DHI

POSITIVE-SHUTOFF PRESSURE CONTROLLER/CALIBRATOR (PPCK)

User's Manual

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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 high pressure measuring devices.

The PPCK consists of a high accuracy pressure transducer used as a reference, a pressure control module, an electronic module, a user interface via front panel display and keypad, a computer interface via a standard RS-232 interface (COM1), and an optional GPIB (IEEE-488) interface.

Using PPCK's front panel, or remotely over the interface, the user can set and measure pressures and execute many other functions such as changing ranges, adjusting operational limits, setting up and using external reference devices, etc..

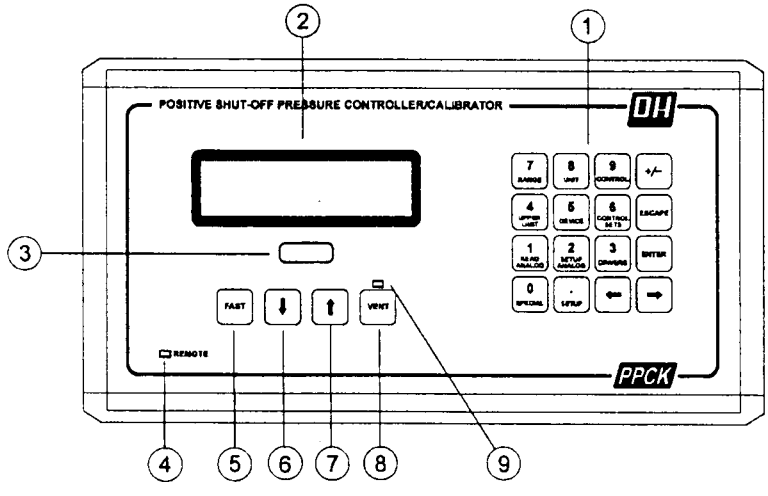
Each PPCK has three pressure ranges. External references (DHI RPMs) can be added to the PPCK to add additional measurement ranges.

PPCK has two different pressure controlling modes: Static and Dynamic.

1.2 LOCATION OF THE COMPONENTS

FRONT PANEL

1) 4 x 4 function/data entry keypad
2) 2 x 20 display
3) Model identifier label
4) Remote mode indicator
5) Fast increase/decrease key
6) Decrease pressure key
7) Increase pressure key
8) Vent key
9) Vent status indicator



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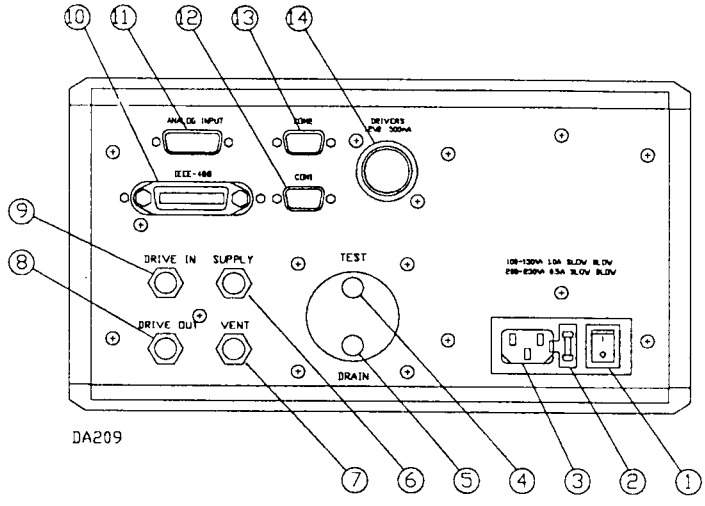
REAR PANEL

1) Power switch
2) Main fuse
3) Power receptacle
4) Test connection: DH200F
5) Drain connection: DH200F
6) High pressure supply connection: DH200F
7) High pressure vent connection: 1/8" NPTF
8) Drive OUT connection: 1/8" NPTF
9) Drive IN connection: 1/8" NPTF
10) IEEE-488 port (optional)
11) Analog Input (optional)
12) RS-232 port (COM1)
13) RS-232 port (COM2)
14) External Drivers (optional)



1.3 SUBASSEMBLY DESCRIPTION

- **Pneumatic Module** - Modularized pneumatic assembly mounted to the right inner wall of the PPCK. The assembly includes the hardware necessary to set and measure pressure. It is made up of pneumatically actuated high pressure valves. One each for the inlet and the outlet of the pressure controlling system and one for the low pressure pneumatic control circuit for high pressure valve actuation. A thermal pressure control module consisting of a heatable coil in a cylindrical volume is used as a second control stage for very fine pressure control. A transfer standard quality pressure sensor provides high accuracy pressure measurement and a lower accuracy barometric sensor assists in monitoring atmospheric pressure changes when needed.

- **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 and ±15 VDC. The second has a +12 VDC output. The 5 VDC signal is used for the TTL level electronics in the PPCK. The ±15 VDC signal is used for the analog circuitry and serial communication ports of the microprocessor card. The 12 VDC signal is used to power the solenoid valves. To avoid crosstalk when powering on or switching off the solenoid valves, the 12 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.

  Front Panel Digital Display and Keypad - The front panel has a 4 x 4 keypad for function execution and data entry, four specialized direct pressure control keys and a 2 x 20 digital display to display all pertinent user information.

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1.4 SPECIFICATIONS

Ranges:
- There are English and SI models which each have three ranges.

English Units
0 to 1000/2000/3000 psi
0 to 2000/4000/6000 psi
0 to 3000/6000/10000 psi

SI Units
0 to 6/10/20 MPa
0 to 12/20/40 MPa
0 to 20/35/70 MPa

Adjustable Control Settings: Static Control Mode
- Target Limit: 0 to F.S.
- Hold Limit: 0 to F.S.
- Stability Test: 0 to F.S./sec

Adjustable Control Settings: Dynamic Control Mode
- Target Limit: automatically set to 0
- Hold Limit: 0 to F.S.
- Stability Test: 0 to F.S./sec

Nominal Control Volume:
- 0 - 50 cc

Measurement Specifications (apply to each range):
- Accuracy: ±(0.01% F.S. + 0.005% of reading for 90 days, or, 0.02% F.S. for one year)
- Linearity: ±0.005% F.S.
- Hysteresis: ±0.005% F.S.

Control Modes:
- 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, kPa, MPa, kg/cm^2, user defined unit (gauge and absolute)

Interfaces:
- External Communications: RS-232C, GPIB (IEEE-488) optional
- Remote Measurement Device: RS-232C for RPM1/RPM2

Pressure Supply:
- High Pressure Supply: Clean, dry, non-corrosive gas 10% above desired control range
- Drive IN: Clean, dry, non-corrosive gas at 100 to 150 psi (700 to 1 000 kPa) for PPCK-P3/P6, 120-150 psi for PPCK-P10

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Pressure Connections:
- Drive IN, Drive OUT, Vent: 1/8" NPTF
- Supply, Test, Drain: DH200F

Temperature Range:
- Operation: 0 to 40° C (32 to 104° F)
- Storage: -25 to 85° C (-15 to 185° F)

Power Requirements:
- 85-264 VAC, 47-440 Hz, 30 VA maximum consumption

Weight & Dimensions:
- 12 kg (26 lb.)
- 30 cm W x 15 cm H x 40 cm D (11.8" x 5.9" x 15.75")

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

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CHAPTER 2 - INSTALLATION

2.1 UNPACKING AND INSPECTION

The 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 of the same size module may be interlocked for stacking.

A rack mount kit is available for mounting the PPCK in a standard 19" rack mount configuration.

A convenient source of clean, dry, non-corrosive gas with a pressure 10% higher than the maximum desired operating pressure is needed for the high pressure supply. Clean, dry gas is also needed for the 100-150 psi (700-1 000 kPa) Drive IN supply valve actuation. In most facilities "shop" or "plant" air is NOT clean and dry without additional treatment.

A power supply of 85-264 VAC is also needed.

For safety and optimum performance the distance from the PPCK and the test volume which it is to control as well as the overall test volume should be minimized as much as possible.

2.3 INITIAL SETUP

- Pressure connections - Six pressure connections are included on the rear panel of the PPCK (see Section 1.2 for numbers referenced):

  Test connection (4) - connect to the system into which pressure is to be controlled. Ensure there are no leaks in the test volume.

  Drain connection (5) - can be left closed. It is a low point from which condensates or other liquids that had entered the system can be drained.

  IMPORTANT: PPCK is a pneumatic controller and not intended for use with liquids. Introducing liquids into the system may cause permanent damage.

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Supply connection (6) - connect a steady supply of clean, dry gas at 10% above the maximum control pressure desired.

IMPORTANT: Whenever the PPCK is connected to a high pressure supply, power should be left ON so that the "auto vent" function will operate should the supply pressure leak into the system causing system pressure to exceed its normal limits.

Vent connection (7) - gas exhausted from the volume into which pressure is being controlled will vent here. Can be left open or connected to tubing for remote gas exhaust if desired.

Drive IN (9) - connect a supply of clean, dry gas at 100-150 psi (700-1 000 kPa) or 200 psi (1 400 kPa) for the 10 000 psi (70 MPa) model. NOTE: in most facilities, "shop" or "plant" air is NOT clean and dry without additional treatment.

Drive OUT (8) - gas exhausted from the valve actuation system will vent here. This port may be left open or connected to tubing for remote gas exhaust if desired.

- **Interface connections** (12 & 13) - Two separate RS-232 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 external communication to the PPCK and COM2 is used to communicate through the PPCK to another device such as a Reference Pressure Monitor (RPM).

- **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 85-264 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 to determine the volume into which it is controlling. Configuration is done using an automated user initiated routine (see Section 3.2.2).

For best performance the 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 Run Screen should be displayed. Once the Run Screen is displayed selections can be made by either pressing the corresponding function key, pressing the Special or Setup Menu keys or operating the pressure control keys (up, down, fast, vent).

In the Special and Setup Menus, the menu item desired can be selected by pressing the corresponding number or moving the cursor onto the desired selection using the horizontal arrow key and pressing ENTER. The ESC[ape] key 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.

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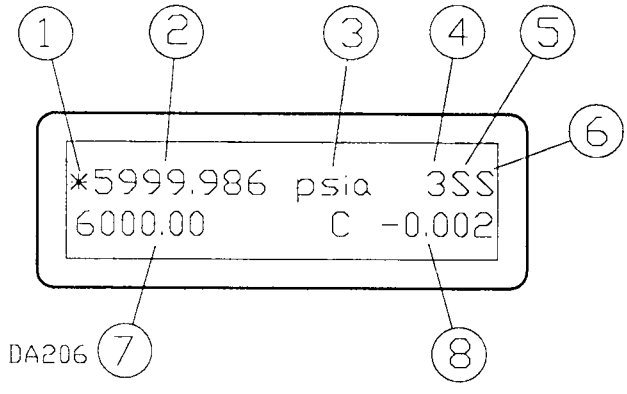
CHAPTER 3 - OPERATION

3.1 MANUAL OPERATION

The PPCK is ready for use when the necessary pneumatic connections have been made, power is applied, the unit has been turned on and all initialization and self test procedures have passed, ending with a display of the Run Screen. Functions can be accessed by directly pressing the appropriate function/numerical keys. These keys act as function keys or data entry keys automatically depending on the context. Menu driven operation is accessed using the Special and Setup keys. Pressure can be adjusted or vented using the pressure control keys under the display.

FRONT PANEL DISPLAY

While in the main Run Screen the front panel display provides information about the current operations of the PPCK. At other times the display provides information on functions and assistance to the operator in making selections.



1) '*' - pressure is "Ready"
   '<' - pressure is "Not Ready" and decreasing
   '>' - pressure is "Not Ready" and increasing
   'TIMEOUT' - the external device has stopped responding

2) 5999.986 - current pressure value

3) psia - current units of measure

4) 3 - current pressure range (1 = low, 2 = mid, 3 = high, X = external)

5) S - current Pressure Control Mode (D = Dynamic, S = Static)

6) S - current Control Mode Sets (U = User, S = System)

7) 6000 - last pressure generation target value in current units of measure

8) C -0.002 - rate of change in pressure in current units of pressure/second

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The following sections describe PPCK functions, explain their purpose and show how they are executed from the front panel.

3.1.1 PRESSURE INCREASE AND DECREASE - NORMAL & FAST MODE

Access keys: FAST, up arrow, down arrow (under the display)

Purpose: Increase and decrease pressure directly in two speeds to set approximate pressure values independently of a target pressure value.

Operation: When in Run Screen, pressing the up arrow increases pressure; pressing the down arrow decreases pressure. The pressure will increase/decrease as long as the key is held. Releasing the keys stops generation and closes all valves. Holding the FAST key while increasing or decreasing pressure increases the rate of change of the decrease/increase.

While operating the pressure control keys the actual pressure and rate of change of pressure can be observed on the upper left and lower right of the display. You must be in the main Run Screen for the pressure control keys to operate.

For automated generation of a specific target pressure value, press ENTER from the Run Screen (see Section 3.1.4).

3.1.2 VENT

Access keys: VENT (under the display)

Purpose: To cause the PPCK to vent pressure and remain in a vented condition until another instruction is given.

Operation: When in the Run Screen, pressing the VENT key allows the vent function to execute. The vent indicator LED lights and the PPCK controls the pressure down to atmospheric pressure leaving the system vented until another command is given. Pressing VENT again, pressing pressure control keys or pressing ENTER interrupts the vent. The VENT key does not operate when the PPCK is not in the Run Screen.

PPCK performs its autozero and atmospheric taring functions while in the vented condition when certain internal tests are met. The vent indicator LED will flash once quickly when these function are executed.

NOTE: if the pressure observed by the PPCK's high pressure sensor somehow comes to exceed the Upper Limit, the system will automatically go to the Run Screen and execute the vent function as a safety measure.

3.1.3 READY/NOT READY INDICATION

When in the Run Screen, PPCK continuously displays a Ready/Not Ready indication. This indication is intended to be used as a simple "go/no go" indication (based on objective criteria) of when in tolerance measurements can be made. The exact criteria used depend on whether the PPCK is in Static or Dynamic Pressure Control Mode (see Section 3.1.7) and whether User or System Control Mode Sets are active (see Section 3.1.10). The indication is by a symbol to the left of the current pressure. The symbols used are:

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1) '>' -"Not Ready" and pressure is increasing
2) '<' - "Not Ready" and pressure is decreasing
3) '*' - "Ready"
4) 'TIMEOUT' - the external device is not responding

PPCK operates using system default Ready/Not Ready criteria unless the user sets customized criteria using the Mode Sets function (see Section 3.1.10). The system default values cover the needs of most users. User defined Mode Sets which change characteristics of how the PPCK controls pressure and when the Ready condition occurs should only be used when needed for special requirements after care study of the information in Section 3.1.10.

3.1.4 AUTOMATIC GENERATION OF A PRESSURE POINT (ENTER)

Access keys: ENTER (Run Screen only).

Purpose: To have the PPCK automatically set and maintain a user requested pressure value.

Operation: Press ENTER when in the Run Screen. PPCK will prompt for a target pressure value. Write the target value using the numerical keys (edit with horizontal arrow keys if necessary) and press ENTER again. The display returns to the Run Screen with the target value displayed in the lower left hand corner of the display. The PPCK will generate and control the target pressure in Dynamic or Static Control Mode depending upon what mode it is currently in (see Section 3.1.7). The Ready/Not Ready indication can be used to determine when the command has been successfully completed.

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 ENTER key. To cancel the suspended generation, press the ESC[ape] key again.

If a pressure outside of the current range of the PPCK or above the current Upper Limit (see Section 3.1.8) is selected, it will not be able to be entered.

3.1.5 CHANGING RANGES (RANGE/7)

Access keys: RANGE/7

Purpose: Changing the PPCK's currently active pressure range between the three available ranges of PPCK. This function is not available if an external device has been selected (see Section 3.1.9).

Operation: Pressing the RANGE/7 key briefly causes the PPCK display to identify the current range. Pressing the +/- key will cause the display to increment through the other available ranges of the PPCK. Press the ENTER key to select the range that is displayed, or the ESC[ape] key to return without changing the range.

The range change can be made only if the current pressure applied to the PPCK is equal to or less than the maximum pressure of the new desired range. If the current pressure exceeds the maximum pressure of the new range selected, an error message will be displayed and the command will not execute.

When a new range is selected, the PPCK optimizes its internal sensor coefficients to work in that range and the Upper Limit and Control Mode Sets change to those of the current range and control mode. The far left character of the character group in the upper right hand corner of the display always indicates the currently active range with 1 = low, 2 = mid, 3 = high, X = external.

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3.1.6 CHANGING PRESSURE MEASUREMENT UNITS (UNITS/8)

Access keys: UNIT/8

Purpose: To change the current unit of measure (pressure units).

Operation: Pressing the UNIT/8 key brings up a menu of six pressure unit selections. After selecting one a prompt for gauge or absolute appears. The selection made will determine whether the PPCK will then operate in gauge (pressures measured relative to atmosphere) or in absolute (pressures measured relative to vacuum). If absolute is selected, the pressure unit indication will be followed by an "a" in the Run Screen display.

3.1.7 STATIC & DYNAMIC PRESSURE CONTROL MODES (CONTROL/9)

Access keys: CONTROL/9

Purpose: To change the PPCK Pressure Control Mode between Static and Dynamic.

Operation: Pressing the CONTROL/9 key when in the Run Screen causes the current Pressure Control Mode to toggle between Dynamic and Static. The current active control mode is always indicated in the Run Screen by the second character from the left in the character group at the upper right hand corner of the display with S = Static, D = Dynamic.

Static and Dynamic Control Modes

Two pressure control modes are available to accommodate the two most commonly used pressure calibration and testing techniques: 1) setting the pressure at a nominal value, stabilizing and then measuring the exact pressure present without controller interference (Static Control), or, 2) having the controller remain continuously active to maintain the set pressure as close as possible to the requested target value (Dynamic Control).

Static Pressure Control

In the Static Pressure Control Mode the final pressure achieved may not be the exact target pressure requested but control errors (the inability of the controller to perfectly set and maintain the pressure) are eliminated. The PPCK sets the pressure to the target value within the Target Limit and then no longer controls unless the pressure goes outside of the Hold Limit, in which case it resets the pressure to the target value within the Target Limit. The exact measured value of the current pressure is always displayed to allow it to be read back. Pressure control is accomplished using the high pressure control valves; the thermal pressure control module is not used. A Ready condition will exist only if:

1) No valve is operating and the pressure has been set to inside the Target Limit.
2) The current pressure is inside the Hold Limit.
3) The current rate of change of pressure is less than the current Stability Test.

NOTE: see Section 3.1.10 for an explanation of the Target, Hold and Stability Limits.

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Dynamic Pressure Control

In the Dynamic Pressure Control Mode, the final pressure achieved is equal to the target pressure requested but control errors (the inability of the controller to perfectly set and maintain the requested pressure) are integrated into that value. PPCK sets the pressure to the target value and continuously controls to keep it as close to the target value as possible. When a Ready condition is achieved, the target pressure is displayed as the current pressure since the current pressure will be assumed to be the target pressure. Pressure control is accomplished using the high pressure control values for coarse adjustment and the thermal pressure control module for fine control as needed. 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: see Section 3.1.8 for an explanation of the Hold and Stability Limits.

3.1.8 UPPER LIMIT SETTING (UL/4)

Access keys: UL/4

Purpose: To set a user defined Upper Limit value that the PPCK will **not** exceed. Usually used to protect the instrument or system under test into which PPCK is controlling pressure. The PPCK should be left turned on with the Run Screen up to allow the overpressure protection to remain active when the unit is left unattended.

Operation: Pressing UL/4 when in the Run Screen allows the Upper Limit value to be set *for the current active range.* When the pressure value reaches the Upper Limit an audible alarm will sound. When the Upper Limit is exceeded by more than 5% the PPCK will automatically vent. The Upper Limit value written for a range remains in memory and will be activated when returning to that range.

NOTE: the user defined Upper Limit default value for each range is 5% over that range and the user cannot set a value greater than this value. When the pressure reaches the system default Upper Limit the pressure indication on the Run Screen will flash. When this Upper Limit is exceeded by more than 5%, the PPCK will automatically decrease in pressure very quickly until the pressure is well under the Upper Limit value.

3.1.9 USE OF AN EXTERNAL PRESSURE MEASURING DEVICE (DEV/5)

Access keys: DEV/5

Purpose: To allow an external DHI RPM to be used as the reference pressure measuring device rather than the PPCK's internal sensor.

Operation: Pressing DEV/5 when in the Run Screen allows up to three external devices to be set up for use as references and allows one of them to be selected as the source of PPCK pressure measurements. Setting up an external device requires specific information about it. When an external device is used, from the standpoint of Control Modes and Control Settings, it is treated as a separate range with its own values. When an external device has been selected, an "X" appears in the far left character of the character group in the upper right hand corner of the display.

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The internal reference is always used whenever the PPCK is using the internal control values to control the pressure. The external device measurement is displayed and used when the PPCK is Static or when the Thermal Pressure Control Module (TPCM) is controlling the pressure. A TIMEOUT error will appear in place of the pressure display if the external device fails to respond.

3.1.9.1 SELECTION OF AN EXTERNAL MEASURING DEVICE (5/1)

Access keys: 1

Purpose: To select the internal PPCK pressure reference or a previously defined external device to be used as the reference pressure measuring device rather than the PPCK's internal sensor.

Operation: Pressing 1 when in the Device Menu displays a menu with five selections, the first is always PPCK. The remaining four menu selections can be defined as RPMs. These must be defined to be available for selection.

3.1.9.2 EDITING AN EXTERNAL PRESSURE MEASURING DEVICE (5/2)

Access keys: 2

Purpose: To edit the external device configuration.

Operation: Pressing 2 when in the Device Menu allows editing of a previously defined external device. Then select one of the five devices to edit. All external devices require range and RS-232 interface information.

RPM: specify address and mode (gauge or absolute)

3.1.9.3 ADDING AN EXTERNAL PRESSURE MEASURING DEVICE (5/3)

Access keys: 3

Purpose: To add a new external device configuration.

Operation: Identical to editing a device (see Section 3.1.9.2), but you must select a device type to add before proceeding.

3.1.10 CONTROL MODE SETTINGS - TARGET, HOLD, STABILITY (SET/6)

Access keys: CONTROL SETS/6

Purpose: To select the Target, Hold, Stability and display resolution settings that are used for the current Pressure Control Mode (Static, Dynamic) for each range used (1, 2, 3, X).

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Operation: Each individual range, any external device, and each Control Mode (Static, Dynamic) has its own Control Mode Sets and resolution. The Control Mode Sets available are Target Limit, Hold Limit and Stability Limit. Pressing Control Sets/6 while in the Run Screen allows selection or editing of the Control Mode Sets *for the current range and Control Mode only*. For each range and control mode there are System Default and User Defined Control Mode Sets. The System Default Control Mode Sets are typical values that will satisfy the needs of most users. The User Defined Control Mode Sets are available to customize the settings for your application. The character furthest to the right at the upper right side of the screen always indicates the current Control Mode Sets with S = System Defaults, U = User Defined.

When Control Sets/6 is pressed the current range and mode is displayed with two choices offered. 1/Select allows System Defaults for user defined values to be active for the current range and control mode. 2/Edit allows the user defined values for the current range and control mode to be modified.

Changes made to the Control Mode Sets of a range or the User Defined Settings are kept in memory for that range and Control Mode and will be activated when returning to that range and mode.

Target, Hold and Stability Limits

Target Limit: The Target Limit determines how close to the target pressure value the PPCK must set the pressure before the pressure setting function is considered complete. In Static Control Mode the pressure must be inside the Target Limit before a Ready condition can occur. When it does the PPCK will shut off and remain inactive until the pressure reaches the Hold Limit (see below). In Dynamic Control Mode the Target Limit is automatically set to zero and cannot be changed since by definition the pressure never reaches the target value and the controller will continuously adjust pressure around it.

Hold Limit: In Static Control Mode the Hold Limit determines the maximum distance the pressure can deviate from the target value before it will be reset to the target value. When the pressure is inside the Hold Limit no control is occurring, the Stability Test is met and a Ready condition will exist. When the Hold Limit is reached, Not Ready occurs and the pressure is reset to the target value inside the Target Limit. In Static Control Mode the Hold Limit is useful in defining the maximum distance from the target value that measurements will be made.

In Dynamic Control Mode the Hold Limit determines the maximum acceptable distance between the actual pressure and the target pressure under which a Ready condition can occur. When the pressure is inside the Hold Limit and the Stability Test is met, a Ready condition will occur and the PPCK display will show the current pressure as equal to the target pressure. In Dynamic Control Mode the Hold Limit is useful in quantifying the maximum control error.

Stability Test: The Stability Test compares the current rate of change of pressure in pressure unit/second to the Stability Limit. A Ready condition cannot occur if the current rate of change exceeds the Stability Limit. In Static Control Mode, the Stability Test is a useful way of assuring that the actual pressure has stabilized adequately before measurements are made. In Dynamic Control Mode, the Stability Test is not relevant since any pressure inside the Hold Limit will be assumed to be equal to the target pressure.

System Default Control Mode Sets and Ready/Not Ready Criteria

Static Pressure Control Mode:
- Target Limit: ±(0.25% of the current range or 0.01% of Range 3, whichever is)larger
- Hold Limit: ±(1% of the current range or 0.1% of Range 3, whichever is larger)
- Stability Limit: 0.005%/second of the current range or 5 ppm/second of Range 3, whichever is larger

Dynamic Pressure Control Mode:
- Target Limit: 0 (zero)
- Hold Limit: ±0.015% of the current range or 0.005% of Range 3, whichever is larger
- Stability Limit: 0.01%/second of the current range or 0.005% of Range 3, whichever is larger

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3.1.11 ANALOG INPUTS (READ ANALOG/1, SETUP ANALOG/2)

Access keys: READ ANALOG/1 and SETUP ANALOG/2

Purpose: Allow reading of up to four analog input signals from devices being calibrated or tested.

Operation: Pressing SETUP ANALOG/2 allows the input range to be selected (4-20 mA, 0-100 mV, 0-5 V, 0-10 V). Pressing READ ANALOG/1 causes the bottom line of the display to show the current analog input value. Pressing the key toggles the display from showing Channel 1 and 2 to Channel 3 and 4. ESC[ape] goes back to the Run Screen.

NOTE: This is an optional feature. Also see Annex - Menu Flow Chart.

3.1.12 EXTERNAL VALVE DRIVERS (DRIVERS/3)

Access keys: DRIVERS/3

Purpose: Allow control of the optional external valve drivers.

Operation: Pressing DRIVERS/3 when in the Run Screen allows the external valve drivers to be operated. The user can operate up to eight 12 V 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's channel number. Pressing ENTER will allow you to change to toggled or momentary action.

NOTE: This is an optional feature. Also see Annex - Driver Command Description.

3.2 SPECIAL MENU (SPECIAL/0)

Access keys: SPECIAL/0

Purpose: To access a menu of infrequently used system functions including internal functions that cannot be accessed by direct function keys.

Operation: In the Run Screen, press SPECIAL/0 and the Special Menu will appear. Make a selection in the menu by pressing the number of the selection or moving the cursor to the selection number using the horizontal arrow keys and pressing ENTER.

3.2.1 SPECIAL - UNITS

Access keys: SPECIAL/1

Purpose: To set up the six units that will be available from the UNIT function (UNIT/2) and to define the User Defined Unit (UDU).

Operation: In the Run Screen press SPECIAL/0, then select UNIT/2. A unit type is selected and assigned to addresses 1 through 6 of the UNIT function. You may choose from either SI or English units.

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3.2.2 SPECIAL - CONFIG

Access keys: SPECIAL/2

Purpose: To run the Thermal Pressure Control Module (TPCM) configuration routine which automatically determines the TPCM coefficients for the current conditions and determines the test volume to which the PPCK is connected.

Operation: Automatically configures the PPCK operating coefficients for optimal performance in the volume of the system to which it is connected. The configuration routine should be performed when the test volume is changed by more than 20%. Prior to executing the configuration routine, the PPCK pressure should be set above 1 000 psi (70 MPa) and the system must be stable and leak free. The configuration routine should take about three minutes to execute and can be interrupted by pressing ESC[ape].

The result of the configuration routine is the calculation of K1 control coefficients. These can be edited under the Configuration Menu which can be useful in special situations but should not be done without consulting DHI.

3.2.3 SPECIAL - INTERNAL

Access keys: SPECIAL/3

Purpose: Allows access to PPCK internal function settings and resets.

Operation: Select SPECIAL from the Run Screen and then 3/INTERN.

3.2.3.1 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.

3.2.3.1.1 SPECIAL - INTERNAL - RESET - UNIT

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

3.2.3.1.2 SPECIAL - INTERNAL - RESET - ALL

Resets all PPCK parameters for config, files, system, settings and units along with external and internal device information.

NOTE: If this option is selected the user must reconfigure the PPCK along with redefining all settings information, sequences and user definable information. This function can also be performed on power up by pressing and holding the "2" key while power is applied.

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3.2.3.1.3 SPECIAL - INTERNAL - RESET - ANALOG

Clears all of the optional analog configurations to defaults.

3.2.3.1.4 SPECIAL - INTERNAL - RESET - SETS

Resets all PPCK settings (Target, Hold and Stability), the current range selection and the resolution.

3.2.3.1.5 SPECIAL - INTERNAL - RESET - SYSTEM

Resets external and internal device information and generation settings. Sets all internal data structures to default values. Also resets the user defined calibrations for the PPCK transducers.

3.2.3.2 SPECIAL - INTERNAL - CAL

Used to view or edit the PPCK internal sensor calibration data.

IMPORTANT: EDITING ANY VALUES HERE WILL ALTER THE CALIBRATION! The values accessible in this menu should be edited only as part of a calibration process.

A programmable PA (Pressure Adder) and PM (Pressure Multiplier) are available for each range of the PPCK reference sensor and its internal barometer. PA and PM are used to adjust zero and span as needed to cause the PPCK to agree with a standard as part of the recalibration process following:

$$Corrected\ Reading = (Uncorrected\ reading \bullet PA) + PM$$

To calibrate the PPCK to its original specifications requires a pressure standard with accuracy of ±0.005% of reading from 20-100% of each of the three PPCK ranges. The normal calibration procedure is to apply known pressures at 20% nominal ascending and descending increments recording the pressure applied by the standard and the PPCK output at each pressure. A wait time of three minutes at each pressure increment prior to taking data is recommended to allow complete stabilization of the pressure and the sensor. Once all the pressure points have been completed, a linear regression of the resulting data is calculated and used to adjust PA and PM as needed to fit the data. This process is repeated independently for each range. You must ensure that the autotare is disabled before calibration takes place (see Section 3.2.3.6).

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3.2.3.3 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 COM1, COM2, and 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.

For the COM1 and COM2 ports, these termination characters are only for data that is transmitted from the PPC. Data to be received by the COM1 or COM2 port must be terminated by either a Carriage Return and Line Feed, or, just a Carriage Return.

3.2.3.4 SPECIAL - INTERNAL - USER LEVEL

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

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 the Config			x	x
Manual Generation				x

A four digit password should be used to access the User Level Menu and must be entered before proceeding. If there is not a password currently defined (password = 0) you will have direct access to the menu. Passwords are numeric and the length may not exceed four digits. You may select between four user levels. The table above identifies the restriction associated with each level.

NOTE: The password should be recorded and stored in a secure location for later use if necessary. If you forget the password, you must call DHI Technical Service to get an alternate password.

3.2.3.5 SPECIAL - INTERNAL - ATM

If the autotare function is enabled the value of the internal atmospheric pressure transducer will be displayed. The number is updated every two seconds.

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If the autotare function is disabled the value of the internal absolute transducer saved during the last autotare will be displayed. This value is used by the PPCK to correct the absolute measurement to gauge. If the user alters this value it will not actually be changed until the autotare function is enabled which allows the unit to execute the autotare sequence when vented.

3.2.3.6 SPECIAL - INTERNAL - TARE

Allows the user to enable and disable the autotare function of the PPCK. Autotaring occurs 10 seconds after the PPCK has first vented and has stabilized, then every 4 seconds after that point as long as the pressure remains stable. The vent light will flash off briefly when this occurs. Disabling the Autotare prevents this process.

In gauge mode autotaring zeros the gauge pressure display and uses a separate internal atmospheric transducer to compensate for changes in atmospheric pressure when the unit is not vented. In absolute mode, the autotare function has no effect.

3.3 SETUP MENU (SETUP/.)

Access key: SETUP/.

Purpose: To allow viewing and editing of the PPCK settings.

Operation: Pressing the SETUP/. key brings up a menu with 5 selections. All of these functions except RSLTN/5 are also accessible from other PPCK menus.

3.3.1 CHANGING PRESSURE MEASUREMENT UNITS (SETUP/. ; UNIT/1)

Access key: SETUP/. ; UNIT/1

Purpose: To change the current unit of measure (pressure units).

Operation: Pressing the UNIT/8 key brings up a menu with six pressure unit selections. After selecting one a prompt for gauge or absolute appears. The selection made will determine whether the PPCK will then operate in gauge (pressures measured relative to atmosphere) or in absolute (pressures measured relative to vacuum). If absolute is selected, the pressure unit indication will be followed by an "a" in the Run Screen display. This feature can also be accessed by pressing the "UNIT/8" key from the Run Screen.

3.3.2 CONTROL MODE SETTINGS - TARGET, HOLD, STABILITY (SETUP/. ; 2..5)

Access key: SETUP/. ; 2..5

Purpose: To select the Target, Hold, Stability, and display resolution settings that are used for the current Pressure Control Mode (Static, Dynamic) for each range used (1, 2, 3, X).

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Operation: Each individual range, any external device and each Control Mode (Static, Dynamic) has its own Control Mode Sets and resolution. The Control Mode Sets available are Target Limit, Hold Limit and Stability Limit. The Target Limit, Hold Limit, and Stability Limits can also be accessed by pressing SET/6 while in the Run Screen.

If the Control Mode Sets are selected through System Sets you can only *view* the Sets. If you wish to *modify* User Sets, press the "SETUP/." key from the Run Screen and select USER.

Changes made to the Control Mode Sets of a range are kept in memory for that range and Control Mode and will be activated when returning to that range and mode.

Target, Hold and Stability Limits

Target Limit: The Target Limit determines how close to the target pressure value the PPCK must set the pressure before the pressure setting function is considered complete. In Static Control Mode the pressure must be inside the Target Limit before a Ready condition can occur. When it does the PPCK will shut off and remain inactive until the pressure reaches the Hold Limit (see below). In Dynamic Control Mode the Target Limit is automatically set to zero and cannot be changed since by definition the pressure never reaches the target value and the controller will continuously adjusts pressure around it.

Hold Limit: In Static Control Mode, the Hold Limit determines the maximum distance the pressure can deviate from the target value before it will be reset to the target value. When the pressure is inside the Hold Limit no control is occurring, the Stability Test is met and a Ready condition will exist. When the Hold Limit is reached, Not Ready occurs and the pressure is reset to the target value inside the Target Limit. In Static Control Mode the Hold Limit is useful in defining the maximum distance from the target value that measurements will be made.

In Dynamic Control Mode, the Hold Limit determines the maximum acceptable distance between the actual pressure and the target pressure under which a Ready condition can occur. When the pressure is inside the Hold Limit and the Stability Test is met, a Ready condition will occur and the PPCK display will show the current pressure as equal to the target pressure. In Dynamic Control Mode the Hold Limit is useful in quantifying the maximum control error.

Stability Test: The Stability Test compares the current rate of change of pressure in pressure unit/second to the Stability Limit. A Ready condition cannot occur if the current rate of change exceeds the Stability Limit. In Static Control Mode, the Stability Test is a useful way of assuring that the actual pressure has stabilized adequately before measurements are made. In Dynamic Control Mode, the Stability Test is not relevant since any pressure inside the Hold Limit will be assumed to be equal to the target pressure.

System Default Control Mode Sets and Ready/Not Ready Criteria

Static Pressure Control Mode:
- Target Limit: ±(0.25% of the current range or 0.01% of Range 3, whichever is larger)
- Hold Limit: ±(1% of the current range or 0.1% of Range 3, whichever is larger)
- Stability Limit: 0.005%/second of the current range or 5 ppm/second of Range 3, whichever is larger

Dynamic Pressure Control Mode:
- Target Limit: 0 (zero)
- Hold Limit: ±(0.015% of the current range or 0.005% of Range 3, whichever is larger)
- Stability Limit: 0.01%/second of the current range or 0.005% of Range 3, whichever is larger

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3.3.3 CHANGING DISPLAY RESOLUTION (SETUP/. - RSLTN/5)

Access key: SETUP/. ; RSLTN/5

Purpose: To change the display resolution for the current range.

Operation: Pressing the RSLTN/5 key from the SETUP menu will allow editing of the resolution. This number represents the number of decimal places that will be displayed in most pressure fields. The number can not be negative or greater than 6.

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CHAPTER 4 - INTERFACING

4.1 OVERVIEW

Most of the commands described in Chapter 3 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 Run Screen (see Section 3.1 - Manual Operation). The front panel REMOTE indicator will light when the PPCK is in Remote Mode and flicker when the communications port is active. All 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.

When the PPCK receives a command it responds 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

NOTE: The command set for the PPCK ver3.XX series is similar to previous versions but some variations may require changes to any current program written for previous versions.

All of the previous command are supported and several new command have been added to enhance operation and support the multi-range features:

CFG, CAL, CALAMB, DATE, RATES, RES, SETS, SN

The PPCK has separate Target, Hold, and Stability settings for each of the three ranges plus the external device and for each of the two generation modes. The user must be sure to make changes to the Control Mode, the range and the device prior to setting the target set, hold set, or stability set. Otherwise, the settings previously defined for the new range, mode, or device will be restored and used.

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

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

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

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

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4.2 COMMAND SUMMARY

ABORT	Halt all current operations
ATM	Read the current atmospheric measurement
AUTOTARE(=)	Enables or disables the autotare function
CAL(=)	Set or read the calibration for the pressure transducer
CALAMB(=)	Set or read the calibration for the atmospheric transducer
CFG(=)	Set or read the CONFIG results
COMx(=)	Set or read the COMx port configuration
CONFIG	Reconfigure PPC for different volumes
DATE(=)	Set or read the date
DEVICE(=)	Specify the PPCK's pressure reference
DF=	Rapidly decrease system pressure
DP=	Decrease pressure by a desired amount
DS=	Slowly decrease system pressure
ERR	Retrieve last error message
HOLD(=)	Set or read current HOLD status
HS(=)	Set or read hold setting in pressure
HS%(=)	Set or read hold setting in % F.S.
IF=	Rapidly increase system pressure
IP=	Increase pressure by a desired amount
IS=	Slowly increase system pressure
LOCAL	Local operation
MEM	Read status from memory test
MODE(=)	Set or read pressure generation mode
PR	Read the current pressure value
PS=	Set desired pressure
PSF=	Set desired pressure using Fast speed only
PSH=	Set desired pressure and hold it
PSS=	Set desired pressure using Slow speed only
RANGE(=)	Set or read the currently PPCK range
RATE	Read the current rate of pressure change
RATES(=)	Set or read the manual generation rates
READY(=)	Same as MODE(=)
READYCK(=)	Sets a flag that is cleared by a "Not Ready" condition
REMOTE	Remote only operation
RES(=)	Set or read the display resolution
RESET	Reset the PPC to the default operating parameters
RETURN	Return to last pressure setting
RPM	Send a command to a remote RPM

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4.2 COMMAND SUMMARY continued

SETS(=)	Set or read the sets mode
SN	Read the PPCK serial number
SR	Read current ready status
SS(=)	Set or retrieve the Stability setting in pressure
SS%(=)	Set or retrieve the Stability setting in % F.S.
STAT	Read pressure generation status
TOUT(=)	Set or retrieve timeout for external device
TP	Read current target pressure
TS(=)	Set or retrieve target pressure limit in pressure
TS%(=)	Set or retrieve target pressure limit in % F.S.
UCOEF	To retrieve current pressure converter
UDU(=)	Set or retrieve User Defined Pressure Unit
UL(=)	Set or retrieve maximum allowable pressure
UNIT(=)	Set or retrieve current pressure unit setting
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

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4.3 INDIVIDUAL COMMAND DESCRIPTIONS

ABORT

PURPOSE: To stop all current action of the PPCK

SYNTAX: "ABORT"

DEFAULT: N/A

REMARKS: An abort command can be sent to halt any and all current operations and place the PPC into an idle state. The ABORT command disables a HOLD if hold is active and closes any valves including vent.

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

EXAMPLE: Typical command: "ABORT"

typical reply: "ABORT"

ERROR: none

ATM

PURPOSE: To retrieve the current atmospheric reference pressure

SYNTAX: "ATM"

DEFAULT: 101.325 kPa (14.6959 psia)

REMARKS: The atmospheric pressure reference that is used to correct an absolute reference to gauge mode can be read. This pressure is updated every 2 seconds. During a vent procedure the atmospheric reference is automatically recorded with the autotare function and will then be used to adjust the gauge measurement to reflect changes in the atmospheric pressure.

EXAMPLE: Typical command: "ATM"

typical reply: "14.25"

ERROR: none

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AUTOTARE(=)

PURPOSE: To enable or disable the PPCK autotaring function

SYNTAX: "AUTOTARE=n"
"AUTOTARE"

DEFAULT: AUTOTARE=1

REMARKS: The PPCK autotares in gauge mode only 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

CAL(=)

PURPOSE: To set or retrieve the internal user Pressure Adder (PA) and Multiplier (PM)

SYNTAX: "CAL=*adder, mult*"
"CAL"

DEFAULT: CAL=0, 1

REMARKS: *adder:* PA in the current pressure units
mult: PM

The parameters must be separated by commas.

The displayed pressure is adjusted using the user defined calibration:

Display pressure = (measured pressure x *mult*) + *adder*

NOTE: This calibration information should be changed with care since it affects the displayed pressure value.

EXAMPLE: Typical command: "CAL=0.01, 1"

typical reply: "0.01 psi, 1.00000"

ERROR: ERR# 6: missing or incorrect parameters

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CALAMB(=)

PURPOSE: To set or retrieve the internal user ambient Pressure Adder (PA) and Multiplier (PM)

SYNTAX: "CAL=*adder, mult*"
"CAL"

DEFAULT: CAL=0, 1

REMARKS: *adder:* ambient PA in Pascal units
mult: ambient PM

The parameters must be separated by commas.

The ambient pressure transducer is used to compensate for changes in the ambient pressures when in gauge mode. This pressure is adjusted using the user calibration PA and PM:

Ambient pressure = (pressure x *mult*) + *adder*

NOTE: This calibration information should be changed with care since it affects the ambient pressure value.

EXAMPLE: Typical command: "CALAMB=0.01, 1"

typical reply: "0.01 Pa, 1.00000"

ERROR: ERR# 6: missing or incorrect parameters

CFG(=)

PURPOSE: To read the current configuration for the Thermal Control Module. This should only be done only in special situations after consulting the DHI.

SYNTAX: "CFG=upK1, dnK1"
"CFG"

DEFAULT: upK1:
dnK1:

REMARKS: upK1: The increasing K1 control coefficient
dnK1: The decreasing K1 control coefficient

These coefficients are usually determined using the "CONFIG" command. In special situations these numbers might need to be directly accessed without using the "CONFIG" command; eg. - if test volume is changed often. Contact DHI for advanced information on this command.

EXAMPLE: Typical command: "CFG"

typical reply: "300.0000, 300.0000"

ERROR: ERR# 6: if invalid arguments

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COM(x)=

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

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

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

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

The parameters must be separated by commas (available parameters are listed below). Once the port is configured it 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	2400
	300	4800
	600	9600
	1200	
Parity:	O - Odd	
	E - Even	
	N - None	
Data bits:	7	
	8	
Stop bits:	1	
	2	

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

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

ERROR: ERR# 11: missing or wrong parameters

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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 Thermal Control Module 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 (ideally done at 2 000 psi). The new operating parameters are stored in memory and are active on power up.

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.

EXAMPLE: Typical command: "CONFIG"

typical reply: "CONFIG"

ERROR: ERR# 10: if pressure is not >1 000 psi

DATE(=)

PURPOSE: To set or read the internal PPCK calender. This date is used for time stamping calibration changes and errors.

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

DEFAULT: N/A

REMARKS: mm: numeric month (1 to 12)
dd: numeric day (1 to 31)
yy: numeric year (0 to 99)

EXAMPLE: Typical command: "DATE=01/01/93"

typical reply: "01/01/93"

ERROR: ERR# 6: if invalid date argument(s)

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DEVICE(=)

PURPOSE: To configure the PPCK to use the indicated RPM as a pressure reference

SYNTAX:
"DEVICE=PPC"
"DEVICE=RPMx(,n)"
"DEVICE"

DEFAULT: DEVICE=PPC

REMARKS:
x = RPM address (if omitted defaults to 1)
n = 0 for absolute RPM, 1 for gauge unit

When DEVICE is not equal to PPCK all pressure commands are executed using the pressure measuring instrument connected to the COM2 port. The PPCK will then have the measurement and control accuracy of the external device. During larger pressure changes the PPCK will always use its internal transducer. If there is a disagreement between the PPCK internal transducer and the external device, overshooting could occur.

DEVICE=PPC: All pressure commands will be executed using the PPCK'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.

** **WARNING** ** Some external devices handle receiving strings at an incorrect baud rate differently. It is highly recommended to setup the COM2 port of the PPCK to the 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# 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

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DF=

PURPOSE: Rapidly decrease system pressure

SYNTAX: "DF=n"

DEFAULT: N/A

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

The system pressure can be rapidly decreased using this command. When a DF=1 command is given the DOWN valve is opened and a user defined fast rate is maintained (see RATES command to define this rate).

EXAMPLE: Typical command: "DF=1"

typical reply: "DF=1"

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

DP=

PURPOSE: Decrease system pressure by specified amount

SYNTAX: "DP=nn"

DEFAULT: N/A

REMARKS: nn = 0 - F.S. in current pressure units

The value of "nn" is in pressure with a maximum value that will not result in an invalid target pressure.

EXAMPLE: Typical command: "DP=5"

typical reply: "5 psi"

NOTE: if the current units are psia the above example will decrease the pressure by 5.0 psi.

ERROR: ERR# 6: if resulting target in invalid

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DS=

PURPOSE: Slowly decrease system pressure

SYNTAX: "DS=n"

DEFAULT: N/A

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

When a "DS=1" command is received the down valve is opened and a user defined slow rate is maintained (see the RATES command to define this rate).

EXAMPLE: Typical command: "DS=1"

typical reply: "DS=1"

ERROR: ERR# 6: if "n" is not a 0 or a 1

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ERR

PURPOSE: To read the error message of the last command

SYNTAX: "ERR"

DEFAULT: ERR# 0 = OK

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

ERROR MESSAGES:

"ERR# 0 = OK"
"ERR# 1 = External device measurement out of range"
"ERR# 2 = Label must be 5 characters or less"
"ERR# 3 = User defined coefficient cannot be 0"
"ERR# 4 = External device not detected"
"ERR# 5 = External device improperly configured"
"ERR# 6 = Numeric argument missing or out of range"
"ERR# 7 = Improper command argument(s) or format"
"ERR# 8 = External device timeout"
"ERR# 9 = Unknown command"
"ERR# 10 = 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# 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 exceeds selected range"
"ERR# 23 = Option not available or installed"
"ERR# 24 = Pressure must be greater than *nnnn* psia"
"ERR# 25 = Cannot modify system variables"
"ERR# 26 = Cannot change range with extern device"
"ERR# 27 = Internal EEPROM Fault"
"ERR# 28 = Must be in DEVICE=PPC mode"

EXAMPLE: Typical command: "ERR"

typical reply: "ERR# 0 = OK"

ERROR: none

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HOLD(=)

PURPOSE: Set or read the current HOLD status

SYNTAX: "HOLD=n"
"HOLD"

DEFAULT: HOLD=0

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

The Hold command, when active causes 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 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 the Control Mode is set to Dynamic the Hold remains on whenever a new pressure is set.

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

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HS(=)

PURPOSE: Set or read the Hold Limit

SYNTAX: "HS=nn"
"HS"

DEFAULT: Dynamic Mode: 0.015% of current range or 0.005% of the largest range, whichever is larger

Static Mode: 1.00% of current range or 0.10% of the largest range, whichever is larger

REMARKS: "nn" is a value in pressure

The Hold Limit (or dead band) is the maximum deviation from the target in pressure allowed before a re-adjustment occurs. When a re-adjustment 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 Dynamic (MODE=1), the Ready (R) indication will stay on while the pressure is inside the Hold Limit and the stability (SS) criteria is met.

If the Sets mode is currently System, changing the Hold Limit will automatically change the Sets mode to User (see the SETS(=) command).

If HS is set to a value that is less than the value of TS, the 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.

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HS%(=)

PURPOSE: Set or read the Hold Limit in % F.S.

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

DEFAULT: Dynamic Mode: 0.015% of current range or 0.005% of the largest range, whichever is larger

Static Mode: 1.00% of current range or 0.10% of the largest range, whichever is larger

REMARKS: "nn" is a value in % F.S.

The Hold Limit (or dead band) is the maximum deviation in pressure allowed before a re-adjustment occurs. When a re-adjustment 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.

If the Sets mode is currently System, changing the Hold Limit will automatically change the Sets mode to User (see the SETS(=) command).

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 >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 a user defined fast rate is maintained (see the "RATES" command to define this rate).

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

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IP=

PURPOSE: Increase system pressure by specified amount.

SYNTAX: "IP=nn"

DEFAULT: N/A

REMARKS: nn = 0 - F.S.

The system pressure can be increased by a specified amount. The value of "nn" is in pressure with a maximum value that will not result in an invalid target pressure.

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: the resulting target pressure is >UL

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. The up valve is opened and a user defined slow rate is maintained (see the "RATES" command to define this rate).

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.

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LOCAL

PURPOSE: Place the device in the Local Mode.

SYNTAX: "LOCAL"

DEFAULT: N/A

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

EXAMPLE: Typical command: "LOCAL"

typical reply: "LOCAL"

ERROR: none

MEM

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

SYNTAX: "MEM"

DEFAULT: N/A

REMARKS: On power up a memory test is run to check the integrity of the internal data RAM. If the memory has been corrupted then "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

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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 PPCK is adjusting the pressure.
n=1: Ready (R) can occur while the PPCK is adjusting the pressure.

n=0: ("Static" Mode)
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 Thermal Control Module will stay at a low "idle" power level. 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

n=1: ("Dynamic Mode")
The PPCK will adjust the pressure using the valves and overshoot the target pressure enough to ensure that the pressure will stabilize just below the target, and then the Thermal Control Module 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

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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 dddddddd uuuuuu". For more information on the Ready setting, see the READY(=) and SS commands.

The Ready information is either "R" for Ready (stable), or "NR" for Not Ready (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.

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

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PS=

PURPOSE: To set a desired pressure within the Target Limit.

SYNTAX: "PS=targ"

DEFAULT: N/A

REMARKS: targ= 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. The "ABORT" command can be used to stop a pressure generation.

EXAMPLE: Typical command: "PS=1000"

typical reply: "1000 psi"

ERROR: ERR# 6: if targ > the UL setting
ERR# 6: if targ < atmosphere

PSF=

PURPOSE: To a desired pressure using the user defined Fast speed only.

SYNTAX: "PSF=targ"

DEFAULT: N/A

REMARKS: targ= 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 (less than 100 psi) pressure. The rate at which the PPCK generates is determined by the user (see the "RATES" command).

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 targ > the UL setting
ERR# 6: if targ < atmosphere

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PSH=

PURPOSE: To set a desired pressure and maintain it.

SYNTAX: "PSH=targ"

DEFAULT: N/A

REMARKS: targ= 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.

In Static mode (MODE=0), when the pressure equals or exceeds the Hold Limit, a Not Ready (NR) condition will exist until the pressure has been reset with in the Target Limit. In Dynamic control mode (MODE=1), 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 targ > the UL setting
ERR# 6: If targ < atmosphere

PSS=

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

SYNTAX: "PSS=targ"

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. The rate at which the PPCK generates is determined by the user (see the "RATES" command).

EXAMPLE: Typical command "PSS=1000"

typical reply: "1000 psia"

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

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RANGE(=)

PURPOSE: To read the range of the PPC in psi or MPa or to select the range to use.

SYNTAX: "RANGE"
"RANGE=x"

DEFAULT: RANGE=3

REMARKS: x: The range to set - 1, 2, 3 or the actual range pressure value

The current active range can be read from the PPC. The range will be one of the three available, and the range units will be in psi or in MPa depending on the PPCK model. To set the range, the user can specify the range number (1 through 3). The returned value will always be the pressure of the selected range.

EXAMPLE: Typical command: "RANGE=2"

typical reply: "4000 psia"

ERROR: ERR# 6: if the range argument is not 1, 2 or 3
ERR# 22: if the pressure is greater than the selected range

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/s"

ERROR: none

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RATES(=)

PURPOSE: To set or read the user defined rates used for fixed rate Manual Control generation.

SYNTAX: "RATES"
"RATES=min,max"

DEFAULT: Rates=10,500 kPa/s

REMARKS: min: The rate maintained during a "PSS", "IS", "DS" command or while the front panel up or down arrow is pressed.

max: The rate maintained during a "PSFS", "IF", "DF" command or while the front panel Fast, up or down arrow is pressed.

The rates are in the current unit/s. The PPCK will try to maintain the defined rate until the generation is aborted.

EXAMPLE: Typical command: "RATES = 10, 50"

typical reply: "10.0 psi/s, 50.0 psi/s"

ERROR: ERR# 6: if the rates given are <0 or >1000 kPa/s

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

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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.

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

EXAMPLE: Typical command: "REMOTE"

typical reply: "REMOTE"

ERROR: none

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RES(=)

PURPOSE: To set or read the pressure resolution for the currently selected range.

SYNTAX: "RES"
"RES=dp"

DEFAULT: dp: The number of decimal places to display

REMARKS: The RES command can be given to change the displayed resolution. If the range is changed, the resolution will for that range will be restored.

EXAMPLE: Typical command "RES=3"

typical reply: "3"

ERROR: ERR# 6: if the argument is <0 or >6

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.

NOTE: You must wait at least 10 seconds after receiving the "RESET" reply for the PPCK to complete the reset cycle before resuming communications.

EXAMPLE: Typical command "RESET"

typical reply: "RESET"

ERROR: none

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RETURN

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

SYNTAX: "RETURN"

DEFAULT: 0.0000 psia

REMARKS: The current Target Setting could be from a remote pressure request, a remote Hold command, or a Hold command. When this command is given, the target pressure is checked and if it is within the normal operating range, the PPCK 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 the last target pressure is 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. You must be in DEVICE=PPC for this command to work properly.

The RPM 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.

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

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

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

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

typical reply: "*0001DP=6"

ERROR: none

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SETS(=)

PURPOSE: To set or read the sets type to use.

SYNTAX: "SETS"
"SETS=xxx

DEFAULT: "SETS=SYS"
xxx: "SYS" to use the manufacturer's defaults settings
"USER" to use the use definable settings

REMARKS: The PPCK range, control, and device dependent sets (Target, Hold, and Stability Limits) can be defined by the user if "SETS=USER" is specified. The fixed manufacturer sets can be used if "SETS=SYS" is specified. The manufacturer's settings are:

STABILITY
Dynamic Mode: 0.01% of current range or 0.005% of the largest range, whichever is larger
Static Mode: 0.005% of current range or 0.0005% of the largest range, whichever is larger

TARGET LIMIT
Dynamic Mode: 0.0
Static Mode: 0.25% of current range or 0.01% of the largest range, whichever is larger

HOLD LIMIT
Dynamic Mode: 0.015% of current range or 0.005% of the largest range, whichever is larger
Static Mode: 1.0% of current range or 0.1% of the largest range, whichever is larger

If the user tries to set the Target, Hold, or Stability by using a Remote command and the "SETS" are set to "SYS", then the PPCK will automatically set the "SETS" to user defined.

EXAMPLE: Typical command "SETS=USER"

typical reply: "USER"

ERROR: ERR# 7: the argument is not "SYS" or "USER"

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SN

PURPOSE: To read the PPCK serial number.

SYNTAX: "SN"

DEFAULT: N/A

REMARKS: Each PPCK is assigned a serial number which is read back by this command.

EXAMPLE: Typical command: "SN"

typical reply: "201"

ERROR: none

SR

PURPOSE: To read the current Ready status.

SYNTAX: "SR"

DEFAULT: N/A

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

EXAMPLE: Typical command: "SR"

typical reply: "R"

ERROR: none

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SS(=)

PURPOSE: Set or read the Stability Limit in pressure/sec.

SYNTAX: "SS=nn"
"SS"

DEFAULT: Dynamic Mode: 0.01% of current range or 0.005% of the largest range, whichever is larger

REMARKS: Static Mode: 0.005% of current range or 0.0005% of the largest range, whichever is larger

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.

If the Sets Mode is currently SYSTEM, then changing the Stability Limit will automatically change the Sets Mode to USER (see the SETS(=) command and the READY command).

"nn" is a value in pressure/sec

EXAMPLE: Typical command: "SS=1 psia"

typical reply: "1 psia"

ERROR: ERR# 6: if "nn" >F.S.

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SS%(=)

PURPOSE: Set or read the Stability Limit in % F.S./sec.

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

DEFAULT: Dynamic Mode: 0.01% of current range or 0.005% of the largest range, whichever is larger
Static Mode: 0.005% of current range or 0.0005% of the largest range, whichever is larger

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 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.

If the Sets Mode is currently SYSTEM, then changing the Stability Limit will automatically change the Sets Mode to USER (see the SETS(=) command and the READY command).

"nn" is a value in %F.S./sec.

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 when used with a PSF command or a PSS command to determine when the pressure has been reached and the command has finished executing. The returned reply will be STAT=1 until the pressure has been reached then the reply will be STAT=0.

EXAMPLE: Typical command "STAT"

typical reply: "STAT=0"

ERROR: none

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TOUT(=)

PURPOSE: To set or retrieve the timeout for an external device.

SYNTAX: "TOUT"
"TOUT=xx"

DEFAULT: TOUT=2

REMARKS: The current timeout in seconds can be read or set.
The timeout is the time required before an external device timeout will occur.

EXAMPLE: Typical command: "TOUT=5"

typical reply: "5"

ERROR: ERR# 6: if "xx" <2 or >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

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TS(=)

PURPOSE: To set or read the Target Limit for a pressure setting.

SYNTAX: "TS=dddd"
"TS"

DEFAULT: Dynamic Mode: 0.0
Static Mode: 0.25% of current range or 0.01% of the largest range, whichever is larger

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).

If the Sets Mode is currently SYSTEM, then changing the Target Limit will automatically change the Sets Mode to USER (see the SETS(=) command).

EXAMPLE: Typical command: "TS=1"

typical reply: "1.0 psia"

ERROR: ERR# 6: if "nn" >F.S.

TS%(=)

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

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).

If the Sets Mode is currently SYSTEM, then changing the Target Limit will automatically change the Sets Mode to USER (see the SETS(=) command).

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

typical reply: "0.01%"

ERROR: ERR# 6: if "nn" >F.S.

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UCOEF

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

SYNTAX: "UCOEF"

DEFAULT: UCOEF=0.000145038

REMARKS: The User Coefficient (UCOEF) is a value that is used to convert the current pressure units to Pascal.

EXAMPLE: Typical command: "UCOEF"

typical reply: "1.45038E-04"

The above example returned the value used to change psi to Pascal. Pressure in Pa = pressure in units/UCOEF.

ERROR: none

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 < or = 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 ba a maximum of 5 characters
ERR# 3: User defined coefficient cannot be 0

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UL(=)

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

SYNTAX: "UL=d"
"UL"

DEFAULT: d: the current 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 overpressure. NOTE: the UL is automatically set to 5% over the device range when an external device is selected. If the pressure somehow continues to increase to 5% over the UL setting, the PPCK will decrease the system pressure rapidly until it is well under the UL pressure.

EXAMPLE: Typical command: "UL=1000"

typical reply: "1000 psia"

ERROR: ERR #6: if "d" <0 or >range +5%

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UNIT(=)

PURPOSE: Set or change the current pressure units.

SYNTAX: "UNIT=xxxxxx"
"UNIT"

DEFAULT: UNIT=psia

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

Unit		Coefficient
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^2a	0.0000101972
label	label a	user defined

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

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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 Vent light will activate and pressure will quickly decrease to atmospheric. The reply to a "VENT" command will be "0" until the system is finished venting.

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 3.00"

ERROR: none

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#

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

SYNTAX: "#ddddd"

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

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4.4 SAMPLE PROGRAM

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

```
 10  ' Sample program
 20  CLS
 30  OPEN "COM1:2400,E,7,1,CS,CD,DS,LF" AS #1        Open computer COM1 port for
 40                                                   communications: 2400 baud, even
 50                                                   parity, 7 data bits, 1 stop bit, no
 60                                                   handshaking, send
 70                                                   line feed.
 80
 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 Stability 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 midscale
460  INPUT #1, PS$                                   Read returned data
470  PRINT "Pressure setting to => ";PS$             Display returned data
```

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4.4 SAMPLE PROGRAM (continued)

```
480  '
490  PRINT #1, "STAT"                    Read generation status until routine is
500  INPUT #1, STAT$                     complete
510  IF STAT$<>"STAT=0" THEN 490
520  '
530  PRINT #1, "CONFIG, VALVE            Configure the PPCK valves
540  INPUT #1, CON$                      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 is complete then
610  PRINT "Current pressure => ";PR$    display
620  '
630  PRINT #1,"PSH=";RG/3                Set pressure to 1/3 scale
640  INPUT #1,PS$                        Read returned data
650  PRINT "Pressure setting to => ";PS$ Print returned data
660  '
670  PRINT #1, "PR"                      Read pressure until
680  INPUT #1, PRES$                     Pressure is ready
690  IF LEFT$(PRES$,2)="NR" THEN 670
700  '
710  PRINT "Pressure set to => ";PRES$   Print Ready pressure
720  PRINT "Test ran successfully"
730  END                                 End program
```

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4.5 SERIAL SIGNAL DESCRIPTION

The PPCK is equipped with two serial ports. COM1 is configured as a DCE type device for RS-232 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 RS-232 communications, which means COM2 always transmits data on Pin 3 and receives data on Pin 2. This port is designed to communicate with an external device.

PIN DESIGNATION

COM1		COM2	
2	TxD	2	RxD
3	RxD	3	TxD
5	Gnd	5	Gnd
		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 RS-232 inputs and outputs.

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

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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
Even Parity
7 Data Bits
1 Stop Bit

Serial Terminator CR-LF

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 RS-232. Please refer to the programming section in the manual for proper format.

- **IEEE Defaults**

  Address: 10
  Bus terminator: CR, LF, EOI enabled

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CHAPTER 5 - MAINTENANCE AND ADJUSTMENTS

No special maintenance or adjustments are required for the PPCK.

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CHAPTER 6 - TROUBLESHOOTING

6.1 PRESSURE LEAKS

If with all valves shut (PPCK at rest, VENT off) 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 DHI 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.

SYMPTOM	***POSSIBLE CAUSE***	***SOLUTION***
• Unit inoperable	• No AC power • Blown main fuse	• plug in unit • replace fuse
• Inability to increase pressure	• low supply pressure • blocked supply line • above Upper Limit • low or no drive pressure	• check supply • replace line • re-adjust UL • check drive pressure
• Inability to decrease pressure	• blocked vent line • low or no drive pressure	• replace line • check drive supply
• No computer communication	• bad interface cable • improper data framing	• replace cable • set up serial port
• Poor pressure control	• settings incorrect • not configured for volume	• check and adjust • run Configuration
• Won't maintain pressure or can't reach pressure	• there is a leak in your test system	• correct leak

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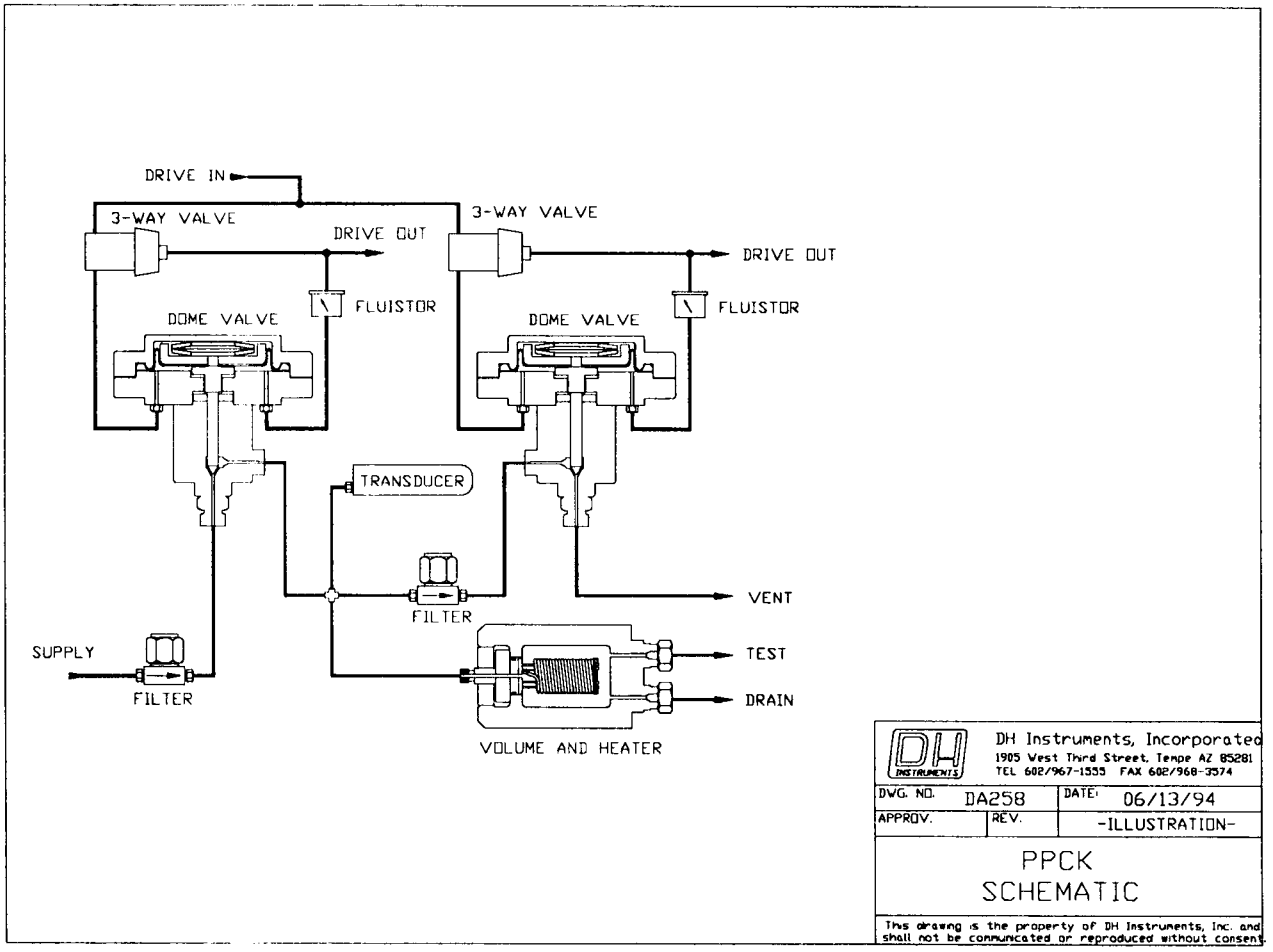
ANNEXES

SYSTEM SCHEMATIC



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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 ENTER will allow the operating mode of the drivers to be set. The two modes of operation are Momentary and Toggle.

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

# of Active Drivers	Max Current per Output
1	500 mA
2	400 mA
3	275 mA
4	200 mA
5	160 mA
6	135 mA
7	120 mA
8	100 mA

PIN DESIGNATION

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

A sample command description is shown on the following page.

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DRVx(=)

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

SYNTAX: "DRVx=s"
"DRVx"

DEFAULT: DRVx=0

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

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

EXAMPLE: Typical command: "DRV3=1"

typical reply: "DRV3=1"

ERROR: none

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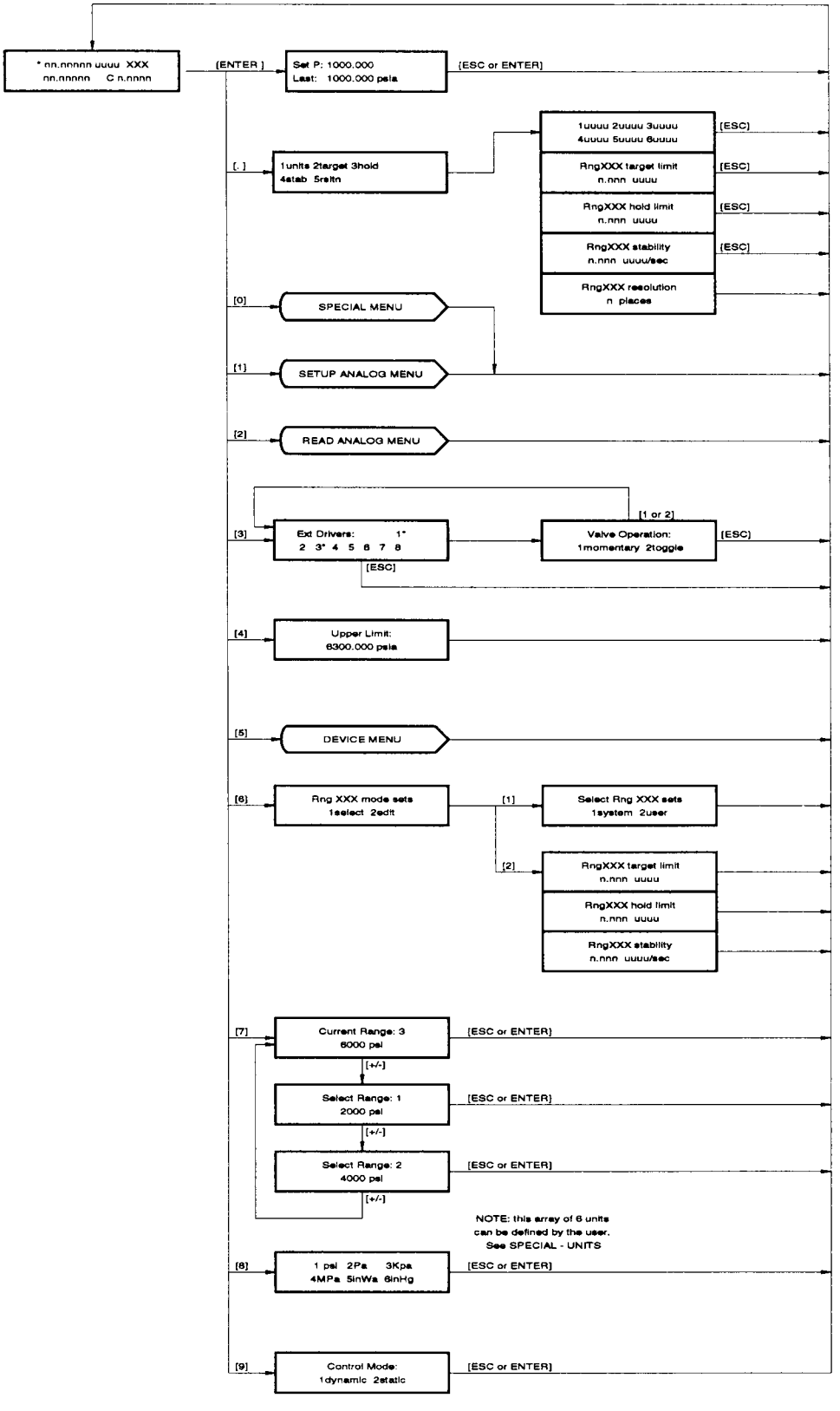
PPCK MENUS - MAIN RUN SCREEN



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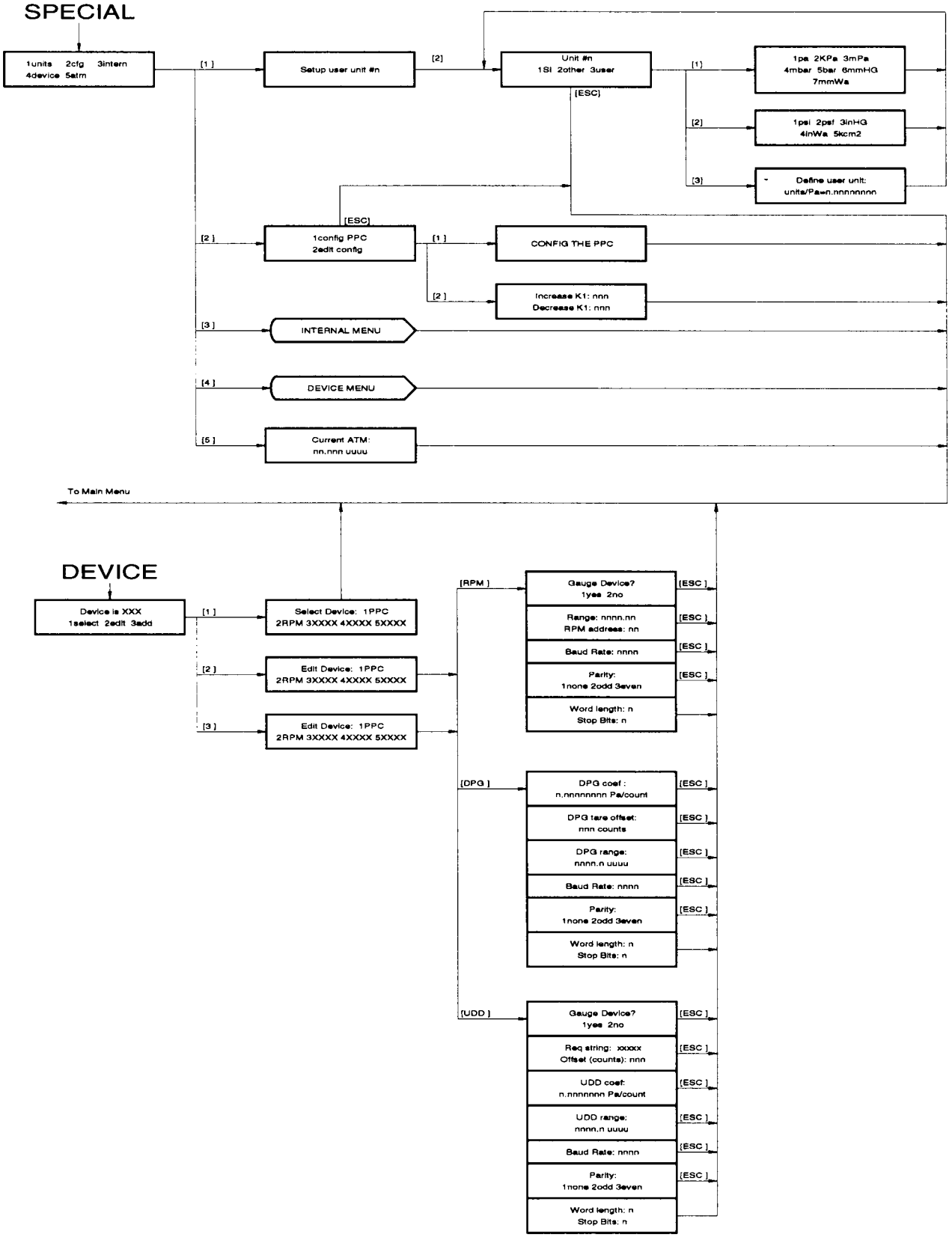
SPECIAL & DEVICE MENU



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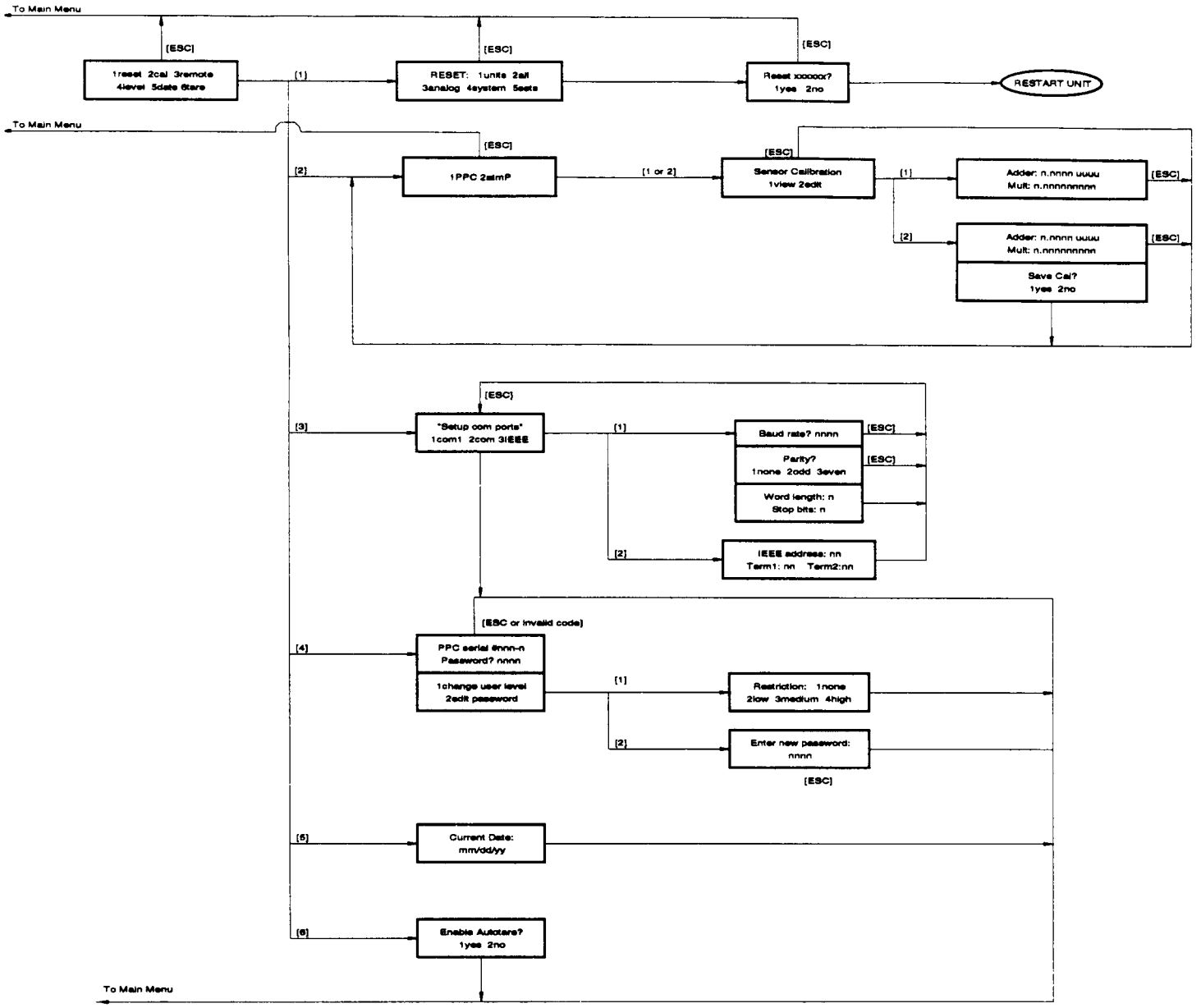
PPCK MENU - INTERNAL MENU



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