POSITIVE-SHUTOFF PRESSURE CONTROLLER/CALIBRATOR 2 (PPC2)

01/92
MANUAL #95-

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CHAPTER 1 - INTRODUCTION

1.1 PRODUCT OVERVIEW

The Positive-Shutoff Pressure Controller/Calibrator, PPC2, is a self-contained pneumatic pressure setting system intended for use in calibrating and testing all sorts of pressure measuring devices.

The PPC2 consists of one or two high accuracy pressure transducers used as references, a pressure control module, an electronic module, a user interface via front panel display and keypad and a computer interface via a standard RS232 interface (COM1) and an option GPIB (IEEE 488) interface.

From PPC2's front panel, the user can set individual pressures as well as program and recall complete calibration routines. All other PPC2 functions such as adjusting operational limits, setting up and using external reference devices, recalibrating the internal sensor, etc. can be accessed through front panel commands.

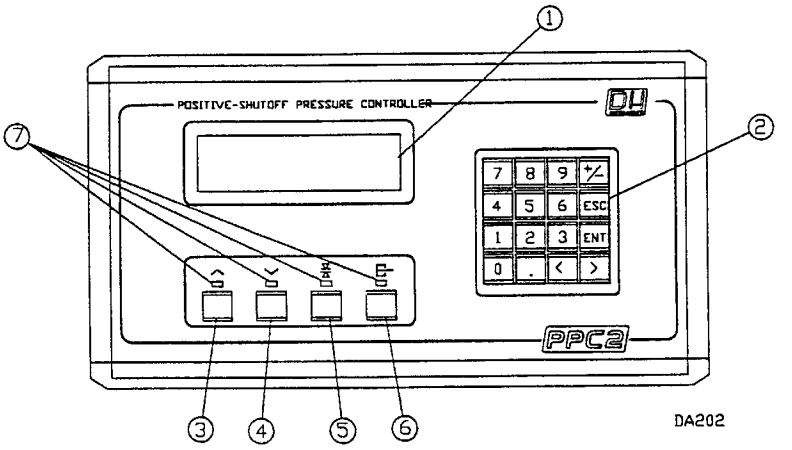
External references (DHI RPM1's and RPM2's or Type 20000 Digital Piston Gauges) can be added to the PPC2 to create a multi-range system from one controller/calibrator.

PPC2 has two different pressure controlling modes. The first is intended for setting truly static pressures near the nominal set point and reading the actual value of pressure present in the system without controller interference. This is called the Static Control Mode. The second is intended when dynamic control at an exact set point is desired and it is going to be assumed that the pressure set is equal to the pressure requested. This is called the Dynamic Control Mode.

1.2 LOCATION OF THE COMPONENTS

FRONT PANEL

1) 2 x 20 display
2) Multi-function keypad
3) Increase pulse key
4) Decrease pulse key
5) Hold key
6) Vent Key
7) Status indicators



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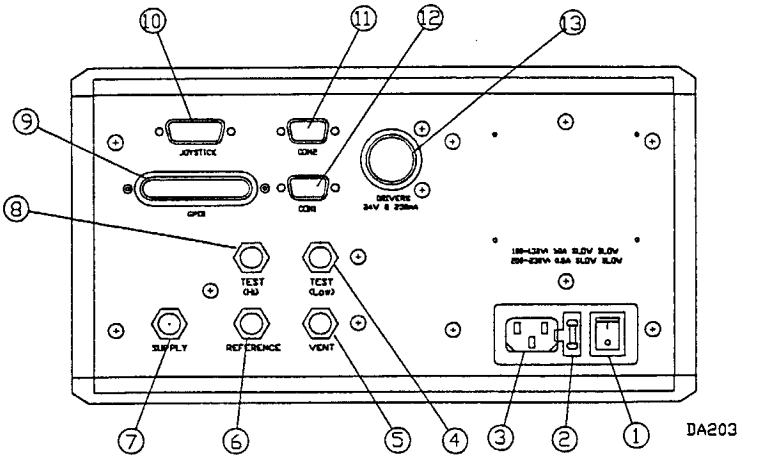
REAR PANEL

1) Power switch
2) Main fuse
3) Power receptacle
4) Test connection, Low; 1/8" NPTF
5) Vent connection; 1/8" NPTF
6) Reference connection; 1/8" NPTF
7) Supply connection; 1/8" NPTF
8) Test connection, High; 1/8" NPTF
9) IEEE 488 port (optional)
10) Joystick (optional)
11) RS232 port (COM2)
12) RS232 port (COM1)
13) External Drivers (optional)



1.3 SUBASSEMBLY DESCRIPTION

- **Pneumatic Module** - Modularized pneumatic assembly mounted to the right inner wall of the PPC2. 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 PPC2 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 VDC signal is used for the TTL level electronics in the PPC2, the ±12 VDC signals are used for the analog circuitry and serial communication ports of the microprocessor card, and the 24 VDC is used to power the solenoid valves. To avoid crosstalk when powering on or switching off the solenoid valves, the 24 VDC supply is a separate card.

- **Electronic Assembly** - A multi-function microprocessor board and the main interfacing board. These cards contain all the logic and hardware for serial communications, IEEE communications, valve drivers, display drivers, analog to digital converter, battery backed RAM and all program memory to successfully perform all required functions.

- **Interface Card** - Located behind the PPC2 front panel. This PCB holds all the switches and LEDs for the manual control and status of the various PPC2 functions.

- **Transducer** - The PPC2 has an on-board pressure transducer that is used to monitor the system pressure. The transducer output is available to the PPC2 for use in setting pressures under microprocessor control or to a host computer. Transducer output is also available in engineering pressure unit over the interface.

  An "auto-tare" function has been programmed into the PPC2 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 using an absolute transducer.

- **Digital Display** - A 2 x 20 digital display is used to display all pertinent user information.

- **Joystick (optional)** - Remote wired device for the proportional setting of desired pressures. The joystick connects to a connector on the rear panel of the PPC2 and contains, in addition to the pressure ramping function, hold and vent functions.

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1.4 SPECIFICATIONS

Ranges:
- 0 to 1 000 psi. For higher pressures please consult factory.

Adjustable Control Settings: Static Control Mode (no valve)
- Target limit: +/-0 to 2% F.S.
- Hold limit: +/-0 to 2% F.S.
- Stability test: 0 to F.S./sec
- Control Precision: +/-0.0005% F.S. or 1 Pa (0.00015 psi) max.

Adjustable Control Settings: Dynamic Control Mode (valve OK)
- Target limit: automatically set to 0
- Hold limit: +/-0.0005% to 2% F.S.
- Stability test: 0 to F.S./sec
- Control Precision: +/-0.0005% F.S. or 1 Pa (0.00015 psi) max.

Nominal Control Volume:
- Standard: 0 to 400 cc (0 to 25 $in.^3$)
- High Volume: 400 cc to 2 litre (25 to 122 $in.^3$)

Slew Rate (0 to F.S.):
- Standard: 30 sec.
- High Volume: 30 sec. to 3.5 min.

Measurement Specifications:
- Accuracy: traceable to NIST including the uncertainty on the standards used for calibration at +/-(0.01% F.S. + 0.005% rdg)
- Repeatability: +/-0.005% F.S.
- Hysteresis: +/-0.005% F.S.
- Linearity: +/-0.005% F.S.
- Vibration sensitivity: negligible.

Control Mode:
- Static: Pressure is set within the target limit and readjusted only when hold limit is reached or exceeded. Ready condition cannot occur while pressure is being controlled.

- Dynamic: Pressure is constantly adjusted to the target value. Ready condition can occur during control.

Engineering Units Supported:
- psi, bar, mbar, Pa, kPa, mmHg, inHg, inH_2O, mmH_2O, kg/cm^2, counts (one user defined and one absolute of all above).

Programmable Sequences:
- Cycle: Repeat a two-step sequence, store up to 50.
- Step: Sequence of evenly spaced increments between two points, store up to 50.
- Custom: Sequence of up to 40 user defined pressures, store up to 50.

Interfaces:
- External Communications: RS232C, GPIB (IEEE488) optional.
- Remote Measurement Device: RS232C for RPM1/RPM2 and 20000 DPG only.

Pressure Supply:
- Clean, dry, non-corrosive gas at 20% over nominal control range.

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Pressure Connections:
- Supply: 1/8" NPTM
- Test, vent, reference: 1/8" NPTF

Temperature Range:
- Operation: 0 to 50 C (32 to 122 F)
- Storage: -25 to 85 C (-15 to 185 F)

Power Requirements:
- 85 to 264 VAC, 47 to 440 Hz, 22 VA max. consumption.

Weight & Dimensions:
- 11 kg (23 lb.); 30 cm W x 15.5 cm H x 34 cm D (11.8" X 5.3" X 13.4")

NOTE: Due to the policy of continual product improvement, all specifications are subject to change without notice.

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CHAPTER 2 - INSTALLATION

2.1 UNPACKING AND INSPECTION

The PPC2 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 PPC2 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** - Five pressure connections are included on the rear panel of the PPC2. The system into which pressure is to be controlled is connected to the Test Connection, High (8) 1/8" NPTF connection. (When working with compound PPCs, the Test Connection, Low (4) pressure connection should only be connected when making true differential measurements. This connector should be unobstructed at all other times.) Hold the bulkhead type connector on the PPC2 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 (5) and the Reference (6) 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 PPC2 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 PPC2. This should be considered when deciding on the location of the PPC2 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 PPC2. Both connections should be made to the desired devices using a standard 9-pin cable. COM1 is for communication to the PPC2 and COM2 is used to communicate through the PPC2 to another device such as a Reference Pressure Monitor (RPM) or Digital Piston Gauge (DPG).

- **Power connections** - The PPC2 should be located close to a convenient source of AC power. The PPC2 has a universal input which will operate on 85 to 264 VAC with no jumper change.

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- **Configuring the system** - For the PPC2 to control properly into the volume into which it is connected it must be configured. Configuration is done using an automated user initiated routine (see 3.4.4 Special - Config - Config PPC).

The PPC2 should be connected using the supplied power cable to a convenient source of AC power. 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 PPC2 is rated plus 20 psi (50 psi for PPC2-1000). For example, the PPC2-250 should have a regulated inlet pressure of 270 psi or less.

For best performance PPC2 should be warmed up 15-20 minutes before operating. Upon power-up 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 will display a message 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 Main Menu should be displayed. Once the Main Menu is displayed selections can be made by either pressing the number of the desired option or by pressing the (Left/Right) arrow keys to place the blinking cursor to the desired option and then pressing the [ENT]er button. The [ESC]ape button will cause the menus to 'back up' to the previous menu selection in most cases. It will also cause some selections to be skipped when the PPC2 is to use values already stored in its internal memory.

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CHAPTER 3 - OPERATION

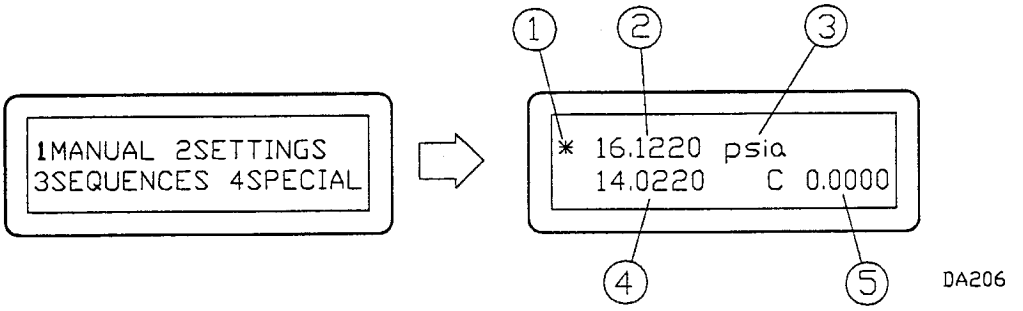
3.1 MANUAL OPERATION

The PPC2 is ready for use when all initialization and self test procedures have passed during power up and if the main menu is displayed. Manual Mode is accessed by selecting #1 from the main menu. Manual Mode can be left to return to the main menu by pressing [ESC]ape. You can also go directly into the Settings #2 Menu from Manual Mode by pressing the [↑] (up) and [↓] (down) special function keys simultaneously.

FRONT PANEL DISPLAY

The front panel, keypad and special function keys are used for accessing user menus/prompts, entering of numeric data and the execution of special commands. Pressure values are also read from this display.

To place the PPC2 into Manual Mode select #1 from the main menu by either pressing 1 or using the arrow keys to place the blinking cursor over the number 1 and then pressing enter to select that option.



(1) * - pressure is "READY"
< - pressure is "NOT READY" and decreasing
> - pressure is "NOT READY" and increasing

(2) 16.1220 - current pressure value.

(3) psia - current units of measure.

(4) 14.0220 - last set target value in current units of measure.

(5) C 0.0000 - rate of change in pressure in current units of pressure/second.

NOTE: For manual pressure generation and control you must insure that you are in Manual Mode (#1).

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ADDITIONAL - Each double bordered box of the items listed in the following sections contain the menu selections necessary to reach the desired function. All the user needs to do is press the number which corresponds to the menu text which appears on the front panel display and the double bordered box in this manual.

The PPC2 can be operated manually either by utilizing the keys on the digital front panel or by entering a numeric value via the key pad and then pressing the [ENT]er key while the Manual (#1) option is selected.

3.1.1 PRESSURE INCREASE AND DECREASE - FAST MODE

The fast speed increase buttons ('.' and right arrow simultaneously) and decrease button ('.' and left arrow simultaneously) 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 button combinations together will cause the proper solenoid valves to open as indicated by the LED corresponding to pressure increase or decrease illuminating. Typical zero to full scale ramping time in fast mode is 20 to 30 seconds.

The system pressure can be observed on the front panel of the PPC2 or read from the internal transducer via the RS232 serial interface or optional IEEE 488 interface on a host computer.

When the system pressure is close to the desired pressure, the keys 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. Once the pressure has settled to within the current operating parameters an '*' will be displayed on the digital front panel next to the Current Pressure Value signifying the pressure is stable and within operating limits (see 3.4.5 Special - Config - Edit Config).

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 (right arrow) is used for the pressure increase and button (left arrow) 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 PPC2 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 the dedicated special function keys ↑ (up) for increasing pressure and ↓ (down) for decreasing. The duration of the pulses can be adjusted by accessing the Settings Menu (#2) and selecting the Step (#1) option and entering the desired numeric value using the front panel key pad. Adjust the pulse value as necessary to achieve the desired level of control.

NOTE: Pressing both the "PULSE UP" and "PULSE DOWN" keys simultaneously will take you directly to the Settings #2 Menu.

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3.1.4 PRESSURE HOLD FUNCTION

When the desired pressure is achieved in the system, the HOLD button (5) can be depressed to cause the PPC2 to maintain this pressure. When the HOLD is activated the current pressure becomes the target pressure. Unlike the previously listed buttons or menu selections, the HOLD button is a push button switch and will toggle between states each time it is depressed while in Manual Mode. The indicator above the HOLD button will light when hold is active. The PPC2 will automatically maintain the pressure within the user specified Hold Limits which is set in the Settings Menu. Manual pressure adjustments should not be done while the Hold function stays activated; it must be deactivated for pressure changes and reactivated to hold the current pressure. If HOLD is on and the pressure is altered, the PPC2 will attempt to adjust the pressure to the value when HOLD was activated.

NOTE: Pressing both the "PULSE UP" and "PULSE DOWN" keys simultaneously take you directly to the Settings #2 Menu.

3.1.5 VENT FUNCTION

The Vent function can be activated or deactivated by entering the Manual Mode and then pressing the VENT button. When the VENT button is activated, the system will be brought back to near atmosphere in fast mode before the vent solenoid valve is opened to bring the system to atmospheric pressure. REMEMBER: you must be in the Manual Mode for activation or deactivation of the vent.

3.1.6 READY/NOT READY INDICATION

When in Manual Mode, the PPC2 constantly displays a Ready/Not Ready indication. The indication is by a symbol to the left of the Current Pressure. The symbols used are:

1. '>' - NOT READY and pressure is increasing
2. '<' - NOT READY and pressure is decreasing
3. '*' - READY

How the Ready/Not Ready condition is determined depends upon the operating mode in which you are using the PPC2. These operating modes are set in the #4 Special Menu under Mode.

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 anytime 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, the PPC2 always displays the exact measured value of the current pressure. 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.

NOTE: The Hold Limit and the Stability Test are set by the user in the #2 Settings Menu.

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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 DH Positive-Shutoff Pressure Controllers.

Dynamic Pressure Control
In the Dynamic Pressure Control Mode, when HOLD is on and the PPC2 is in Ready condition, it displays the target pressure. 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.

NOTE: The Hold Limit and the Stability Test are set by the user in the #2 Settings Menu.

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 a PPC is around +/-5 PPM F.S. See Also 3.4.7 Special - Mode (Control) and 3.2.3 Settings - Hold Limit.

3.1.7 AUTOMATIC SINGLE PRESSURE POINT SETTING

In Manual Mode the PPC2 can be commanded to set a single pressure point. While in Manual Mode, press [ENT]er. The Target Setting Menu is displayed and shows the last target value set.

Write in the new target value you want (use the arrow keys to move the cursor and edit if necessary). Change the Hold function from on to off (or vice versa) by pressing the HOLD key depending on whether you want HOLD to be on or off when you set the pressure. Once the value of pressure entered is correct and the HOLD is in the desired state, press [ENT]er. PPC2 will set the pressure to the target value and indicate "*" when ready.

To suspend a pressure setting routine, press [ESC]ape. To resume a suspended pressure setting, press the [ENT]er key. To return to the Main Menu Pressure [ESC]ape again.

3.2 SETTINGS (SETS)

Settings are the criteria the PPC2 uses for pressure generation and control. The settings determine such things as 'step size', 'target limit', 'hold limit' etc. It should be noted that the finer the value (smaller, approaching zero) the longer it take the PPC2 to generate pressures. There is a trade off however, precision for speed. Listed below is a summary of the possible settings.

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3.2.1 SETTINGS - STEP SIZE

Controls the step size which will be obtained when the Manual Mode special function PULSE keys are used.

Range: 0-2% of F.S.

3.2.2 SETTINGS - TARGET LIMIT

Controls how close to the target value the pressure will be set before the pressure setting sequence is considered complete.

Range: 0 to F.S.

3.2.3 SETTINGS - HOLD LIMIT

When in Static Pressure Control Mode: Determines the maximum deviation in pressure from the target value that will be allowed before the pressure will be reset to the target value within the target limit. When the pressure reaches the Hold Limit, the Ready condition will be turned off and will stay off until the pressure is set within the target limit.

When in Dynamic Pressure Control mode: Determines the maximum distance in pressure from the target at which a Ready indication can occur. Thus, the Hold Limit is the maximum value of the control error.

NOTE: see 3.4.7 Special - Mode (Control) and 3.1.6 Ready/Not Ready Indication.

3.2.4 SETTINGS - STABILITY

The Stability Setting is used only as one of the criteria in determining whether Ready or Not Ready will exist.

For a Ready condition to exist, the rate of change of pressure must be less than the current Stability Setting.

In Static Pressure Control Mode the Stability Setting should be set to the maximum rate of change of pressure at which it is acceptable to take readings. Keep in mind that if there is a leak present that is greater than that rate, a Ready condition will never be achieved.

In Dynamic Pressure Control Mode the Stability Setting is not critical since the intention is to actively control pressure at a set point and make measurements when pressure is inside the Hold Limit regardless of pressure stability. A good default value for the Stability Setting in this mode is 1.5 times the Hold Limit.

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3.2.5 SETTINGS - UNITS

Determines which pressure units are to be used for data entry and display. If the PPC2 is in manual mode and units have been changed, all the current settings will be updated to reflect the change. If the PPC2 is in Sequences the change will only affect the current pressure sequence.

Limits: up to six units can be displayed and selected from the units available in the Settings - Units Menu.

NOTE: see 3.4.1 Special - Units.

3.2.6 SETTINGS - RESOLUTION

Determines the number of digits to the right of the decimal point to display. During pressure generation and on the external interfaces the PPC2 will use the maximum amount of decimal precision.

3.2.7 SETTINGS - AUTOMATIC SETS

Used to set operating limits automatically based on the F.S. and accuracy of the device being calibrated. Automatic Sets automatically sets Step Value, Target Limit, Hold Limit, Stability Test and resolution. Pressure units desired and Ready criterion (Static Control Mode vs. Dynamic Control Mode) must be set separately by the user. You can edit any of the settings made as a result of Automatic Sets by making the appropriate selection and editing it in the Settings Menu.

When you select the Automatic Sets you will then be prompted to enter the F.S. of the unit under test and the accuracy of the unit under test (in % F.S.).

Automatic Sets are then made based on the Unit Under Test (UUT) tolerance. The system calculates the UUT tolerance:

UUT F.S. x UUT F.S. accuracy = UUT tolerance

The values then set are:

Step value:	UUT tolerance/3 or 0.005% PPC2 F.S., whichever is larger.
Target limit:	UUT tolerance/4 or 0.0015% F.S, whichever is larger.
Hold limit:	UUT tolerance/3 or 0.0015% F.S., whichever is larger.
Stability test:	UUT tolerance/2 per second.
Resolution:	UUT tolerance/10 or maximum resolution, whichever is lower.

3.3 SEQUENCES

PPC2 allows you to set up, store and recall for later execution complete sequences with the settings parameters that you desire.

Three types of sequences may be set up (Cycle, Step or Custom) depending on the type of test you are running. The three types are described below.

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Sequences is accessed from the Main Menu by Selection #4. The next choice is the type of sequence with which you want to work (Cycle, Step or Custom). Once you have selected the type of sequence with which you want to work, you can select between 1RUN, 2EDIT, 3SETS.

1RUN will allow you to select a sequence by its numerical address and execute it.

When the address of the sequence you want to run is entered, you will be asked to confirm the upper limit (UL) of that sequence. The UL was set automatically when the sequence was edited at a value just above the maximum pressure contained in the sequence. The UL is automatically set to prevent accidental overpressure of the device you are testing. You are now asked to confirm it as a way of verifying that you are running the proper sequence.

After confirming the UL setting, the sequence begins to execute. The display is identical to the Manual Mode display except that the sequence you are running is identified by CYC, STP or CUS and the sequence number. The increment that is currently being set is also displayed.

To interrupt a sequence press [ESC]ape. This will interrupt execution of the current function but not of the sequence itself. Press [ENT]er and the sequence will continue where it was interrupted. Pressing [ESC]ape again goes to a menu where you are asked to confirm that you want to abort the sequence. If you confirm you do, the sequence will be aborted.

2EDIT will allow you to select a sequence by its numerical address and edit the sequence. At the last step of editing of the sequence, you will be asked if you want to edit the settings for that sequence. Edit is also used to view an existing sequence.

3SETS will allow you to select a sequence by its numerical address and edit the settings (Step, Target, Hold, etc.) for that sequence. At the last step of editing the settings for a sequence, you will be asked if you want to edit the sequence itself. Sets is also used to view the settings for an existing sequence.

NOTE: Sequences are edited, stored and executed by the type of sequence (Cycle, Step or Custom) and the sequence number within that type.

3.3.1 CYCLE SEQUENCE

Up to 50 Cycle Sequences may be programmed and stored. The Cycle Sequence is designed to allow quick configuration and execution of a test that consists of repeatedly setting two pressures.

In setting up a Cycle Sequence, you specify the first pressure and the second pressure and the number of times you want to cycle between the two. The maximum number of times is 50. Example of setting up a Cycle Sequence:

Goal: Cycle a pressure measuring device between 0 and F.S. five times.

OPTION	COMMENT
1 - Cycle	Selects Cycle Sequences.
2 - Edit	Selects Edit mode for this Cycle.
Enter sequence #1	You are going to edit sequence address #1. Write in different address if desired.
Enter increment #1	This is the first pressure point. Enter the target pressure value; in this case 0.

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Enter Increment #2	This is for the second pressure point. Enter the target pressure value; in this case F.S..
ESC or ENTER	This confirms the values entered. If ESC is pressed the changes are not saved. If ENTER is pressed the changes are saved and the system continues to the next step.
Number of Cycles	Number of times the two step cycle is to be executed; in this case 5.
Next Point on	Selects when to generate the next pressure. Choices are after delaying a certain number of seconds or when the operator presses [ENT]er.
1-Delay 2-Enter	After a delay or ENTER; if delay is selected you will then specify the delay time.
Vent after Sequence	Vent the system after the complete sequence regardless of what the last sequence pressure is.
1-Yes 2-No	Select the preferred method.
Hold On	Selects whether the hold function is to be on at the pressure set points (see 3.1.4 Pressure Hold Function and 3.2.3 Settings - Hold Limit)
1-Yes 2-No	Select the preferred method
Set Control Mode 1-Dynamic 2-Static	Do you want the sequence to execute in Static or Dynamic Pressure Control Mode? (see 3.1.6 Ready/Not Ready Indication and 3.4.7 Special - Mode (Control))
Edit Cycle Sets	Do you want to edit the settings that will be used when this sequence is run? (see 3.2 Settings (Sets))
1-Yes 2-No	If yes is selected, you will go to the Settings Menu for that sequence.
Store Current Cycle at #? 1-Yes 2-No	Do you want to store this cycle sequence at cycle address #? You can write a new address if desired.
< Overwrite Current Seq >	If an existing sequence has been edited this query will appear.

To run this sequence press the [ESC]ape button until '1RUN, 2EDIT 3CUSTOM' is displayed then press #1 'Run'.

3.3.2 STEP SEQUENCE

Up to 50 Step Sequences may be programmed and stored. The Step Sequence is designed to allow quick configuration and execution of a test that consists of a minimum pressure, a maximum pressure and a number of evenly spaced increments in between. This is, for example, where you set up a typical 10% increments up and down calibration run.

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In setting up a Step Sequence, you specify the first pressure and the last pressure and the number of steps in between (the maximum number of steps is 100). Keep in mind that the steps will be calculated in even increments which can result in unusual increments if the difference between the first and last pressures divided by the number of steps is not a whole number. If that is the case, you may want to use a Custom Sequence. Example of setting up a Step Sequence:

Goal - Calibrate a transducer by generating 10 increasing equally spaced pressures between 0 and 100 and then return back to the starting pressure in 10 equally spaced steps. At each step you want the system to wait 5 seconds and then go to the next step.

OPTION	COMMENT
2 - Step	Selects Step Sequences.
2 - Edit	Selects Edit mode for Steps.
Enter Step #1	You are going to edit Step Sequence address #1.
Enter first Pressure Point	Starting pressure value; in this case 0.
Enter last Pressure Point	Ending pressure value; in this case 100.
Enter number of Steps	Number of steps between the starting and ending pressure; in this case 10.
Return to Start	Do you want to go back from the last pressure to the first in the same steps? In this case, yes.
Next Point on	Time delay before next pressure or enter button press; in this case select delay.
Dwell Time at Step	Time delay in seconds before the next pressure will be set; in this case enter 5.
Vent after Sequence	Vent the PPC2 when finished ?; in this case NO since the last pressure is 0 anyway.
Hold On	Selects whether HOLD is to be on at the pressure set points (see 3.1.4 Pressure Hold Function and 3.2.3 Settings - Hold Limit)
Set Control Mode 1-Dynamic 2-Static	Do you want the sequence to execute in Static or Dynamic Pressure Control Mode? (see 3.1.6 Ready/Not Ready Indication and 3.4.7 Special - Mode (Control))
Edit Step #01 sets	Do you want to edit the settings that will be used when this sequence is run? (see 3.2 Settings (Sets))
Store Current Cycle at #?	Do you want to store this cycle sequence at cycle address #? You can write a new address if desired.
< Overwrite Current Seq >	If an existing sequence has been edited this query will appear.

To run this sequence press the [ESC]ape button until '1RUN, 2EDIT 3CUSTOM' is displayed then press #1 'Run'.

Press [ESC]ape	Go back to Sequence Menu.
Select Run	Select 1 enter to run Step Sequence.

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3.3.3 CUSTOM SEQUENCE

Up to 50 Custom Sequences may be programmed and stored. The Custom Sequence is designed to allow a series of user defined pressures to be entered and executed. This type of sequence is used when the test consists of non-evenly spaced increments or random values. For a typical evenly spaced increment calibration you will find the Step Sequence easier to use and for a repeated two pressure cycle, the Cycle Sequence is used.

In setting up a Custom Sequence, you specify the total number of pressures that are to be set and then you enter the value of each pressure. Example of setting up a Custom Sequence (for greater detail see the Cycle and Step Sequence examples):

OPTION	COMMENT
3 - Custom	Selects Custom Sequence pressure generation.
2 - Edit	Selects Edit mode for Custom Sequence.
Edit Custom Sequence	Enter address of Custom Sequence you want to edit.
Total # of Pressure Points	Enter the total number of points, (n).
Enter Pressure Point	For pressure points 1 through (n), enter value to be set.

3.4 SPECIAL

The 'Special' Menu allows the user to access special functions affecting PPC2 operation:

3.4.1 SPECIAL - UNITS

Determines the pressure units that will be available in the Settings Menu (see 3.2 Settings (Sets)). The units are divided into SI and other units and include user defined units.

Limits: 6 units maximum are selectable at any one time. Those six units will then be accessed from the Settings Menu.

3.4.2 SPECIAL - UL (UPPER LIMIT)

Sets the upper limit or the maximum allowable pressure that can be generated. If the pressure exceeds the upper limit the internal warning buzzer will produce an audible tone to signify a potential hazard. The PPC2 will automatically shut of at the UL pressure. The default UL is determined by the range of the PPC2's internal sensor. UL values are set automatically when external devices are selected and when sequences are executed.

3.4.3 SPECIAL - CONFIG

Automatically configures the PPC2 operating coefficients for optimal performance in the volume of the system to which it is connected.

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3.4.4 SPECIAL - CONFIG - CONFIG PPC

Executes the configuration routines and adjusts the internal coefficients. The configuration procedure changes the operating parameters to adapt to different volumes. Config is also used to determine if a vacuum pump is connected to the reference port. If a vacuum pump is detected the vacuum flag will be set (VAC=1) otherwise the flag will be disabled (VAC=0).

The configuration routine should be executed at roughly mid-scale between the minimum and maximum pressure at which you will be working. The configuration routine takes about two minutes to execute. At the end of configuration execution, the PPC2 is left vented.

3.4.5 SPECIAL - CONFIG - EDIT CONFIG

Allows the user to alter the configuration information via the front panel. This can be useful in special situations but should not be done without consulting DH Instruments.

3.4.6 SPECIAL - DEV (DEVICE)

Allows the user to set up and use external measuring devices with PPC2. Generally this is used to add ranges. External devices that can be used are RPM1/RPM2 Reference Pressure Monitors or type 20000 Digital Piston Gauges. Two RPMs and two DPGs can be set up.

Editing allows the user to change the operational characteristics of the selected device. The editable characteristics are:

PPC

Measurement Period - Internal transducer integration time. The default value is 1 500 milliseconds. This figure should not be changed except by recommendation from the factory.

RPM

Gauge Device - Is the RPM a gauge or absolute version? Yes or no query.

Range - Maximum operating pressure of the RPM (F.S. + 10%).

RPM Address - Logical Address of the RPM. It is possible to daisy chain RPM's together but requires a different RPM address in the chain. Valid addresses are 1 to 98.

COM2 Port - Serial parameters for the COM2 port (see 3.4.19 Special - Internal - Remote).

DPG

DPG coef. - Pascals per count. One count is considered the first digit to the left of the decimal point.

DPG Tare offset - Offset in the number of counts.

DPG Range - Maximum allowable pressure for the DPG device (F.S. + 10%).

COM2 Port - Serial parameters for the COM2 port (see 3.4.19 Special - Internal - Remote).

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3.4.7 SPECIAL - MODE (CONTROL)

Sets the Ready criterion. Determines whether PPC2 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 Pressure Mode is selected by "valve OK".

When in Manual Mode, the PPC2 constantly displays a Ready/Not Ready Indication. The indication is by a symbol to the left of the Current Pressure. The symbols used are:

1. '>' - NOT READY and pressure is increasing
2. '<' - NOT READY and pressure is decreasing
3. '*' - READY

How the Ready/Not Ready condition is determined depends upon the operating mode in which you are using the PPC2. These operating modes are set in the #4 Special Menu under Mode.

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 anytime 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, the PPC2 always displays the exact measured value of the current pressure. 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.

NOTE: The Hold Limit and the Stability Test are set by the user in the #2 Settings Menu.

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 DH Positive-Shutoff Pressure Controllers.

Dynamic Pressure Control
In the Dynamic Pressure Control Mode, when HOLD is on and the PPC2 is in Ready condition, it displays the target pressure. 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.

NOTE: The Hold Limit and the Stability Test are set by the user in the #2 Settings Menu.

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 a PPC is around +/-5 PPM F.S. See Also 3.4.7 Special - Mode (Control) and 3.2.3 Settings - Hold Limit.

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3.4.8 SPECIAL - VALVES (EXTERNAL VALVES): OPTIONAL

Allows the user to operate up to 8 valve drivers manually from the front panel. The valves can be toggled on/off or momentarily.

3.4.9 SPECIAL - INTERNAL

Allows the user to reset options, select user levels and passwords. Generally, this option is only selected by individuals with advanced knowledge of PPC2 operations.

3.4.10 SPECIAL - INTERNAL - RESET

Resets operational parameters and returns the PPC2 to a known state. These commands should be used with care because configuration information will be lost.

3.4.11 SPECIAL - INTERNAL - RESET - CONFIG

Resets all configuration information to default values (see 3.4.3 Special - Config). The default values are dependent upon to the range of the PPC2.

3.4.12 SPECIAL - INTERNAL - RESET - ALL

Resets all PPC2 parameters for config, files, system , units, user level along with external and internal device information.

NOTE: If this option is selected the user must reconfigure the PPC2 along with re-defining all Settings information, Sequences and user defined Units. This option must be selected with care because it resets **ALL** user definable information. This function can also be performed on Power Up by pressing and holding the "2" key while power is applied.

3.4.13 SPECIAL - INTERNAL - RESET - SYSTEM

Resets external and internal device information along with calibration data only. Sets all internal data structures to default values.

3.4.14 SPECIAL - INTERNAL - RESET - UNIT

Clears **ALL** user defined units and sets system units to their default values.

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3.4.15 SPECIAL - INTERNAL - CAL

Used to recalibrate the PPC2 or view calibration data.

3.4.16 SPECIAL - INTERNAL - CAL - VIEW

Allows viewing of the current PPC2 calibration coefficients and previous calibrations but does not allow alteration of the values.

3.4.17 SPECIAL - INTERNAL - CAL - SET

Allows the user to enter the PA (pressure adder offset) and PM (pressure multiplier) along with the calibration data. Refer to the DHI RPM manual for a more detailed description. Changing these values will alter the calibration!

3.4.18 SPECIAL - INTERNAL - CAL - RECAL

Runs the PPC2 Recalibration routine which is used if you want to recalibrate the internal sensor.

Calibrations can be performed in gauge or absolute mode (with a gauge or absolute standard). Generally, you should calibrate in absolute mode if you will use the PPC2 primarily with absolute pressure units and gauge mode if you will use the PPC2 primarily with gauge units.

To perform the calibration you need a pressure standard with accuracy greater than the stated accuracy of the PPC2. You will need to be able to set and or measure pressures at 10% increments over the PPC2's range but the set values do not need to be exactly at the nominal pressure calibration points.

Connect the pressure standard to the PPC2 test port. You can then use the PPC2 to set pressures or the pressure standard to set pressures if it has that capability. In either case, full scale pressure needs to be connected to the PPC2's supply port or the PPC2 will not hold pressure. The complete calibration sequence can be completed in about 90 minutes.

3.4.19 SPECIAL - INTERNAL - REMOTE

Allows the user to configure the communications ports. The COM1 data framing parameters can be set up along with the IEEE bus address. The COM1 and COM2 ports can be set up as follows:

Baud Rate:	300, 600, 1200, 2400, 4800 or 9600
Parity:	none, odd or even
Word Length:	7 or 8
Stop Bits:	1 or 2

The IEEE address can be from 1 to 30.

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3.4.20 SPECIAL - INTERNAL - USER LEVEL

Establishes user levels with restrictions and password protection for each restricted level.

Restrictions at User Levels

USER LEVEL:	None	Low	Med	High
PROCEDURE:				
Calibration		x	x	x
Reset Menu		x	x	x
Set UL			x	x
Setup Units			x	x
Set ATM			x	x
Change Device			x	x
Edit a Sequence			x	x
Edit the Config			x	x
Manual Generation				x

Each restriction level has its own password. Passwords are numeric and the length may not exceed 4 digits.

The user must select the restriction desired before entering a new password. The current password must be entered before entering a new password. A pasword of "0000" will disable the password.

NOTE: The password should be recorded and stored in a secure location for later use if necessary. If you forget the password(s) you must use either 3.4.13 Special - Internal- Reset- System, or, 3.4.12 Special - Internal - Reset - All.

3.4.21 SPECIAL - INTERNAL - ATM

Defines the value of atmospheric pressure used by the PPC2 for internal functions.

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CHAPTER 4 - INTERFACING

4.1 OVERVIEW

Most of the commands described in Chapter 4 can also be executed by commands from a computer. The host controlling device is interfaced to the PPC2 using either COM1 or the optional GPIB (IEEE-488) Interface.

Initiating communications with the PPC2 will automatically place the PPC2 into Remote Mode. When in Remote, the PPC2 will display a screen similar to the Manual screen (see 3.1 Manual Operation). The letters "REM" will appear in the upper right hand side of the display. All of the front panel controls are locked out in Remote Mode. You may return to Local Mode by using the "Local" command, or, by pressing the [ESC]ape key. If you have sent the "Remote" command the only way to return to Local is by using the "Local" command.

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.
                                                      Stop all action on the PPC.
30   PRINT #1,"ABORT"
                                                      Read returned reply
40   INPUT #1, REPLY$
                                                      Print reply
50   PRINT "Received data => ";REPLY$
                                                      Request pressure reading.
60   PRINT #1,"PR"
                                                      Read reply.
70   INPUT #1,PRESSURE$
                                                      Print reply.
80   PRINT "Current pressure reading => ";PRESSURE$
                                                      Close COM1 port
90   CLOSE #1
                                                      END program.
100  END
```

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

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


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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.
DEVICE(=)	Specify the PPC2'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.
PPC	Send a command to the internal transducer.
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.
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 PPC2 to an external device.

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4.3 INDIVIDUAL COMMAND DESCRIPTIONS

ABORT

PURPOSE: To stop all current action of the PPC2.

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.

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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" and "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.

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CONFIG

PURPOSE: To automatically configure the PPC2 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.

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DEVICE(=)

PURPOSE: To configure the PPC2 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

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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.

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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

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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

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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

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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 PPC2-250, if "HS=.75" is sent to the PPC2, 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 PPC2-250, 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.

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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.

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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.

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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.

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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

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PPC

PURPOSE: To send a command to the internal transducer(s).

SYNTAX: "PPC,dddd"
"PPCS,dddd"

DEFAULT: n/a

REMARKS: The PPC command is useful for reading the coefficients of the internal transducer.

The PPCS command is used to perform a write to the EEPROM of the internal transducer. This command should be used with caution because a given register is only guaranteed for 10,000 rewrites.

EXAMPLE: typical command: "PPC,DP"

typical reply: "*0001DP=6"

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

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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 PPC2 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.

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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.

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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

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READY(=)

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

SYNTAX: "READY=x"
"READY"

DEFAULT: READY=0

REMARKS: n = 0: Ready (R) cannot occur while the system is adjusting pressure.
n = 1: Ready (R) can occur while the system is adjusting pressure.

n = 0:
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:
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.

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.

EXAMPLE: Typical command: "READY=1"

typical reply: "READY=1"

ERROR: ERR# 6: If x specified wrong.

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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 re-applying 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

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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 PPC2 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

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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 PPC2-250, if "SS=.5" is sent to the PPC2, 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 PPC2-250, 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.

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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

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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

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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.

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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: "UDD=uuuuu,cccccc"
"UDD"

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.

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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 or read 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

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UNIT(=)

PURPOSE: Set or change the current pressure units.

SYNTAX: "UNIT=xxxxxx"
"UNIT"

DEFAULT: UNIT=psia

REMARKS: The units in which the PPC2 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	label a	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

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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.

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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 PPC2 Ver 3.00 1/04/90"

ERROR: none

#

PURPOSE: To send a command through the PPC2 to an external device.

SYNTAX: "#ddddd"

DEFAULT: n/a

REMARKS: If the PPC2 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 PPC2 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

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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
```


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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
```


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4.5 SERIAL SIGNAL DESCRIPTION

The PPC2 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 PPC2 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 PPC2 from transmitting serial data when the RS232 host is not ready to accept it. When this line is low, transmission from the PPC2 is held off.

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

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4.5.1 SERIAL CABLE WIRING DIAGRAMS

If a cable was not purchased with the PPC2, the following diagrams will be helpful in making your own cable for communication with the host.

IBM PC/XT/PS2 to PPC2				
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 PPC2				
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 PPC2 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.

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4.6 IEEE OPTION

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

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CHAPTER 5 - MAINTENANCE AND ADJUSTMENTS

No special maintenance or adjustments are required for the PPC2.

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CHAPTER 6 - TROUBLESHOOTING

6.1 PRESSURE LEAKS

PPC2 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 (PPC2 at rest), pressure continuously drops, there is a leak in the system. First, check the system external to the PPC2 thoroughly for leaks or plug the PPC2 output connection and recheck the PPC2. If there is a leak in PPC2, a liquid type leak detector can be used sparingly to check the PPC2 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 PPC2 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 • GPIF/RS232 switch improperly set	• Replace cable • See Chapter 4 • Check switch and adjust
• Poor pressure control	• Settings incorrect	• Check and adjust Settings Menu
• Won't maintain a a pressure	• Hold Not ON	• Turn on hold by pressing HOLD button
• Won't maintain pressure	• There is a lack in your test system	• Correct leak or set Ready condition to "valve OK"

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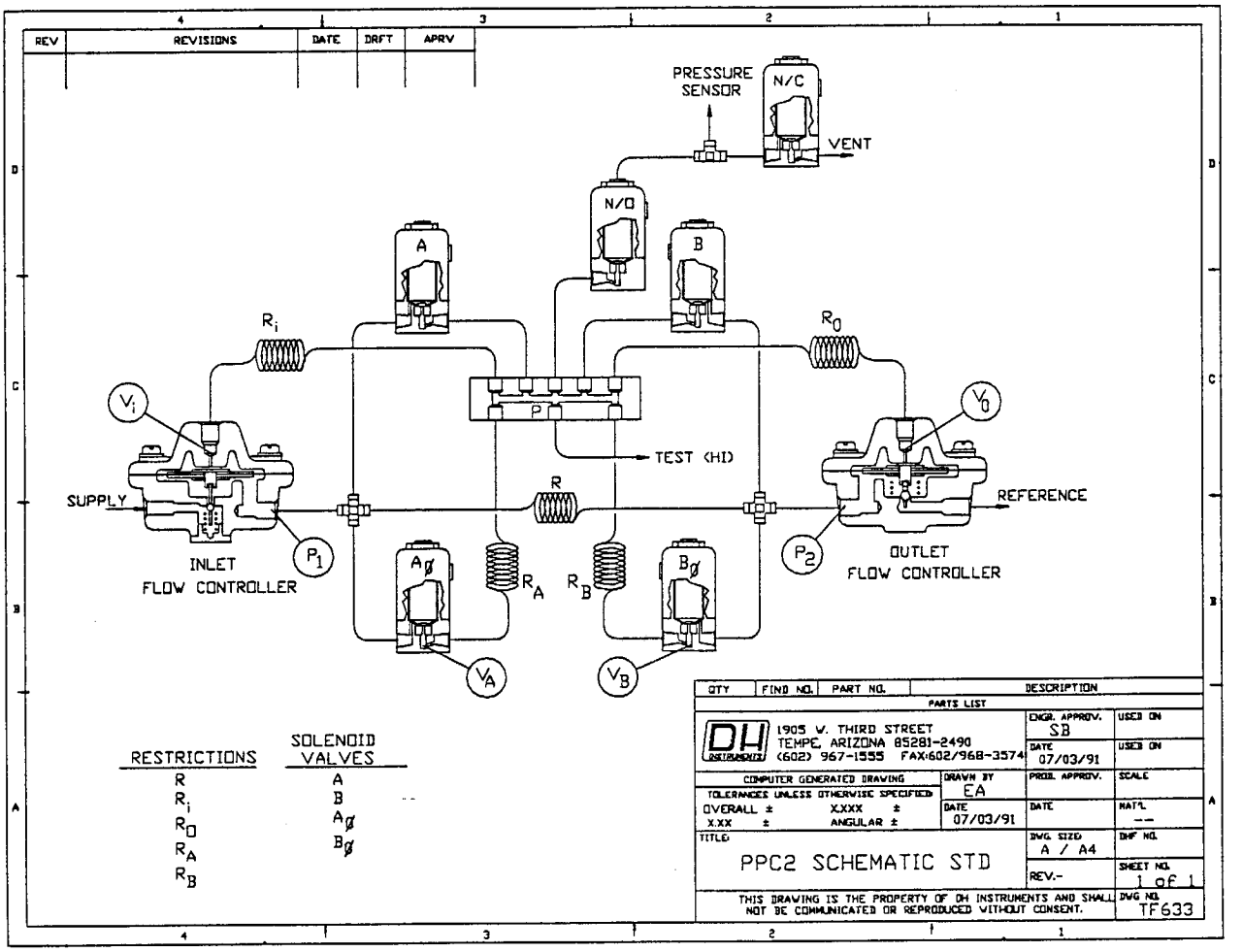
ANNEXES

SYSTEM SCHEMATIC



DRIVER DESCRIPTION

The PPCK provides eight open collector drivers for operating external valves, solenoids, indicators, etc. When operating from the 'Special-Driver' screen, pressing [ENT]er will allow the operating mode of the drivers to be set. The two modes of operation are Momentary and Toggle.

Each output can sink 500 mA at 12v. It is recommended that no more than two drivers be activated at once. If more than two drivers will be used simultaneously, the following guideline should be followed:

# of active drivers	Max current per output
1	500 mA
2	400 mA
3	275 mA
4	200 mA
5	160 mA
6	135 mA
7	120 mA
8	100 mA

PIN DESIGNATION

EXTERNAL DRIVERS		
Pin	Description	
1	D1	Driver #1 (Open collector)
2	D1	Driver #1 (+24V)
3	D2	Driver #2 (Open collector)
4	D2	Driver #2 (+24V)
5	D3	Driver #3 (Open collector)
6	D3	Driver #3 (+24V)
7	D4	Driver #4 (Open collector)
8	D4	Driver #4 (+24V)
9	D5	Driver #5 (Open collector)
10	D5	Driver #5 (+24V)
11	D6	Driver #6 (Open collector)
12	D6	Driver #6 (+24V)
13	D7	Driver #7 (Open collector)
14	D7	Driver #7 (+24V)
15	D8	Driver #8 (Open collector)
16	D8	Driver #8 (+24V)

A sample command description is shown on the following page.

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DRVx(=)

PURPOSE: To set or retrieve the status of the external drivers.

SYNTAX: "DRVx=s"
"DRVx"

DEFAULT: DRVx=0

REMARKS: x=1 to 8: Corresponds to the specific driver.
s=0 or 1: 0 is off, 1 is on.

The PPCK has eight open-collector drivers that can be used to drive external valves, solenoids, etc. The state of these valves can be controlled using the DRVx= command. The status of the driver can be read with the DRVx command or by viewing their current status under the 'Special-Drivers' menu of the PPCK.

EXAMPLE: typical command: "DRV3=1"

typical reply: "DRV3=1"

ERROR: none

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