (Input) | 1 mA to ground.<br>Toggles On and Off. |
| 14 | Degas 2 ON/OFF (Input) | 1 mA to ground.<br>Toggles On and Off. |
| 5 | Normally Open | |
| 3 | Common | Fil Status 1<br>Relay Contacts |
| 4 | Normally Closed | |
| 2 | Normally Open | |
| 9 | Common | Fil Status 2<br>Relay Contacts |
| 1 | Normally Closed | |




J211



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## 2-10. INSTALLATION OF OPTION CARDS

The following paragraphs provide instructions for configuring and installing the option cards for proper operation.

## 2-11. CONVECTRON GAUGE OPTION

Paragraph 2-15 provides instructions on the installation of the Convectron gauge option. Information for the installation of the Convectron gauge tube is given in paragraphs 2-12, 2-13 and 2-14.

## 2-12. CONVECTRON GAUGE TUBE INSTALLATION

**WARNING**

303 Vacuum Process Controllers are intended for use only on vacuum systems which have suitable devices installed that will limit the pressure from external gas sources to the level the system can safely withstand and which also have suitable pressure relief valves or rupture disks installed. Confirm that these safety devices are properly installed before installing the VPC. In addition, check that (l) the proper gas cylinders are installed, (2) gas cylinder valve positions are correct on manual systems, and (3) the automation is correct on automated systems.

This option permits two Granville-Phillips 275 Convectron gauges to be operated simultaneously to provide digital pressure measurement from 1 x $10^{-3}$ to 1000 Torr of air, $N_2$ or Ar. Pressure of other gases may be measured by using the conversion charts in Figures 3-5 to 3-10. Gas mixtures of constant composition such as air may be measured with suitable calibration. Variable composition gas mixtures cannot be measured. With this option, system status may be monitored from atmospheric pressure down to where the ionization gauges may be turned on automatically by the VPC.

The following precautions in the installation and use of Convectron gauges must be observed.

1. a. Keep the tube clean. Do not remove the mounting port cover until you are ready to install the tube.

   b. The gauge tube should be installed with the port oriented vertically downward to ensure that no system condensates or other liquids collect in the gauge tube.

   c. The gauge tube axis must be horizontal if it is to be used at pressures above 1 Torr (l mbar or 100 Pa). Erroneous readings will result at pressures above 1 Torr (l mbar or 100 Pa) if the tube axis is not horizontal.

   d. Pipe thread or flange mounting connections should be used for positive pressure applications. In any case, the absolute pressure in the tube should not exceed 1000 Torr or 1333 mbar or 133 KPa.

   e. Do not perform electrical continuity tests on the tube with instruments applying voltages in excess of 1 volt when the tube is at vacuum, or 5 volts when at atmospheric pressure. Exceeding these voltages will damage the sensing element.



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f. Do not mount the gauge tube in a manner such that deposition of process vapors upon the internal surfaces of the gauge tube may occur through line-of-sight access to the interior of the gauge tube.

g. Do not install the gauge tube where high amplitudes of vibration are present. Excessive vibration will cause forced convection at high pressure giving erroneous readings.

h. Do not bake the gauge tube to temperatures exceeding 150°C.

i. Do not expose the gauge tube to mercury vapor or other agents that will alter the emission characteristics of the gold-plated sensor wire or corrode the materials exposed to vacuum.



**When high voltage is present, all exposed conductors of a vacuum must be maintained at earth ground.**

2.Under certain conditions, dangerous high voltage can be coupled directly to an ungrounded conductor through a gas almost as effectively as through a copper wire connection. This hazard, which is not peculiar to this product, is a consequence of the ability of an electric current to flow through a gas under certain circumstances. A person may be seriously injured, or even killed, by merely touching an exposed ungrounded conductor at high potential.
When high voltages are used within the vacuum system and the *CONVECTRON* Gauge envelope is not reliably grounded through its vacuum connection, either a separate ground wire must be added, or the envelope must be shielded to positively prevent human contact. The gauge envelope may be grounded by using a metal hose clamp on the gauge connected by a #12 awg copper wire to the grounded vacuum chamber.
High voltage can couple through a gas to the internal electrodes of a gauge. Do not touch the exposed pins on any gauge installed on a vacuum system where high voltage is present.

All materials have been chosen for ultra high vacuum service, corrosion resistance and bakeability to 150°C. The gauge tube envelope is type 304 stainless steel. All metallic joints in the envelope are TIG welded. No solder is used within the envelope. The following materials are exposed to the vacuum: Type 304 stainless steel, Carpenter Alloy 52, Kovar*, Kapton® gold plated tungsten and borosilicate glass. The blue trim cover is molded of Polyetherimide thermoplastic suitable for service to 150°C.

## 2.13. GAUGE TUBE ORIENTATION

The gauge tube will operate and read pressures below 1 Torr (1 mbar or 100 Pa) when mounted in any orientation. Above 1 Torr (1 mbar or 100 Pa), the gauge tube will accurately read pressures only when mounted with its axis horizontal, preferably with the port pointing vertically downward as shown in Figure 2-4. Point the port downward to facilitate the removal of condensation and other contaminants.

## 2-14. GAUGE TUBE MOUNTING

The following methods may be used for tube mounting:

a. Compression Mount (Quick Connect)

This type of installation is not used for positive pressure applications. The gauge tube port is designed to fit a standard l/2-inch (1.27 cm) compression mount, such as the Cajon Co.

---

* Trademark, Carpenter Technology



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Ultra-Torr® fittings. Remove the cap plug from the gauge tube port, insert the gauge tube port into the compression fitting and finger tighten the press ring. If a seal is not achieved, it is likely due to the extreme cleanliness of the O-ring. A light film of vacuum grease, such as Apiezon* will ensure sealing and is normally preferable to the use of pliers or pipe wrench to tighten the press ring.

b. NPT Mount

The threads on the gauge tube port will fit a standard 1/8 NPT female fitting. Wrap the threads of the port with Teflon® tape and screw the port into the system fitting hand tight. Do not use a wrench or any other tool. The gauge tube body functions adequately as its own wrench. Tighten only to achieve a seal. Further tightening, in excess of one-half turn, will result in possibly overstressing the tube port. If the installation leaks, suspect the female pipe threads of the NPT fitting.

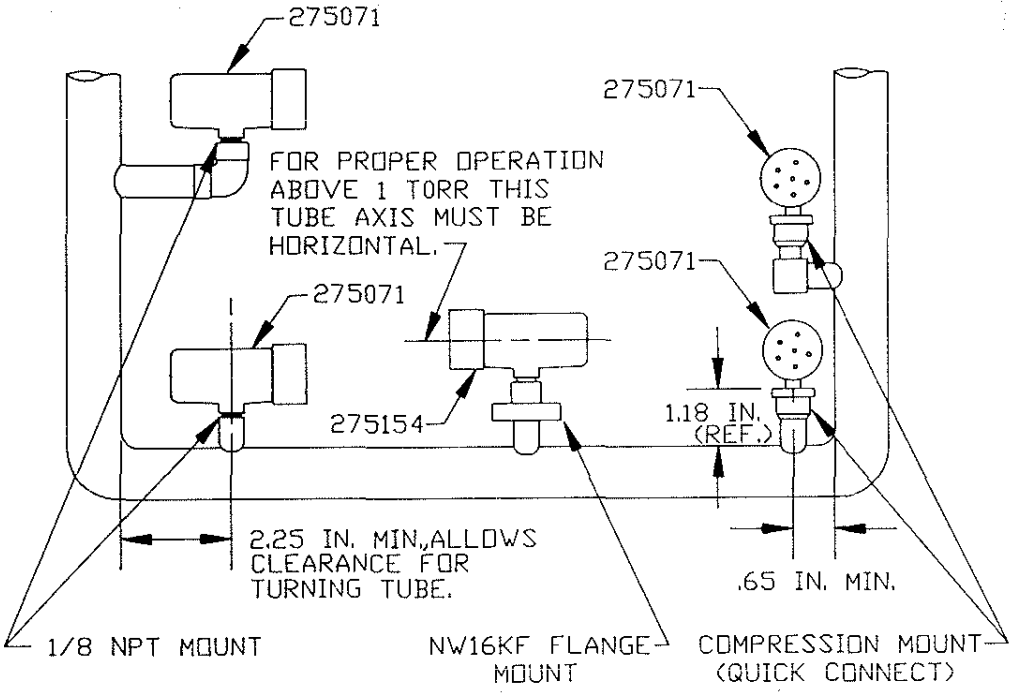



Figure 2-4. Convectron Gauge Tube Mounting

## 2-15. CONVECTRON GAUGE OPTION CARD INSTALLATION

The Convectron gauge option card may be installed in any unused option card slot. If the card has been installed at the factory, the option slot will be indicated by a label on the back panel of the unit. If the card is to be installed by the user, perform the following procedure.

a. Turn off power to the VPC and remove all electrical connections to the VPC.

*Trademark, James C. Biddle Company



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**CAUTION**

Most of the printed circuit boards contain electronic devices which can be damaged by static electricity. Ground yourself to a suitable electrical ground before removing option boards from their protective packaging and any other time the boards are handled. Avoid touching any of the electrical contacts. Do not slide or rub a circuit board across plastic or other insulators which may cause a build up of damaging static charges.

b. Remove the top cover of the VPC.

c. Remove the blank cover on the rear panel covering the connector opening for the selected slot.

d. Remove the option board retaining bracket.

e. Carefully insert the option card into the main circuit board connector and the option board connector through the rear-panel opening.

f. Secure the metal plate on the option card to the rear panel using the screws provided.

g. Replace the option board retaining bracket.

h. Replace and secure the top cover.

i. Apply the option label supplied to the rear panel with the arrows pointing toward the option installed.

j. Connect the Convectron gauge option cable to the option card connector and to the gauge tubes.

k. Replace all electrical connections removed in step a.

## 2-16. PROCESS CONTROL OPTION

Up to three process control option cards can be installed, each card contains four single-pole, double-throw relays. These relays can be assigned to 12 control channels, each with its own status indicator on the front panel. Fully programmable, each channel can be assigned to any one of the four possible gauge tubes in the system. Set point, time delay, time out, hysteresis and manual override can be programmed for each process control channel. Refer to paragraphs 3-20 through 3-30 for operation instructions for the process control option.

**WARNING**

It is the installers responsibility to ensure that the automatic signals provided by the process control option are always used in a safe manner. To help ensure safety of personnel and equipment, and to provide for manual operation and maintenance of the equipment, switches must be installed such that all equipment subject to automatic process control can be



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operated manually as well. Figure 2-5 illustrates typical connections.

Carefully check manual operation of the system and the programming before switching it to automatic operation. Where an equipment malfunction could cause a hazardous situation, always provide for fail-safe operation. As an example, in an automatic backfill operation where a malfunction might cause high internal pressures, provide an appropriate pressure relief device.

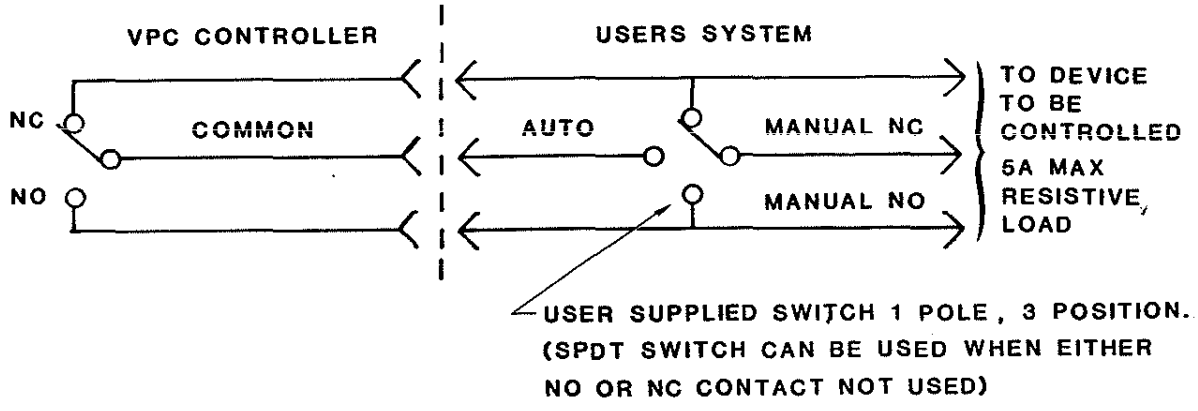



Figure 2-5. Typical Process Control Switch Connections

To help in implementing the manual override function, a series of manual override switch panels can be purchased under the 314 product series. The 314 product copies the appearance of the 303 VPC and comes with 4, 8, or 12 switches and 2 connector styles for ease of user interfacing. If assistance is required for specific process control applications, contact an Applications Engineer at Granville-Phillips Co.

## 2-17. PROCESS CONTROL CARD INSTALLATION

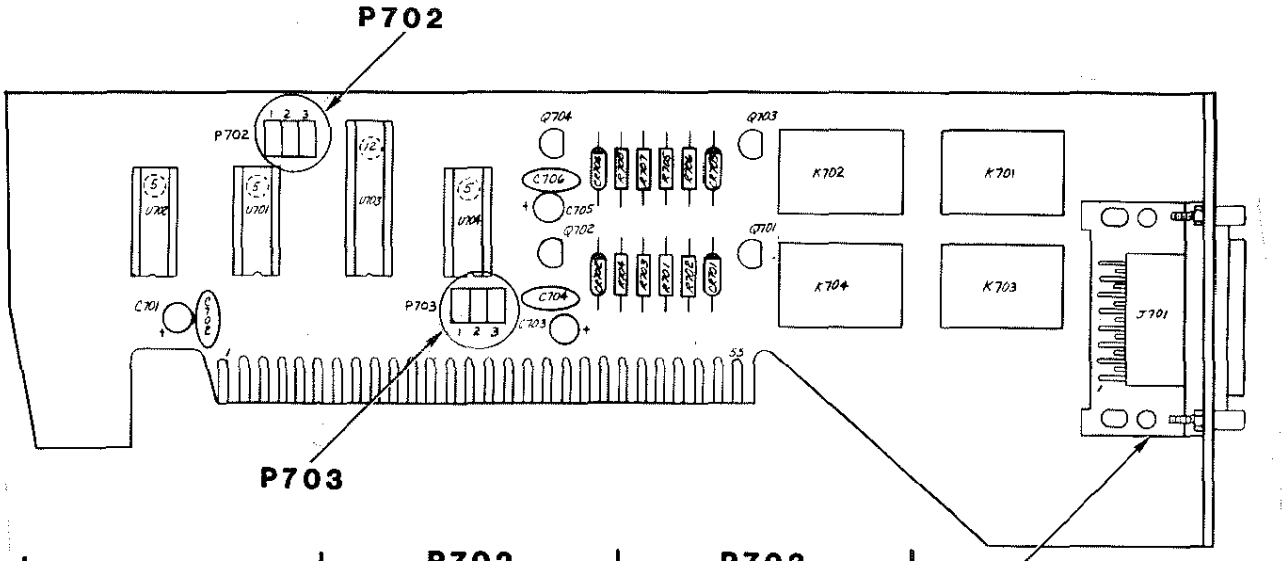
Process control cards installed at the factory will be furnished with PC channel assignments shown below. The assignment of PC Channels must run consecutively beginning with PC channel number 1.

| Option Slot | PC Channel |
|---|---|
| A | 1, 2, 3, 4 |
| B | 5, 6, 7, 8 |
| C | 9, 10, 11, 12 |

PC Channel assignments may be changed by repositioning the jumpers on P702 and P703 as illustrated in Figure 2-6. Table 2-3 lists the process control option board relay connections to connector J701.



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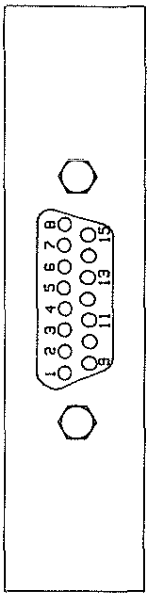

| CHANNELS | P702 JUMPER POSITION * | P703 JUMPER POSITION * |
|---|---|---|
| 1-4 | P702 1 2 3 | P703 1 2 3 |
| 5-8 | P702 1 2 3 | P703 1 2 3 |
| 9-12 | P702 1 2 3 | P703 1 2 3 |

* MUST MATCH

Figure 2-6. Process Control Option Card

Table 2-4. Process Control Connections

| PC Relay No. | Contact Function | Connector Pin No. |
|---|---|---|
| 1-5-9 | NO | 7 |
| 1-5-9 | NC | 15 |
| 1-5-9 | Com. | 8 |
| 2-6-10 | NO | 5 |
| 2-6-10 | NC | 13 |
| 2-6-10 | Com. | 6 |
| 3-7-11 | NO | 3 |
| 3-7-11 | NC | 11 |
| 3-7-11 | Com. | 4 |
| 4-8-12 | NO | 1 |
| 4-8-12 | NC | 9 |
| 4-8-12 | Com. | 2 |





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**CAUTION**

Most of the printed circuit boards contain electronic devices which can be damaged by static electricity. Ground yourself to a suitable electrical ground before removing option boards from their protective packaging and any other time the boards are handled. Avoid touching any of the electrical contacts. Do not slide or rub a circuit board across plastic or other insulators which may cause a build-up of damaging static charges.

If the card is to be installed by the user, perform the following procedure:

a. Turn off power to the VPC and remove all electrical connections to the controller.

b. Remove the top cover of the VPC.

c. On the process control card, connect the jumper on P702 and P703 for the process channels to be controlled. Refer to Figure 2-6 for jumper positions. Process control channels must run consecutively, channels 1-4 must be installed before 5-8 can be used, and channels 5-8 must be installed before channels 9-12 can be used.

d. Determine which option slot is to be used. (Option slots A, B, and C provide room for relays on the option cards.)

e. Remove the blank cover on the rear panel covering the connector opening for the selected slot.

f. Remove the option board retaining bracket.

g. Carefully insert the option card into the main circuit board connector with the option card connector through the rear-panel slot.

h. Secure the metal plate on the option card to the rear panel using the screws provided.

i. Reinstall the retaining bracket

j. Reinstall and secure the top cover.

k. Apply the option label supplied to the rear panel with the arrows pointing to the installed card.

l. Reconnect all connectors removed in step a.

m. Follow the steps in the following paragraph to connect the option board to the system.

## 2-18. PROCESS CONTROL SYSTEM CONNECTIONS

Prior to connecting the process control option card to the system, it is strongly recommended that the following steps be accomplished. If application assistance is desired contact an Applications Engineer at the Granville Phillips Co.

a. Unless the control logic is simple and obvious, develop a logic diagram of the process control function.



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b. Develop a specification table which lists the proposed pressure setting, time delay, time out setting, hysteresis, and alarm setting for each process control relay. Refer to Figure 3-13 for a typical process control specification table.

c. Draw a circuit schematic which specifies exactly how each piece of system equipment will be connected to the VPC. In specifying how to connect the equipment heed the WARNING in paragraph 2-16.

d. With the process control option connector disconnected from the option board, connect the process control cable to the device to be controlled according to the circuit schematic developed in c. above.

e. Ensure that all process controlled devices are under manual control prior to connecting the process control connector into the appropriate process control option receptacle on the rear panel. Refer to Figure 2-5.

f. Attach a copy of the circuit diagram for the process control circuit to this manual for future reference or for troubleshooting.

## 2-19. EXTERNAL ENABLE OPTION

The external enable option provides both a means to input signals from external system devices and output TTL signals which indicate the status of the individual process control channels. The signals that are input from external sources are logically "AND"ed with the individual pressure set points. If both signals are TRUE, the particular Process Control channel will be enabled. The outputs and inputs for the option are organized in groups of 4. If this option is to be used, Process Control options must be installed for all channels to be used. All unused inputs must be connected to the option ground. If the unused inputs are not grounded, the particular PC channel can never be activated. Refer to paragraph 3-30 for more detailed operating instructions.

External enable signals may be obtained for a PC channel N (where N = 1 through 12.) by:

a. Connecting the external enable input pin for channel N to ground Pin 1 of JA0l (do not use other grounds). Refer to Table 2-5 for connector JA0l connections.

b. Connecting the external enable input pin for channel N to the external enable output pin of another PC channel.

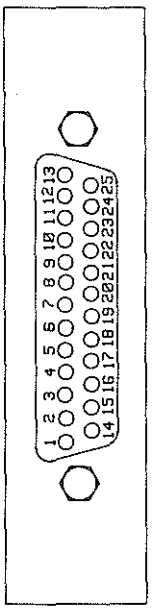
c. Furnishing a TTL compatible active low signal or contact closure to the external enable input pin for channel N using pin 1 of JA0l as the ground reference. Do not use other grounds.



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Table 2-5. External Enable Option Input/Output Connections

| PC Channel | Input to PC Channel Pin No. | Output from PC Channel Pin No. |
|---|---|---|
| 1 | 17 | 2 |
| 2 | 16 | 3 |
| 3 | 15 | 4 |
| 4 | 14 | 5 |
| 5 | 21 | 6 |
| 6 | 20 | 7 |
| 7 | 19 | 8 |
| 8 | 18 | 9 |
| 9 | 25 | 10 |
| 10 | 24 | 11 |
| 11 | 23 | 12 |
| 12 | 22 | 13 |




Note - Pin 1 of JA01 is ground.

If the external enable option is factory installed, the option slot will be indicated by a label on the back panel of the unit. Connect the external enable cable for the system process control required in accordance with the pin numbers listed in Table 2-5.

**Note**

If this option card is installed but is not being used, each channel must be enabled or each input connected to pin 1 of JA0l, or the option card removed to permit process controls to operate.

To install an external enable option card, perform the following procedure:

**CAUTION**

Most of the printed circuit boards contain electronic devices which can be damaged by static electricity. Ground yourself to a suitable electrical ground before removing option boards from their protective packaging and any other time the boards are handled. Avoid touching any of the electrical contacts. Do not slide or rub a circuit board across plastic or other insulators which may cause a build up of damaging static charges.

a. Turn off power to the VPC and remove all electrical connections to the controller.

b. Remove the top cover of the VPC.

c. Determine which option slot is to be used and remove the blank cover.

d. Remove the option board retaining bracket.



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e. Carefully insert the option card into the main circuit board connector with the option card input/output connector through the rear-panel slot.

f. Secure the metal plate on the option card to the rear panel using the screws provided.

g. Reinstall the retaining bracket.

h. Reinstall and secure the top cover.

i. Apply the option label supplied to the rear panel with the arrows pointing to the installed card.

j. Reconnect all connectors removed in step a.

k. Ensure that cable connections are in accordance with enable signals required and are connected to the correct pins as listed in Table 2-6. Then insert the external cable connector into external enable receptacle.

## 2-20. RS232C INTERFACE OPTION

This option provides half-duplex, bidirectional communications between the VPC and a host computer by use of an EIA standard RS232C serial ASCII interface. All functions that are available on the front panel can be controlled via this interface. The interface can also be used to access all programmed parameters and pressure data as well as program the VPC's operation. Baud rates up to 9600 are available via a selector switch on the option board. This option is available factory installed or it may be ordered and installed by the user.

**Note**

A separate manual is provided with the RS232C option which contains specifications, programming requirements and installation instructions. Further applications information may be obtained from the Customer Service Department at Granville-Phillips Company.

## 2-21. BCD OPTION

The BCD interface option provides parallel binary coded decimal pressure and status information to a remote device with a compatible interface. The use of two option cards is possible providing data from both display channels simultaneously. Selection of the gauge(s) providing pressure data is a programmed function. The outputs and control inputs are defined as to their functions, interface requirements, and pin out in Table 2-7. All logic levels are 5 volt TTL compatible. The outputs can be tri-stated to a high impedance allowing several VPC's to be bussed together. Refer to paragraph 3-47 for detailed operating information.

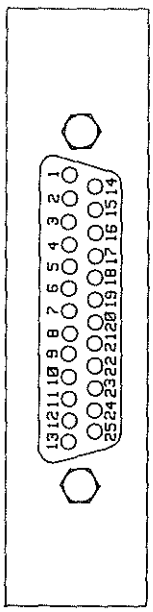
The option cards are installed at the factory if ordered with the VPC or can be installed by the user if an upgrade is desired.



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Table 2-6. BCD Option Connections

| No. | Function | TTL Loads | Notes |
|---|---|---|---|
| 1 | | 15 | 1's digit - LSB |
| 2 | | 15 | 1's digit |
| 4 | | 15 | 1's digit |
| 8 | | 15 | 1's digit - MSB |
| 1 | | 15 | .1's digit - LSB |
| 2 | | 15 | .1's digit |
| 4 | | 15 | .1's digit |
| 8 | | 15 | .1's digit - MSB |
| 1 | | 15 | .01's digit - LSB |
| 2 | | 15 | .01's digit |
| 4 | | 15 | .01's digit |
| 8 | | 15 | 1's digit - MSB |
| | Option Common | - | Ground |
| | Data Valid Output | 5 | 0 = Data stable |
| | Data Bus Input | 1 | 1 = Tri-State output bus internal pull-up |
| | Hold Input | 1 | 0 = Hold data, internal pull-up |
| | CG/IG Output | 15 | 1 = IG |
| | Degas Status Output | 15 | 1 = Degas on |
| | Trouble Output | 15 | 1 = Trouble |
| | Exponent Sign | 15 | 1 = + (plus) |
| | Exponent lO's bit. | 15 | |
| 1 | | 15 | Exponent 1's digit LSB |
| 2 | | 15 | Exponent 1's digit |
| 4 | | 15 | Exponent 1's digit |
| 8 | | 15 | Exponent 1's digit MSB |






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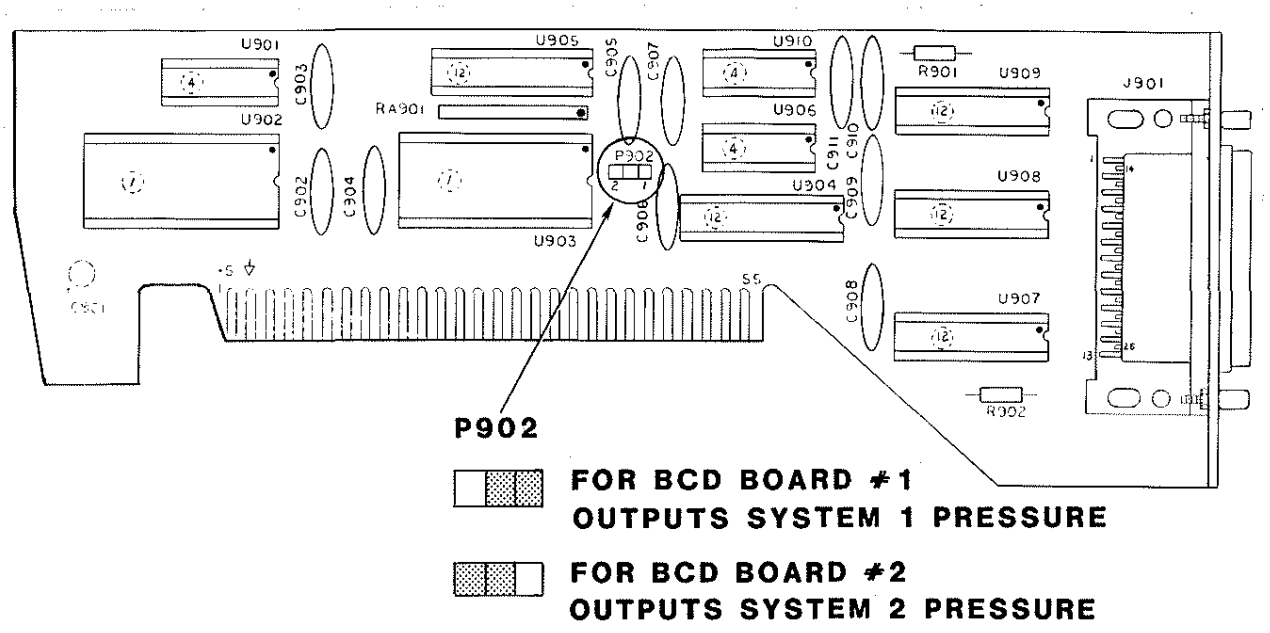



Figure 2-7. BCD Option Card

To install a BCD option card, perform the following procedure:

**CAUTION**

Most of the printed circuit boards contain electronic devices which can be damaged by static electricity. Ground yourself to a suitable electrical ground before removing option boards from their protective packaging and any other time the boards are handled. Avoid touching any of the electrical contacts. Do not slide or rub a circuit board across plastic or other insulators which may cause a build up of damaging static charges.

a. Turn off power to the VPC and disconnect all cables from the controller.

b. Remove the cover of the VPC.

c. Determine which slot(s) are to be used for the option card(s) and remove the blank cover(s) on the rear panel covering the slot(s).

d. Remove the option board retaining bracket.

e. Ensure that the card is configured for the data it is to output (refer to Figure 2-7).

f. Carefully insert the BCD card into the main circuit board connector with the input/output connector through the rear-panel slot.

g. Secure the plate on the BCD card to the rear panel with the screws provided.

h. Reinstall the retaining bracket and top cover.



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i. Apply the option label supplied to the rear panel with the arrows pointing toward the installed card.

## 2-22. ELECTROMETER B OPTION

The Electrometer B option is available to those users who have purchased a VPC A model and would like to upgrade the unit. This option allows the user to simultaneously operate two Bayard-Alpert type ionization gauge tubes and display the measured pressures from both tubes at the same time. Refer to paragraph 3-7 for operating details.

**CAUTION**

Most of the printed circuit boards contain electronic devices which can be damaged by static electricity. Ground yourself to a suitable electrical ground before removing option boards from their protective packaging and any other time the boards are handled. Avoid touching any of the electrical contacts. Do not slide or rub a circuit board across plastic or other insulators which may cause a build up of damaging static charges.

a. Turn off power to the VPC and remove all electrical connections to the controller.

b. Remove top cover and the option retaining bracket.

c. Remove the screw which secures the A electrometer to the rear panel. Remove the electrometer card.

d. Carefully insert the B electrometer card into the main circuit board connector with the BNC connectors through the rear-panel holes.

e. Secure the B electrometer card to the rear panel.

f. Reinstall the retaining bracket and top cover.

g. Connect gauge cables to the VPC as shown in Figure 1-2 and Table 1-3.

h. Reconnect all cables removed in step a.

## 2-23. ANALOG OUTPUT OPTION

The analog output option provides analog voltage outputs corresponding to the pressures being measured. The voltage is linearly proportional to the pressure in each decade over the entire range from $10^{-11}$ to 999 Torr, assuming that the Convectron gauge option is installed and the VPC is properly programmed. For a Convectron pressure reading of 000 the output voltage will be 3.77 Volts. Refer to paragraph 3-48 for programming and operating instructions. The analog output voltage, when used with a process control channel and a suitable recorder, can be used to record a pressure vs. time curve, thus providing a powerful performance tracking and troubleshooting tool for the user. The source impedance of each analog output is 100 ohms.



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The analog output option may be ordered factory installed or it may be installed by the user. To install an analog output option, proceed as follows:

**CAUTION**

Most of the printed circuit boards contain electronic devices which can be damaged by static electricity. Ground yourself to a suitable electrical ground before removing option boards from their protective packaging and any other time the boards are handled. Avoid touching any of the electrical contacts. Do not slide or rub a circuit board across plastic or other insulators which may cause a build up of damaging static charges.

a. Turn off power to the VPC and remove all electrical connections to the controller.

b. Remove top cover and the option retaining bracket.

c. Determine which option slot or slots are to be used and remove the blank cover(s) on the rear panel covering the slot(s).

d. Ensure that the card is configured to output the desired channel data (refer to Figure 2-8).

e. Carefully insert the option card into the main circuit board connector with the output connector through the rear-panel slot.

f. Secure the plate on the option card to the rear panel with the screws provided.

g. Reinstall the retaining bracket and top cover.

h. Apply the option label supplied to the rear panel with the arrows pointing toward the installed card.

i. Ensure that the interface connections are as listed in Table 2-7. Connect analog output option connector to the installed card.

j. Reconnect all cables removed in step a.



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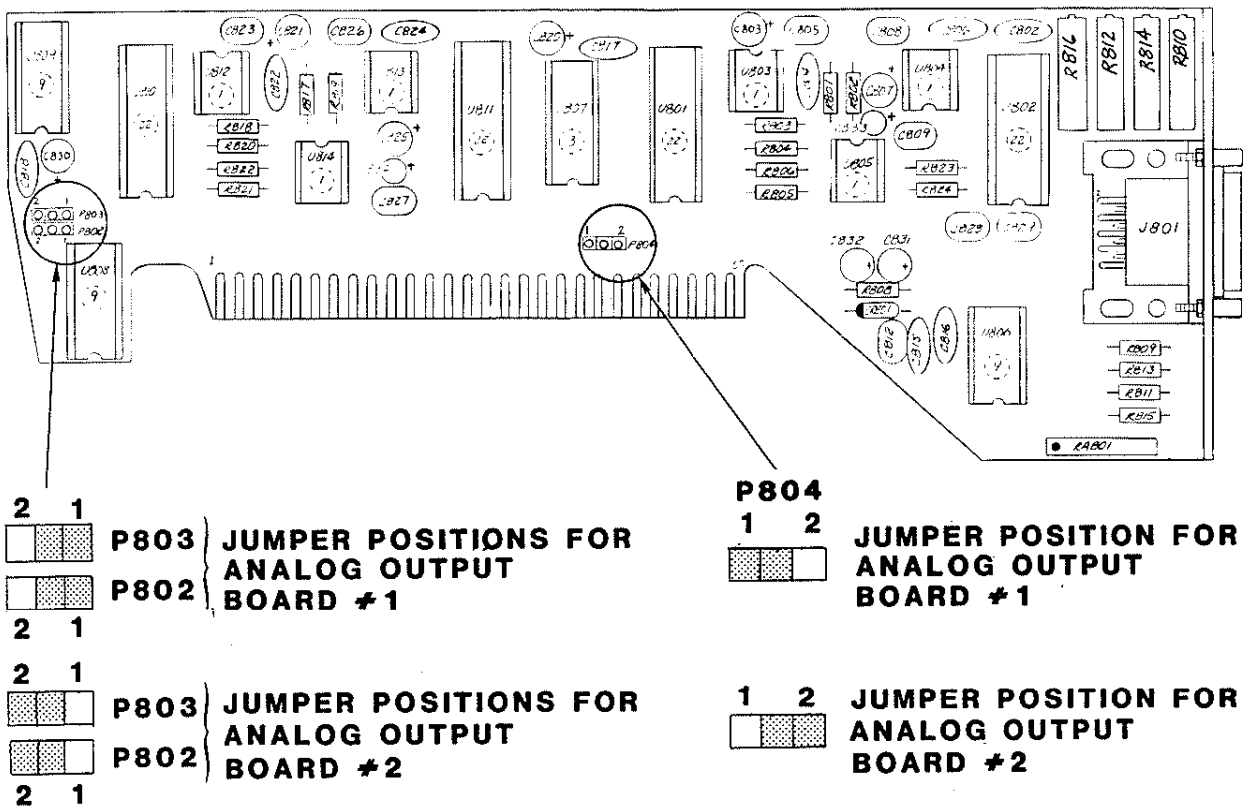
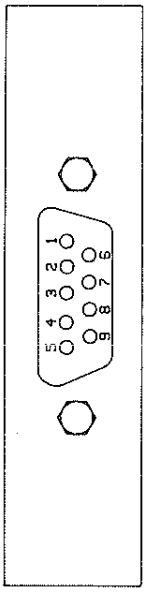



Figure 2-8. Analog Output Option Card

Table 2-7. Analog Output Option Connections

| Pin No. J801 | Display Channel No. | Function |
|---|---|---|
| 5 | 2 | High (+v) |
| 4 | 2 | Gnd |
| 7 | 1 | High (+v) |
| 6 | 1 | Gnd |



## 2-24. IEEE 488 OPTION

This option provides addressable parallel communications between the VPC and a host computer by way of the IEEE 488 interface standard. All functions that are available on the front panel can be controlled via this interface. The interface can be used to access all programmable parameters, pressure data and VPC operational features. Up to 20 VPCs can be connected together to one IEEE 488 interface board and each VPC can be addressed from 1 to 32. This option is available factory installed or it may be ordered and installed by the user.



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## 2-25. INITIAL POWER UP PROCEDURE

**WARNING**

Safe operation of ion producing equipment requires grounding of both the vacuum chamber and the power supply. LETHAL VOLTAGES may be established under some operating conditions unless correct grounding is provided. Refer to figure 2-9 for proper grounding procedure.

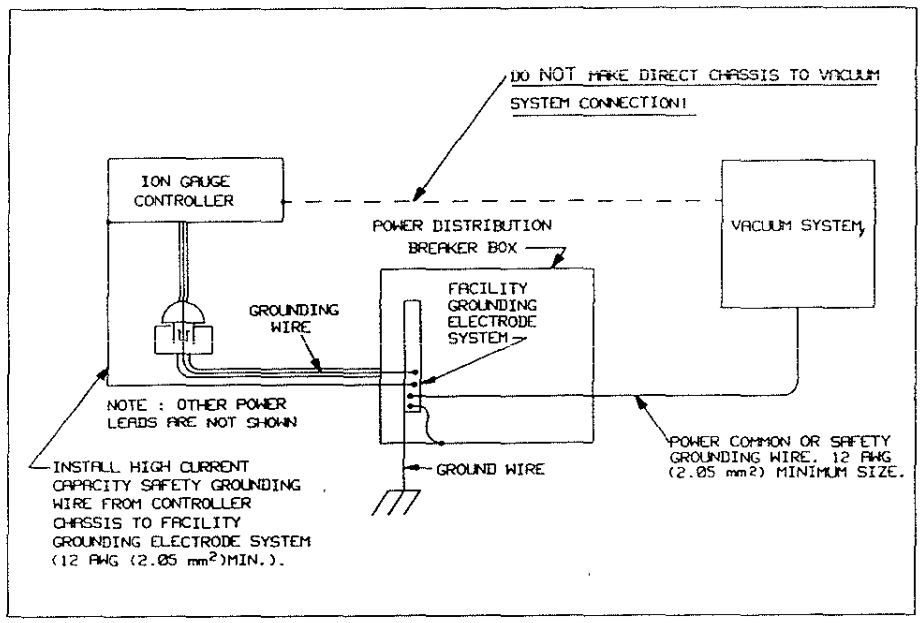



Fig. 2-9. Correct System Grounding

Grounding the System:

1. Connect a heavy duty ground wire #12 AWG or larger from the ground lugs on the back of the controller to your facility grounding electrode system. This will provide an earth ground for the controller if the power cable is not in place. Do not connect the ground lug to the vacuum system or other component. Connect it directly to the facility grounding system such as a grounded outlet box or a grounded copper water supply pipe. Do not rely on small metal water lines to ground a component. Later on someone may replace the metal tubing with plastic tubing thus unwittingly causing a potentially dangerous situation.

**Be aware that an electrical discharge through a gas may couple dangerous high voltage directly to an ungrounded conductor almost as effectively as would a copper wire connection. A person may be seriously injured or even killed by merely touching an exposed ungrounded conductor at high potential.**
**This hazard is not peculiar to this product.**

2. Provide a connection to ground for other instruments with electrodes in the vacuum system possibly exposed to high voltage electrical discharges.

3. Provide a connection to ground for each ungrounded metal component in, on or around the vacuum system, including the gauge envelopes, which personnel may touch and which can potentially be exposed to high voltage electrical discharges within the vacuum system. For example, a metal bell jar resting on an



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organic O-ring must be connected to ground if an ionization gauge is to be used or if other high voltage sources are present in the vacuum system.



**Complying with the usual warning to connect the power cable only to a properly grounded outlet is necessary but not sufficient for safe operation of a vacuum system with this or any similar high voltage producing product. Grounding this product does not and cannot guarantee that other components of the vacuum system are all maintained at earth ground.**



**All conductors in, on or around the vacuum system exposed to potential high voltage electrical discharges must either be shielded at all times to protect personnel or must be connected to earth ground at all times.**

Research at Granville-Phillips has established that ion producing equipment, such as ionization gauges, mass spectrometers, sputtering systems, etc., from many manufacturers may, under some conditions, provide sufficient conduction via a plasma to couple a high voltage electrode to the vacuum chamber. If conductive parts of the chamber are not grounded, they may attain a potential near that of the high voltage electrode during this coupling. Potentially fatal electric shock could then occur because of the high voltage between these chamber parts and ground.

During routine pressure measurement, using a Granville-Phillips ionization gauge, about 160V may become present on ungrounded chambers at pressures near $10^{-3}$ Torr. Similar voltages have been measured when testing with controllers from other manufacturers. All isolated or insulated conductive parts of the chamber must be grounded to prevent these voltages from occurring. During electron bombardment degassing, local increases in pressure may cause the potential of the ungrounded chamber to rise to many hundreds of volts. Grounding of all the conductive chamber parts prevents this voltage.

Grounding, though simple, is very important! Please be certain that the ground circuits are correctly utilized, both on your gauge controllers and on your vacuum chambers, regardless of their manufacturer, for this phenomenon is not peculiar to Granville-Phillips equipment. If you have questions, please contact one of our technical personnel.

Prior to applying ac power to the VPC, ensure that the unit has been correctly installed in accordance with the instructions in this section. Check all cabling to ensure that the individual interconnecting cables are connected in accordance with system requirements and that strain reliefs are provided as required.

a. Position the power ON/OFF switch, located on the rear panel to the ON position.

b. When power is applied, the CPU performs several self checks and then initializes all VPC functions for proper operation. Refer to Chapter 3 for details.

**Note**

The unit of measure indicator will remain on when the unit is turned on. If the Convectron gauge option is installed, the CGl and CG2 indicators will be on and Display 1 and 2 will indicate CGl and CG2 pressures respectively.

c. Refer to the appropriate paragraph in Chapter 3 for the specific operating procedures required for system operation.

d. The unit is shipped with all calibrations set per specification. However,if the need should arise for adjustment, refer to Chapter 5 for user accessible calibration procedures.



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# NOTES



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# CHAPTER 3
# OPERATION

## 3-1. FRONT PANEL CONTROLS AND INDICATORS

The operating controls and associated indicators are located on the front panel of the unit. They provide full operational control and status of the VPC and associated system. Figure 3-1 illustrates the controls and indicators and Table 3-1 lists each control and indicator referenced to the figure.

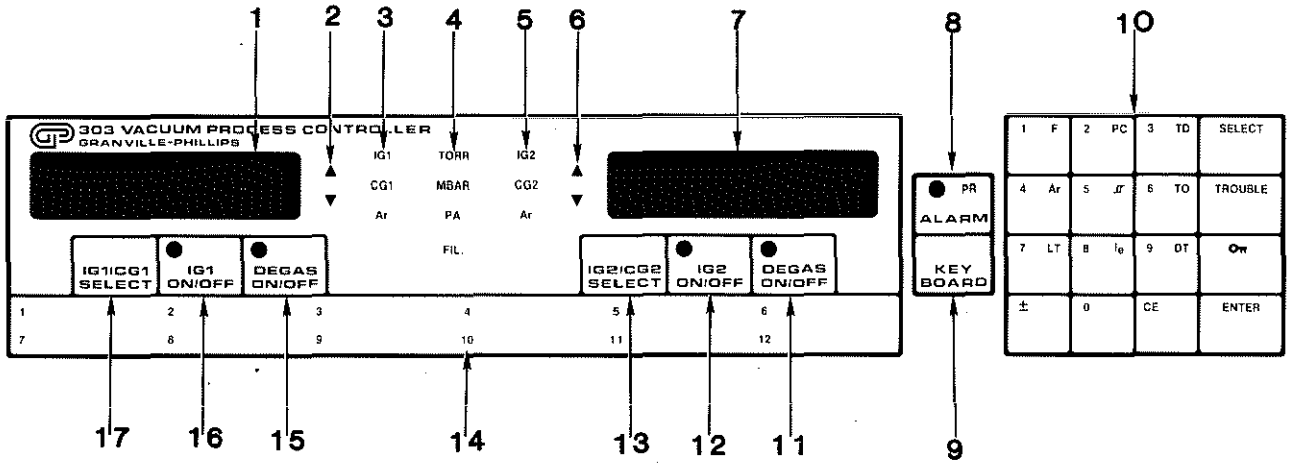



Figure 3-1. Front Panel Controls and Indicators

Table 3-1. VPC Controls and Indicators

| Index No. | Para. Ref. | Control/Indicator Nomenclature | Description |
|---|---|---|---|
| 1 | 3-2 | Display-Channel 1 | Displays channel 1 (IG1/CG1) pressure in calculator notation ($5.63^{-5}$ for $5.63 \times 10^{-5}$). Also displays program contents. |
| 2 | 3-44 | ▲ ▼ | Direction and rate-of-change indicators for channel 1. Flashes or lights when rate of change exceeds programmed value. |
| 3 | 3-2 | IG1 | Lights to indicate ionization gauge tube 1 pressure is being displayed on Display 1. |
| | | CG1 | Lights to indicate Convectron gauge 1 pressure is being displayed on Display 1. |



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Table 3-1. VPC Controls and Indicators (Cont.)

| Index No. | Para. Ref. | Control/Indicator Nomenclature | Description |
|---|---|---|---|
| | 3-21 | PC | Process Control flashes when process control mode is selected. Allows the operator to read or program any process control set point, gauge assignment and alarm setting. Selectable with process control option. |
| | 3-22 | TD | Time Delay Flashes when time delay mode is selected. Allows the operator to read or program any process control time delay. This function causes a delay of 0 to 999 seconds after a channel is enabled until it is activated. Selectable with process control option. |
| | 3-17 | SELECT | Lights during programming mode. Allows operator to select CG1, IG1, CG2 or IG2 for programming functions. |
| | 3-31 | Ar | Argon flashes when Argon programming mode is selected. Allows the operator to read or program which gauge(s) will directly indicate Argon pressure. |
| | 3-24 |  | Hysteresis flashes when hysteresis programming mode is selected. Allows the operator to read or program at what percent above the set point pressure a process control will deactivate. Values of 0 to 999% may be programmed. Selectable with process control option. |
| | 3-23 | TO | Time Out. Flashes when time out mode is selected. Allows operator to read or program the time that a process control will be activated if it remains enabled. Values of 1 to 999 minutes and infinite may be programmed. Selectable with process control option. |
| | 5-6 | TROUBLE | Lights to indicate that a malfunction has occurred in the VPC. A code in the digital display indicates the source of error. Refer to paragraph 5-6 for further information. |
| | 3-16 | LT | Leak Test blinks when VPC is in leak test mode. Used to set up Leak Test mode. |
| | 3-12 | Ie | Emission Current blinks to indicate that emission current is being displayed for each IG. |



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Table 3-1. VPC Controls and Indicators (Cont.)

| Index No. | Para. Ref. | Control/Indicator Nomenclature | Description |
|---|---|---|---|
| | 3-32 | DT | Degas Time flashes when degas time mode is selected. Allows the operator to read or program the amount of time that each ion gauge is to be degassed. |
| | 2-3, 3-17 |  | Security indicator. Lights red when the programming mode is secured. Flashes red when allowing security code entry. Lights green when secured functions may be programmed. |
| | 3-17 | ± | Lights when pressure settings are being programmed. Alternately enters a - or + sign for the exponent. |
| | 3-17 | CE | Clear Entry. Lights during programming mode. Pressing key clears last numeric entry. |
| | 3-17 | ENTER | Lights during programming mode. Enters programmed data. |
| 11 | 3-10 | DEGAS ON/OFF | Alternately switches on and off degas power to IG2 when gauge is on. Lights when gauge is being degassed. |
| 12 | 3-6, 3-9 | IG2 ON/OFF | Alternately switches on and off IG2. Lights when gauge is on. |
| 13 | 3-15 | IG2/CG2 SELECT | Alternately selects IG2 or CG2 pressure for Display 2. |
| 14 | 3-20 | Process Control channels 1 through 12 | Indicator lights when process control is activated. Indicator blinks at three different rates; when process control is enabled but not activated, is enabled by manual override, or disabled by manual override. Indicator is off when process control is disabled. Used with process control option. |
| 15 | 3-10 | DEGAS ON/OFF | Alternately switches on and off degas power to IG1 when gauge is on. Lights when gauge is being degassed. |
| 16 | 3-5, 3-8 | IG1 ON/OFF | Alternately switches on and off IG1. Lights when gauge is on. |
| 17 | 3-15 | IG1/CG1 SELECT | Alternately selects IG1 or CG1 pressure for Display 1. |



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## 3-2. DISPLAYS AND INDICATORS

The VPC uses two-41/2 digit LED decimal displays to indicate pressure and various programmable parameters. The pressure is displayed in scientific notation with three digits in the mantissa and one and a half digits plus the sign in the exponent. Pressures above $9.99 \times 10^{-1}$ are displayed without an exponent. Pressures between $1 \times 10^{-9}$ and $9.99 \times 10^{-1}$ are displayed in the form: "X.XX-Y" to be read as $X.XX \times 10^{-Y}$. Below $1 \times 10^{-1}$ the resolution of the displayed pressure decreases. In the $10^{-10}$ decade only two significant digits are displayed in the mantissa while in the $10^{-11}$ decade the mantissa contains one significant digit. The VPC may be programmed to truncate the IG pressure mantissa to two digits from $1 \times 10^{-9}$ to maximum IG pressure (refer to paragraph 3-35) to avoid operator confusion in unstable systems.

When the VPC is in the keyboard programming mode, the displays are used to provide information on the various program parameters. The display data is described in the sections of this manual concerning the individual programmable functions.

The VPC uses LED front panel indicators to display the unit of measure, gauge being read, gauge status, gas calibration, process control status, and instrument malfunction as well as keypad functions for programming. Some of the status indicators serve dual purposes as programming displays.

## 3-3. OPERATING PROCEDURES

The following paragraphs provide the procedures for operating the VPC in its various operating modes. Procedures for operating the basic VPCA and VPCB are presented first and then procedures for extended programming are presented.

Before attempting to operate the VPC, ensure that the:

a. VPC has been properly installed as specified in Chapter 2.

b. Ionization gauge tubes and Convectron gauges (where applicable) are connected to the VPC.

c. POWER switch on rear panel is in ON position.

d 1. System gas is air or $N_2$. If another gas type is to be measured, refer to paragraph 3-14 for conversion information concerning the Convectron gauges, or to paragraph 3-45 for information concerning the ionization gauges.

2. VPC IG sensitivity is set for the sensitivity of the gauge tube you are using. (see paragraph 3-45)

e. System pressure is low enough to allow the IGs to operate. If not, reduce system pressure.

The following parameters can be changed using the programmable functions and function codes: Unit of pressure (paragraph 3-46), IG sensitivity (paragraph 3-45), rate of change indicators (paragraph 3-44), overpressure trip point (paragraph 3-41), overpressure time delay (paragraph 3-42), direct Argon pressure readout (paragraph 3-31), and maximum emission current (paragraph 3-36). The following procedures assume that the factory default settings (paragraph 3-49) are programmed for these parameters.



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## 3-4. OPERATING IG1 OR IG2 WITH VPCA

Either IG1 or IG2 can be operated sequentially with VPCA. To operate the individual tubes, perform the following procedures. A security code entry is not required. Refer to Figure 3-2 for the applicable controls and indicators.

**Note**

In Figure 3-2 and subsequent illustrations in this section, only the shaded controls and indicators are utilized in the associated operating procedure.

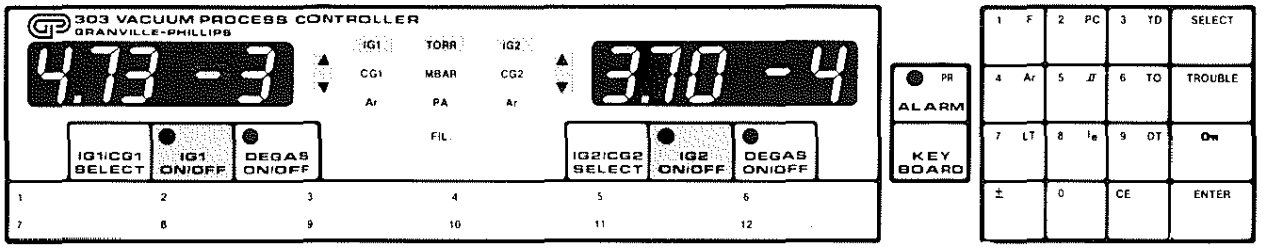



Figure 3-2. Controls and Indicators, IG1 and IG2

## 3-5. OPERATING IG1 (VPCA)

a. TORR units indicator is on.

b. To apply power to IG1, depress IG1 ON/OFF. IG1 ON/OFF indicator turns on.

c. IG1 gauge indicator turns on.

d. IG1 pressure displayed (Display 1), e.g., 4.73-3. Display 2 is blank or shows CG2 pressure (where applicable).

e. Rate-of-change indicator, ▲▼, turns on as applicable.

**Note**

If on initial turn on, the system pressure is greater than the factory-set overpressure trip point of $5 \times 10^{-3}$ Torr, the filament will automatically turn off. Reduce pressure and perform procedure again. If the functions F28 and F29 are used, the connection gauge pressures may prevent the tubes from staying on. (See paragraph 3-43).

## 3-6. OPERATING IG2 (VPCA)

a. TORR units indicator is on.

**Note**

If IG1 is on, it must be turned off before IG2 can be turned on.



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b. To apply power to IG2, depress IG2 ON/OFF. IG2 ON/OFF indicator turns on.

c. IG2 gauge indicator turns on.

d. Rate-of-change indicator, ▲▼, turns on.

e. IG2 pressure displayed in Display 2, e.g., 3.70-4. Display 1 is blank or shows CG2 pressure, or IG2 pressure (where applicable).

## 3-7. OPERATING IG1 AND IG2 WITH VPCB

Note: Electrometer B option must be installed to use this procedure.

Both IG1 and IG2 can be operated simultaneously. Display 1 provides IG1 pressure readout and Display 2 provides IG2 pressure readout. Controls and indicators active with VPCA are active with VPCB. Refer to Figure 3-2 for these controls and indicators.

## 3-8. OPERATING IG1 (VPCB)

a. TORR unit indicator is on.

b. To apply power to IG1, depress IG1 ON/OFF. IG1 ON/OFF indicator turns on.

c. IG1 gauge indicator turns on.

d. Rate-of-change indicator, ▲▼, turns on.

e. IG1 pressure displayed in Display 1, e.g., 4.73-3. Display 2 is blank or shows CG2 pressure, or IG2 pressure (where applicable).

## 3-9. OPERATING IG2 (VPCB)

a. TORR unit indicator is on.

b. To apply power to IG2, depress IG2 ON/OFF. IG2 ON/OFF indicator turns on.

Note

IG1 and associated indicators may remain on.

c. IG2 gauge indicator turns on.

d. Rate-of-change indicator, ▲▼, turns on.

e. IG2 pressure displayed in Display 2, e.g., 3.70-4.



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## 3-10. DEGASSING ION GAUGE TUBES

The VPC (A/B) is factory programmed for manual degas operation at a maximum power of 40 watts. Due to gauge biasing effects during electron bombardment, only the approximate IG pressure can be displayed while a gauge is degassing. Both gauges cannot be degassed simultaneously and the VPC prevents initiation of degas at pressures above 5 x $10^{-5}$ Torr. During the degas cycle, approximate gauge pressure, degas power and time remaining may be read by the operator (paragraph 3-34). Degas time duration (paragraph 3-32) and maximum power (paragraph 3-33) can be changed using the programmable functions and function codes. The following procedures assume that the factory default settings are programmed for these parameters.

**WARNING**

Voltages as high as 800V peak are present in the controller, on the cable, and at the IG tube during degas. If a current-worthy common ground is not present between the vacuum chamber and the controller chassis, this voltage can, under some conditions, appear between these surfaces. This can be very dangerous! Check the grounds! Always turn off the power to the controller before connecting the cable to the controller or to the IG tube. Do not operate the controller ungrounded or near water. The VPC is intended for use only in a clean, dry laboratory environment. Operation in other environments may cause damage to the controller and reduce the effectiveness of the safety features.

To degas an IG tube, proceed as follows: Figure 3-3 illustrates the controls and indicators for the degas function.

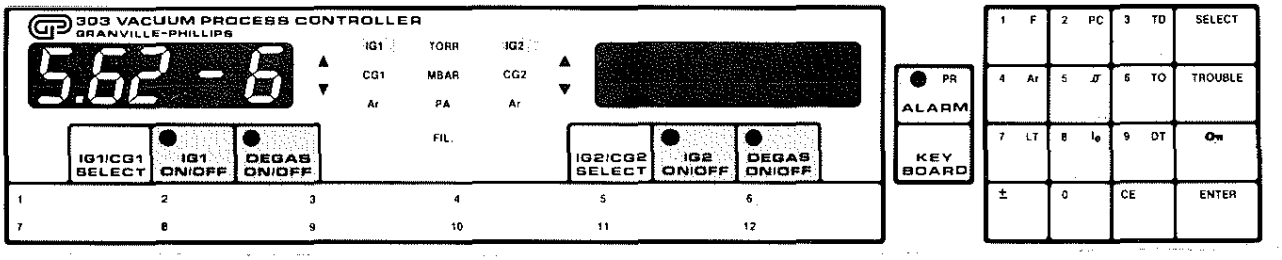



Figure 3-3. Controls and Indicators, Degas

a. To degas IG1 the tube must be on. Depress IG1 ON/OFF to apply power to the tube.

b. The appropriate IG indicators turn on.

c. After pressure stabilizes, depress DEGAS ON/OFF for IG1.

d. The DEGAS ON/OFF indicator lights and IG pressure Degas time remaining, or Degas power is shown in Display 1.



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e. Electron bombardment degas power is factory programmed to increase in the following manner:

| Time On | % Full Power |
|---|---|
| 0-15 sec | 25 |
| 15-30 sec | 50 |
| over 30 sec | 100 |

f. The approximate pressure of IG1 is displayed in Display 1. The upper pressure readout capability will be limited depending on degas power selected.

g. To stop the degas operation, depress DEGAS ON/OFF.

h. Degas power immediately drops to zero.

i. IG1 pressure is displayed in Display 1.

j. Automatically timed degas operation is described in paragraph 3-32.

k. The same procedure is used to degas IG2. Controls associated with IG2 are utilized.

In the case where the tube is extremely dirty, the 303 controller may not be able to sustain degas at the desired wattage, and the tube may turn off. In this case decrease the degas power until the 303 can sustain the degas. Then, as the tube cleans up, increase the degas power as desired.

## 3-11. REMOTE OPERATION OF IONIZATION GAUGES

The VPC is equipped to allow filament and degas control of the ionization gauges from external signals. Connector J211 on the rear panel provides both inputs to switch the ion gauge functions and relay contacts to indicate the gauge status. Refer to Paragraph 2-9 and Table 2-3 for J211 connections.

The following operational characteristics apply to the Remote Operation feature.

a. All input logic levels are 5 volt TTL compatible. They employ internal pull-up resistors to minimize the required external circuitry. Refer to Table 1-1 for specifications.

b. All inputs are active low; that is, the input must be pulled to a logic low level (or ground) to enable the function.

c. The inputs function similar to the corresponding front panel switches. That is, if a function is valid to be switched, it may be enabled from either the front panel or the Remote input. For example, the degas may only be enabled if the ion gauge is on and the pressure is less than $5 \times 10^{-5}$ Torr.

d. In order to be executed, the function must be valid when the input signal goes to logic low.

e. The inputs operate on a toggle principle; the function will switch on and off with alternate input logic low transitions.

f. Once a function is executed with the logic low signal, the input will be ignored by the VPC until it returns to a logic high state.



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g. There is a 50 millisecond debounce period for all input transitions. Thus, the input signal must remain at the high or low logic level longer than 50 milliseconds to be recognized by the VPC.

h. There is a 5 second delay after the ionization gauge is switched on before the corresponding degas input is valid. The pressure must also be less than 5 x $10^{-5}$ Torr.

i. The Remote connector J211 also provides access to relay contacts which indicate the status of the two ionization gauges. The respective relay is energized when the ionization gauge is on. Refer to Table 1-1 for relay contact ratings.

## 3-12. DISPLAYING EMISSION CURRENT

This procedure permits the display of the emission current (Ie) when the IG tubes are operating. A security code entry is not required to display emission current. The maximum emission current is factory set to 4 milliamperes. For higher pressures, the emission current is automatically reduced to various fixed levels which are less than 4 mA. The maximum emission current is programmable (refer to paragraph 3-36). To display emission current, perform the following procedure. Refer to Figure 3-4 for the applicable controls and indicators.

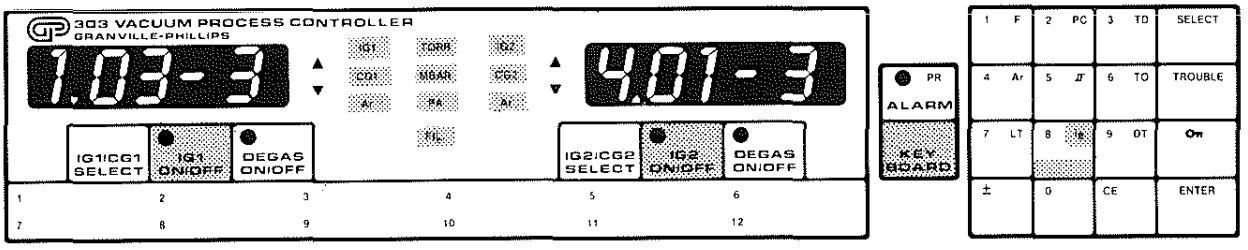



Figure 3-4. Controls and Indicators, Emission Current

a. If the IG is not on, depress the IG ON/OFF key, the appropriate IG ON/OFF indicator will light. Allow a few seconds for the IG to stabilize before reading the emission current.

b. Depress KEYBOARD switch to activate keypad. Displays 1 and 2 blank.

c. Depress Ie key on keypad. Ie indicator flashes.

d. Emission current in amps for IG1 is displayed in Display 1.

e. Emission current in amps for IG2 is displayed in Display 2.

f. To exit emission current display, depress another function key or to exit keypad, mode, depress KEYBOARD.



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## 3-13. OPERATION OF CONVECTRON GAUGES

Note: The Convectron gauge option must be installed per paragraph 2-11 to use the following procedures.

The Convectron gauges operate continuously whenever power is applied to the VPC. When the ion gauge tubes are turned off, the Convectron gauge tube pressures are displayed.

**WARNING**

303 Vacuum Process Controllers are intended for use only on vacuum systems which have suitable devices installed that will limit the pressure from external gas sources to the level the system can safely withstand and which also have suitable pressure relief valves or rupture disks installed. Confirm that these safety devices are properly installed before installing the VPC. In addition, check that (l) the proper gas cylinders are installed, (2) gas cylinder valve positions are correct on manual systems, and (3)the automation is correct on automated systems.

## 3-14. INDICATED VS. TRUE PRESSURE

**WARNING**

If used improperly, Convectron gauges can supply misleading pressure indications.These misleading pressure indications may result in dangerous overpressure conditions within the system.

Convectron gauges measure pressure by measuring the heat loss to the gas from a heated, gold-plated sensor wire maintained at a constant temperature. At low pressures, thermal conductivity cooling of the sensor is used. At high pressures, convective cooling is used.

It is important to understand that the pressure indication of a Convectron gauge depends on the gas type as well as the pressure. This follows because the amount of gas cooling at a given pressure varies from one gas type to another. Helium has a greater cooling effect than air and air has a greater cooling effect than argon.

The VPC with the Convectron gauge option is factory calibrated to read the pressure of $N_2$ directly and, when programmed, to read argon directly (refer to paragraph 3-31).

If the pressure of argon is measured with a Convectron gauge which is calibrated for air, serious errors in pressure indication will result. Conversely, if the argon calibration is used for measuring air pressure, other serious errors will result.

The pressure of other pure gases may be measured using conversion charts. To determine the true pressure of an alternative gas, the VPC must be calibrated for $N_2$ and the conversion charts, Figures 3-5 through 3-10, used to derive the true gas pressure from the indicated pressure. Table 3-2 identifies the proper conversion graph for each application.



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Table 3-2. Conversion Chart Applications

| Figure No. | Range and Units | Gases |
|---|---|---|
| 3-5 | 1 to 100 mTorr | All |
| 3-6 | 0.1 to 1000 Torr | Ar, $CO_2$, $CH_4$, Freon 12, He |
| 3-7 | 0.1 to 1000 Torr | $D_2$, Freon 22, Kr, Ne, $O_2$ |
| 3-8 | $10^{-3}$ to $10^{-1}$ mbar | All |
| 3-9 | 0.1 to 1000 mbar | Ar, $CO_2$, $CH_4$, Freon 12, He |
| 3-10 | 0.1 to 1000 mbar | $D_2$, Freon 22, Kr, Ne, $O_2$ |



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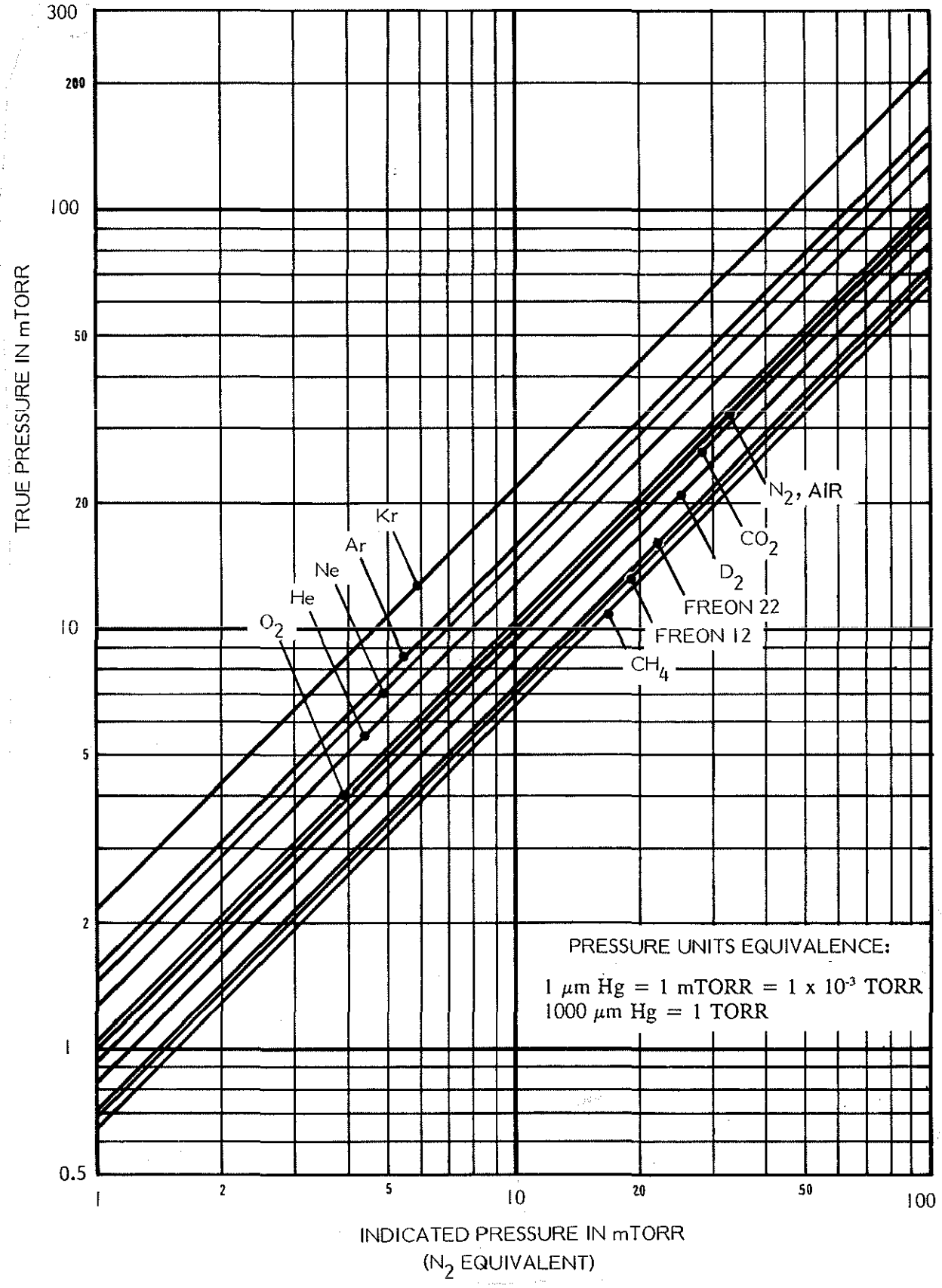



Figure 3-5. Conversion Chart 1 to 100 mTorr



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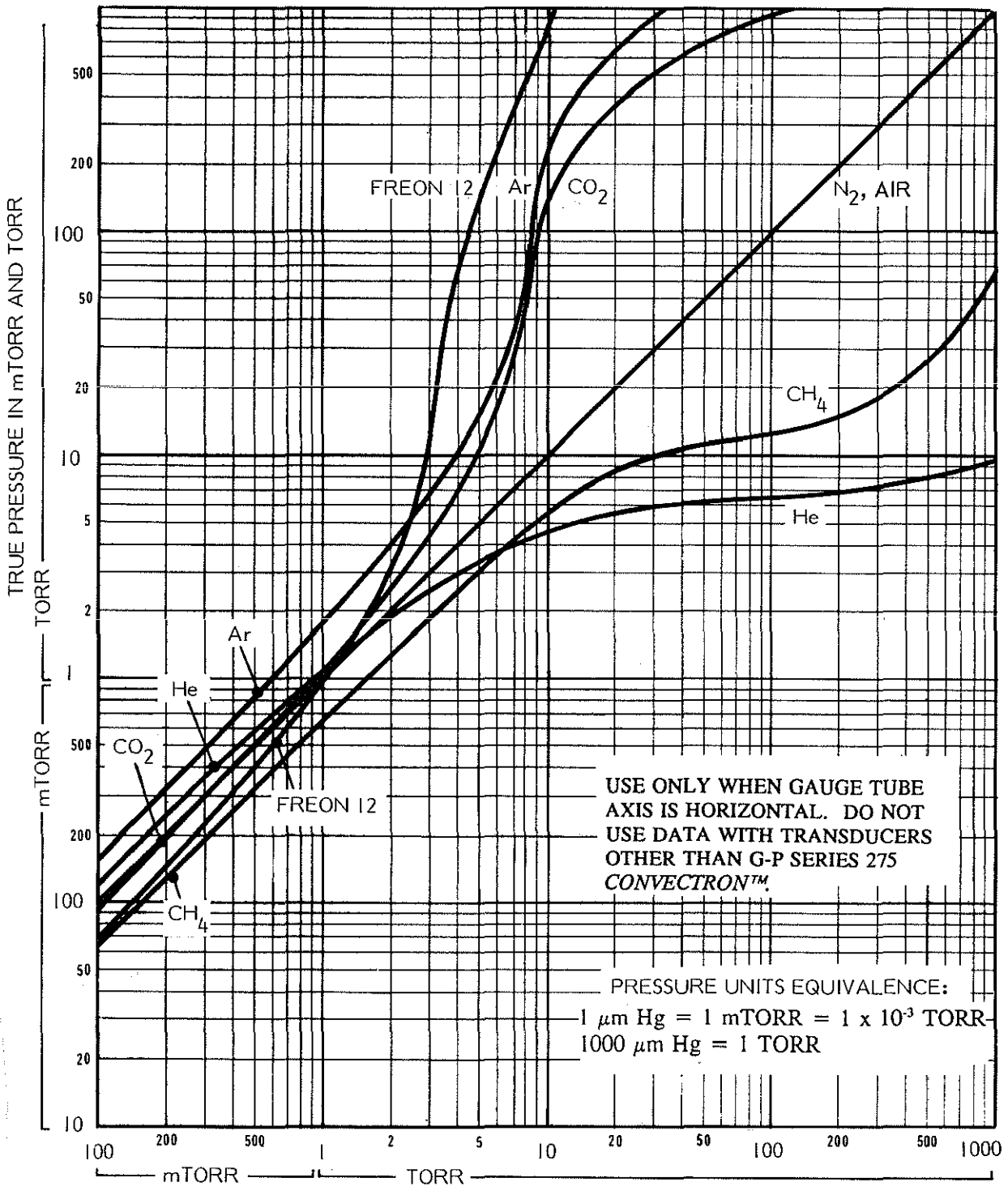



Figure 3-6. Conversion Chart 0.1 to 1000 Torr



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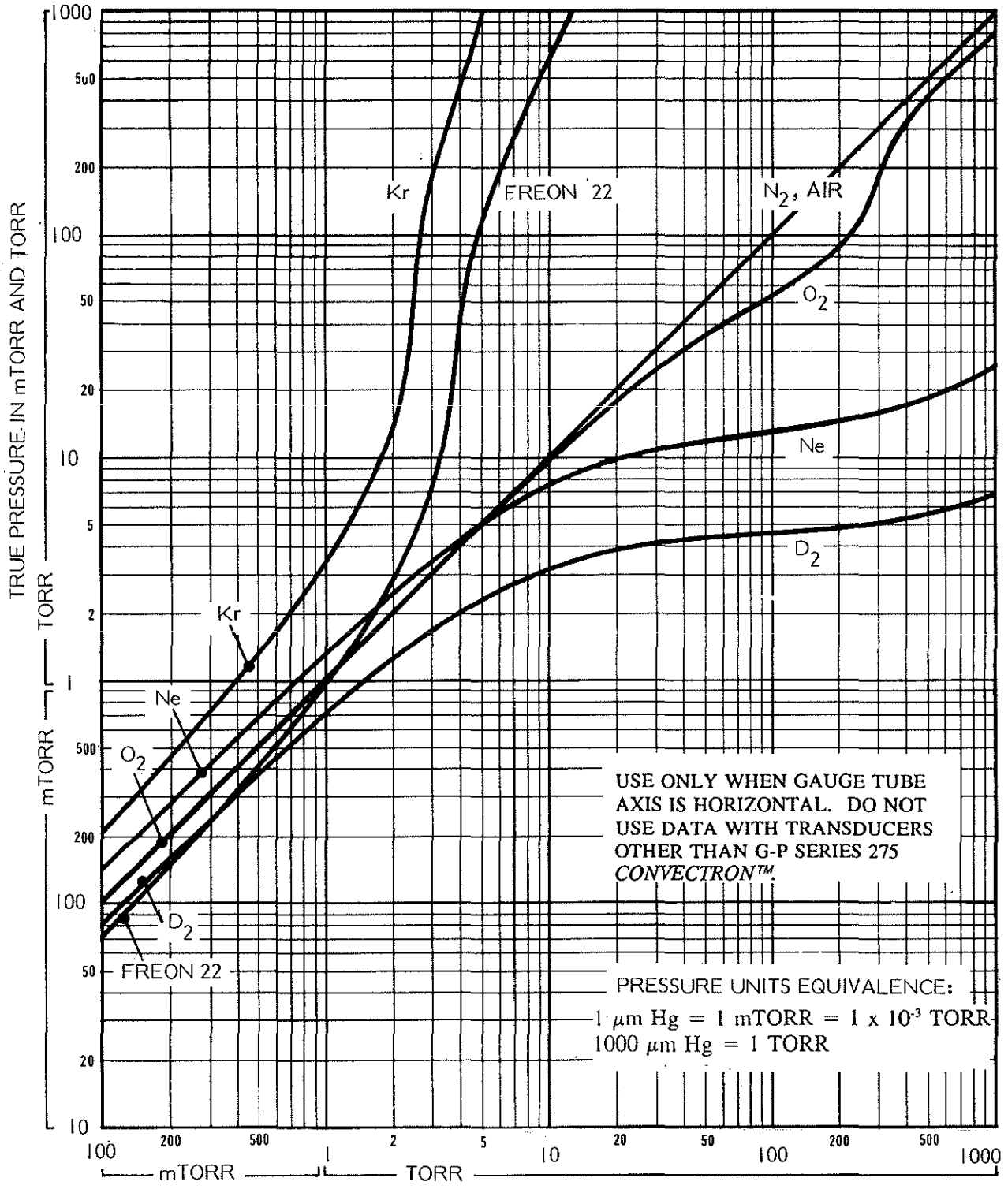



Figure 3-7. Conversion Chart 0.1 to 1000 Torr



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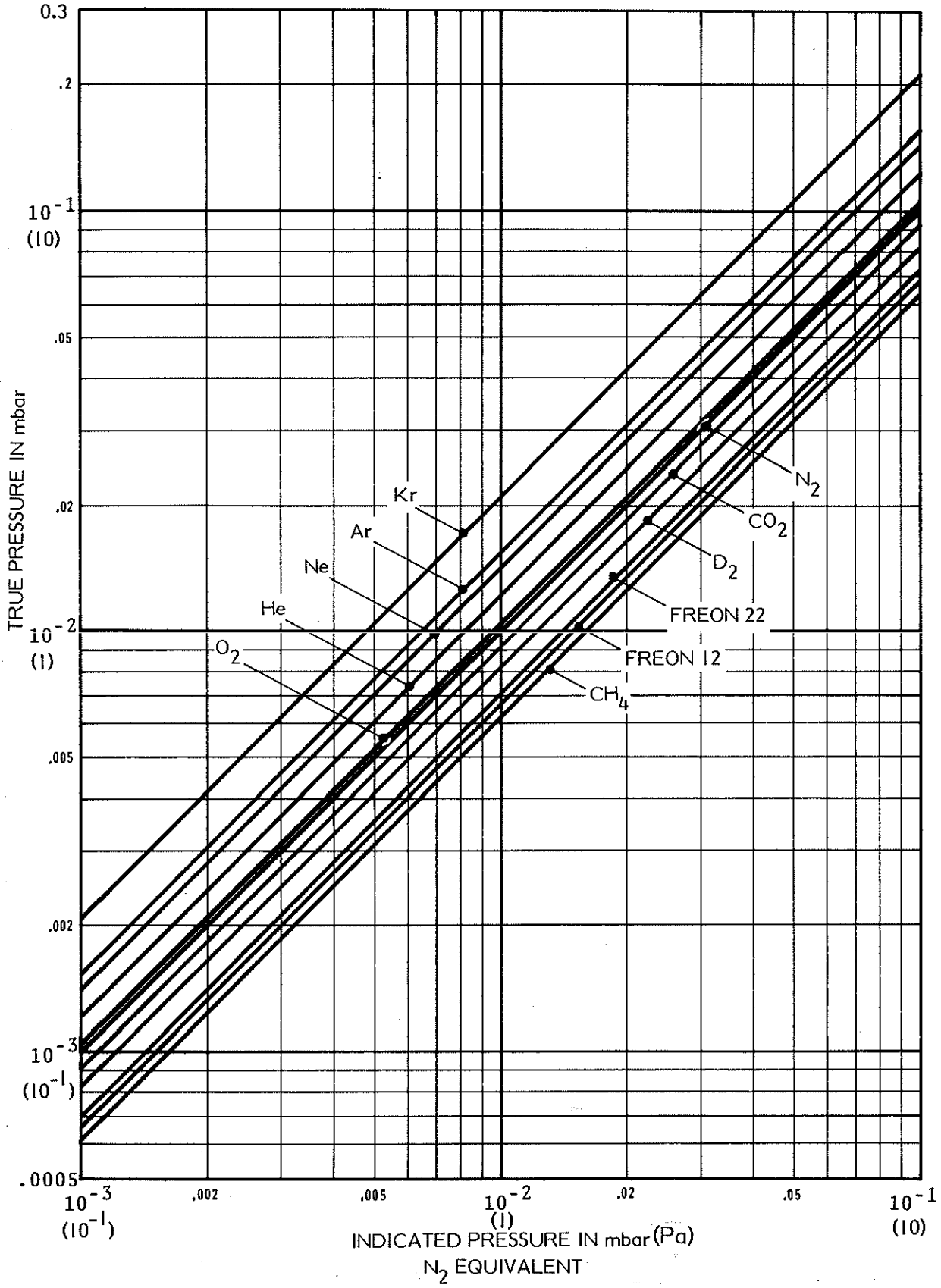



Figure 3-8. Conversion Chart $10^{-3}$ to $10^{-1}$ mbar



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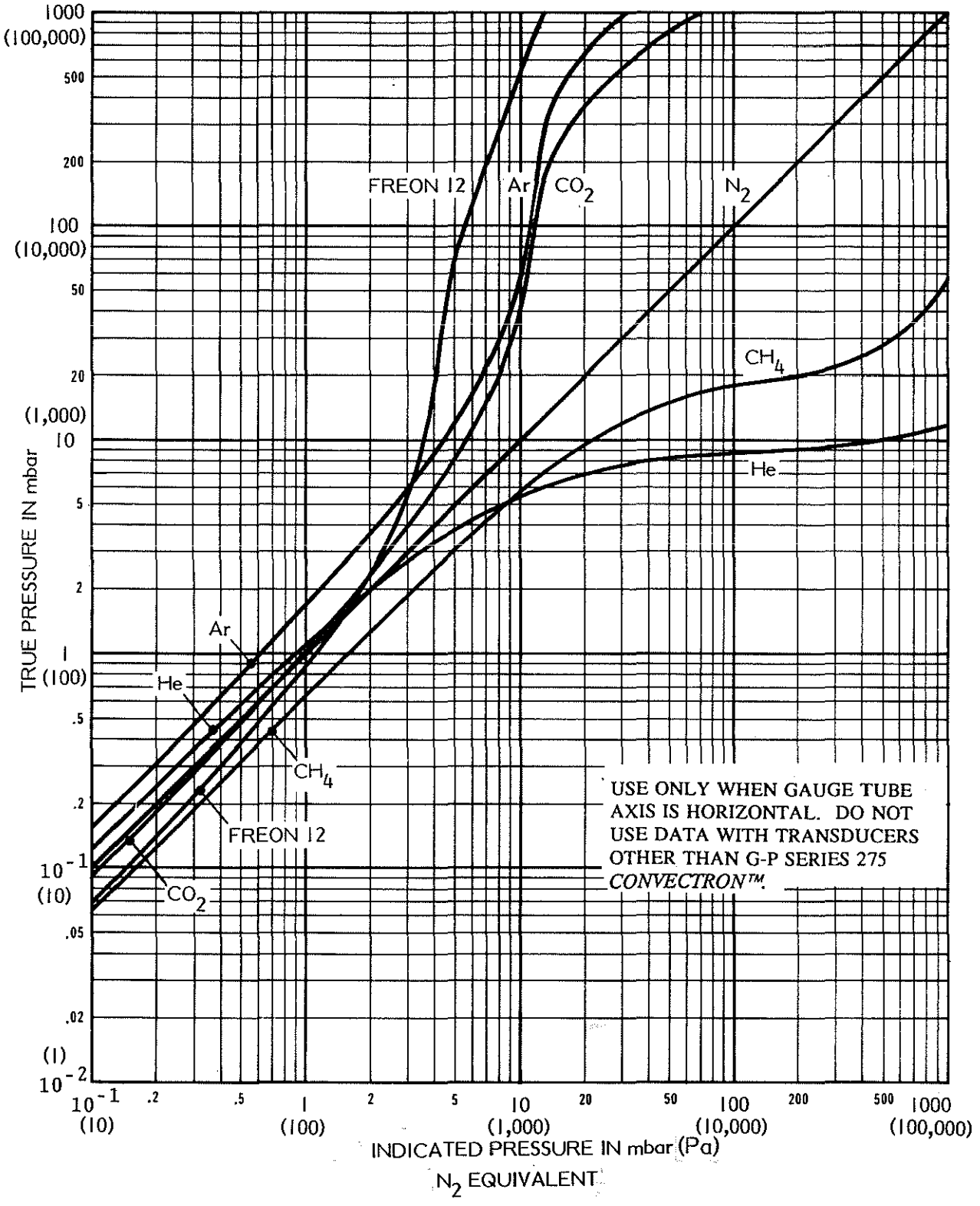



Figure 3-9. Conversion Chart 0.1 to 1000 mbar



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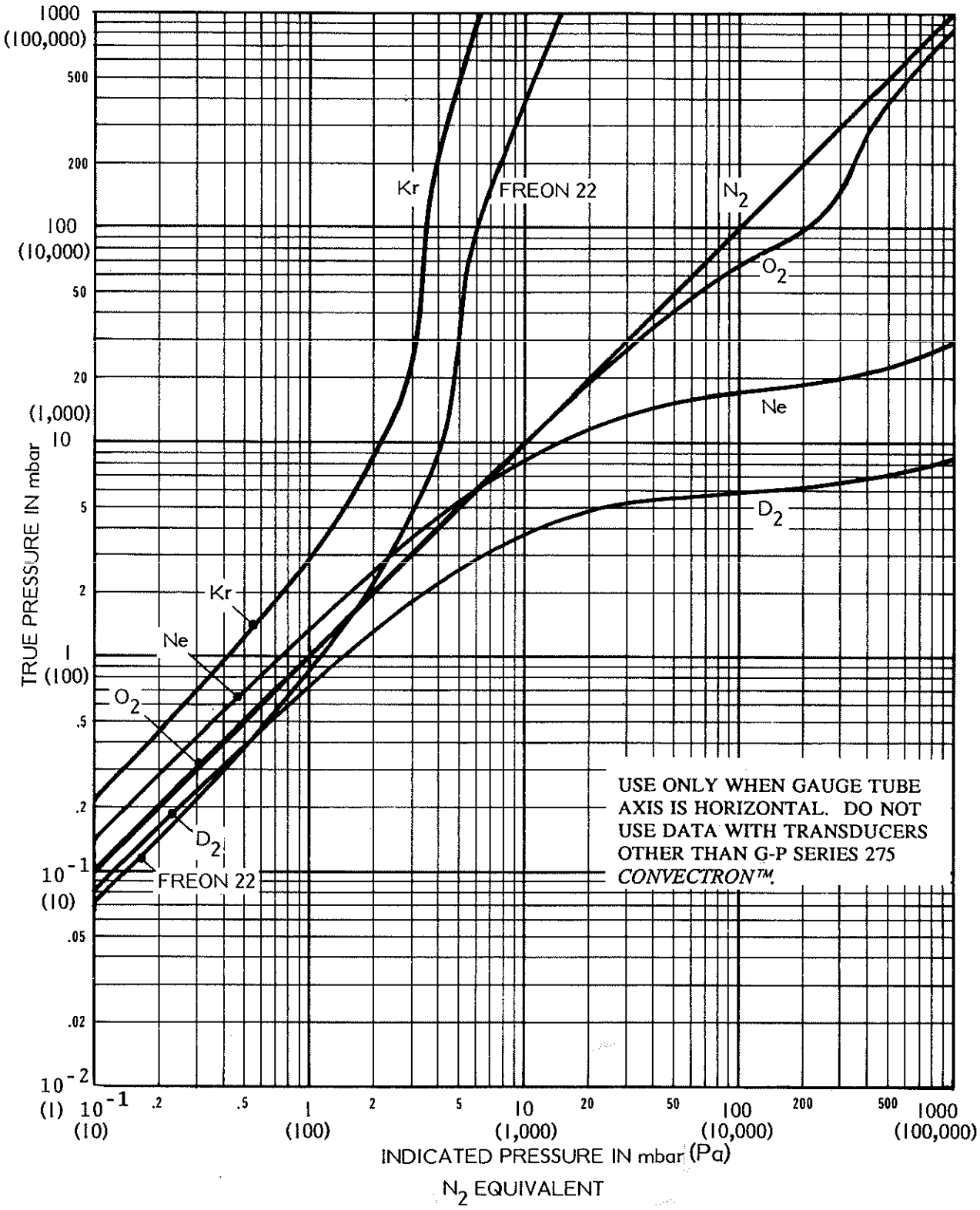



Figure 3-10. Conversion Chart 0.1 to 1000 mbar



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The following examples illustrate the interpretation of the graphs for conversion from a desired true gas pressure to an indicated $N_2$ pressure.

a. Assume that a true pressure of 20 Torr of $CO_2$ is the desired process control set point. On Figure 3-6, locate 20 Torr on the true pressure scale. Read horizontally to the right to the intersection of the 20 Torr line and the $CO_2$ curve. Reading the horizontal axis, this point is 6.5 Torr, indicated pressure ($N_2$ equivalent). Thus the correct process control setting for 20 Torr of $CO_2$ is 6.5 Torr, $N_2$ equivalent.

b. Assume that it is desired to obtain a He pressure of 100 Torr in the system. On Figure 3-6, locate 100 Torr on the true pressure scale. Read horizontally to the right to intersect the He curve. Because the intersection of the 100 Torr line and the He curve is off scale, it is apparent that a true pressure of 100 Torr of He exceeds the capability of the system and cannot be measured.

## 3-15. READING CONVECTRON GAUGES

When the VPC is in normal display mode (keyboard off) and IG1 is off, Convectron gauge 1 (CG1) pressure is shown continuously in Display 1. When IG1 is on, proceed as follows to display the CG1 pressure. Refer to Figure 3-11 for the controls and indicators used in this procedure.

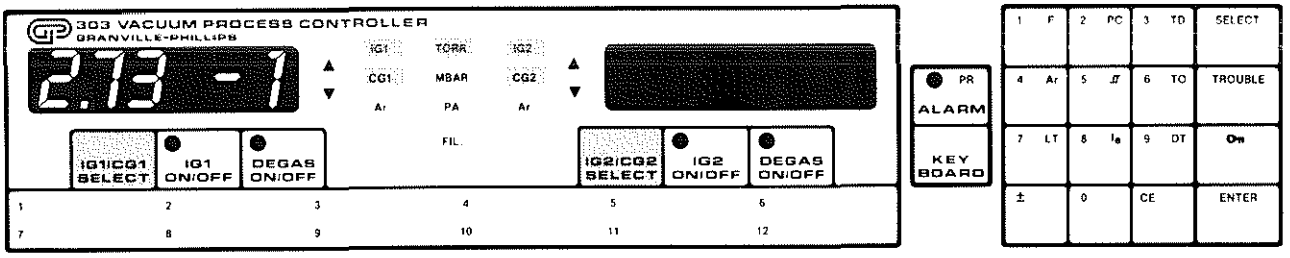



Figure 3-11. Control and Indicators, Convectron Gauge

a. Torr unit indicator is on. IG1 ON/OFF and IG1 indicators are on.

b. To display CG1 pressure, depress IG1/CG1 SELECT.

c. IG1 indicator turns off and CG1 indicator turns on.

d. CG1 pressure is shown in Display 1.

e. Successive depressions of the IG1/CG1 SELECT key alternately select IG1 then CG1.

f. The procedure for displaying CG2 is similar to that above but using controls and indicators for Display 2.

## 3-16. LEAK TESTING

This procedure permits the operator to check the vacuum system for leaks. An audible tone is provided which has a variable repetition rate which varies with the magnitude of the leak signal. It is not necessary to enter the security code to perform this test. Refer to Figure 3-12 for the controls and indicators used for this test.



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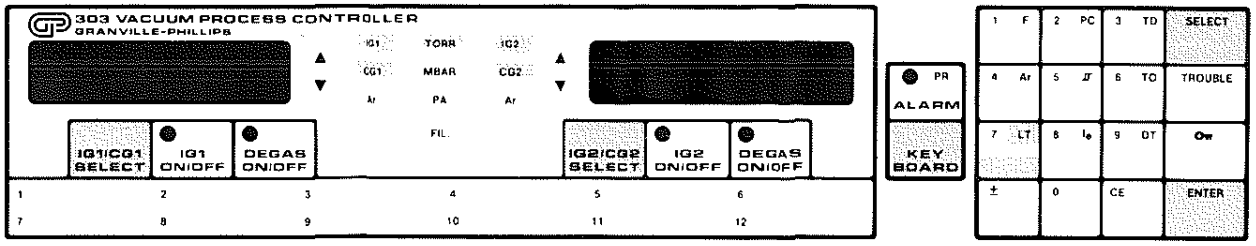



Figure 3-12. Controls and Indicators, Leak Test

a. Determine the gauge to be used for leak testing and using the appropriate IG/CG SELECT key, select that gauge to be displayed (refer to paragraph 3-15).

b. Stabilize the pressure of the selected gauge to the lowest attainable reading.

c. To enter the keypad, depress Keyboard key. Displays 1 and 2 blank.

d. Depress function key LT. The LT indicator will flash. Depress the SELECT key to choose the gauge desired for leak testing, e.g., IG1.

e. Depress ENTER key. The VPC will emit an audible tone at a constant repetition rate.

f. Probe the system with a test gas. A suitable gas has a sensitivity different than that of the system gas for the selected gauge. The sensitivity of the leak test is proportional to the difference in gas sensitivities. For example, Helium is suitable for probing leaks measured with an ionization gauge.

g. The leak is located in the probed region where the repetition rate of the audible tone is greatest.

h. To exit the leak test mode, depress any lit function key or depress KEYBOARD key to exit the keyboard mode.

i. Turning on or off the ion gauge or degas mode will invalidate test and cause the VPC to exit the leak test mode.



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## 3-17. PROGRAMMING THE VPC

The VPC is designed to be easily and rapidly programmed. The programming steps are listed in the following paragraphs. The general programming concepts which are utilized are as follows:

a. The programming mode is either activated or deactivated by depressing the KEYBOARD key.

b. Only the required function names or numbers are illuminated when the programming mode is activated. If the next programming step is to enter a function, only the function indicators are on. If the next programming step is to enter a numerical value, only the numbers on the keyboard will be illuminated.

c. Depress ENTER after a numeric entry to store the value in the nonvolatile memory.

d. If the security key is red, depress the security key, key in the security code and depress ENTER. Security status is irrelevant if it is only desired to read programmed settings without changing them.

e. Enter pressures in calculator notation. The decimal point is automatically entered after the first significant figure, e.g., $3.73 \times 10^{-5}$ is entered as 373-5 and displayed as 3.73-5.

f. Operating pressures are not displayed while in the keyboard mode.

## 3-18. DISPLAYING MEMORY CONTENTS

When security is on (security key red), programmed parameters can be displayed by following the steps listed in the applicable procedure to display programmed parameter.

When security is off (security key is green), programmed parameters can be displayed without alteration. Follow the steps to program a function and after viewing the data, press ENTER. If you begin to program data and then decide not to change it, press CE for Clear Entry followed by ENTER in order not to change programmed parameter. At any point, the KEYBOARD key can be pressed and programmed parameters will not be changed.

## 3-19. PROGRAMMABLE FUNCTIONS

Table 3-3 lists the VPC functions which can be programmed by the operator. The programming key codes, description of parameters, keystrokes required, Display 1 & 2 displays along with notes on each function are on one sheet for user convenience. All functions that have programmed factory defaults are secured functions.



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Table 3-3. List of Functions

| Function | Description of parameter | Keystrokes | Disp 1 | Disp 2 | Page # | Notes (FACTORY DEFAULT) |
|---|---|---|---|---|---|---|
| F0 | RESTORE FACTORY DEFAULTS | (F, 0, ENT) | 0 | BLANK | 3-66 | 5 SEC RED KEY |
| F1 | ANA. OPTION 1, OUTPUT 1 | (F, 1, ENT) (SEL, ENT) | 1 | BLANK | 3-63 | NOW ASSOC TO CH 1 (IG1) |
| F2 | ANA. OPTION 1, OUTPUT 2 | (F, 2, ENT) (SEL, ENT) | 2 | BLANK | 3-63 | NOW ASSOC TO CH 2 (IG2) |
| F3 | ANA. OPTION 2, OUTPUT 1 | (F, 3, ENT) (SEL, ENT) | 3 | BLANK | 3-63 | NOW ASSOC TO CH 1 (IG1) |
| F4 | ANA. OPTION 2, OUTPUT 2 | (F, 4, ENT) (SEL, ENT) | 4 | BLANK | 3-63 | NOW ASSOC TO CH 2 (IG2) |
| F5 | BCD OPTION 1 | (F, 5, ENT) (SEL, ENT) | 5 | BLANK | 3-60 | BCD ASSOC TO CH 1 (IG1) |
| F6 | BCD OPTION 2 | (F, 6, ENT) (SEL, ENT) | 6 | BLANK | 3-60 | BCD ASSOC TO CH 2 (IG2) |
| F7 | DEGAS, MAXIMUM POWER | (F, 7, ENT) (SEL, WATTS, ENT) | 7 | DEGAS, WATTS | 3-41 | 5 WATT INCREMENTS (40W) |
| F8 | DEGAS, DISPLAY PRESSURE | (F, 8, ENT) | 8 | BLANK | 3-43 | (ON) |
| F9 | DEGAS, DISPLAY TIME REMAINING | (F, 9, ENT) | 9 | BLANK | 3-43 | TIME REMAINING MIN. (OFF) |
| F10 | DEGAS, DISPLAY POWER | (F, 10, ENT) | 10 | BLANK | 3-43 | POWER,(OFF) |
| F11 | DISPLAY 2 OR 3 DIGITS | (F, 11, ENT) (2 or 3, ENT) | 11 | 2 OR 3 | 3-44 | BOTH DISPLAYS PRG'D (3) |
| F12 | MAXIMUM EMISSION CURRENT | (F, 12, ENT, SEL) (x[Ie], ENT) | 12 | Ie in mA | 3-45 | .01-.04, .1-.4, 1, 2, 4, 10 (4mA) |
| F13 | FILAMENT, AUTO ON ENABLE | (F, 13, ENT) (F, 13, SEL, ENT) | 13 | BLANK | 3-49 | IG1 OR IG2 OR NONE (OFF) |
| F14 | FILAMENT, AUTO ON PRESSURE | (F, 14, ENT) (SEL, 1-999[X-3], ENT) | 14 | PRESSURE | 3-50 | IG1 OR IG2 OR NONE ($3x10^{-3}$T) |
| F15 | OVERPRESSURE TRIP POINT | (F, 15, ENT) | 15 | PRESSURE | 3-51 | IG1 OR IG2 OR NONE ($5x10^{-3}$T) |
| F16 | OVERPRESSURE TIME DELAY | (F, 16, ENT, SEL) (TIME ENT) | 16 | TIME DELAY | 3-52 | .0-9.5 IN .5 SEC INCRE. (0 SEC) |
| F17 | RATE OF CHANGE UP SLOW | (F, 17, ENT) (NEW %, ENT) | 17 | % RATE CHG. | 3-55 | 1-999% IN 1% INCRE. (50%) |
| F18 | RATE OF CHANGE UP FAST | (F, 18, ENT) (NEW %, ENT) | 18 | % RATE CHG. | 3-55 | 1-999% IN 1% INCRE. (500%) |
| F19 | RATE OF CHANGE DOWN SLOW | (F, 19, ENT) (NEW %, ENT) | 19 | % RATE CHG. | 3-55 | 1-999% IN 1% INCRE.. (5%) |
| F20 | RATE OF CHANGE DOWN FAST | (F, 20, ENT) (NEW %, ENT) | 20 | % RATE CHG. | 3-55 | 1-999% IN 1% INCRE. (50%) |
| F21 | SENSITIVITY | (F, 21, ENT, SEL) (NEW SENS. ENT) | 21 | SENSITIVITY | 3-57 | .1-99.9/TORR (10/TORR) |
| F22 | TEST LAMPS | (F, 22, ENT) | 22 | - - - | 5-2 | ALL LAMPS OUT |
| F23 | TEST RAM | (F, 23, ENT) | 23 | BLANK | 5-3 | REVERTS TO KEYBOARD |
| F24 | UNITS, TORR | (F, 24, ENT) | 24 | BLANK | 3-59 | (ON) |
| F25 | UNITS, MBAR | (F, 25, ENT) | 25 | BLANK | 3-59 | (OFF) |
| F26 | UNITS, PASCAL | (F, 26, ENT) | 26 | BLANK | 3-59 | (OFF) |
| F27 | ZERO CONVECTRON AT VACUUM | (F, 27, ENT) (SEL, ENT) | 27 | BLANK | 5-11 | PUMP DOWN AND ZERO (YES) |
| F28 | FILAMENT AUTO OFF ENABLE CG 1 | (F, 28, ENT) (SEL, ENT) | 28 | BLANK | 3-54 | IG1, IG2, NONE, BOTH (NONE) |
| F29 | FILAMENT AUTO OFF ENABLE CG 2 | (F, 29, ENT) (SEL, ENT) | 29 | BLANK | 3-54 | IG1, IG2, NONE, BOTH (NONE) |
| F30 | RTS NORMAL | (F, 30, ENT) | 30 | BLANK | 3-67 | RS-232 MODEM STANDARD (ON) |
| F31 | RTS INVERTED | (F, 31, ENT) | 31 | BLANK | 3-67 | INVERTED FROM STNDRD (OFF) |
| F32 | PROCESS PAUSE | (F, 32, ENT) | 32 | BLANK | 3-32 | ALL CH, PAUSE |
| F33 | PROCESS PAUSE/RESET | (F, 33, ENT) | 33 | BLANK | 3-32 | ORIGINAL TIMING REMAINS |
| F34 | PROCESS RESTART | (F, 34, ENT) | 34 | BLANK | 3-33 | POWER-UP TIMING RESTART |
| F35 | DISPLAY PRESSURE DURING OVERRIDE | (F, 35, ENT) | 35 | BLANK | 3-34 | WON'T SHOW ALL RANGES |
| F36 | FIX EMISSION | (F, 36, ENT) | 36 | BLANK | 3-46 | (OFF) |
| F37 | RETURN RANGING EMISSION | (F, 37, ENT) | 37 | BLANK | 3-48 | (ON) |
| F41-52 | PC ON/OFF TOGGLE | (F, N[PC], ENT) | N(PC) | BLANK | 3-35 | REPEAT TO TOGGLE CHANNEL |
| F71-82 | PC RESUME AUTOMATIC | (F, N[PC], ENT) | N(PC) | BLANK | 3-36 | |
| PC | PC SETPOINT SETUP | (PC, CH#, ENT) (P.Set PNT, ALARM, SEL, ENT) | CH | PRESS. SET. PNT. | 3-26 | 0-999 TORR, ALM, ANY GAUGE (IG1, 000, NO ALM) |
| TD | PC TIME DELAY | (TD, CH#, ENT) (X[SEC], ENT) | CH | SEC DELAY | 3-29 | 0-999 SECS (0 SEC.) |
| TO | PC TIME OUT (ENABLED TIME) | (TO, CH#, ENT) (X[MIN], ENT) | CH | MIN DELAY | 3-30 | 0-999 MINS (0 MIN.) |
| LT | LEAK TEST | (LT, SEL, ENT) | (PRESSURE) | | 3-19 | PROBE W/TEST GAS |
| Ie | EMISSION CURRENT | (Ie) | Ie | Ie | 3-10 | |
| DT | DEGAS TIME | (DT, SEL, X[MIN], ENT) | X | MINS | 3-39 | 0-999 MINS (0 MIN.) |
| ⌰ | PC HYSTERESIS | (⌰, CH #, ENT %[1-999], ENT) | CH | PC HYST. % | 3-31 | 1-999% (10%) |
| F64-F91 | SOFTWARE REVISION LEVEL | (F, 64, ENT, F, 91, ENT) | F64, F91 | Rev. # | 5-15 | SOFTWARE REV. LEVEL |



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## 3-20. PROCESS CONTROL PROGRAMMING

Each process control relay channel installed can be programmed for various pressure and time parameters. The four states of process control activity are listed and defined in Table 3-4. The table also shows the status of each process channel indicator for each process control state. Table 3-5 lists the six parameters which can be programmed for each process control channel. The parameters are defined and are referenced to the appropriate paragraph for programming instructions

**WARNING**

It is the installers responsibility to ensure that the automatic signals provided by the process control option are always used in a safe manner. To help ensure safety of personnel and equipment, and to provide for manual operation and maintenance of the equipment, switches must be installed such that all equipment subject to automatic process control can be operated manually as well. Figure 2-6 illustrates a typical connection.

Carefully check manual operation of the system and the programming before switching to automatic operation. Where an equipment malfunction could cause a hazardous situation, always provide for fail-safe operation. As an example, in an automatic backfill operation where a malfunction might cause high internal pressures, provide an appropriate pressure relief device



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Table 3-4. Process Control State Definitions

| Process Control States | Definition | Front Panel PC Channel Indicators |
|---|---|---|
| Disabled | Pressure is above set point or optional external input signal is absent. Process control activity cannot start. | Off |
| Manually Disabled/ Paused | Manual override function (F41-F52) or Pause function (F32-F33) has been used to set Process Relay(s) to OFF. It can be returned to automatic operation through use of F71-F82 or F34. | Flashing (1/2 sec. on every 2 sec.) |
| Enabled | Pressure is below set point and optional external enable signal is present. This condition is required for time delay to start and for relay activation. | Flashing |
| Manually Activated/ Paused | Manual override function (F41-F52) or Pause function (F32-F33) has been used to set Process Relay(s) to ON. It can be returned to automatic operation through use of F71-F82 or F34. | Flashing (1/2 sec. off every 2 sec.) |
| Activated | Process control relay is activated. | On |
| Terminated | Time out is complete and relay is deactivated. Channel is not, however, disabled. (It must be disabled before it can again be enabled.) | Off |



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Table 3-5. Process Control Programming

| Programmed Parameter | Definition | Programming Instructions | Factory Setting |
|---|---|---|---|
| Gauge assignment | Pressure gauge which enables the process control. | Paragraph 3-21 | IG1 |
| Pressure set | The value below which the pressure point must decrease to enable the process control channel. | Paragraph 3-21 | 0 |
| Alarm | Sets the audible alarm to sound when the process control channel is activated. | Paragraph 3-21 | Off |
| Time delay (TD) | Seconds of delay from the time a channel is enabled until it is activated. | Paragraph 3-22 | 0 |
| Time out (TO) | Minutes that a channel will be activated if it remains enabled. | Paragraph 3-23 | 0 = (Infinite) |
| Hysteresis | The percentage increase in pressure above the pressure set point that must be reached before the channel will be disabled. | Paragraph 3-24 | 10% |
| Manual operation | Allows user to put Relay and Channel to a known ON or OFF state for Manual Operator Control. | Paragraph 3-25 | N/A |
| Paused operation | Puts a pause on all timer values and relay states to allow for operator intervention into the automatic sequence. | Paragraph 3-28 | N/A |

The following will be helpful in designing the process control programs.

a. It is most helpful to develop a specification table which lists the proposed pressure setting, time delay, time out, hysteresis, and alarm settings for each process control channel. Refer to Figure 3-13 for a typical process control specification table.

b. In order for a relay to be activated (energized), the process control channel must be enabled. Once enabled, the time delay period which was programmed starts, and the relay is activated at the end of the time delay period.



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c. In order for a channel to be enabled, the pressure must be below the set point. If the external enable option is installed, the input line for that channel must be held low (refer to paragraph 3-30).

d. A process control assigned to an ionization gauge will not be enabled during degas or for approximately 15 seconds after degas. If enabled prior to degas, but not yet activated because of time delay, the relay will activate after the time delay is over, even if degas has been turned on.

e. If a channel is disabled for any reason, the time delay will be reset when the channel is re-enabled.

f. Once activated, a relay will remain activated for its programmed time duration (time out) as long as it remains enabled.

g. If time out occurs or if the external enable input is removed, including during degas, the relay will deactivate.

h. Once a time delay or time out has started, it cannot be changed by reprogramming except as in paragraphs i and j.

i. If the time delay is programmed to a value of zero while a time delay is in progress, the process control channel will immediately become activated.

j. If a function code 0 is programmed (refer to paragraph 3-45) at any time, all process control parameters will immediately return to their factory settings (refer to Table 3-5). This will cause all process controls to become disabled.

## 3-21. DISPLAYING AND SETTING PROCESS CONTROL PRESSURE SET POINTS AND ALARM

Note: Process control option(s) must be installed per paragraph 2-17 to use this procedure.

This procedure permits the operator to display and program the process control pressure set point, gauge selection and alarm function (refer to Table 3-5 for definitions). The valid range of inputs for a pressure set point is the pressure range of the selected gauge. The VPC is factory programmed so that all set points are zero, the gauge selected is IG1, and the alarm is off.



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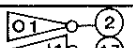
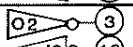
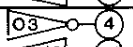
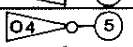
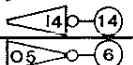
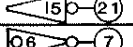
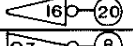
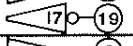
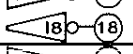
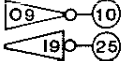
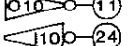
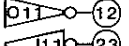
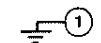
| PROCESS CONTROL PROGRAMMING LOG | | | | | | | |
|---|---|---|---|---|---|---|---|
| CHANNEL | GAUGE | PRESSURE | HYSTERESIS % | TD SECONDS | TO MINUTES | ALARM ( ✓ ) | EXTERNAL ENABLE WIRING |
| 1 | IG1 | 5e-7 | | | | |  |
| 2 | IG2 | 5e-7 | | | | |  |
| 3 | IG2 | 5e-7 | | | | |  |
| 4 | | | | | | |  |
| 5 | | | | | | |  |
| 6 | | | | | | |  |
| 7 | | | | | | |  |
| 8 | | | | | | |  |
| 9 | | | | | | |  |
| 10 | | | | | | |  |
| 11 | | | | | | |  |
| 12 | | | | | | |  |
| | | | | | | |  |

Figure 3-13. Process Control Specification Table

It should be noted that when function code 0 is programmed (refer to paragraph 3-49), the process controls will immediately return to their factory programmed state, disabled.

Assume for this procedure that IG2 is to be the selected gauge to operate process control relay 3 when the pressure falls below $3.70 \times 10^{-5}$ Torr. Also, that the alarm is to sound. Refer to Figure 3-13 for the applicable controls and indicators.

**Note**

This is a secured function. Security key must be green to make any changes to program parameters. Refer to paragraph 3-17.

Refer to Figure 3-14 for the controls and indicators utilized in this procedure.



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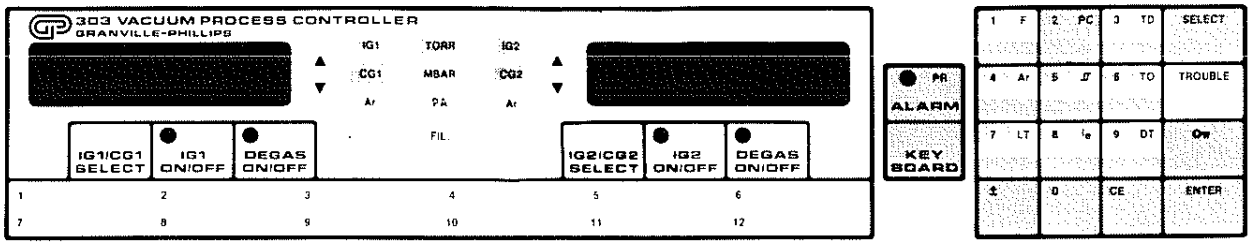



Figure 3-14. Controls and Indicators, Process Control Pressure Set Points

a. Depress KEYBOARD key to activate keypad. Displays 1 and 2 blank.
On keypad, depress PC key. PC indicator flashes.
Numerals are lit on keypad.

b. Key in 3 for process control channel 3.

c. Depress ENTER key.
Display 1 - PC channel selected - 3.
Display 2 - The existing pressure set point is displayed for process control channel 3.
Gauge indicator - Indicates the gauge assigned to process control channel 3.
Units indicator - Torr indicator is lit. If another unit indicator is lit, refer to paragraph 3-46 to change units if desired.
ALARM indicator - Lights red if alarm function is programmed to process control channel selected. PR, alarm program indicator, is lit.
Keypad - Functions are displayed.

Note

At this time the existing pressure control set point for process control channel 3, the gauge assigned, and alarm function is displayed. If this information is all that is desired, press ENTER and, to exit the keypad, press KEYBOARD key. To change parameters, continue with procedure.

d. Depress SELECT key repeatedly until the desired gauge tube indicator, IG2, is lit. Any number of process control channels may be assigned to the same gauge.

e. If the ALARM indicator is off, press ALARM key. ALARM indicator turns on.

f. Key in new pressure set point for process control channel 3 ($370 - 5 = 3.70 \times 10^{-5}$).
Depress ENTER.
Display 1 - Channel selected - 3.
Display 2 - New pressure set point, 3.70-5
Units indicator - Torr.
Gauge indicator - Selected gauge IG2.
ALARM indicator - On.
Keypad - Functions are displayed.

g. Depress KEYBOARD key to exit keypad.

A set point pressure of 999 Torr with a gauge assignment of CG1 causes the channel to be continuously enabled subject to the external enable status (refer to paragraph 3-30).



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## 3-22. DISPLAYING AND SETTING PROCESS CONTROL TIME DELAY (TD)

Note: Process control option(s) must be installed per paragraph 2-17 to use this procedure.

This procedure permits the operator to display and program the process control time delay (TD). This is the number of seconds between the process control being enabled until it is activated. Delays from 0 to 999 seconds may be programmed. The VPC is factory programmed to a time delay of zero.

It should be noted that when function code 0 is programmed (refer to paragraph 3-49), the process controls will immediately return to their factory programmed state, disabled. If the time delay is programmed to a value of zero while the delay is in process, the process control will immediately be activated.

**Note**

This is a secured function. Security key must be green to make any changes to program parameters. Refer to paragraph 3-17.

Refer to Figure 3-15 for the controls and indicators utilized in this procedure.

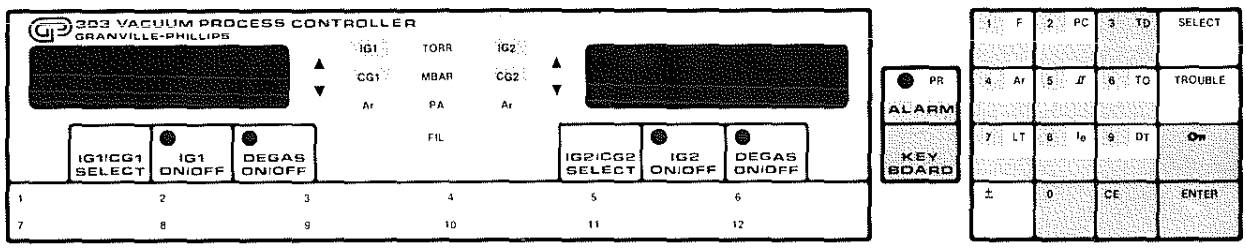



Figure 3-15. Controls and Indicators, Time Delay

a. Depress KEYBOARD key to activate keypad. Displays 1 and 2 blank. On keypad, depress TD key. TD indicator flashes. Keypad - Numerals displayed.

b. Key in process control channel desired, e.g., 3, and depress ENTER.
Display 1 - Displays process control channel selected - 3.
Display 2 - Current time delay in seconds.
Gauge indicator - Gauge currently assigned to PC channel 3 - IG2.
ALARM indicator - lit if alarm is programmed.
Keypad- Numerals are displayed.

**Note**

At this time the time delay currently programmed for PC channel 3 is displayed. If this information is all that is desired, press ENTER key, and to exit the keypad, press KEYBOARD key. To change parameters, continue with procedure.

c. Key in the new time delay as the number of seconds (0 to 999) that must elapse after the channel is enabled before the PC channel is activated, e.g., 100 sec.



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d. Depress ENTER
Display 1 - PC channel - 3.
Display 2 - New time delay setting - 100 sec. for PC channel 3.
Gauge indicator - gauge assigned to PC channel 3 - IG2.
ALARM indicator - lit if alarm is programmed.
Keypad - Functions are displayed.

e. Depress KEYBOARD key to exit keypad.

## 3-23. DISPLAYING AND SETTING PROCESS CONTROL TIME OUT (TO).

**Note**

Process control option(s) must be installed per paragraph 2-17 to use this procedure.

This procedure permits the operator to display and program the process control time out (TO). This is the length of time that a process control will be activated provided it remains enabled. A time out of 1 to 999 minutes can be programmed with a value of zero causing the process control to be activated as long as it is enabled. The VPC is factory programmed to a time out value of zero.

It should be noted that when function code 0 is programmed (refer to paragraph 3-41), the process controls will immediately return to their factory programmed state, disabled.

**Note**

This is a secured function. Security key must be green to make any changes to program parameters. Refer to paragraph 3-17.

Refer to Figure 3-16 for the controls and indicators utilized in this procedure.

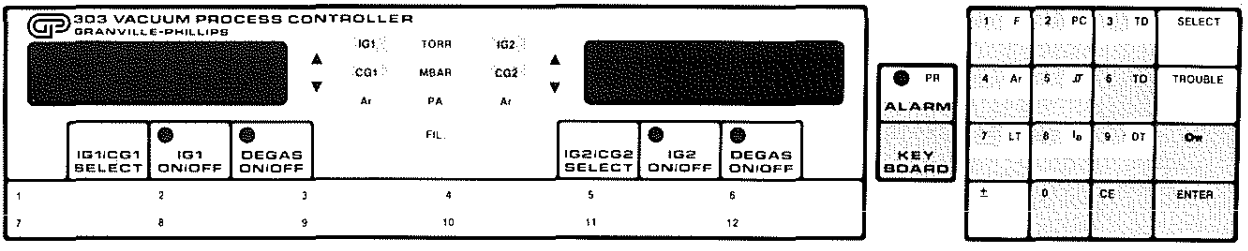



Figure 3-16. Controls and Indicators, Time Out

a. Depress KEYBOARD key to activate keypad. Displays 1 and 2 blank.
On keypad, depress TO key. TO indicator flashes.
Keypad - Numbers are displayed.

b. Key in process control channel desired, e.g., 3. Depress ENTER.

c. Display 1 - PC channel - 3.
Display 2 - Current setting of time out.
Gauge indicator - Gauge assigned to PC channel 3, e.g., IG2.
ALARM indicator - lit if alarm is programmed.



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**Note**

At this time the TO currently programmed for PC channel 3 is displayed. If this information is all that is desired, press ENTER key, and to exit the keypad, press KEYBOARD key. To change the TO parameter, continue with procedure.

d. Key in new TO time in minutes, e.g., 30, and press ENTER key.
Display 1 - PC channel- 3.
Display 2 - New time out setting - 30.
Gauge indicator - IG2.
ALARM indicator -lit if alarm is programmed.
Keypad - Functions are displayed.

e. Depress KEYBOARD key to exit keypad.

## 3-24. DISPLAYING AND SETTING PROCESS CONTROL HYSTERESIS

This procedure permits the operator to display and program the hysteresis value for a specified process control channel. Hysteresis is the percentage increase in pressure that must be reached before the process control will be disabled. Hysteresis is useful to prevent a process control relay from being disabled on a small pressure rise. Percentages from 0 to 999% can be programmed. The VPC is factory programmed to 10% hysteresis. It should be noted that when function code 0 is programmed (refer to paragraph 3-49), the process controls will immediately return to their factory programmed state, disabled.

**Note**

This is a secured function. Security key must be green to make any changes to program parameters. Refer to paragraph 3-17.

Refer to Figure 3-17 for the controls and indicators utilized in this procedure.

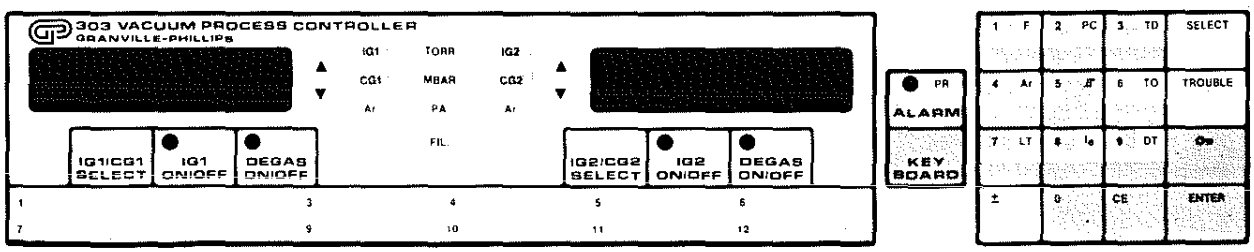



Figure 3-17. Controls and Indicators, Hysteresis

a. Depress KEYBOARD Key to activate keypad. Displays 1 and 2 blank.
On keypad, depressing ⧸⧹ key. ⧸⧹ indicator flashes.
Keypad - Numbers are displayed.

b. Key in process control channel desired, e.g., 3.



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c. Depress ENTER key.
Display 1 - PC channel- 3.
Display 2 - Current hysteresis setting.
Gauge indicator - Gauge assigned to PC channel 3, e.g., IG2.
ALARM indicator - lit if alarm is programmed.
Keypad- Numbers are displayed.

**Note**

At this time the hysteresis setting currently programmed for PC channel 3 is displayed. If this information is all that is desired, press ENTER key, and to exit keypad, press KEYBOARD key. To change the hysteresis setting, continue with procedure.

d. Key in desired hysteresis setting as the percentage of set point pressure, e.g., 20%.

e. Depress ENTER key.
Display 1 - PC channel - 3.
Display 2 - New hysteresis setting, e.g., 20 (%).
Gauge indicator - Gauge assigned to PC channel 3, e.g., IG2.
ALARM indicator - lit if alarm is programmed.
Keyboard - Functions are displayed.

f. Depress KEYBOARD key to exit keypad.

A programmed hysteresis of 100% will allow the pressure to rise to twice the set point value before the process control is disabled. A hysteresis of 999% will allow a full decade of pressure increase above the set point.

## 3-25. ENABLING PAUSE OF PROCESS CONTROL CHANNELS

Functions F32-F34 allow the process control channels to be paused, reset and restarted. F35 allows monitoring pressures in Keyboard mode during manual override. Functions F41-F52 allow PC channels 1-12 to be manually toggled. Functions F71-F82 allow PC channels 1-12 to return to automatic mode.

F32 leaves all PC channels in their present state and F33 resets all PC channels to their power-up state. Putting the PC channels into a paused state with timing stopped or reset allows manual manipulation of the PC channels.

**Note**

This is a secured function. The security key must be green to make any change in the state of the process control operation. Refer to paragraph 3-17.



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Refer to figure 3-18 for the controls and indicators used for this procedure.

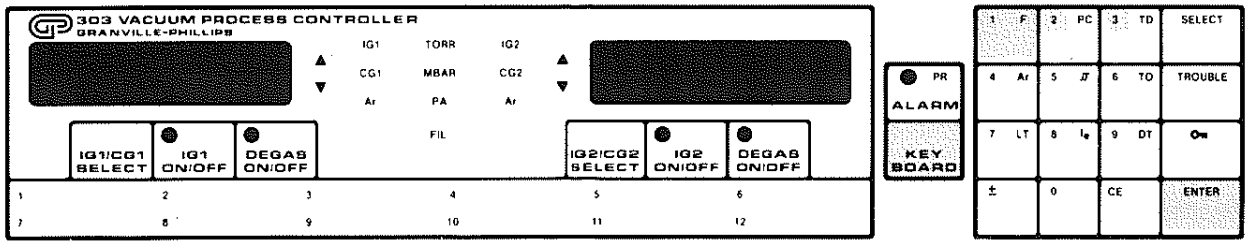



Figure 3-18. Controls and Indicators, Pause & Reset of PC Channels

**Note**

a. Depress KEYBOARD key to activate the keypad.

b. Unsecure the keypad.

c. On the keypad depress the function key F. F indicator flashes.

d. Key in 32 or 33 for pause or pause/reset.

e. Depress ENTER.
Display 1-32 or 33
Display 2-Blank

f. Depress KEYBOARD key to exit keypad.

The PC channel indicator light toggles for 1/2 second every 2 seconds. This indicates the PC channels are in a manual or paused state. The PC channels stay in this paused state until F34 is executed. This starts the process and returns the indicators to their normal state. While paused, the pressures can be displayed by invoking F35. This allows viewing pressures while manipulating the PC channels.

## 3-26. RESTARTING THE PAUSED PROCESS CONTROL CHANNELS

Refer to Figure 3-19 for the controls and indicators used in these procedures. This procedure explains the use of F34 to restart the process control channels which have been previously paused.

**Note**

This is a secured function. The security key must be green to make any change in the state of the process control operation. Refer to paragraph 3-17.



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Refer to figure 3-19 for controls and indicators used for this procedure.

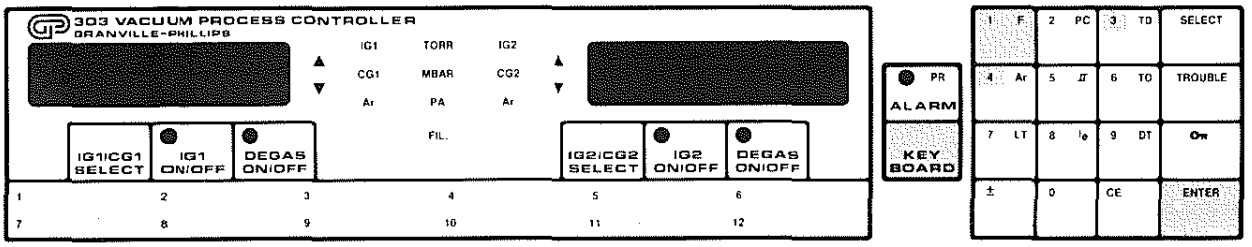



Figure 3-19. Controls & Indicators, PC Restart

a. Depress the KEYBOARD key to activate the keypad.

b. Unsecure the keypad.

c. On the keypad, depress the function key F. F indicator flashes.

d. Key in 34 for restart.

e. Depress ENTER.
Display 1-34
Display 2-Blank

f. Depress KEYBOARD key to exit keypad.

At this point all the process channels will resume their automatic operation. The timing will be continued for those channels that had only been paused, and where pause/reset was used, the timing will continue from the power-up state. If functions F41-F52 are used while in the paused state, the timing functions will be affected as stated in Section 3-25.

## 3-27. DISPLAY OF PRESSURES DURING PROCESS CONTROL FUNCTIONS

After executing this funciton, pressures will be displayed while the system is paused, and in between periods of the manual override functions. This allows system monitoring while process channels are manipulated without having to go out of the keyboard mode. If any function besides the manual override functions are executed, the displays revert back to the function data display mode.

**Note**

This is a secured function. The security key must be green to make any changes to the programmed parameters. Refer to paragraph 3-17.



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Refer to Figure 3-20 for controls and indicators used for this procedure.

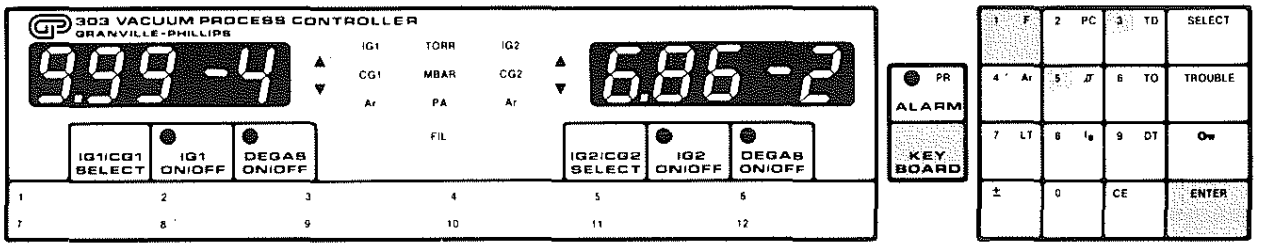



Figure 3-20. Controls & Indicators, Manual PC Pressure Display

a. Depress KEYBOARD key to activate the keypad.

b. Unsecure the keypad.

c. On the keypad depress the function key F. F indicator flashes.

d. Key in 35 for pressure display.

e. Depress ENTER.
Display 1-2 Pressure Data

f. Depress KEYBOARD key to exit keypad.

After ENTER is depressed, the displays go to the pressures as normally displayed. For functions F32, F33, F34, F41-F52 and F71-F82, pressures are displayed after the ENTER key has been depressed. After the F key or any other function key has been depressed, the displays go back to the function input mode. This function is activated while power remains on. After power cycling, this function has to be reset.

## 3-28. MANUAL OVERRIDES FOR PROCESS CONTROL CHANNELS

When first executed, the process control channel goes into a manual mode without toggling the relay state. The PC indicator light toggles for 1/2 second every 2 seconds indicating the PC channel is in manual mode. After the PC channel is in manual mode, subsequent executions of a function (i.e., F43 for channel #3) cause that PC channel state to toggle. Pressures can be displayed between executions of F41-F52 by first executing F35. This allows pressure display during manipulation of the PC channels without exiting the keypad entry screen.

**Note**

These are secured functions. The security key must be green to make any change in the state of the process control channels. Refer to paragraph 3-17.



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Refer to Figure 3-21 for controls and indicators used in this procedure.

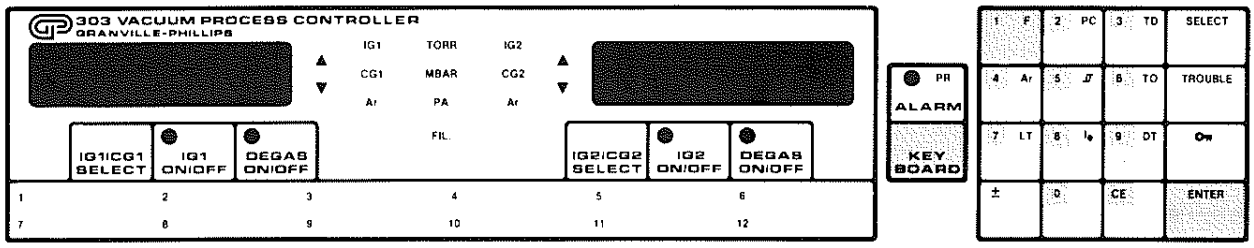



Figure 3-21. Controls & Indicators, PC Manual Override

a. Depress KEYBOARD to activate the keypad.

b. On the keypad depress the function key F. F indicator flashes.

c. Key in 41 through 52.

**Note**

There is a separate function for each process control channel. The functions are numbered sequentially from 41 through 52 which correspond to channels 1-12.

d. Depress ENTER.
Display 1 - function code or pressure.
Display 2 - blank or pressure.
PC INDICATOR - toggles for 1/2 second every 2 seconds (i.e., ON for 1.5 sec. if channel ON, OFF for 1.5 sec. if channel OFF).

e. Depress KEYBOARD key to exit keypad.

The process control channel is manual until returned to automatic mode by functions F71-82 or until cycling power.

## 3-29. RETURNING PROCESS CONTROL CHANNELS TO AUTOMATIC OPERATION

These functions are used in conjunctions with functions F41-F52 to exercise manual control over the process control channels. Operation of the PAUSE or PAUSE/RESET commands (F32, F33) is not affected. If a PC channel has been manupulated via one of functions 41-52, then when it is released to automatic control, it will be in its power-up state if inactive, and will begin its programmed time-out if active. During a pause (functions 32 or 33), channels cannot be individually released to automatic operation, i.e., functions 71-82 are disabled. Function 34 must be used for this purpose. Pressure can be displayed between executions of functions F71-F82 by first executing F35. This allows pressure display during manipulation of the PC channels without exiting the keypad entry screen.

**Note**

These are secured functions. The security key must be green to make any changes in the state of the process control channels. Refer to paragraph 3-17.



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Refer to Figure 3-22 for controls and indicators used in this procedure.

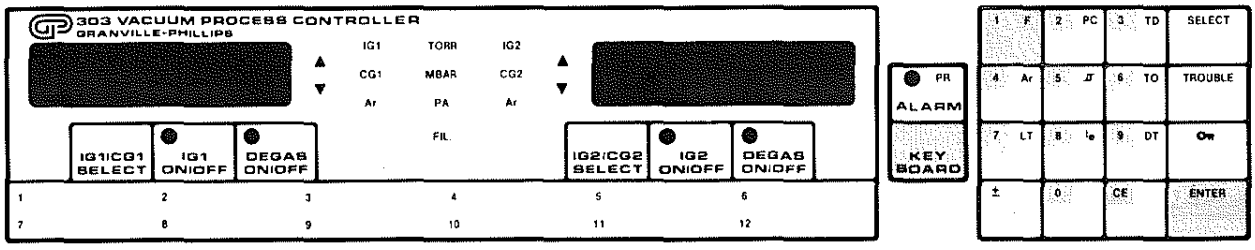



Figure 3-22. Controls & Indicators, PC Resume Automatic

a. Depress KEYBOARD to activate the keypad.

b. On the keypad, depress the function key F. F indicator flashes.

c. Key in function 71 through 82.

**Note**

There is a separate function for each process control channel. The functions are numbered sequentially from 71 through 82 which correspond to channels 1 through 12.

d. Depress ENTER.
Display 1 - function code of pressure
Display 2 - blank or pressure.
PC Indicator - constant ON or OFF.

f. Depress KEYBOARD key to exit keypad.

## 3-30. EXTERNAL ENABLE OPTION

This option permits external signals to affect or be affected by the VPC process control functions. The input signals may be switch closures, logic outputs or other process control channels. The external enable option is useful in automating a vacuum process since it can link the VPC with other system operations. This creates a control system which is operated from one location and is automated by VPC functions.

The external enable signal must be activated (logic low or grounded) and the pressure must be below the pressure set point to enable the process control channel. To cause a process control channel to be enabled only on the external enable signal, set the pressure set point to 999 and the gauge setting to CG1. The external enable input signal can be obtained for a PC channel N (where N = 1 through 12) by:

a. Connecting the external enable input pin for channel N to ground, Pin 1 of JA01 (do not use other grounds). Refer to Table 2-5 for connector JA01 connections.

b. Connecting the external enable input pin for channel N to the external enable output pin of another PC channel.

c. Furnishing a TTL compatible active low signal or contact closure to the external enable input pin for channel N using pin 1 of JA01 as the ground reference. Do not use other grounds.



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The external enable option also has outputs which indicate the status of the individual channels PC-1 through PC-12. A TTL low output indicates that the PC channel is activated while a TTL high indicates the PC channel is deactivated.

Refer to paragraph 2-19 for connections to the external enable option card.

## 3-31. PROGRAMMING FOR DIRECT ARGON READOUT

The procedure permits the operator to display or program the displayed pressure from any gauge to read directly for Argon or Nitrogen. The VPC is factory programmed to read $N_2$ pressure from all gauges.

It should be noted that when function code 0 is programmed (refer to paragraph 3-49) the VPC will immediately return to its factory programmed gas calibration, $N_2$.

**WARNING**

Danger of injury to personnel and damage to equipment exists on all vacuum systems that incorporate gas sources or involve processes capable of pressurizing the system above the limits it can safely withstand.

For example, danger of explosion in a vacuum system exists during backfilling from pressurized gas cylinders because many vacuum devices such as ionization gauge tubes, glass windows, glass bell jars, etc., are not designed to be pressurized.

Install suitable devices that will limit the pressure from external gas sources to the level that the vacuum system can safely withstand. In addition, install suitable pressure relief valves or rupture disks that will release pressure at a level considerably below that pressure which the system can safely withstand.

Suppliers of pressure relief valves and pressure relief discs are listed in Thomas Register under the respective headings "Valves, Relief" and "Discs, Rupture".

**WARNING**

303 Vacuum Process Controllers are intended for use only on vacuum systems which have suitable devices installed that will limit the pressure from external gas sources to the level the system can safely withstand and which also have suitable pressure relief valves or rupture disks installed. Confirm that these safety devices are properly installed before installing the VPC. In addition, check that (1) the proper gas cylinders are installed, (2) gas cylinder valve positions are correct on manual systems, and (3) the automation is correct on automated systems.



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Note

This is a secured function. The security key must be green to make any changes to programmed parameters. Refer to paragraph 3-17.

Refer to Figure 3-23 for the controls and indicators used for this procedure.

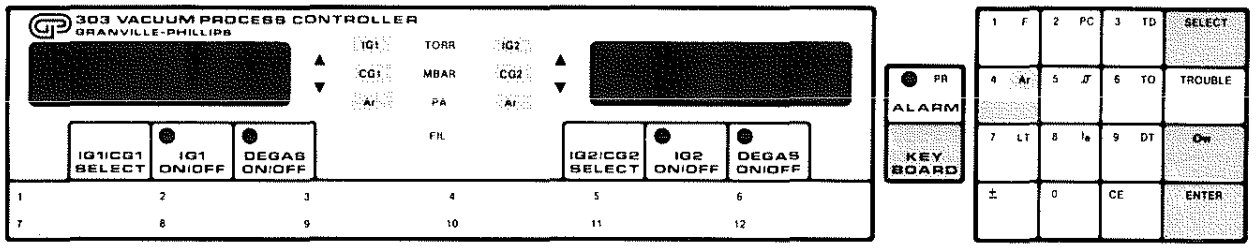



Figure 3-23. Controls and Indicators, Argon Readout

a. Depress KEYBOARD key to activate keypad. Displays 1 and 2 blank. On the keypad, depress Ar key. Ar indicator flashes.

b. Depress the SELECT key repeatedly until the desired gauge indicator is lit. If the Ar indictor for that gauge display is lit, the gauge is programmed to display Argon pressure. If the Ar indicator is not lit, the gauge is programmed to display $N_2$ pressure.

Note

At this time the gas pressure display currently programmed for the selected gauge is displayed. If this information is all that is desired, press ENTER key, and to exit keypad, press KEYBOARD key. To change the program, continue with procedure.

c. Depress Ar key to switch the Ar indicator on or off.
Depress ENTER key.
If other gauges are to be selected for Argon readout, repeat steps b and c for each gauge.

Displays 1 and 2 - Blank.
Keypad - Functions are displayed.

d. Depress KEYBOARD key to exit keypad.

## 3-32. DISPLAYING AND SETTING DEGAS TIME

This procedure permits the operator to display or program the degas time (DT) for each ionization gauge. Time durations from 1 to 999 minutes may be programmed for automatic degas. A setting of 0 permits manual operation of degas. The VPC is factory programmed for manual operation.

In both the manual and automatic degas modes, a soft turn-on is provided to minimize the pressure burst in a dirty IG tube. Figure 3-24 illustrates the power up and power down during degas. During the first 15 seconds after application of degas power, approximately one-fourth of the programmed power is applied. During the next 15 seconds, approximately one-half of the programmed degas power is applied. At the end of the first 30 seconds, maximum programmed degas power is applied.



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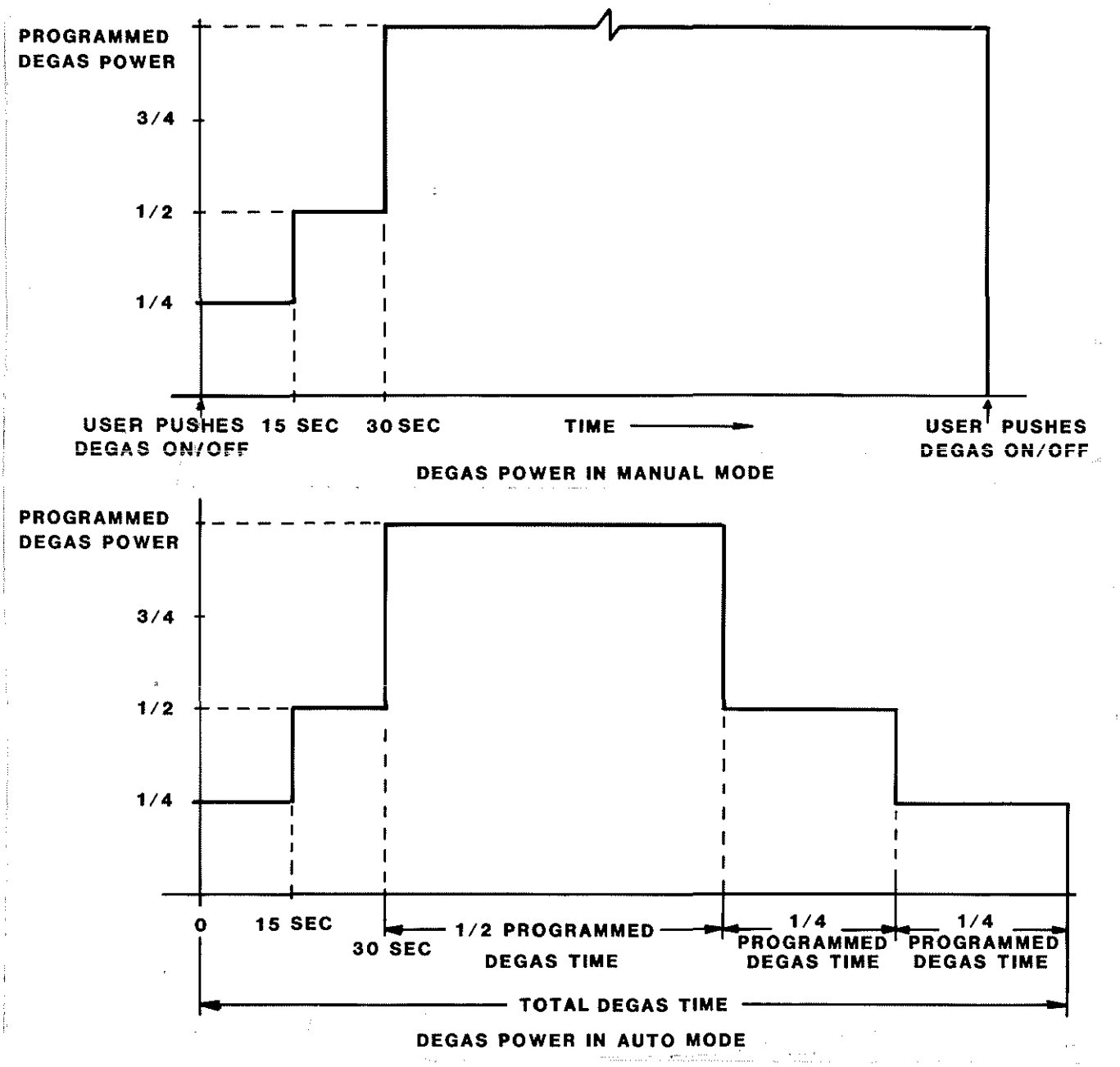



Figure 3-24. Degas Power Application and Removal

In the manual mode, degas power is immediately shut off when the DEGAS ON/OFF key is depressed. In the automatic mode, a soft turn-off occurs. This provides a cleaner IG tube in less time as contrasted with sharply turning off maximum degas power[1]. During the third quarter of programmed degas time, the power drops to one-half of the maximum. During the final quarter of the programmed degas time, one-fourth of the maximum degas power is applied. At the expiration of the programmed time, the degas power drops to zero.

It should be noted that when a function code 0 is programmed (refer to paragraph 3-49) all degas parameters will immediately return to their factory settings. This will cause the degas time to return to manual mode.

---

[1] D.R. Denison, Rev. Sci. Instr., 10, 1115 (1962).



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## Note

This is a secured function. The security key must be green to make any changes to program parameters. Refer to paragraph 3-17.

Refer to Figure 3-25 for the controls and indicators utilized in this procedure.

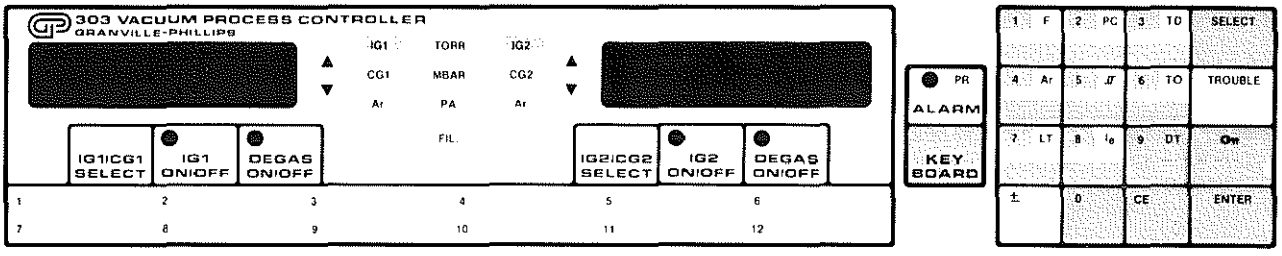



Figure 3-25. Controls and Indicators, Degas Time

a. Depress KEYBOARD key to activate keypad. Displays 1 and 2 blank. On keypad, depress DT key. DT indicator flashes.

b. Depress SELECT key repeatedly until the desired IG gauge indicator is lighted, e.g., IG1.
Display 1 - Blank.
Display 2 - Current setting of degas time in minutes for IG1.

## Note

At this time the degas time setting currently programmed for the selected gauge displayed. If this information is all that is desired, press ENTER key, and to exit the keypad, press KEYBOARD key. To change the degas time, continue with procedure.

c. Key in desired degas time in minutes (0 to 999). For example, if IG1 is to be automatically degassed for 20 minutes, key in 20.
Display 2 - 20 minutes.

d. Depress ENTER key. IG1 will now be automatically degassed for 20 minutes when DEGAS ON/OFF for IG1 is activated
Display 1 - Blank.
Display 2 - New setting of degas time
Keyboard - Functions displayed.

e. Perform steps b through d for IG2.

f. Depress KEYBOARD key to exit keypad.

### 3-33. DISPLAYING AND SETTING MAXIMUM DEGAS POWER

This procedure allows the operator to display and program the degas power. Degassing is accomplished by electron bombardment of the ionization gauge electrodes. Degas power may be set from 5 to 80 watts in 5 watt steps. The VPC is factory programmed for a maximum degas power of 40 watts.



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**Note**

This is a secured function. The security key must be green to make any changes to the programmed parameters. Refer to paragraph 3-17.

It should be noted that when a function code 0 is programmed (refer to paragraph 3-49), all degas parameters will immediately return to their factory settings. This will cause the maximum degas power to be 40 watts.

Refer to Figure 3-26 for the controls and indicators utilized in this procedure.

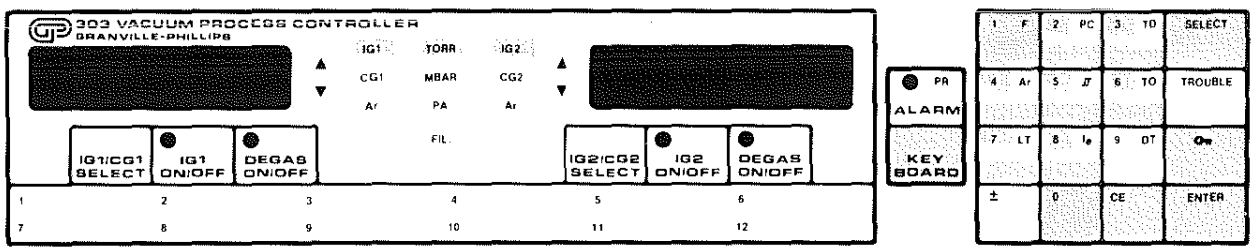



Figure 3-26. Controls and Indicators, Maximum Degas Power

a. Depress KEYBOARD key to activate keypad. Display 1 and 2 blank
On keypad depress function key F. F indicator flashes.
Key in 7.
Depress ENTER.

b. Depress SELECT key repeatedly until the desired IG gauge indicator is lighted, e.g., IG2.
Display 1 - Function code; 7.
Display 2 - Current setting of maximum degas power in watts for IG displayed.

**Note**

At this time the degas power setting currently programmed for the selected gauge is displayed. If this information is all that is desired, press ENTER key, and to exit keypad, press KEYBOARD key. To change the degas power, continue with procedure.

c. Key in desired degas power setting (5 to 80 watts in 5 watt increments), e.g., 65 watts, key in 65.
Display 2 - Degas Power - 65 (watts).

d. Depress ENTER key.
Display 1 - Function code - 7.
Display 2 - Degas power - 65 watts
Keyboard - Functions are displayed.

e. Depress KEYBOARD key to exit keypad.



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## 3-34. DISPLAYING DEGAS PARAMETERS DURING DEGAS (Pressure, Time Remaining, or Power)

The following procedures allow the operator to display during a degas operation the IG pressure, the remaining degas time, or the degas power. Even though these functions only provide display of data, they are secured functions. The VPC is factory programmed to display IG pressure during degas.

**Note**

This is a secured function. The security key must be green to make any changes to the programmed parameters. Refer to paragraph 3-17.

Refer to Figure 3-27 for the controls and indicators utilized in this procedure.

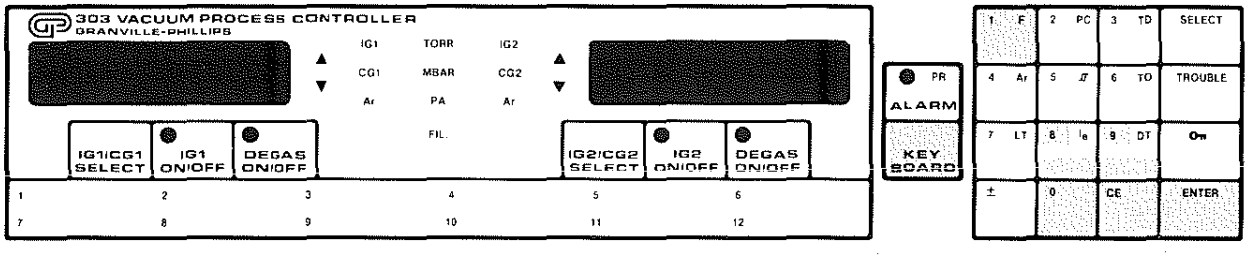



Figure 3-27. Controls and Indicators, Display of Degas Parameters

a. Depress KEYBOARD key to activate keypad.

b. On keypad depress function key F. F indicator flashes.

c. If it is desired to display IG pressure during degas, key in 8.
If it is desired to display degas time remaining, key in 9.
If it is desired to display degas power during degas, key in 10.

d. Depress ENTER.
Display 1 - Function code entered in step c.
Display 2 - Blank.

e. Depress KEYBOARD key to exit keypad.
Whenever an ionization gauge is degassed, the appropriate display will show the programmed function.

As an example, assume that IG1 is being degassed and it is desired to know the time remaining for degas. Perform the following procedure.

a. Depress KEYBOARD key to activate keypad.
On keyboard depress function key F. F indicator flashes.
Key in 9.
Display 1 - Function code - 9.
Display 2 - Blank.

b. On keypad depress ENTER key.
Depress KEYBOARD key to exit keypad.



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Display 1 - Time remaining for degas in minutes.
Display 2 - Pressure for IG2 or CG2 as applicable.

## 3-35. PROGRAMMING FOR TWO OR THREE DIGIT IG DISPLAY

This procedure allows the operator to display or program the number of digits displayed in the mantissa of IG pressures. This function is useful to avoid operator confusion in less stable systems. When the display is reduced to two digits, the value is truncated. Convectron gauge pressure display cannot be altered. The VPC has been factory programmed to display three digits plus the exponent for IG pressures above $9.9 \times 10^{-1}$. At pressures below $1 \times 10^{-9}$ the display resolution is reduced (refer to paragraph 3-2).

**Note**

This is a secured function. The security key must be green to make any changes to programmed parameters. Refer to paragraph 3-17.

Refer to Figure 3-28 for the controls and indicators used in this procedure.

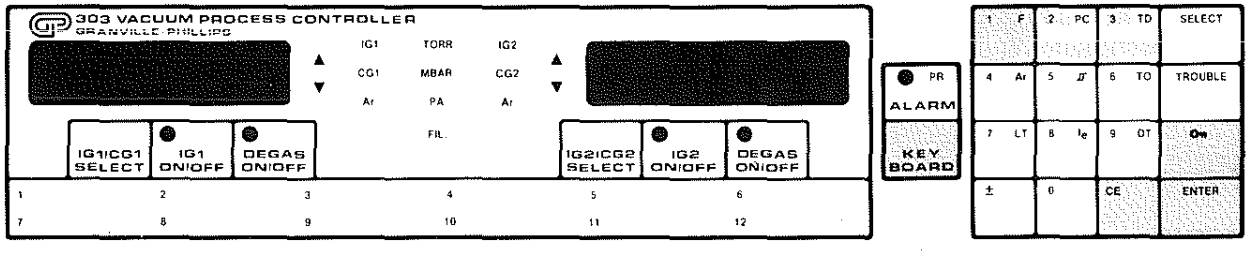



Figure 3-28. Controls and Indicators, Two or Three Digit Display

a. Depress function key F. F indicator flashes.
Key in 11.
Depress ENTER key.
Display 1 - Function code 11.
Display 2 - 2 or 3 displayed.

**Note**

At this time the IG display format currently programmed is displayed. If this information is all that is desired, press ENTER key, and to exit keypad, press KEYBOARD key. To change the display format continue with procedure.

b. Depress key 2 for two-digit displays or 3 for three-digit displays. Both displays will be programmed.

c. Depress ENTER key.
Depress KEYBOARD key to exit keypad.
Displays 1 and 2 - will display IG pressure in the programmed mode, either two or three digit mantissas.



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## 3-36. PROGRAMMING MAXIMUM OR FIXED EMISSION CURRENT

This procedure permits the operator to display or program the maximum or fixed IG emission current for each gauge. This procedure should not be used in programming the sensitivity of the ion gauge. Refer to paragraph 3-45 for sensitivity programming instructions.

The maximum or fixed current can be programmed to 0.01, 0.02, 0.04, 0.1, 0.2, 0.4, 1, 2, 4 or 10 milliamperes. The current is factory set at 4 mA.

It should be noted that when a function code 0 is programmed (refer to paragraph 3-49), the maximum emission current will immediately return to its factory setting of 4 mA.

**Note**

This is a secured function. The security key must be green to make any changes to a programmed parameter. Refer to paragraph 3-17.

Refer to Figure 3-29 for the controls and indicators utilized in this procedure.

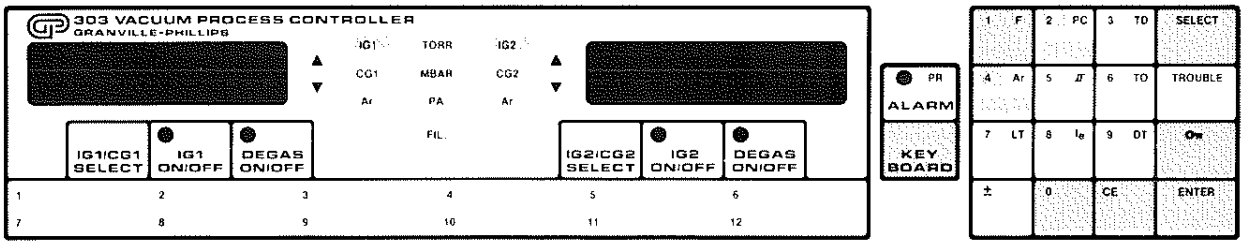



Figure 3-29. Controls and Indicators, Maximum Emission Current

a. Depress KEYBOARD key to activate keypad.
On keypad, depress function key F. F indicator flashes.
Key in 12.

b. Depress ENTER key.

c. Depress SELECT key repeatedly until desired IG gauge is selected as indicted by IG1 or IG2 indicators.
Display 1 - Function code 12.
Display 2 - Maximum emission current in milliamps for IG indicated by gauge indicator.

**Note**

At this time the maximum or fixed emission current currently programmed for the selected gauge is displayed. If this information is all that is desired, press ENTER key, and to exit keypad, press KEYBOARD key. To change the maximum emission current continue with procedure.

d. Key in 0.01, 0.02, 0.04, 0.1, 0.2, 0.4, 1, 2, 4 or 10 for desired maximum emission current or fixed emission. Since the decimal point appears automically, to key in 10 microamps (0.01) key in 2 zeros followed by a 1. For 200 micro amps, key in 02.



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e. Depress ENTER key.
Display 1 - Function code 12.
Display 2 - Programmed emission current.
Keyboard - Functions displayed.

f. To program the maximum emission current for the other gauge, repeat steps c through e.

g. Depress KEYBOARD key to exit keypad.

## 3-37. FIXED EMISSION SETTINGS FOR ION GAUGES

Additional functions allow emission current to be fixed at the programmed maximum. These functions, (F36 and F37), toggle between fixed and ranging emission. The VPC normally ranges emission current automatically at predetermined points for pressures above 5 x $10^{-4}$ Torr. If emission current is fixed using this function the VPC will not read the entire range of pressures (see Table 3-6). Whether this is acceptable for your process needs to be determined. To set emission current see instructions for Function F12 in section 3-36. This function effects IG1 and IG2 and should be executed with the ion gauge tubes turned off.

**Note**

This is a secured function. The security key must be green to make any changes to the programmed parameters. Refer to Paragraph 3-17.

Refer to Figure 3-30 for the controls & indicators used in this procedure.

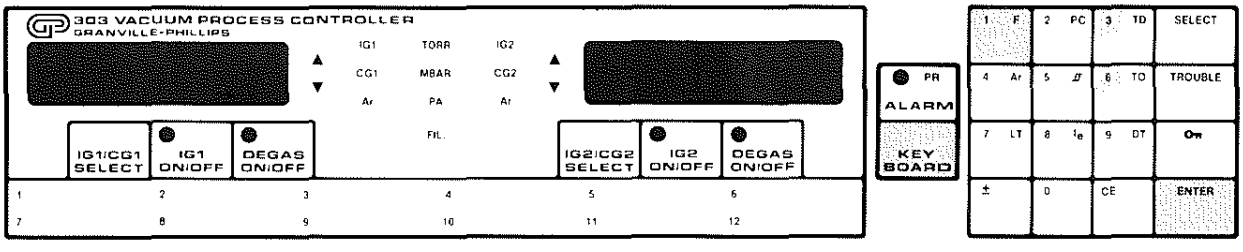



Figure 3-30. Controls and Indicators, Fixed Emission Currents

a. Depress the KEYBOARD key to activate the keypad.

b. On the keypad, depress the function key F. F indicator flashes.

c. Key in 36 for fixed emission current.

d. Depress ENTER.
Display 1 - function code 36.
Display 2 - blank.



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Table 3-6. Pressure Measurement Ranges for Fixed Emissions.

| (mA) Emission Current | (Torr)* Pressure Range | High Pressure Limit | Low Pressure Limit |
|---|---|---|---|
| .01 | | $1 \times 10^{-1}$ | $5 \times 10^{-8}$ |
| .02 | | $5 \times 10^{-2}$ | $2 \times 10^{-8}$ |
| .04 | | $2 \times 20^{-2}$ | $1 \times 10^{-8}$ |
| .1 | | $1 \times 10^{-2}$ | $5 \times 10^{-9}$ |
| .2 | | $5 \times 10^{-3}$ | $2 \times 10^{-9}$ |
| .4 | | $2 \times 10^{-3}$ | $1 \times 10^{-9}$ |
| 1 | | $1 \times 10^{-3}$ | $5 \times 10^{-10}$ |
| 2 | | $5 \times 10^{-4}$ | $2 \times 10^{-10}$ |
| 4 | | $2 \times 10^{-4}$ | $1 \times 10^{-10}$ |
| 10 | | $1 \times 10^{-4}$ | $5 \times 10^{-11}$ |

* These pressures are for a 10/Torr sensitivity.



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To compute pressure limits for sensitivities other than 10/Torr use the following formulas:

$$P_{min} = 5 \times 10^{-12}/I_e S$$

$$P_{max} = 10^{-5}/I_e S$$

$I_e$ = Emission current in Amps

S = Sensitivity in $Torr^{-1}$

## 3-38. VARIABLE EMISSION SETTING FOR ION GAUGE

The VPC normally ranges emission current automatically at a predetermined point for pressures above $5 \times 10^{-4}$ Torr. this function affects IG1 and IG2.

**Note**

This is a secured function. The security key must be green to make any changes to the programmed parameters. Refer to paragraph 3-17.

Refer to figure 3-31 for the controls & indicators used in this procdure.

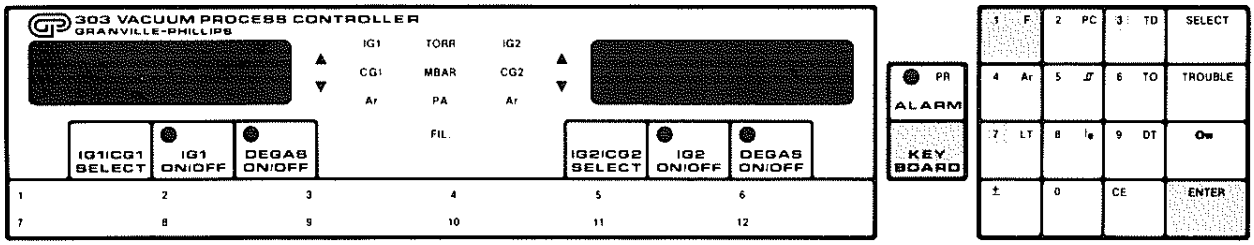



Figure 3-31. Controls and Indicators, Variable Emission Currents

a. Depress KEYBOARD key to activate the keypad.

b. On the keypad, depress the function key F. F indicator flashes.

c. Key in 37 for ranging emission current.

d. Depress ENTER.

Display 1 - function code 37.
Display 2 - blank.



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## 3-39. PROGRAMMING FILAMENT AUTOMATIC ON

**Note**

Convectron gauge option must be installed per paragraph 2-15 to use the following procedure.

This procedure permits the operator to display or program the status of the filament Auto On function. This function causes the VPC to automatically turn on a selected ionization gauge at a specified pressure of the associated Convectron gauge. Only IG1 can be automatically turned on with CG1 and only IG2 can be automatically turned on with CG2. This function is useful in automating system pump-down procedures. The VPC is factory programmed with this function off.

**Note**

This is a secured function. The security key must be green to make any change to programmed parameters. Refer to paragraph 3-17.

Refer to Figure 3-32 for the controls and indicators used in this procedure.

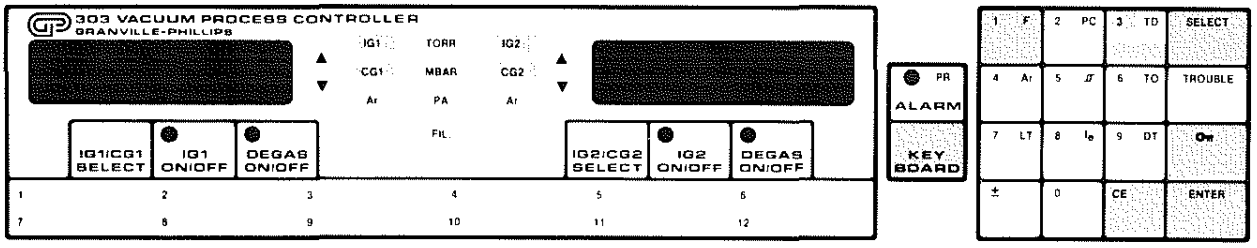



Figure 3-32. Controls and Indicators, Filament Auto On

a. Depress KEYBOARD key to activate keypad.
On keypad depress function key F. F indicator flashes.
Key in 13.

b. Depress ENTER key.
Display 1 - Function code 13.
Display 2- Blank.
Gauge indicators - IG1 and CG1 and/or IG2 and CG2 are lit if they are programmed for filament Auto On.

**Note**

At this time the filament Auto On status currently programmed is displayed. If this information is all that is desired, press ENTER key, and to exit keypad, press KEYBOARD key. To change the filament Auto On status, continue with procedure.

c. Depress SELECT key repeatedly until the desired IG and CG indicators are lit - each lit pair indicates that filament Auto On is enabled for those gauges. One, both or neither pair is selectable.



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d. Depress ENTER key.
Display 1 - Function code 13.
Display 2- Blank Gauge indicators - lit pairs of gauges have filament Auto On function enabled.
Keypad - Functions are displayed.

e. Depress KEYBOARD key to exit keypad.

f. To display or program the pressure set point for activating the Auto On function refer to paragraph 3-40.

## 3-40. DISPLAYING AND SETTING FILAMENT AUTOMATIC ON PRESSURE

**Note**

Convectron Gauge option must be installed per paragraph 2-15 to use the following procedure.

This procedure permits the operator to display and program the pressure at which an ionization gauge will be automatically turned on if it has been programmed to do so (paragraph 3-39). The filament Auto On pressure can be programmed to values between 1 x $10^{-3}$ and 9.99 x $10^{-1}$ Torr or millibar or between 1 x $10^{-1}$ and 9.99 x $10^{+1}$ Pascal. The filament Auto On pressure is factory programmed at 3 x $10^{-3}$ Torr. The filament Auto On set point has a non-programmable hysteresis of +50%.

**Note**

This is a secured function. The security key must be green to make any change to programmed parameters. Refer to paragraph 3-17.

Refer to Figure 3-33 for the controls and indicators used in this procedure.

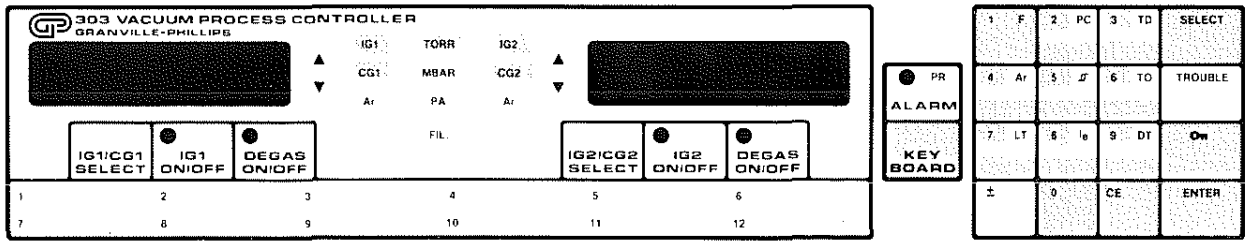



Figure 3-33. Controls and Indicators, Filament Auto On Pressure

It should be noted that the Auto On function is dependent upon the accuracy of the Convectron gauge option. Refer to paragraph 5-9 for calibration instructions.

a. Depress KEYBOARD key to activate keypad.
On keypad depress function key F. F indicator flashes.
Key in 14.

b. Depress ENTER key.
Display 1 - Function code 14.
Display 2 - Auto On pressure currently programmed.
Units indicators- Unit of pressure currently programmed is lit.



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c. Depress SELECT repeatedly until desired gauge indicators are lighted, e.g., IG1 and CG1 or IG2 and CG2.
Display 1 - Function code 14. Display 2 - Current setting of Auto On pressure for selected gauge, e.g., $3x10^{-3}$.

**Note**

At this time the Auto On pressure currently programmed for the selected gauge is displayed. If this information is all that is desired, press ENTER key, and to exit keypad, press KEYBOARD key. To change the Auto On pressure, continue with procedure.

d. Key in new Auto On pressure set point for the selected gauge. This pressure must be in the $10^{-3}$ Torr Range ((1-999) x $10^{-3}$) and the $^{-3}$ exponent is shown by the VPC. The unit of measure is that displayed by the units indicators. For example, to program a set point of 7 x $10^{-3}$ Torr, ensure that the Torr indicator is lit, key in 7.

e. Depress ENTER key.
Display 1 - Function code 14.
Display 2 - New Auto On pressure, 7.00-3.
Keypad - Functions are displayed.

f. Depress KEYBOARD key to exit keypad.

g. To enable the filament Auto On Function, refer to paragraph 3-39.

## 3-41. DISPLAYING AND SETTING OVERPRESSURE TRIP POINT

This procedure permits the operator to display and program the setting of the pressure at which an ionization gauge will automatically turn off to protect the gauge filaments from the effects of high pressure. Values from 0 to 999 are valid inputs. The overpressure trip point is factory programmed to 5 x $10^{-3}$ Torr which is considered satisfactory for most applications. This trip point pressure is compared against the calculated ion gauge pressure and for systems with fast-rising pressures, can be compared against Convection gauge pressures. (See F28, F29 paragraph 3-43).

It should be noted that when a function code 0 is programmed (refer to paragraph 3-49), the overpressure trip point will immediately return to its factory setting of 5 x $10^{-3}$ Torr.

**Note**

This is a secured function. The security key must be green to make any change to programmed parameters. Refer to paragraph 3-17.



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Refer to Figure 3-34 for the controls and indicators used in this procedure.

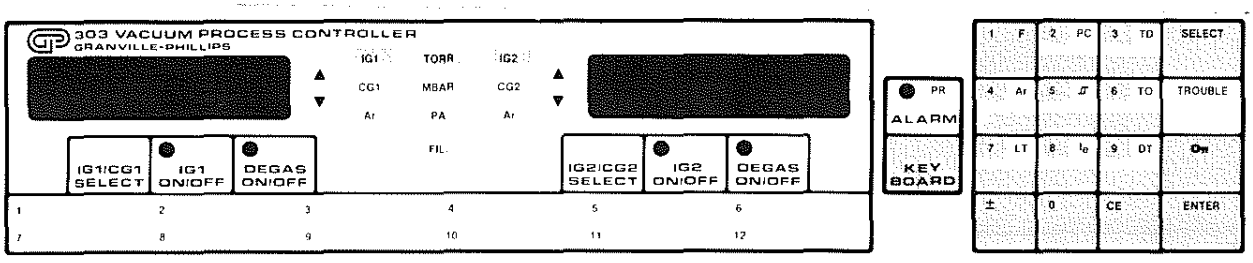



Figure 3-34. Controls and Indicators, Overpressure Trip Point

a. Depress KEYBOARD key to activate keypad.
On keypad depress function key F. F indicator flashes.
Key in 15.
Depress ENTER.
Depress SELECT key repeatedly until the desired gauge indicator is lit, e.g., IG2.
Display 1 - Function code - 15.
Display 2 - Overpressure trip point of selected gauge currently programmed, e.g., 5.00-3 ($5 \times 10^{-3}$ Torr).
Units indicators- Unit of pressure currently programmed is lit. For example, Torr.

Note

At this time the overpressure trip point currently programmed for the selected gauge is displayed. If this information is all that is desired, press ENTER key, and to exit keypad, press KEYBOARD key. To change the overpressure trip point, continue with procedure

b. Key in the new overpressure trip point. The unit of measure is that displayed by the units indicators. For example, key in 75-3 to turn off IG2 at $7.5 \times 10^{-3}$ Torr.

c. Depress ENTER key.
Display 1 - Function code 15.
Display 2 - New overpressure trip point.
Keypad - Functions are displayed.

d. Depress KEYBOARD key to exit keypad.

e. To display or program the overpressure time delay, refer to paragraph 3-42.

## 3-42. DISPLAYING AND SETTING OVERPRESSURE TIME DELAY

This procedure permits the operator to display and change the programmed overpressure time delay. This delay is the time (in seconds) that will elapse after the overpressure trip point has been exceeded before the IG filament is turned off. This time delay will prevent a random pressure spike from turning off the IG and will still provide protection from a sustained risk. This delay may be programmed from 0.0 to 9.5 seconds in 0.5 second increments. The VPC is factory programmed for an overpressure delay of 0.5 second.

It should be noted that when a function code 0 is programmed (refer to paragraph 3-49), the overpressure time delay will immediately return to its factory setting of 0.5 second.



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## CAUTION

Increasing the time delay to prevent nuisance tripping may risk damage to the ionization gauge filament if it is left on too long with excess pressure. This is especially risky with tungsten filaments.

## Note

This is a secured function. The security key must be green to make any change to programmed parameters. Refer to paragraph 3-17.

Refer to Figure 3-35 for the controls and indicators utilized in this procedure.

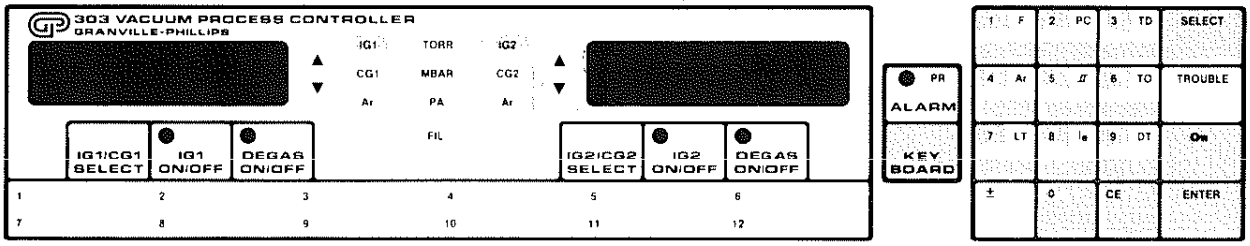



Figure 3-35. Controls and Indicators, Overpressure Time Delay

a. Depress KEYBOARD key to activate keypad.
On keypad depress function key F. F indicator flashes.
Key in 16.
Depress ENTER.

b. Depress SELECT key repeatedly until desired IG gauge indicator is lit, e.g., IG2.
Display 1 - Function code- 16.
Display 2 - Time delay in seconds currently programmed for IG tube selected, e.g., 1.0 (second).

## Note

At this time the overpressure time delay currently programmed for the selected gauge is displayed. If this information is all that is desired, press ENTER key, and to exit keypad, press KEYBOARD key. To change the overpressure time delay, continue with procedure.

c. Key in desired time delay, e.g., 2.5 seconds.
Display 2 - 2.5 (seconds).

d. Depress ENTER key.
Display 1 - Function code 16.
Display 2 - New overpressure time delay.

e. Depress KEYBOARD key to exit keypad.

f. To display or program the overpressure set point, refer to paragraph 3-41.



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## 3-43. PROGRAMMING FILAMENT AUTOMATIC OFF FUNCTION

Function codes F28 - F29 turn off the ionization gauge (IG) tube(s) in response to overpressures measured by a Convectron gauge. (CG). The user selects which Convectron gauge is assigned to monitor pressure for an IG tube. The selections available are IG1, IG2, IG1 and IG2, or NONE.

Function F28 sets CG1 and function 29 sets CG2.

The pressure at which the IG tubes shut off is set by the overpressure trip point (F15 - paragraph 3-41).

These functions turn off the ionization gauge when system vent or backfill rates exceed the ionization gauges pressure measurement rates.

The VPC is factory programmed with the Convectron gauges not associated with any ionization gauge.

**Note**

This is a secured function. The security key must be green to make any change to programmed parameters. Refer to paragraph 3-17.

Refer to Figure 3-36 for the controls & indicators utilized in this procedure.

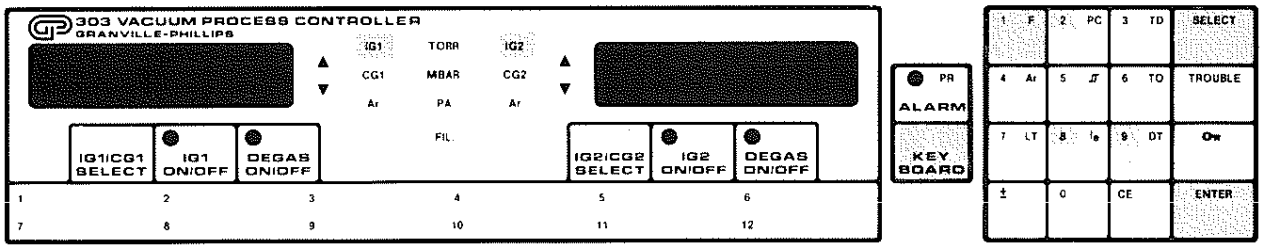



Figure 3-36. Controls and Indicators, Filament Auto Off

a. Depress KEYBOARD to activate keypad.
On keypad depress function key F. F indicator flashes.
Key in 28 or 29.

b. Depress ENTER.
Display 1 - Function code 28 or 29.
Display 2 - Blank.
Gauge indicators - IG1, IG2, or IG1 and IG2 are lit if they are programmed for Filament Auto Off. If no indicators are lit, no gauges are selected.

**Note**

At this time the Filament Auto Off status currently programmed is displayed. If this information is all that is desired, press ENTER. To exit the keypad, press KEYBOARD. To change the Filament Off status, continue.



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c. Depress SELECT key repeatedly until the desired IG indicators for the designated Convection are lit - each light indicates that filament AUTO OFF is enabled for that gauge. One, both or neither ionization gauge is selectable.

d. Depress ENTER.
Display 1 - Function code 28 or 29.
Display 2 - Blank.
Gauge indicators - lit gauges have filament Auto Off function enabled.
Keypad - Functions.

e. Depress KEYBOARD to exit keypad.

f. To display or program the pressure set point for activating the AUTO OFF function, refer to F15 paragraph 3-43.

## 3-44. DISPLAYING AND SETTING RATE OF CHANGE INDICATORS

This procedure permits the operator to display or program the thresholds at which the rate of change indicators are activated. The direction of pressure change in each of the two pressure measuring channels is indicated by lighted arrows; up for increasing pressure and down for decreasing pressure. The rate of change of pressure is indicated by a slowly flashing arrow for pressures which are slowly changing and an arrow which is constantly lighted for a pressure which is rapidly changing. The rate of change is expressed in percent change of pressure reading per second. That is: Rate of change value = $\Delta$ P/second x 100. Thus a 100% rate of change for an increasing pressure means that the pressure is doubling every second as in a relatively slow backfill operation. A 50% rate of change for decreasing pressure means that the pressure is being halved each second, a very rapid rate of decrease. Values of 1 to 999%, for positive changes and 1 to 99% for negative changes can be programmed. Both displays are programmed by this function.

The factory programmed values will satisfy most needs concerning this feature and it is unlikely that reprogramming will be necessary. The factory preset values are as follows:

a. Rate of change "up slow"- 50%/second.

b. Rate of change "up fast" - 500%/second.

c. Rate of change "down slow" - 5%/second.

d. Rate of change "down fast" - 50%/second.

**Note**

This is a secured function. The security key must be green to make any change to programmed parameters. Refer to paragraph 3-17.



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Refer to Figure 3-37 for the controls and indicators used in this procedure.

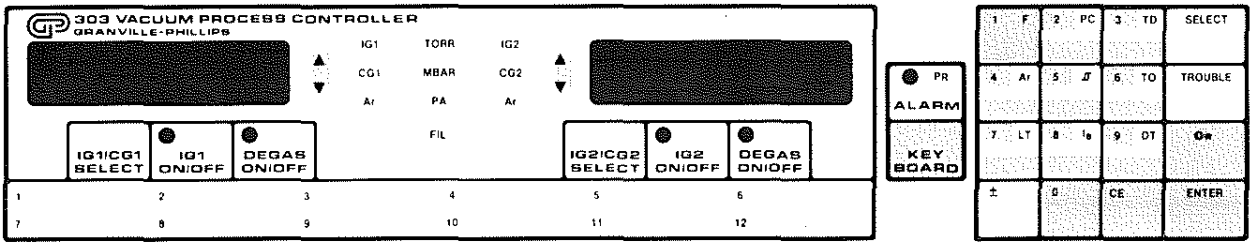



Figure 3-37. Controls and Indicators, Rate of Change

a. Depress KEYBOARD key to activate keypad.
On keypad depress function key F. F indicator flashes.

(1)To display or program the "up slow" value, key in 17. This is the percent pressure increase per second to blink the ▲ indicator.

(2)To display or program the "up fast" value, key in 18. This is the percent pressure increase per second to light the ▲ indicator.

(3)To display or program the "down slow" value, key in 19. This is the percent pressure decrease per second to blink the ▼ indicator.

(4)To display or program the "down fast" value, key in 20. This is the percent pressure decrease per second to light the ▼ indicator.

b. Depress ENTER key.
Display 1- Function code.
Display 2 - Present value (percent change per second).

Note

At this time the rate of change value currently programmed is displayed. If this information is all that is desired, press ENTER key, and to exit keypad, press KEYBOARD key. To change the rate of change value, continue with procedure.

c. Key in new percent rate of change to light the ▲/▼ indicators. For example, to program maximum sensitivity to the flashing indicators, enter a value of 1 in Functions 17 and 19. This will provide an indication when the pressure increases or decreases by 1% per second.

d. Depress ENTER key.
Display 1 - Function code.
Display 2 - New setting of rate of change.

e. Each pressure rate of change is set in the same manner.

f. Depress KEYBOARD key to exit keypad.



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## 3-45. DISPLAYING AND SETTING IG SENSITIVITY

This procedure permits the operator to program the VPC to exactly match the sensitivity of an ionization gauge. The sensitivity of a gauge is dependent upon its exact geometry as well as the gas being measured. Values of 0.1 to 99.9/Torr or 0.1 to 99.9/mbar or 1 x $10^{-3}$ to 9.99 x $10^{-1}$/Pascal can be programmed. The VPC is factory programmed for a sensitivity of 10/Torr for $N_2$. This is a typical value for a glass tubulated Bayard-Alpert gauge. Refer to the manufacturer's specifications or your own calibration data to determine the sensitivity of the gauges used. Nude gauge designs such as the GPC 274022 274023 and varian UHV24 have a typical sensitivity of about 25/Torr for $N_2$. If you are using a gauge tube of this type, the IG sensitivity should be set to this value (25/Torr). Otherwise, measurement errors will result. Table 3-7 lists the relative gauge sensitivities for common gases. These values are from NASA Technical Note TND 5285, Ionization Gauge Sensitivities as reported in the literature, by Robert L. Summers, Lewis Research Center, National Aeronautics and Space Administration. Refer to this technical note for further definition of these average values and for the gauge sensitivities of other gases.

To program the VPC to be direct reading for gases other than air, $N_2$, or Ar (if set to display pressure for Ar directly), calculate the sensitivity $K_x$ for gas type x as follows:

$$K_x = r_X K N_2$$

where $KN_2$ is the gauge sensitivity for $N_2$.

Table 3-7. Relative Sensitivity for Common Gases

| Gas | $r_x$ |
|---|---|
| He | 0.18 |
| Ne | 0.30 |
| $D_2$ | 0.35 |
| $H_2$ | 0.46 |
| $N_2$ | 1.00 |
| Air | 1.00 |
| $O_2$ | 1.01 |
| CO | 1.05 |
| $H_2O$ | 1.12 |
| NO | 1.16 |
| Ar | 1.29 |
| $CO_2$ | 1.42 |
| Kr | 1.94 |
| $SF_6$ | 2.50 |
| Xe | 2.87 |

It should be noted that when a function code 0 is programmed (refer to paragraph 3-49), the IG sensitivity will immediately return to its factory setting of l0/Torr.

**Note**

This is a secured function. The security key must be green to make any change to programmed parameters. Refer to paragraph 3-17.



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Refer to Figure 3-38 for the controls and indicators used in this procedure.

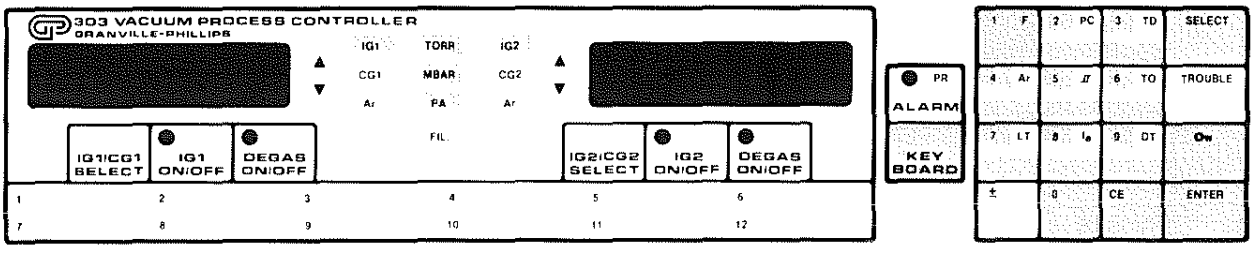



Figure 3-38. Controls and Indicators, IG Sensitivity

a. Depress KEYBOARD key to activate keypad.
On keypad, depress function key, F. F indicator flashes.
Key in 21.

b. Depress ENTER key.
Depress SELECT key repeatedly until desired gauge indicator is lit, e.g., IG2.
Display 1 - Function code - 21.
Display 2- Current sensitivity for selected gauge.
Units indicators - Unit of pressure currently programmed is lit, e.g., Torr.

c. When the VPC is programmed for Torr or mbar units of pressure, the sensitivity is displayed as a three digit number with one decimal place. For example a sensitivity of 11.5/Torr is displayed 11.5. When the VPC is programmed for Pascal units, the sensitivity is displayed as a three digit number with 2 decimal places plus an exponent.

Note

At this time the gauge sensitivity currently programmed for the selected gauge is displayed. If this information is all that is desired, press ENTER key, and to exit keypad, press KEYBOARD key. To change the gauge sensitivity, continue with procedure.

d. Key in the new gauge sensitivity, noting the decimal notation in display 2. When programming the VPC, enter the sensitivity as 3 digits with no decimal point. The decimal point will be automatically displayed. For units of Pascal the $10^{-3}$ exponent will be automatically displayed.

e. Depress ENTER key.
Display 1 - Function code 21.
Display 2 - New sensitivity setting.
Units indicators - Unit of pressure currently programmed is lit.
Keypad - Functions are displayed.



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Examples: To enter 11.5/Torr, set unit of pressure to Torr (refer to paragraph 3-46) and follow steps a. through e. above. Key in 115 and depress ENTER key. Display 2 reads 11.5 (11.5/Torr).

To enter 1.2/mbar, set unit of pressure to mbar (refer to paragraph 3-46) and follow steps a. through e. above. Key in 12 and depress ENTER key. Display 2 reads 1.2 (1.2/mbar).

To enter 5 x $10^{-2}$/Pascal, set unit of pressure to Pascal (refer to paragraph 3-46) and follow steps a. through e. above. Key in 50 and depress ENTER key. Display 2 reads 50-3 (5 x $10^{-2}$/Pascal).

f. Depress KEYBOARD key to exit keypad.

## 3-46. SETTING UNITS OF PRESSURE IN TORR, MBAR, OR PASCAL

This procedure allows the operator to program the unit of measure for pressure displays. The VPC is factory programmed to read out in Torr.

It should be noted that when a function code 0 is programmed (refer to paragraph 3-49), the unit of pressure will immediately return to its factory setting of Torr.

**Note**

This is a secured function. The security key must be green to make any change to programmed parameters. Refer to paragraph 3-17.

Refer to Figure 3-39 for the controls and indicators used in this procedure.

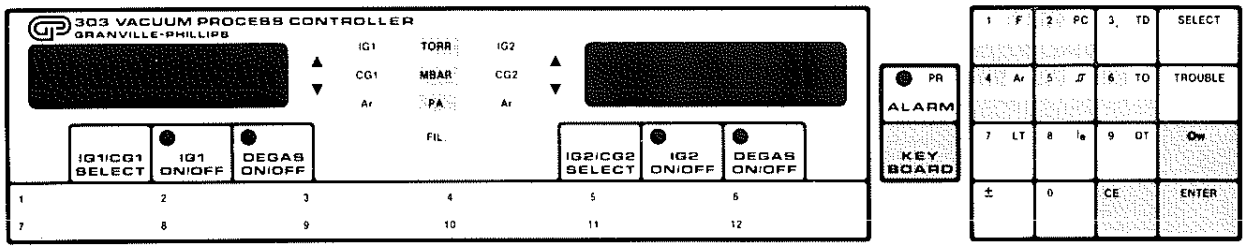



Figure 3-39. Controls and Indicators, Pressure Units

a. Depress KEYBOARD key to activate keypad.
On keypad depress function key F. F indicator flashes.

(1)To program the unit of pressure to Torr, key in 24.

(2)To program the unit of pressure to millibar, key in 25.

(3)To program the unit of pressure to Pascal, key in 26.



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b. Depress ENTER key.
Display 1 - Function code.
Display 2- Blank.
Units indicator - Appropriate indicator is lit (TORR, MBAR or PA) to indicate selected units.

c. Depress KEYBOARD key to exit keypad.

## 3-47. BCD OPTION

**Note**

BCD output option must be installed per paragraph 2-21 to use the following information and procedures.

The BCD interface option provides parallel binary coded decimal pressure and status information to a remote device with a compatible interface. The outputs and control inputs are defined as to their function, interface requirements, and pin out in Table 3-8.



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Table 3-8. BCD Option Connections

| Pin No. J901 | Function | TTL loads | Notes (all digits use positive true logic) |
|---|---|---|---|
| 1 | 1 | 15 | 1's digit - LSB(1) |
| 2 | 2 | 15 | 1's digit(2) |
| 3 | 4 | 15 | 1's digit(4) |
| 4 | 8 | 15 | 1's digit - MSB(8) |
| 5 | 1 | 15 | .1's digit - LSB(1) |
| 6 | 2 | 15 | .1's digit |
| 7 | 4 | 15 | .1's digit |
| 8 | 8 | 15 | .1's digit - MSB(8) |
| 9 | 1 | 15 | .01's digit - LSB(1) |
| 10 | 2 | 15 | .01's digit |
| 11 | 4 | 15 | .01's digit |
| 12 | 8 | 15 | .01's digit - MSB(8) |
| 13 | Option Common | - | Ground |
| 14 | Data Valid Output | 5 | 0 = Data stable |
| 15 | Data Bus Input | 1 | 1 = Three state output bus, internal pull-up |
| 16 | Hold Input | 1 | 0 = Hold data, internal pull-up |
| 17 | CG/IG Output | 15 | 1 = IG |
| 18 | Degas Status Output | 15 | 1 = Degas on |
| 19 | Trouble Output | 15 | 1 = Trouble |
| 20 | Exponent Sign | 15 | 1 = + (plus) |
| 21 | Exponent 10's bit | 15 | |
| 22 | 1 | 15 | Exponent 1's digit LSB(1) |
| 23 | 2 | 15 | Exponent 1's digit |
| 24 | 4 | 15 | Exponent 1's digit |
| 25 | 8 | 15 | Exponent 1's digit MSB(8) |

The following operational characteristics apply to the BCD output option.

a. Data from the BCD option card comes from only one display group. Two BCD option cards may be installed to output data from both display groups simultaneously. The display group associated with the BCD option card is selected by a jumper on the card. Refer to paragraph 2-21.

b. If the CG option is not installed and the CG pressure is programmed to be output, the output is maximum pressure in the programmed unit of pressure.

c. All input and output logic levels are 5 volt TTL compatible.

d. A logic high on the Data Bus Input (pin 15) will tri-state the data output lines. This can be used to multiplex BCD option cards on a common bus.



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e. The Data Valid Output is logic low when the data is stable. It is held high for approximately 10 microseconds, twice per second to update the data.

f. The Hold Input may be held at logic low to prevent update of the data outputs.

g. All control inputs have internal pull-up resistors to avoid extraneous external circuitry.

h. Data from the BCD output option is in the form X.XX x 10 ± YY. The decimal point always follows the most significant digit.

i. When a function code 0 is programmed (refer to paragraph 3-49), the BCD output will immediately return to its factory set gauge assignment. The factory set gauge assignment is the ionization gauge of the display group for which the option card is configured (refer to paragraph 2-21).

The following procedure permits the operator to display and program the gauge selection for the BCD output option card(s). The VPC may be programmed to output the following sets of data from the BCD option card.

1. IG pressure.

2. CG pressure (where CG option is installed).

3. System pressure - IG pressure if the IG is on; otherwise, CG pressure (if installed). The system pressure is indicated by the IG and CG indicators being lit.

4. Display pressure - The gauge pressure currently shown in the display. The display pressure is indicated by neither the IG nor CG indicator being lit.

The VPC is factory programmed to output pressure data from the ionization gauge.

**Note**

This is a secured function. Security key must be green to make any changes to program parameters. Refer to paragraph 3-17.

Refer to Figure 3-40 for the controls and indicators used in this procedure.

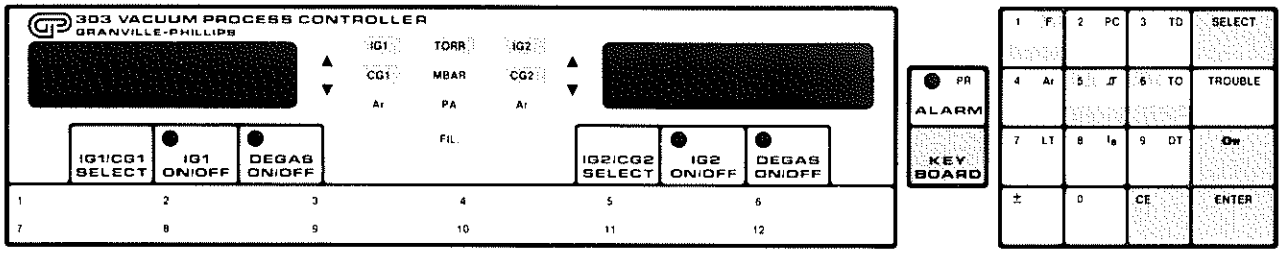



Figure 3-40. Controls and Indicators, BCD Output



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a. Depress KEYBOARD key to activate keypad.
On keypad, depress function key, F. F indicator flashes.
To program the BCD option associated with Display 1 (BCD 1), key in 5.
To program the BCD option associated with Display 2 (BCD 2), key in 6.

b. Depress ENTER key.
Display 1 - Function code 5 or 6.
Display 2 - Blank.
Gauge Indicators - Currently programmed gauge assignment for selected BCD option.

**Note**

At this time the gauge selection currently programmed for the BCD option is displayed. If this information is all that is desired, press ENTER key, and to exit keypad, press KEYBOARD key. To change the gauge selection continue with procedure.

c. Depress SELECT key repeatedly until desired gauge(s) for BCD option data is selected.

d. Depress ENTER key.
Display 1 - Function code 5 or 6.
Display 2 - Blank.
Gauge indicator - Programmed gauge assignment for BCD option.

e. Depress KEYBOARD key to exit keypad.

## 3-48. ANALOG OUTPUT OPTION

**Note**

The Analog Output option must be installed per paragraph 2-23 to use the following information and procedures.

The Analog Output option card provides analog voltages corresponding to the gauge pressures. Each card provides an output for IG1 and/or CG1 pressures and an output for IG2 and/or CG2 pressures (if CG option is installed). The following operational characteristics apply to the Analog Output option.

a. The outputs are linearly proportional to the pressure in each decade within the range of the instrument (refer to Figure 3-42).

b. The outputs are d.c. voltages of 0.5 volt/decade, regardless of unit of measure programmed.

c. When the VPC is programmed for Torr unit of pressure, the output is 0 to 7.0 volts corresponding to a pressure range of $1 \times 10^{-11}$ to 1000 Torr.

d. When the VPC is programmed for millibar unit of pressure, the output is 0 to 7.07 volts corresponding to a pressure range of $1 \times 10^{-11}$ to $1.33 \times 10^{3}$ mbar.

e. When the VPC is programmed for Pascal unit of pressure, the output is 0 to 7.07 volts corresponding to a pressure range of $1 \times 10^{-9}$ to $1.33 \times 10^{5}$ Pascal.



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f. If the CG option is not installed and the CG pressure is programmed to be output, the output is full scale for the programmed unit of pressure.

g. If the Convectron gauge reaches a pressure where 000 is displayed, the Analog output Voltage will be 3.77 volts for all units of measurement.

h. Two Analog Output option cards (boards 1 and 2) may be installed to output data from four gauge combinations (see paragraphs 1 to 4 below). Each option card has an output for Display 1 and Display 2.

i. When a function code 0 is programmed (refer to paragraph 3-49), the Analog outputs will immediately return to their factory set gauge assignments of the respective ionization gauge pressures.

The following procedure permits the operator to display and program the gauge selection for the Analog Output option card(s). The VPC may be programmed to output the following sets of data from the Analog Output option card.

1. IG pressure.

2. CG pressure (where CG option is installed).

3. System pressure - IG pressure if the IG is on; otherwise, CG pressure (if installed). The system pressure is indicated by the IG and CG indicators being lit.

4. Display pressure - The gauge pressure currently shown in the display. The display pressure is indicated by neither the IG nor the CG indicator being lit.

The VPC is factory programmed to output pressure data from the ionization gauges.

**Note**

This is a secured function. Security key must be green to make any changes to program parameters. Refer to paragraph 3-17.

Refer to Figure 3-41 for the controls and indicators used in this procedure.

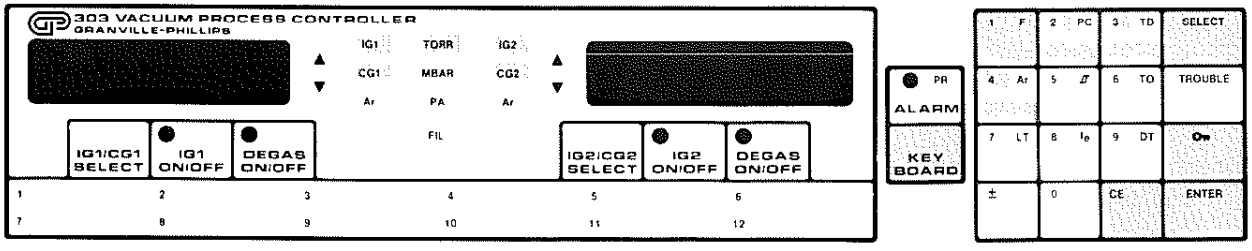



Figure 3-41. Controls and Indicators, Analog Output



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a. Depress KEYBOARD key to activate keypad.
On keypad, press function key F. F indicator flashes.
To program the Analog board 1 output associated with Display 1, key in 1. (Pins 7 & 6).
To program the Analog board 1 output associated with Display 2, key in 2. (Pins 5 & 4).
To program the Analog board 2 output associated with Display 1, key in 3. (Pins 7 & 6).
To program the Analog board 2 output associated with Display 2, key in 4. (Pins 5 & 4).

b. Depress ENTER key.
Display 1 - Function code 1, 2, 3, or 4.
Display 2- Blank.
Gauge indicator - Currently Programmed gauge assignment for Analog Output option.

**Note**

At this time the gauge selection currently programmed for the Analog Output option is displayed. If this information is all that is desired, press ENTER key, and to exit keypad, press KEYBOARD key. To change the gauge selection continue with procedure.

c. Depress SELECT key repeatedly until desired gauge(s) for Analog Output option data is selected. (Refer to paragraph 1 to 4 above).

d. Depress ENTER key.
Display 1 - Function code 1,2,3, or 4.
Display 2- Blank.
Gauge indicator - Programmed gauge assignment for analog output for selected output and board.

e. Depress KEYBOARD key to exit keypad.



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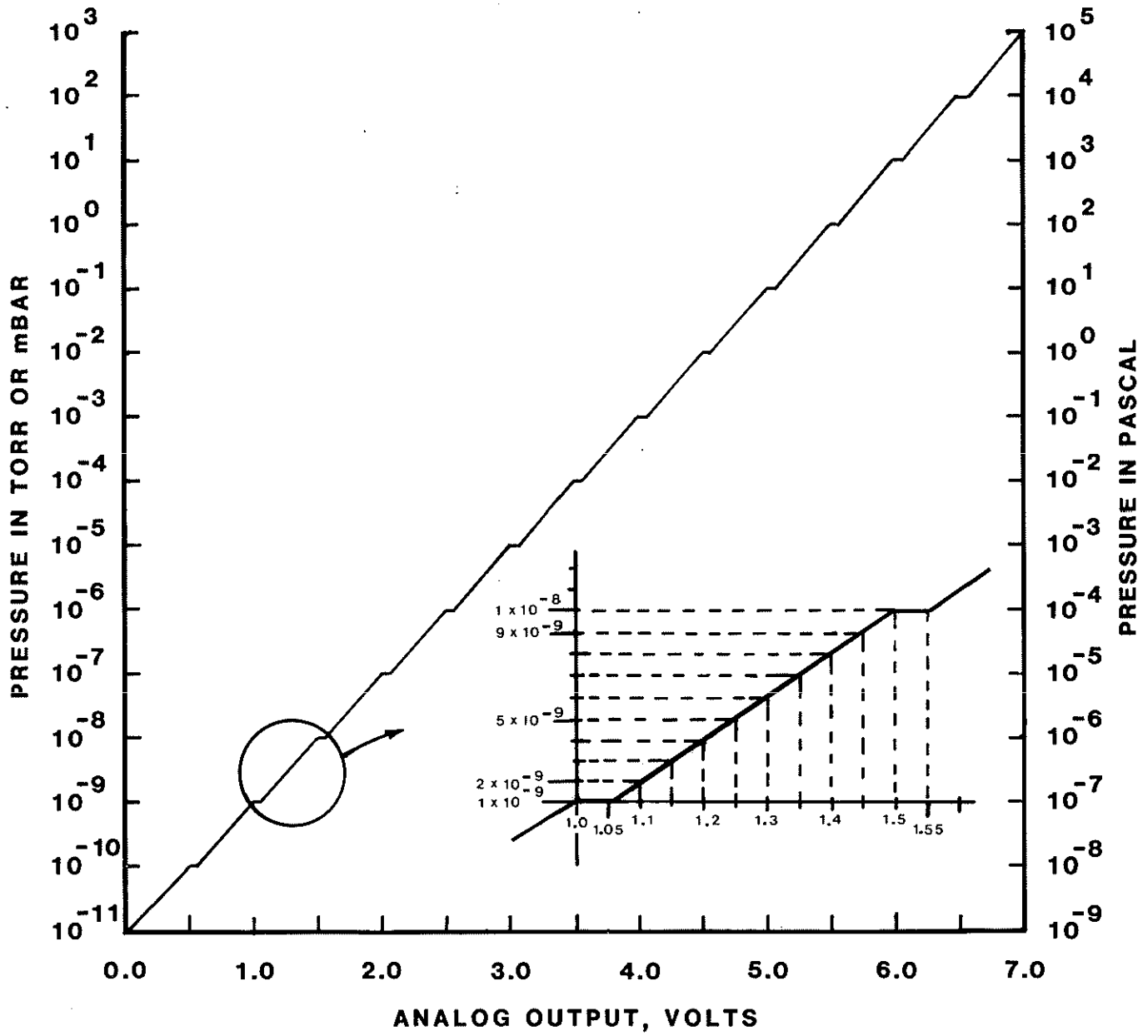



Figure 3-42. Analog Optional Pressure vs. Output Voltage

## 3-49. SETTING FACTORY PROGRAMMED VALUES

This function allows the operator to program the VPC to the original programming parameters as described in the preceding paragraphs. The VPC is factory programmed with these parameters.

It should be noted that when function code 0 is programmed, it may affect such systems and display parameters as degas time, process control status, emission current, overpressure shutdown, gauge sensitivity, unit of pressure, gas calibration, and computer interface terminators and control line definitions. Exercise due caution in using this function.

**Note**

This is a secured function. The security key must be green to make any change to programmed parameters. Refer to paragraph 3-17.



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Refer to Figure 3-43 for the controls and indicators used in this procedure.

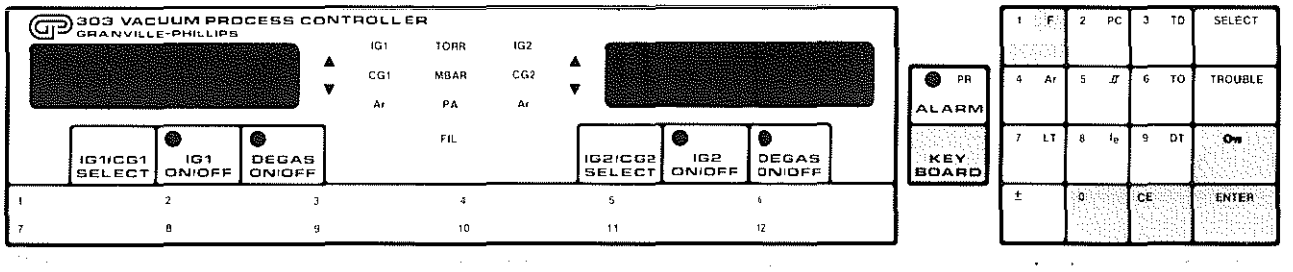



Figure 3-43. Controls and Indicators, Factory Programmed Values

a. Depress KEYBOARD key to activate keypad.
On keypad depress function key F. F indicator flashes.
Key in 0.

b. Depress ENTER key.
Display 1 - 0.
Display 2- Blank.
Security key - Red.

c. Wait approximately five seconds until the Security Key lights green.
(Note: for older versions of software there will be a power-on reset.)
Display 1 - 0.
Dissplay 2- Blank.
Security Key - Green.
Keypad - Functions are displayed.

d. Depress KEYBOARD key to exit keypad.

## 3-50. INVERTING THE RTS CONTROL LINE OF THE RS232 INTERFACE

Function codes F30 and F31 sets RTS line polarity of the RS232 interface board. Function 30 sets the Request to Send (RTS) line as it would normally be used to interface to a modem. Function 31 inverts RTS line polarity to allow interface control between the VPC and other equipment.

The VPC is factory-programmed to use this line as a modem interface control line, per the RS232C standard.

**Note**

This is a secured function. The security key must be green to make any changes to the programmed parameters. Refer to paragraph 3-17.

Refer to Figure 3-44 for the controls and indicators used in this procedure.



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# CHAPTER 4
# THEORY OF OPERATION

## 4.1 INTRODUCTION

This section provides the theory of operation for the VPC. Only basic theory of the VPC is provided and, where applicable, the theory is referenced to simplified schematics and block diagrams.

## 4.2 BASIC IONIZATION GAUGE TUBE OPERATION

The functional parts of a typical ionization gauge are the filament (cathode), grid (anode) and ion collector, shown schematically in Figure 4-1. These electrodes are maintained by the gauge controller at +30, +180, and 0 volts, respectively, with respect to ground.

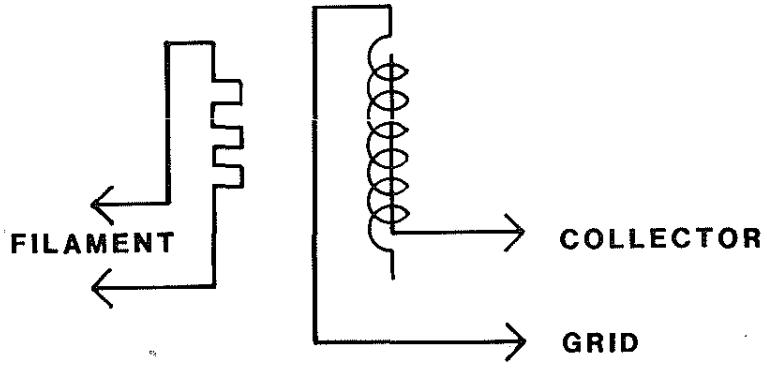



Figure 4-1. Simplified Schematic of Typical IG Tube

The filament is heated by alternating current to such a temperature that electrons are emitted, and accelerated towards the grid by the potential difference between the grid and filament. All the electrons eventually collide with the grid, but many first traverse the region inside the grid one or more times. When an energetic electron collides with a gas molecule, an electron is dislodged from the molecule, leaving it with a positive charge. Most ions are then accelerated to the collector. The rate at which electron collisions with molecules occur is proportional to the density of gas molecules, and hence the current of ions reaching the ion collector is proportional to the gas density or to the pressure of gas in the gauge at constant temperature.

The ion gauge controller, shown schematically in Figure 4-2, varies the heating current to the filament to maintain a constant electron emission, and measures the ion current to the collector. The pressure is calculated from these data by circuitry which is not shown.

During degas, the grid voltage is raised to 500 volts and the electron current is increased. The electrons acquire a high energy when accelerated through the potental difference between filament and grid, and strike the grid and ion collector thus heating these electrodes to a temperature sufficient to free them of contamination.



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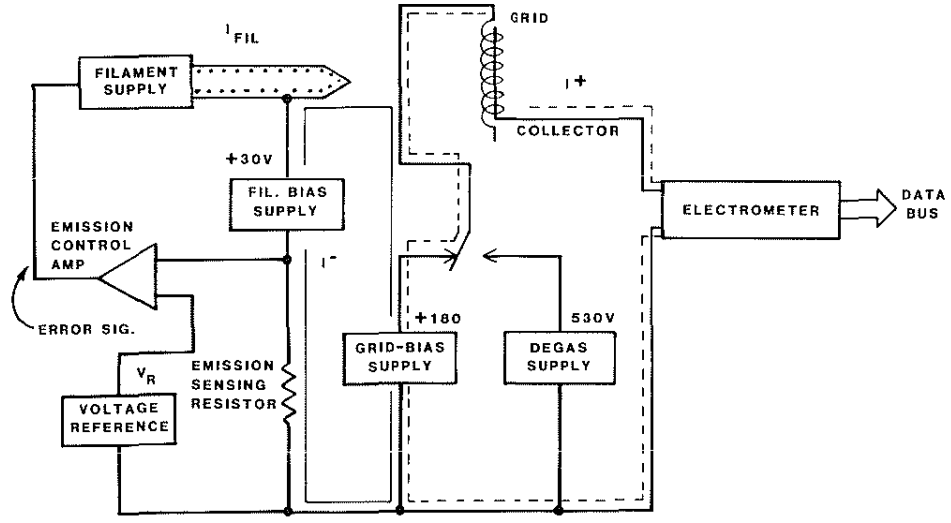



Figure 4-2. Simplified Block Diagram IG Controller

## 4-3. VPC BLOCK DIAGRAM DESCRIPTION

Figure 4-3, the block diagram for the VPC, illustrates the hardware architecture of the instrument. Each block interfaces to the CPU (central processing unit) through the digital databus. Some blocks which need to signal the processor on their own time schedule have interrupt connections to the processor. Some blocks have analog data which must be conveyed to the processor. These are connected to the analog bus which connects to a single A/D converter which, in turn, is interfaced to the processor. Some blocks are connected directly to the address bus so that 1/O (Input/Output) data can be transmitted and received directly. Thus, all activity in each functional block is controlled and monitored by the microprocessor in the CPU. All data is processed by the CPU before being sent out to displays or other outputs.



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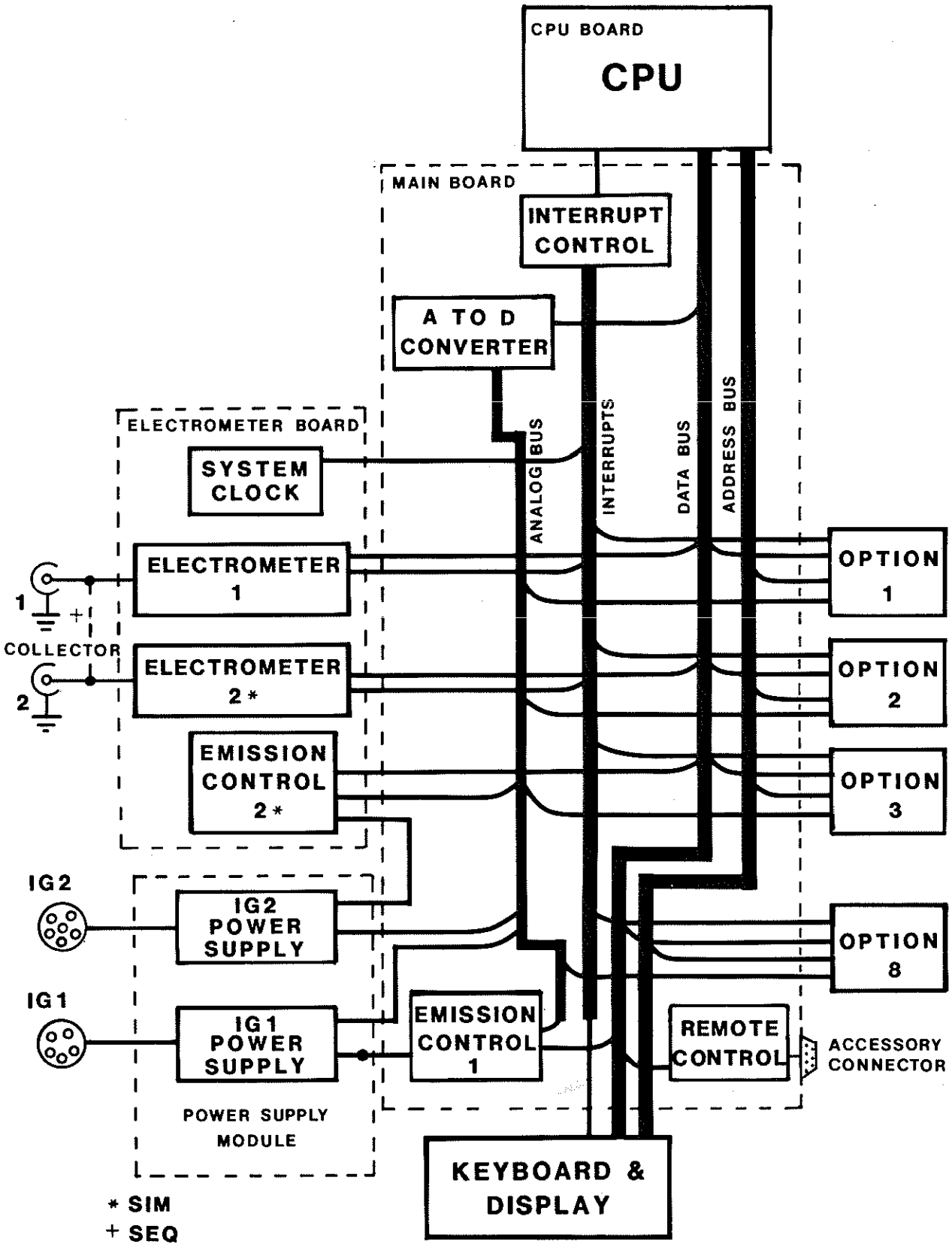



Figure 4-3. VPC Simplified Block Diagram



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## 4-4. VPC POWER SUPPLY

The power transformer provides all the low and high voltage sources for the instrument and gauges. The dual, tapped primary allows operation on 100, 120, 220, and 240 Vac sources. The ac power is passed through an rfi/emi filter upon entering the unit.

## 4-5. LOW VOLTAGE POWER SUPPLIES

The +5, +12, and -12 Vdc power are generated from full-wave rectifiers and IC regulators. The +5V supply, which is used for the logic, memory, and microprocessor circuits is protected from over voltage conditions by a metal oxide varistor and internal regulator circuits.

## 4-6. GRID BIAS POWER SUPPLY

The 180V grid bias is derived from a full-wave bridge rectifier and filter. The filtered dc voltage is regulated to +180V by individual series pass circuits for each of the two IG's. These circuits provide for short circuit current limit protection of about 15 mA, and can be switched on and off by the CPU.

The voltage on each grid is monitored by periodically switching the output of a voltage divider to the analog bus. In this way, the microprocessor can keep track of any improper voltage on the grid of the IG tubes and alert the operator if this occurs.

## 4-7. DEGAS POWER SUPPLY

The degas voltage of 530 Vdc is generated by a full-wave bridge rectifier, and is not filtered. Each IG channel has a relay which, when activated by the CPU, applies this high voltage to the grid lead, overriding the 180 Vdc bias. The degas supply is protected by a fuse Fl located on the rear panel and connected in series with the transformer degas winding.

## 4-8. IG FILAMENT VOLTAGE SUPPLY

The IG filaments are powered by separate filament windings. The filament voltage is regulated by a triac providing full-wave phase control switching. The triac is triggered by an optically-coupled trigger which is connected to the emission control circuit. Each filament circuit is protected by a fuse located on the rear panel.

## 4-9. CENTRAL PROCESSOR UNIT (CPU)

The 8085 microprocessor is the heart of the central processing unit. The operating system of the instrument is contained in permanent read-only memory IC. Programmed parameters are stored in an Electrically Erasable Programmable, Read-Only Memory (EEPROM). The microprocessor can erase and reprogram any one of the bytes of this memory which then stays intact even when power is removed. The address, data, and control signals which interface this board to the rest of the controller are buffered by line drivers. The data bus is used to send and receive data, thus requiring bi-directional devices which can both transmit or receive data under microprocessor command.

When power is first applied to the CPU, the power-up reset circuit connected to the reset input of the microprocessor causes it to begin the operating program in a controlled, repeatable fashion. The CPU performs several self checks on itself and on the instrument, and then initializes all functions for proper operation.



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The interrupt controller, although located on the main board, can actually be considered as part of the CPU. When an interrupt is transmitted to one of the interrupt controller's inputs, it conveys information to the microprocessor as to how to service the interrupt. Interrupts come from system clock ticks, electrometer data ready, keypad key closure, remote input commands, computer interface options to signal incoming data, and filament control voltage out of range.

## 4-10. A TO D CONVERTER

Analog voltages from the emission control circuit, grid voltage supply, and Convectron gauge option card are all processed by a common A to D converter. The converter is a 12-bit, dual/slope integrating device which interfaces directly to the microprocessor bus. The integration time is adjusted by the microprocessor to give optimum ac noise rejection depending on the ac line frequency. The A to D reference is derived from a 9V reference device which is divided and buffered to a 1.024 volt level. The converter is then set to read full scale (4,096 counts) at 2.048 volts input.

The differential input to the converter is connected to an analog bus. Voltages to be measured are sequentially switched into the two wire bus by analog CMOS switches. The switches are activated at the proper time by the microprocessor. The converter is then commanded to take a reading. When it is finished, it signals the data to the microprocessor, and another analog switch is then selected. The following voltages are read by the converter:

a. Voltages across emission sense resistors.

b. Emission sense amplifiers control voltages.

c. Grid voltages.

d. Convectron gauge bridge voltages.

## 4-11. EMISSION CONTROL CIRCUITS

The emission control circuit (refer to Figure 4-2) senses the voltage across the emission sensing resistor, compares it against a reference voltage derived from a D to A converter, and controls the phase angle of the trigger pulse to a filament control triac. The error signal from the emission sensing amplifier controls the charging current in the capacitor of a programmable unijunction transistor triac firing circuit. The greater the error signal, the faster the capacitor charges, and the sooner the firing threshold is obtained. The sync signal from the power supply resets the triggering cycle at each power line sine-wave zero crossing.

The proper emission sensing resistor is selected by the microprocessor by controlling the FET switches. The sensing resistor can be set to 20, 200, 2,000, or 20,000 ohms through software control.

The reference voltage is generated by a 4-bit DAC circuit. Sixteen discrete steps can be programmed from the microprocessor. With this ability, plus the ability to switch sensing resistors, the emission current can be regulated from 10 microamperes to 160 milliamperes.

The analog multiplexer can be set to connect either the voltage across the emission sensing resistor or the error voltage from the sensing amplifier to the A to D converter. The voltage across the sensing resistor is monitored to guarantee that emission is in regulation, and the error signal is monitored to indicate marginal filament conditions.



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The 30-volt filament bias is obtained by passing the emission current from the filament to the sensing resistors through a 30-volt regulator circuit consisting of a 27-volt zener, two diodes, and an NPN power transistor.

The emission control circuit for the second IG, when the simultaneous tube operation option "B"is installed, is located on the plug-in dual electrometer board.

## 4-12. ELECTROMETER

The electrometer converts ion current flowing from the IG collector to ground into a digital code which is transmitted to the microprocessor. This digital code is then converted to a pressure reading using the known tube sensitivity and the measured emission current. The VPC is designed to accept two electrometer card versions that allow the upgrading of 'A' version VPC to a 'B' version VPC. The 'A' version electrometer card accepts ion current only from the IG that is turned on. The 'B' version electrometer card allows the turning on of both IG's and accepts ion current from both gauges simultaneously.

## 4-13. KEYBOARD AND DISPLAY

Each LED used to backlight display graphics has its own latch/driver. Each seven-segment numeric display device has its own BCD-to-seven segment decoder/latch/driver. The microprocessor transmits data to these latches to control the display. For the individual LED's, each byte controls up to 8 indicators. For the numeric displays, each byte contains BCD data for two digits.

The keyboard circuitry detects the row and column contact pair of the keyboard matrix. A decoded 8-bit counter applies a signal to each row, one at a time. When a key is depressed, the signal appears on one of the column lines. At this time the counter is halted and an interrupt signals the processor to read the status of the row and column lines. This digital code is then translated by the processor into a particular command, and the appropriate response is performed. A short signal is also communicated to the beeper to give audio feedback each time a valid key is depressed.

## 4-14. REMOTE CONTROL

Four inputs are provided through the rear panel accessory connector for controlling filaments and degas remotely. When an input is grounded by either a contact closure or an active low logic state, the current path is completed through an LED inside an optical coupler. The coupler then drives logic circuits which interrupt the microprocessor in the same way as a key closure on the keypad. The microprocessor then interrogates the logic of the input circuits to determine which input has switched to ground. The microprocessor then resets the flip-flops in the input circuits so that the grounded input can remain and not be acknowledged until it returns high (open) and then low (closed) again.

Two SPDT relays are connected to this accessory connector to signal the status of each filament circuit. When a filament is turned on, the microprocessor latches the corresponding relay to its on state.

## 4-15. CONVECTRON GAUGE OPTION

The Convectron transducer is represented in Figure 4-4 as Rl, R2, R3, and R4. These four resistances form the legs of a bridge circuit, with R1 designating the sensor wire of the transducer. R2 is a resistive network in the tube which compensates for changes in the ambient temperature. At bridge null, Rl=R2xR3/R4. If there are no changes in ambient temperature, the value of R1 is a constant and the bridge is balanced.



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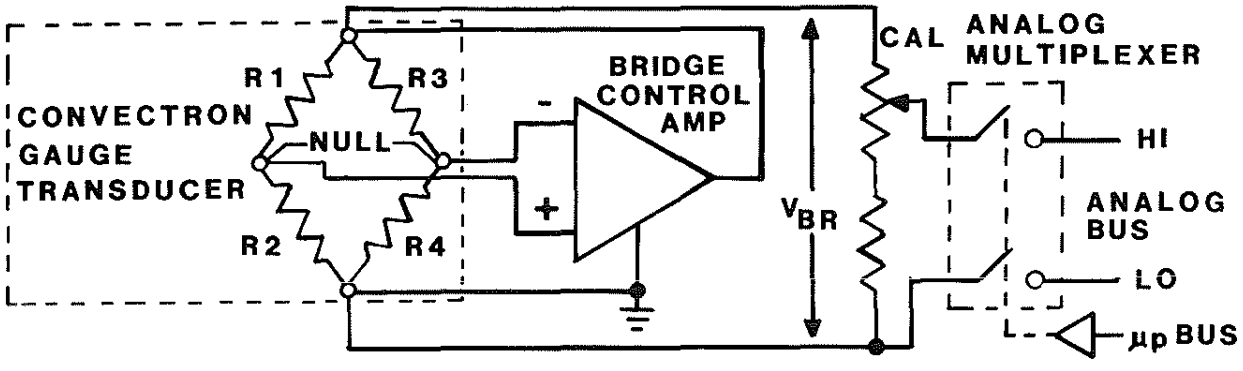



Figure 4-4. Simplified Schematic Convectron Gauge Option

As the vacuum system pressure is decreased, there are fewer molecules in the system to conduct the heat away from the sensor wire causing the temperature and resistance of Rl to increase. The increased resistance of R1 causes the bridge to unbalance and a voltage is developed across the null terminals. The bridge control circuit senses the null voltage and decreases the voltage across the bridge until the null voltage is again zero. When the bridge voltage is decreased, the power dissipated in the sensor wire is decreased causing the resistance of Rl to decrease to its previous value. The opposite events happen for a pressure increase. The bridge voltage is a non-linear function of pressure and the relationship is shown in Figure 4-5.

**WARNING**

Danger of injury to personnel and damage to equipment exists on all vacuum systems that incorporate gas sources or involve processes capable of pressurizing the system above the limits it can safely withstand.

For example, damage of explosion in a vacuum system exists during backfilling from pressurized gas cylinders because many vacuum devices such as ionization gauge tubes, glass windows, glass bell jars, etc., are not designed to be pressurized.

Install suitable devices that will limit the pressure from external gas sources to the level that the vacuum system can safely withstand. In addition, install suitable pressure relief valves or rupture disks that will release pressure at a level considerably below that pressure which the system can safely withstand.

Suppliers of pressure relief valves and pressure relief disks are listed in Thomas Register under the respective headings "Valves, Relief" and "Discs, Rupture".



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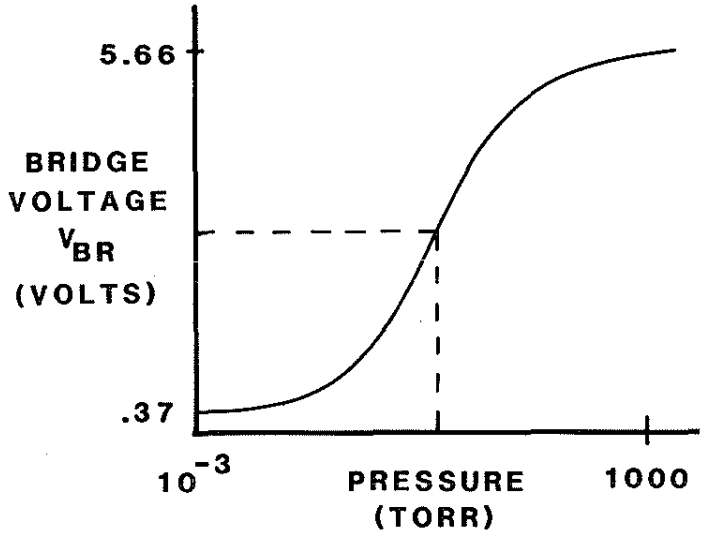



Figure 4-5. Convectron Gauge Bridge Voltage vs. Pressure

The bridge voltage is adjusted by the CAL adjustment before it enters the analog multiplexer switch to match the gauge's voltage curve exactly to the controller's A to D converter sensitivity. The microprocessor closes the analog switches at the appropriate time so the A to D converter can sample the voltage. The software contained in a ROM then converts the voltage reading to a pressure which is distributed to the display, data output options, and to the process control algorithm.

## 4-16. PROCESS CONTROL OPTION

Each process control option contains four data latch channels, four relay drivers, and four SPDT power relays. There is also the decoding logic required to interface with the microprocessor bus. The decoding logic is jumper selectable so that four relays on the option board will respond to pc channels 1-4, 5-8, or 9-12. When the processor decides to open or close a particular relay, a 0 or a 1 is transmitted to the appropriate data latch which, in turn, controls a relay driver and relay coil. The correct data pattern is transmitted to the data latches many times each second to ensure proper configuration at all times.

## 4-17. EXTERNAL ENABLE OPTION

The enable option senses a logic signal for each of the twelve possible process control channels to allow or prevent process control relay action. It also provides twelve individual logic outputs indicating the status of the twelve process control relays.

Enable/disable logic states are sensed by the microprocessor by addressing the three-state buffers whose inputs are connected to the logic inputs, and whose outputs are connected to the microprocessor data bus. Each input is pulled up by a resistor to the disable state. A TTL low or ground applied to the input represents the enable state.

The logic states of the twelve process control relay channels are latched on the outputs of the data latches which are addressed by the microprocessor and driven by the data bus. A low logic level represents an activated process control relay.



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## 4-18. BCD OUTPUT OPTION

The pressure data calculated by the microprocessor is converted into binary coded decimal form and then transmitted to the BCD output option board. The output data is transmitted to the option card from the microprocessor in five steps. First, a data update signal is toggled high to indicate that the data is about to be changed. Then, twenty-four bits of BCD pressure data and status data are loaded into the output data latches in three 8-bit bytes. Finally, the data update signal is reset to indicate that the new data is now ready and stable in the output latches.

## 4-19. ANALOG OUTPUT OPTION

The analog output option consist of two identical circuits capable of providing two simultaneous analog voltage signals. The voltages are a result of the summation of two independent digital-to-analog converters (DAC's). One DAC supplies a decade or exponent signal which increases 0.5 volt per decade. The other DAC supplies a linear in-decade signal which varies from 0 to 0.5 volt. Figure 4-6 is a simplified schematic which illustrates the analog process.

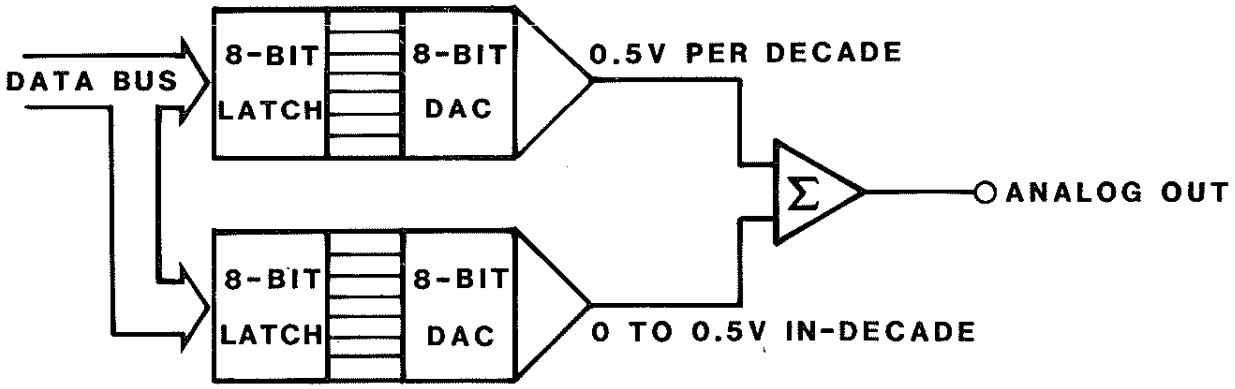



Figure 4-6. Simplified Analog Output Option Schematic

## 4-20. RS232C OPTION

The RS232C option is built around an Intel 8251A Programmable Comunications Interface chip. The asynchronous baud rate of this interface is selectable to 9,600 baud. The clock for these data rates is derived from the main board clock. Programmable memory resides on this board for use in controllers with old CPU boards. The 8251 is double buffered on both the transmit and receive data ports and performs all the bit checking and error detection required by a serial data link. The data protocol is switch selectable. For further information see a data sheet for the 8251 (USART).

## 4-21. IEEE 488 OPTION

The IEEE 488 Option is built around a Texas Instruments 9914 IEEEE 488 communications controller chip. The address decoding and much of the control line manipulation is handled by this chip. A single interrupt line is used for both the transmitted and received data. Programmed memory reside on this board for use in controllers with old CPU boards. For further information, see a data sheet for the 9914. The VPC and IEEE 488 option have the following interface capabilities as specified in the IEEE 488 standard. (SH1, AH1, T5, L4, SR1, RC2, PP1, DC1, E1, DT0, C0).



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# NOTES



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# CHAPTER 5
# MAINTENANCE

## 5-1. INTRODUCTION

This section provides the procedures that are recommended for user maintanance of the VPC. Granville-Phillips recommends that the user does not attempt to make any major repair to the VPC. This recommendation is based on the complexity of the VPC.

Granville-Phillips also recommends that the user either replace faulty printed circuit boards or return the faulty VPC to the factory for repair.

If system downtime is of prime concern to the user, it is recommended that a spare VPC or a set of spare printed circuit boards be maintained for immediate replacement. The parts listed in Chapter 6 allow the user to order the printed circuit boards and accessories, components, and hardware to make minor repairs. The following paragraphs provide information which will aid maintenance personnel in trouble analysis.

## 5-2. TROUBLESHOOTING GUIDELINES

**WARNING**

Voltages as high as 800V peak are present in the controller, on the cable, and at the IG tube during degas. Always turn off the power to the controller before connecting any cable to the controller or to the IG tube. Do not operate the controller ungrounded or near water. The VPC is intended for use only in a clean, dry laboratory environment. Operation in other environments may cause damage to the controller and reduce the effectiveness of the safety features.

Granville-Phillips recommends that the following guidelines be followed when performing any troubleshooting procedures involving the VPC.

a. Avoid placing any static charge on any component.

b. Use a grounded conductive work surface.

c. Use conductive envelopes to store or ship MOS devices or printed circuit boards containing them.

d. Do not operate the VPC with any MOS devices removed from the unit.

e. Do not handle MOS devices more than is absolutely necessary.

f. Do not use a ohmmeter for troubleshooting within the VPC. Rely on voltage measurements to analyze problems.

g. If necessary to use a soldering iron use a grounded-type only.



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## 5-3. OPERATOR TESTS

The operator can program the VPC to perform two self tests. One test sequences all the indicators on and off. The second test permits the operator to check the random access memory for proper functioning. These tests may be performed at any time and it is not necessary to enter a security code to perform the tests.

## 5-4. INDICATOR TEST

To perform this test, refer to Figure 5-1 for controls and indicators for the indicator test and proceed as follows:

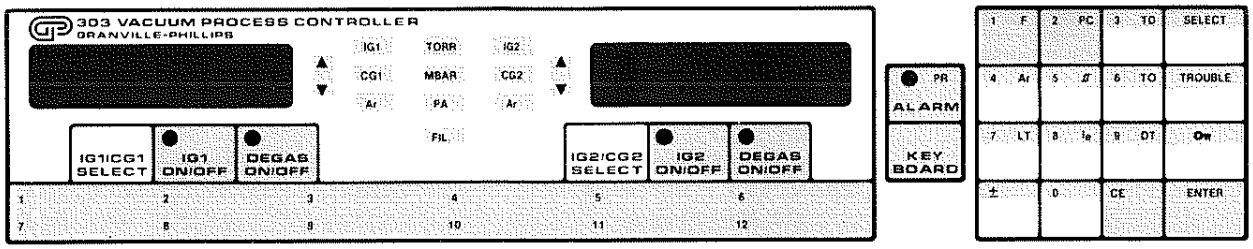



Figure 5-1. Controls and Indicators, Indicator Test

a. Press KEYBOARD key to access the keypad.

b. Press function key F. Key in 22.

c. Press ENTER key.

d. The LED indicator lamps and displays will sequence in four groups --on for three seconds. The groups will sequence in the following manner. If any of the indicators fail to light the Display Board is faulty and should be repaired.

   (l) Displays all 8's, +l's, all decimal points, IGl, CGl, Ar, TORR, MBAR, PA, FIL, IG2, CG2 and Ar indicators.

   (2) IGl ON/OFF, DEGAS ON/OFF, IG2 ON/OFF, DEGAS ON/OFF, ALARM, PR, and all PC digits on.

   (3) All keypad indicator lights, security key green.

   (4) All keypad indicator lights, security key red.

e. At the end of the tests (9 seconds) the keyboard will return to the function mode and Display 1 will contain 22.

f. To exit the keypad mode, press KEYBOARD key.



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## 5-5. RANDOM ACCESS MEMORY TEST

To perform this test, refer to Figure 5-2 for controls and indicators for the RAM test and proceed as follows:

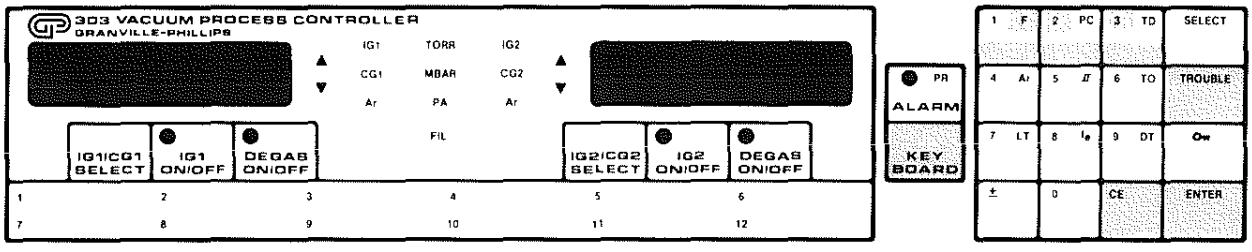



Figure 5-2. Controls and Indicators, RAM Test

a. Press the KEYBOARD key to enter the keypad mode.

b. Press function key F. Key in 23.

c. Press ENTER key.

d. If a fault is detected in the RAM, the TROUBLE indicator will turn on. The trouble code will be displayed and the system will halt.

e. If no fault is detected, the VPC will return to the keypad mode after several seconds.

f. To exit the keypad mode, press the KEYBOARD key.

## 5-6. TROUBLE INDICATORS AND CODES

The TROUBLE indicator alerts the operator to a VPC malfunction. The trouble code will either be automatically displayed or can be displayed depending on the nature of the trouble. Table 5-1 lists the trouble codes and definitions.



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Table 5-1. Trouble Indicators and Codes

| Mode | Trouble | Definition |
|---|---|---|
| a | 1 | BAD RAM |
| a | 2 | BAD NV RAM |
| a | 3 | BAD A/D CONVERTER |
| b | 4 | IG1 GRID VOLTAGE OUT OF RANGE |
| b | 5 | IG2 GRID VOLTAGE OUT OF RANGE |
| b | 6 | IG1 FILAMENT CONTROL EXCEEDED CAPABILITY |
| b | 7 | IG2 FILAMENT CONTROL EXCEEDED CAPABILITY |
| b | 8 | KEY STUCK ON KEYBOARD |
| c | 9 | MICROPROCESSOR READ BAD INSTRUCTION RST7 |
| c | 10 | MICROPROCESSOR RESET BY TIMED SUPERVISORY CIRCUIT |
| c | 11 | MICROPROCESSOR READ BAD INSTRUCTION |
| b | 13 | DEGAS FUSE BLOWN OR FAULTY DEGAS PARTS |
| b | 14 | HIGH VOLTAGE ON IG1 CONNECTOR WITH IG1 TURNED OFF |
| b | 15 | HIGH VOLTAGE ON IG2 CONNECTOR WITH IG2 TURNED OFF |

There are three modes with which the VPC responds to trouble conditions.

a. The 303 VPC will light the trouble light, turn off ion gauges and process control relays, and display the trouble code in the right hand display. The controller will cease operation until power is cycled.

b. The 303 VPC will light the trouble light but continue normal operation. The trouble light may turn itself off if the condition that caused the trouble indication goes away.

c. These trouble conditions will cause the 303 VPC to go through a power-up reset state as if the power on/off switch were cycled. This will cause all the ion gauges and process control relays to turn off.



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Listed below are all the trouble conditions and the possible faults that could cause each condition:

1. TROUBLE 1 - Bad RAM

   This is an indication that the Random Access Memory (RAM-U15) failed to test properly. The test is run when the unit is turned on and when a Function 23 is executed. Replace U15 if problem persists.

2. TROUBLE 2 - Bad NV RAM.

   This is an indication that the Non Volatile Random Access Memory (NV RAM U1 and U2) did not store information properly. These parts are where the selectable process and gauge parameters are stored. To clear the problem, push the keys KEYBOARD, F, O, ENTER to attempt to clear memory to factory defaults. You will have to reprogram all the selectable process and gauge parameters after doing this. If the problem persists, replace U1 and U2.

3. TROUBLE 3 - Bad A/D Converter

   This is an indication that the Analog to Digital Converter (U230) has either failed or is unable to read any valid input voltages. The suspect parts are U230, U233, and U236 on the main PC board and U606 on the Convectron board. This trouble could also be caused by a failed part on the data bus, or an analog input voltage that is too high.

4.-5. TROUBLE 4-5 - IG1-2 Grid Voltage Out of Range

   This is an indication that the grid voltage is outside of the acceptable range for normal ion gauge or degas operation. Refer to Section 5-9 Adjustment and Calibration of the Grid Bias Potential. If the problem persists, there is a problem with the parts in the 180V regulation circuit or the overcurrent protect circuit. See replaceable parts list for 180V regulator parts and current protect parts.

6.-7. TROUBLE 6-7 - IG1-2 Filament Control Exceeds Capablilty

   This is an indication that either your ion gauge filament is burned out or that the 303 VPC power supply is reaching its filament output power limits. This could indicate the filament is contaminated and can't maintain the selected emission current or there is a faulty part in the filament control circuit, or faulty connections between the VPC and the ion gauge.

8. TROUBLE 8 - Key Stuck on Keyboard

   This is an indication that the front panel keypad has a key which has not been released for 30 seconds. Since the keyboard is inoperative with a stuck key, the controller will halt operation and display 8 in the right hand display. You can replace the front panel with a 303 front panel replacement kit (P/N 008585) or return the unit to Granville-Phillips for repair.

9. TROUBLE 9 - Microprocessor Read Bad Instruction - RST7

   This is an indication that the microprocessor read an instruction code of FF hex from the data bus. This could be caused by electronic noise pickup by the VPC, a failed part,



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or a faulty socket or interconnection. The VPC will automatically restart as if the power were cycled off and on. The trouble light will remain on until the user presses the trouble key.

10. TROUBLE 10 - Microprocessor Reset by Timed Supervisory Circuit, i.e., (watch dog)

This is an indication that the 303 VPC went through a RESET cycle because it failed to execute the proper instructions within a specified time period. Since the VPC appeared inoperative, a Timed Supervisory circuit (watch dog timer) caused a reset of the microprocessor. This failure could be caused by any of the items mentioned in the Trouble 9 explanation and will follow the same display response as mentioned in Trouble 9.

11. TROUBLE 11 - Microprocessor Read Bad Instruction.

This indicates a failure similar to Trouble 9 with the data bus reading an invalid code other than FF hex. See Trouble 9 for further details.

13. TROUBLE 13 - Degas Fuse Blown

This is an indication of insufficient grid voltage during the degas operation of the ion gauge. This could be caused by a blown degas fuse (F1), a faulty overcurrent protection circuit, or a bad transformer. Check the F1 fuse or check for proper grid voltage during degas. 530V DC.

**WARNING**

Voltages as high as 800V peak are present in the controller. Do not touch any components in the power supply section of the 303.

14.-15. TROUBLE 14-15 - High voltage on IG1-2 Cable Connector with IG1-2 Turned Off

This is an indication that there is high voltage on the outputs of the IG1-2 connectors and a possible safety hazard could exist. This could be caused by a faulty degas relay (K501, 502) or a bad 180V regulator circuit. See replacement parts sections for further information.



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## 5-7. CONVECTRON GAUGE TUBE CLEANING

When the fine sensor wire becomes so contaminated with oil or other films that its emissivity or diameter is appreciably altered, a change in tube calibration will result. Cleaning with trichloroethylene, perchloroethylene, toluene, or acetone is possible, but it must be done very carefully so as not to damage the sensor.

**WARNING**

The fumes from trichloroethylene, perchloroethylene, toluene, and acetone can be dangerous to health if inhaled. They should be used only in well ventilated areas exhausted to the outdoors. Acetone and toluene are highly flammable and should not be used near an open flame or energized electrical equipment.

To clean the sensor wire, hold the gauge tube with the tube body horizontal and the port projecting upward at a 45 angle. Slowly fill it with solvent. As the tube becomes nearly full, turn the port vertical and fill completely. Allow the solvent to remain in the tube for at least 10 minutes. Do not shake the tube as liquid forces on the sensor can become large enough to affect the transducer calibration. After flushing one or more times, slowly pour out the solvent so that air may enter smoothly during pouring. Slowly rotate the tube and tip end-to-end to allow all the solvent to drain out. Then allow the tube to dry overnight with the port vertically downward and uncapped. Ensure that no solvent odor remains before reinstalling the gauge tube in the system. The tube can be baked at temperatures below 150°C.

## 5-8. TROUBLESHOOTING DATA

Tables 5-2 through 5-9 are symptom-to-probable cause troubleshooting tables. Analysis of the indicator and referencing applicable table will aid in the location of the malfunction.

Table 5-2. Input Power Faults

| Symptom | Possible Cause. |
|---|---|
| 1. All indicator lights out. No evidence of power to unit. | a. Input line fuse blown<br>b. Defective power outlet<br>c. Defective power cord<br>d. Power cord not connected<br>e. Ac source does not match line selection |
| 2. Input line fuse blows repeatedly. | a. Incorrect line fuse rating<br>b. Ac source does not match line selector<br>c. Defective power module assembly<br>d. Defective MOV voltage surge device |
| 3. Ac power to unit, but indicators are not on. | a. Defective ON/OFF switch.<br>b. Defective RFI/EMI filter, line selector/fuse holder unit<br>c. Defective power supply module |



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Table 5-3. Power Supply Faults

| Symptom | Possible Cause |
|---|---|
| 1. All indicator lights out. | a. +5V fuse on pc board for 5V supply blown<br>b. Poor edge connections to display, main circuit, or CPU pc boards |
| 2. Power supply output voltages missing or incorrect* value. | a. Defective power supply module<br>b. Poor contacts on:<br>(1) Printed circuit board edge connectors<br>(2) Power supply output connector<br>c. Internal circuit failure loading supply due to excessive drain<br>d. Defective gauge cable causing excessive drain |

| Value (Vdc) | Voltage limits (Vdc) | | |
|---|---|---|---|
| +5 | +4.85 | to | +5.25 |
| +12 | + 1 1.0 | to | +13.0 |
| -12 | -1 1 .0 | to | - 13.0 |
| +180 (grid 1 and 2) | +170 | to | +190 - filament on |
| | 0 | to | +30 - filament off |

Voltages are measured with respect to circuit or chassis ground.

*Correct voltage values are:
(Refer to Figure 5-3 for test point locations)

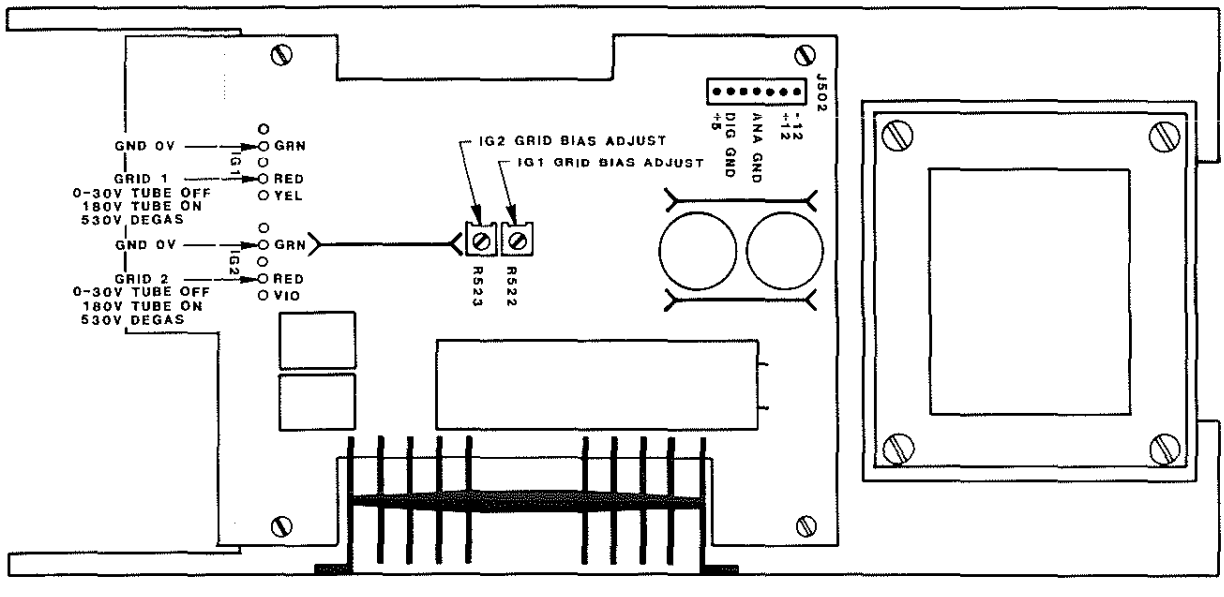



Figure 5-3. Voltage Test Points



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Table 5-4. Filament Turn-on Problems

| Symptom | Possible Cause |
|---|---|
| 1. No response to filament turn-on command. | a. Defective keyboard or keyboard connector<br>b. Defective display printed circuit board assembly<br>c. Defective main, CPU, or electrometer printed circuit board |
| 2. IG ON/OFF indicator lights for one second then turns off. | a. IG filament open<br>b. Incorrect connections to IG<br>c. Defective IG cable or connector<br>d. Filament circuit breaker or fuse open<br>e. Defective power supply module<br>f. Defective main, CPU , or electrometer printed circuit board<br>g. Defective 180V supply<br>h. Defective gauge tube<br>i. Pressure in the IG tube too high or above maximum pressure setting<br>j. Overpressure time delay too short<br>k. F28 or 29 enabled and CG at atmosphere |
| 3. Filament lights very bright as soon as power is applied to IG. | a. Defective power supply module<br>b. Defective main, CPU, or electrometer printed circuit board |

Table 5-5. IG Pressure Reading Problems

| Symptom | Possible Cause |
|---|---|
| 1. Pressure reads in $10^{-11}$ Torr range at all times, or 000. | a. Broken or disconnected collector cable<br>b. Defective electrometer printed circuit board |
| 2. Pressure reading is very inaccurate. | a. Defective collector cable<br>b. Electrical leakage in gauge cable or gauge<br>c. Unknown gas composition<br>d. Defective electrometer printed circuit board<br>e. Tube sensitivity improperly programmed<br>f. Dirty filament or tube |
| 3. IG filament turns off only at high pressures but below upper limit. | a. Upper limit improperly programmed<br>b. IG filament weak<br>c. Low ac line voltage<br>d. Badly contaminated tube<br>e. Defective main printed circuit board |



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Table 5-6. Degas Problems

| Symptom | Possible Cause |
|---|---|
| 1. Degas cannot be initiated. DEGAS ON/OFF switch does not respond. | a. Pressure above $5x10^{-5}$ Torr<br>b. IG filament is not on<br>c. Defective keypad<br>d. Defective keypad/display printed circuit board<br>e. Defective power module |
| 2. IG filament turns off once degas is initiated. | a. Weak IG filament<br>b. Blown degas fuse<br>c. Defective power supply module, current limit circuit or transformer<br>d. Degas power set beyond IG's own emission limit<br>e. Badly contaminated tube |

Table 5-7. Convectron Gauge Option Problems

| Symptom | Possible Cause |
|---|---|
| 1. Blank or flashing CG display. | a. Convectron option printed circuit board not fully plugged in<br>b. Defective Convectron gauge cable<br>c. Defective Convectron gauge tube*<br>d. Defective Convectron gauge option assembly |
| 2. Incorrect pressure indication. | a. Convectron gauge tube elements contaminated (refer to paragraph 5-7)<br>b. Faulty CG tube calibration Replace tube<br>c. Faulty CG controller calibration (refer to paragraph 5-9)<br>d. Gauge tube not properly mounted or subject to vibration or temperature extremes (refer to paragraph 2-14)<br>e. Unknown gas being measured (refer to paragraph 3-14)<br>f. Faulty CG cable<br>g. Faulty CG option printed circuit board assembly<br>h. Reactive gas has altered tube characteristics |

*Resistance checks for CG tube:



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Do not perform electrical continuity tests on the tube with instruments applying voltages in excess of 1 volt when the tube is at vacuum, or 5 volts when at atmospheric pressure. Exceeding these voltages will damage the sensing element.

| Pins | Resistance |
|---|---|
| 1 to 2 | 20 to 30 ohms |
| 2 to 3 | 50 to 60 ohms |
| 1 to 5 | 175 to 190 ohms |
| Any pin to envelope | Open circuit |

If the resistance from pin 1 to 2 is approximately 800 ohms, the sensor wire in the tube is open.

Table 5-8. Process Control Option Problems

| Symptom | Possible Cause |
|---|---|
| 1. Process control will not activate. PC channel indicator(s) will not light. | a. External enable signal absent<br>b. Defective external enable option printed circuit board |
| 2. Process control will not activate. PC channel indicators light steadily, but process control relay will not operate. | a. Defective process control option printed circuit board<br>b. Process control relay defective |
| 3. Process control activity at wrong set points or times. | a. Incorrect programming<br>b. Defective CPU printed circuit board |

## 5-9. ADJUSTMENT AND CALIBRATION

All adjustments and calibrations are adjusted to specifications and sealed during final factory tests, and should require no further adjustment. If some readjustment becomes necessary, proceed with the following steps.

1. CONVECTRON GAUGE CALIBRATION

The Convectron gauge atmospheric and zero vacuum adjustments are factory set for a factory-calibrated Convectron gauge tube. Recalibration may be required due to contamination of the tube. To perform this procedure, proceed as follows:

a. Apply power to the VPC and perform the procedure listed in paragraphs 3-5, 3-6 to display CG1 and CG2 on the displays.

**Note**

Both Convectron gauges must be at atmospheric pressure.

b. Allow the Convectron gauges to stabilize for approximately 15 minutes.



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c. On the metal plate of the Convectron gauge option printed circuit board are two adjustment access holes. One, below the gauge connector, allows access to the potentiometer for CGl adjustment. The hole above the connector allows access for adjustment of CG2.

d. With both Convectron gauges stabilized and at atmospheric pressure, adjust CGl and CG2 until the displays indicate atmospheric pressure.

e. Pump the system down until the pressure is well below 1 x $10^{-3}$ Torr.

f. Enter the keypad mode by pressing KEYBOARD key.

g. Depress function key F. Key in 27.

Note

This is a secured function. Security key must be green to make any changes to programmed parameters. Refer to paragraph 3-17.

Figure 5-4. Illustrates the controls and indicators used in the Convectron gauge zero

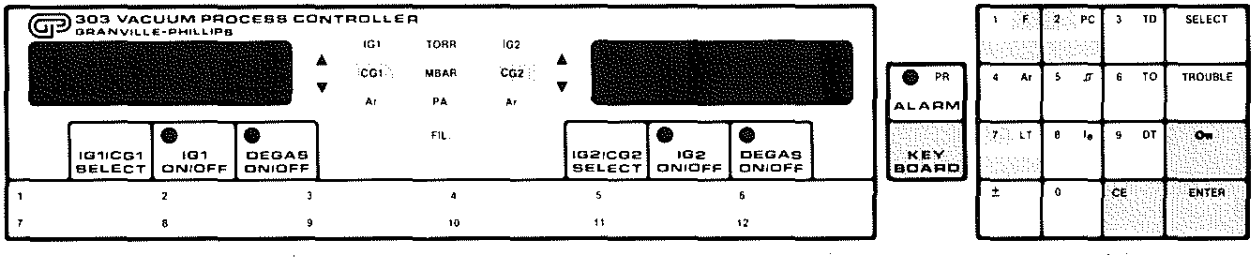



Figure 5-4. Controls and Indicators, Convectron Gauge Zero

h. Depress SELECT until CG1 indicator is lighted.

i. Depress ENTER.

j. Perform steps g through i for CG2.

This procedure has calibrated the CG tubes for the local atmospheric pressure and stored an offset value in the nonvolatile RAM which corresponds to a zero pressure reading for each Convectron gauge.



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2. AUDIO TRANSDUCER VOLUME

The volume of the audio "beeper" can be adjusted by rotating the potentiometer located on the main board in the location shown in Fig. 5-5.

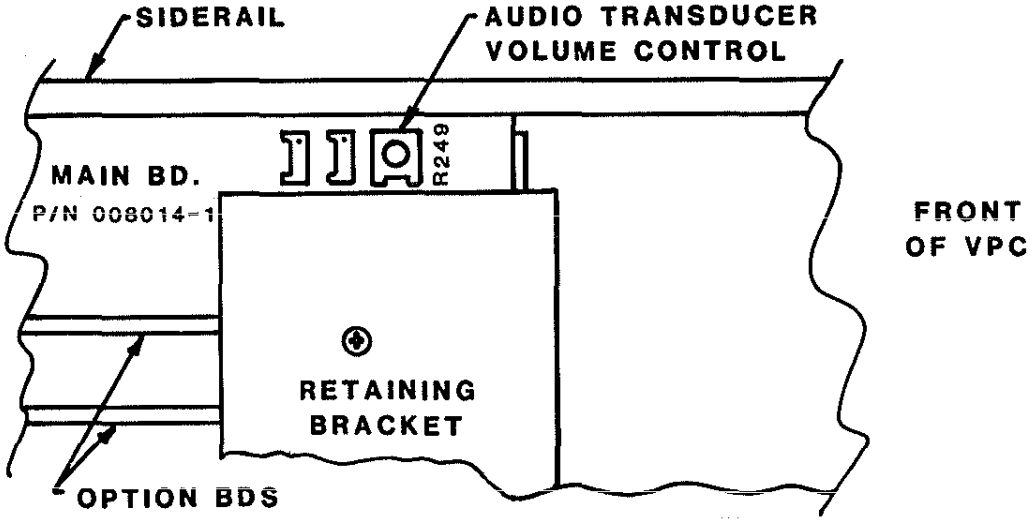



Figure 5-5. Audio Transducer Volume Control

3. GRID BIAS POTENTIAL ADJUSTMENT

The grid bias potential for IG1 and IG2 are factory calibrated to 180 volts dc ± 10 volts relative to the collector. This is the nominal voltage specified for most Bayard-Alpert type ionization gauges. Some gauges however, are specified to operate at a different grid potential. These gauges can be operated with the VPC by adjusting the grid bias potentiometers. Refer to Figure 5-3 for the locations of the adjustment potentiometers and the voltage test points to set this parameter. An adjustment range of 135 to 200 volts dc is available.

4. ANALOG OUTPUT CALIBRATION

For 303 VPCs equipped with a new vertical mount CPU Board, there is a function which allows the Analog Output option board to be calibrated. This function is also useful for chart recorder setup and calibration. To perform this procedure, proceed as follows:

Refer to Figure 5-6 for controls and indicators used in this procedure.

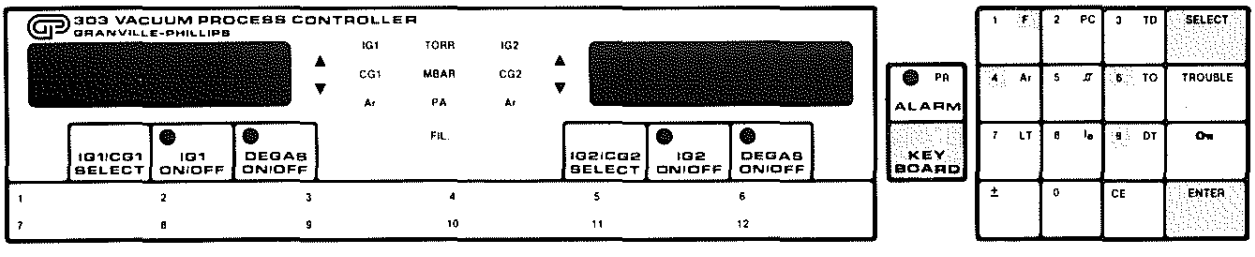



Figure 5-6. Controls and Indicators for Analog Output Calibration

a. Depress KEYBOARD to activate the keypad.

b. On the keypad, depress the function key F. F indicator flashes.



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c. Key in 64 for second level functions.

d. Depress ENTER
Display 1 & 2 - BLANK

e. Depress the function key F. F indicator flashes.

f. Key in 94 for Analog Output calibration.

g. Depress ENTER.
Display 1 - 94
Display 2 - BLANK

h. **Note**

At this point the output voltage should be 7Vdc. If it is not, calibrate it by adjusting R814 for output 1 (pins 7 to 6) or R810 for output 2 (pins 5 to 4). (Refer to Figure 2-8 for potentiometer locations).

i. Depress SELECT.

**Note**

At this point the output voltage should be .5Vdc or the max output range of the analog output. If it is not, calibrate it by adjusting R816 for output 1 (pins 7 to 6) or R812 for output 2 (pins 5 to 4). (Refer to Figure 2-8 for potentiometer locations).

j. Depress SELECT

**Note**

At this point the output voltage should be 6.25 Vdc which equates to a pressure reading of $5.0 \times 10^{+1}$ Torr. If the calibration is not correct or if you want to calibrate a different output, depress SELECT and return to step h for further instructions.

k. Depress ENTER.

l. Depress KEYBOARD key to exit keypad.



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## 5-10. CHECKING SOFTWARE REVISION LEVEL

This procedure allows the checking of the software revision level from the front panel. This is helpful in determining why certain programming functions may not be enabled in your VPC.

To perform this procedure, proceed as follows:

Refer to Figure 5-7 for controls and indicators used in this procedure.

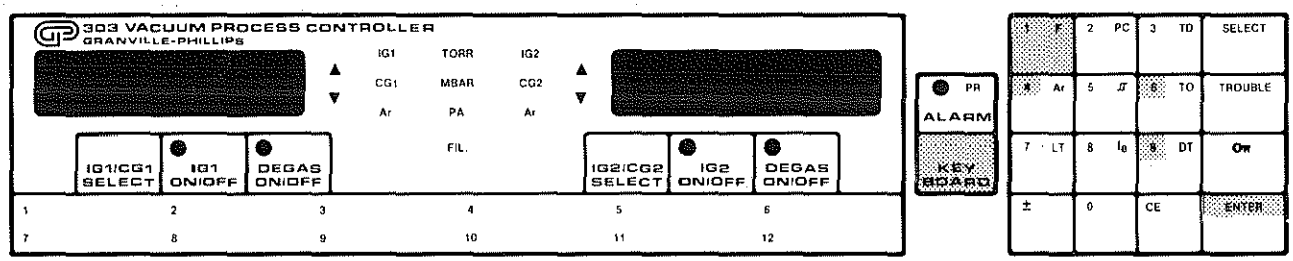



Figure 5-7. Controls and Indicators for Checking Software Revision.

a. Depress KEYBOARD key to activate the keypad.

b. On the keypad, depress the function key F. F indicator flashes.

c. Key in 64 for second level function.

d. Depress ENTER
Display 1 & 2 - Blank

e. Depress function key F. F indicator flashes.

f. Key in 91 for Software Revision number.

g. Depress ENTER
Display 1-6
Display 2- Software Revision Code.

h. Depress KEYBOARD key to exit keypad.

See Table 5-1 for further explanations of revision codes.



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Table 5-9. Software Revision Code Descriptions

| REVISION | CHANGE DESCRIPTION. |
|---|---|
| 1.- 4. | Various improvements and fixes. |
| 5. | Additional functions: F28-F31 PC ON/OFF.<br><br>Change in functions: continuous pressure output over RS232 when in keypad mode. |
| 6.- 8. | Various improvements and IEEE 488 interface release - High Resolution added to CG display. |
| 10.- 14. | Additional functions: F32-F37 F40-F52 F70-F82.<br>Change in functions: F12, F0 after Trouble 2.<br>Introduction of New Vertical mount CPU board. |
| 15.- ON | Additional functions F64 F94.<br>All software and future revisions reside on one memory part for the CPU and all options<br>Revised Trouble Code list.<br>Security code programming from the front panel. |



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# CHAPTER 6
# REPLACEABLE PARTS LIST

## 6-1. GENERAL

This chapter contains the recommended replaceable parts for the VPC.

## 6-2. REPLACEABLE PARTS LIST

Table 6-1 lists the replaceable parts for the VPC. The list provides a part description, electrical/mechanical specifications as applicable, vendor, and vendor part number as applicable and Granville-Phillips part or catalog number.

Table 6-1. Replaceable Parts List

| Part Description | Vendor-Part No. | Granville-Phillips Part or Catalog No.* |
|---|---|---|
| Power Module Assembly | | 008081 |
| Fuses/Circuit Breakers | | |
| Linefuse for 100/120 Vac, 3A, SB, 3AG | Littelfuse 313003 | 008238 |
| Linefuse for 220/240 Vac, 1.5A, SB, 3AG | Littelfuse 31301.5 | 008239 |
| Degas Fuse .25A, NB | Littelfuse 312250 | 006979 |
| Degas Fuse Holder | Schurter FEC 031.1603 | 008327 |
| Degas Fuse Carrier, 3AG | Feller AG FEC 031.1613 | 008328 |
| 5V Supply Fuse, 5A, 250V, 3AG | Littelfuse 321005 | 008179 |
| 5V Fuse Holder, PC Board Vertical Mtg Current rating 3A.250V | Schurter FAC 031.3803 | 007103 |
| 5V Supply Fuse Carrier | Schurter FEK 031.1666 | 006966 |
| Filament Circuit Breaker, 6A<br>Replace with | Heinman KD1-6<br>Kit, Fuse | 008103<br>303057 |
| Filament Fuse 6 Amp MB<br>Varistor 5.5 Vdc<br>Varistor 130 Vdc<br>Varistor 910 | Littelfuse 314006 | 002278<br>008310<br>0078559<br>009384 |
| Assembly Rear Panel | | 008078 |



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Table 6-1. Replaceable Parts List (Cont.)

| Part Description | Vendor-Part No. | Granville-Phillips Part or Catalog No.* |
|---|---|---|
| Power Cord 115V (U.S.) | Electro-cords # E1015(8.0) | 006444 |
| 230V (CEE(7)) | Electro-cords # 2123-02MGY | 006971 |
| Connector, Power with Voltage Selector and Filter | Corcom 6JA | 008098 |
| Degas Relay, SPDT, 12V, 320 ohms, 6A Contacts | American Zettler AZ8-ICH 12 DE<br>ITT Components LZ-12HC<br>Deltrol Controls 425-IC- 12VDC | 008035 |
| Power Transformer | | 008196 |
| Kit Retrofit Transformer | | 008560 |
| Power Switch ON/OFF AC Switch, Rocker SPST | Alcoswitch XR-llOA 02<br>Carling TA 201-T<br>- Black Bezel-Red Rocker | 008099 |
| Power Module Printed Circuit Board Assembly | | 008036 |
| 180V Regulator Parts | MJE340 | 005232 |
| 5.1V Zener | 1N4733A | 005228 |
| Overcurrent Protection | BUZ50B Power Fet | 008444 |
| | MOC3010 | 008031 |
| | 1N4735 | 005995 |
| | EG200 Diodes | 004383 |
| | 30V Surge Protector | 009095 |
| Filament Triac, Silicon Bi-directional Thyristor, Peak blocking E-200 V min., RMS conduction 1-15 A min. at 80° C. Case T0-220 | Triac Assembly | 007943 |
| Regulator, IC Regulator, 5V, 5A | Fairchild MA78H05KC | 008197 |
| CPU Printed Circuit Board Assy. | | *303062 |



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Table 6-1. Replaceable Parts List (Cont.)

| Part Description | Vendor-Part No. | Granville-Phillips Part or Catalog No.* |
|---|---|---|
| Main Printed Circuit Board Assy. | | 008084 |
| Filament Status Relay, SPDT 24V, 128 ohms, 6A Contacts | American Zettler AZ8-ICH-24DE<br>ITT Components LZ-24HC<br>Deltrol Controls 425-IC-24VDC | 008150 |
| Analog Switch | Motorola 4066 | 008116 |
| 27V Zener | 1N4750 | 008294 |
| 5.1V Zener | 1N4733 | 005228 |
| A/D Converter | 7109 12 Bit | 007109 |
| Interrupt Controller | 9519A | 008160 |
| Connector, Accessory, Right Angle, subminiature D-type, 15-Pin Plug with Socket Type Contacts | ITT Cannon DAP-15SCA<br>Holmberg H2R15RA282 | 008010 |
| Accessory Cable Connector 15-Pin Female | ITT Cannon DA15S | 005414 |
| Shell, Connector with Cable Clamp | ITT Cannon DA-51211 | 005415 |
| Front Panel Assembly | | 008076 |
| Adhesive Process Control Overlay | | 008347 |
| Display Printed Circuit Board Assy. | | 008077 |
| Seven Segment Display | HP-5082-7653 | 005549 |
| ± 1 Display Element | HP-5082-7656 | 008130 |
| Red LED, T-1-3/4 | HP-HLMP-3390 | 008302 |
| Yellow LED, T-1-3/4 | HP-HLMP-3490 | 008131 |
| Red LED, Rectangular Bar, Short | HP-HLMP-2300 | 008133 |
| Red LED, Rectangular Bar, Long | HP-HLMP-2350 | 008165 |
| Yellow LED, Rectangular Bar, Long | HP-HLMP-2450 | 008132 |
| Red-Green LED, T-1-3/4 | Xciton SC-4591 | 008164 |
| Audio Transducer (Old)<br>(New) | Project Unlimited AT-20S<br>AT-23K | 008144<br>008393 |
| Electrometer A (Single) Printed Circuit Board Assy. | | 008088 |
| Electrometer B (Double) Printed Circuit Board Assy. | | 008086 |
| BNC Jack | Amphenol 31-221 | 000608 |



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Table 6-1. Replaceable Parts List (Cont.)

| Part Description | Vendor-Part No. | Granville-Phillips Part or Catalog No.* |
|---|---|---|
| Process Control Option Printed Circuit Board Assy. | | *303014 |
| Process Control Relay | American Zettler AZ8-ICH-24DE<br>ITT Components LZ24HC<br>Deltrol Controls 425-1C-24VDC | 008150 |
| Process Control Option Cable Connector Kit | | 008264 |
| Process Control Printed Circuit Board Connector, Right Angle, 15-Pin | ITT Cannon DAP-15PCA | 008152 |
| Jumper Socket, 2-Pin | | 006891 |
| Convectron Gauge Option Printed Circuit Board Assy. | | *303013 |
| Fuse, Resistor, 15 ohm, 5%, 1/8 W, Carbon Comp. (Replace with PTC) | Allen-Bradley RC05 | 005548<br>009228 |
| Analog Switch (Older Units) | 4066 Cmos | 008116 |
| Analog Switch (New Units) | DG212 | 009545 |
| Printed Circuit Board Connector, Right Angle subminiature D Type 15-Pin, Plug with Socket type Contacts | ITT Cannon DAP-15SCA<br>Holmberg H2R15RA28AZ | 008010 |
| Printed Circuit Board Connector | ITT Cannon DA-15P | 008250 |
| Connector Shell | Amphenol 17-1588-06 | 008247 |
| Jackpost kit | ITT Cannon D110551 | 008139 |
| BCD Output Option Printed Circuit Board Assy. | | *303017 |
| Option Connector kit | | 008267 |
| Connector, Plug, 25 Sockets, Right Angle, PC Board Mount. | ITT Cannon DBPL-25SCA | 008211 |
| Plug, Jumper | Berg 65474-001 | 006891 |
| Jackpost kit | ITT Cannon D 110551 | 008139 |



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Table 6-1. Replaceable Parts List (Cont.)

| Part Description | Vendor-Part No. | Granville-Phillips Part or Catalog No.* |
|---|---|---|
| Analog Output Option Printed Circuit Board Assy. | | *303018 |
| Option Connector Kit | | 008268 |
| Connector, Plug, 9 Sockets Right Angle, PC Board Mount | ITT Cannon DEP-095CA Holmberg H2RO9RA28A2 | 008153 |
| Plug, Jumper | Berg 65474-001 | 006891 |
| Jackpost Kit | ITT Cannon D110551 | 008139 |
| RS232C Output Option Printed Circuit Board Assy. | | *303016 |
| Option Connector Kit | | 008266 |
| Connector, Plug, 25 Sockets, Right Angle, PC Board Mount | ITT Cannon DBPL-25SLA | 008211 |
| Plug, Jumper | Berg 65474-001 | 006891 |
| Jackpost Kit | ITT Cannon D110551 | 008139 |
| External Enable Option Printed Circuit Board Assy. | | *303015 |
| Option Connector Kit | | 008265 |
| Connector, Receptacle, 25 Pin, Right Angle, PC Board Mount | ITT Cannon DBP-25PCA | 008113 |
| Jackpost Kit | ITT Cannon D110551 | 008139 |
| IEEE488 Output Option Printed Circuit Board Assembly | | *303020 |
| IG Connector Parts | | |
| Connector Body | Amp 206044-1 | 008272 |
| Shell and Cable Clamp | Amp 206070-1 | 008274 |
| Connector Pins | Amp 66589-1 | 008102 |

## 6-3. ACCESSORY CABLES

Various cable lengths are available for both ionization gauge and Convectron gauge tube installations. For operation of ionization gauge tubes, two cables are required for a VPC installation. One Convectron gauge cable operates two Convectron gauge tubes. Table 6-2 lists the cables available for ionization gauge tube installations, and Table 6-3 lists the Convectron gauge tube cables.



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Table 6-2. Ionization Gauge Tube Cables

| Cable Description | Granville-Phillips Catalog No. |
|---|---|
| Shielded, molded connector. | |
| Fit tubulated gauges. | |
| 10 feet (3m) | 303022 |
| 25 feet (8m) | 303023 |
| 50 feet (15m) | 303024 |
| Shielded, separate pin connectors. | |
| Fit nude tubes. | |
| 10 feet (3m) | 303026 |
| 25 feet (8m) | 303027 |
| 50 feet (15m) | 303028 |
| Fit Varian 564 gauge. | |
| 10 feet (3m) | 303036 |
| 25 feet (8m) | 303037 |
| 50 feet (15m) | 303038 |

Table 6-3. Convectron Gauge Tube Cables

| Cable Length | Granville-Phillips Catalog No. |
|---|---|
| 10 feet (3m) | 303030 |
| 25 feet (8m) | 303031 |
| 50 feet (15m) | 303032 |
| to 599 feet (116m) | 303040 |

Note: Each cable operates two Convectron gauge tubes.

Table 6-4. IEEE488 Cables

| Cable Length | Granville-Phillips Catalog No. |
|---|---|
| 1 Meter | 303042 |
| 2 Meter | 303043 |
| 4 Meter | 303044 |



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## 6-4. REPAIR ORDERING INSTRUCTIONS

A repair order should accompany returned equipment even when the equipment is being returned for warranty repairs at no charge. This should include a detailed description of the problematic symptoms in addition to the telephone number and address where we may contact you. Equipment returned for repair should be carefully and strongly packaged to withstand shipping abuse. Components or printed circuit boards to be returned separately should be protected against static damage by wrapping them in static proof containers or in aluminum foil prior to packaging them for shipment. Address replacement/repair orders and correspondence to Granville-Phillips Company, Service Department, 5675 East Arapahoe Avenue, Boulder, Colorado, 80303. Telephone: (303) 443-7660, Telex No: 45-791, FAX (303) 443-2546.

If a replacement printed circuit board is desired, it is important that you give the Service Department the complete part or catalog number of the board, as well as the catalog number and, model number for your VPC. This will ensure that you receive the correct replacement.

**NOTE**

Under no circumstances will Granville-Phillips be liable for shipping damages due to rough handling, improper packaging, or other circumstances beyond its control.

All return shipments must be freight prepaid.



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