PPC1™
Positive Shut-Off Pressure Controller
User's Manual

911100
550045
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NOTES

CHAPTER 1 - INTRODUCTION

1.1 PRODUCT OVERVIEW

The Positive-Shutoff Pressure Controller, PPC1, is a self-contained pneumatic pressure setting system intended for the precise setting and stabilization of pressures in leak-free volumes using local front panel or remote commands from a computer. An RS 232 interface is included as a standard feature and a GPIB (IEEE-488) interface is available as an option.

Unlike pressure controllers which are "dynamic" controllers operating by adjusting a constant leak, the PPC1 inlets and exhausts very precise amounts of pressure and will shut off completely when a pressure is set. Thus, it sets truly static pressure.

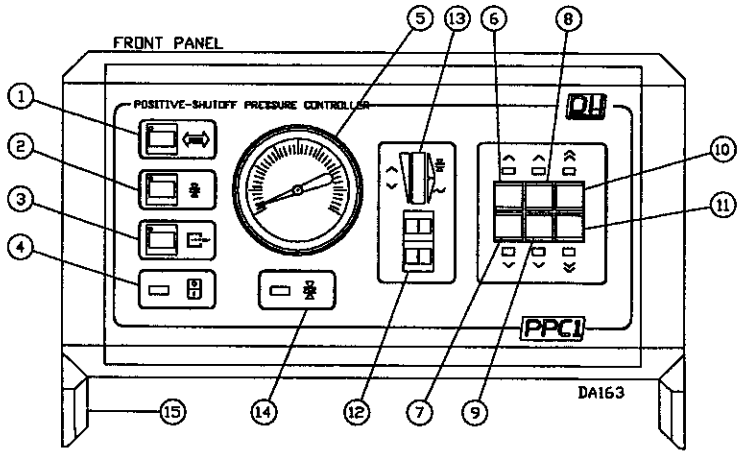
The PPC1 is designed primarily as a versatile, easy-to-use pressure control component in calibration systems using a pressure transducer or a DHI Type 20000 digital piston gauge as a reference. When used with an external pressure measuring device with an RS 232 interface, the external device can be connected to the PPC1 and used as the PPC1 control signal. The external device can also be read through the PPC1. Other uses for the PPC1 are to input pressure and float a traditional piston gauge, or to precisely set, maintain or cycle pressure into any closed volume.

A second model, PPC2, includes a built-in quartz pressure transducer to provide on-board high resolution and high accuracy.

1.2 LOCATION OF THE COMPONENTS

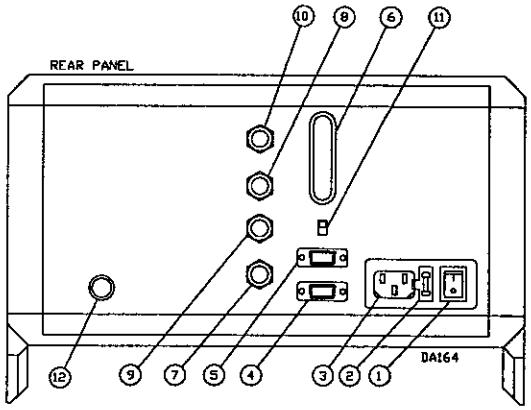
FRONT PANEL

1) Local/remote mode selector
2) Pressure hold push-button
3) Vent push-button
4) Power indicator
5) Pressure gauge
6) Pressure increase push-button - pulse mode
7) Pressure decrease push-button - pulse mode
8) Pressure increase push-button - slow speed
9) Pressure decrease push-button - slow speed
10) Pressure increase push-button - fast speed
11) Pressure decrease push-button - fast speed
12) Multi-function selector (pulse duration, stability, hold)
13) Multi-function indicator (pulse setting, hold setting, stability limit)
14) Stable reading indicator
15) Folding foot



REAR PANEL

1) Power switch
2) Main fuse
3) Power receptacle
4) RS 232 port (COM2)
5) RS 232 port (COM1)
6) IEEE 488 port (optional)
7) Supply pressure connection; 1/8" NPTF
8) Test connection; 1/8" NPTF
9) Reference connection; 1/8" NPTF
10) Vent connection; 1/8" NPTF
11) Interface selector switch
12) Joystick (optional)



1.3 SUBASSEMBLY DESCRIPTION

- **Pneumatic Module** - Modularized pneumatic assembly mounted to the right inner wall of the PPC1. The module consists of two flow controllers, one for the inlet and one for the outlet of the pressure controlling system, solenoid valves for the selection of the pressure ramping mode and frequency control, and specially tuned restrictors to control the response rate of the flow controllers and system pressure changes.

- **Power Supplies** - Two separate card-mounted power supplies are used in the PPC1 to allow isolation between different signals. One power supply has outputs of +5 VDC, +12 VDC, and -12 VDC. The second has a +24 VDC output. The 5 V signal is used for the TTL level electronics in the PPC1, the ±12 VDC signals are used for the analog circuitry and serial communication ports of the STD bus card, and the 24 volts is used to power the solenoid valves. To avoid crosstalk when powering or switching off the solenoid valves, the 24 V supply is a separate card.

- **STD Bus System Card** - A multi-function computer board. This card contains three separate serial ports, a keypad port, a display port, timer, clock, battery-backed RAM, 40 digital I/O lines, 8 analog inputs, and 1 analog output.

- **Interface Card** - Located behind the PPC1 front panel. This PCB holds all the switches and LED's for the manual control and status of the various PPC1 functions. Logic is also on this card for the amplification, current source, and signal conditioning for the on board PPC1 transducer.

- **Transducer** - The PPC1 has an on-board absolute pressure transducer that is used to monitor the system pressure. The transducer output is available to the PPC1 for use in setting pressures under microprocessor control or to a host computer. The output of the transducer is expressed in counts with an available range of zero to 1000 counts. Transducer output is also available in engineering pressure unit over the interface. An optional display is available to display the measure read by the transducer.

  An "auto-tare" function has been programmed into the PPC1 which will re-zero the transducer each time the vent valve is open and the transducer output is between predetermined output and stability limits for a certain amount of time. This pressure will be stored as the value of atmospheric pressure until the next "auto-tare" opportunity. This value is used to offset readings when operating in the gauge pressure mode.

- **Pressure Gauge** - Analog pressure gauge on the front panel provides a visual display of the approximate system pressure. The range of the gauge varies depending on the model PPC1 purchased.

- **Joystick (optional)** - Remote wired device for the proportional setting of desired pressures. The joystick connects to a connector on the rear panel of the PPC1 and contains, in addition to the pressure ramping function, hold and vent functions.

1.4 SPECIFICATIONS

On-board transducer accuracy:
- ±0.2% F.S.

Repeatability:
- ±0.1% F.S.

Minimum pressure step:
- Local: 0.001% F.S.
- Remote: N/A

Slew rate:
- 0 - F.S. 30 seconds max.
- <15 sec. typical between stable pressures

Control precision:
- Local mode: ±0.001% F.S.
- Remote mode: Depends on external device used as a reference and interfaced to the PPC1. Assuming an external device of sufficient resolution and response time, PPC1 will set and stabilize a pressure with precision of ±0.0015% F.S.

External operating volumes:
- 0 - 200 cc. Larger volumes possible but decrease slew rate.

Pressure ranges available:
- 0.2 to 30 psia / -14.2 to 15 psig
- 0.2 to 100 psia / -14.2 to 100 psig
- 0.2 to 250 psia / -14.2 to 250 psig
- 0.2 to 500 psia / -14.2 to 500 psig
- 0.2 to 1000 psia / -14.2 to 1000 psig

Power:
- 85 - 264 VAC; 47- 440 Hz

Power Consumption:
- 22 VA

Fuses:
- 1 A Slow-blow external
- (2) 2 A internal

Dimensions:
- 9.5"(241.3 mm)W x 11.8"(300 mm)D x 3U(133.4 mm)H

Weight:
- 25 lbs. (12 kg)

Maximum input pressure:
- 20% above specific PPC1 model operating pressure

Pressure medium:
- Clean, dry, non-corrosive gas

(User Notes)

CHAPTER 2 - INSTALLATION

2.1 UNPACKING AND INSPECTION

PPC1 is delivered as a complete self-contained unit. Plugs have been installed in the pressure connections on the rear panel. The following accessories are included:

- User's manual
- Power cable
- Spare fuse

2.2 SITE REQUIREMENTS

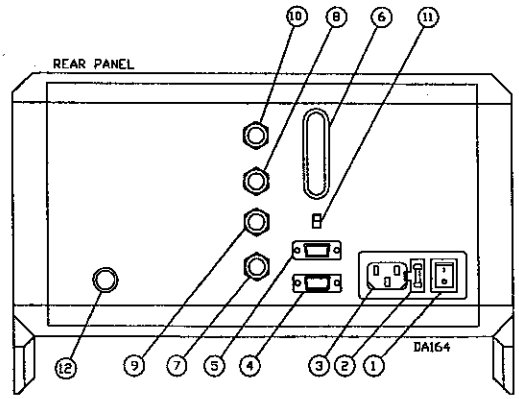
The PPC1 can be placed on any flat, stable surface at a convenient working height. The front feet are retractable so that the unit can be used either flat or with the front panel raised for easier viewing. These feet are also designed so that other DH equipment with the same size module may be interlocked for stacking.

A convenient source of clean, dry, non-corrosive gas should be nearby as well as 85 to 264 VAC.

2.3 INITIAL SETUP

- **Pressure connections** - Four pressure connections are included on the rear panel of the PPC1. The system into which pressure is to be controlled is connected to the test connection (8) (1/8" NPTF connection). Hold the bulkhead type connector on the PPC1 with a wrench while tightening.

  The source of clean, dry, gas to be used as the pressure medium is connected to the 1/8" NPTF inlet pressure connection (7). Both the vent (10) and the reference (9) connections may be left open to atmosphere or connected to tubing for remote exhaust of the gas, depending on the gas used and the specific safety requirements of the user. If the PPC1 is to be used to control below atmosphere, a vacuum pump is connected to the reference connection. NOTE: A continuous exhausting of gas medium is necessary for proper performance of the PPC1. This should be considered when deciding on the location of the PPC1 at the test site. The reference connection which is constant exhaust should never be plugged.



- **Interface connections** - Two separate RS232 interface connectors are included on the PPC1. Both connections should be made to the desired devices using a standard 9-pin cable. COM1 is for communication to the PPC1 and COM2 is used to communicate through the PPC1 to another device such as a Reference Pressure Monitor (RPM) or Digital Piston Gauge (DPG) or any RS232 device with a structured output.
- **Power connections** - The PPC1 should be located close to a convenient source of AC power. The PPC1 has a universal input which will operate on 85 to 264 VAC with no jumper change.

CHAPTER 3 - OPERATION

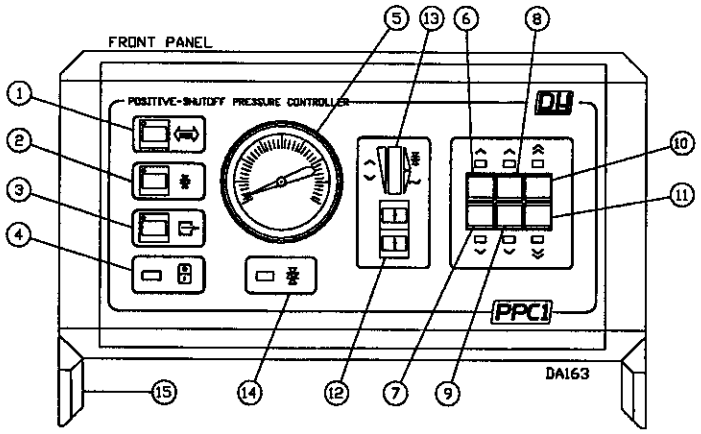
3.1 MANUAL OPERATION

The PPC1 should be connected using the supplied power cable to a convenient source of AC power. All pressure connections should be made as described in the Initial Setup section of Chapter 2. For proper operation of the flow controllers and to assure good long term performance of the internal transducer, the input pressure to the device should be regulated to a maximum pressure to that at which the PPC1 is rated plus 20 psi (50 psi for PPC1-1000). For example, the PPC1-250 should have a regulated inlet pressure of 270 psi, although as much as a 20% over-pressurization can be tolerated without causing damage to the unit.

For best performance PPC1 should be warmed up 15-20 minutes before operating. Upon powerup a memory test is run to test the integrity of the internal data RAM. If the memory has been corrupted or the internal battery has failed, the front panel LED's will flash to alert the user. If a memory failure has occurred, all default operating parameters will be loaded into memory. After the memory test is complete the LED's should go off. The only LED's that should remain on are the power indicator and the pulse width indicator until different functions are selected. The PPC1 will be in the manual operating mode when first powered and can be returned to this mode by pushing the Local/Remote switch unless a REMOTE command has been given by an external computer.

3.1.1 PRESSURE INCREASE AND DECREASE - FAST MODE

The fast speed increase button (10) and decrease button (11) are used to ramp pressure as quickly as possible, depending on the volumes and pressures involved at each portion of the test. Holding in one of these buttons will cause the proper solenoid valve to open as indicated by the LED corresponding to the valve illuminating. Typical zero to full scale ramping time in fast mode is 20 to 30 seconds.



The approximate system pressure can be observed on the analog gauge of the PPC1 or read from the internal transducer via the RS232 bus on a host computer (or the optional digital display).

When the system pressure is close to the desired pressure, the button can be released so that the slow and pulse modes of operation can be selected for finer control of pressure to set a precise pressure value.

3.1.2 PRESSURE INCREASE AND DECREASE - SLOW MODE

The slow mode of pressure ramping is performed in the same manner as the fast mode above except that button (8) is used for the pressure increase and button (9) is used to decrease pressure. The speed of operation is typically about 1/8 of the fast mode.

3.1.3 PRESSURE INCREASE AND DECREASE - PULSE MODE

Although the fast and slow modes of operation are available, an additional finer control of pressure is sometimes necessary to prevent overshooting or to allow very small pressure change increments. For this reason the PPC1 also has available a mode of operation that allows the user to increment pressures in a predictable pulsed manner. The buttons used for pulse mode pressure changes are (6) for increasing pressure and (7) for decreasing. The duration of the pulses can be adjusted using the two pushbuttons (12). Pushing the top button will cause an increase in the pulse duration and pushing the lower causes a decrease.

To adjust the pulse value, the PPC1 must be in the local mode (local/remote "off"). The pulse setting is then displayed on the bar graph and can be adjusted to 0.001, 0.002, 0.005, 0.01, 0.02, 0.05, 0.1, 0.2, 0.5 and 1% of full scale. Adjust the pulse value as necessary to achieve the desired level of control.

3.1.4 PRESSURE HOLD FUNCTION

When the desired pressure is achieved in the system, the HOLD button (2) can be depressed to limit the amount of divergence from this pressure. Unlike the previously listed switches, the HOLD button is a pushbutton switch and will toggle between states each time it is depressed. The PPC1 will automatically maintain the pressure within user specified units. Manual pressure adjustments or venting can be done while the hold function stays activated; and once the manual functions are completed, the hold function will then resume control.

To locally set hold limits (the hold set value within which the system pressure is allowed to fluctuate before the PPC1 readjusts the pressure) the PPC1 must be put into remote mode. The top five segments of the LED bar graph will now indicate the hold setting zone of 0.1, 0.2, 0.5, 1, or 2% of full scale pressure. This setting can be changed using the top button of the multi-function selector (12). The PPC1 has a default hold limit value of ±0.2% F.S. established whenever the system is reset.

3.1.5 VENT FUNCTION

The VENT button is also a pushbutton switch. When the vent button is activated, the system will be brought back to approximately 20 psia in fast mode before the vent solenoid valve is opened to bring the system to atmospheric pressure.

3.1.6 READ FUNCTION

The READ indicator LED will light whenever the system pressure meets a user adjustable stability limit and is within the hold limits established as above if in HOLD mode. The stability criterion is indicated on the bottom five segments of the multi-function indicator and is adjusted to 0.02, 0.05, 0.1, 0.3 and 0.5% of full scale pressure/second with the lower button of the multi-function selector. To perform this adjustment, the system must be in remote mode.

3.1.7 RECONFIGURE FUNCTION

Running the reconfigure routine automatically calculates and resets the PPC1 constants for the system working volume and determines if a vacuum pump is connected to the reference port.

To initiate the reconfigure function, set pressure to between 10% and 60% of the full scale rating for the specific PPC1, put the PPC1 into remote mode, and depress the hold button for 1.5 seconds. The PPC1 will pulse up and then down briefly to check the positive and negative slopes, activate both pulse solenoid valves simultaneously to determine offset, and then return the system using fast speed as low as possible to check for the absence or presence of a vacuum pump. The system is then vented.

If the measured system pressure is not within 10% to 60% of the full scale pressure, the reconfigure routine will not execute. The PPC1 default volume value is set to zero cc. each time a hard reset is done. The reconfigure routine should be performed following each hard reset or whenever the volume into which the PPC1 is controlling is changed.

3.1.8 RECALIBRATE FUNCTION

The ability to recalibrate the on-board transducer built-in to the PPC1. Whenever this routine is performed, new values are calculated and then automatically entered into the PPC1 permanent memory.

To perform the procedure, first set full scale pressure to the PPC1 by connecting an outside source such as a deadweight tester to the test connection; then place the PPC1 into remote mode and depress the vent push-button for five seconds. The PPC1 will record full scale transducer output, vent to zero pressure, record the transducer output again, and calculate a new slope based on these values.

If the transducer output is greater than ±2% different from the previously established full scale output, the calibration routine will not initiate. A default to original factory settings can be done by turning PPC1 power off and then on while keeping the vent button depressed.

3.1.9 REMOTE/LOCAL FUNCTION

This function is controlled by the push-button labeled Remote (1) on the front panel. This button allows the PPC1 to toggle between local and remote each time the button is pushed.

When the PPC1 is in remote mode, most normal front panel commands are locked out. The exception to this is that the PPC1 must be in remote for manual setting of the hold zone and the stability criterion and for the reconfigure and recalibrate functions to be initiated.

3.1.10 RESET FUNCTION

This function resets all parameters, except the transducer coefficients, to the original factory settings. To perform a hard reset, turn the PPC1 off and then on while depressing the hold button (2) on the front panel.

3.2 REMOTE OPERATION

Setting the Ready flag determines whether PPC1 will operate in Static or Dynamic Pressure Control Mode and how thus the Ready/Not Ready determination will be made. Static Pressure Mode is selected by "no valve", Dynamic Presure Mode is selected by "valve OK". The PPC1 constantly displays a Ready/Not Ready indication. The indication is by an LED located below the pressure gauge.

3.2.1 READY/NOT READY INDICATION

How the Ready/Not Ready condition is determined depends upon the operating mode in which you are using the PPC1. These operating modes can only be set by a remote computer.

There are two choices of operating modes: Static Pressure Control and Dynamic Pressure Control. These two operating modes use different criteria in making the Ready/Not Ready determination. Functionally, the difference between the Static and Dynamic Pressure Control Modes can be summarized by saying that in the Dynamic Mode the valves will constantly adjust the pressure around the set point and a Ready condition will occur any time the pressure is inside the Hold Limit whether a valve is operating or not, whereas in the Static Mode no valve can be operating for Ready to occur.

Static Pressure Control
In the Static Pressure Control Mode a Ready condition will exist only if:

1. No valve is operating (no active pressure control is occurring).
2. Pressure is inside the Hold Limit, If HOLD is on.
3. The current rate of change of pressure is less than the current stability test.

The Static Pressure Control Mode is used when you want to set a pressure near a nominal point and then read back the exact value of pressure currently in the system. This mode of operation allows pressure to be measured without integrating any control errors. It is frequently used in analog gauge calibration when the gauge needle will be set to a cardinal point and then the pressure actually present in the system is read back.

NOTE: The Static Pressure Control Mode is unique to DHI Positive-Shutoff Pressure Controllers.

Dynamic Pressure Control
In the Dynamic Pressure Control Mode a Ready condition exists when:

1. Pressure is inside the Hold Limit, If HOLD is on.
2. The current rate of change of pressure is less than the current stability test.

The Dynamic Pressure Control Mode is used when you will assume that the set pressure is exactly the target pressure you requested and you do not want to read back the exact value of pressure currently in the system. In this mode of operation control errors, the difference between the pressure that you asked for and the pressure actually present in the system, will be integrated. The maximum integrated control error is equal to the current hold limit setting. The Dynamic Control Mode is used when the actual calibration points must be equal to cardinal values of pressure. Particularly when calibrating manually, this mode is used when one must calibrate with leaks present in the system.

NOTE: The Dynamic Control Mode is used by most traditional pressure controllers. It is convenient but it integrates control errors. The minimum control error, with PPC1 is around ±5 PPM F.S.

CHAPTER 4 - INTERFACING

4.1 OVERVIEW

All of the commands described in Chapter 4 can also be executed by commands from a computer. The host controlling device is interfaced to the PPC1 using either COM1 or the optional GPIB (IEEE-488) interface.

Depressing button (1), the Remote switch, toggles the PPC1 between the manual (local) and computer control (remote) modes.

The following program has been written in GWBASIC and is intended as a demonstration program only.

```
 10  CLS                                          Clear screen.
 20  OPEN "COM1:2400,E,7,1,CS,CD,DS,LF" AS #1     Set up computer COM1 port for
                                                  2400 baud, even parity, 7 data bits,
                                                  1 stop bit, no handshaking, send line
                                                  feed.
 30  PRINT #1,"ABORT"                             Stop all action on the PPC.
 40  INPUT #1, REPLY$                             Read returned reply
 50  PRINT "Received data => ";REPLY$             Print reply
 60  PRINT #1,"PR"                                Request pressure reading.
 70  INPUT #1,PRESSURE$                           Read reply.
 80  PRINT "Current pressure reading => ";PRESSURE$  Print reply.
 90  CLOSE #1                                     Close COM1 port
100  END                                          END program.
```

If the actual pressure value is required in a numeric format, the following line can be added.

```
 75  PRESSURE=VAL(MID$(PRESSURE$,3,10))
```

4.2 COMMAND SUMMARY

ABORT	Halt all current operations.
ATM(=)	Set or retrieve current atmospheric reference.
COMx(=)	Set or retrieve the COMx port configuration.
CONFIG	Reconfigure PPC for different volumes.
COUNTS	Read the transducer input in counts.
DATE(=)	Set or retrieve current date.
DEVICE(=)	Specify the PPC1's pressure reference.
DPG(=)	Set or retrieve Digital Piston Gauge configuration.
DF=	Rapidly decrease system pressure.
DP=	Decrease pressure desired amount.
DS=	Slowly decrease system pressure.
ERR	Retrieve last error message.
HOLD(=)	Set or retrieve current HOLD status.
HS(=)	Set or retrieve hold setting in pressure.
HS%(=)	Set or retrieve hold setting in % F.S.
IF=	Rapidly increase system pressure.
IP=	Increase pressure desired amount.
IS=	Slowly increase system pressure.
ISO(=)	Isolate PPC from inlet supply for low absolute pressure (optional configuration)
LOCAL	Local operation.
MEM	Read status from memory test.
PR	Read the current pressure value.
PS=	Set desired pressure.
PSH=	Set desired pressure and hold it.
PSF=	Set desired pressure using fast speed only.
PSS=	Set desired pressure using slow speed only.
RANGE	Read the range of the PPC in psi.
RATE	Read the current rate of pressure change.
READY(=)	Set or retrieve READY criterion mode.
REMOTE	Remote only operation.
RESET	Reset the PPC to the default operating parameters.
RETURN	Return to last pressure setting.
RPM	Send a command to a remote RPM.
SR	Read current ready status.
SS(=)	Set or retrieve the stability setting in pressure.
SS%(=)	Set or retrieve the stability setting in % F.S.
STAT	Read pressure generation status.
TIME(=)	Set or retrieve current time.
TOUT(=)	Set or retrieve timeout for external device.
TP	Read current target pressure.
TS(=)	Set or retrieve Target pressure limit in pressure.
TS%(=)	Set or retrieve Target pressure limit in % F.S.
UCOEF	To retrieve current pressure converter.
UDD(=)	Set or retrieve User Defined Device.
UDU(=)	Set or retrieve User Defined pressure Unit.
UL(=)	Set or retrieve maximum allowable pressure.
UNIT(=)	Set or retrieve current pressure unit setting.
VAC(=)	Set or retrieve vacuum pump status.
VENT(=)	Set or retrieve current vent status.
VER	Read version number of the internal software.
#	Send a command through the PPC1 to an external device.

4.3 INDIVIDUAL COMMAND DESCRIPTIONS

ABORT

PURPOSE: To stop all current action of the PPC1.

SYNTAX: "ABORT"

DEFAULT: n/a

REMARKS: An abort command can be sent to halt any and all current operations and place the PPC into an idle state.

The ABORT command disables a HOLD if hold is active, and closes any valves, including vent.

This command is also useful to abort out of a configuration procedure.

EXAMPLE: typical command: "ABORT"

typical reply: "ABORT"

ERROR: none

ATM(=)

PURPOSE: To set or retrieve the current atmospheric reference pressure.

SYNTAX: "ATM=dddd"
"ATM"

DEFAULT: 101.325 kPa (14.6959 psia)

REMARKS: The atmospheric pressure reference that is used to correct an absolute reference to gauge mode can be set or read. During a vent procedure, the atmospheric reference is automatically recorded with the auto tare function and will then be used. If a value other than the measured value is desired, then the value can be changed. If an absolute device is used as the pressure measuring device in gauge mode, then the ATM value will be subtracted from the measurement.

EXAMPLE: typical command: "ATM=14.25"

typical reply: "14.25"

ERROR: ERR# 6: The value of dddd must be > 13 psia and < 16 psia.

COM(x)=

PURPOSE: To set or retrieve the configuration of the COM ports.

SYNTAX: "COMx=baud,parity,data,stop"
"COMx"

DEFAULT: COM1=2400,E,7,1
COM2=2400,E,7,1

REMARKS: x = 1: COM1 port
x = 2: COM2 port

The parameters must be separated by commas.

The available parameters are listed below. Once the port is configured, the configuration is stored in permanent memory and becomes active on power up.

When the configuration of the primary port (COM1) is changed, the returned reply will be sent at the original COM1 settings but all subsequent replies will be sent at the new configuration settings.

When an external pressure reference is used and connected to the COM2 port, the port should be configured before a "DEVICE=" command is given. Care must be taken to assure that the COM2 port is configured the same as the COM port on the external device.

If the IEEE option has been installed and is active, the "COM1" arid "COM1=" commands are not allowed. Any attempt to set or read the COM1 port will result in an error message (ERR# 13).

Serial parameters:

Baud rates:	150	4800
	300	9600
	600	
	1200	
	2400	
Parity:	O - Odd	
	E - Even	
	N - None	
Data bits:	7	
	8	
Stop bits:	1	
	2	

EXAMPLE: typical command: "COM1=9600,E,7,1"

typical reply: "9600,E,7,1"

ERROR: ERR# 11: Missing or wrong parameters.
ERR# 13: COM1 commands given with IEEE active.

CONFIG

PURPOSE: To automatically configure the PPC1 operating coefficients for optimal performance in the volume of the system to which it is connected.

SYNTAX: "CONFIG"

DEFAULT: n/a

REMARKS: The configuration procedure changes the operating parameters of the pulsing subroutines to adapt to different volumes. The procedure calculates the slope for the increasing speed and the decreasing speed and if the pressure measuring device is external (DEVICE<>PPC), will calculate the offset between the two values. CONFIG is also used to determine if a vacuum pump is connected to the reference port. If a vacuum pump is detected then the vacuum flag will be set (VAC=1) otherwise the flag will be disabled (VAC=0). The procedure will only execute when the pressure in the system is within 10-60% of full scale. It is recommended that the procedure be performed at mid scale. When completed, the PPC will be left vented to atmosphere.

If an attempt is made to communicate with the PPC while a configuration procedure is in progress, the returned reply will be "BUSY". The only valid command that will be accepted during this procedure is an "ABORT" command.

The new operating parameters are stored in memory and are active on power up.

EXAMPLE: typical command: "CONFIG"

typical reply: "CONFIG"

ERROR: ERR# 10: If pressure is not within the specified limits, 10%-60% F.S.

COUNTS

PURPOSE: Read the internal transducer input in counts.

SYNTAX: "COUNTS"

DEFAULT: n/a

REMARKS: The transducer's output is converted to a digital signal by an Analog to Digital converter. The resolution is 10 bits with a normal operating range of 0 - 1000 counts.

EXAMPLE: typical command: "COUNTS"

typical reply: "526"

ERROR: none

DATE(=)

PURPOSE: To set or retrieve the current date.

SYNTAX: "DATE=mm/dd/yy"
"DATE"

DEFAULT: 00/00/00 If battery fails.

REMARKS: mm = month 1 - 12
dd = day 1 - 31
yy = year 0 - 99

The current date can be read or set.

All parameters are required, none are optional.

EXAMPLE: typical command: "DATE=01/01/90"

typical reply: "01/01/90"

ERROR: ERR# 6: Improper numeric argument.

DEVICE(=)

PURPOSE: To configure the PPC1 to use the indicated pressure reference.

SYNTAX:
"DEVICE=PPC"
"DEVICE=RPMx"
"DEVICE=DPG"
"DEVICE=label"
"DEVICE=DIS"
"DEVICE"

DEFAULT: DEVICE=PPC

REMARKS: x = RPM address. If omitted defaults to 1.

When DEVICE is not equal to PPC, then all pressure commands are executed using the pressure measuring instrument connected to the COM2 port. The PPC will then have the measurement and control accuracy of the external device.

DEVICE=PPC:
All pressure commands will be executed using the PPC's internal pressure transducer.

DEVICE=RPMx:
The RPMx will be used as the pressure reference for pressure generation. The address option of the RPM allows for a convenient way to chain transducers.

DEVICE=DPG:
The DIGITAL PISTON GAUGE will be used as the reference for pressure generation. The "DPG=" command must be given to configure the Digital Piston Gauge before the device can be selected.

DEVICE=label:
Any RS232 device with a structured output can be used as the external pressure reference. The label must first be defined using the "UDD=" command before this device can be selected.

DEVICE=DIS:
This command is the same as DEVICE=PPC except the PPC assumes that an optional remote display is attached to the COM2 port. The current pressure reading will then be displayed.

** **WARNING** ** Some external devices handle receiving strings at an incorrect baud rate differently. It is highly recommended to setup the COM2 port of the PPC to same configuration as the external device before any "DEVICE=" command is given.

EXAMPLE: typical command: "DEVICE=RPM"

typical reply: "RPM1"

ERROR: ERR# 4: If external device was not detected.
ERR# 16: If Digital Piston Gauge not defined.
ERR# 17: If User Defined Device not defined

DF=

PURPOSE: Rapidly decrease system pressure.

SYNTAX: "DF=n"

DEFAULT: n/a

REMARKS: n = 1: activates command.
n = 0: deactivates command.

The system pressure can be rapidly decreased using this command. When a DF=1 command is given, the FAST DOWN valve is opened and left opened.

EXAMPLE: typical command: "DF=1"

typical reply: "DF=1"

ERROR: none

DP=

PURPOSE: Decrease system pressure by specified amount.

SYNTAX: "DP=nn"

DEFAULT: n/a

REMARKS: nn = 0 - 2% F.S.

The system pressure can be decreased or pulsed down by a specified amount.

The value of nn is in pressure with a maximum value of 2% F.S. Commands greater than 2% F.S. will be ignored and an error will occur.

EXAMPLE: typical command: "DP=.5"

typical reply: ".5 psi"

If the current units are psia, then the above example will decrease the pressure by 0.5 psi.

ERROR: ERR# 6: If nn < 0 or nn > 2% F.S.

DPG(=)

PURPOSE: Set or retrieve DIGITAL PISTON GAUGE configuration.

SYNTAX: "DPG=coef,offset"
"DPG"

DEFAULT: DPG not configured

REMARKS: coef = Pascal per count.
offset = Offset in counts. If omitted, defaults to 0.

One count is considered the first digit to the left of the decimal point. The DIGITAL PISTON GAUGE must be configured before a DEVICE=DPG command is given.

EXAMPLE: typical command: "DPG=689.475908,0"

typical reply: "689.475908,0"

ERROR: ERR# 6: If coef = 0.

DS=

PURPOSE: Slowly decrease system pressure.

SYNTAX: "DS=n"

DEFAULT: n/a

REMARKS: n = 1: activates command.
n = 0: deactivates command.

The system pressure can be slowly decreased using this command. When a "DS=1" command is received, the down slow valve is opened and left opened.

EXAMPLE: typical command: "DS=1"

typical reply: "DS=1"

ERROR: none

ERR

PURPOSE: To read the error message of the last command.

SYNTAX: "ERR"

DEFAULT: ERR# 0 = OK

REMARKS: If the last response returned from the PPC was an error (ERR# xx), then the error message that corresponds to that error can be read. If an error is received and a valid command is sent to the PPC before the "ERR" command has been sent, the error pointer is reset and an "ERR# 0 = OK" will be returned with the next "ERR" command.

ERROR MESSAGES:

"ERR# 0 = OK"
"ERR# 1 = External device measurement out of range"
"ERR# 2 = Label must be 5 characters or less"
"ERR# 3 = User defined coefficient cannot be 0"
"ERR# 4 = External device not detected"
"ERR# 5 = External device improperly configured"
"ERR# 6 = Numeric argument missing or out of range"
"ERR# 7 = Improper command argument(s) or format"
"ERR# 8 = External device timeout"
"ERR# 9 = Unknown command"
"ERR# 10 = Pressure must be between 10% and 60% F.S."
"ERR# 11 = Missing or improper command argument"
"ERR# 12 = System overpressured"
"ERR# 13 = Not allowed with IEEE interface enabled"
"ERR# 14 = User unit not defined"
"ERR# 15 = Range jumper setting invalid"
"ERR# 16 = DPG not defined"
"ERR# 17 = UDD not defined"
"ERR# 18 = Command not yet available"
"ERR# 19 = Not available with absolute units"
"ERR# 20 = Not available with gauge device"
"ERR# 21 = User device not defined"
"ERR# 22 =Pressure must be below 20 psia"
"ERR# 23 =Option not available or installed"
"ERR# 24 =Not available with isolation on"

EXAMPLE: typical command: "ERR"

typical reply: "ERR# 0 = OK"

ERROR: none

HOLD(=)

PURPOSE: Set or read the current HOLD status.

SYNTAX: "HOLD=n"
"HOLD"

DEFAULT: HOLD=0

REMARKS: n = 1: actives HOLD
n = 0: deactivates HOLD

The hold command, when active cause the pressure to be maintained around the target pressure within the hold limit. The command can be given with a pressure command (PSH) or it can be given alone. If the HOLD command is sent alone, then the pressure measuring device is read and that pressure value becomes the target pressure HOLD value. When the pressure deviates by more than the limit set by the HOLD SETTING (HS) then the pressure is returned to the target pressure.

If a "HOLD=1" command is given then the target pressure can be read using the "TP" command.

EXAMPLE: typical command: "HOLD=1"

typical reply: "HOLD=1"

ERROR: none

HS(=)

PURPOSE: Set or read the hold limit.

SYNTAX: "HS=nn"
"HS"

DEFAULT: For DEVICE=PPC: HS=0.2% F.S.
For DEVICE=external: HS=0.01% F.S.

REMARKS: The hold limit or dead band is the maximum deviation from the target in pressure allowed before a readjustment occurs. When a readjustment occurs, the pressure is returned to within the limit set by TS. If HOLD is active and a correction occurs, the ready indicator will go off and any corresponding pressure readings (PR) will return "NR" at the beginning of the string until the pressure has been reset.

With the ready mode set to READY=1, the pressure will be reset to the target when it gets to 75% of the hold limit. The ready (R) indication will stay on while the pressure is inside the hold limit and the stability (SS) criteria is met.

nn is a value in pressure.
The available values of nn in pressure for DEVICE=PPC correspond to: .1%, .2%, .5%, 1% 2% F.S.

When DEVICE=PPC and a pressure value is given that is not an exact multiple of % F.S., then the value will default to the nearest appropriate value (i.e., for PPC1-250, if "HS=.75" is sent to the PPC1, the default value of HS will become .5 psi which is closest to .2% F.S.).

If HS is set to a value that is less than the value of TS, than TS will automatically default to 1/2 the value of HS.

The available values of nn in pressure for external devices are: 0 - F.S. (i.e., for PPC1-250, 0-250 psi). When the pressure measuring device is external the hold setting indicator on the front panel will not be active.

EXAMPLE: typical command: "HS=.2"

typical reply: ".2 psi"

ERROR: ERR# 6: If nn < 0.0005% of F.S. or nn > F.S.

HS%(=)

PURPOSE: Set or read the hold limit in % F.S.

SYNTAX: "HS%=nn"
"HS%"

DEFAULT: For DEVICE=PPC: HS=0.2%
For DEVICE=external: HS=0.01%

REMARKS: The hold limit or dead band is the maximum deviation in pressure allowed before a readjustment occurs. When a readjustment occurs, the pressure is returned to within the limit set by TS. If HOLD is active and a correction occurs, the stability indicator will go off and any corresponding pressure readings (PR) will return "NR" at the beginning of the string.

nn is a value in % F.S.
The available values of nn are: .1%, .2%, .5%, 1% and 2% F.S.

When DEVICE=PPC and a value is given that is not an exact match for the available values, then the value will default to the nearest appropriate value.

If HS is set to a value that is less than the value of TS, than TS will automatically default to 1/2 the value of HS.

The available values of nn for external devices are: 0 - F.S. When using external devices, the hold setting indicator on the front panel will not be active.

EXAMPLE: typical command: "HS%=.2"

typical reply: ".2%"

ERROR: ERR# 6: If nn < 0.0005% of F.S. or nn > 100%

IF=

PURPOSE: Rapidly increase system pressure.

SYNTAX: "IF=n"

DEFAULT: n/a

REMARKS: n = 1: activates command.
n = 0: deactivates command.

The system pressure can be rapidly increased using this command.
When a "IF=1" COMMAND is received the up fast valve is opened and left opened.

EXAMPLE: typical command: "IF=1"

typical reply: "IF=1"

ERROR: ERR# 12: The command is not allowed if the pressure is above the UL setting.

IP=

PURPOSE: Increase system pressure by specified amount.

SYNTAX: "IP=nn"

DEFAULT: n/a

REMARKS: nn = 0 - 2% F.S.

The system pressure can be increased or pulsed up by a specified amount.

The value of nn is in pressure with a maximum value of 2% F.S. Commands greater then 2% F.S. will be ignored and an error will occur.

EXAMPLE: typical command: "IP=.5"

typical reply: ".5 psia"

If the current units are psi, then the above example will increase the pressure by .5 psi.

ERROR: ERR# 12: The command is not allowed if the pressure is above the UL setting.

IS=

PURPOSE: Slowly increase system pressure.

SYNTAX: "IS=n"

DEFAULT: n/a

REMARKS: n = 1: activates command.
n = 0: deactivates command.

The system pressure can be slowly increased using this command. When a "IS=1" command is given the up slow valve is opened and left opened.

EXAMPLE: typical command: "IS=1"

typical reply: "IS=1"

ERROR: ERR# 12: The command is not allowed if the pressure is above the UL setting.

ISO(=) (OPTIONAL CONFIGURATION)

PURPOSE: To isolate the PPC from the inlet supply and connect the input to the reference port for the purpose of obtaining a very low absolute pressure.

SYNTAX: "ISO=n"
"ISO"

DEFAULT: ISO=0

REMARKS: n = 1: actives ISOLATION valve
n = 0: deactivates ISOLATION valve

This function is only available on PPC's that have been equipped with the low pressure option.

The isolation function is intended to be used for obtaining a low absolute pressure when used in conjunction with the DF command. IT IS NOT INTENDED TO BE USED FOR PRESSURE CONTROL. When ISO=1 the inlet supply is shut off and the entire system is connected to the reference port.

The ISO function can be toggled on and off from the front panel by pressing the three down pressure keys simultaneously. When ISO=1 the down pulse LED will be lit to indicate the status of the ISOLATION valve. The down pulse function is disabled at this time and pressing this button will have no effect on the system.

The following remote commands will disable the ISO function: IF, IS, IP, PSx, ABORT, VENT and RESET. The ISO function can also be disabled from the front panel by pressing any of the increase pressure push-buttons or by pressing the three-key combination of the down pressure push-buttons. Pressing the VENT button will also deactivate the ISO function.

The hold function can not be activated when ISO=1. If HOLD is active when this command is given, then the hold will be turned off. The ISO function will only operate at operating pressures less than 20 psia.

EXAMPLE: typical command: "ISO=1"

typical reply: "ISO=1"

ERROR: ERR# 22: Pressure must be below 20 psia.
ERR# 23: Option not available or installed.
ERR# 24: Not available with isolation on.

LOCAL

PURPOSE: Place the device in the LOCAL mode.

SYNTAX: "LOCAL"

DEFAULT: n/a

REMARKS: In LOCAL mode all front panel operations are available. The LOCAL command deactivates REMOTE mode.

EXAMPLE: typical command: "LOCAL"

typical reply: "LOCAL"

ERROR: none

MEM

PURPOSE: Read the status of the internal data RAM since the last power up.

SYNTAX: "MEM"

DEFAULT: n/a

REMARKS: On power up a memory test is run to check the integrity of the internal data RAM. If the memory has been corrupted then the front LED's of the PPC will flash to alert the user. The status of the memory can be read from a remote computer.

Return string:
"MEM=1" system memory is OK
"MEM=0" system memory has been corrupted and the default operating parameters were loaded into memory.

EXAMPLE: typical command: "MEM"

typical reply: "MEM=1"

ERROR: none

PR

PURPOSE: Read the current pressure value.

SYNTAX: "PR"

DEFAULT: n/a

REMARKS: The current pressure value is read in the units previously selected. The data string also contains ready information. The string is in the format "ss ddddddd uuuuuu".

The ready information is either "R" for Ready or stable, or "NR" for Not Ready or unstable. The criteria for "N" or "NR" is the stability value that has been set using the "SS" command and the hold setting set by the "HS" command.

The data is the returned pressure in the corresponding units.

For more information on the available units, see the UNITS command.

For more information on the ready setting, see the READY(=) and SS commands.

EXAMPLE: typical command: "PR"

typical reply: "R 56.1 psi "

The length of the returned string is 20 characters. To strip off the stability data and the units, and convert the string to a real number, the following command can be added at line 35.

```
35 IN=VAL(MID$(IN$,3,10))
40 PRINT IN
```

typical reply: "56.1"

ERROR: none

PS=

PURPOSE: To set a desired pressure within the target limit.

SYNTAX: "PS=xxxxx"

DEFAULT: n/a

REMARKS: xxxxx= -1 atmosphere to F.S. in gauge or .5% F.S. to F.S. in absolute.

The pressure command is interpreted in whatever unit the system has last been set. If a pressure is requested that is not in the normal range of operation, the pressure request will not be implemented and an error will returned. Generally pressures below 0.5% F.S. in absolute can be achieved but not set accurately. To go lower than 0.5% F.S. use the decrease fast (DF) command and wait for the pressure to reach the desired value. The PS command will continue to execute until the pressure has been set to within the target limit.

EXAMPLE: typical command: "PS=50"

typical reply: "50 psi"

ERROR: ERR# 6: If xxxxx < 0 Paa or xxxxx > the UL setting
ERR# 6: If xxxxx < Atmosphere and no vacuum pump attached.

PSH=

PURPOSE: To set a desired pressure and maintain it.

SYNTAX: "PSH=xxxxx"

DEFAULT: n/a

REMARKS: xxxxx= -1 atmosphere to F.S. in gauge or .1% F.S. to F.S. in absolute.

The PSH command is a combination of the PS command and the HOLD command. The pressure command is interpreted and executed in the unit that was last set using the UNIT= command.

The PPC1 will first set the requested pressure within the target limit and then activate the HOLD function. While the HOLD is active, whenever the pressure deviates from the set value by more than the value set using the HS command, the pressure will be readjusted to the set point. If a pressure is requested that is not in the normal range of operation, the pressure request will not be implemented and an error will be returned.

If READY=0, when the pressure equals or exceeds the hold limit, a Not Ready (NR) condition will exist until the pressure has been reset with in the target limit. When READY=1 the pressure will be reset to the target setting at 75% of the hold limit and a ready condition will remain unless the stability criteria is exceeded.

EXAMPLE: typical command: "PSH=50"

typical reply: "50 psi"

ERROR: ERR# 6: If xxxxx < 0 Paa or xxxxx > the UL setting
ERR# 6: If xxxxx < Atmosphere and no vacuum pump attached.

PSF=

PURPOSE: To a desired pressure using fast speed only.

SYNTAX: "PSF=xxxxx"

DEFAULT: n/a

REMARKS: xxxxx= -1 atmosphere to F.S. in gauge or .1% F.S. to F.S. in absolute.

The pressure command is interpreted in whatever unit the system has last been set. If a pressure is requested that is not in the normal range of operation, the pressure request will not be implemented and an error will returned.

The PSF command is useful for setting a rough pressure very quickly. The command is also very useful in setting a very low absolute pressure.

The STAT command can be used to determine when execution of a PSF command is complete. PSF always uses the internal transducer.

EXAMPLE: typical command: "PSF=75"

typical reply: "75 psia"

ERROR: ERR# 6: If xxxxx < 0 Paa or xxxxx > the UL setting
ERR# 6: If xxxxx < Atmosphere and no vacuum pump attached.

PSS=

PURPOSE: To set a desired pressure using slow speed only.

SYNTAX: "PSS=xxxxx"

DEFAULT: n/a

REMARKS: The pressure command is interpreted in whatever unit the system has last been set. If a pressure is requested that is not in the normal range of operation, the pressure request will not be implemented and an error will returned.

The PSS command is useful in setting a rough pressure with the internal transducer or in setting a constant slow speed pressure ramp.

EXAMPLE: typical command "PSS=75"

typical reply: "75 psia"

ERROR: ERR# 6: If xxxxx < 0 Paa or xxxxx > the UL setting
ERR# 6: If xxxxx < Atmosphere and no vacuum pump attached.

RANGE

PURPOSE: To read the range of the PPC in psi.

SYNTAX: "RANGE"

DEFAULT: n/a

REMARKS: The range or model can be read form the PPC.

EXAMPLE: typical command: "RANGE"

typical reply: "100 psi"

ERROR: none

RATE

PURPOSE: To read the current rate of change of pressure.

SYNTAX: "RATE"

DEFAULT: n/a

REMARKS: The current rate of deviation in pressure units per second can be read. A positive value indicates that the pressure is increasing while a negative value indicates that the pressure is decreasing.

EXAMPLE: typical command: "RATE"

typical reply: ".002 psi/sec"

ERROR: none

READY(=)

PURPOSE: To set or read the status of the READY criterion mode.

SYNTAX: "READY=x"
"READY"

DEFAULT: READY=0

REMARKS: n = 0: (Static Pressure Control) Ready (R) cannot occur while the system is adjusting pressure.

n = 1: (Dynamic Pressure Control) Ready (R) can occur while the system is adjusting pressure.

n = 0: Static Pressure Control

For READY (R) to occur the following conditions must be met:
a) No valve is being operated.
b) If hold is on, the current pressure value is inside the hold limit.
c) The pressure stability criteria is met.

n = 1: Dynamic Pressure Control

For READY (R) to occur the following conditions must be met:
a) If hold is on, the current pressure value is inside the hold limit. The pressure stability criteria is met.

NOTE: See Chapter 3.2.2 Ready/Not Ready Indication.

EXAMPLE: READY=0 will result in less pressure ready conditions. This type of ready is recommended when the greatest accuracy is desired and the exact measured pressure values will be used. READY=1 is recommended for higher speed and lower accuracy when the set pressure will be assumed to be equal to the target pressure.

typical command: "READY=1"

typical reply: "READY=1"

ERROR: ERR# 6: If x specified wrong.

REMOTE

PURPOSE: To place the device into a remote lock-out mode.

SYNTAX: "REMOTE"

DEFAULT: n/a

REMARKS: A REMOTE command deactivates the front panel. All front panel controls will be disabled.

The REMOTE command can only be cancelled by a LOCAL command or by resetting the device by turning off the power then reapplying it.

EXAMPLE: typical command: "REMOTE"

typical reply: "REMOTE"

ERROR: none

RESET

PURPOSE: To reset all operating parameters to factory default settings.

SYNTAX: "RESET"

DEFAULT: n/a

REMARKS: The RESET command can be given to return the PPC to a known state. This command should be used with care because all configuration information will be lost.

EXAMPLE: typical command "RESET"

typical reply: "RESET"

ERROR: none

RETURN

PURPOSE: To return the pressure to the current target value.

SYNTAX: "RETURN"

DEFAULT: 0.0000 psia

REMARKS: The current target setting could be from a remote pressure request, a remote hold command, or a local hold command. When this command is given, the target pressure is checked and if it is within the normal operating range, the PPC1 will set that pressure. The Return is the same as a PS= command with the target pressure equal to the last target pressure value.

EXAMPLE: typical command: "RETURN"

typical reply: "75 psia"

ERROR: ERR# 6: If last Target Pressure not in normal operating range.

RPM

PURPOSE: To send a command through the PPC to a remote RPM.

SYNTAX: "RPMx,dddd"
"RPMSx,dddd"

DEFAULT: n/a

REMARKS: x: 1 - 99

x is the address of the RPM. If x is omitted then the default address is 1. Address 99 is a global address to send a command to all RPMs that are connected to the COM2 port.

The RPMS command is used to perform a write to the EEPROM of the RPM1. This command should be used with caution because a given register is only guaranteed for 10,000 rewrites. See the RPM1 manual for further information on writing to the EEPROM.

A "RPM,DP" command has the same syntax as sending *0100DP to the RPM from a remote computer.

A "RPMS,DP=6" has the same syntax as sending *0100EW*0100DP=6 to the RPM from a remote computer.

The commands available are given in the RPM1 manual. They allow you to change the RPM resolution, integration time, etc.

EXAMPLE: typical command: "RPM,DP" or "RPM1,DP"

typical reply: "*0001DP=6"

ERROR: none

SR

PURPOSE: To read the current READY status.

SYNTAX: "SR"

DEFAULT: n/a

REMARKS: The current READY status can be read directly using this command. If the reply is "NR" then the pressure is not ready within the limits set by "SS" and "HS". If the reply is "R" then the pressure is ready within the limits. See also the READY command.

EXAMPLE: typical command: "SR"

typical reply: "R"

ERROR: none

SS(=)

PURPOSE: Set or read the stability limit in pressure/sec.

SYNTAX: "SS=nn"
"SS"

DEFAULT: For DEVICE=PPC SS=0.1% F.S./sec
For DEVICE=external SS=0.01% F.S/sec

REMARKS: The stability setting is one of the criteria that determines whether the ready light will go on and whether the pressure values returned by "PR" will be preceded by "R" or "NR". Stability is set in terms of pressure. If the rate of change of pressure is greater than the current setting, then the ready light will go off and any corresponding pressure readings (PR) will return "NR" at the beginning of the string.

nn is a value in pressure/sec.
The available values of nn in pressure for DEVICE=PPC correspond to: .02%, .05%, .1%, .3% .5% F.S.

When DEVICE=PPC and a pressure value is given that is not an exact multiple of % F.S. then the value will default to the nearest appropriate value (i.e., for PPC1-250, if "SS=.5" is sent to the PPC1, the default value of SS will become .75 psi which is closest to .3% F.S.).

The available values of nn in pressure/sec for external devices are: 0 - 5% F.S. (i.e., for PPC1-250, 0-12.5 psi).

When external devices are used the stability setting indicator on the front panel will not be active.

See also the READY command.

EXAMPLE: typical command: "SS=.1"

typical reply: ".1 psia"

ERROR: ERR# 6: If nn < .0005% of F.S.

SS%(=)

PURPOSE: Set or read the stability limit in % F.S./sec.

SYNTAX: "SS%=nn"
"SS%"

DEFAULT: For DEVICE=PPC SS=0.1% F.S./sec
For DEVICE=external SS=0.01% F.S./sec

REMARKS: The stability setting is one of the criteria that determines whether the ready light will go on and whether the pressure values returned by "PR" will be preceded by "R" or "NR". Stability is set in terms percent of full scale per second. If the rate of change of pressure is greater than the current setting, then the ready light will go off and any corresponding pressure readings (PR) will return "NR" at the beginning of the string.

nn is a value in % F.S./sec.
The available values of nn in are: .02%, .05%, .1%, .3% and .5% F.S.

When DEVICE=PPC and a pressure value is given that is not an exact multiple of % F.S. then the value will default to the nearest appropriate value.

The available values of nn for external devices are: 0 - 5% F.S.

When external devices are used the stability indicator on the front panel will not be active.

See also the READY command.

EXAMPLE: typical command: "SS%=.1"

typical reply: ".1%"

ERROR: ERR# 6: If nn < .0005% of F.S.

STAT

PURPOSE: To read the pressure generation status.

SYNTAX: "STAT"

DEFAULT: STAT=0

REMARKS: The current status of pressure generation status can be read. If the returned data is "STAT=1" then there is at least one valve operating. If the returned data is "STAT=0 then all valves are close. The STAT command is useful if it is used with a PSF command or a PSS command to determine when the pressure has been reached and the command has finished executing. The returned reply will be STAT=1 until the pressure has been reached then the reply will be STAT=0.

EXAMPLE: typical command "STAT"

typical reply: "STAT=0"

ERROR: none

TIME(=)

PURPOSE: To set or retrieve the current time.

SYNTAX: "TIME=hh:mm:ss"
"TIME"

DEFAULT: 00:00:00 If battery fails

REMARKS: hh = HOURS 0 - 23
mm = MINUTES 0 - 59
ss = SECONDS 0 - 59

The hours and minutes are required. The seconds are optional.

The current time can be read or set.

EXAMPLE: typical command "TIME=03:45:00"

typical reply: "03:45:00"

ERROR: ERR# 6: Improper numeric argument.

TOUT(=)

PURPOSE:	To set or retrieve the timeout for an external device.
SYNTAX:	"TOUT" "TOUT=xx"
DEFAULT:	TOUT=2
REMARKS:	The current timeout in seconds can be read or set. The timeout is the time required before an external device timeout will occur.
EXAMPLE:	typical command: "TOUT=5"
	typical reply: "5"
ERROR:	ERR# 6: If xx < 2 or xx > 20.

TP

PURPOSE:	To read the value of the target pressure.
SYNTAX:	"TP"
DEFAULT:	0.0000 psia
REMARKS:	The current target pressure value can be read using this command.
EXAMPLE:	typical command: "TP"
	typical reply: "75 psia"
ERROR:	none

TS(=)

PURPOSE: To set or read the target limit for a pressure setting.

SYNTAX: "TS=dddd"
"TS"

DEFAULT: For DEVICE=PPC TS=0.1% F.S.
For DEVICE=external TS=0.01% F.S

REMARKS: This command is used to set how closely to the target value the pressure will be set before the pressure setting sequence is considered complete.

If TS is set to a value that is greater than HS, then HS will automatically be set equal to TS.

If DEVICE=PPC and TS is set to a value that is greater than HS, an error will occur and the command will not be executed.

EXAMPLE: typical command: "TS=.01"

typical reply: ".01 psi"

ERROR: ERR# 6: If nn < .0005% of F.S. or > F.S.

TS%(=)

PURPOSE: To or read set the target limit for a pressure setting in % F.S.

SYNTAX: "TS%=dddd"
"TS%"

DEFAULT: For DEVICE=PPC TS=0.1%
For DEVICE=external TS=0.01%

REMARKS: This command is used to set how closely to the target value the pressure will be set before the pressure setting sequence is considered complete.

If TS% is set to a value that is greater than HS%, then HS% will automatically be set equal to TS%.

If DEVICE=PPC and TS% is set to a value that is greater than HS%, an error will occur and the command will not be executed.

EXAMPLE: typical command: "TS%=.01"

typical reply: ".01%"

ERROR: ERR# 6: If nn < .0005% of F.S.

UDD(=)

PURPOSE: Set or read USER DEFINED DEVICE configuration.

SYNTAX: "UDD=label,prs,num,coef,offset"
"UDD"

DEFAULT: UDD not defined

REMARKS: label = Device label (maximum five characters).
prs = Pressure Request String.
num =Number of invalid characters at the beginning of the returned data string.
coef = pressure coefficient to convert 1 count to Pascal (cannot be 0).
Offset = Offset for reading on counts.

The USER DEFINED DEVICE configuration must be set before a DEVICE=???? command is given.

EXAMPLE: typical command "UDD=21000,SI,3,13.78952,0"

typical reply: "21000,SI,3,13.78952,0"

ERROR: none

UDU(=)

PURPOSE: To set or retrieve the USER DEFINED UNIT.

SYNTAX: "UDU=uuuuu,cccccc"
"UDU"

DEFAULT: UDU not defined

REMARKS: uuuuu = User unit label (five characters maximum)
ccccc = User coefficient (cannot be <= 0)

The USER COEFFICIENT (UCOEF) is a value that is used to convert the current pressure units to PASCAL.

EXAMPLE: typical command "UDU=Punit,.0015"

typical reply: "Punit,.0015"

Pressure in Pa = Pressure in units / UCOEF

ERROR: ERR# 2: uuuuu must ba a maximum of 5 characters.
ERR# 3: User defined coefficient cannot be 0.

UCOEF

PURPOSE: To read the value of the current pressure converter.

SYNTAX: "UCOEF"

DEFAULT: UCOEF=0.000145038

REMARKS: The USER COEFFICIENT (UCOEF) is a value that is used to convert the current pressure units to PASCAL.

EXAMPLE: typical command: "UCOEF"

typical reply: "1.45038E-04"

The above example returned the value used to change PSI to PASCAL.

Pressure in Pa = Pressure in units / UCOEF

ERROR: none

UL(=)

PURPOSE: To read or set the maximum allowable pressure (Upper Limit).

SYNTAX: "UL=dddd"
"UL"

DEFAULT: RANGE + 2%

REMARKS: When the pressure exceeds the upper limit, all increase pressure commands, both local and remote are deactivated and the system shuts off. This command is useful in protecting instruments from accidental over pressure.

EXAMPLE: typical command: "UL=75"

typical reply: "75 psia"

ERROR: ERR#6: If dddd < 0

UNIT(=)

PURPOSE: Set or change the current pressure units.

SYNTAX: "UNIT=xxxxxx"
"UNIT"

DEFAULT: UNIT=psia

REMARKS: The units in which the PPC1 interprets and executes commands can be changed. The available units are:

Unit		Coefficient
psi	psia	.000145038
bar	bara	0.00001
mbar	mbara	0.01
Pa	Paa	1.0
KPa	KPaa	0.001
mmHg	mmHga	0.00750063
inHg	inHga	0.0002953
inH_20	inH_20a	0.004021732 @ 20°C
mmH_20	mmH_20a	0.1019716 @ 4°C
Kg/cm^2	Kg/cm^2a	0.0000101972
label	labela	user defined

When operating in DEVICE=RPM mode, a unit change command to the PPC will also change the units displayed by the RPM. When using an absolute RPM, a change from absolute to gauge units will be permitted but the RPM's display will not change. The values returned by the "PR" command will be corrected to gauge using the default or last measured ATM value if available.

EXAMPLE: typical command: "UNIT=mbar"

typical reply: " mbar "

ERROR: none

VAC(=)

PURPOSE: To set or read the vacuum pump status.

SYNTAX: "VAC=x"
"VAC"

DEFAULT: VAC=0

REMARKS: x = 0: no vacuum pump attached.
x = 1: vacuum pump attached.

The vacuum pump status is automatically set during a configuration, but it may be set from a remote computer. If a vacuum pump is attached, then the command would be "VAC=1". If no vacuum pump is attached, then the command would be "VAC=0". When VAC=1, the PPC will accept and execute pressure set (PS,PSS,PSF,PSH) command below atmosphere. If VAC=0, commands to set pressure below atmosphere will return an error.

EXAMPLE: typical command: "VAC=1"

typical reply: "VAC=1"

ERROR: ERR# 6: If x specified wrong.

VENT(=)

PURPOSE: To vent the system to atmosphere or read the current vent status.

SYNTAX: "VENT=n"
"VENT"

DEFAULT: VENT=0

REMARKS: n = 1: activates vent procedure.
n = 0: closes vent valve.

When n = 1 the pressure will decreases to 20 psia and then the vent valve is opened to atmosphere. If the current pressure is below atmosphere, pressure is increased to 10 psia and then the vent valve is opened.

EXAMPLE: typical command: "VENT=1"

typical reply: "VENT=1"

ERROR: ERR# 6: If x specified wrong.

VER

PURPOSE: Read the version number of the internal software.

SYNTAX: "VER"

DEFAULT: n/a

REMARKS: The software version of the EPROM can be read.

EXAMPLE: typical command: "VER"

typical reply: "DH Instruments PPC1 Ver 3.00 1/04/90"

ERROR: none

#

PURPOSE: To send a command through the PPC1 to an external device.

SYNTAX: "#ddddd"

DEFAULT: n/a

REMARKS: If the PPC1 receives a command from the serial port (COM1) with a "#" as the preceding character, the character will be stripped off and the command will be sent out the secondary serial port (COM2).

If the PPC1 is in the DEVICE=PPC mode, any data received from the secondary serial port (COM2) will be sent back out the main serial port (COM1) automatically.

EXAMPLE: typical command: "#*0100P3"

typical reply: "*000114.503"

ERROR: none

4.4 SAMPLE PROGRAM

The following program demonstrates a procedure that could be followed to correctly set a desired pressure. The COM commands reply contains commas that most basic programs recognize as line delimiters. If the data is to be read correctly it may be necessary to use the LINE INPUT command found in most BASICS.

```
10   ' Sample program
20   CLS
30   OPEN "COM1:2400,E,7,1,CS,CD,DS,LF" AS #1        Open computer COM1 port
40                                                    for communications:
50                                                    2400 baud, even parity,
60                                                    7 data bits, 1 stop bit,
70                                                    no handshaking, send
80                                                    line feed.
90
100  PRINT #1, "ABORT"                               stop any current PPC action
110  INPUT #1, IN$                                   read returned data
120  PRINT IN$                                       display returned data
130  '
140  PRINT #1, "RANGE"                               read the range of the PPC
150  INPUT #1, RG$                                   read returned data
160  PRINT "PPC range => ";RG$                       display returned data
170  RG=VAL(RG$)                                     set rg value
180  '
190  PRINT #1, "COM2=1200,N,8,1"                     setup COM2 port for RPM
200  LINE INPUT #1, IN$                              read returned data line input

210  IF LEFT$(IN$,1)=CHR$(10) THEN IN$=RIGHT$(IN$,LEN(IN$)-1):GOTO 210

220  SERIAL$=IN$
230  PRINT "Com2 => ";SERIAL$                        display returned data
240  '
250  PRINT #1, "UNIT=PSIA"                           change Units to PSIA
260  INPUT #1, UNIT$                                 read returned data
270  PRINT "Unit => ";UNIT$                          display returned data
280  '
290  PRINT #1, "DEVICE=RPM"                          change device to external RPM
300  INPUT #1, DEV$                                  read returned data
310  PRINT "Device => ";DEV$                         display returned data
320  '
330  PRINT #1, "TS=.002"                             set Target Setting to .002 psi
340  INPUT #1, TS$                                   read returned data
350  PRINT "Target Set => ";TS$                      display returned data
360  '
370  PRINT #1, "HS=.004"                             set Hold Setting to .004 psi
380  INPUT #1, HS$                                   read returned data
390  PRINT "Hold setting => ";HS$                    display returned data
400  '
410  PRINT #1, "SS=.001"                             set Stab. Setting to .001 psi
420  INPUT #1, SS$                                   read returned data
430  PRINT "Stability Setting => ";SS$               display returned data
440  '
450  PRINT #1, "PSF=";RG/2                           Set pressure to mid scale
460  INPUT #1, PS$                                   read returned data
470  PRINT "Pressure setting to => ";PS$             display returned data
```

4.4 SAMPLE PROGRAM (cont.)

```
480  '
490  PRINT #1, "STAT"                    read generation status
500  INPUT #1, STAT$                     until routine is complete
510  IF STAT$<>"STAT=0" THEN 490
520  '
530  PRINT #1, "CONFIG                   configure the PPC
540  INPUT #1, CON$                      read returned data
550  PRINT "Configuration => ";CON$      display returned data
560  '
570  PRINT #1, "PR"                      read PPC pressure
580  INPUT #1, PR$                       read data
590
600  IF PR="BUSY" THEN 570               read until configuration
610  PRINT "Current pressure => ";PR$    is complete then display
620  '
630  PRINT #1,"PSH=";RG/3                set pressure to 1/3 scale
640  INPUT #1,PS$                        read returned data
650  PRINT "Pressure setting to => ";PS$ print returned data
660  '
670  PRINT #1, "PR"                      read pressure until
680  INPUT #1, PRES$                     pressure is ready
690  IF LEFT$(PRES$,2)="NR" THEN 670
700  '
710  PRINT "Pressure set to => ";PRES$   print ready pressure
720  PRINT "Test ran successfully"
730  END                                 end program
```

4.5 SERIAL SIGNAL DESCRIPTION

The PPC1 is equipped with two serial ports. COM1 is configured as a DCE type device for RS232 communications, which means COM1 always transmits data on pin 2 and receives data on pin 3. This port is designed to communicate with a host computer. COM2 is configured as a DTE type device for RS232 communications, which means COM2 always transmits data on pin 3 and receives data on pin 2. This port is designed to communicate with an external device.

PIN DESIGNATION

COM1		COM2	
2	TxD	2	RxD
3	RxD	3	TxD
5	Gnd	5	Gnd
7	CTS	9	+12V

TxD - Transmit Data - Output

This pin transmits serial data from the PPC1 to either the host (COM1) or an external device (COM2).

RxD - Receive Data - Input

This pin accepts serial data sent by the host (COM1) or an external device (COM2).

Gnd - Ground

This pin sets the ground reference point for the other RS232 inputs and outputs.

CTS - Clear To Send - Input

The CTS input is used as a hardware handshake line to prevent the PPC1 from transmitting serial data when the RS232 host is not ready to accept it. When this line is low, transmission from the PPC1 is held off.

+12V - This pin is brought out on pin 9 of COM2 to supply an external device such as a DH RPM1.

4.5.1 SERIAL CABLE WIRING DIAGRAMS

If a cable was not purchased with the PPC1, the following diagrams will be helpful in making your own cable for communication with the host.

IBM PC/XT/PS2 to PPC1

DB-25 Female			DB-9 Male	
TxD	2	---------->	3	RxD
RxD	3	<----------	2	TxD
RTS	4	---------->	7	CTS
Gnd	7	<---------->	5	Gnd

IBM AT to PPC1				
DB-9 Female			DB-9 Male	
TxD	3	---------->	3	RxD
RxD	2	<----------	2	TxD
RTS	7	---------->	7	CTS
Gnd	5	<---------->	5	Gnd

4.5.2 SERIAL PORT CONFIGURATION

The default operating parameters for COM1 and COM2 are:

2400 baud
Even Parity
7 Data Bits
1 Stop Bit

Serial Terminator CR-LF

These parameters can be changed using the COM1 and COM2 commands.

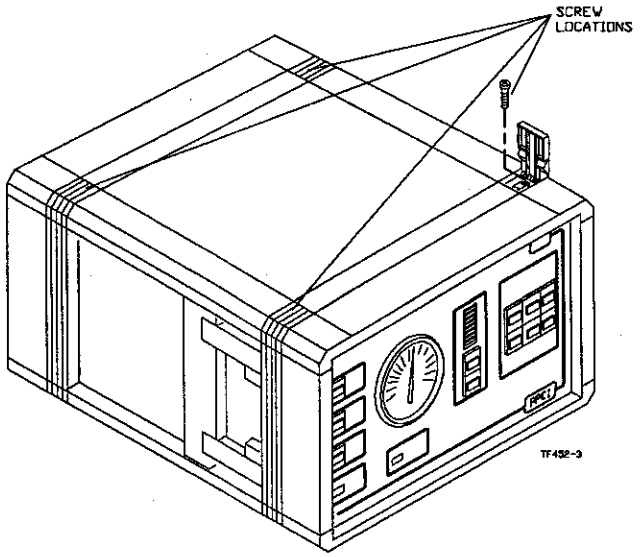
The PPC1 looks for a line feed to terminate the received data string. The host computer should make certain that a line feed is asserted at the end of the string.

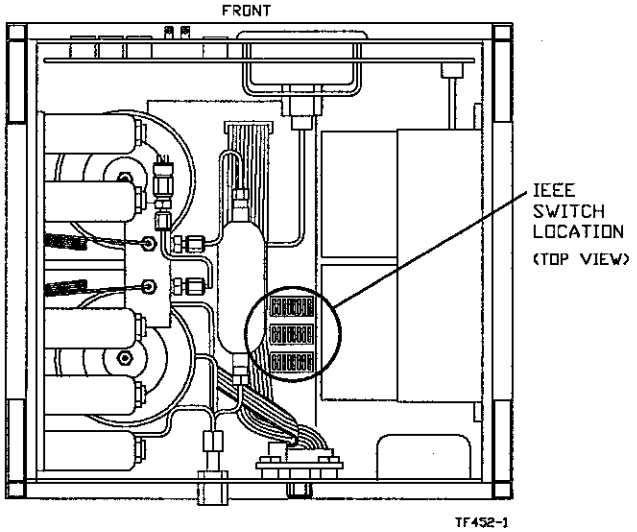
4.6 IEEE OPTION

The PPC can be equipped with an optional IEEE interface. When this option is used the following precautions must be observed.

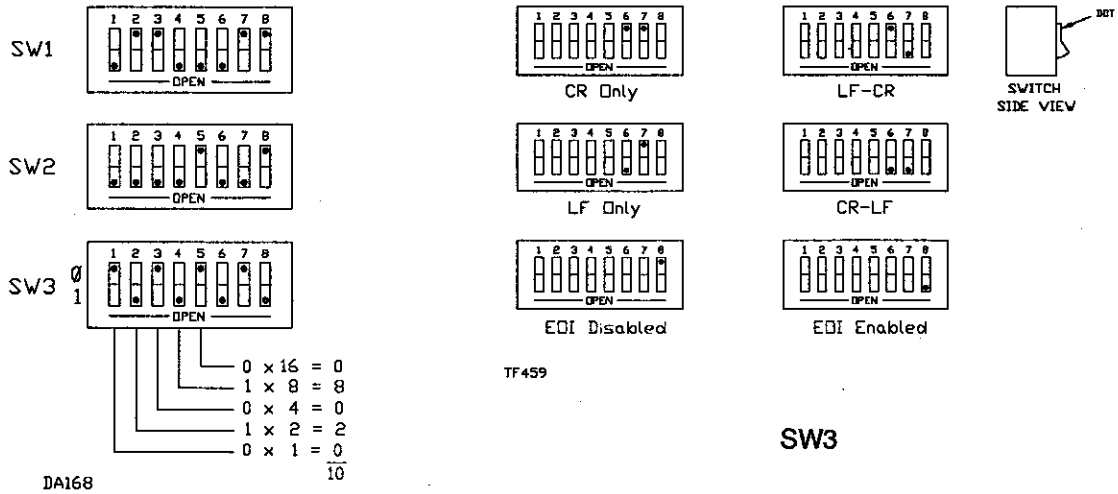
- The switch on the rear panel must be in the UP or GPIB position before power is applied.
- The address must be set to a unique standard address.

When changing the address of the IEEE interface it is necessary to remove the top cover of the PPC. This can be done by removing the (4) screws that secure the top (see figure below for screw locations). Once the cover has been removed, the switches can be set to the desired address.





Factory default switch settings:



SW1 and SW2 are set at the factory and should not be adjusted. SW3-1 through SW3-5 select the IEEE bus address. SW3-6 through SW3-8 determine the IEEE Bus terminator. The factory default is LF with EOI enabled. The address is selected by simple binary weighing with switch 3-1 being the least significant bit and switch 3-5 the most significant. The factory default is address 10.

The command syntax is the same for IEEE as it is for RS232. Please refer to the programming section in the manual for proper format.

- **IEEE Defaults**

  Address: 10
  Bus terminator: LF, EOI enabled

CHAPTER 5 - MAINTENANCE AND ADJUSTMENTS

No special maintenance or adjustments are required for the PPC1.

CHAPTER 6 - TROUBLESHOOTING

6.1 PRESSURE LEAKS

PPC1 has a constant pressure flow through it but this flow is only to assure proper operation of the regulators and does not affect the controlled volume. If, with all valves shut (PPC1 at rest), pressure continuously drops, there is a leak in the system. First, check the system external to the PPC1 thoroughly for leaks or plug the PPC1 output connection and recheck the PPC1. If there is a leak in PPC1, a liquid type leak detector can be used sparingly to check the PPC1 internal fittings. Be very careful to keep the liquid away from all electrical components. Tighten any loose fittings. If the leak still cannot be corrected, contact the DH Instruments Technical Service Department.

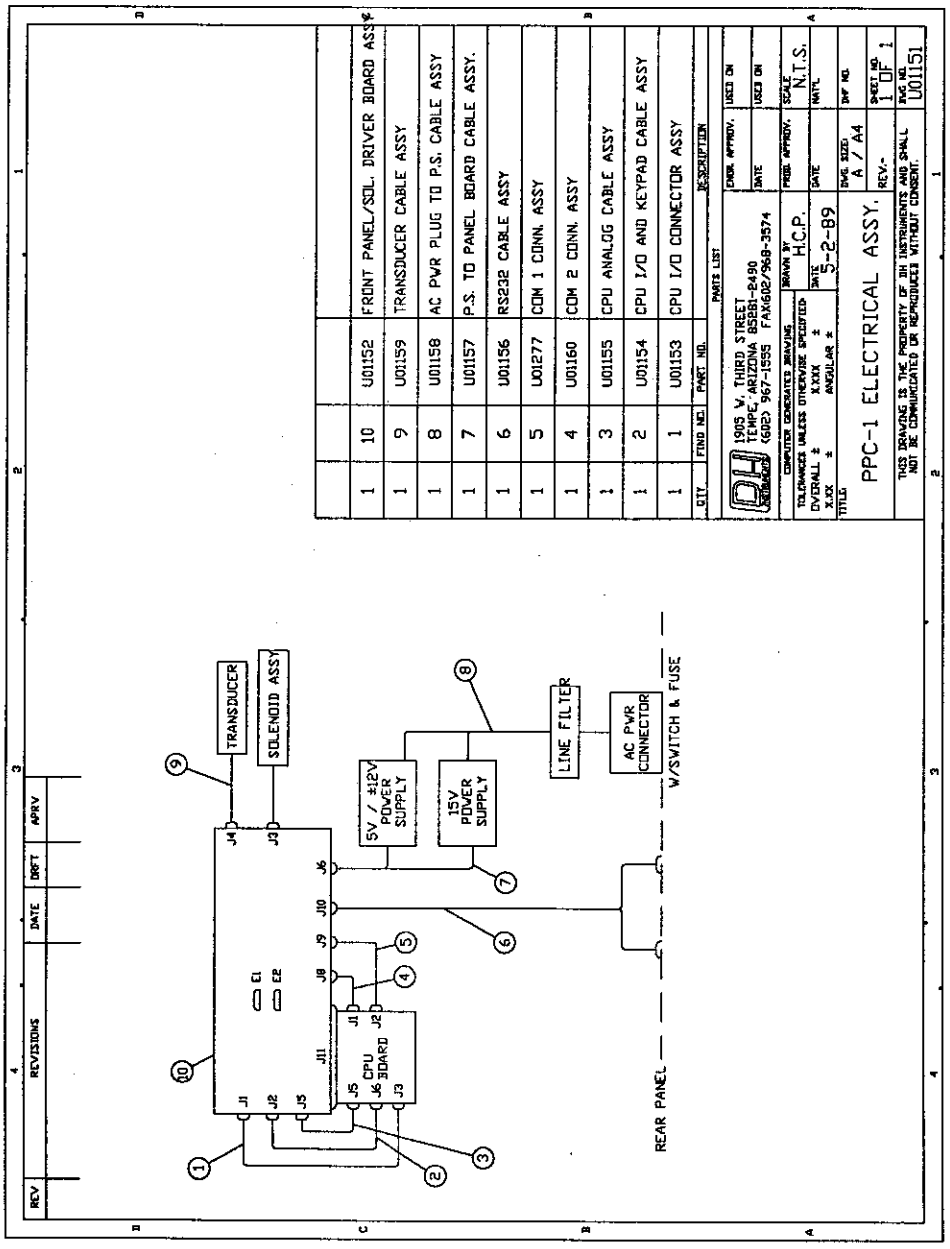
6.2 CONTROL HARDWARE PROBLEMS

In addition to the problem of pressure leaks discussed above, there are other conditions which could occur both internal and external to the PPC1 that can either cause damage to the unit or hinder proper operation. A list of possible problems is given below. If additional help is required, contact a DHI Technical Services representative.

SYMPTOM	*POSSIBLE CAUSE*	*SOLUTION*
• Unit inoperable	• No AC power • Blown main fuse	• Plug in unit • Replace fuse
• Inability to increase pressure	• Low supply pressure • Blocked supply line • Above Upper Limit	• Check supply • Replace line • Readjust UL
• Inability to decrease pressure	• Blocked vent line	• Replace line
• No computer communication	• Bad interface cable • Improper data framing	• Replace cable • See Chapter 4

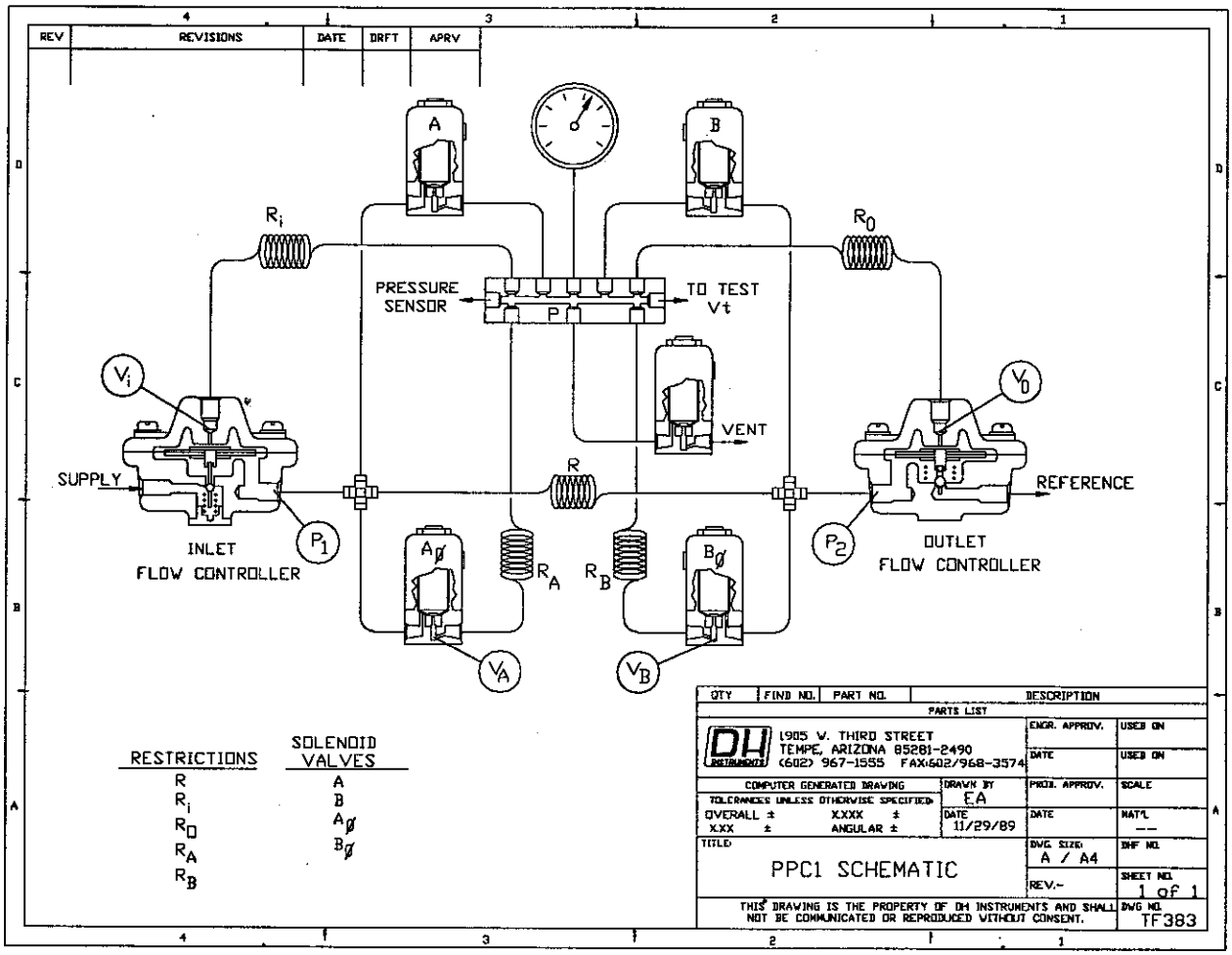
ANNEXES

ELECTRICAL ASSEMBLY



ANNEXES

SYSTEM SCHEMATIC



(User Notes)

(User Notes)