

CHAPTER 1 - INTRODUCTION

1.1 PRODUCT OVERVIEW

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

The PPCK consists of a high accuracy pressure transducer 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 PPCK's front panel, the user can set individual pressures as well as program and recall complete calibration routines. All other PPCK 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 RPM1s and RPM2s or Type 20000 Digital Piston Gauges) can be added to the PPCK to create a multi-range system from one controller/calibrator.

PPCK 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

[PICTURE]

FRONT PANEL

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

[PICTURE]

REAR PANEL

- 1) Power switch
- 2) Main fuse
- 3) Power receptacle
- 4) Test connection: DH 1500
- 5) Drain connection: DH 1500
- 6) High pressure supply connection:
DH 1500
- 7) High pressure vent connection:
DH 1500
- 8) Drive OUT connection; 1/8" NPTF
- 9) Drive IN connection: 1/8" NPTF
- 10) IEEE 488 port (optional)
- 11) RS232 port (COM1)
- 12) RS232 port (COM2)
- 13) External Drivers (optional)

1.3 SUBASSEMBLY DESCRIPTION

- **Pneumatic Module** - Modularized pneumatic assembly mounted to the right inner wall of the PPCK. The module consists of two high pressure valves, 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 PPCK 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 PPCK, 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 PPCK front panel. This PCB holds all the switches and LEDs for the manual control and status of the various PPCK functions.
- **Transducer** - The PPCK has an on-board pressure transducer that is used to monitor the system pressure. The transducer output is available to the PPCK 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 PPCK 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. The transducer will then be corrected to atmosphere using the internal atmospheric transducer. This value is used to offset readings when operating and can be disabled using the "Autotare = 0" command.

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

1.4 SPECIFICATIONS

Ranges:

- 0 to 3 000 psi, 0 - 6 000 psi. For higher pressures please consult factory.

Adjustable Control Settings: Static Control Mode (no valve)

- Target limit: 0 to F.S.
- Hold limit: 0 to F.S.
- Stability test: 0 to F.S./sec
- Control Precision: better than $\pm 0.002\%$ F.S.

Adjustable Control Settings: Dynamic Control Mode (valve OK)

- Target limit: automatically set to 0
- Hold limit: 0 to F.S.
- Stability test: 0 to F.S./sec
- Control Precision: better than $\pm 0.002\%$ F.S.

Nominal Control Volume:

- 0 - 50 cc

Slew Rate (0 to F.S.):

- No external volume:
 - * 0 F.S., 100 seconds typical
 - * 120 seconds typical between stable pressures
- 50 cc external volume:
 - * 0 - F.S., 160 seconds typical
 - * 180 seconds typical between stable pressures

Measurement Specifications:

- Accuracy: $\pm 0.1\%$ F.S.

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, inH₂O, mmH₂O, kg/cm², user defined unit (one user defined and one absolute of all above).

Programmable Sequences:

- Cycle: Repeat a two-step sequence, store up to 30.
- Step: Sequence of evenly spaced increments between two points, store up to 30.
- Custom: Sequence of up to 40 user defined pressures, store up to 30.

Interfaces:

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

Pressure Supply:

- Supply: Clean, dry, non-corrosive gas at PPCK range +10%.
- Drive (IN): Clean, dry, non-corrosive gas at 150 to 165 psi.

Pressure Connections:

- Drive IN, Drive OUT: 1/8" NPTF
- Supply, vent: DH 1500
- Test, Drain: DH 1500

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:

- 18 kg (40 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.

CHAPTER 2 - INSTALLATION

2.1 UNPACKING AND INSPECTION

The PPCK 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 PPCK 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 DHI 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** - Six pressure connections are included on the rear panel of the PPCK. The system into which pressure is to be controlled is connected to the Test port.

The source of clean, dry, gas to be used as the pressure medium is connected to the Supply Pressure Connection (6). Both the Vent (7) and the Drive OUT (8) 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.

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

- **Configuring the system** - For the PPCK 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). If the supply pressure is different from 110% F.S. of the PPCK the Valve Setup must also be run (see 3.4.15.1 Special - Internal - Valsset- Setup PPCK Values).

The PPCK should be connected using the supplied power cable to a convenient source of AC power. For proper operation, the recommended supply pressure is 110% of the PPCK F.S. Lower supply pressures (but not less than 35% F.S.) can be used but will decrease performance. For example, the PPCK-P3 should have a regulated inlet pressure of 3 300 psi or less. The Drive IN pressure should be regulated to an inlet pressure of 150 psi.

For best performance PPCK 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 [ENTER] 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 PPCK is to use values already stored in its internal memory.

CHAPTER 3 - OPERATION

3.1 MANUAL OPERATION

The PPCK 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 PPCK 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 [ENT]er to select that option.

[PICTURE]

- (1) '*' - pressure is "Ready"
'<' - pressure is "Not Ready" and decreasing
'>' - pressure is "Not Ready" and increasing
'S' - suspend generation (see 3.1.6)
- (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).

ADDITIONAL - Each 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 bordered box in this manual.

The PPCK can be operated manually either by utilizing the keys on the digital front panel, or, by pressing the [ENT]er key while in the manual mode and entering a numeric value via the key pad, followed by pressing [ENT]er.

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 60 to 100 seconds. The fast increase and decrease modes operate independently of configuration and valve setup so they should be used to set a pressure if the PPCK is poorly configured or the valve setup is not current. The system pressure can be observed on the front panel of the PPCK.

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 the right arrow button is used for the pressure increase and the left arrow button is used to decrease pressure. The speed of operation is typically about 1/10 of the Fast Mode. The PPCK must be configured (see 3.4.4.1 Special - Config) to generate pressures using the slow speed buttons.

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 PPCK also has available a mode of operation that allows the user to increment pressures in predictable steps. The buttons used for Pulse Mode pressure changes are the dedicated special function keys ↑ (up) for increasing pressure and ↓ (down) for decreasing. The pressure steps can be adjusted by accessing the Settings Menu (#2) and selecting the Step (#5) option and entering the desired numeric value using the front panel key pad. Pressing the ↑ (up) or ↓ (down) button will change the current target pressure by the step amount and will generate the new target pressure. Adjust the step 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.

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 PPCK 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 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 PPCK will automatically maintain the pressure within the user specified Hold Limits which are 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 PPCK 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 atmosphere in fast mode. 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 PPCK 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"
4. 'S' - Suspend generation (see Section 3.1.6)

How the Ready/Not Ready condition is determined depends upon the operating mode in which you are using the PPCK. 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 PPCK 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 the pressure will be controlled only until the pressure is inside the Target Setting. If HOLD is activated, then the pressure will be corrected once it has fallen outside of the Hold Setting.

Static Pressure Control

In the Static Pressure Control Mode, the PPCK always displays the exact measured value of the current pressure. A Ready condition will exist only if:

1. No valve is operating and the pressure has reached the inside of the target limit.
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.
4. The heater has stabilized.

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 DHI Positive-Shutoff Pressure Controllers.

Dynamic Pressure Control

In the Dynamic Pressure Control Mode, when the PPCK is in Ready condition, it displays the target pressure. A Ready condition exists when:

1. Pressure is inside the Hold Limit.
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 PPCK is around ± 50 ppm of 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 PPCK can be requested to set a single pressure point. While in Manual Mode, press [ENT]er. The Target Setting screen 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. PPCK will set the pressure to the target value and indicate '**' when ready.

To suspend a pressure setting routine, press [ESC]ape. An 'S' will flash in the upper left hand corner of the display when the pressure setting is suspended. To resume a suspended pressure setting, press the [ENT]er key. To cancel the suspended generation, press the [ESC]ape key again.

3.2 SETTINGS (SETS)

Settings are the criteria the PPCK 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 PPCK to generate pressures. There is a trade off however, precision for speed. Listed below is a summary of the possible settings.

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. The target limit is set to zero in Dynamic Mode automatically.

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.

3.2.5 SETTINGS - UNITS

Determines which pressure units are to be used for data entry and display. If the PPCK is in Manual Mode and Units have been changed, all the current settings will be updated to reflect the change. If the PPCK 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. If you change devices (see 3.4.6 Special - Dev) the resolution will change to the maximum resolution of that device.

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 select the pressure units. Then you must enter the F.S. of the unit under test and the accuracy of the unit under test (in % F.S.).

Automatic Sets are based on the Unit Under Test (UUT) tolerance and the operating mode. The system calculates the UUT tolerance:

$$\text{UUT tolerance} = \text{UUT F.S.} \times \text{UUT F.S. accuracy}$$

The values set when in Static mode are:

Step value: UUT tolerance/3 or 0.005% PPCK F.S., whichever is larger.
Target limit: UUT tolerance or 0.001% F.S, whichever is larger.
Hold limit: UUT tolerance x4 or 0.001% F.S., whichever is larger.
Stability test: UUT tolerance/4 per second.
Resolution: UUT tolerance/10 or maximum resolution, whichever is lower.

The values set when in Dynamic mode are:

Step value: UUT tolerance/3 or 0.005% PPCK F.S., whichever is larger.
Target limit: 0
Hold limit: UUT tolerance/10 or 0.001% 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

PPCK 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.

Sequences is accessed from the Main Menu by Selection #3 (Sequences). 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.

If a target pressure in the sequence is outside of the PPCK operating range, a "target out of range" error will be displayed and the sequence will be aborted.

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 30 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.

<u>OPTION</u>	<u>COMMENT</u>
1 - Cycle	Selects Cycle Sequences.
2 - Edit	Selects Edit mode for this Cycle.
Enter Cycle 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.
Enter Increment #2	This is for the second pressure point. Enter the target pressure value; in this case F.S..
[ESC]ape or [ENT]er	This confirms the values entered. If [ESC]ape is pressed the changes are not saved. If [ENT]er 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-[ENT]er	After a delay or [ENT]er; 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 sure 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 #?	Do you want to store this cycle sequence at cycle address #? You can write a new address if desired.
1-Yes 2-No	
< 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 3SETS' is displayed then press #1 'Run'.

3.3.2 STEP SEQUENCE

Up to 30 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.

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 6 000 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.

<u>OPTION</u>	<u>COMMENT</u>
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 6 000.
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 [ENT]er 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 PPCK 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.

3.3.3 CUSTOM SEQUENCE

Up to 30 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. **NOTE:** You may specify up to 41 pressures. 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 PPCK 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 PPCK will automatically shut off at the UL pressure. The default UL is determined by the range of the PPCK'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 PPCK operating coefficients for optimal performance in the volume of the system to which it is connected.

3.4.4 SPECIAL - CONFIG - CONFIG PPC

Executes the heater configuration and adjust heater constants. This procedure adapts the PPCK heater to different volumes. This configuration must be executed above 1 000 psi with a leak free system and is ideally done at 2 000 psi. The configuration takes about three minutes. Pressing the [ESC]ape key during execution will abort the configuration. This configuration must be performed when the test volume has changed.

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 the PPCK. Generally this is used to add ranges. External devices that can be used are RPM1/RPM2 Reference Pressure Monitors, Type 20000 Digital Piston Gauges, and user defined external devices. Up to four external devices may be set up at once.

3.4.6.1 SPECIAL - DEV (DEVICE) - SELECT

Allows the user to select one of the set up external devices. The first device is always PPC and is the default when the PPCK has been reset. The other four selections must be set up by the user (see 3.4.6.3 Special - Dev - Add) before being selected. Once you have selected the device, the PPCK will initialize and check for communications and for proper data from the device. If there is an error, it will be displayed.

3.4.6.2 SPECIAL - DEV (DEVICE) - EDIT

Editing allows the user to change the operational characteristics of the devices. 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 RPMs 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 3.4.11 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 counts.
DPG Range - Maximum allowable pressure for the DPG device (F.S. + 10%).
Gauge Device - Is the DPG a gauge or absolute version? Yes or no query.
COM2 Port - Serial parameters for the COM2 port (see 3.4.11 Special - Internal - Remote).

UDD
Req String - Displays the data request string to be sent to the user defined device to request a measurement. This string can only be set remotely using the "UDD=" command.
Offset (cnts) - Offset in counts (must be set remotely). Press the [ENT]er key to continue.
Coefficient - Pascals per count. One count is considered the first digit to the left of the decimal point. (Must be set remotely).
COM2 Port - Serial parameters for the COM2 port (see 3.4.11 Special - Internal - Remote).

3.4.6.3 SPECIAL - DEV (DEVICE) - ADD

Allows additional external devices to be set up. Up to four external devices may be set up at once. If a device "slot" has not been set up, then a "---" will appear to show that it is empty. You should first select the device slot (#2 through #5) that you wish to use to add your device. If you choose a slot that is not empty, you will overwrite the device currently set up in that slot. The first slot (1PPC) is fixed and cannot be changed. Once you have selected a slot, then you will be queried to choose the device type. You may choose RPM

or DPG. If you have set up a User Defined Device (UDD) using the remote "UDD=" command, then you may also choose this device using the specified device label. Then you will be queried to enter additional data about the device (see 3.4.6.2 Special - Dev - Edit).

3.4.7 SPECIAL - MODE (CONTROL)

Sets the Ready criterion. Determines whether PPCK will operate in Static or Dynamic Pressure Control Mode and how thus the Ready/Not Ready determination will be made.

When in Manual Mode, the PPCK 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"
4. 'S' - Suspend generation (see Section 3.1.6)

How the Ready/Not Ready condition is determined depends upon the operating mode in which you are using the PPCK. 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 PPCK 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 the pressure will be generated until the pressure is inside the Target Setting. If HOLD is activated, then the pressure will be corrected once it has fallen outside of the Hold Setting.

Static Pressure Control

In the Static Pressure Control Mode, the PPCK always displays the exact measured value of the current pressure. A Ready condition will exist only if:

1. No valve is operating and pressure has reached the inside of the target limit.
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.
4. The heater has stabilized.

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 DHI Positive-Shutoff Pressure Controllers.

Dynamic Pressure Control

In the Dynamic Pressure Control Mode, when the PPCK is in Ready condition, it displays the target pressure. A Ready condition exists when:

1. Pressure is inside the Hold Limit.
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 ± 50 PPM. See Also 3.4.7 Special - Mode (Control) and 3.2.3 Settings - Hold Limit.

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. Actuated drivers are indicated by an '*' displayed next to the driver channel number. Pressing [ENT]er will allow you to change to toggled or momentary action.

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 PPCK operations.

3.4.9.1 SPECIAL - INTERNAL - RESET

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

3.4.9.2 SPECIAL - INTERNAL - RESET - UNIT

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

3.4.9.3 SPECIAL - INTERNAL - RESET - ALL

Resets all PPCK 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 PPCK 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.

3.4.9.4 SPECIAL - INTERNAL - RESET - FILES

Clears all of the sequences that are currently set up.

3.4.9.5 SPECIAL - INTERNAL - RESET - SYSTEM

Resets external and internal device information and generation settings. Sets all internal data structures to default values.

3.4.10 SPECIAL - INTERNAL - CAL

Used to recalibrate the PPCK or view calibration data. If "device = RPM" then the calibration will refer to the RPM calibration.

3.4.10.1 SPECIAL - INTERNAL - CAL - VIEW

Allows viewing of the current PPCK calibration coefficients and previous calibrations but does not allow alteration of the values. The date of the last PPCK calibration will be shown at the top of the display.

3.4.10.1.1 SPECIAL - INTERNAL - CAL - VIEW - POINTS

Not yet available.

3.4.10.1.2 SPECIAL - INTERNAL - CAL - VIEW - PA/PM

Displays the current Pressure Adder (PA) and Pressure Multiplier (PM).

3.4.10.2 SPECIAL - INTERNAL - CAL - SET

Allows the user to enter the PA (pressure adder offset) and PM (pressure multiplier) along with the calibration data. Changing these values will alter the calibration!

3.4.10.3 SPECIAL - INTERNAL - CAL - RECAL

Not yet available.

3.4.11 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 31. The IEEE terminating characters can be set from 1 to 255. If the first terminating character is set to 0, then only the second terminating character will be used.

3.4.12 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 password 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 send the "RESET" command to the PPCK using the COM1 or IEEE port.

3.4.13 SPECIAL - INTERNAL - ATM

Defines the value of atmospheric pressure used by the PPCK to correct the absolute internal transducer measurement to gauge pressure. It is also used to tare the internal transducer when the PPCK is vented. This number is updated every two seconds while in Manual Mode using the internal atmospheric transducer. The user may change this number, but it will be overwritten by the PPCK when entering Manual Mode.

3.4.14 SPECIAL - INTERNAL - TARE

Allows the user to disable the Autotare function of the PPCK. Autotaring zeros the internal transducer if in gauge mode, or, offsets it to read the current atmospheric pressure if in absolute mode. Autotaring occurs 10 seconds after the PPCK has first vented and has become stable and every 4 seconds after that point as long as the pressure remains stable. Disabling the Autotare prevents this process. The current atmospheric pressure is always measured using the internal atmospheric transducer.

3.4.15 SPECIAL - INTERNAL - VALSET

Allows the user to set up the PPCK valve constants to match the supply pressure, or to edit the setup.

3.4.15.1 SPECIAL - INTERNAL - VALSET - SETUP PPC VALUES

Initiates a routine that sets up the PPCK valves to operate correctly with the current supply pressure. This should only be done when the supply pressure is changed or control is poor. The setup needs to be executed with the test pressure set above 75% of the supply pressure, and the supply must be greater than 35% F.S. of the PPCK F.S..

When executed, this routine will query the user for the supply pressure. If the supply or current test pressure fails to meet the above criteria an error will be displayed and the setup will be aborted. Otherwise the setup routine will continue and takes about four minutes. After the setup is complete, the PPCK is left in a vented state. Pressing the [ESC]ape key will abort this routine.

3.4.15.2 SPECIAL - INTERNAL - VALSET - EDIT VALUE SETUP

Allows the user to view and edit the valve opening times and slopes. This can be useful in special situations, but should not be done without consulting DH Instruments.

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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 PPCK using either COM1 or the optional GPIB (IEEE-488) Interface.

Initiating communications with the PPCK will automatically place the PPCK into Remote Mode. When in Remote, the PPCK 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. NOTE: The Valve Setup command can only be given locally.

Anytime the PPCK receives a command, it will reply back with a reply string. You must wait for and receive this reply before issuing another command. This reply is less than two seconds for all commands except the following:

PR:	3 seconds
SR:	3 seconds
RATE:	3 seconds
UNIT:	10 seconds
DEVICE:	10 seconds

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

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

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

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

4.2 COMMAND SUMMARY

ABORT	Halt all current operations.
ATM	Retrieve current atmospheric reference.
AUTOTARE(=)	Enables or disables the Autotare function.
COMx(=)	Set or retrieve the COMx port configuration.
CONFIG	Reconfigure PPC for different volumes.
DEVICE(=)	Specify the PPCK's pressure reference.
DF=	Rapidly decrease system pressure.
DP=	Decrease pressure desired amount.
DPG(=)	Set or retrieve Digital Piston Gauge configuration.
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.
LOCAL	Local operation.
MEM	Read status from memory test.
MODE(=)	Set or retrieve pressure generation mode.
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(=)	Same as MODE(=).
READYCK(=)	Sets a flag that is cleared by a "not ready" condition.
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.
RX(=)	Sets the receive termination characters.
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.
TX(=)	Sets the transmit termination characters.
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.

4.2 COMMAND SUMMARY continued

VENT(=)	Set or retrieve current vent status.
VER	Read version number of the internal software.
#	Send a command through the PPCK to an external device.

4.3 INDIVIDUAL COMMAND DESCRIPTIONS

ABORT

<i>PURPOSE:</i>	To stop all current action of the PPCK.
<i>SYNTAX:</i>	"ABORT"
<i>DEFAULT:</i>	n/a
<i>REMARKS:</i>	<p>An abort command can be sent to halt any and all current operations and place the PPC into an idle state.</p> <p>The ABORT command disables a HOLD if hold is active, and closes any valves, including vent.</p> <p>This command is also useful to abort out of a configuration procedure.</p>
<i>EXAMPLE:</i>	<p>Typical command: "ABORT"</p> <p>typical reply: "ABORT"</p>
<i>ERROR:</i>	none

ATM

<i>PURPOSE:</i>	To retrieve the current atmospheric reference pressure.
<i>SYNTAX:</i>	"ATM"
<i>DEFAULT:</i>	101.325 kPa (14.6959 psia)
<i>REMARKS:</i>	<p>The atmospheric pressure reference that is used to correct an absolute reference to gauge mode can be read. This pressure is updated every 2 seconds. During a vent procedure, the atmospheric reference is automatically recorded with the auto tare function and will then be used. If an absolute device is used as the pressure measuring device in gauge mode, then the ATM value will be subtracted from the measurement.</p>
<i>EXAMPLE:</i>	<p>Typical command: "ATM"</p> <p>typical reply: "14.25"</p>
<i>ERROR:</i>	none

AUTOTARE(=)

PURPOSE: To enable or disable the PPCK Autotaring function.

SYNTAX: "AUTOTARE=n"
"AUTOTARE"

DEFAULT: AUTOTARE=1

REMARKS: The PPCK autotares while vented and stable. You may wish to disable the autotaring if the PPCK operating conditions prevent a truly vented to atmospheric condition.

EXAMPLE: Typical command: "AUTOTARE=0"

typical reply: "AUTOTARE=0"

ERROR: ERR# 6: If "n" not a 0 or a 1.

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.

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"

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

ERR# 11: Missing or wrong parameters.

CONFIG

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

SYNTAX: "CONFIG"

DEFAULT: n/a

REMARKS: The Configuration adjusts the heater control constants for different test volumes. This configuration needs to be executed if the test volume has changed. The system pressure must be greater than 1 000 psi, and is ideally done at 2 000 psi.

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 >1 000 psi.

DEVICE(=)

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

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

**** 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
ERR# 5: If the external RPM is configured improperly.
ERR# 1: If the external device disagrees with the PPCK measurement.
ERR# 2: If the external device is a gauge device and the PPCK is in Absolute Mode.

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 DOWN valve is opened and left opened and a rate of 150 psi/sec is maintained.

EXAMPLE: Typical command: "DF=1"
typical reply: "DF=1"

ERROR: ERR# 6: If n not a 0 or a 1.

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 down by a specified amount.

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

EXAMPLE: Typical command: "DP=5"
typical reply: "5 psi"

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

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

DPG(=)

PURPOSE: Set or retrieve DIGITAL PISTON GAUGE configuration.

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

DEFAULT: DPG not configured

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

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

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

ERROR: ERR# 6: If coef = 0.

DS=

PURPOSE: Slowly decrease system pressure.

SYNTAX: "DS=n"

DEFAULT: n/a

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

The system pressure can be slowly decreased using this command. When a "DS=1" command is received, the down valve is opened and the rate is maintained at around 15 psi/sec.

EXAMPLE: Typical command: "DS=1"
typical reply: "DS=1"

ERROR: ERR# 6: If n not a 0 or a 1.

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 = Config pressure must be greater than 1 000 psi."
"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 = Pressure must be greater than *nnnn* psia."

EXAMPLE: typical command: "ERR"

typical reply: "ERR# 0 = OK"

ERROR: none

HOLD(=)

PURPOSE: Set or read the current HOLD status.

SYNTAX: "HOLD=n"
"HOLD"

DEFAULT: HOLD=0

REMARKS: n = 1: activates 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: ERR# 6: If n not a 0 or a 1.

HS(=)

PURPOSE: Set or read the hold limit.

SYNTAX: "HS=nn"
"HS"

DEFAULT: HS=0.5% 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 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.

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.

EXAMPLE: Typical command: "HS=2"

typical reply: "2 psi"

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

HS%(=)

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

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

DEFAULT: HS=0.5% F.S.

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.

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.

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

typical reply: ".2%"

ERROR: ERR# 6: If nn < 0% 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 valve is opened and left opened and rate is maintained at 150 psi/sec.

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.
ERR# 6: If n is not a 0 or a 1.

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 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: "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.
ERR# 6: nn is greater than 2% F.S.

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.

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.
ERR# 6: If n is not a 0 or a 1.

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 "PPC MEMORY FAULT" will be displayed 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

MODE(=)

PURPOSE: To set the pressure generation mode to Static or Dynamic control.

SYNTAX: MODE=n
MODE

DEFAULT: MODE=0

REMARKS: n=0: Ready (R) can't occur while the valves are adjusting the pressure.
n=1: Ready (R) can occur while the valves are adjusting the pressure.

n=0: ("STATIC" MODE)

If the Target Set (TS) is greater than 0.25% F.S., then the PPCK will adjust the pressure using the valves only. It will overshoot the target pressure by the TS amount. If HOLD is on, re-adjustment of the pressure will occur when the pressure falls outside of the Hold Set (HS). The heater will stay at a low "idle" power level.

If the Target Set (TS) is less than or equal to 0.25% F.S., then the PPCK will adjust the pressure using the valves until the pressure is very close to the target. The heater will then be used to adjust the pressure to the target pressure. Once the pressure has reached the target pressure and is stable the heater will stay at the current power level. If HOLD is on, re-adjustment of the pressure will occur when the pressure falls outside of the Hold Set (HS). In either case, Ready (R) will occur when:

- a) the valves are not operating
- b) if HOLD is on, the pressure must be inside the Hold Set (HS)
- c) the Pressure Stability (SS) criteria is met
- d) the heater has stabilized

n=1: ("DYNAMIC MODE")

The PPCK will adjust the pressure using the valves very close to the target pressure, and then the heater will be used to adjust and maintain the pressure at the target pressure. When the pressure is Ready (R) the displayed pressure will be the target, not the actual current pressure. HOLD will be enabled automatically when a pressure is set. Ready (R) will occur when:

- a) the pressure is inside the Hold Set (HS)
- b) the Pressure Stability (SS) criteria is met

EXAMPLE: Typical command: "MODE=1"

typical reply: "MODE=1"

ERROR: ERR# 6: If n is not a 0 or a 1.

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 uuuuu".

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 561.0 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: "561.0"

ERROR: none

PS=

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

SYNTAX: "PS=xxxxx"

DEFAULT: n/a

REMARKS: xxxxx= 0 to F.S. in gauge or atmosphere 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 PS command will continue to execute until the pressure has been set to within the target limit. If READY=1, hold will be activated automatically with a PS= command.

EXAMPLE: Typical command: "PS=1000"

typical reply: "1000 psi"

ERROR: ERR# 6: If xxxxx > the UL setting
ERR# 6: If xxxxx < atmosphere

PSH=

PURPOSE: To set a desired pressure and maintain it.

SYNTAX: "PSH=xxxxx"

DEFAULT: n/a

REMARKS: xxxxx= 0 to F.S. in gauge or atmosphere 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 PPCK 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 within the target limit. When READY=1 the pressure will be continually controlled and a ready condition will remain unless the stability criteria is exceeded or if the pressure falls outside of the hold limit.

EXAMPLE: Typical command: "PSH=1000"

typical reply: "1000 psi"

ERROR: ERR# 6: If xxxxx > the UL setting
ERR# 6: If xxxxx < atmosphere

PSF=

PURPOSE: To a desired pressure using fast speed only, or, to set pressure when the valve setup has not yet been executed.

SYNTAX: "PSF=xxxxx"

DEFAULT: n/a

REMARKS: xxxxx= 0 to F.S. in gauge or atmosphere 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=1000"

typical reply: "1000 psia"

ERROR: ERR# 6: If xxxxx > the UL setting
ERR# 6: If xxxxx < atmosphere

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=1000"

typical reply: "1000 psia"

ERROR: ERR# 6: If xxxxx > the UL setting
ERR# 6: If xxxxx < atmosphere

RANGE

PURPOSE: To read the range of the PPC in psi.
SYNTAX: "RANGE"
DEFAULT: n/a
REMARKS: The range or model can be read from the PPC.
EXAMPLE: typical command: "RANGE"
typical reply: "3000 psia"
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: "2.2 psi/sec"
ERROR: none

READY(=)

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

SYNTAX: "READY=x"
"READY"

DEFAULT: READY=0

REMARKS: Performs the same function as the MODE(=) command. The READY command is not recommended for new applications.

EXAMPLE: Typical command: "READY=1"
typical reply: "READY=1"

ERROR: ERR# 6: If x is not a 0 or a 1.

READYCK(=)

PURPOSE: To set or check the ready check flag, or, used to determine if a NOT READY condition has occurred.

SYNTAX: "READYCK=1"
"READYCK"

DEFAULT: READYCK=0

REMARKS: The internal ready check flag is cleared whenever the PPCK reaches a Not Ready (NR) condition. The "READYCK" command will return the status of this flag. This flag can be set only by sending the "READYCK=1" command while the PPCK is in a Ready condition. If you send the "READYCK=1" command when the PPCK is in a Not Ready (NR) condition, the reply will be "READYCK=0".

If you set READYCK=1 when the PPCK achieves a Ready (R) condition, you can use READYCK later to determine if a Not Ready (NR) condition has occurred. If NR has occurred READYCK will return "0". If NR has not occurred READYCK will return "1".

EXAMPLE: Typical command: "READYCK=1"
typical reply: "READYCK=1" (if PPCK condition is Ready)
typical reply: "READYCK=0" (if PPCK condition is Not Ready)

ERROR: ERR# 6: If n is not a 1.

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.

EXAMPLE: 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.
Typical command: "REMOTE"

ERROR: typical reply: "REMOTE"
none

RESET

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

SYNTAX: "RESET"

DEFAULT: n/a

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

EXAMPLE: Typical command "RESET"
typical reply: "RESET"

ERROR: none

RETURN

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

SYNTAX: "RETURN"

DEFAULT: 0.0000 psia

REMARKS: The current target setting could be from a remote pressure request, a remote hold command, or a local hold command. When this command is given, the target pressure is checked and if it is within the normal operating range, the PCK 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: "750 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 EPROM 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 EPROM.

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

RX(=)

PURPOSE: To change the termination characters for strings received by the COM2 port.

SYNTAX: "RX=n(,n)"
"RX"

DEFAULT: "RX=13,10 (carriage return, line feed)

REMARKS: Any string received by the PPCK COM2 port must have one or two terminating character(s) appended on to the end of it. The "RX" command arguments are decimal representations of these characters. If only one argument is given, then only one terminating character will be used.

EXAMPLE: Typical command: "RX=10"
typical reply: "RX=10"

ERROR: ERR# 6: If n < 1 or > 255.

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: SS=1.0% 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.

See also the READY command.

EXAMPLE: Typical command: "SS=1 psia"

typical reply: "1 psia"

ERROR: ERR# 6: If nn > F.S.

SS%(=)

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

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

DEFAULT: SS=1.% 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.

See also the READY command.

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

typical reply: ".1%"

ERROR: ERR# 6: If nn > 100%

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

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: "750 psia"

ERROR: none

TS(=)

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

SYNTAX: "TS=dddd"
"TS"

DEFAULT: TS=0.1% 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. TS is temporarily set to 0 if in Dynamic Mode (MODE=1).

EXAMPLE: Typical command: "TS=1"
typical reply: "1.0 psia"

ERROR: ERR# 6: If nn > F.S.

TS%(=)

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

SYNTAX: "TS%=ddd"
"TS%"

DEFAULT: TS=0.1% 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%. TS% is temporarily set to 0 if in Dynamic Mode (MODE=1).

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

ERROR: ERR# 6: If nn > F.S.

TX(=)

PURPOSE: To change the termination character(s) for strings sent out of the COM2 port.

SYNTAX: "TX=n(,n)"
"TX"

DEFAULT: TX=13,10 (carriage return, line feed)

REMARKS: Any string sent out off the PPCK COM2 port must have one or two terminating character(s) appended onto the end of it. The "TX" command arguments are decimal representation of these characters. If only one argument is given, then only one terminating character will be used.

EXAMPLE: Typical command: "TX=10"
typical reply: "TX=10"

ERROR: ERR# 6: If n < 1 or > 255.

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

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 three 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 in counts.

The USER DEFINED DEVICE configuration must be set before a DEVICE=???? command is given, or, before a user defined device can be set up or selected from the front panel.

The user defined device must respond with data in less than two seconds after the pressure request string is sent.

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

ERROR: ERR# 7: Missing or improper command argument(s).
ERR# 21: User device not defined.

UDU(=)

PURPOSE: To set or retrieve the USER DEFINED UNIT.

SYNTAX: "UDU=uuuuu,ccccc,g"
"UDU"

DEFAULT: UDU not defined

REMARKS: uuuuu = User unit label (five characters maximum)
ccccc = User coefficient (cannot be <= 0)
g = "g" if user unit a gauge unit, else leave blank

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 be a maximum of 5 characters.
ERR# 3: User defined coefficient cannot be 0.

UL(=)

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

SYNTAX: "UL=dddd"
"UL"

DEFAULT: RANGE: +5%

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. Note that UL is automatically set to 10% over the device range when an external device is selected.

EXAMPLE: Typical command: "UL=1000"

typical reply: "1000 psia"

ERROR: ERR #6: If dddd < 0, or, if dddd > RANGE +5%.

UNIT(=)

PURPOSE: Set or change the current pressure units.

SYNTAX: "UNIT=xxxxxx"
"UNIT"

DEFAULT: UNIT=psia

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

<u>Unit</u>		<u>Coefficient</u>
psi	psia	0.000145038
psf	psfa	0.00000100728
bar	bara	0.00001
mbar	mbara	0.01
Pa	Paa	1.0
KPa	KPaa	0.001
MPa	MPaa	0.000001
mmHg	mmHga	0.00750063
inHg	inHga	0.0002953
inWa	inWaa	0.004021732 @ 20°C
mmWa	mmWaa	0.1019716 @ 4°C
Kcm ²	Kcm ² a	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 internal atmospheric transducer. If using an RPM, the time required to get a reply from the PPCK can be from 6 to 10 seconds.

EXAMPLE: typical command: "UNIT=mbar"

typical reply: " mbar "

ERROR: ERR# 7: Invalid unit specified.
ERR# 12: Absolute unit specified with a gauge device.

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 exhaust valve.

When n = 1 the pressure will quickly decrease to atmospheric and then the Vent light will come on when the pressure is stable.

EXAMPLE: Typical command: "VENT=1"
typical reply: "VENT=1"

ERROR: ERR# 6: If n not set to 1 or 0.

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 PPCK-A1000 Ver 2.00"

ERROR: none

#

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

SYNTAX: "#dddd"

DEFAULT: n/a

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

EXAMPLE: Typical command: "#*0100P3"

typical reply: "*000114.503"

ERROR: none

4.4 SAMPLE PROGRAM

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

```

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

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

220 SERIAL$=IN$
230 PRINT "Com2 => ";SERIAL$                  display returned data
240 '
250 PRINT #1, "UNIT=PSIA"                    change Units to PSIA
260 INPUT #1, UNIT$                          read returned data
270 PRINT "Unit => ";UNIT$                  display returned data
280 '
290 PRINT #1, "DEVICE=RPM"                   change device to external RPM
300 INPUT #1, DEV$                            read returned data
310 PRINT "Device => ";DEV$                 display returned data
320 '
330 PRINT #1, "TS=2"                         set Target Setting to 2 psi
340 INPUT #1, TS$                            read returned data
350 PRINT "Target Set => ";TS$             display returned data
360 '
370 PRINT #1, "HS=4"                         set Hold Setting to 4 psi
380 INPUT #1, HS$                            read returned data
390 PRINT "Hold setting => ";HS$           display returned data
400 '
410 PRINT #1, "SS=1"                         set Stab. Setting to 1 psi
420 INPUT #1, SS$                            read returned data
430 PRINT "Stability Setting => ";SS$      display returned data
440 '
450 PRINT #1, "PSF=";RG/2                    Set pressure to mid scale
460 INPUT #1, PS$                            read returned data
470 PRINT "Pressure setting to => ";PS$     display returned data

```

4.4 SAMPLE PROGRAM (cont.)

```
480 '
490 PRINT #1, "STAT"           read generation status
500 INPUT #1, STAT$           until routine is complete
510 IF STAT$<>"STAT=0" THEN 490
520 '
530 PRINT #1, "CONFIG, VALVE"  configure the PCK valves
540 INPUT #1, CON$           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, PRESS$         pressure is ready
690 IF LEFT$(PRESS$,2)="NR" THEN 670
700 '
710 PRINT "Pressure set to => ";PRESS$ print ready pressure
720 PRINT "Test ran successfully"
730 END                       end program
```

4.5 SERIAL SIGNAL DESCRIPTION

The PPCK 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

<u>COM1</u>		<u>COM2</u>	
2	TxD	2	RxD
3	RxD	3	TxD
5	Gnd	5	Gnd
		9	+12V

- TxD** - Transmit Data - Output
This pin transmits serial data from the PPCK 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.
- +12V** - This pin is brought out on pin 9 of COM2 to supply an external device such as a DHI RPM1.

4.5.1 SERIAL CABLE WIRING DIAGRAMS

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

IBM PC/XT/PS2 to PPCK					
DB-25 Female				DB-9 Male	
TxD	2	----->	3	RxD	
RxD	3	<-----	2	TxD	
Gnd	7	<----->	5	Gnd	

IBM AT to PPCK					
DB-9 Female				DB-9 Male	
TxD	3	----->	3	RxD	
RxD	2	<-----	2	TxD	
Gnd	5	<----->	5	Gnd	

4.5.2 SERIAL PORT CONFIGURATION

The default operating parameters for COM1 and COM2 are:

2400 baud	Serial Terminator	CR-LF
Even Parity		
7 Data Bits		
1 Stop Bit		

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

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

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: CR, LF, EOI enabled

CHAPTER 5 -

MAINTENANCE AND ADJUSTMENTS

No special maintenance or adjustments are required for the PPCK.

CHAPTER 6 - TROUBLESHOOTING

6.1 PRESSURE LEAKS

If, with all valves shut (PPCK at rest), pressure continuously drops, there is a leak in the system. First, check the system external to the PPCK thoroughly for leaks or plug the PPCK output connection and recheck the PPCK. If there is a leak in PPCK, a liquid type leak detector can be used sparingly to check the PPCK 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 PPCK 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.

<u>SYMPTOM</u>	<u>POSSIBLE CAUSE</u>	<u>SOLUTION</u>
<ul style="list-style-type: none">• Unit inoperable	<ul style="list-style-type: none">• No AC power• Blown main fuse	<ul style="list-style-type: none">• Plug in unit• Replace fuse
<ul style="list-style-type: none">• Inability to increase pressure	<ul style="list-style-type: none">• Low supply pressure• Blocked supply line• Above Upper Limit• PPCK not configured	<ul style="list-style-type: none">• Check supply• Replace line• Readjust UL• Configure the PPCK (see 3.4.4) and/or execute the Valve Setup command. Use PSF in remote or the fast pressure setting keys in local to set the configuration and/or valve setup pressure.
<ul style="list-style-type: none">• Inability to decrease pressure	<ul style="list-style-type: none">• Blocked vent line• Drive pressure low• PPCK not configured	<ul style="list-style-type: none">• Replace line• Check drive supply• Configure the PPCK (see 3.4.4) and/or execute the Valve Setup command. Use PSF in remote or the fast pressure setting keys in local to set the

- | | | |
|--|--|---|
| <ul style="list-style-type: none"> • Inability to decrease pressure continued | <ul style="list-style-type: none"> • PPCK not configured continued | <ul style="list-style-type: none"> • configuration and/or valve setup pressure. |
| <ul style="list-style-type: none"> • No computer communication | <ul style="list-style-type: none"> • Bad interface cable • Improper data framing | <ul style="list-style-type: none"> • Replace cable • See Section 4 |
| <ul style="list-style-type: none"> • Poor pressure control | <ul style="list-style-type: none"> • Settings incorrect | <ul style="list-style-type: none"> • Check and adjust Settings Menu |
| <ul style="list-style-type: none"> • Won't maintain pressure | <ul style="list-style-type: none"> • Hold Not ON • PPCK not configured | <ul style="list-style-type: none"> • Turn on hold by pressing HOLD button • Configure the PPCK (see 3.4.4) and/or execute the Valve Setup command. Use PSF in remote or the fast pressure setting keys in local to set the configuration and/or valve setup pressure. |
| <ul style="list-style-type: none"> • Won't maintain pressure | <ul style="list-style-type: none"> • There is a leak in your test system | <ul style="list-style-type: none"> • Correct leak |

ANNEXES

SYSTEM SCHEMATIC

[PICTURE]

DRIVER DESCRIPTION

The PPCK provides eight open collector drivers (optional) 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.

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
