DH Instruments
A Fluke Company

PPC3™
Pressure Controller/Calibrator
Operation and Maintenance Manual

High pressure liquids and gases are potentially hazardous. Energy stored in these liquids and gases can be released unexpectedly and with extreme force. High pressure systems should be assembled and operated only by personnel who have been instructed in proper safety practices.

This instrument is not to be operated in any other manner than that specified by the manufacturer.

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ABOUT THIS MANUAL

This manual is intended to provide the user with the basic information necessary to operate a PPC3 pressure controller/calibrator. It also includes a great deal of additional information provided to allow you to optimize PPC3 use and take full advantage of its many features and functions.

Before using the manual, take a moment to familiarize yourself with the Table of Contents structure: Sections 1, 2 and 3 should be read by all first time PPC3 users. Section 3 is most important for those using the local front panel interface but should be read over by all users to familiarize themselves with general PPC3 operating principles. Section 4 is for remote operation from an external computer. Section 5 provides maintenance and calibration information. Section 6 is a quick troubleshooting guide. Use it to troubleshoot unexpected PPC3 behavior based on the symptom of that behavior. Certain words and expressions have specific meaning as they pertain to PPC3. The Glossary, Section 6, is useful as a quick reference for exact definition of specific words and expressions as they are used in the manual.

For those of you who "don't read manuals", go directly to Section 2.3 to set up your PPC3 and then go to Section 2.4 for power-up and verification. This will get you up and running quickly with a minimal risk of causing damage to yourself or your new PPC3. THEN... when you have questions or start to wonder about all the great features you might be missing, get into the manual!

Manual Conventions

(CAUTION) is used in throughout the manual to identify user warnings and cautions.

(NOTE) is used throughout the manual to identify operating and applications advice and additional explanations.

[ ] indicates direct function keys (e.g., **[RANGE]**).
< > indicates PG7000 screen displays (e.g., **<1yes>**).

NOTES

1. INTRODUCTION

1.1 PRODUCT OVERVIEW

PPC3 is a stand-alone, pressure controller intended to precisely set and control gas pressure into a closed volume as is commonly needed for the calibration and testing of pressure measuring instruments. It has been designed to provide very high performance combined with maximum versatility and ease of use.

PPC3 can be equipped with a low cost utility sensor for pressure monitoring or one or two Quartz Reference Pressure Transducers (Q-RPTs) to allow it to set and measure pressure with very low measurement uncertainty. Up to four external Q-RPTs in one or two external Reference Pressure Monitors (RPM4s), can also be integrated into a PPC3 system. In some cases, a barometer is also included.

Pressure control is achieved by a patented pneumatic module based on digitally controlled solenoid valves and differential pressure regulators.

PPC3 is controlled locally by the operator using a front panel display, keypad and function keys or remotely by a computer using ASCII character command strings over an RS232 or IEEE-488.2 interface.

PPC3 models are available to measure and control pressure in ranges from as low as - 3 to 3 kPa (0.4 psi) to as high as 0 to 10 MPa (0 to 1 500 psi) in absolute, gauge and compound gauge measurement modes.

1.2 SPECIFICATIONS

1.2.1 GENERAL SPECIFICATIONS

Power Requirements	85 to 264 VAC, 50/60 Hz, 30 VA max consumption
Operating Temperature Range	15 to 35 °C
Storage Temperature Range	- 20 to 70 °C
Vibration	Meets MIL-T-28800D
Weight	12.7 kg (28.2 lb) approx
Dimensions	18 cm H x 32 cm W x 40 cm D (7.1 in. x 12.6 in. x 15.8 in.)
Ventilation	To prevent product overheating, provide proper ventilation. Allow 10 cm (4 in.) clearance from rear panel cooling fan.
Microprocessors	Motorola 68302, 16 MHz
Communication Ports	RS232 (COM1), RS232 (COM2), IEEE-488.2
Fuses	1 A, 250 VAC fuse, 5 x 20 mm, time lag type fuse Internal power supply fuse not replaceable by operator: 2A, 250 V (UV 440-2 power supply), 3.15A, 250 V (NFS40-7612 power supply)
Pressure Ranges	Six controller models from 200 kPa (30 psi) max to 10 MPa (1 500 psi) max. Low uncertainty measurement provided by selection of quartz reference pressure transducer(s) (Q-RPTs)
Operating Medium	Any clean, dry, non-corrosive gas
Pressure Connections	SUPPLY: 1/8 in. NPT F TEST(+): 1/8 in. NPT F TEST(-): 1/8 in. NPT F ATM (Vent): 10-32 UNF EXHAUST: 1/4 in. NPT F
Pressure Limits	Maximum Working Pressure: Controller or Hi Q-RPT maximum Maximum Test Pressure w/out Damage: 110 % controller or Hi Q-RPT maximum Recommended Supply Pressure: Maximum control pressure + 10 % Maximum Supply Pressure w/out Damage: PPC3-10M: 14 MPa (2 000 psi) PPC3 -7M: 9.6 MPa (1 400 psi) PPC3-2M, -700K, -200K: 3.5 MPa (500 psi)

1.2.2 PRESSURE MEASUREMENT SPECIFICATIONS

1.2.2.1 QUARTZ REFERENCE PRESSURE TRANSDUCER (Q-RPT)

Quartz reference pressure transducers (Q-RPTs) can be installed in PPC3 to obtain low uncertainty pressure measurement. One or two Q-RPTs can be included in the PPC3 and/or additional Q-RPTs can be used externally mounted in **DHI** RPM4 Reference Pressure Monitors (see Section 3.2.4).

The type (Axxx, Gxxx, BGxxx, BAxxx) and range of the Q-RPT module(s) determines the PPC3 measurement specifications.

All Q-RPTs whose maximum pressure is over 200 kPa (30 psi) are of the absolute pressure type (Axxx) using an evacuated, permanently sealed reference. Axxx Q-RPTs can measure absolute, gauge and negative gauge pressure. Gauge pressure with an Axxx (absolute) Q-RPT is obtained by offsetting atmospheric pressure and applying dynamic compensation for atmospheric changes using the on-board barometer (see Section 3.2.3). Gxxx (gauge) Q-RPTs can measure positive gauge pressure only. BGxxx (bi-directional gauge) Q-RPTs can measure gauge and negative gauge pressure. See Section 3.3.3, PRINCIPLE, for additional information on absolute, gauge and negative gauge measurement modes.

PPC3s configured with two Q-RPT modules have only one TEST(+) and TEST(-) port. PPC3 internal valves and logic handle switching between the two Q-RPTs as needed.

Q-RPTs are available with two different performance levels, STANDARD class and PREMIUM class. See the product label on the PPC3 rear panel, the label on the Q-RPT module on the rear panel and/or the product calibration reports to determine the class of the Q-RPTs installed in PPC3.

Table 1. Reference Pressure Transducer (Q-RPT) Designations and Ranges

RPT DESIGNATION	SI VERSION		US VERSION	
	MAXIMUM PRESSURE Absolute [kPa]	MAXIMUM PRESSURE Gauge [kPa]	MAXIMUM PRESSURE Absolute [psi]	MAXIMUM PRESSURE Gauge [psi]
A10M[1]	10 000	10 000	1 500	1 500
A7M[1]	7 000	7 000	1 000	1 000
A3.5M[1]	3 500	3 500	500	500
A2M[1]	2 000	2 000	300	300
A1.4M[1]	1 400	1 400	200	200
A700K[1]	700	700	100	100
A350K[1]	350	250	50	35
A200K[1]	200	100	30	15
A160K[1]	160	60	23	8
A100K[1]	110	10	16	1.5
BA100K[4]	110	- -	16	- -
G200K[2]	- -	200	- -	30
G100K[2]	- -	100	- -	15
G15K[2]	- -	15	- -	2.2
BG15K[3]	- -	±15	- -	±2.2

1. All AXXXX RPTs support absolute, gauge and compound (negative) gauge modes.
2. All GXXXX RPTs are positive gauge mode only.
3. BG15K is bi-directional gauge from - 15 to + 15 kPa (- 2.2 to + 2.2 psi).
4. BA100K is a barometric range whose low point is 70 kPa absolute (10 psi).

Warm Up Time	None required, 30 minute temperature stabilization recommended for best performance from cold power up.	
Resolution	To 1 ppm, user adjustable	
Compensated Temperature Range	5 to 35 °C	
Acceleration Affect	± 0.008 % /g maximum, worst axis Allows operation at ± 20° from reference plane without significant effect	
Predicted One Year Stability[1]	± 0.005% of reading	
	STANDARD CLASS	**PREMIUM CLASS**
Precision[2]	± 0.008% of reading or 0.0024% of Q-RPT span, whichever is greater[5]	± 0.005% of reading, 0.0015% of AutoRanged span, or 0.0005% of Q-RPT span, whichever is greater[6]
Measurement Uncertainty[3]	± 0.01% of reading or 0.0030% of Q-RPT span, whichever is greater[5]	± 0.008 % of reading, 0.0024% of AutoRanged span, or 0.0007% of Q-RPT span, whichever is greater[6]
Delivered Pressure Uncertainty[4]	± 0.011 % of reading or 0.0033% of Q-RPT span, whichever is greater[5]	± 0.009 % of reading, 0.0027% of AutoRanged span, or 0.0008% of Q-RPT span, whichever is greater[6]

1. Predicted Q-RPT measurement stability limit (k=2) over one year assuming regular use of AutoZero function. AutoZero occurs automatically in gauge mode whenever vented, by comparison with barometric reference in absolute mode. Absolute mode predicted one year stability without AutoZ is ± (0.005 % Q-RPT span + 0.005 % of reading).
2. Combined linearity, hysteresis, repeatability. Add + 1 Pa (0.00015 psi) in gauge mode with an Axxx (absolute) Q-RPT for the resolution and short term stability of the on-board barometer.
3. Maximum deviation of the Q-RPT indication from the true value of applied pressure including precision, predicted one year stability limit, temperature effect and calibration uncertainty, combined and expanded (k=2) following the ISO "Guide to the Expression of Uncertainty in Measurement."
4. Maximum deviation of the PPC3 controlled pressure from the true value including measurement uncertainty and dynamic control hold limit.
5. % of reading value times measured pressure from 100 to 30 % of Q-RPT span. Under 30 % of Q-RPT span, % of reading value times 30 % of Q-RPT span. For example, if the Q-RPT is a Standard A160K, the Measurement Uncertainty in pressure is 0.010% times the measured pressure to 48 kPa (160 kPa span x 30%) and 0.0048 kPa (160 kPa span x 30% x 0.01%) under 48 kPa.
6. % of reading value times measured pressure from 100 to 30 % of AutoRanged span. Under 30% of AutoRanged span, % of reading value times 30% of AutoRanged span. If AutoRanged span is less then 30% of maximum Q-RPT span, % of reading values times measured pressure, or % of reading times 9% of Q-RPT span, whichever is greater. For example, if the Q-RPT is a Premium A160K and AutoRanged span is 160 kPa, the Measurement Uncertainty in pressure is measured pressure x 0.008% to 48 kPa (160 kPa AutoRanged span x 30%) and 0.0038 kPa (160 kPa span x 30% x 0.008%) under 48 kPa. If the AutoRanged span is 100 kPa (greater than 30% of 160 kPa maximum Q-RPT span), the measurement uncertainty in pressure is measured pressure x 0.008% to 30 kPa (100 kPa AutoRanged span x 30%) and 0.0024 kPa (100 kPa span x 30% x 0.008%) under 30 kPa. If the AutoRanged span is 30 kPa (less than 30% of the 160 kPa maximum Q-RPT span), the measurement uncertainty in pressure is measured pressure x 0.008% to 14.4 kPa (160 kPa maximum Q-RPT span x 9%) and 0.0012 kPa (160 kPa maximum Q-RPT span x 9% x 0.008%) under 14.4 kPa.

1.2.2.2 UTILITY SENSOR

Base PPC3 pressure controllers include a utility sensor. If a Hi Q-RPT (see Section 3.2.4) is installed, there is no utility sensor.

Utility sensors are used for pressure control, system monitoring and safety functions. They are intended for indication only, not to provide reference pressure measurement. Q-RPTs (see Section 1.2.2.1) are used for reference measurement.

Warm Up Time	None required
Range	PPC3-10M: 10 MPa (1 500 psi) absolute and gauge PPC3-7M: 7 MPa (1 000 psi) absolute and gauge PPC3-2M: 2 MPa (300 psi) absolute and gauge PPC3-700K: 700 kPa (100 psi) absolute and gauge PPC3-200K: 300 kPa (45 psi) absolute; 200 kPa (30 psi) gauge
Resolution	0.001 % of span
Precision	0.1 % of span

1.2.2.3 ON-BOARD BAROMETER

The on-board barometer is used only to measure changes in atmospheric pressure to provide dynamic compensation of the Q-RPT's atmospheric pressure offset when using an Axxx (absolute) Q-RPT to make gauge pressure measurements.

Warm Up Time	None required
Range	70 to 110 kPa (10 to 16 psi)
Resolution	0.001 % of span
Precision	0.1 % of span
Predicted Stability	0.05 kPa/yr (0.008 psi/yr)

The on-board barometer is only present in PPC3s that have an Axxx (absolute) or BGxxx (bi-directional gauge) internal Q-RPT.

1.2.3 PRESSURE CONTROL SPECIFICATIONS

	PPC3-200K	PPC3-700K	PPC3-2M	PPC3-7M	PPC3-10M
Control Precision	± 0.002 % of reading or of 2 % of controller span, whichever is greater.* Q-RPT used must provide resolution higher than expected control precision.				
Lowest Controllable Pressure (gauge mode)	Zero set by automated venting. Lowest point above or below zero limited only by Q-RPT resolution and control precision.				
Lowest Controllable Pressure (absolute, negative gauge modes)	1.5 kPa (0.2 psia)	3 kPa (0.4 psia)	5 kPa (0.75 psia)	5 kPa (0.75 psia)	10 kPa (1.5 psia)
Ultimate Pressure (absolute, negative gauge)	**TEST(+)** port is isolated and connected to vacuum supply. Typically < 50 Pa (0.008 psia) depending on vacuum source and test volume configuration.				5 kPa (0.75 psia)
Typical Pressure Setting Ready Time	15 to 30 seconds.				
Optimum TEST Volume	500 cc	500 cc	500 cc	250 cc	250 cc
Default Dynamic Control Hold Limit	± 0.005 % of current range				

* Control precision is reduced in absolute mode under 7 kPa (1 psi) absolute.

2. INSTALLATION

2.1 UNPACKING AND INSPECTION

2.1.1 REMOVING FROM PACKAGING

PPC3 is delivered in a corrugated container with high density polyethylene inserts to hold it in place; or in the optional molded, medium density polyethylene shipping case with a custom foam insert.

Remove the PPC3 and its accessories from the shipping container and remove each element from its protective plastic bag.

2.1.2 INSPECTING CONTENTS

Check that all items are present and have no visible damage.

A standard PPC3 includes all items indicated in Table 2.

Table 2. PPC3 Packing List

DESCRIPTION		PART #
1 ea.	PPC3 Pressure Controller/Calibrator	FAM007
1 ea.	Calibration Report	550100
1 ea.	Test Report	550200
ACCESSORIES:		**401918 (401918-CE)**
1 ea.	Operation and Maintenance Manual	550128
1 ea.	Power Cord (7.5 ft.)	100770 (100770-CE)
1 set	(6) Rubber Feet Caps	400203
1 ea.	Drivers Connector	401382
1 ea.	General Accessories Disk (white CD)	102987

2.2 SITE REQUIREMENTS

The PPC3 can be installed on any **flat, stable surface** at a convenient height. The front feet can be extended so that the unit can be inclined slightly for easier viewing. The PPC3 can also be mounted in a standard 19 in. rack using the optional rack mount kit.

Minimizing the distance between the PPC3 and the device or system under test will enhance control performance and reduce pressure setting times.

Ready access to the PPC3 rear panel should be considered to facilitate making and breaking pressure connections.

Pneumatic and RS-232 connections to RPM4s should be considered if RPM4s are to be used as external reference pressure measurement devices (see Section 2.3.7).

The Self Purging Liquid Trap (SPLT), if used, should be mounted vertically at the low point of the connection between the PPC3 **TEST(+)** port and the test (see Section 2.3.8.1).

If you are using a G15K or BG15K Q-RPT with a Dual Volume Unit (DVU), its location and connections should be considered (see Section 2.3.8.2).

Support facilities required include:

- **An electrical power source** of 85 to 264 VAC, 50 - 60 Hz.
- **A continuous, regulated pressure supply** of clean, dry, non-corrosive gas at PPC3 maximum control pressure + 10 % (at least 70 kPa (10 psi) in the case of a BG15K Q-RPT) to be connected to the PPC3 **SUPPLY** port. Lower gas pressure supply can be used but should exceed the maximum desired test output pressure by 10 to 20 %.
- **A vacuum source** of less than 1 psia (7 kPa) and with displacement of at least 3 cfm (90 lm) if control of pressures under 3 psi (20 kPa) gauge is desired.

2.3 SETUP

2.3.1 PREPARING FOR OPERATION

To prepare PPC3 for check out and operation:

❶ Remove the plastic caps from the PPC3 rear panel pressure connections.

❷ Remove the protective plastic sheet from the front panel display.

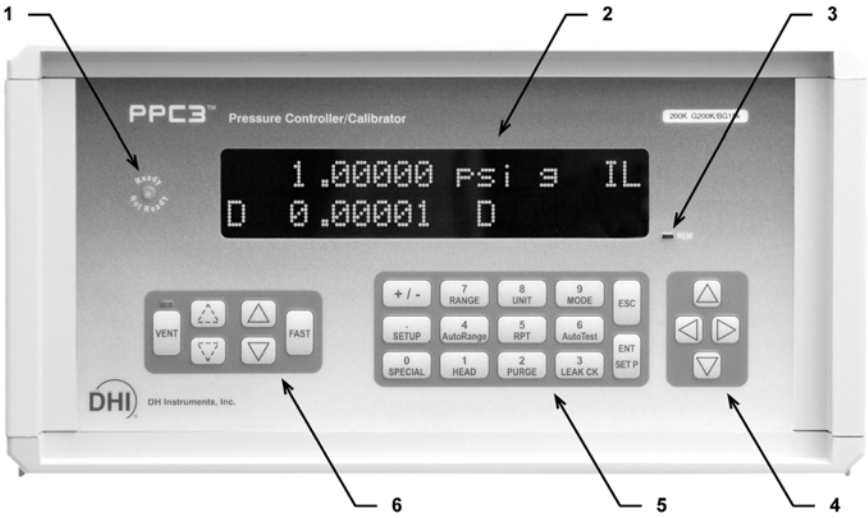
❸ Install the rubber feet caps onto the bottom case feet, if desired.

❹ Familiarize yourself briefly with the front and rear panel (see Section 2.3.2).

Then proceed with Sections 2.3.3 to 2.3.11

2.3.2 FRONT AND REAR PANELS

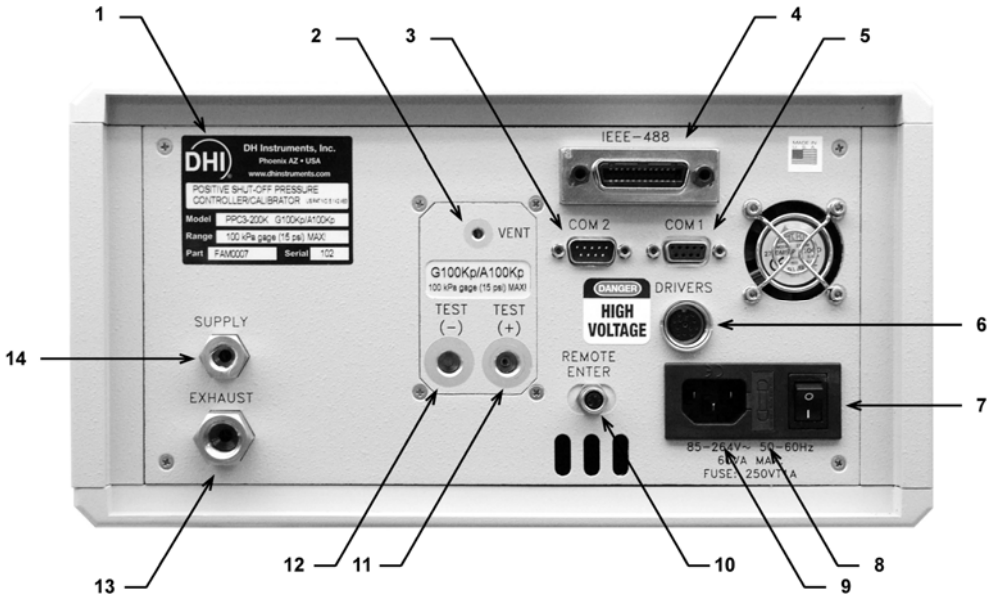
2.3.2.1 FRONT PANEL



1. Ready/Not Ready Indicator
2. Display
3. Remote Activity Indicator
4. Cursor Control Keys
5. Multi-Function Keypad
6. Direct Pressure Control Keys

Figure 1. Front Panel

2.3.2.2 REAR PANEL



1. Label, Product
2. VENT port
3. COM2 Connector
4. IEEE-488 Connector
5. COM1 Connector
6. Drivers (12 V) Connector
7. Power Switch
8. Fuse
9. Electrical Power Connector (IEC-320-C13)
10. Remote **[ENT]** Connector
11. Pressure Connection, TEST(+)
12. Pressure Connection, TEST(-)
13. Pressure Connection, EXHAUST
14. Pressure Connection, SUPPLY

Figure 2. Rear Panel

2.3.3 POWER CONNECTION

❶ Check that the PPC3 power switch is OFF.

❷ Connect the supplied power cable to the rear panel power module.

❸ Connect the other end of the power cable to an electrical supply of 85 to 264 VAC, 50/60 Hz.

2.3.4 REMOTE [ENTER/SET P] CONNECTION (FOOTSWITCH OR OTHER SWITCH)

Connect the optional remote ENTER footswitch, if available or a user supplied switch fitted to the optional cable (see Section 7.3). Connect the cable to the PPC3 rear panel connection labeled **REMOTE ENTER**. Activating the switch is equivalent to pressing the **[ENT/SET P]** key on the front panel (see Section 3.1.4).

2.3.5 CONNECTING TO A PRESSURE SUPPLY (SUPPLY PORT)

Using a pressure connecting hose or tube of appropriate pressure rating, connect the pressure supply to the **SUPPLY** port on the rear panel of PPC3. The PPC3 **SUPPLY** port connection is **1/8 in. NPT female**.

The supply pressure should be equal to the maximum PPC3 control pressure + 10 % (or at least 70 kPa (10 psi) for a BG15K Q-RPT). Lower gas pressure sources can be used but should exceed the maximum desired test output pressure by 10 to 20 %.

Never connect a pressure supply greater than 20 % over the maximum control pressure of the PPC3 model you are using (except models with a BG15K Q-RPT only). Be sure to connect the pressure supply to the SUPPLY port. Connecting to another port is likely to damage PPC3.

2.3.6 CONNECTING A VACUUM PUMP (EXHAUST PORT)

For PPC3 to set pressures under atmosphere and/or to reliably set pressure under 20 kPa (3 psi) gauge (other than zero gauge), a vacuum supply must be connected to the **EXHAUST** port.

Never connect a pressure supply to or plug the PPC3 EXHAUST port.

To avoid building up pressure on the EXHAUST port or on a vacuum pump connected to the EXHAUST port, the vacuum source should either be continuously ON or the EXHAUST port should be bypassed to atmosphere when the vacuum source is OFF. This is because when a supply pressure is applied to the PPC3 SUPPLY port and the PPC3 is NOT in the vent ON condition, there may be a constant gas exhaust through the PPC3 EXHAUST port.

To assure optimum pressure control when changing the pressure applied to the EXHAUST port from vacuum to atmosphere or vice-versa, be sure to change the control reference setting if the setting is NOT in AUTO mode (see Section 3.5.7.2).

2.3.7 CONNECTING EXTERNAL Q-RPTS IN RPM4 REFERENCE PRESSURE MONITORS

PPC3 can be connected pneumatically and by RS-232 to one or two RPM4 reference pressure monitors to use up to four external Q-RPTs (two in each RPM4) as external reference pressure measurement devices (see Section 3.2.4).

The PPC3 then manages communications and other RPM4 functions to integrate the RPM4 measurement capabilities into the PPC3 system. The RPM4 Q-RPT module's Self Defense System (SDS) is used to shut-off RPM4 Q-RPTs from the pressurized system when they are not in use (see the RPM4 Operation and Maintenance Manual).

As a general rule, making the pneumatic connection between the PPC3 TEST port and the remote Q-RPT as direct as possible favors good pressure control. As distance, volumes and restrictions between the PPC3 TEST port and the remote Q-RPT are added, the possibility of difficulty with pressure control when using the external Q-RPT increases.

To connect a PPC3 to an RPM4 to be used as part of the PPC3 system proceed as follows:

Set up the RPM4 for use as an external device to PPC3 following the instructions in the RPM4 Operation and Maintenance Manual, Using RPM4 With a PPC3 Controller/Calibration Section.

❶ Using tubing of appropriate pressure rating and a Tee, connect the RPM4 Q-RPT **TEST(+)** port to the PPC3 **TEST(+)** port. The third leg of the Tee is for the connection to the device or system under test. If there are two RPM4s, Tee the second RPM4 in series with the first one. The order of the RPM4s on the test line is not relevant.

If an RPM4 Q-RPT will be used in a gauge pressure range of less than 100 kPa (15 psi), consider connecting the RPM4 Q-RPT module TEST(-) port to the PPC3 TEST(-) port and to the "low" connection of the DUT if available. This will improve pressure control and stability when ambient pressure is unstable. If the Q-RPT is an Axxx designation Q-RPT, this connection should be made but also be left open to atmosphere.

When external Q-RPTs are used with PPC3, the maximum set pressure is the maximum pressure of the PPC3 controller/calibrator. The maximum pressure of the PPC3 is determined by the PPC3 controller model or the Hi Q-RPT if one is installed (see Section 1.2.1).

❷ Using a standard pin-to-pin DB-9M to DB-9F RS232 cable, connect COM2 of the PPC3 to COM1 of the RPM4 (see Section 4.2.1.3). If there are two RPM4s, connect COM2 of the first RPM4 to COM1 of the second RPM4. The order of the RPM4 daisy chain is not relevant.

❸ Turn ON the PPC3 and RPM4(s).

❹ Press **[RPT]** on the PPC3 key pad. This causes PPC3 to execute the Q-RPT search function (see Section 3.3.5). Q-RPTs with whom communication is established will be shown on the PPC3 display identified by their position (see Table 3).

For PPC3 to identify external RPM4s, the RPM4 COM1 port settings must be:

Baud rate: between 1200 and 19200
Parity: Even
Date bits: 7
Stop bits: 1

If PPC3 is not able to establish communications with RPM4s and their Q-RPTs, check that the RPM4 COM1 port setting conform to the requirements above. If the COM1 port settings are correct, check that the correct communications cable is being used (standard pin-to-pin DB-9M to DB-9F RS232) and is connected to the correct communications ports.

PPC3 COM2 > 1st RPM4 COM1; 1st RPM4 COM2 > 2nd RPM4 COM1

See the RPM4 Operation and Maintenance Manual for additional information on RPM4 RS232 communications and COM port settings.

2.3.8 CONNECTING TO THE DEVICE UNDER TEST (TEST(+) AND TEST(-) PORTS)

If you are using a self purging liquid trap (SPLT), see Section 2.3.8.1 before proceeding to connect the device under test.

If the PPC3 has a G15K or BG15K Q-RPT, a dual volume unit (DVU) should be installed for very low pressure control. See Section 2.3.8.2 before proceeding to connect to the device under test.

Using a pressure connecting hose or tube of appropriate pressure rating, connect the device or system to be tested to the PPC3 **TEST(+)** port. The PPC3 **TEST(+)** connection is **1/8 in. NPT female**.

PPC3 TEST(+) AND TEST(-) PORTS

All PPC3s have a **TEST(+)** and a **TEST(-)** port. See Figure 13 for PPC3 internal Q-RPT **TEST** port configurations.

The **TEST(+)** port is connected to Axxx (absolute) Q-RPTs and to the **high** side of Gxxx or BGxxx (gauge, bi-directional gauge) Q-RPTs.

The **TEST(-)** port is connected to PPC3s internal barometer, if present, and to the **low** side of Gxxx or BGxxx (gauge, bi-directional gauge) Q-RPTs.

- **When operating in absolute mode:** The **TEST(-)** port is left open to atmosphere.
- **When operating in gauge or negative gauge mode with a range greater than 50 kPa (7.5 psi):** The **TEST(-)** port is normally left open to atmosphere. A possible exception is when the device or system under test is in an ambient pressure that may differ significantly from the ambient pressure around the PPC3. For example, if the PPC3 is controlling pressure into DUTs in an environmental chamber, the pressure in the environmental chamber may be different from ambient pressure around the PPC3. In this case, connecting a tube from the **TEST(-)** port to the inside of the chamber may improve measurement results. If the Q-RPT in use is an Axxx Q-RPT, this tube must be left open to the environment so that the pressure inside cannot deviate too far from ambient. When using an Axxx Q-RPT, if this tube is connected to the low or reference side of DUTs, be sure to open to the local environment as well.
- **When operating in gauge or negative gauge mode with a range less than 50 kPa (7.5 psi):** As a general rule, it is preferable to connect the PPC3 **TEST(-)** port(s) directly to the low or reference side of the device under test to assure that these are at the same pressure. When using an Axxx Q-RPT, this connection must also be open to atmosphere. When using a Gxxx or BGxxx Q-RPT, it is preferable that this connection not be open to atmosphere.

Do not apply pressure to the TEST(+) port without having a pressure supply equal to or greater than the applied pressure connected to the SUPPLY port. When controlling pressure to the TEST(+) port externally, do not cause the pressure to change at a very rapid rate. For example, do not vent suddenly by opening an external valve. Internal damage to the PPC3 may result.

Do not connect a pressure supply to the TEST(-) port. The pressure applied to this port should be maintained at atmospheric pressure (between 70 and 110 kPa (10 and 16 psia)). Exceeding these limits may damage a Gxxx or BGxxx Q-RPT and/or the PPC3's on-board barometer.

Operating the PPC3 connected to a system with liquid contaminants without taking proper precautions to purge the system and test line may cause contamination of the PPC3 that will require non-warranty service.

Minimizing the length of the test connection tubing will enhance control performance and reduce pressure setting time. For normal operation, the total volume of the device or system under test including connecting tubing should be less than 1 000 cc (60 in^3) up to 2 000 kPa (300 psi) and less than 500 cc (30 in3) above 2 000 kPa (300 psi).

Minimizing the length of the test connection tubing and restrictions in connections will enhance control performance and reduce pressure setting time.

PPC3 pressure control will not operate properly if there are excessive leaks in the test system. In general, the maximum acceptable leak rate for optimal PPC3 automated pressure control operation and to assure in tolerance measurements with default pressure control parameters is ± 0.5 % of set pressure/minute. In DYNAMIC CONTROL mode, to handle higher test system leak rates, increase the hold limit using CUSTOM CONTROL (see Section 3.4.6.1).

PPC3 pressure control may be adversely affected if the test connection tubing is too restrictive. For optimum results, the inner diameter of the connecting hose should be > 1.75 mm (0.07 in.), or more.

2.3.8.1 INSTALLING A SELF PURGING LIQUID TRAP (SPLT)

The SPLT (optional) is intended to collect and exhaust liquid or other contaminants that may be present in the device or system under test so that they do not return to contaminate the PPC3.

The SPLT is installed in the **TEST(+)** connection line at a low point between PPC3 and the device or system under test. If the PPC3 system includes external Q-RPTs in RPM4(s), the RPM4s should be connected on the PPC3 side of the SPLT.

See the SPLT Operation and Maintenance manual for more complete instructions on SPLT installation.

2.3.8.2 INSTALLING A DUAL VOLUME UNIT (DVU), G15K AND BG15K Q-RPTS

To achieve in tolerance pressure control with the very low range of the G15K and BG15KQ-RPTs, a PK-PPC-BG-DVU dual volume units should be installed in-line on the **TEST(+)** and **TEST(-)** ports. The DVU includes two thermally isolated volumes installed in the test line to improve control stability.

See the PK-PPC-BG-DVU instruction sheet for additional information on its installation.

2.3.9 THE VENT PORT

The PPC3 **VENT** port is the system vent to atmosphere point used to set zero gauge pressure as well as to obtain Q-RPT measurements of atmospheric pressure. The PPC3 on-board barometer, if present is connected to the **VENT** port. Though a pressure hose can be connected to the **VENT** port to direct the vented gas flow, a completely unobstructed connection to atmosphere must be maintained for PPC3 reference pressure measurements to operate normally.

The PPC3 **VENT** port fitting is **10-32 UNF**.

NEVER plug, obstruct or connect a supply pressure to the PPC3 VENT port. This may adversely affect GAUGE mode operation and AutoZeroing functions.

2.3.10 CHECK/SET SECURITY LEVEL

PPC3 has a security system based on user levels. By default, the security system is set to "low", which includes certain access restrictions, and there is no password required to change the security level. See Section 3.5.5.5 for information on the security level system. As part of the PPC3 startup, determine the security level that is appropriate for the PPC3 and set a password if desired.

PPC3 is delivered with the security level set to "low" to avoid inadvertent altering of critical internal settings but with access to changing security levels unrestricted. It is recommended that the low security level be maintained at all times and password protection be implemented if control over setting of security levels is desired.

2.3.11 TURN OFF ABSOLUTE AND NEGATIVE GAUGE MODE (AXXX RPT)

If your PPC3 has an Axxx (absolute) Q-RPT, it is able to operate in gauge, negative gauge and absolute measurement modes (see Section 3.3.3). If the PPC3 will be used only in gauge mode, the other measurement modes can be turned off so they are no longer accessible. This can avoid confusion and/or accidental use of the wrong measurement mode. See Section 5.2.5 for complete information on turning off absolute and negative gauge measurement modes.

2.4 POWER-UP AND VERIFICATION

2.4.1 SWITCH POWER ON

Actuate the power switch on the PPC3 rear panel. Observe the front panel display as PPC3 initializes, error checks and goes to the MAIN RUN screen (see Section 3.1.1).

PPC3 power-up condition is Internal, Hi Q-RPT or utility sensor active, VENT ON unless the pressure measured by the Hi Q-RPT is more than 20 kPa (3 psi) away from standard atmospheric pressure.

If the PPC3 fails to reach the MAIN RUN screen, service is required. Record the sequence of operations and displays observed.

2.4.2 CHECK PRESSURE MEASUREMENT OPERATION

2.4.2.1 CHECKING ABSOLUTE MODE PRESSURE MEASUREMENT

If the PPC3 has an Axxx (absolute) Q-RPT or a utility sensor (IuH), check that it operates properly in **absolute** mode.

If the PPC3 is not vented (VENT LED OFF), press the **[VENT]** direct pressure control key to vent the PPC3 (VENT LED ON) (see Section 3.1.3).

Using the **[RANGE]** function key to change ranges if necessary and select the Axxx (absolute) Q-RPT DF range (see Section 3.3.1). Press the **[MODE]** function key and select **<absolute>** mode (see Section 3.3.3). Use **[UNIT]** to change the pressure unit if desired (see Section 3.3.2).

Observe the current value of atmospheric pressure. Check that the value agrees with the local value of atmospheric pressure. Repeat this process for all the Axxx (absolute) Q-RPTs and or the utility sensor in the PPC3 system. Check that the values of atmospheric pressure measured by the different devices agree with each other within PPC3 or RPM4 measurement tolerances as applicable (see Section 1.2.2.1, 1.2.2.2). If they do not agree within tolerances, the PPC3 or RPM4 Q-RPT may need calibration or repair.

2.4.2.2 CHECKING GAUGE MODE PRESSURE MEASUREMENT

If the PPC3 is not vented, press the **[VENT]** direct pressure control key to vent it (see Section 3.1.3).

Press the **[MODE]** function key and select **<gauge>** mode. Change the pressure unit if desired (see Section 3.3.3).

Observe that, within ten seconds, zero is indicated. It is normal for PPC3 to indicate a value other than zero for up to ten seconds when first entering **gauge** mode.

Using the **[RANGE]** function key to change ranges, observe that zero is indicated for each Q-RPT within 10 seconds. It is normal for PPC3 to indicate a value other than zero when vented when **gauge** mode is first entered or ranges are changed. After about ten seconds, the VENT LED should flash and zero should be indicated. If this does not occur, check that the AUTOZERO function is ON (see Section 3.5.1). If AUTOZERO is ON and the displayed pressure will not zero when vented in gauge or bi-directional gauge measurement mode, PPC3 may need repair.

2.4.3 LEAK CHECK

If desired, perform a leak check of the test system (see Section 3.3.9).

2.4.4 PURGE

If an SPLT is included and installed in the test line and the Device Under Test (DUT) may be contaminated with liquids, perform a purge of the DUT (see Section 3.3.8). The PURGE function must first be activated (see Section 3.5.7.4). This will rid the DUT of contaminating liquids.

Operating the PPC3 connected to a system with liquid contaminants without taking proper precautions to purge the system and test line may cause contamination of the PPC3 that will require non-warranty service.

2.4.5 CHECK PRESSURE CONTROL OPERATION

Select a pressure range using **[RANGE]** (see Section 3.3.1).

Press **[SETUP]**, **<6control>**, **<2dynamic>** (see Section 3.4.6). Then **[ESC]** back to the MAIN RUN screen.

Press **[ENT]**. Key in a target pressure within the active range and press **[ENT]** again (see Section 3.3.10).

Verify the maximum pressure rating of the system connected to the PPC3 TEST(+) port before entering a target pressure. Do not enter a target pressure greater than the pressure rating of the system connected to the PPC3 TEST(+) port.

PPC3 should set the target pressure and indicate *Ready* (see Section 3.2.2) continuously in 15 to 60 seconds. If it does not, see Section 6 to troubleshoot.

2.5 SHORT TERM STORAGE

The following procedure is recommended for short term storage of PPC3:

❶ Vent the PPC3 test pressure.

❷ Turn the power OFF using the rear panel power switch.

❸ Shut OFF or disconnect the pressure supply.

❹ Shut OFF or disconnect the vacuum supply. Be sure the pressure supply is disconnected or the vacuum pump is bypassed from the PPC3 EXHAUST port before turning OFF the vacuum pump.

3. OPERATION

3.1 USER INTERFACE

PPC3 is designed to offer a practical balance between simple, straight forward operation and the availability of a wide variety of advanced functions with a high level of operator discretion. The local operator interface is through a 2 x 20 display, a function/data keypad, a cursor control pad and direct pressure control keys.

Remote communication is by RS232 (COM1) or IEEE-488. See Section 4 for specific information on remote communication.

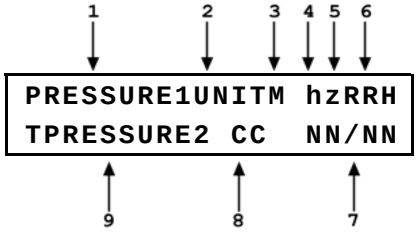
3.1.1 MAIN RUN SCREEN

The PPC3 MAIN RUN screen is its home display that is reached on power-up and from which other functions and menus are accessed. It is the very top level of all menu structures.

The MAIN RUN screen is where the operator works with PPC3 to set and read pressures. It provides complete information on the system's current configuration and operating status.

Figure 3 and its legend table summarize the PPC3 MAIN RUN screen fields and their functions.

PPC3 has a screen saver function which causes the display to dim if no key is pressed for 10 minutes. Pressing a key restores full power to the display. The screen saver time can be changed or screen saving can be completely suppressed (see Section 3.5.5.1).

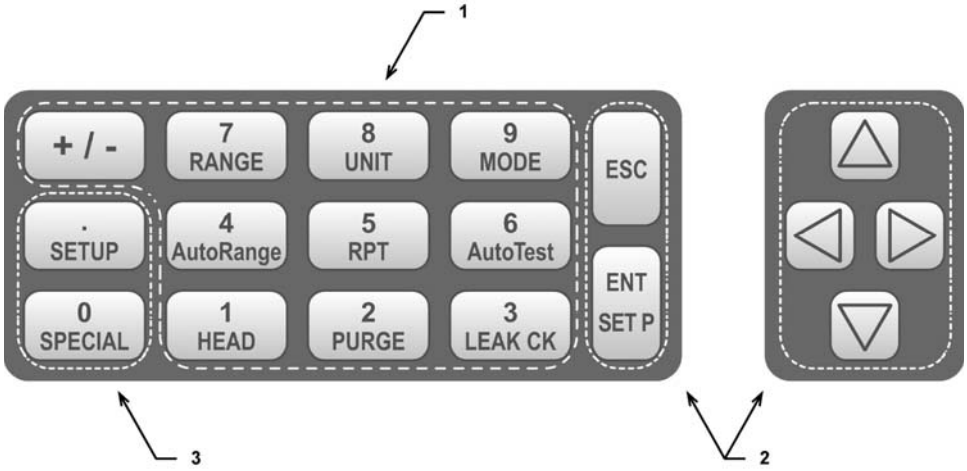


DISPLAY FIELD	NAME	PURPOSE	CONTENTS	SECTION
1. PRESSURE1	Measured pressure	Displays pressure measured by active Q-RPT	Numerical pressure value and sign	1.2.2.1 1.2.2.2 3.3.10
2. UNIT	Unit of measure	Identifies pressure unit of measure in which PRESSURE1 and PRESSURE2 are displayed	Pressure unit of measure abbreviation	3.3.2
3. M	Measurement mode	Identifies measurement mode of displayed pressure	**<a>**: absolute **<g>**: gauge or negative gauge	3.3.3
4. h	Head pressure indicator	Indicates whether a fluid head correction is applied to PRESSURE1	**<h>**: the fluid head is not zero **<blank>**: fluid head is zero	3.3.7
5. z	AutoZero indicator	Indicates whether the AutoZero function is ON or OFF	**<z>**: AutoZ is ON **<blank>**: AutoZ is OFF	3.5.1
6. RRH	Active Q-RPT position indicator	Indicates the position of the active utility sensor or Q-RPT in the PPC3 system	**<IH>**: Internal Hi **<IuH>**: Internal Hi (utility sensor) **<X1H>**: External 1 Hi **<X1L>**: External 1 Lo **<X2H>**: External 2 Hi **<X2L>**: External 2 Lo	3.2.4
7. NN/NN	Sequence progress indicator	Indicates progress of an ATest sequence, during test execution	**<NN/NN>**: Number of this point over total number of points in the sequence	3.3.6
8. CC	Pressure control indicator	Indicates type of pressure control, whether control is currently active and whether custom control limits are in use	**<D>**: Control mode is dynamic **<S>**: Control mode is static **<C> i**s appended to the **<D>** or **<S>** if control limits are custom Control character(s) flash if PPC3 is actively controlling	3.2.1 3.4.6
9. TPRESSURE2	Pressure information indicatior	Pressure indication depending on current PPC3 function. Leading character identifies the value.	**<R>**: Pressure rate of change in current pressure unit/second **<T>**: Pressure control target **<D>**: Deviation from the pressure control target	3.3.10

Figure 3. MAIN RUN Screen Display Fields

3.1.2 FUNCTION / DATA KEYPAD LAYOUT AND PROTOCOL

The PPC3 has a function/data keypad for local operator access to direct functions, function menus and for data entry.



1. The **Function/Data keys** allow very commonly used functions to be accessed directly by a single keystroke when pressed from the MAIN RUN screen (see Section 3.2.7). The name of the function is on the bottom half of the key. These keys enter numerical values when editing.
2. The **Editing and Execution keys** are for starting and suspending command execution, cursor control in menus and editing entries.
3. The **Menu/Data keys** provide access to function menus when pressed from the MAIN RUN screen. The menu name is on the bottom half of the key. The SETUP menu is for more frequently used functions (see Section 3.4). The SPECIAL menu is for functions that are not generally used as a part of day to day operation (see Section 3.5). These keys enter numerical values when editing.

Figure 4. Keypad Layout

Pressing the **[ENT/SET P]** key generally causes execution or forward movement in the menu tree. Pressing **[ENT/SET P]** from the MAIN RUN screen allows an automated pressure control command to be given.

Pressing the **[ESC]** key moves back in the menu tree and/or causes execution to cease or suspend. Pressing **[ESC]** repeatedly eventually returns to the MAIN RUN screen and, from there, allows momentary viewing of the PPC3 introduction screen.

Pressing the **[+/-]** key changes a numerical sign when editing. It also toggles through multiple screens when available and is a shortcut to a momentary display of the active RANGE from the MAIN RUN screen.

Pressing the **[△]**, **[▽]**, **[◁]** and **[▷]** keys allows reverse, forward and up, down cursor movement when editing data entry or moving in menus.

Some screens go beyond the two lines provided by the display. This is indicated by a flashing down arrow in the second line of the display. Press the cursor control keys to move the cursor to access the lines that are not visible or directly enter the number of the hidden menu choice if you know it.

3.1.3 DIRECT PRESSURE CONTROL KEYS

Figure 5. Direct Pressure Control Keys

The direct pressure control keys provide direct manual control of pressure increase, decrease, jog and vent. They can be useful in adjusting pressure when automated pressure control to a target value is not needed. The jog keys are also used to adjust the target pressure during active pressure control.

The **[△]** and **[▽]** direct pressure control keys interrupt and override automated pressure control.

Pressing the **[VENT]** key causes PPC3 to control pressure to near atmospheric pressure and then open the system vent valve (see Figures 12 and 13). On-going execution of the vent function is indicated by lighting a RED LED just above the **[VENT]** key. Completion of the vent process is indicated by the *Ready/Not Ready* indicator light becoming GREEN with the vent RED LED still lighted. The vent valve remains open until the **[VENT]** key is pressed again, another direct pressure control key is pressed, or an automated pressure control command is given.

Pressing the **[△]** and **[▽]** direct pressure control keys causes pressure to increase or decrease at the slow slew rate. Holding the **[FAST]** key pressed while pressing the **[△]** or **[▽]** key causes the pressure increase or decrease speed to change from slow to fast.

Pressing the **[△]** and **[▽]** direct pressure control keys causes the pressure to jog or step by a fixed amount. During active pressure control, they cause the target pressure to be changed by the fixed amount. One press causes one step. The approximate value of the step is set automatically depending on the current active PPC3 range. The value can be adjusted using **[SETUP]**, **<3jog>** or pressing both the up and down jog keys simultaneously (see Section 3.4.3).

Pressing the up and down pressure jog keys ([△] and [▽]) simultaneously is a shortcut to the jog step size adjustment menu.

3.1.4 REMOTE [ENT/SET P] FOOTSWITCH

The optional remote ENTER function is a switch that duplicates the function of the front panel **[ENT]** key. The remote ENTER function is serviced by a connector on the PPC3 rear panel labeled **REMOTE ENTER**. An optional footswitch is available to activate remote entry hands free or a user supplied switch may be used. See Section 7.3 for information on remote ENTER switch wiring.

The remote ENTER feature can be particularly convenient when running AutoTests (see Section 3.3.6) in which using a footswitch to **[ENT]** allows hands free operation.

3.1.5 SOUNDS

PPC3 is equipped with a variable frequency tone device to provide audible feedback and alarms. The beeper is used for the following indications.

Valid key press	Brief beep. Choice between three frequencies or NO sound is available (see Section 3.5.5.2).
Invalid key press	Descending two tone “blurp”.
Leak check completed	Three two second beeps (see Section 3.3.9).
Upper or lower limit exceeded	Intermittent one second beeps (see Section 3.4.4)
External device not connected	Eight second high frequency beep (see Section 2.3.7)
Pmax! (overpressure limit) exceeded	Eight second high frequency beep (see Section 3.4.4.1).
AutoTest reading in tolerance/out of tolerance reading	Ascending triad/descending triad (see Section 3.3.10).

3.2 GENERAL OPERATING PRINCIPLES

3.2.1 AUTOMATED PRESSURE CONTROL

PPC3 automated pressure control provides automated adjustment and control of pressure to a user designated target value. Pressing **[ENT/SET P]** from the MAIN RUN screen allows a pressure control target value to be entered and executed. Pressing **[ESC]**, a direct pressure control key or a function key causes active pressure control to be interrupted. Sending a remote command when in local mode also interrupts pressure control.

PPC3 supports two pressure control modes to meet different pressure setting and controlling requirements: dynamic and static. Pressure control parameters for each control mode are automatically set to optimal default values for the operating PPC3 range when the range is selected or AutoRange is used (see Section 3.3.4). Control parameters can be customized using the **[SETUP]**, **<6control>** function (see Section 3.4.6).

Control parameters:

Target Value	The pressure setpoint specified by the operator.
Hold Limit	A symmetrical positive and negative limit around the target value within which the controlled pressure is maintained.
Stability Limit	A rate of change of pressure limit in units of pressure/second used as a criterion for the *Ready/Not Ready* condition in static control or when PPC3 is idle (control not active).

See this section, Dynamic Control and Static Control for a detailed explanation of each control mode and its advantages, the default control parameters and the control customization options.

Dynamic Control

Dynamic control mode is designed to set the pressure to the target value and control continuously to keep pressure within the hold limit and as close to the target value as possible (see Figure 6). The advantage of this control mode is that the final pressure achieved is the same as the target value. The maximum value of the control error is equal to the hold limit. The average value of the control error is generally much smaller than the hold limit.

During dynamic pressure control, the hold limit is active. If the pressure goes outside of the hold limit, a *Not Ready* condition occurs. See Tables 6 and 7 for default hold limit values and Section 3.3.6 to customize the hold limit.

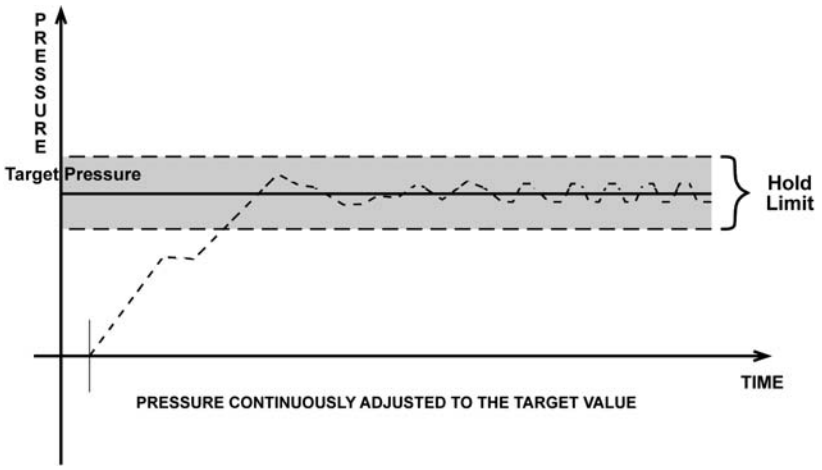


Figure 6. Dynamic Pressure Control Operation

Static Control

Static control mode is designed to set the pressure near the target value and then interrupt active control to allow pressure to stabilize naturally within the hold limit. The advantage of this control mode is that pressure can be set and/or measured within a defined limit of a target without interference from the pressure control system. In a system without excessive leaks, the pressure stability achieved may be greater than the stability with which the pressure control system can actively control pressure. Using static control to control pressure near the desired set point and then measuring back the stabilized pressure without interference of the control function can allow control errors to be completely eliminated. However, the final pressure achieved is not equal to the target value.

During static pressure control, the hold limit is active. If the pressure goes outside of the hold limit, a *Not Ready* condition occurs (see Section 3.2.2) and pressure is readjusted to the target value (see Tables 6 and 7 and Section 3.3.6 for setting the hold and stability limits to user defined values).

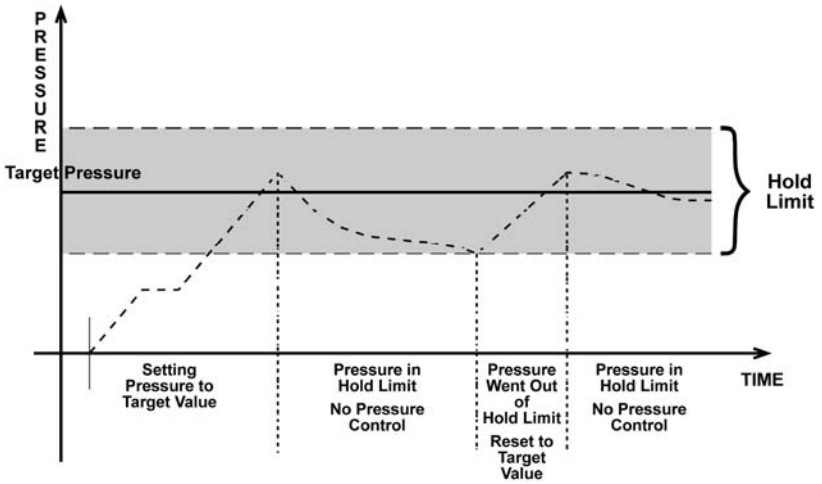


Figure 7. Static Pressure Control Operation

3.2.2 PRESSURE READY/NOT READY

There is a *Ready/Not Ready* indication LED on the PPC3 front panel. This indication is intended to provide the user with a clear and objective criterion for determining when a valid pressure measurement can be made.

The *Ready/Not Ready* LED indications are:

<Green, no flash> *Pressure* ***Ready***, control idle. PPC3 is NOT actively controlling the pressure. This indicates no control is occurring and the pressure stability is within the stability limit.

<Green, slow flash> *Pressure* ***Ready***, control active. PPC3 is actively controlling the pressure and the criteria for a *Ready* condition to occur have been met.

<Red > *Pressure* ***Not Ready***. Either PPC3 is idle and pressure does not meet the stability test or PPC3 is actively controlling the pressure and ***Ready*** conditions have not yet been met. The control characters in the middle of the second line of the display flash if control is active.

When pressure control is NOT active: A ***Ready*** condition occurs any time NO control valve is operating and the pressure rate of change is inside the stability limit. The stability limit is defined in terms of rate of change of pressure in current pressure units per second.

When pressure control is active: The criteria for determining the ***Ready/Not Ready*** condition depend on whether the current control mode is static or dynamic. Pressure ***Ready/Not Ready*** parameters are set by default when AutoRange is used, or a control mode is selected. The parameters can be customized if desired (see Section 3.4.6).

Dynamic Control Ready/Not Ready

With dynamic pressure control active, a ***Ready*** condition occurs whenever:

- The current measured pressure is inside the hold limit.

In dynamic control mode, normal procedure is to assume that when a Ready condition occurs (pressure inside the control hold limit), the measured pressure equals the target pressure. For this reason, when the pressure is Ready in dynamic control mode, the measured pressure display is equal to the target pressure.

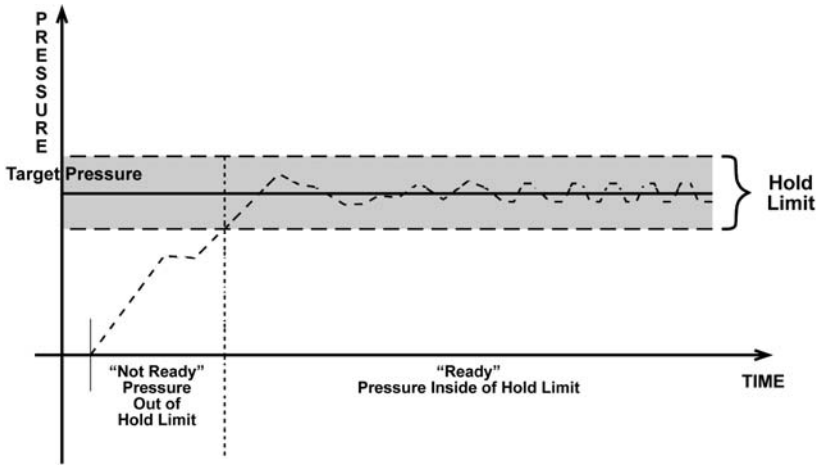


Figure 8. *Ready/Not Ready* in Dynamic Pressure Control Mode

Static Control Ready/Not Ready

With static pressure control active a *Ready* condition occurs whenever:

- NO control valve is operating.
- The current measured pressure is at the target value within the hold limit.
- The rate of change of pressure is less than the current stability limit.

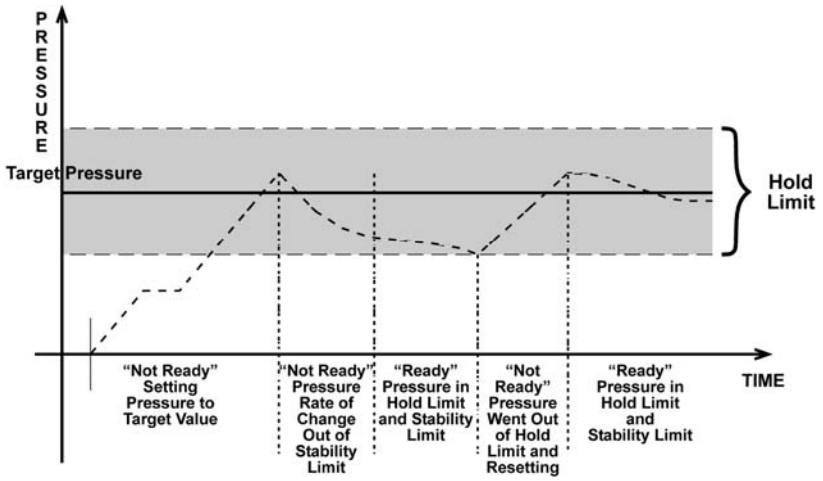


Figure 9. *Ready/Not Ready* in Static Control Mode

Ready/Not Ready When Not Actively Controlling

When NO automated pressure control is active, *Ready* is indicated whenever the rate of change of pressure is less than the current stability limit (see Section 3.4.6.1).

3.2.3 GAUGE AND NEGATIVE GAUGE MODES WITH AN AXXX (ABSOLUTE) Q-RPT, DYNAMIC COMPENSATION FOR ATMOSPHERIC PRESSURE

Q-RPTs with the designation Axxx are intrinsically absolute but they are also used in gauge and negative gauge measurement modes (difference from atmosphere) (see Section 3.3.3, ❍ PRINCIPLE). Gauge measurement mode is achieved by subtracting the value of atmospheric pressure, $\mathbf{P_{offset,G}}$, from the Q-RPT's absolute reading using AutoZ (see Section 3.5.1). In gauge or negative gauge measurement mode, the AutoZ routine that measures $\mathbf{P_{offset,G}}$, is run automatically whenever the PPC3 is in the vented condition. This assures the continuous automated updating of the $\mathbf{P_{offset,G}}$ value corresponding to atmospheric pressure. Gauge pressure is the measured absolute pressure, $\mathbf{P_u}$, minus the atmospheric offset.

$$\mathbf{P_{gauge} = P_u - P_{offset,G}}$$

However, atmospheric pressure can change between opportunities to run AutoZ and update the value of $\mathbf{P_{offset,G}}$, for example when running an extended test without venting. PPC3 uses ***dynamic compensation for atmospheric pressure*** to correct for these changes in atmospheric pressure. When AutoZ executes, and $\mathbf{P_{offset,G}}$ is determined, the reading of PPC3's on board barometer, $\mathbf{P_{atm,0}}$, is also recorded. Later, when no longer vented, the change in atmospheric pressure, $\mathbf{\Delta P_{atm}}$, since $\mathbf{P_{offset,G}}$ was updated, is the difference between the current barometer reading, $\mathbf{P_{atm}}$, and the barometer reading at the time of AutoZ execution, $\mathbf{P_{atm,0}}$:

$$\mathbf{\Delta P_{atm} = P_{atm} - P_{atm,0}}$$

Dynamic compensation for atmospheric pressure uses ΔP_{atm} to correct the value of $P_{offset,G}$, thus always compensating real time for changes in atmospheric pressure:

$$P_{gauge} = P_u - P_{offset,G} - \Delta P_{atm}$$

Gauge pressure measurement on an Axxx (absolute) Q-RPT allows instantaneous switching between gauge and absolute measurements modes. Any additional uncertainty in gauge pressure mode due to the dynamic compensation for atmospheric pressure technique is a function of the resolution and short term stability of the on-board barometer, not its absolute measurement uncertainty. This additional uncertainty is ± 1 Pa (0.00015 psi).

3.2.4 MULTIPLE INTERNAL AND EXTERNAL Q-RPTS

A base PPC3 pressure controller includes a high precision, utility pressure sensor whose range is equal to the controller's range. The utility sensor is not intended to serve as a pressure reference for low uncertainty measurement. It is for indication, pressure control, system safety and maintenance functions only.

To obtain low uncertainty, traceable pressure measurement, PPC3 uses Quartz Reference Pressure Transducers (Q-RPT). Up to six Q-RPTs can be included in a PPC3 pressure controller/calibrator system. One or two Q-RPTs can be built into the PPC3, up to four may be located outside the PPC3 enclosure, in RPM4 reference pressure monitors (one or two per RPM4). Once the Q-RPTs available to a PPC3 system have been set up and identified, their use is managed by PPC3 transparently to the operator.

The use of multiple Q-RPTs, combined with PPC3's infinite ranging capability and AutoRange feature (see Section 3.3.4), make it possible for a single PPC3 pressure controller/calibrator system to cover an extremely wide range of test ranges and measurement modes with low uncertainty in each range.

Communication between RPM4s and a PPC3 controller is by daisy chained RS232 connections from PPC3's COM2 port. One common pressure connection can be made between the PPC3 and RPM4 pressure ports (see Section 2.3.7 for information on setting up a PPC3 with external RPM4s). RPM4 Q-RPT modules' SDS function protects RPM4 Q-RPTs from overpressure when they are not in use.

The PPC3 RPT function (see Section 3.3.5) is used to identify Q-RPTs available to the PPC3. The PPC3 then manages the internal and external Q-RPTs transparently to the operator, selecting the appropriate Q-RPT for the range of operation and operating valves to connect and disconnect them as needed.

Each Q-RPT has a default range, which is its maximum range. It can also be downranged using PPC3's AutoRange function.

The PPC3 internal pneumatic layout for handling its utility sensor and one or two Q-RPTs depends on the number of Q-RPTs and their type (Axxx absolute, Gxxx gauge, BGxxx bi-directional gauge). Figure 13 provides pneumatic schematics of the different PPC3 internal utility sensor and Q-RPT configurations with a chart of valve status for various operating conditions.

Before operating PPC3 with external Q-RPTs, check carefully that the RPM4's Q-RPT TEST(+) port(s) is/are connected to the PPC3 TEST(+) port. If an external Q-RPT is NOT connected to the PPC3 TEST(+) port, it will NOT measure the pressure generated by PPC3 and PPC3 may reach a pressure higher than the target pressure before its watchdog function recognizes that the external Q-RPT is not connected (see Section 3.4.4.1). The PPC3 watchdog function monitors differences in the change in pressure indicated by an active, external Q-RPT and the PPC3 Hi utility sensor or Q-RPT (watchdog). If the difference becomes excessive, control is aborted, an audible warning sounds and a warning is displayed. If this occurs, make sure the PPC3 and RPM4 Q-RPT TEST(+) ports are connected together and try again.

Position Identification of Q-RPTs In a PPC3 System

Position identification of the currently active Q-RPT or utility sensor in the PPC3 system is continuously displayed in the upper right hand corner of the PPC3's MAIN RUN screen and most other screens. See Table 3 for position designation protocol for the Q-RPTs available in a PPC3 system.

See Table 1 for a complete listing of Q-RPTs available and their default ranges.

Table 3. Position Designators of Q-RPTs in a PPC3 System

Q-RPT POSITION	IDENTIFICATION	DISPLAY SYMBOL*
Internal to PPC3, utility sensor, if present	Internal Utility, Hi	IuH
Internal to PPC3, Q-RPT of maximum range	Internal, Hi	IH
Internal to PPC3, Q-RPT with lower maximum range in PPC3 with two Q-RPTs or a utility sensor and Q-RPT.	Internal, Lo	IL
External to PPC3, Q-RPT of higher maximum range in 1st RPM4 on PPC3/RPM4 communications daisy chain	External 1, Hi	X1H
External to PPC3, Q-RPT with lower maximum range in dual Q-RPT RPM4 that is the 1st RPM4 on the PPC3/RPM4 communications daisy chain	External 1, Lo	X1L
External to PPC3, Q-RPT of higher maximum range in 2nd RPM4 on PPC3/RPM4 communications daisy chain	External 2, Hi	X2H
External to PPC3, Q-RPT with lower maximum range in dual Q-RPT RPM4 that is the 2nd RPM4 on the PC3/RPM4 communications daisy chain	External 2, Lo	X2L

* The display symbol is included in the upper, right hand corner of most PPC3 displays and menus as a convenient indicator of the active Q-RPT.

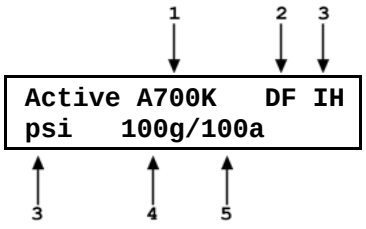
3.2.5 MULTIPE RANGES (Q-RPTS, AUTORANGE AND INFINITE RANGING)

A PPC3 range is defined as a pressure span and associated settings.

A PPC3 may have multiple ranges. Each Q-RPT (and the utility sensor, if present) available to the PPC3 system has a default range which is its maximum span. Additional ranges, lower than the Q-RPT's maximum span, may be created using AutoRange (see Section 3.3.4). Ranges created using AutoRange may be saved with all their settings for reactivation later (see Section 3.5.1).

A PPC3 range is identified by a range screen showing the Q-RPT used by the range, its current unit of measure and its full scale pressure in gauge and absolute (if available) measurement modes.

1. Q-RPT or utility sensor designator.
2. Type of range. DF for the Q-RPT's default range; AR for a range created by AutoRange.
3. Q-RPT or utility sensor position designator.
4. Current pressure unit of measure.
5. Full scale pressure in current unit of measure in gauge and/or absolute measurement mode depending on type of Q-RPT and the measurement modes available.



Most settings made in a PPC3 range, such as unit of measure, measurement mode, display resolution, control mode and control parameters are specific to the range. Many settings made while a range is active apply to that range and not other ranges. The range specific

settings are stored with the range and recalled whenever the range is made active. This makes setting up and saving ranges a convenient way to store and recall frequently used operating configurations. See Table 4 for a listing of PPC3 adjustments and settings and whether they are range, Q-RPT or system specific.

The ranges available on a PPC3 system are accessed using **[RANGE]** (see Section 3.3.1) and/or created using **[AutoRange]** (see Section 3.3.4). External Q-RPTs connected to the PPC3 (see Section 3.2.4) are initialized using **[RPT]** (see Section 3.3.5).

Table 4. Settings and What They Are Specific To (Range, Measurement Mode, Q-RPT, System)

SETTING	PURPOSE	SPECIFIC TO	SECTION
Unit	Set pressure unit of measure	Range	3.3.2
Mode	Set pressure measurement mode (absolute, gauge, negative gauge)	Range	3.3.3
Resolution	Set pressure display resolution	Range	3.4.2
Jog	Set jog step size	Range	3.4.3
Control	Set pressure control mode and parameters	Range	3.4.6
Upper Limit	Set upper and lower pressure limit alarm	Range and measurement mode	3.4.4
AutoZ	Run AutoZ, ON/OFF, set and view value	Range and measurement mode	3.5.1
Screen Saver, Sound, Time, ID, Level	Set system user preferences	System	3.5.5
Head	Set fluid head correction height, fluid, unit of measure	System	3.3.7 3.5.3
Control reference	Set EXHAUST port pressure condition	System	3.5.7.2
Purge	Enable/disable purge function	System	3.5.7.4
Valve Drivers	Set status of external valve drivers	System	3.4.7
Lo vnt	Set status of **TEST(-)** vent valve, if present	System	3.5.7.5
Cal	Various Q-RPT and utility sensor calibration functions	Q-RPT, utility sensor or barometer	3.5.8

3.2.6 OPERATION WITH A PG7000 PISTON GAUGE

PPC3 can act as a pressure control source to automated setting pressure and floating the piston of a PG7000 gas operated piston gauge.

For automated operation, the PPC3 communicates with the PG7000 through an RS232 connection from the PG7000 COM3 port to the PPC3 COM1 port. Pressure control commands are sent from the PG7000 when it is in “AutoGen” mode (see the PG7000 Operation and Maintenance Manual).

The PPC3 may also be operated manually using its direct pressure control keys (see Section 3.1.3).

3.2.7 DIRECT FUNCTION KEYS SUMMARY

Local operation of PPC3 is through the front panel keypad. To minimize menu layers, the keypad numerical keys also provide direct access to the most commonly used functions. The function accessed is labeled on the bottom half of the key. Direct function keys are active

whenever PPC3 is in its MAIN RUN screen. Table 5 summarizes the operation of the direct function keys and Sections 3.3.1 through 3.3.10 detail their operation.

Table 5 provides a brief summary of direct function key operation. It may be useful to keep a copy of this summary near the PPC3, especially when first becoming acquainted with its operation.

Table 5. Summary of PPC3 Function Key Operation

DIRECT FUNCTION KEYS ARE ACTIVE FROM THE MAIN RUN SCREEN See corresponding manual Sections 3.3.1 through 3.3.10 for full detail.			
1 HEAD	Adjust DUT fluid head calculation height. Set to zero to defeat correction.	7 RANGE	View active range and toggle through available ranges. **[ENT]** on a range activates it.
2 PURGE	Run automated DUT purge routine using SPLT accessory.	8 UNIT	Select pressure unit of measure for the active range. Choice of units available in this menu can be customized.
3 LEAK CK	Run an automated leak check at the current pressure.	9 MODE	Select the pressure measurement mode for the active range (absolute, gauge or negative gauge).
4 AutoRange	Set up and optimize all aspects of PPC3 measurement, control and displays for a specific operating range and measurement mode.	0 SPECIAL	Menu of less commonly used internal functions and settings.
5 RPT	Search for and initialize internal and external Q-RPTs available to the PPC3 system.	. SETUP	Menu of commonly used setup features including save/delete AutoRange ranges, display resolution setting, jog step adjustment, upper/lower limit setting, AutoTest data viewing, pressure control mode selection and limits adjustment, external 12V driver actuation
6 AutoTest	Set up and run automated test sequences.	ENT SET P	Input a pressure control set point command from the run screen. ENTER values when editing.

3.3 DIRECT FUNCTION KEYS

3.3.1 [RANGE]

❍ PURPOSE

To view and/or change the active pressure measurement range and associated settings.

[RANGE] selects from existing ranges. See [AutoRange] to create ranges (see Section 3.3.4).

❍ PRINCIPLE

A PPC3 range is defined as a pressure span and associated settings (see Section 3.2.5).

A PPC3 may have multiple ranges. Each Q-RPT (and the utility sensor if present) available to the PPC3 system has a default range which is its maximum full scale. Additional ranges, lower than the Q-RPT's full scale, may also be created using AutoRange (see Section 3.3.4).

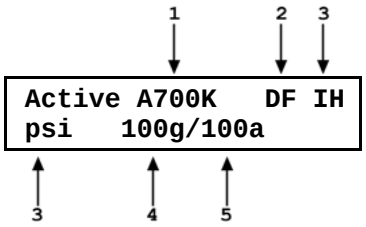
Ranges created using AutoRange may be saved with all their settings for reactivation (see Section 3.4.1).

The **[RANGE]** function key allows the available PPC3 pressure ranges to be viewed and selected, including automated switching of both internal and external Q-RPTs when necessary.

❍ OPERATION

Pressing the **[RANGE]** function key activates the range viewing and selecting function. When the **[RANGE]** function key is first pressed, the range identification screen for the active range is displayed. For example:

1. Q-RPT or utility sensor designator.
2. Type of range. DF for the Q-RPT's default range; AR for a range created by AutoRange.
3. Q-RPT or utility sensor position designator.
4. Current pressure unit of measure.
5. Full scale pressure in current unit of measure in gauge and/or absolute measurement mode depending on type of Q-RPT and range.



Pressing the **[+/-]** key or the **[RANGE]** key again while in the RANGE functions toggles through displays of the other available ranges, from lowest range to highest range.

To select a range to become the active range, press **[ENT]** while the desired range is displayed. PPC3 must be vented for the range change to occur. Press **[VENT]** if necessary to complete the range change.

When selecting a range, if the range's Q-RPT is an external Q-RPT and the PPC3 cannot communicate with it, PPC3 displays **<Cannot find range's external Q-RPT (Xn)>**. Use **[ENT]** or **[ESC]** to return to the range selection screen. For information on setting up and communicating with external Q-RPTs see Section 2.3.7.

Pressing **[ESC]** while in the RANGE function returns to the MAIN RUN screen with no range change having been made.

Range full scale limits are given in the pressure unit that is currently active for that range (see Section 3.3.1). Change the active unit to display the range limits in a different unit.

Pressing [+/-] from the MAIN RUN screen provides a shortcut to a momentary view of the range identification screen for the active range.

PPC3 saved AutoRange ranges that use Q-RPTs in external RPM4s are available for selection from the [RANGE] key. AutoRange ranges saved locally on the RPM4, are not available on the PPC3 [RANGE] key.

Many PPC3 settings and functions are range specific. See Table 4 for identification of range specific settings.

To protect against overpressure situations and for maximum measurement performance, the active range can only be changed when the system is vented. If [ENT] is pressed while in the RANGE function when PPC3 is NOT vented, the display indicates <Vent system fully to change range>. Pressing the [VENT] key will cause PPC3 to vent and complete the range change.

Before operating PPC3 with external Q-RPTs, check carefully that the external Q-RPT TEST(+) port is connected to the PPC3 TEST(+) port. If the external Q-RPT is NOT connected to the PPC3 TEST(+) port, it will not measure the pressure generated by PPC3 and PPC3 may reach a pressure higher than the target pressure before its watchdog function recognizes that the external Q-RPT is not connected.

3.3.2 [UNIT]

❍ PURPOSE

To select the unit of pressure in which PPC3 displays pressure values.

For information on selecting the measurement mode (absolute, gauge, negative gauge), see Section 3.3.3.

❍ PRINCIPLE

PPC3 allows the unit of measure in which pressure values are displayed to be changed.

PPC3 supports 15 different pressure units of measure as well as user defined units. To simplify operation, quick access to six unit choices is made available under the **[UNIT]** key. The default units available depend on whether the PPC3 was originally configured as an SI or US version. The **[UNIT]** key contents can be customized by the user to any configuration of six units (see Section 3.5.6).

Internally, PPC3 always operates in Pascal (Pa), the SI unit of pressure. Values of pressure are represented in other units by the application of conversion factors to convert from Pa (see Section 7.2.1).

❍ OPERATION

To change the pressure unit of measure for the active range, press **[UNIT]** from the MAIN RUN screen while the range is active. The display is:

```
1kPa 2Pa 3MPa
4hPa 5bar 6mbar
```

The cursor is on the number corresponding to the pressure unit of measure active for the current range.

To change the pressure unit of measure, select the desired unit. Making the selection returns to the MAIN RUN screen with the selected unit active.

The pressure measurement unit selected is range specific. When in a given range, all functions and settings are represented in the current measurement unit for that range. However, certain internal and/or metrological functions (e.g., Q-RPT calibration coefficients) are always represented in Pa regardless of the active range unit of measure. In addition, when the active unit is an altitude unit, the range and upper limit indications are in kPa if the unit is meters (m) and psi if the unit is feet (ft).

See Section 7.2.1 for tables of the conversion factors used by PPC3.

If the pressure unit selected is inWa (inches of water), the reference temperature for water density must we specified in a separate menu (choices are 4 °C, 20 °C 60 °F). No reference temperature selection is necessary for the unit mmWa as the only reference temperature commonly used for mmWa is 4 °C.

The default pressure units of measure available under the UNIT function depend on whether the PPC3 has been set up as an SI or US version (indicated by SI or US at bottom right of introduction screen). The choice of six units available under the UNIT function can be customized from a wider selection by the user (see Section 3.5.6). The units available under the UNIT function can be reset to default by reset (see Section 3.5.4.2).

3.3.3 [MODE]

❍ PURPOSE

To set the measurement mode (absolute, gauge or negative gauge) for the active range.

For information on selecting the unit of measure, see Section 3.3.2.

❍ PRINCIPLE

PPC3 supports simple, one-step switching between up to three different measurement modes:

Absolute Measures pressure relative to vacuum (zero is hard vacuum). Range is from zero absolute to full scale.

Gauge Measures pressure relative to atmosphere (zero is ambient pressure). Range is from zero gauge to full scale, full scale must be greater than zero.

Negative gauge Measures pressure relative to atmosphere (zero is ambient pressure). Range is negative and positive from zero, negative to minus one atmosphere and positive to full scale. With a BGxxx RPT, negative range is the negative equivalent of the positive range.

Which measurement modes are available depends on the type(s) of Q-RPT available. There are three Q-RPT types:

Axxx Q-RPTs with designators starting with “A” measure pressure relative to a sealed vacuum reference and are intrinsically absolute. Axxx Q-RPTs support measurement in absolute, gauge and negative gauge modes. Gauge and negative gauge modes are accomplished by PPC3’s automated offsetting of atmospheric pressure and dynamic compensation for atmospheric pressure changes between offsets using an on-board barometer (see Section 3.2.3). Access to absolute and negative gauge operation can be turned OFF if these modes are not used (see Section 5.2.5).

Gxxx Q-RPTs with designators starting with “G” measure positive pressure relative to the **TEST(-)** port that is connected to atmosphere. Gxxx Q-RPTs support measurement in gauge mode only.

BGxxx Q-RPTs with designators starting with “BG” measure positive and negative pressure relative to the **TEST(-)** port that is connected to atmosphere. BGxxx Q-RPTs support measurement in gauge and negative gauge modes.

When changing measurement modes for a range, if the full scale of the range is 700 kPa (100 psi) or greater, the full scale is the same in both absolute and gauge modes. If the full scale is less than 700 kPa (100 psi), the gauge mode full scale is 100 kPa (14.5 psi) lower than the absolute mode full scale. If the absolute mode full scale is less than 100 kPa (14.5 psi), there is no gauge mode available. Gauge and negative gauge mode, when available, always have the same full scale.

❍ OPERATION

To change the active measurement mode for a range, press **[MODE]** from the MAIN RUN screen while the range is active. The display depends upon the Q-RPT or utility sensor that is active.

```
Measurement mode:
1abs 2gage 3neg gage
```

If an Axxx Q-RPT or a utility sensor is active, all thee measurement modes are supported: absolute, gauge and negative gauge. Only gauge is available if absolute and negative gauge modes are OFF (see Section 5.2.5).

If a Gxxx Q-RPT is active, only gauge measurement mode is supported. When the **[MODE]** key is pressed, **<Gauge RPT, gauge mode only>** is displayed.

Certain PPC3 settings, including AutoZ ON/OFF (see Section 3.5.1) are range AND measurement mode specific. See Table 4 for a listing of settings and what they are specific to.

Absolute and negative gauge modes on an Axxx Q-RPT can be turned OFF in the calibration function (see Section 5.2.5). When absolute and negative gauge mode are turned OFF for an Axxx Q-RPT, only gauge mode can be activated. <Gauge mode only, other modes OFF> is displayed when [MODE] is pressed.

3.3.4 [AUTORANGE]

❍ PURPOSE

To automatically set up PPC3 to optimize its measurement and control characteristics and features to cover a specific pressure range.

[AutoRange] creates new ranges. See [Range] to select from existing ranges (see Section 3.3.1).

❍ PRINCIPLE

PPC3 is designed to support the calibration and test of a very wide variety of test ranges in various measurement modes with a single pressure controller system.

The AutoRange function simplifies the task of selecting the Q-RPT best suited to cover a specific test range and setting controller parameters appropriately for the range. These are set automatically based on operator entry of desired measurement mode, pressure unit of measure and range full scale. The selections and settings made by AutoRange are summarized in Table 6.

A range set up using AutoRange and all its range specific settings, may be saved for later recall using **[SETUP]**, **<1range>** (see Section 3.3.1). Saved ranges are available for selection using **[RANGE]** (see Section 3.4.1). If a range created by AutoRange is not saved, it is overwritten by the next AutoRange or erased when another range is selected or PPC3 power is turned OFF.

Use [AutoTest], <1QDUT> to AutoRange PPC3 based on DUT tolerance (see Section 3.3.6.2).

Table 6. Settings Made by AutoRange

SETTING/SELECTION	PURPOSE	SET TO	SECTION
Unit	Set pressure unit of measure	Operator specified during AutoRange	3.3.2
Mode	Set pressure measurement mode (absolute, gauge, negative gauge)	Operator specified during AutoRange	3.3.3
Full scale	Establish span maximum	Operator specified during AutoRange	None
AutoRange span	Basis of span based setting calculations	Absolute mode: Zero absolute to full scale Gauge mode: Zero gauge to full scale Negative gauge mode: Minus atmosphere to full scale (negative equivalent of full scale to on BGxxx Q-RPT).	None
Q-RPT	Select most appropriate Q-RPT to cover range and mode and operate PPC3 and RPM4 internal valving to connect the selected Q-RPT to the **TEST** port(s) and shut off other Q-RPTs in the system	Absolute and negative gauge mode: Axxx Q-PRT with lowest default full scale that is greater than the AutoRange full scale Gauge mode: Q-RPT with lowest span whose full scale is greater than AutoRange full scale, Gxxx over Axxx if spans are equal.	None
Upper limit Lower limit	Set maximum and minimum pressure control target limits	Upper limit: 105 % of operator entered full scale pressure Lower limit: None in absolute mode, zero in gauge mode, minus atmosphere in negative gauge mode, minus equivalent of upper limit in negative gauge mode on a BGxxx Q-RPT.	3.4.4
Resolution	Set pressure display resolution	10 ppm of AutoRange span or 1 ppm of default Q-RPT range, whichever is larger.	3.4.2
Control mode	Select dynamic or static pressure control	Dynamic control	3.2.1
Control parameters	Set dynamic and static control *Ready/Not Ready* control limits	Dynamic control hold limit: ± 50 ppm of AutoRange span, 5 ppm of Q-RPT span or 0.4 ppm of controller full scale, whichever is greater Dynamic and static control stability limit: 50 ppm of AutoRange span or 2 ppm of Q-RPT span per second, whichever is greater Static control hold limit: 1 % of AutoRange span	3.2.1 3.4.6.1
Jog step	Set jog step size	100 ppm of AutoRange span	3.3.3
Q-RPT turn down (Premium class Q-RPTs only)	Turn down Q-RPT characterization to improve measurement uncertainty when span is reduced	See Premium Q-RPT pressure measurement specifications	1.2.2.1

OPERATION

To use the AutoRange function, press **[AutoRange]** and respond to the PPC3's prompts.

❶ **Select AutoRange measurement mode:** The screen is identical in appearance and function to the **[MODE]** screen (see Section 3.3.3). The choice of measurement modes offered reflects all the Q-RPT types available (Axxx, Gxxx, BGxxx) in the PPC3 system, not just the active Q-RPT.

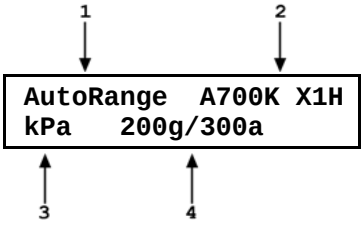
❷ **Select pressure unit of measure:** The screen is identical in appearance and function to the **[UNIT]** screen (see Section 3.3.2).

Altitude units of measure (m, ft) are not available for AutoRange.

❸ **Enter the AutoRange full scale pressure: Enter the full scale pressure value in the <------>** entry field and press **[ENT]**. If the full scale pressure entered cannot be covered by any of the Q-RPTs available, an error message is displayed. If the full scale pressure can be covered by an available Q-RPT, AutoRange proceeds to the range display.

❹ **View proposed AutoRange range:** The proposed AutoRange range screen is:

1. Indication that this is a screen of the proposed AutoRange range.
2. Designator and position of the Q-RPT that AutoRange has selected to cover the AutoRange full scale and measurement mode.
3. Pressure unit of measure specified in AutoRange.
4. AutoRange full scale pressure in gauge mode and absolute mode if available. Shows absolute mode only if AutoRange measurement mode is absolute and full scale is less than 100 kPa (14.5 psi). Gauge mode only if the Q-RPT is a Gxxx, BGxxx or Axxx with absolute OFF.



If an external Q-RPT that should be available is not being selected by AutoRange, use [RPT] to search for Q-RPTs and determine whether external Q-RPTs have been properly connected and initialized (see Section 3.3.5). The PPC3 utility sensor (IuH) cannot be AutoRanged.

❺ **Accept proposed AutoRange:** To accept the proposed AutoRange and go the MAIN RUN screen with the AutoRange range active, press **[ENT]** or **[AutoRange]**. To modify the AutoRange full scale, measurement mode or pressure unit of measure, use **[ESC]** to back up through the AutoRange screens and make changes.

If you would like to use a Q-RPT other than the one selected by AutoRange, use **[RPT]** or the cursor control keys to toggle through the choices available. Only Q-RPTs that can cover the specified full scale and measurement mode are shown. Press **[ENT]** or **[AutoRange]** when the desired Q-RPT is displayed.

The BA100K Q-RPT cannot be AutoRanged.

Before operating PPC3 with external Q-RPTs, check carefully that the Q-RPT TEST(+) port is connected to the PPC3 TEST(+) port. If the external Q-RPT is NOT connected to the PPC3 TEST(+) port, it will not measure the pressure generated by PPC3 and PPC3 may reach a pressure higher than the target pressure before its watchdog function recognizes that the external RPT is not connected.

To verify or confirm the range from the MAIN RUN screen, use [+/-] or [RANGE] to view the active range (see Section 3.3.1).

See Table 6 for a listing of all selections and settings affected by AutoRange and their default values.

3.3.5 [RPT]

❍ PURPOSE

Search for, initialize and display internal and external Q-RPTs available to the PPC3 system.

❍ PRINCIPLE

Up to six Q-RPTs can be included in a PPC3 pressure controller/calibrator system (see Section 3.2.4). PPC3 communicates with external Q-RPTs by RS232 over its COM2 port.

To be available for use by the PPC3 system, external Q-RPTs must be identified and initialized. A Q-RPT search function occurs automatically each time PPC3 power is cycled. Also, pressing **[RPT]** initiates the Q-RPT search and allows the Q-RPTs that are available to PPC3 to be viewed. Use **[RPT]** to keep the PPC3 system configuration current if you connect and disconnect Q-RPTs without turning PPC3 power OFF and ON.

See Section 2.3.7 for information on hooking up external Q-RPTs to a PPC3 system.

Before operating PPC3 with external Q-RPTs, check carefully that the Q-RPT TEST(+) port is connected to the PPC3 TEST(+) port. If the external Q-RPT is NOT connected to the PPC3 TEST(+) port, it will not measure the pressure generated by PPC3 and PPC3 may reach a pressure higher than the target pressure before its watchdog function recognizes that the external RPT is not connected.

❍ OPERATION

To run the Q-RPT and utility sensor search and initialize function, press **[RPT]**. PPC3 displays **<Searching for RPTs…>** while it runs the search function. When the RPT search is complete, the Q-RPTs identification screen is displayed.

1. IH, and L: Identification of RPTs in Internal (PPC3), Hi and Lo positions.
2. X1H and L: Identification of RPTs in External 1 (first RPM4), Hi and Lo positions.
3. X2H and L: Identification of RPTs in External 2 (second RPM4), Hi and Lo positions.

```
 IH:A7Mu     L:none
X1H:A7M      L:A700K
X2H:G200K    L:none
```

The cursor is on the position designator of the active Q-RPT or utility sensor. Use the cursor control keys to move the cursor to other positions and to view the third line if present. Press **[ENT]** to make the selected Q-RPT or utility sensor active in its default range (see Section 3.2.5). Press **[RPT]** again to cause the Q-RPT search to run again. Press **[ESC]** to return to the MAIN RUN screen without making any changes.

See Table 1 for a listing of Q-RPT designators and their corresponding default ranges and Table 3 for information on Q-RPT system position identification designators.

For PPC3 to successfully identify and initialize external RPM4s, the RPM4 COM1 port settings must be:

Baud rate: between 1 200 and 19 200
Parity: Even
Date bits: 7
Stop bits: 1

If PPC3 is not able to establish communications with RPM4s and their Q-RPTs, check that the RPM4 COM1 port setting conform to the requirements above. If the COM1 port settings are correct, check that the correct communications cable is being used (standard pin-to-pin DB-9M to DB-9F RS232) and is connected to the correct communications ports.

PPC3 COM2 > 1st RPM4 COM1; 1st RPM4 COM2 > 2nd RPM4 COM1

See the RPM4 Operation and Maintenance Manual for additional information on RPM4 RS232 communications and COM port settings.

When an RPM4 is initialized as an external device to a PPC3 pressure controller, the RPM4 front panel keypad is locked out and the second line of the display becomes:

<PPC3 EXT DEV: IDLE> (if RPM4 is initialized by PPC3 but not currently in use)
<PPC3 EXT DEV: ACTIVE> (if RPM4 is initialized by PPC3 and is currently in use)

After using an RPM4 as an external device for a PPC3, cycle power to return to the previous RPM4 settings, restore front keypad capability and return to the normal MAIN RUN screen.

Some screens, such as the RPT identification screen, go beyond the two lines provided by the display. Press the cursor control keys to move the cursor to access the lines that are not visible or directly enter the number of the hidden menu choice if you know it. The third line is not included if no 2nd (X2) RPM4 is detected.

3.3.6 [AUTOTEST]

❍ PURPOSE

To execute a programmed sequence of automated pressure control target values and/or to AutoRange the PPC3 based on the full scale and tolerance of the device under test.

❍ PRINCIPLE

The AutoTest function is intended to facilitate the execution of a series of pressure control target values such as is commonly needed when PPC3 is used to run a calibration sequence on a device or system being tested.

There are two types of sequences:

Quick Test — Allows quick definition and execution of a sequence **in the current range and using all of the current settings** (pressure unit of measure, measurement mode, control mode, control settings, display resolution).

Quick DUT Test (QDUT) — **AutoRanges PPC3 based on the full scale and tolerance of a device under test**, prompts the user

through the increments of a calibration sequence and logs calibration data. The first portion of the QDUT function can be used alone to automatically set PPC3 range and operating characteristics appropriately for the device under test. The sequence function assumes that the pressure at each target point will be adjusted so that the device under test reads a cardinal target pressure point. This is particularly useful when calibrating analog gauges.

Test sequences are defined by the minimum pressure, maximum pressure and test increment in % of full scale. For tests, in gauge mode, the minimum pressure is always zero. For test in absolute or negative gauge mode, the minimum pressure may be other than zero and is defined by the user.

❍ OPERATION

To run an AutoTest press **[AutoTest]** from the MAIN RUN screen.

The display is:

```
Run an AutoTest:  IH
1Quick  2QDUT
```

Select the test type desired. See Section 3.3.6.1 for Quick Test or Section 3.3.6.2 for QDUT Test.

3.3.6.1 QUICK AUTOTEST

❍ OPERATION

To run a Quick Test, press **[AutoTest]** and select **<1Quick>**.

The display is:

```
Run current       IH
QuickTest   1yes 2no
```

This selection provides the choice between running the last Quick Test or setting up a new Quick Test definition. Select **<1yes>** to rerun the last Quick Test. Select **<2no>** to define a new Quick Test.

When **<2no>** is selected from the Run current QuickTest menu, the set-up/edit routine is accessed. The first display is:

```
Quick Test FS:    IH
700 kPa g
```

1

1. Entry field for maximum pressure of the Quick Test sequence. Recalls value last entered.

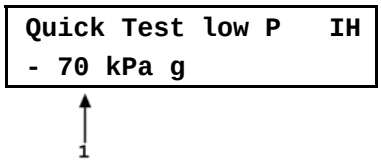
This entry determines the maximum pressure of the Quick Test sequence. Enter the maximum pressure and press **[ENT]**.

Sequence FS must be less than the pressure upper limit of the active pressure range or an error will occur when the test begins to run. To set up and run a sequence including a pressure greater than the current upper limit, increase the upper limit before running the sequence (see Section 3.4.4) or change to a higher range if available (see Section 3.3.1). To AutoRange the PPC3 automatically for a specific sequence based on the characteristics of a DUT, use a QDUT Test (see Section 3.3.6.2).

To set up a test for which all the pressure are negative gauge (gauge pressures less than atmospheric pressure), enter zero (0) as the <Quick Test FS> and the lowest negative gauge pressure as <Quick Test low P>.

If the active measurement mode is absolute or negative gauge (see Section 3.3.3), the lowest pressure must also be defined. The next display is:

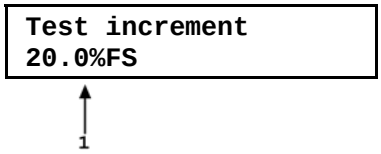
1. Entry field for minimum pressure of the Quick Test sequence. Recalls last value entered.



This entry determines the lowest pressure of the Quick Test sequence for tests in absolute or negative gauge measurement mode. Enter the test lowest pressure point and press **[ENT]**. In negative gauge mode the value must be zero or a negative number.

The display is:

1. Entry field for sequence pressure increment in % of full scale. Recalls last value entered.

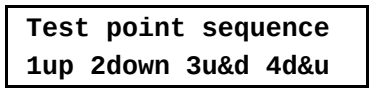


This selection determines the size of the pressure increment in terms of % of the full scale span of the test. The pressure sequence will run in pressure steps of (span x increment %) ending with the uneven increment if applicable.

Enter the desired pressure increment and press **[ENT]**.

Sequences in negative gauge measurement mode are divided into two segments, zero to FS (positive) and zero to low pressure (negative). Each segment is divided into increments using the test increment size. For example, a test with a FS pressure of 50 kPa, a low pressure of –50 kPa and a test increment of 20%, runs in a 0 to 50 kPa segment and a 0 to –50 kPa segment in increments of 10 kPa.

The display is:



This selection determines the order in which the test sequence increments will execute. Selecting **<1up>** causes the sequence to execute starting at the low point and going to the full scale value.

Selecting **<2down>** causes the sequence to run starting at the full scale value and go to the low poihnt.

Selecting **<3u&d>** causes the sequence to run from low point to full scale and back to low point.

Selecting **<3d&u>** causes the sequence to run from full scale to low point and back to full scale.

Sequences in negative gauge measurement mode are divided into two segments, zero to FS (positive) and zero to low pressure (negative). Each segment is divided into increments using the test increment size.

<1up> causes the sequence to run from the low pressure to the FS pressure through zero and <2down> causes the sequence to run from FS to the low pressure through zero.

<3u&d> causes the sequence to run from zero to FS to zero to the low pressure to zero. <4d&u> causes the sequence to run from zero to the low pressure to zero to FS to zero.

After making the increment order selection the display is:

```
Next point on:
1ENTER  2Timer
```

This selection determines how the sequence will proceed from point to point when the test is run.

If **<1ENTER>** is selected, the sequence proceeds to the next target value whenever, and only whenever, **[ENT]** is pressed.

If **<2Timer>** is selected, a timer is started each time a pressure *Ready* condition is achieved (see Section 3.2.2). The sequence continues to the next pressure point without operator intervention once the timer has expired. After selecting **<2Timer>**, an additional screen is presented for entry of the timer value in seconds (minimum 1, maximum 999).

After making the next increment on selection the next display is:

1. Indication of minimum and maximum pressure included in the sequence which is about to run.

```
ENTER to run kPa g
0.000 to 700.000
```

1

This screen is offered for the user to check, prior to execution, that the correct sequence is defined and that it does not exceed the range of the device or system being tested. Pressing **[ESC]** returns to theAutoTest selection screen without sequence execution. Pressing **[ENT]** causes sequence execution to proceed.

Pressure control begins to set the first target value of the sequence (or vent executes if the first increment is zero gauge pressure). The display is the MAIN RUN Screen with indication of the sequence progress:

1. Indication of sequence increment that is currently being executed / total increments in sequence. Changes to ENTER or countdown time remaining once *Ready* condition has been reached at target value.

```
 117.232 kPa g      IH
T 140.000   D     2/11
```

1

Except for the bottom right hand corner, the sequence run display is identical to the normal MAIN RUN screen (see Section 3.1.1). The bottom right corner provides information on sequence execution. This information updates as each sequence increment is executed.

If the sequence was set up with **<Next increment on timed delay>**, execution proceeds automatically each time a *Ready* condition has occurred at the increment and the countdown timer has expired. If the sequence was set up with **<Next increment on ENTER>**. Press **[ENT]** to continue to the next increment.

After the last point of the test sequence has been executed, PPC3 vents and operation returns to the main run screen.

Regardless of whether the sequence was set up for next increment on time delay or on ENTER, pressing [ENT] always causes the sequence to proceed to the next increment. This feature can be used to skip one or several increments if desired.

To interrupt the sequence at any time, press **[ESC]**. Pressure control ceases immediately and the display goes to:

```
Abort Quick AutoTest
1no  2yes
```

Select **<2yes>** to cause the sequence to abort and return to the MAIN RUN screen. Select **<1no>** to cause the sequence to resume where it left off.

All Quick Sequences end with a VENT command after the last point. To avoid the VENT, press [ESC] rather than [ENT] after the last point.

3.3.6.2 QDUT AUTOTEST

❍ **OPERATION**

The QDUT AutoTest AutoRanges the PPC3 (see Section 3.3.4) based on the span and tolerance of a DUT before running a test sequence. QDUT AutoTest also calculates DUT in or out of tolerance conditions and collects data while running the test. See Section 3.4.5 for information on QDUT AutoTest data files.

To run a QDUT Test, press **[AutoTest]** and select **<2QDUT>**.

The display is:

```
Run current QDUT
AutoTest:   1yes 2no
```

This selection provides the choice between running the last QDUT Test, including AutoRanging the PPC3 based on the previously entered DUT characteristics or setting up a new QDUT Test definition. Select **<1yes>** to rerun the last QDUT Test (see below in this Section). Select **<2no>** to define a new QDUT Test.

When **<2no>** is selected from the Run Current QDUT Test menu, the set-up/edit routine is accessed. The information needed to AutoRange PPC3 based on the DUT characteristics is then collected (see Section 3.3.4).

The first display is the selection of the pressure control mode in which the test is to be run (see Section 3.4.6).

```
Control mode:
1dynamic 2static
```

Select the pressure control mode that is to be used by the PPC3 when running the test points..

The next display is the selection of the measurement mode of the DUT (see Section 3.3.3). If only gauge mode is available, this display is skipped.

```
DUT measurement mode
1abs 2gage 3neg gage
```

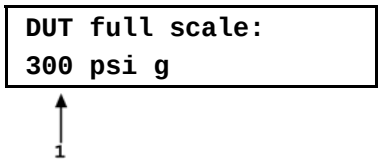
Select the measurement mode of the DUT that is being tested. If the desired measurement mode is not available, the QRPTs available to PPC3 do not support the measurement mode or it is turned off.

The next display is to specify the unit of measure. Select the unit of measure in which the test is to be run. The choice of units available can be customized (see Section 3.5.6).

```
1kPa 2Pa 3MPa
4hPa 5bar 6mbar
```


The next display is to specify the full scale (maximum pressure) of the DUT or test.

1. Entry field for maximum pressure of the QDUT Test sequence.



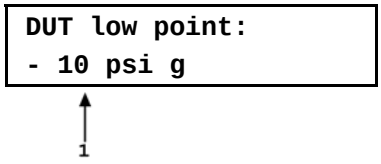
This entry determines the maximum pressure of the QDUT Test sequence. Enter the maximum pressure and press **[ENT]**.

Sequence full scale must be achievable by a QRPT available to PPC3 or an error will occur when PPC3 attempts to AutoRange to the specified full scale. (see Section 3.2.4).

To set up a test for which all the pressure are negative gauge (gauge pressures less than atmospheric pressure), enter zero (0) as the <DUT full scale> and the lowest negative gauge pressure as <DUT low point>.

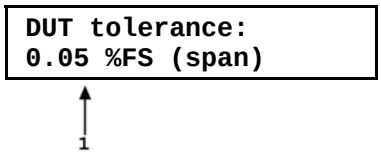
If the measurement mode selected is absolute or negative gauge, the lowest pressure must also be defined. The display is:

1. Entry field for minimum pressure of the QDUT Test sequence. Recalls last value entered.



This entry determines the lowest pressure of the QDUT sequence for tests in absolute or negative gauge measurement mode. In negative gauge measurement mode, the value must be zero or negative. Enter the test lowest pressure point and press **[ENT]**. The display is:

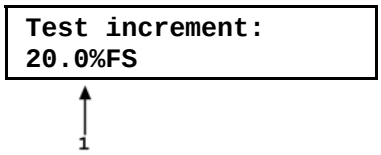
1. Entry field for tolerance of the DUT that is being tested in % of the DUT's span.



This entry determines the in and out of tolerance limits for the DUT when the test is run. It is also used to determine appropriate PPC3 resolution and hold limit settings for the resulting AutoRange range.

Enter the DUT tolerance and press **[ENT]**. The display is:

1. Entry field for sequence pressure increment in % of full scale. Recalls last value entered.



This selection determines the size of the pressure increment for the test in terms of % of the full scale (FS) value entered in the DUT Full Scale screen. The pressure sequence will run in pressure steps of (full scale x increment %) ending with the uneven increment if applicable.

Enter the desired pressure increment and press **[ENT]**.

Sequences in negative gauge measurement mode are divided into two segments, zero to full scale (positive) and zero to low pressure (negative). Each segment is divided into increments using the test increment size. For example, a test with a FS pressure of 50 kPa, a low pressure of –50 kPa and a test increment of 20%, runs in a 0 to 50 kPa segment and a 0 to –50 kPa segment in increments of 10 kPa.

The display is:

```
Test point sequence
1up 2down 3u&d 4d&u
```

This selection determines the order in which the test sequence increments will execute. Selecting **<1up>** causes the sequence to execute starting at low point and going to the full scale value.

Selecting **<2down>** causes the sequence to run starting at the full scale value and going to low point.

Selecting **<3u&d>** causes the sequence to run from low point to full scale and back to low point.

Selecting **<3d&u>** causes the sequence to run from full scale to low point and back to full scale.

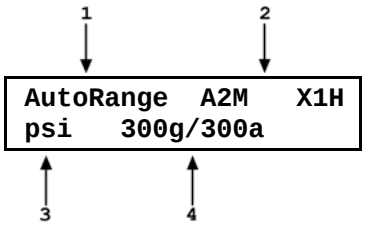
Sequences in negative gauge measurement mode are divided into two segments, zero to full scale (positive) and zero to low point (negative). Each segment is divided into increments using the test increment size.

<1up> causes the sequence to run from the low point to the full scale pressure through zero and <2down> causes the sequence to run from full scale to the low point through zero.

<3u&d> causes the sequence to run from zero to full scale to zero to the low point to zero. <4d&u> causes the sequence to run from zero to the low point to zero to full scale to zero.

The next display is the proposed AutoRange range to run the QDUT test (see Section 3.3.4 for additional information on AutoRange).

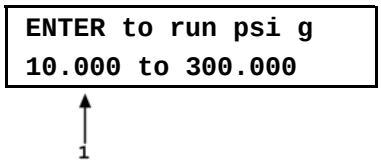
1. Indication that this is a screen of the proposed AutoRange range.
2. Designator and position of the Q-RPT that AutoRange has selected to cover the QDUT full scale and measurement mode.
3. Pressure unit of measure specified in QDUT setup.
4. AutoRange full scale pressure in gauge mode and absolute mode if available. Shows absolute mode only if QDUT measurement mode is absolute and full scale is less than 100 kPa (14.5 psi).



The cursor keys or the **[RPT]** key can be used to toggle through other Q-RPTs available to cover the QDUT specified range and measurement mode. When the desired Q-RPT is displayed, press **[ENT]** to accept the proposed AutoRange.

The QDUT AutoTest can now be run. The display is:

1. Indication of minimum and maximum pressure included in the sequence which is about to run.



This screen is offered for the user to check, prior to execution, that the correct sequence is defined and that it does not exceed the range of the device or system being tested.

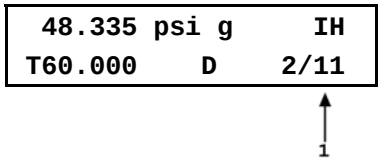
Pressing **[ESC]** twice returns to the MAIN RUN screen without sequence execution (this feature can be used to AutoRange the PPC3 based on DUT characteristics without running a specific test sequence. Pressing **[ENT]** causes sequence execution to proceed.

The display is:

Perform any operations that are needed before running the test such as making connections or exercising the DUT. The PPC3 direct pressure control keys are active to allow pressure adjustment (see Section 3.1.3). When ready to begin the test, press **[ENT]**.

Dynamic pressure control begins to set the first target value of the sequence (or vent executes if the first increment is zero gauge pressure). The display is:

1. Indication of sequence increment that is currently being executed / total increments in sequence. Changes to ENTER once *Ready* condition has been achieved at target value.

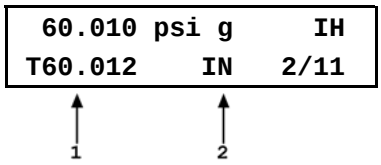


Except for the bottom right hand corner, the sequence run display is identical to the normal MAIN RUN screen (see Section 3.1.1). The bottom right corner provides information on sequence execution. This information updates as each sequence increment is executed.

Once a *Ready* condition has been achieved (see Section 3.2.2), use the direct manual pressure control keys (**[△]** and **[▽]**) to adjust the pressure set by PPC3 until the DUT reads the cardinal value of the pressure increment.

Once the DUT indicates the cardinal value of the pressure increment, press **[ENT]**. The display is:

1. Final target pressure at which DUT indicated cardinal value of the pressure point.
2. **<IN>** or **<OUT>** depending on whether DUT was in or out of tolerance. DUT is <IN> if cardinal point – PPC3 pressure < DUT tolerance * DUT span.



Press **[ENTER]** to accept this test point and proceed to the next test point or **[←]** to repeat the point.

Repeat the set pressure, take reading and accept data procedure until all points in the sequence have been accepted.

All Quick Sequences end with a VENT command after the last point. To avoid the VENT, press [ESC] after the last point.

After the last point in the sequence has been completed, the display is:

```
AutoTest complete
1exit 2repeat 3data
```

Select **<1exit>** to go the MAIN run screen retaining the AutoRange that was setup by QDUT.

Select **<2repeat>** to start the same test again at **<Exercise DUT & [ENT]>**.

Select **<3data>** to view the data collected in the QDUT AutoTest that was just completed (see Section 3.4.5).

3.3.7 [HEAD]

❍ PURPOSE

To cause a pressure fluid head correction to be added or subtracted to the pressure measured by the PPC3 reference pressure transducer in order to predict the pressure at a height other than the PPC3's reference level.

❍ PRINCIPLE

PPC3 measures gauge or absolute pressure at the height of the rear panel **TEST(+)** port. Frequently, when performing a calibration or test, the device or system under test is at a different height than the PPC3's **TEST(+)** port. This difference in height, frequently called **head**, can cause a significant difference between the pressure measured by the PPC3 at its **TEST** port height and the pressure actually applied to the device under test which is at a different height. In this case, it is useful to make a head correction to the pressure measured by the PPC3 in order to predict the pressure actually applied at a different height.

PPC3 can calculate **head** pressures for nitrogen, helium and air as the test gas over its working pressure range. The HEAD function allows the height difference to be specified and causes the resulting head pressure to be added to the pressure measured at the **TEST** port.

The **[HEAD]** function key is used to specify the height difference between the PPC3 **TEST** port and another height. Entering a height of zero turns the function off. The height units and the test gas are specified by pressing **[SPECIAL]**, **<3Head>** (see Section 3.5.3).

Use of the HEAD function to assure in tolerance measurements is most important in low absolute pressure ranges. Specifying the head height within ± 3 in. (7.5 cm) is adequate to assure that, even in the worst case, the uncertainty on the head correction will be insignificant relative to the tolerance on the measurement.

❍ OPERATION

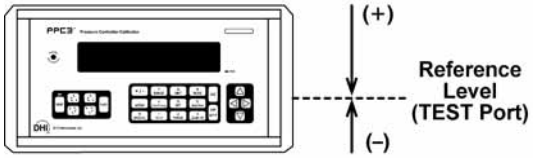
To access the HEAD function, press the **[HEAD]** function key. The display is:

```
Edit head height:
+ 25    cm      N2
```

1. Entry field for head height.
2. Test gas currently specified for the head correction.

Edit the head height to the desired value. Press **[ENT]** to return to the MAIN RUN screen with the new head correction active. Press **[ESC]** to return with no changes.

The reference height of the PPC3 pressure measurement is the middle of the PPC3 TEST port. The head height should be entered as a positive value if the device or system under test is higher than the PPC3 and negative if it is lower.



The HEAD function is NOT range specific. The HEAD ON or OFF status remains the same as ranges are changed. Edits made to the head settings are independent of active range or Q-RPT.

When a head correction is being applied, it is indicated by <h> in the top line of the MAIN RUN screen (see Section 3.1.1). When the head correction is zero, the <h> is not shown.

To change units of head height between inches and centimeters and to change the test gas species, use [SPECIAL], <3head> (see Section 3.5.3).

When using external Q-RPTs in RPM4, it is recommended that the RPM4 head height be adjusted to the reference level of the PPC3 before connecting the RPM4. Then, the normal PPC3 reference level to DUT head corrections can be made for all the Q-RPTs, whether internal or external to PPC3.

3.3.8 [PURGE]

❍ PURPOSE

To execute the PPC3 test system PURGE function using the optional Self Purging Liquid Trap (SPLT). PURGE is used to collect and exhaust liquid contaminants from the device or system under test before they reach the PPC3.

❍ PRINCIPLE

PPC3 is designed to precisely set, control and measure gas pressure. Liquid contamination of the PPC3 internal pressure control module and/or the Q-RPT module can cause poor pressure control and interfere with pressure measurement. Liquid contaminants that may be present in test devices or systems that are connected to the PPC3 **TEST(+)** port are likely to make their way back to PPC3's internal pneumatic system as the test device or system is pressurized and depressurized by PPC3. To every extent possible, only clean hoses and tubing should be used to connect PPC3 to test devices or systems and those devices and systems should be free of liquid contaminants. However, in the event that PPC3 must used to test devices or systems that may contain small amounts of liquid contaminants, a Self Purging Liquid Trap (SPLT) accessory supported by the PURGE function is available.

Execution of the PURGE function is automated and proceeds as follows:

❶ If current pressure is greater than 700 kPa (100 psi) gauge, pressure is controlled down to less than 700 kPa (100 psi) gauge.

❷ Pressure control stops and a 5 second wait occurs.

❸ SPLT exhaust valve is opened.

❹ PPC3 waits until pressure is less than 20 kPa (3 psi) gauge or 110 kPa (16 psi) absolute.

❺ PPC3 internal vent valve is opened with the SPLT exhaust valve left open.

The PURGE function makes use of the PPC3 valve driver option. Valve driver number 8 is used to actuate the SPLT exhaust valve. When making use of valve drivers, note that if the PURGE function is enabled, valve driver number 8 will be actuated independently of valve driver commands.

❍ OPERATION

For the PURGE function to execute, the function must have been enabled using [SPECIAL], <7internal>, <4purge> (see Section 3.5.7.4) and an optional Self Purging Liquid Trap (SPLT) must be installed in the test line (see Section 2.3.8.1).

The most common use of the PURGE function is at the beginning of a test just after the device or system under test has been connected to the PPC3 **TEST(+)** port. Generally, the purge process should be completed before leak checking is performed.

To purge the DUT and/or system under test using the PURGE function, proceed as follows:

❶ **Connect the system or device under test (DUT) to the PPC3 TEST(+) port:** Make sure the optional SPLT is properly installed between the DUT and the PPC3, **TEST(+)** port including the electrical connection for the PPC3 DRIVER connector to the SPLT valve. Always clean as much liquid and contamination as possible out of the DUT before connecting it.

❷ **Set the purge pressure:** Use the PPC3 direct pressure control keys (see Section 3.1.3) or automated pressure control (See Section 3.3.10) to the set purge pressure. The purge pressure should be roughly the DUT full scale or 1 MPa (150 psi), whichever is lower. Avoid activating the purge function at pressure > 1 MPa (150 psi).

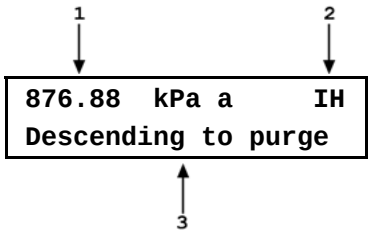
❸ **Press [PURGE]:**

Pressing [ESC] at any time during execution of the purge routine causes the purge function to abort and returns to the MAIN RUN screen.

Confirm your intention to run the PURGE routine by pressing **[ENT]**.

If the current pressure is over 700 kPa (100 psi) gauge, the display is:

1. Current measured pressure.
2. Active Q-RPT position designation.
3. Indication that PPC3 is reducing pressure to the purge pressure of < 700 kPa (100 psi).



PPC3 controls pressure down to less than 700 kPa (100 psi), stops control and displays **<Preparing to purge>** for five seconds. After the five second delay, PPC3 opens the SPLT exhaust valve and displays **<PURGING>**.

Once the pressure reaches less than 20 kPa (3 psi) gauge or 110 kPa (16 psi) absolute, PPC3 opens its internal vent valve and returns to the MAIN RUN screen in its normal vented condition.

❹ Repeat steps ❷ and ❸ until no liquids or other contaminants are expelled when the SPLT exhaust valve opens.

The internal volume of the SPLT is about 20 cc. The SPLT will not operate effectively if the volume of liquid contaminants collected is greater than about 10 cc. The SPLT is designed to protect the PPC3 only against residual liquid contamination. Even if an SPLT is being used, precautions should be taken to reduce potential liquid contamination from the device or system under test as much as possible before making the connection to the PPC3 TEST(+) port.

Do not plug the SPLT exhaust valve. The purge routine can not be completed with the SPLT exhaust valve plugged and the SPLT's protective function will not be effective.

If the SPLT is electrically connected to the PPC3, its exhaust valve will always be open when the PPC3 vent valve is open. If desired, it may be closed manually using the DRIVER function (see Section 3.4.7).

3.3.9 [LEAK CK]

PURPOSE

To run an automated leak check routine that determines the leak rate of the system connected to the PPC3 **TEST(+)** port.

PRINCIPLE

Leaks in the system connected to PPC3's **TEST(+)** port can cause differences between the pressure measured by the PPC3 Q-RPTs and pressure in other parts of the test system. A large leak can cause the PPC3 to be unable to set and control pressures reliably. The LEAK CHECK function is provided as a means of checking and quantifying the leaks that may be present in the system.

The principle of the LEAK CHECK function is the measurement of the natural decrease or increase of pressure in a fixed volume over time. The LEAK CHECK function allows a leak check time to be set. The total pressure change and the average rate of change over the leak check time are calculated and displayed.

Changing the pressure in a test system causes adiabatic temperature changes in the gas that need to have dissipated before a valid leak measurement can be made. In general, a 30 second to 1 minute wait before running a leak check is adequate to allow the adiabatic temperature change to dissipate and valid leak measurements to be made. However, stabilization time may be much longer with liquid test media, as volumes increase and as pressures increase.

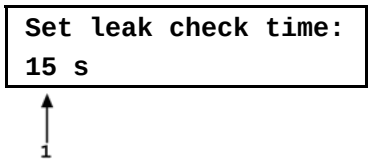
OPERATION

To run a leak check, first set the pressure to the desired leak check pressure using the direct pressure control keys (see Section 3.1.3) or automated pressure control (see Section 3.3.10).

Changing the pressure in the test system causes adiabatic temperature changes in the gas that need to have dissipated before a valid leak measurement can be made. Generally, a 30 second to 1 minute wait, depending on the magnitude of the pressure change and the size of the total pressurized volume, is adequate.

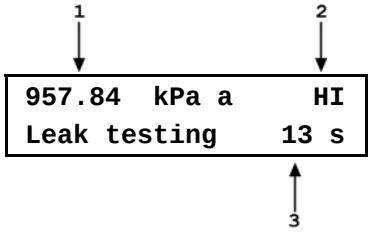
To access the LEAK CHECK function, press **[LEAK CHECK]** from the MAIN RUN screen. Select **<1run>** to run a leak test. The display is:

1. Edit field for the time over which the leak check pressure change will be measured, in seconds.



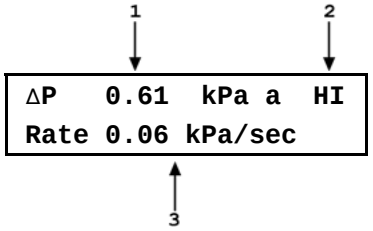
Edit the leak check time if desired (minimum 1, maximum 999) and press **[ENT]**. Press **[ENT]** again when ready to start the leak test. The leak test display is:

1. Standard MAIN RUN screen first line showing measured pressure.
2. Active RPT position indicator
3. Indication that leak test is running and countdown of time remaining.



[ESC] can be used to abort the running leak test. **[ENT]** while the leak test is running restarts the leak check timer. When the leak check timer countdown has completed, the leak check results screen is displayed:

1. Total pressure change from start to finish of leak check time.
2. Indicator of RPT used to run leak check.
3. Average rate of change of pressure over the leak check time period.



From the leak check results screen, press **[ENT]** to repeat the leak test.

Press **[ESC]** to return to leak check main menu and exit to the MAIN RUN screen.

As a general rule, the maximum acceptable leak rate for optimal PPC3 automated pressure control operation and to assure in tolerance measurements with default pressure control parameters is 0.5 % of current range span/minute. In dynamic control mode, to handle higher test system leak rates, increase the hold limit using [SPECIAL], <6control>, <1limits> (see Section 3.4.6.1).

To view the results of the most recently completed leak check, press **<2view>**. If NO leak check data is stored (i.e., if the PPC3 has never run a leak test or a reset has cleared previous leak test results), the results screen displays **<Data NOT available>** briefly and returns to MAIN RUN screen. Press **[ENTER]** or **[ESC]** to return to the MAIN RUN screen.

Leak check is range specific in the sense that leak check is run using the active range. However, only one set of leak check results is maintained in memory and each leak test completed overwrites the memory. View leak check always shows the results of the last leak check run regardless of the range that is now active. The results screen includes the range indicator to indicate the range in which the leak check was run.

3.3.10 [ENT/SET P] (SET PRESSURE AUTOMATICALLY)

PURPOSE

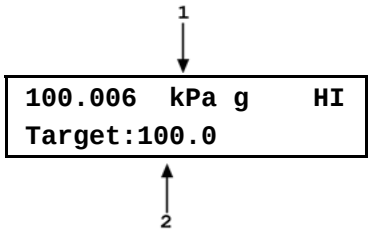
To use the automated pressure control functions of PPC3 to set and maintain target pressure values.

OPERATION

The active range pressure control mode and parameters can be viewed and edited using [SPECIAL], <6control> (see Section 3.4.6).

To set a pressure, press **[ENT/SET P]** from the MAIN RUN screen. The display is:

1. Standard MAIN RUN screen first line showing measured pressure and active Q-RPT.
2. Edit field for the pressure control target pressure.

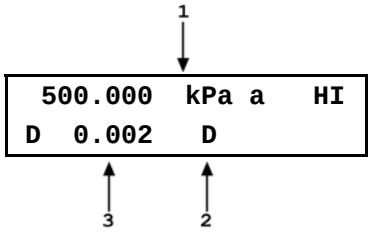


Edit the target pressure value as desired (see Section 3.3.10.2 for information on zero pressure commands).

The [△] and [▽] direct pressure control keys jog the target pressure up and down by the jog step value (see Section 3.1.3).

Press **[ENT/SET P]** to start pressure control to the target pressure and return to the MAIN RUN screen. The MAIN RUN screen when pressure control is active is:

1. Standard MAIN RUN screen first line showing measured pressure and active Q-RPT. Shows target pressure value when condition is *Ready*.
2. Current control mode indicator. Flashes when automated pressure control is active. Character is **<D>** for dynamic control, **<S>** for static control. **<C>** is appended if custom control parameters are in use.
3. Current deviation from the target pressure (**<D>**) when in dynamic control mode and condition is *Ready*. Target pressure value (**<T>**) when controlling and condition is *Not Ready*. Pressure rate of change **<R>** when in static control mode and waiting for stability.



Observe the *Ready/Not Ready* indicator LED (see Section 3.2.2) for indication of when the controlled pressure has reached the target and stabilized. PPC3 continues controlling following static or dynamic control operation protocol (see Section 3.2.1) until automated pressure control is interrupted.

A target pressure entry that exceeds the current upper limit (see Section 3.4.4) or that is out of range will not be accepted as the target value.

If PPC3 is unable to control pressure or appears to control pressure poorly, see Section 6 to troubleshoot.

For PPC3 to set pressures under atmosphere and/or to reliably set pressures under 20 kPa (3 psi) gauge other than zero gauge, a vacuum pump must be connected to the EXHAUST port (see Section 2.3.6) and PPC3 must be set up for control using a vacuum reference (see Section 3.5.7.2). Setting zero gauge pressure does not require a vacuum.

The [△] and [▽] direct pressure control keys can be used while controlling to jog the pressure control target value up or down by the jog step value (see Section 3.1.3). These keys also jog the target value when in the ENTER target value screen.

3.3.10.1 INTERRUPTING AUTOMATED PRESSURE CONTROL

Automated pressure control is interrupted by:

- **Pressing [ESC]:** Suspends control and remains in MAIN RUN screen. Does not vent pressure. PPC3 passively measures the pressure applied to its **TEST(+)** port.
- **Pressing any direct pressure control key other than the jog keys (see Section 3.1.3):** Suspends control and executes direct pressure control.
- **Pressing any function key:** Suspends control and goes to the selected function. Does not vent pressure. PPC3 passively measures the pressure.
- **Pressing [ENT/SET P]:** Suspends control and goes to ENTER target pressure value screen. Does not vent pressure. PPC3 passively measures the pressure applied to its **TEST(+)** port.

To resume automated pressure control, press **[ENT/SET P]** and ENTER a target pressure value.

3.3.10.2 AUTOMATED PRESSURE COMMANDS FOR ZERO PRESSURE

Zero in gauge mode: A command for automated pressure control to a target value of zero when in **gauge or negative gauge** measurement mode is interpreted in the same manner as if the **[VENT]** direct pressure control key had been pressed (see Section 3.1.3). A *Ready* condition occurs when the vent sequence has completed, including running AutoZ if applicable (see Section 3.5.1).

Zero in absolute mode: In response to a command for automatic pressure control to a target value of zero when in **absolute** measurement mode, PPC3 opens its down control valves fully to the **EXHAUST** port allowing the vacuum source connected to the **EXHAUST** port to pull down the pressure as far as possible (see Figure 12). The down valves stay open until another pressure command is given or control is aborted. In addition, on all PPC3 controllers except PPC3-A10M, a bypass is closed to interrupt the natural flow of gas out the **EXHAUST** port through the pneumatic module pressure regulators. How low the pressure in the PPC3 and the system connected to the PPC3 **TEST(+)** will go is a function of the quality of the vacuum pump used, the characteristics of the volume connected to the **TEST(+)** port and PPC3's internal restrictions.

A *Ready* condition occurs when the pressure control stability limit is reached (see Section 3.2.2).

Due to the manner in which PPC3 handles an automated pressure command for zero in absolute pressure measurement mode, a *Ready* condition can occur at a pressure well outside of the hold limit. When setting zero in absolute measurement mode, the *Ready* condition should NOT be interpreted as meaning that the pressure is zero within the hold limit. *Ready* is an indication that the rate of change of pressure inside PPC3 has reached the current stability limit. The current pressure measured by PPC3, not zero, should be used as the value of pressure applied to the device or system under test.

When PPC3 is given a command to set zero in absolute measurement mode, the rate of change of pressure will decrease as the pressure decreases and the rate will eventually be near zero when the vacuum pump has pulled down the pressure in the PPC3 and the test volume as far as possible. To make best use of the *Ready*/*Not Ready* indication when setting zero in absolute measurement mode, set the stability limit (see Section 3.4.6.1) to a value that represents the rate of change of pressure expected when the vacuum pump connected to the EXHAUST port has reduced pressure as far as possible.

3.4 [SETUP]

❍ PURPOSE

[SETUP] accesses a menu of functions and features commonly used in setting up and using PPC3.

❍ OPERATION

To access the SETUP menu, press **[SETUP]** from the MAIN RUN screen. The display is:

```
1range 2res 3jog 4UL
5ATest 6control 7drv
```

SETUP menu choices include:

<1range> Save and delete ranges created by AutoRange (see Section 3.4.1).

<2res> Adjust the resolution of pressure displays (see Section 3.4.2).

<3jog> Adjust the jog function pressure step value (see Section 3.4.3).

<4UL> Adjust upper and lower pressure setting limits (see Section 3.4.4).

<5ATest> View data files resulting from running QDUT AutoTests (See Section 3.4.5).

<6control> Select pressure control mode and view/adjust control limits (See section 3.4.6).

<7drv> Set and view status of external 12V drivers (see Section 3.4.7).

3.4.1 <1RANGE>

❍ PURPOSE

Save AutoRange ranges and associated settings for recall. Delete previously saved AutoRange ranges.

❍ PRINCIPLE

The PPC3 AutoRange function creates a range and automatically sets various operating parameters proportionally to the range (see Section 3.3.4). Operating settings can then be changed by the user. Many operating settings are specific to the current range (see Table 4).

[SPECIAL], **<1range>** allows the AutoRange range and associated settings to be saved for later recall using the **[RANGE]** key (see Section 3.3.1). This can save the user from having to recreate frequently used ranges and custom settings.

[SPECIAL], **<1range>** is also used to delete ranges that have been saved but are no longer needed.

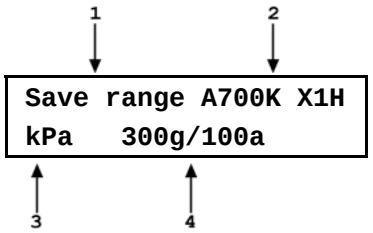
3.4.1.1 SAVING AN AUTORANGE RANGE

❍ **OPERATION**

To save a range created by AutoRange, the range must be the active range. Use AutoRange to create the range (see Section 3.3.4) and then make any desired feature and setting adjustments.

Once the AutoRange range is set up as desired, press **[SETUP]**, **<1range>** and select **<1save>**. The display is:

1. Indication that this is an AutoRange range to be saved.
2. Designator and position of the Q-RPT used by the range to be saved.
3. Pressure unit of measure of the range to be saved.
4. Full scale pressure of the range to be saved in gauge mode and absolute mode if available.



Press **[ENT]** to save the range or **[ESC]** to return to the MAIN RUN screen without saving the range.

Default (DF) Q-RPT ranges cannot be saved. They are permanent.

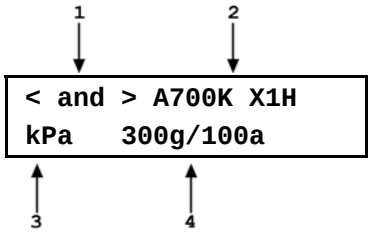
Duplicate AutoRange ranges cannot be saved. A duplicate AutoRange range is a range that has the same measurement mode and full scale and uses the same Q-RPT as a range that has already been saved.

3.4.1.2 DELETING AUTORANGE RANGES

❍ **OPERATION**

To delete a single saved AutoRange range, press **[SETUP]**, **<1range>**, **<2delete>**. If there are any saved ranges available to delete, the display is:

1. Indication that the cursor control keys may be used to toggle through the saved ranges to select the one to be deleted.
2. Designator and position of the Q-RPT used by the range to be deleted.
3. Pressure unit of measure of the range to be deleted.
4. Full scale pressure of the range to be deleted in gauge mode and absolute mode if available.



Use the cursor control keys to toggle through the ranges available to be deleted. When the desired range to be deleted is displayed, press **[ENT]**. If you are sure you want to delete this range, press **[ENT]** again in response to the **<Delete?>** query. Press **[ESC]** to return to the **<AutoRange:>** screen without deleting a range.

To delete all of the saved AutoRange ranges, press **[SETUP]**, **<1range>**, **<3delete all>**. If you are sure you want to delete all the ranges, respond **<1yes>** to the **<Delete all saved ranges?>** query. If not, respond **<2no>**.

3.4.2 <2RES> (RESOLUTION)

❍ **PURPOSE**

To set the resolution with which measured pressures and other pressure indications and settings are displayed.

❍ PRINCIPLE

The resolution with which PPC3 displays pressure values can be adjusted. This feature can be used to reduce the resolution when lower precision measurements are being made and excess resolution might confuse or distract the operator.

The resolution setting determines the number of digits with which pressure is displayed. The resolution is calculated based on the full scale of the range and then rounded to the furthest digit to the right. For example, resolution of 0.001 % on a range of 150 kPa is 150 X 0.001 % = 0.0015 which is rounded down to 0.001 kPa.

Default resolution is 10 ppm of active range span. Resolution is set automatically by AutoRange (see Section 3.3.4).

❍ OPERATION

To access the resolution function, press **[SETUP]**, **<2res>**. The display is:

```
Display resltn:   IH
0.0010 %FS   < and >
```

Use the cursor control keys to set the desired level of resolution. Press **[ENT]** to return to the MAIN RUN screen with the new resolution setting active or **[ESC]** to make no changes.

The resolution setting is range specific. A resolution setting made in one range does NOT affect other ranges.

The measured pressure resolution is fixed for altitude units at 1 m in meters and 1 ft in feet.

The maximum resolution setting is limited in AutoRange ranges that are less than 10% of the Q-RPT default full scale.

The maximum resolution setting when using a utility sensor is 0.001% of utility sensor span.

3.4.3 <3JOG>

❍ PURPOSE

Adjust the nominal change in pressure caused by using the jog direct pressure control keys ([△] and [▽]).

❍ PRINCIPLE

The jog direct pressure control keys, [△] and [▽], increase or decrease pressure by a nominal amount each time they are pressed. If pressure control is NOT active, pressing the jog key causes an up or down pressure step. If pressure control is active, the jog key causes the pressure control target value to be changed by the amount of the jog step.

[SETUP], **<3jog>** allows the nominal value of the jog step to be adjusted.

The default jog step is 100 ppm of active range span. The maximum jog step is 5 % of active range span. Jog step value is set automatically by AutoRange (See Section 3.3.4).

❍ OPERATION

To access the jog step adjustment function, press **[SETUP]**, **<3jog>**. The display is:

```
Jog step size:     IH
0.020 kPa
```

Edit the value of the jog step as desired. Press **[ENT]** to return to the MAIN RUN screen with the new jog step size active. Press **[ESC]** to return to the MAIN RUN screen with no change to the jog step size.

Pressing [△] and [▽] simultaneously is a short cut to the <Jog step size:> menu.

The jog step setting is range specific. A jog step setting made in one range does NOT affect other ranges.

3.4.4 <4UL> (UPPER LIMIT)

❍ PURPOSE

To set the upper and lower limit pressure value for a pressure range and measurement mode.

❍ PRINCIPLE

The UPPER LIMIT function allows the setting of a maximum pressure not to be exceeded when using a specific range and measurement mode. Absolute and gauge measurement modes (see Section 3.3.3, ❍ PRINCIPLE) have their own, specific limits. Negative gauge mode and the BA100K Q-RPT also have a lower limit.

Automated pressure control targets greater than the upper limit or lower than the lower limit are not accepted. When the pressure measured by PPC3 exceeds the upper limit or lower limit, automated or direct manual pressure control is aborted and an intermittent warning beep sounds.

The UPPER LIMIT function is most often used to protect the device or system connected to the PPC3 **TEST(+)** port from accidental overpressure.

The default upper limit is 105 % of AutoRange span or 102 % of Q-RPT default (maximum) range, whichever is lower. The default lower limit is - 110 kPa (- 16 psi), except with a BGxxx Q-RPT in which the default lower limit is the negative equivalent of the upper limit. The default lower limit of a BA100K is 66 kPa (9.6 psi).

❍ OPERATION

To view or edit upper and lower limits press **[SETUP]**, **<4UL>**.

If the current measurement mode is absolute or gauge, there is an upper limit only. The display is:

```
Upper limit:       IH
204.000 kPa a
```

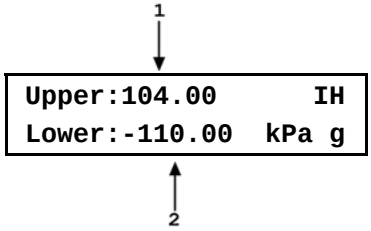
1

1. Entry field for upper limit value in active pressure unit of measure and measurement mode.

Edit the upper limit value as desired. The maximum upper limit is 105 % of AutoRange range or 102 % of default QRPT range, whichever is smaller. Press **[ENT]** to return to the MAIN RUN screen with the new upper limit active. Press **[ESC]** to return to the MAIN RUN screen with no change to the upper limit.

If the current measurement mode is negative gauge or the Q-RPT is a BA100K, there is also a lower limit. The display is:

1. Entry field for upper limit value.
2. Entry field for lower limit value and active range pressure unit of measure and measurement mode indication.



Edit the upper and lower limit values as desired. Use the cursor control keys to move between the two edit fields. The lower limit must be a negative value. Press **[ENT]** to return to the MAIN RUN screen with the new upper and/or lower limit active. Press **[ESC]** to return to the MAIN RUN screen with no change to the limits.

When the upper or lower limit has been exceeded, the display of current pressure flashes and a buzzer sounds for 3 seconds at 2 second intervals. Reduce pressure using direct pressure control keys or an automated pressure command to return to normal operation.

Upper limit values are specific to each range and measurement mode. Be careful not to assume that the upper limit set in one measurement mode will apply to the other. For example, if you set 150 kPa as the upper limit in gauge mode, the upper limit will not be 150 kPa in negative gauge mode of the same range.

Upper limits are always specified and displayed in the current pressure unit except for altitude units. When in altitude units, upper limits are expressed in kPa if the altitude unit is meters (m) and psi if the altitude unit is feet (ft).

3.4.4.1 OVER PRESSURE FUNCTION

In addition to the UL function, PPC3 has an over pressure function.

The over pressure function executes when a Q-RPT measures a pressure that is 104 % of its default span or a utility sensor measures a pressure that is 110 % of its default span. BG15K Q-RPTs also have a negative over pressure limit. The BG15K Q-RPT negative over pressure limit is - 17.5 kPa (- 2.3 psi).

When PPC3 is using an external Q-RPT in an RPM4, the PPC3 utility sensor or Hi Q-RPT acts as a watchdog. If the watchdog measures a pressure greater than the maximum pressure of the active external Q-RPT, PPC3 executes the overpressure function.

The over pressure function causes all pressure control to be interrupted and disabled, changes the active range to the default range of the Internal, Hi (IH) Q-RPT or utility sensor and causes the measured pressure display to flash. If the Q-RPT is a Gxxx or BGxxx, the **TEST(+)/TEST(-)** bypass valve is opened. The overpressure function also logs the time and date of the overpressure condition in both user and factory logs to assist in incident diagnosis (see Section 3.5.9).

To recover from an overpressure condition, correct the overpressure condition and cycle PPC3 power. Be sure to correct the condition that caused the overpressure before cycling power.

RPM4 has its own, independent overpressure function. When a Q-RPT on an RPM4 is active, both the PPC3 and the RPM4 may execute overpressure routines in response to an overpressure condition of the RPM4. See the RPM4 Operation and Maintenance Manual for information on the RPM4 overpressure function.

3.4.5 <5ATEST>

❍ **PURPOSE**

To view the data files that are created when QDUT AutoTests are run (see Section 3.2.6.2).

❍ **PRINCIPLE**

PPC3 supports QDUTAutoTests (see Section 3.2.6.2). When a QDUT AutoTest is run, the PPC3 pressure accepted by the operator at each point is logged. The logged pressure and an identifying header are stored in a data file. The data file can be viewed immediately following the last point of the sequence by selecting **<3data>**. In addition, the last data files recorded can be viewed anytime using **[SETUP]**, **<5ATest>**.

Data File Protocol

Up to ten QDUT AutoTest data files are buffered, ten at a time, in PPC3 memory. When a new test is completed, its data file goes to the front of the queue and the oldest data file is deleted.

Data files are identified by a header whose first line is the full scale of the DUT and the number of test points in the QDUT AutoTest sequence. The second line is the date (YYYYMMDD) and time (HH:MM:SS) at which the last point of the sequence was accepted.

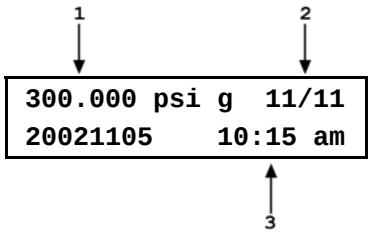
Following the data file header, each test point is recorded including the pressure setting of the PPC3 with head, AutoZ and range status as well as an indication of whether the reading was out of tolerance and the test point number over the total number of test points in the QDUT sequence.

❍ **OPERATION**

To access the QDUT AutoTest data file viewing function press **[SETUP]**, **<5ATest>**.

The first display is the data file header which can be used to toggle through data files:

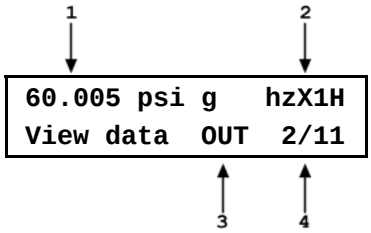
1. Full scale of the QDUT AutoTest sequence with pressure unit of measure and measurement mode.
2. Number of test points completed / total number of test points in the sequence definition.
3. Date (YYYYMMDD) and time the last point was completed.



Use the forward and backward cursor control keys or to scroll through the headers of the other QDUT AutoTest data files available. PPC3 stores up to ten data files in order of execution with a new data file pushing all the files back and deleting the oldest one. When the header of the data file you would like to view appears, press **[ENT]** or the down cursor control key to view the first point of the identified sequence.

The display is:

1. PPC3 pressure logged for the test point.
2. Head, AutoZ and active Q-RPT indicator (same as in the PPC3 MAIN RUN screen).
3. Indication that this point was out of tolerance. Indicates **<IN>** if point was in tolerance. Definition of out of tolerance is (Nominal point – PPC pressure > DUT tolerance * DUT FS).
4. Number of this test point / total number of points in the sequence.



Press **[ENT]** to move to the next data point or use the up and down cursor control keys to scroll backwards and forwards through the test points. The data file header is between the first point and the last point.

Press **[ESC]** to exit the data file. Confirmation is required to exit the data view function.

3.4.6 <6CONTROL>

❍ PURPOSE

To set the automated pressure control mode for the active range, customize control parameters, activate default control parameters.

❍ PRINCIPLE

The CONTROL function allows the active control mode for the current range to be set to either dynamic or static. The control mode set is specific to the active range and is saved with that range when ranges are changed. For a complete description of the operation and purpose of static and dynamic control modes see Section 3.2.1.

When a control mode is selected using the CONTROL function, CONTROL parameters are automatically set to default values for the active range (see Table 7 for definition of PPC3 default control parameters). The default control parameters have been determined to be most suitable for the typical user to operate within PPC3 pressure control and measurement specifications. Each PPC3 default range has default control parameters and AutoRange automatically sets control parameters appropriate for the AutoRange range.

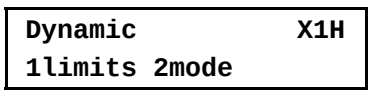
Control mode parameters can be viewed and customized in the CONTROL function (see Section 3.4.6.1). Customizing the hold and/or stability control parameters changes the conditions required for a *Ready* condition to occur (see Section 3.2.2). This can be used to increase control speed (reduce time to *Ready*), usually by decreasing control precision, or to increase precision which usually decreases control speed. For example, changing the dynamic pressure control hold limit from its default value of ± 50 ppm of the active range to ± 100 ppm of the active range will decrease the time required to set a pressure since the limit within which the pressure must be set has increased. However, it will also increase the maximum possible control error when *Ready* is indicated.

Table 7. Default Pressure Control Parameters

	STATIC MODE	DYNAMIC MODE
HOLD LIMIT	± 1 % of range span	± 50 ppm of range span, 5 ppm of Q-RPT span or 0.4 ppm of controller span, whichever is greater
STABILITY LIMIT	50 ppm of range span or 2 ppm of Q-RPT span, per second, whichever is greater	50 ppm of range span or 2 ppm of Q-RPT span, per second, whichever is greater

❍ OPERATION

To access the CONTROL function, press **[SETUP]**, **<6control>**. The display is:



Select **<1limits>** to view or edit the current control limits (see Section 3.4.6.1).

Select **<2mode>** to change the control mode.

The display is:

```
Control mode:    X1H
1dynamic 2static
```

The cursor is on the active control mode. Making a control mode selection activates the control mode, sets default control parameters and returns to the main run screen. To set custom control parameters, press **[SETUP]**, **<6control>**, **<1limits>** from the MAIN RUN screen (see Section 3.4.6.1).

Control mode setting is range specific. A change in control mode made while in one PPC3 range does NOT affect the control mode setting in other ranges.

The current control mode is indicated by two characters in the middle of the bottom line of the MAIN RUN screen (<S> for static and <D> for dynamic with <C> appended if custom control settings are in use). (See Section 3.1.1)

3.4.6.1 <LIMITS> (CUSTOM CONTROL PARAMETERS)

❍ **PURPOSE**

To view active pressure control parameters and/or set custom control parameters.

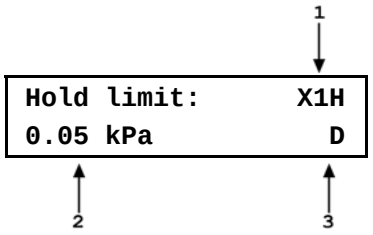
❍ **PRINCIPLE**

See Section 3.4.6, ❍ PRINCIPLE.

❍ **OPERATION**

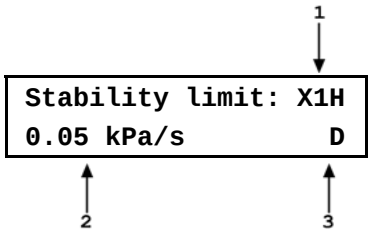
To view active control parameters and/or set custom control parameters, press **[SETUP]**, **<6control>**, **<1limits>** from the MAIN RUN screen. The display is:

1. Active Q-RPT designator.
2. View/edit field of hold limit value in active pressure unit of measure. Shows active hold limit.
3. Active control mode (**<D>** for dynamic, **<S>** for static).



Edit the hold limit value if desired and press **[ENT]** to view the stability. The next display is:

1. Active Q-RPT designator.
2. View/edit field of stability limit value in active pressure unit of measure. Shows active stability limit.
3. Active control mode (**<D>** for dynamic, **<S>** for static).



Edit the stability limit value if desired and press **[ENT]** to return to the main run screen with the edited values active.

To reset default control parameters for a range and control mode, select the control mode using [SETUP], 6control, 2mode.

Custom control parameters are range specific. Changes made in one range are stored for that range and are recalled when that range is returned to. Changes made in one range do not affect any other range.

When custom control parameters are active, a <C> is appended to the control mode indicating character (<S> for static, <D> for dynamic) in the middle of the bottom line of the MAIN RUN screen.

3.4.6.2 TURNING-OFF CUSTOM CONTROL PARAMETERS

To return to default pressure control parameters for the active range and control mode, select the control mode using **[SETUP]**, **<6control>**, **<2mode>** (see Section 3.4.6).

3.4.7 <7DRV> (DRIVERS)

- **PURPOSE**

To control the output signals of PPC3's 8 channel, 12 V external drivers.

- **PRINCIPLE**

PPC3 external drivers are available to drive peripheral equipment in a PPC3 system, for example, solenoid valves or the optional Self Purging Liquid Trap (SPLT). The driver electrical connections are available from a rear panel connector

See Section 7.1 for driver specifications and pin-outs.

- **OPERATION**

To access the driver control function press **[SETUP]**, **<7drv>**. The display is:

```
External drivers: 1
2  3  4  5  6  7  8
```

Pressing the keypad numerical key driver number turns that driver ON and OFF with either a momentary or a toggled response. An active driver is indicated by **<*>** immediately following the driver number.

Pressing **[ENT]** while in the External drivers menu causes a menu to appear that allows selection of whether the driver actuation by selecting the driver number will be **<1momentary>** or **<2toggle>**.

The PPC3 PURGE function makes use of the valve driver option. Valve driver number 8 is used to actuate the SPLT exhaust valve. The SPLT exhaust valve Is actuated when performing the PURGE function and in the background every time the PPC3 VENT function is used. When making use of valve drivers, note that when the PURGE function is enabled, valve driver number 8 will be actuated independently of user initiated valve driver commands (see Section 3.3.8).

3.5 [SPECIAL]

❍ PURPOSE

[SPECIAL] accesses a menu of PPC3 functions and features that are less commonly used or not normally used in regular operation.

❍ OPERATION

Press **[SPECIAL]** from the MAIN RUN screen to access the SPECIAL menu. The display is:

```
1AutoZ 2remote 3head
4reset 5pref 6Punit↓
7internal 8cal 9log
```

Some screens, such as the SPECIAL menu, go beyond the two lines provided by the display. This is indicated by a flashing arrow in the second line of the display. Press the cursor control keys to move the cursor to access the lines that are not visible or directly enter the number of the hidden menu choice if you know it.

SPECIAL menu choices include:

<1AutoZ> Manage AutoZero function for the active Q-RPT or utility sensor (see Section 3.5.1).

<2remote> View and edit PPC3 COM port (RS-232) and IEEE-488 interface settings (see Section 3.5.2).

<3head> Set HEAD function fluid and height unit of measure (see Section 3.5.3).

<4reset> Access PPC3's various reset functions (see Section 3.5.4).

<5pref> View and set screen saver time, keypad sound frequency, unit ID number, time/date, security protection level (see Section 3.5.5).

<6Punit> Customize the **[UNIT]** key pressure unit of selections (See section 3.5.6).

<7intern> Access internal functions including control configuration, control reference, on-board barometer viewing, purge function ON/OFF, direct control of Q-RPT Lo Vent valves (see Section 3.5.7).

<8cal> View and adjust PPC3 utility sensor, Q-RPT and barometer calibration coefficients (see Sections 3.5.8 and 5.2).

<9log> View the PPC3 incident log (see Section 3.5.9).

3.5.1 <1AUTOZ>

❍ PURPOSE

To offset the PPC3 system Q-RPTs relative to a reference value in order to compensate for possible changes in Q-RPT zero between full recalibrations.

❍ PRINCIPLE

AutoZ Purpose and Principle

The main component of the change over time of the PPC3 Q-RPTs is change in zero or offset, independent of span. Offsetting or "rezeroing" PPC3 Q-RPTs relative to a reference between recalibrations allows measurement uncertainty specifications to be maintained with less frequent full calibrations. The PPC3 AutoZero function (AutoZ) provides full on-board support for the rezeroing process to simplify its application by the user.

The AutoZero function uses three values:

1. $\mathbf{P_{std,0}}$**:** The pressure value indicated by the AutoZ reference, the device that is acting as the reference relative to which to offset the Q-RPT.

   For Axxx (absolute) Q-RPTs in **absolute measurement** mode, the pressure at which AutoZ is performed is normally atmospheric pressure and the $\mathbf{P_{std,0}}$ value can be supplied by manual entry.

   For Gxxx and BGxxx (gauge) Q-RPTs or Axxx (absolute) Q-RPTs in **gauge measurement** mode, $\mathbf{P_{std,0}}$ is always zero (atmospheric pressure) which is supplied by definition when the Q-RPT is vented to atmosphere.

2. $\mathbf{P_{u,0}}$**:** The pressure reading of the Q-RPT, with no AutoZ offset, at the time AutoZ is performed.

3. $\mathbf{P_{offset,G}}$ and $\mathbf{P_{offset,A}}$**:** The difference between the reading of the Q-RPT with no AutoZ offset ($\mathbf{P_{u,0}}$) and the indication of the AutoZ reference ($\mathbf{P_{std,0}}$) for gauge ($_G$) or absolute measurement mode ($_A$):

$$\mathbf{P_{offset} = P_{u,0} - P_{std,0}}$$

$\mathbf{P_{offset}}$ represents the change in zero of the Q-RPT relative to the AutoZ standard ($\mathbf{P_{std,0}}$). The AutoZ function manages the determination, storage and application of $\mathbf{P_{offset}}$ for PPC3 system Q-RPTs in absolute and gauge measurement modes.

When the Q-RPT is calibrated, $\mathbf{P_{offset}}$ is set to zero. $\mathbf{P_{offset}}$ is then redetermined at regular intervals using the AutoZ function. The most recent value of $\mathbf{P_{offset}}$ is applied to the Q-RPT reading to correct for change in zero over time.

The AutoZ function can be turned ON and OFF. Table 8 summarizes the effect of AutoZ ON and OFF for the three Q-RPT types in different measurement modes.

AutoZ in absolute measurement mode with an Axxx Q-RPT

Q-RPTs with the designation Axxx are intrinsically absolute. They have an evacuated and sealed reference. Axxx Q-RPTs can measure absolute pressure (difference from vacuum).

In absolute measurement mode, the source of $\mathbf{P_{std,0}}$ must be an absolute pressure, nominally atmospheric pressure, with uncertainty significantly better than that of the Q-RPT that is being AutoZeroed. For higher range Q-RPTs, this is easily accomplished with a variety of digital barometers or with a lower range Q-RPT in the PPC3 system. For lower range Q-RPTs, a piston gauge or other standard may be required to provide $\mathbf{P_{std,0}}$ with low enough uncertainty.

When using an Axxx (absolute) Q-RPT in absolute measurement mode, with AutoZ ON, absolute pressure is calculated as:

$$\mathbf{P_{abs} = P_{\underline{u}} - P_{\underline{offset,A}}}$$

In absolute measurement mode, execution of the AutoZ function to update the AutoZ value ($\mathbf{P_{\underline{offset,A}}}$), is initiated by the operator.

AutoZ in gauge and negative gauge measurement modes with an Axxx Q-RPT, dynamic compensation for atmospheric pressure

Q-RPTs with the designation Axxx are intrinsically absolute but they can also be used in gauge and negative gauge measurement modes (difference from atmosphere) (see Section 3.3.3, ❍ PRINCIPLE). Gauge measurement mode is achieved by subtracting the value of atmospheric pressure from the Q-RPT's absolute reading using AutoZ and by dynamically compensating for changes in atmospheric pressure between opportunities for AutoZ to execute (see Section 3.2.3).

In gauge measurement modes on an Axxx Q-RPT, the value of $\mathbf{P_{std,0}}$ is always zero gauge pressure. Zero gauge pressure, by definition, is applied to the Q-RPT when it is vented to atmosphere. In gauge measurement modes, the AutoZ routine is run automatically whenever the PPC3 is in the vented condition. This assures regular automated updating of

the $\mathbf{P_{offset,G}}$ value corresponding to atmospheric pressure. Gauge pressure is the measured absolute pressure, $\mathbf{P_u}$, minus $\mathbf{P_{offset,G}}$.

$$\mathbf{P_{gauge} = P_u - P_{offset,G}}$$

When AutoZ is ON, dynamic compensation for atmospheric pressure is also applied to compensate for changes in atmospheric pressure between AutoZ updates (see Section 3.2.3). The measured gauge pressure is calculated using $\mathbf{\Delta P_{atm}}$ to correct the value of $\mathbf{P_{offset.G}}$.

$$\mathbf{P_{gauge} = P_u - P_{offset.G} - \Delta P_{atm}}$$

In gauge measurement mode with an Axxx RPT, execution of the AutoZ function to update the value of $\mathbf{P_{atm,0}}$, occurs automatically whenever PPC3 is vented. Updating $\mathbf{\Delta P_{atm}}$ occurs automatically continuously during unvented operation.

AutoZ in gauge measurement mode with a Gxxx or BGxxx Q-RPT

Q-RPTs with the designation Gxxx or BGxxx are intrinsically gauge. They have an atmospheric reference port and measure gauge pressure (difference from atmosphere).

In gauge measurement mode the value of $\mathbf{P_{std,0}}$ is always zero gauge pressure. Zero gauge pressure, by definition, is applied to the Q-RPT when it is vented to atmosphere. In gauge measurement mode, the AutoZ routine is run automatically whenever the PPC3 is in the vented condition. This assures the regular automated updating of the $\mathbf{P_{offset,G}}$ value.

When using a Gxxx Q-RPT in gauge measurement mode, with AutoZ ON, gauge pressure is calculated as:

$$\mathbf{P_{gauge} = P_u - P_{offset,G}}$$

AutoZ ON/OFF

The AutoZ function can be turned ON and OFF, separately for gauge and absolute measurement modes. Table 8 summarizes the effect of AutoZ ON and OFF for different Q-RPT types in absolute and gauge measurement modes.

Table 8. AutoZ ON and OFF

Q-RPT TYPE	MEASUREMENT MODE	AutoZ STATUS	P_{offset} APPLIED	ΔP_{atm} APPLIED	AutoZ ROUTINE RUNS
Axxx (or utility sensor)	Absolute	ON	YES	Not Applicable	When initiated by operator
		OFF	NO		Not available
	Gauge or negative gauge	ON	YES	YES	Automatically when PPC3 in VENT condition
		OFF		NO	
Gxxx or BGxxx	Gauge or negative gauge	ON	YES	Not Applicable	Automatically when PPC3 in VENT condition
		OFF	NO		No

Recommendations for the Use of the AutoZ Function

The AutoZ function provides a powerful and easy to use tool for improving the stability over time of PPC3 internal and external Q-RPTs and maximizing the recalibration interval by compensating for change in zero between full recalibrations. The following simple recommendations will help assure that you use this feature to best advantage.

- In **gauge measurement** mode: Always leave AutoZ ON when operating.
- In **absolute measurement** mode: Always leave AutoZ ON when operating **if** the AutoZ routine has been run regularly using a valid P_{offset} reference.
- In **absolute measurement** mode: Run AutoZ at least every 30 days or when PPC3 has been exposed to temperature changes exceeding 15 ºC (36 ºF).

- In **absolute measurement** mode: Run AutoZ only when a reference whose measurement uncertainty is known to be significantly better than that of the Q-RPT to be AutoZeroed is available. Keep range ratios in mind when comparing uncertainty. A ± 0.01 % FS barometer is roughly 10 times better than an ± 0.01 % 1 MPa (150 psi) Q-RPT because the Q-RPT/barometer pressure ratio is 10:1. The measurement uncertainty comparison should be made at 30 % of span for both *standard class* and *premium class* Q-RPTs. Though it may not be practical, the best possible reference with which to run AutoZ in absolute measurement mode on Q-RPTs of A350K or lower, is a gas operated piston gauge (such as a **DHI** PG7601) applying atmospheric pressure to the PPC3 test port. The best day to day reference is a properly calibrated **DHI** RPM4 with a BA100K or A100K Q-RPT.
- In **absolute measurement mode:** Allow the PPC3 to stabilize at atmospheric pressure and ambient temperature for 10 to 15 minutes before running AutoZ.

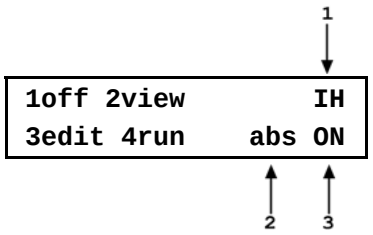
❍ **OPERATION**

The AutoZ function and values are Q-RPT AND measurement mode (gauge/negative gauge or absolute) specific.

When AutoZ is run for an external Q-RPT in an RPM4, the PPC3 causes the RPM4 to run its own AutoZero routine. The RPM4 Q-RPT is then AutoZeroed as if it had been AutoZeroed independently of the PPC3.

To access the PPC3 AutoZ function menu press **[SPECIAL]**, **<1AutoZ>**. The display is:

1. Active Q-RPT designator.
2. Indication of active measurement mode (**<abs>** for absolute, **<gage>** for gauge and negative gauge).
3. Indication of whether AutoZ is currently ON or OFF for this Q-RPT and measurement mode.



- Select **<1off>** (or **<1on>**) to change the AutoZ status for the current Q-RPT and measurement mode from ON to OFF or vice versa.

AutoZ ON is indicated by a <z> in the MAIN RUN screen, top line, fourth character from the right. When AutoZ is OFF, the character is blank.

- Select **<2view>** to view the current value of $\mathbf{P_{offset}}$ for the active Q-RPT and measurement mode.

P_{offset} should be zero for Axxx Q-RPTs when the PPC3 is new or has just been calibrated. P_{offset} should be roughly equal to atmospheric pressure for an Axxx (absolute) Q-RPT operating in gauge mode.

- Select **<3edit>** to edit the value of $\mathbf{P_{offset}}$ for the active Q-RPT and measurement mode (see Section 3.5.1.1).

The value of P_{offset} is always displayed and entered in Pascal (Pa). Normally, in day to day operation, the value of P_{offset} is changed by running AutoZ (see Section 3.5.1.2), not direct editing.

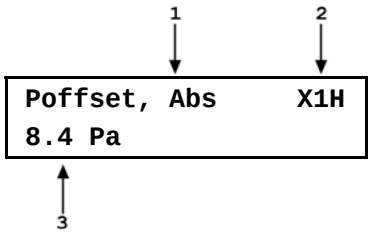
- Select **<4run>** to run the AutoZ routine which determines and activates $\mathbf{P_{offset}}$ relative to $\mathbf{P_{std,0}}$ (see Section 3.5.1.2). **<4run>** is only applicable to Axxx (absolute) Q-RPTs in absolute measurement mode. AutoZ is run automatically without operator intervention in gauge and negative gauge measurement modes whenever PPC3 is in the VENT condition (see Section 3.2.3, ❍ PRINCIPLE).

3.5.1.1 EDIT AUTOZ

The edit AutoZ function should be used with great caution as entering inappropriate values and turning ON AutoZ may result in out of tolerance measurements. In normal day to day operation, the value of the AutoZ offset, P_{offset}, should be changed using the run AutoZ function (seen Section 3.5.1.2) in absolute measurement mode or automatically in gauge modes. Before editing P_{offset}, see Section 3.5.1, ❍ PRINCIPLE.

To edit the current $\mathbf{P_{offset}}$ value for the active Q-RPT and measurement mode, press **[SPECIAL]**, **<1AutoZ>**, **<3edit>**. The display is:

1. **<abs>** for absolute, **<gage>** for gauge and negative gauge.
2. Active Q-RPT for which $\mathbf{P_{offset}}$ is being viewed.
3. Edit field for value of $\mathbf{P_{offset}}$.



Edit $\mathbf{P_{offset}}$ as desired and press **[ENT]** to activate the new value. Press **[ESC]** to abandon changes.

The value of P_{offset} is always displayed and entered in Pascal (Pa).

Edit and view AutoZ are not available for external Q-RPTs in gauge mode.

3.5.1.2 RUN AUTOZ

Run AutoZ applies only to Axxx Q-RPTs in absolute measurement mode. In gauge and negative gauge measurement modes, AutoZ is run automatically whenever the PPC3 is in the VENT condition.

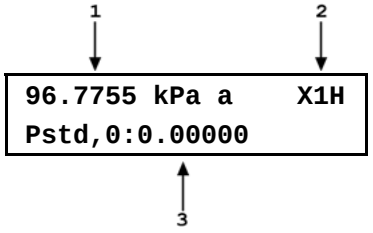
Run AutoZ is the function by which the current Q-RPT reading is compared to a reference, $\mathbf{P_{std,0}}$, at atmospheric pressure to determine a new value of $\mathbf{P_{offset}}$. The value of $\mathbf{P_{offset}}$ is then used by AutoZ to automatically correct the Q-RPT for possible change in zero (see Section 3.5.1, ❍ PRINCIPLE).

To access run AutoZ, press **[SPECIAL]**, **<1AutoZ>**, **<4run>**. If the current measurement mode is gauge, a message indicating that AutoZ cannot be run manually in gauge mode is displayed.

Allow the PPC3 to stabilize at atmospheric pressure and ambient temperature for 10 to 15 minutes before running AutoZ.

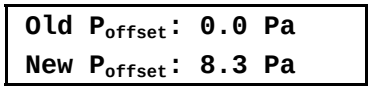
If the current measurement mode is absolute, the display is:

1. Real time reading (without head correction), pressure unit of measure and measurement mode of the active Q-RPT.
2. Active Q-RPT position designator.
3. Entry field for the value of $\mathbf{P_{std,0}}$. in the current pressure unit of measure.



Enter the value of the AutoZ reference ($\mathbf{P_{std,0}}$) in the same unit of measure as the top line display and press **[ENT]**. PPC3 logs the readings and calculates a new AutoZ offset value. The next display is:

Press **[ENT]** to activate the new value of $\mathbf{P_{offset}}$ or **[ESC]** to start over with entry of a new AutoZ reference ($\mathbf{P_{std,0}}$) value.



While the value of $P_{std,0}$ is entered in the current pressure unit of measure, the value of P_{offset} is always in Pascal (Pa). .

If running AutoZ results in a value of P_{offset} that is greater than ± 0.005 % FS of the span of the Q-RPT that is being AutoZeroed, the Q-RPT and/or the reference used as the source of Pstd,0 may be out of tolerance or the AutoZ process may have been faulty. Before activating a new P_{offset} greater than ± 0.005 % FS of the active Q-RPT, check to be sure that both the Q-RPT and the reference were in good working order, properly vented to stable atmospheric pressure, at the same height, and reading in the same pressure units when AutoZ was run.

When running AutoZ, if a HEAD correction is currently active (see Section 3.3.7), it is momentarily disabled to avoid "zeroing out" the head value.

3.5.2 <2REMOTE>

❍ PURPOSE

To configure the PPC3 COM1, COM2 and IEEE-488 (GPIB) communication ports. To test COM1 and COM2 communications. To select remote programming communications format.

❍ PRINCIPLE

The PPC3 has two RS-232 communications ports referred to as COM1 and COM2 and a single IEEE-488 (GPIB) port. COM1 or the IEEE-488 port is for communicating with a host computer (see Section 4), and COM2 is reserved for communicating with an external device (i.e. an RPM4, a multimeter, etc.). These ports' settings can be viewed and changed using **[SPECIAL]**, **<2remote>**.

PPC3 has two remote communications formats, classic and enhanced. Which of these is active can be selected.

A self test is supplied for RS-232 communications. The self test allows verification that the PPC3 RS232 ports (COM1 and COM2) are operating properly and that a valid interface cable is being used.

❍ **OPERATION**

To access the communications settings, press **[SPECIAL]**, **<2Remote>**.

Choice include:

<1COM1> To view and edit COM1 settings (see Section 3.5.2.1.).

<2COM2> To view and edit COM2 settings (see Section 3.5.2.1.).

<3IEEE> To view and edit IEEE-488 settings (see Section 3.5.2.2).

<4format> To select remote programming command format (see Section 3.5.2.3).

<5RS232test> To run the COM1 and COM2 communications test (see Section 3.5.2.4).

3.5.2.1 <1COM1> AND <2COM2>

The COMx ports can be set for specific communications settings. The settings are baud rate, parity, data bits and stop bits. The available options are:

Baud 300, 600, 1 200, 2 400, 4 800, 9 600, 19 200, 28 800, 38 400

Parity NONE, ODD or EVEN

Length 7 or 8

Stop Bit 1 or 2

The default is <2 400, E, 7,1> for both COM1 and COM2.

The user can also specify one or two termination characters as well as define these characters. These are referred to as “Term1” and “Term2”. These define the characters that mark the end of commands that are sent to the PPC3. The PPC3 looks for an ASCII(13) (carriage return) to terminate a received command but responds with both and ASCII(13) (carriage return) and an ASCII(10) (line feed). There are no other options.

3.5.2.2 <3IEEE-488>

The IEEE-488 port’s primary address can be set from 1 to 31 in this screen. The factory default value is 10. Secondary addressing is not used or supported. This address must not conflict with the address of any other device on the same IEEE-488 bus.

The receiving terminating character must be a line feed and EOI. Carriage returns are ignored if received. The PPC3 sends a line feed and asserts the EOI line to terminate a reply. These settings are fixed to agree with IEEE Std. 488.2. If you change the address, the IEEE interface will reset (PON) and become idle.

3.5.2.3 <4FORMAT>

The PPC3 has two different syntax formats available for the remote program commands. The **classic** format is compatible with previous PPC products and is the default format. The **enhanced** format follows the syntax, format, and status reporting features of IEEE Std 488.2. The details of each are covered in Section 4.3.

[SPECIAL], **<2remote>**, **<4format>** allows the remote program command syntax to be selected. The cursor is on the active format. Select **<1classic>** to activate the classic command format or **<2enhanced>** for the enhanced format.

Selecting a format resets the IEEE-488 interface and puts it into an idle state.

3.5.2.4 <5RS232 SELF-TEST>

The RS232 self-test is provided to check the PPC3 COM ports and the interface cable independently of an external device or computer.

If you are having difficulty communicating with PPC3 from a host computer using RS232, the RS232 self test can help establish that the PPC3 COM1 port you are trying to communicate with and the interface cable you are using are good.

To run a self test of the RS232 ports (COM1 and COM2), press **[SPECIAL]**, **<2remote>**, **<5RS232test>**.

The display prompts you to connect COM1 to COM2 using a standard pin-to-pin DB-9F to DB-9M RS232 cable (see Section 4.2.1.1).

Once the cable has been installed, press **[ENT]** to run the self-test. The test is first executed in the COM1→COM2 direction and then in the COM2→COM1 direction.

If the COM1→COM2 test passes: <PASSED> displays briefly and the test proceeds to COM2→COM1.

If COM2→COM1 passes: <PASSED> is displayed briefly followed by the conclusion, **<The RS232 test has PASSED>**.

If a test fails: Execution is suspended until **[ENT]** is pressed.

The PPC3 RS232 test can fail for three reasons:

1. The RS232 cable being used is incorrect (see Section 4.2.1.1 for information on the correct cable).
2. COM1 and COM2 do NOT have the same serial communications settings and therefore cannot communicate together (see Section 3.5.2.1 to set the COM ports).
3. COM1 or COM2 is defective.

The reason for failed communications is almost always a cable or incorrect RS232 interface settings. Be sure that these are correct before concluding that a COM port is defective.

3.5.3 <3HEAD>

- **PURPOSE**

To view or change the properties of the HEAD function (see Section 3.3.7) including the unit of measure of length for head height entry and the test gas species for density calculations.

- **OPERATION**

From the MAIN RUN screen, pressure **[SPECIAL]**, **<3Head>**.

Select the desired height unit of measure and press **[ENT]**.

Select the type of gas that is being supplied to PPC3 and press **[ENT]**. The characteristics of the gas selected will be used by PPC3 in calculating head pressures.

Use **[HEAD]** to set a head height if desired.

3.5.4 <4RESET>

❍ PURPOSE

To reset various PPC3 settings to default or factory values.

❍ PRINCIPLE

PPC3 stores its user definable settings in non-volatile memory. The reset menu allows the user to selectively or completely reset these settings to factory defaults. This clears out any settings that the user has made, and should be used only to restore the PPC3 to a known state. PPC3 goes through its power up sequence after any type of reset is executed.

PPC3 reset functions will change current settings to factory defaults. These may include settings vital to PPC3 operation and affecting the calibration of the quartz reference pressure transducers (Q-RPTs). Reset functions should only be used by qualified personnel with knowledge of reset consequences. Reset functions should note used experimentally.

❍ OPERATION

To access the RESET menu, press **[SPECIAL]**, **<4reset>**. The display is:

```
1sets 2units 3ATest
4cal 5all
```

RESET menu choices include:

<1set> to reset general system operating parameters (see Section 3.5.4.1).

<2units> to reset unit of measure functions (see Section 3.5.4.2).

<3ATest> to reset AutoTest parameters and clear the AutoTest data log (see Section 3.5.4.3).

<4cal> to reset internal calibration coefficients and modes (see Section 3.5.4.4).

<5all> to reset all settings except ID and security password to factory default values (see Section 3.5.4.5).

3.5.4.1 <1SET>

❍ PURPOSE

Sets most general operating parameters back to default values. Does not affect calibration coefficients, remote interfaces or AutoRange ranges. The Reset – Sets resets are itemized in Table 9.

Table 9. Reset – Sets

RESET	RESULT	SEE SECTION
[UNIT]	Returns pressure unit of measure to first of six available.	3.3.2
[MODE]	Returns measurement mode to the natural Q-RPT mode.	3.3.3
[RANGE]	Hi Q-RPT or utility sensor default range.	3.3.1
[HEAD]	0 cm height and Nitrogen medium.	3.3.7
Control Mode	Dynamic	3.4.6
Control Limits	Default values of Hi RPT default range.	3.4.6.1
Upper Limit	Default value of Hi RPT default range.	3.4.4
Resolution	0.001% FS of Hi RPT default range.	3.4.2
Purge	Disable purge function.	3.5.7.4
AutoZ	AutoZ ON. P_{offset} value not affected.	3.5.1
Control Ref	Auto.	3.5.7.2
Leak Check	15 second run time	3.3.9
Screen Saver	10 minutes to activation.	3.5.5.1
Key Sounds	Medium	3.5.5.2
Lo Vnt	Automatic.	3.5.7.5
Config	Return to default control coefficients.	3.5.7.1

3.5.4.2 <2UNITS

❍ **PURPOSE**

Sets the six pressure units available under the UNIT function to the SI or US default selections depending on whether the PPC3 has been factory set for SI or US (see Section 3.3.2).

Sets the user defined unit to 1.000/Pa (see Section 3.5.6).

Sets the reference temperature for inWa unit to 20°C.

3.5.4.3 <3ATEST>

❍ **PURPOSE**

- Resets Quick Test and Q-DUT Tests to default characteristics (see Section 3.3.6).
- Clears AutoTest data log (see Section 3.4.5).

3.5.4.4 <4CAL>

❍ **PURPOSE**

The Reset - Cal function will reset Q-RPT, utility sensor and barometer calibration coefficients and settings and reset AutoZ values to zero. This will change the PPC3 calibration and could cause it to make out of tolerance measurements.

Clears all user values affecting the calibration of Q-RPTs, utility sensor and the on-board barometer. Does not clear factory coefficients. The Reset – Cal resets are itemized in Table 10.

Table 10. Reset – Cal

RESET	RESULT	SEE SECTION
All Q-RPT user calibration coefficients	PA to zero, PM to 1.	5.2.1.1, 5.2.7
Axxx Q-RPT absolute and negative gauge mode	ON.	5.2.5
Utility Sensor calibration coefficients	PA to zero, PM to 1.	5.4
On-board barometer calibration coefficients	PA to zero, PM to 1.	5.3
Calibration date	Set all dates to 19800101.	5.2.7, 5.4, 5.3
AutoZ values	All P_{offset} values to zero for absolute mode and 101325 Pa for gauge and negative gauge modes.	3.5.1
AutoZ function	ON, all Q-RPTs, all measurement modes.	3.5.1

3.5.4.5 <5ALL>

❍ **PURPOSE**

The reset - all function clears and deletes large amounts of user defined information including critical calibration data.

Combines all resets in one global reset command that clears the entire user section of non-volatile memory returning PPC3 to the "as delivered" condition except the ID function (see Section 3.5.5.4) and the security level password (see Section 3.5.5.5). The Reset – All resets are itemized in Table 11.

Table 11. Reset – All

RESET	RESULT	SEE SECTION
Reset – Sets	All the resets of Reset - Sets	3.5.4.1
Reset – Units	All the resets of Reset - Units	3.5.4.2
Reset – Atest	All the resets of Reset - ATest	3.5.4.3
Reset – Cal	All the resets of Reset - Cal	3.5.4.4
Remote Interfaces	COM1, COM2 and IEEE-R88 interfaces to default settings.	3.5.2
Remote Communications	Remote command format to Classic.	3.5.2.3
Level (Security)	Low.	3.5.5.5

3.5.5 <5PREFS>

❍ **PURPOSE**

To access a menu of PPC3 operational preferences and functions.

❍ **OPERATION**

To access the PREFS menu press **[SPECIAL]**, **<5prefs>**. The display is:

```
1ScrSvr 2sound 3time
4ID 5level
```

The PREFS menu includes:

<1ScrSvr> View and change the screen saver activation time (see Section 3.5.5.1).

<2sound> View and change the keypress sounds (see Section 3.5.5.2).

<3time> View and edit the internal time and date settings (see Section 3.5.5.3).

<4ID> View the PPC3 serial number (SN) and view or edit the ID number (see Section 3.5.5.4).

<5level> View and set user security level and password (see Section 3.5.5.5).

3.5.5.1 <1SCRSVR>

- **PURPOSE**

To adjust the idle time after which PPC3's SCREEN SAVER activates.

- **PRINCIPLE**

PPC3 has a SCREEN SAVER function which causes the display to dim after a front panel key is NOT pressed for a certain amount of time. The default screen saver time activates the screen saver after 10 minutes. The screen saver activation time can be adjusted by the user or screen saving can be completely eliminated.

Setting screen saver time to zero eliminates the SCREEN SAVER function so that the display permanently remains at full brightness.

- **OPERATION**

To access the SCREEN SAVER function, press **[SPECIAL]**, **<5prefs>**, **<1ScrSav>**. Edit, in minutes, the idle time after which screen saver will activate to dim the screen. Set the time to zero to eliminate the SCREEN SAVER function.

3.5.5.2 <2SOUND>

- **PURPOSE**

To adjust or suppress the PPC3 valid key press sound.

- **PRINCIPLE**

PPC3 provides audible feedback by a brief "beep" when a valid key press is made. The tone frequency of this beep may be selected from three choices or it may be completely suppressed. Invalid key presses are indicated by a descending two tone "blurp" which cannot be suppressed.

- **OPERATION**

To access the keypad sound adjustment function press **[SPECIAL]**, **<5prefs>**, **<2sound>**.

Select between **<2lo>**, **<3mid>** or **<4hi>** to adjust the valid key press tone frequency.

Select **<1none>** to suppress the valid key press tone.

The sound function only affects the valid key press tone. The invalid key press tone cannot be suppressed.

3.5.5.3 <3TIME>

- **PURPOSE**

To view and edit the PPC3 internal time and date settings.

❍ **OPERATION**

To access the TIME function press **[SPECIAL]**, **<5prefs>**, **<3time>**. The display is:

```
Edit:  1time 2date
08:32:11 am 20020925
```

Select **<1time>** to edit the time. Edit hours, then minutes, then am/pm by pressing **[ENT]** after each entry. Seconds go to zero when minutes are entered. This can be used to synchronize the time with a time standard.

Select **<2date>** to edit the date. The date must be specified in YYYYMMDD format.

The PPC3 date and time are set to United States Mountain Standard Time in the final test and inspection process at the factory. If desired, use the TIME and DATE functions to set your local time and date.

3.5.5.4 <4ID>

❍ **PURPOSE**

To view or edit the PPC3 user ID and to view the PPC3 serial number.

❍ **OPERATION**

To access the ID function press **[SPECIAL]** and select **<5prefs>**, **<2ID>**. Select **<1view>** to view the current ID.

Select **<2edit>** to edit the ID.

The ID has twelve characters. When the edit screen is opened, the cursor is on the first character. Numerical values can be entered directly from the keypad. In addition, the cursor control keys can be used to toggle through a list of available alpha numeric characters. Holding the key slews through the characters. Character order going up is: blank space, symbols, lower case letters, upper case letters, numbers. After selecting a character, press **[ENT]** to activate it and move to the next character field.

When a character is selected the cursor moves to the next character. To leave a blank character, press **[ENT]** with the field for that character blank. Use this for the trailing characters if the ID being entered is less than twelve characters.

After the last of the twelve characters has been entered, the **<Save ID?>** option is offered. Select **<1no>** to return to the ID edit screen. Select **<2yes>** to save the edited ID.

The ID can be set remotely from a computer which is quite a bit more convenient than entering characters from the keyboard (see Section 4.4, ID command). The ID is not cleared or reset by any RESET function (see Section 3.5.4).

3.5.5.5 <5LEVEL> (SECURITY)

❍ **PURPOSE**

To set user protection levels to restrict access to certain functions and to edit the password required for changing user levels.

❍ **PRINCIPLE**

PPC3's front panel user interface provides the means to access all PPC3 user defined data, settings and functions including calibration data. Inadvertent, uninformed or unauthorized altering or deleting of data, settings and functions

could require extensive reconfiguration by the user and might cause invalid readings and behavior. For these reasons, depending upon the application in which PPC3 is being used, it may be desirable to restrict access to certain functions for certain users. The user level function provides a means of restricting access to certain functions. Four different levels of security are available.

Access to changing security levels can be left open, or be protected by a password.

Security Levels

The security levels are structured to support typical operating environments as follows:

None This level is intended for use only by the system manager and/or calibration facility. It allows access and editing in all areas including critical metrological information.

Low Low security is designed to protect the specific metrological information and SYSTEM DIAGNOSTIC AND MAINTENANCE functions of the system against accidental alteration. It is intended for an advanced operator performing many different tasks. Low security is the default user level setting.

Medium Medium security is designed to protect specific metrological information in the system and to assure that the PPC3 is operated using consistent operational parameters.

High High security is designed to protect all operating parameters. It is intended to minimize operator choices, for example to perform repeated identical calibrations under consistent conditions.

PPC3 is delivered with the security level set at low to avoid inadvertent altering of critical internal settings but with access to changing security levels unrestricted. It is recommended that the low security level be maintained at all times. If there is a risk of unauthorized changing of the security level, changing authority should be password protected (see ❍ OPERATION of this section).

The security levels are structured to support typical levels of operation as shown in Table 12. Specifically, the security levels prevent execution of the functions accessed by the key strokes marked by "•":

Table 12. Security Levels

FUNCTION	LOW	MEDIUM	HIGH
[RANGE]			•
[UNIT]			•
[MODE]			•
[AutoRange]		•	•
[RPT]		•	•
[AutoTest], <2QDUT>			•
[AutoTest], <1Quick>, <Run current Quick ATest: 2no>			•
[HEAD]			•
[PURGE]			•
[LEAK CK]			•
[SETUP]			•
[SETUP], <1range>		•	•
[SETUP], <2res>		•	•
[SETUP], <4UL>		•	•
[SETUP], <6control>		•	•
[SETUP], <7drv>		•	•
[SPECIAL]			•
[SPECIAL], <1AutoZ>		•	•
[SPECIAL], <1AutoZ>, <1on/1off>	•	•	•
[SPECIAL], <1AutoZ>, <3edit>	•	•	•
[SPECIAL], <2remote>			•
[SPECIAL], <2remote>, make changes		•	•
[SPECIAL], <3head>		•	•
[SPECIAL], <4reset>		•	•
[SPECIAL], <4reset>, <4cal>	•	•	•
[SPECIAL], <4reset>, <5all>	•	•	•
[SPECIAL], <5pref>, <1ScrSvr>		•	•
[SPECIAL], <5pref>, <2sound>		•	•
[SPECIAL], <5pref>, <3time>		•	•
[SPECIAL], <5pref>, <3time>, make changes	•	•	•
[SPECIAL], <5pref>, <4ID>, <2edit>	•	•	•
[SPECIAL], <6Punit>		•	•
[SPECIAL], <7internal>		•	•
[SPECIAL], <7internal>, <1config>		•	•
[SPECIAL], <8cal>		•	•
[SPECIAL], <8cal>, <2edit> under any selection	•	•	•
[SPECIAL], <9log>, view			•
[SPECIAL], <9log>, clear log	•	•	•
Remote communications disabled			•

"•" indicates the function/menu is NOT accessible.

❍ OPERATION

PPC3 is delivered with no active password and access to the User Level menu is open. The user level is set to <1Low>. User levels can be changed freely until a password has been created.

To access the LEVEL function press **[SPECIAL]**, **<5prefs>**, **<5level>**. The display is:

```
1change user level
2edit password
```

Selecting **<1change user level>** brings up the restriction menu:

```
Restrictions: 1none
2low 3medium 4high
```

The cursor is on the current restriction level. Select a different level or or **[ESC]** back to the MAIN RUN screen.

If no password is active, selecting **<2edit password>** displays the user password and allows it to be edited.

```
Password: pppppp
0 disables password
```

Once a password has been entered, the user level cannot be changed without reentering the password.

Passwords can be up to six numbers in length and cannot start with a zero. If **<0>** is entered, the password is made inactive and the user will not be required to enter a password to access the user level menu. This condition, with a security level of **<2low>**, is the factory default.

If there is an active password, the PPC3 password entry screen appears. The user must enter the user defined password or the factory secondary password to proceed further:

```
PPC3  SNnnnn-xx
Password: pppppp
```

The first field, **<nnnn>**, is the serial number of the PPC3, followed by a second field, **<xx>**, that represents the number of times that a secondary password has been used. The second field, **<xx>**, increments each time a secondary password is used. The third field, **<pppppp>** is for user entry of the normal password.

The factory secondary password is available in case the user's password has been misplaced or forgotten. It can be obtained by contacting a DHI Authorized Service Center (see Table 31). The factory secondary password is different for all PPC3's and changes each time it is used.

3.5.6 <6PUNIT>

❍ PURPOSE

To customize the selection of pressure units of measure that are available in the **[UNIT]** key menu.

❍ PRINCIPLE

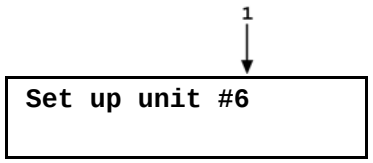
The **[UNIT]** function key makes available a choice of six default pressure units (US or SI units depending on whether the PPC3 has been factory set as US or SI) (see Section 3.3.2). PPC3 also supports many commonly used units other than those included in the default set up. These units can be made available for active selection by customizing the UNIT function

using **[SPECIAL]**, **<6PresU>**. This allows PPC3 to offer a very wide selection of units while simplifying day to day operation. The typical user customizes the **[UNIT]** function key to support his/her six most commonly used units.

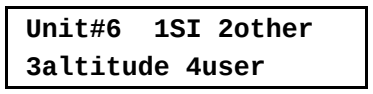
❍ OPERATION

To customize the **[UNIT]** function key, from the MAIN RUN screen press **[SPECIAL]**, **<6PresU>**. The display is:

1. Entry field to specify which unit position (1 – 6) of the **[UNIT]** function key menu is to be changed.



Enter the number of the unit position that you would like to change. The display becomes:



Select the desired pressure unit category (SI units include units *based* on SI such as mmHg), then select the desired unit from the unit menu.

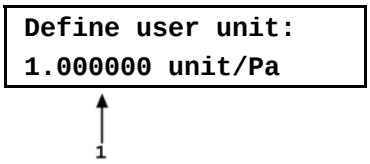
The units of measure available are listed in Table 13.

Table 13. UNIT Function - Available Units of Measure

<1SI>	<2OTHER>	<3ALTITUDE>	<4USER>
<1Pa> <2hPa> <3kPa> <4MPa> <5mbar> <6bar> <7mmHg> <8mmWa>	<1psi> <2psf> <3inHg> <4inWa> <5kcm2> <6Torr> <7mTorr>	<1ft> <2m>	

If **<4user>** is selected, the user unit must be defined. The display is:

1. Entry field.



Enter the number of user units per Pascal (Pa) in the entry field. Pressing **[ENT]** defines the user unit and returns to the **<Set up unit #n>** screen.

The user defined unit label can be customized to any alphanumeric, four character label using the remote command "UDU" (see Section 4.4.4).

See Section 7.2.1 for the pressure unit conversion factors used by PPC3.

3.5.7 <7INTERNAL>

❍ PURPOSE

To view, set, adjust, and maintain various aspects of PPC3's internal operation.

❍ OPERATION

To access the internal selections press **[SPECIAL]**, **<7internal>**. The display is:

```
1config 2control ref
3baro 4purge 5lo vnt
```

The INTERNAL menu choices include:

<1config> To run an automated routine that readjusts internal pressure control coefficients (see Section 3.5.7.1).

<2control ref> To view or manually set the **EXHAUST** port condition (see Section 3.5.7.2).

<3baro> View the real time output of the on-board barometer, if present (see Section 3.5.7.3).

<4purge> Turn the automated purging function ON and OFF (see Section 3.5.7.4).

<5lo vnt> Operate Q-RPT module Gxxx and BGxxx low VENT valve directly (see Section 3.5.7.5).

3.5.7.1 <1CONFIG>

❍ PURPOSE

To run an automated routine that readjusts internal pressure control coefficients. This function is considered part of PPC3 maintenance and is therefore covered in the maintenance section of this manual (see Section 5.5).

❍ OPERATION

This function is considered part of PPC3 maintenance and is therefore covered in the maintenance section of this manual (see Section 5.5).

3.5.7.2 <2CONTROL REF>

❍ PURPOSE

To specify whether PPC3 should automatically determine whether a vacuum source or atmospheric pressure is connected to its **EXHAUST** port or to manually set the **EXHAUST** port condition.

❍ PRINCIPLE

The PPC3 exhaust (down) control valves and the output of the exhaust pressure regulator are connected to the PPC3 **EXHAUST** port (see Figure 12).

The response of the pressure control module, particularly when controlling pressure near and under atmospheric pressure, changes depending on whether the **EXHAUST** port is connected to a vacuum source or left open to atmosphere. To use the proper pressure control algorithms, PPC3 must know the condition of the **EXHAUST** port.

The ControlRef function allows the PPC3 to know whether its **EXHAUST** port is at vacuum or atmospheric pressure. An independent exhaust pressure sensor measures the pressure present at the port. Normally, the exhaust sensor output is used automatically by PPC3 to determine the **EXHAUST** port condition. If desired, this automatic determination can be overridden and the **EXHAUST** port condition set manually.

The ControlRef function allows setting of whether the **EXHAUST** port condition will be determined automatically using the exhaust sensor or set manually. It also allows viewing of the current status of the **EXHAUST** port.

The normal condition of the ControlRef function is <1auto>. In this condition, the operator need not be concerned with informing the PPC3 of EXHAUST port pressure conditions as PPC3 determines the existing condition automatically. The other settings are normally used only for special applications or trouble shooting. Pressure control near and under atmospheric pressure will not operate properly if ControlRef is not set correctly.

❍ OPERATION

To access the CONTROL REFERENCE function press **[SPECIAL]**, **<7internal>**, **<2ControlRef>**. The display is:

```
Control ref: 1auto
2vac 3atm 4view
```

Select:

<1auto> To set the PPC3 to determine the **EXHAUST** port condition automatically using its internal exhaust sensor. This is the normal Control Ref setting.

<2vac> To set the PPC3 to assume that a vacuum supply is connected to the **EXHAUST** port.

<3atm> To set the PPC3 to assume that the **EXHAUST** port is open to atmospheric pressure.

<4view> To view the current **EXHAUST** port condition assumed by PPC3 and how it was determined.

Before connecting a vacuum pump or vacuum source to the PPC3 EXHAUST port, see Section 2.3.6 for information on vacuum connection requirements and precautions.

The ControlRef function setting is not range or control mode specific. The setting made in ControlRef is common across Q-RPTs and ranges as they are changed.

3.5.7.3 <3BARO>

❍ PURPOSE

To view the value of atmospheric pressure as measured by the PPC3 on-board barometer.

There is no on-board barometer in PPC3's that have Gxxx (gauge) internal Q-RPTs only.

❍ **PRINCIPLE**

PPC3's that include an Axxx (absolute) and/or BGxxx (bi-directional gauge) Q-RPT or a utility sensor (Auxxx)are equipped with a separate, on-board barometer. The atmospheric pressure measurements made by the on-board barometer are used for dynamic compensation of atmospheric pressure when using an Axxx Q-RPT to make gauge pressure measurements (see Sections 3.3.3, ❍ PRINCIPLE and 3.2.3) and for static pressure compensation when using a BGxxx Q-RPT.

See Figure 13 for schematics showing the position of the on-board barometer in PPC3's measurement system.

The on-board barometer is a low accuracy sensor used only for measuring small changes in atmospheric pressure over short periods of time (see Section 3.2.3) and for line pressure compensation when using a BG15K Q-RPT. PPC3 measurement uncertainty does not depend on the measurement uncertainty of the on-board barometer.

❍ **OPERATION**

PPC3's that have only Gxxx Q-RPTs (no Axxx or BGxxx) are NOT equipped with an on-board barometer.

To view the current reading of the on-board barometer press **[SPECIAL]**, **<7internal>**, **<3baro>**. The display is in the active pressure unit of measure (see Section 3.3.2).

3.5.7.4 <4PURGE>

❍ **PURPOSE**

To enable and disable the PURGE function and **[PURGE]** key which automate use of the optional Self Purging Liquid Trap (SPLT) (see Section 3.3.8).

❍ **OPERATION**

To access the purge enable/disable function press **[SPECIAL]**, **<7internal>**, **<4purge>**. Select **<1yes>** to enable purge or **<2no>** to disable purge.

When the purge function is enabled, PPC3 makes background use of valve driver channel #8 independently of user actions (see Sections 3.3.8, 3.4.7).

3.5.7.5 <5LO VNT>

❍ **PURPOSE**

To cause a PPC3 or external RPM4's Gxxx or BGxxx Q-RPT TEST(-) vent valve to stay open or closed rather than open and close automatically.

This feature is active only when the active Q-RPT is a Gxxx (gauge) or BGxxx (bi-directional gauge) Q-RPT.

❍ PRINCIPLE

A PPC3 or an RPM4 equipped with a Gxxx (gauge) or BGxxx (bi-directional gauge) Q-RPT has a TEST(-) vent valve in its Q-RPT module (see Figure 13).

The TEST(-) vent valve connects the **TEST(-)** port to the **VENT** port which also connects the Q-RPT and the device or system under test low side to atmosphere. In normal PPC3 operation, the TEST(-) valve is closed automatically whenever the PPC3 is performing fine pressure control to isolate the TEST(-) circuit from fluctuations in ambient pressure. The valve is opened at all other times. This assures that the pressure in the TEST(-) circuit does not move too far away from atmospheric pressure as it might if it were permanently shut off. In normal RPM4 operation as an external device to a PPC3, the TEST(-) valve is normally closed. It is only opened when PPC3 is controlling with coarse pressure control.

[SPECIAL], **<7internal>**, **<5lo vnt>** allows the TEST(-) vent valve to be set to be permanently open, permanently closed or to operate in its default automated condition. It also allows the current status of the valve to be viewed.

❍ OPERATION

The normal setting for the TEST(-) vent valve is <1auto> in which PPC3 automatically controls the valve based on current PPC3 operation. Settings other than <1auto> should only be selected by advanced users.

When the active Q-RPT is an external RPM4 Q-RPT, the Lo Vent operation applies to the RPM4 Q-RPT module. The Lo Vent settings made from the PPC3, apply only as long as the RPM4 is a PPC3 external device. When the RPM4 power is cycled, the RPM4 Lo Vent will return to its original state.

To access the LO VNT function press **[SPECIAL]**, **<7internal>**, **<5lo vent>**. If a Gxxx (gauge) or BGxxx (bi-directional gauge) Q-RPT is not active, the display is: **<Available with Gxxx or BGxxx RPT only>**.

If a Gxxx or BGxxx Q-RPT is active, the display is:

```
Test(-) vent:1auto
2open 3close 4view
```

Select **<1auto>** for the TEST(-) vent valve operation to be controlled automatically by PP3 based on current operation. This is the default and recommended setting.

Select **<2open>** to cause the TEST(-) valve to open and remain open regardless of PPC3 operation until the setting is changed. If PPC3 detects a condition in which it determines there could be a risk of overpressure to the RPT by opening the TEST(-) vent valve, the message **<Cannot open lo vent, DP overpressure risk>** is displayed. If this message is displayed, return to normal operation, vent the PPC3 and try again.

Select **<3close>** to cause the TEST(-) valve to close and remain closed regardless of PPC3 operation until the **<lo vnt >** setting is changed.

Select **<4view>** to view the current condition of the TEST(-) valve. The display indicates whether current valve operation is controlled by the PPC3 (**<Auto TEST(-) vent>**) or has been set manually (**<Manual TEST(-) vent>**) followed by the current valve status (**<Open>** or **<Close>**).

The LO VNT function setting always applies to the active Q-RPT module, whether the module is internal to PPC3 or in an external RPM4 (see the RPM4 Operation and Maintenance Manual).

3.5.8 <8CAL>

❍ PURPOSE

To calibrate the PPC3 utility sensor, Hi and/or Lo Q-RPTs and adjust the on-board barometer. This function is considered part of PPC3 maintenance and is therefore covered in the maintenance section of this manual (see Sections 5.2, 5.3, 5.4).

❍ PRINCIPLE

See Sections 5.2, 5.3 and 5.4.

❍ OPERATION

See Sections 5.2, 5.3 and 5.4.

3.5.9 <9LOG>

❍ PURPOSE

To view and/or clear the PPC3 event log.

❍ PRINCIPLE

PPC3 records to a log each time one of the following events occurs:

- Pmax! of an internal PPC3 Q-RPT or utility sensor is exceeded (see Section 3.4.4.1).
- A memory fault occurs.

Over pressure events on external Q-RPTs are not logged on the PPC3. They are logged in the RPM4's log (see the RPM4 Operation and Maintenance Manual).

❍ OPERATION

To view the event log press **[SPECIAL]**, **<9Log>**.

Use **[◁]** and **[▷]** to move back and forth between older and newer log entries.

Each log entry has two screens, one with the event description and one with the even time and date. Use **[△]** and **[▽]** to toggle between the two screens. The oldest logged event appears.

After the last log has been viewed, the option to clear the log, **<1no>**, **<2yes>** is presented. Use **<2yes>** to remove all entries from the log. Use **<1no>** to continue without altering the log.

To leave the log, use **[ESC]**.

NOTES

4. REMOTE OPERATION

4.1 OVERVIEW

Most of the PPC3 front panel functions can also be executed by commands from a remote computer. The host computer can communicate to the PPC3 using the PPC3 COM1 RS232 port or the IEEE-488 port.

Before writing test code which makes use of PPC3 remote commands, familiarize yourself with its operating principles by reading Section 3 of this manual.

4.2 INTERFACING

Sending a program message to the PPC3 places it into **remote** mode. The remote indicator to the right of the display window lights when the PPC3 is in **remote** mode. It will also flicker when a program message is received. The menus usually accessed from the front panel are locked out while in remote. The **[ESC]** key returns the PPC3 to local operation unless the **<REMOTE>** program message, which locks out all keypad operation, was sent to the unit.

4.2.1 RS232 INTERFACE

4.2.1.1 COM1

The PPC3 COM1 RS232 interface is located on the back of the unit. It is a 9-pin male DB-9F connector configured as a DCE device. Data is transmitted out of the unit using pin 2, and is received on pin 3. This allows a normal pin-to-pin DB-9M to DB-9F RS232 cable to be used to connect to a DTE host.

Handshaking is not required or supported. The COM1 receive buffer is 80 bytes deep. If you overflow the buffer by sending too much data, the data will be lost. Because of this, you **must** send a single program message at a time and you **must** wait for the PPC3 to reply from the previous command before issuing another command.

Table 14. COM1 Pin Designations and Connections

PPC3 COM1 DB-9F PIN DESIGNATIONS		
PIN #	**FUNCTION**	**DESCRIPTION**
2	TxD	This pin transmits serial data from the PPC3 to the host.
3	RxD	This pin accepts serial data from the host computer.
5	Grn	This pin is the common return for the TxD and RxD signals.

IBM PC/XT DB-9F CONNECTIONS		IBM PC/XT DB-9M TO PPC3 DB9F CONNECTION	
DB-25M	**DB-9F**	**DB-9M**	**DB-9F**
2	3	3	3
3	2	2	2
7	5	5	5

4.2.1.2 IEEE-488

The PPC3 IEEE-488 interface is located on the back of the unit. The physical and electrical interface conforms to IEEE Std 488.1-1987 Subset E2 and IEEE Std. 488.2-1992. You should not attempt to communicate with the IEEE-488 interface while using the COM1 interface. The IEEE-488 receive buffer is 250 bytes deep. If you attempt to overflow the buffer, the PPC3 will hold off release of the NRFD handshake line until it can service and empty the receive buffer. This keeps the buffer from overflowing. It is recommended that you use the query form for all remote commands and wait for a reply to each command to ensue proper operation and order of command execution.

4.2.1.3 COM2

The PPC3 COM2 RS232 interface is located on the back of the unit. Its most common use is to connect to **DHI** RPM4 reference pressure monitors to PPC3 to add external measurement devices to the PPC3 system (see Section 3.2.4)

COM2 can be used to allow the host computer to communicate with another device through the PPC3. This allows the user to use one host COM port to communicate with the PPC3 and an additional RS232 device. Refer to the "#" and **"PASSTHRU"** remote program commands for details.

COM2 is a 9-pin female DB-9F connector configured as a DTE device. Data is transmitted out of the unit using pin 3, and is received on pin 2. This allows a normal pin-to-pin DB-9M to DB-9F RS232 cable to be used to connect to a DCE device.

Handshaking is not required or supported.

Table 15. COM2 DB-9F Pin Designations

PIN #	FUNCTION	DESCRIPTION
2	RxD	This pin transmits serial data from the PPC3 to a device.
3	TxD	This pin accepts serial data from the external device.
4	DTR	This pin is Data Terminal Ready (DTR) (held at + 5 V).
5	Grn	This pin is the common return for the TxD and RxD signals.

4.3 PROGRAMMING FORMATS

PPC3 supports two program message formats, the "classic" and "enhanced" formats. The user must select which format to use. Selection can be accomplished from the front panel (see Section 3.5.2.3) or remotely using the **"MSGFMT"** program message (see Section 4.4.4).

The main difference between the two formats is that when using the IEEE-488 interface, a **"?"** must be included in an enhanced command for there to be a response from the PPC3. In all other cases (classic or enhanced), every command has a response. In addition, the enhanced message format supports IEEE Std 488.2 syntax, format and status reporting.

The default is the classic format to allow downward compatibility with existing host software.

In either format, it is recommended that you start out a command sequence with the **"*CLS"** command, which clears all of the communication and error queues. The basic commands are similar for both the classic and enhanced formats, but the usage, syntax, format and status reporting are different.

The PPC3 program message set is downward compatible with the previous PPC2 and PPC2+ program message set. Some PPC2 and PPC2+ commands are not fully supported due to functional differences between PPC3 and earlier products.

4.3.1 CLASSIC PROGRAM MESSAGE FORMAT

The classic program message format is downward compatible with the previous PPC2 and PPC2+ program message set. However, several PPC2 and PPC2+ functions are not supported by PPC3 and neither are their corresponding commands (these include "DEVICE", "DPG", "ISO", "PPC", "HOLD", "TOUT", "TS"). The classic format is recommended if you need downward compatibility with older PPC2 and PPC2+ controllers.

Each program message sent is also a query. You can only send one program message to the PPC3 at time. After sending any program message, you must wait for the PPC3 to reply before sending another program message. This reply will contain data, or a numeric error message if the program message was invalid. You must wait for this reply before issuing another program message to the PPC3. This insures that the PPC3 has completed the program message. Most remote program messages will return a reply within 500 ms except:

"PR", **"PRR"**, **"SR"**, **"ATM"**, **"RATE"**: Up to 2.0 seconds to allow a new measurement.

"RPT", **"ARANGE"**: Up to 10 seconds

The syntax and format used for each program message in the classic mode is listed next to the keyword 'Classic:' in each program message summary in Section 4.4.4.

4.3.2 ENHANCED PROGRAM MESSAGE FORMAT

The enhanced program message format uses the IEEE Std. 488.2 format, syntax and status reporting. Errors are reported using the IEEE Std. 488.2 status reporting model. If an error is reported, the error is put into an Error Queue and the **"ERR?"** query program message can be used to get a text description of the most recent error. If you are using the IEEE-488 port, the service request line can be setup to be asserted if this occurs (see Section 4.5.2). In the enhanced format, there are two possible program message types for every program message. Each of these two types starts with the same basic text referred to as the program message header. The two types are COMMAND type and QUERY type commands.

4.3.2.1 USING COMMAND TYPE COMMANDS

Enhanced format commands DO NOT reply when using the IEEE-488 interface unless a "?" is included in the command. Do not expect a response from PPC3 to non-query (no "?") commands as there is none. Remote software will time-out waiting for a response from PPC3. However, in RS232 communications, there is always a response and the response MUST be read prior to issuing another command.

The COMMAND type of program message executes a process and can additionally send data to the PPC3 in the form of comma delimited arguments. This data is usually a setting of some sort that is stored in the PPC3. If data is specified, it must be preceded by at least one white space from the program message header and be within the range and format described in the program message description. The keyword **"Command:"** appears to the left of the required syntax in each program message description in Section 4.4.4.

If you are using the IEEE-488 port, the Command type does not generate a reply unless you place a query operator **"?"** immediately after the command. You also may send multiple program messages at once by separating each program message with a semicolon. The commands are queued and executed in as received order after the entire message stream has been received, so care in determining order of execution is needed.

If you are using the RS232 port COM1, the Command type will always generate a reply so you **must** wait for a reply before issuing another program message. Because of this, you can only send one Command program message at a time while using the COM1 port.

Examples:

- **IEEE-488 enhanced mode command series using query operator:**

  "*CLS?" (Clear the error queue. Wait for reply.)
  "UNIT? KPA" (Generates a reply. User must wait for reply before continuing.)
  "MMODE? A" (Generates a reply. User must wait for reply before continuing.)
  "PS? 100" (Generates a reply. User must wait for reply before continuing.)

- **IEEE-488 enhanced mode commands without query operator:**

  "*CLS" (Clear the error queue. No reply.)
  "UNIT KPA" (No reply)
  "MMODE A" (No reply)
  "PS 100" (No reply)
  "ERR?" (Wait for reply. User should use **"ERR?"** query following a series of non query commands to check for errors that may have occurred.)

- **IEEE-488 enhanced mode multiple commands without query operator:**

  "*CLS" (Clear the error queue. No reply)
  "UNIT KPA;MMODE A;PS 100" (Three commands at once. No reply)
  "ERR?" (Wait for reply. User should use **"ERR?"** query following a series of non query commands to check for errors that may have occurred)

- **COM1 enhanced mode command:**

  "*CLS" or **"*CLS?"** (Clear the error queue. Wait for reply.)
  "UNIT KPA" or **"UNIT? KPA"** (Generates a reply. User must wait for reply before continuing.)
  "MMODE A" or **"MMODE? A"** (Generates a reply. User must wait for reply before continuing.)
  "PS 100" or **"PS? 100"** (Generates a reply. User must wait for reply before continuing.)

4.3.2.2 USING QUERY TYPE COMMANDS

The QUERY type of program message just requests data from the PPC3. Placing the query operator **"?"** immediately after the command creates a query. You **must** wait for a reply with a query. If you send any type of program message to the PPC3 after a query before receiving a reply, the program message will be discarded and an error will be generated. Errors are reporting using the IEEE Std. 488.2 status reporting model. A Query program message always ends with a question mark. Most queries will return a reply within 200 ms except:

"PR?", **"PRR?"**, **"SR?"**, **"ATM?"**, **"RATE?"**: Up to 2.0 seconds.

"RPT", **"ARANGE"**: Up to 10 seconds

The syntax for using a QUERY program message is listed next to the keyword **"Query:"** in each program message summary in Section 4.4.4.

4.4 COMMANDS

4.4.1 PROGRAMMING MESSAGES

Table 16. Program Message List

#	Send a command string out of the PPC3 COM2 port.
ABORT	Stop pressure generation.
ARANGE	Read or set a new AutoRange to use.
ATM	Read the current atmospheric pressure (on-board barometer).
AUTOPURGE	Read or set the status of the automatic purge function.
AUTOVAC	Read or set the status of the control reference (EXHAUST port).
AUTOZERO	Read or set the status of the AutoZ automatic zeroing function.
CALAMB	Read or set the on-board barometer calibration
COM1	Read or set the configuration of the COM1 port.
COM2	Read or set the configuration of the COM2 port.
DATE	Read or set the current date.
DF	Decrease the pressure quickly (fast).
DP	Decrease the pressure a given amount.
DRV	Read or set the status of the external valve drivers.
DS	Decrease pressure slowly.
ERR	Read the last error message.
GPIB	Read or set the GPIB interface address.
HEAD	Read or set the fluid head settings.
HS	Read or set the current control hold limit in pressure.
HS%	Read or set the current control hold limit in percent span of the active range.
ID	Read or set the PPC3 alphanumeric asset ID tag.
IF	Increase the pressure quickly (fast).
IP	Slowly increase the pressure a given amount.
IS	Increase the pressure slowly.
L2	Selects “classic” program message format
L3	Selects “enhanced” program message format
LL	Read or set the lower limit for the current range (negative gauge mode only).
LOCAL	Return control to the PPC3 front panel.
MEM	Read the power-up memory test status.
MMODE	Read or change the active measurement mode.
MODE	Read or set the current pressure control mode.
MSGFMT	Read or set the type of program message format to use.
NVENT	Read or set the status of the lo vent valve (Gxxx or BGxxx Q-RPT only).
PASSTHRU	Send a command string out of the PPC3 COM2 port.
PCAL:IH	Read or set the user Lo RPT calibration information.
PCAL:IL	Read or set the user Hi RPT calibration information.
PCAL*n*:HI	Read or set the user Hi RPT calibration information (PPC2+ legacy command).
PCAL*n*:LO	Read or set the user Lo RPT calibration information (PPC2+ legacy command).
PR	Read the next PPC3 pressure.
PRR	Read the next PPC3 pressure, rate, and ATM.
PS	Set a new target pressure and start automated pressure control.
PSF	Set a new target pressure and use only the fast speed to reach the target.
PSS	Set a new target pressure and use only the slow speed to reach the target.
QPRR	Read the last PPC3 pressure, rate and ATM.
RANGE	Read or set the active range (PPC2+ legacy command).
RANGE	Read or set and Q-RPT or utility sensor default range (PPC3 command).
RATE	Read the next available rate of change of pressure.
READYCK	Read or set a flag that is cleared by a *Not Ready* condition.
REMOTE	Enable remote local lockout operation.
RES	Read or set the pressure display resolution for the current transducer and range.
RESET	Reset the PPC3 to the default user parameters.
RETURN	Start a new automated pressure control set using the current target value.
RPT	Read the available Q-RPT data or initiate the RPT search process.
SCRSAV	Read or set the front panel screen saver period.
SN	Read the serial number of the PPC3.
SR	Read the next available pressure status (*Ready/Not Ready*).
SS	Read or set the stability required for a *Ready* condition.
SS%	Read or set the stability required for a *Ready* condition (% span/ s).
STAT	Read the pressure generation status.

TIME	Read or set the current time of day.
TP	Read the current target pressure.
UCOEF	Convert a pressure in Pascal to pressure in the current units.
UDU	Read or set the user defined pressure unit.
UL	Read or set the upper limit for the current range.
UNIT	Read or set the pressure unit of measure for the current range.
VAC	Read or set the exhaust reference status flag.
VENT	Read, execute or abort a vent process.
VER	Read the PPC3 software version.
ZNATERR*n*:HI	PPC2+ legacy command. No function in PPC3.
ZNATERR*n*:LO	PPC2+ legacy command. No function in PPC3.
ZOFFSET*n*	Read or set the AutoZero P_{offset} for the specified Q-RPT.
ZOFFSET:IH	Read or set the AutoZ offset for Hi RPT.
ZOFFSET:IL	Read or set the AutoZ offset for Lo RPT.
ZOFFSET*n*:HI	Read or set the AutoZ offset for Hi Q-RPT (PPC2+ legacy command).
ZOFFSET*n*:LO	Read or set the AutoZ offset for Lo Q-RPT (PPC2+ legacy command).

4.4.2 ERROR MESSAGES

Table 17. Error #s and Descriptions

REPLY	DESCRIPTION
ERR# 0	“OK”
ERR# 2	“Text argument is too long”
ERR# 3	“Arguments 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	“Missing or improper command argument(s)”
ERR# 8	“External device time-out error”
ERR# 9	“Unknown command”
ERR# 10	“Missing or invalid command suffix”
ERR# 11	“Command missing argument”
ERR# 12	“System overpressured” or “overpressure may result”
ERR# 13	“Text queue overflow”
ERR# 14	“User unit not defined”
ERR# 16	“Generation failure”
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 is not stable”
ERR# 23	“Option not available or installed”
ERR# 24	“Unit must be vented”
ERR# 25	“Transducer out of calibration”
ERR# 26	“COM port failed to initialize”
ERR# 27	“Internal device failure”
ERR# 28	“Device failure”
ERR# 29	“Device not available”
ERR# 30	“Must be on range IH”
ERR# 31	“Exceeds upper or lower limit”
ERR# 32	“Not stable enough”
ERR# 37	“Data table is full”
ERR# 38	“Selected range is not available”
ERR# 39	“Data verify error”
ERR# 45	“Argument not allowed”
ERR #46	“Argument cannot be negative”
ERR #52	“Command obsolete”
ERR# 53	“Not Available”

4.4.3 PROGRAM MESSAGE DESCRIPTION OVERVIEW

Each program message description is separated into the following sections:

Purpose	A brief description of the programs message's function.
Command	This is the Enhanced program message syntax to send data to the PPC3 or to execute a PPC3 function. The PPC3 **must** be set to use the enhanced format (see Section 3.5.2.3) to use the syntax and style shown. It may be sent alone, or followed by at least one white space and additional argument(s) to show that arguments can be passed. If there are multiple arguments, then commas must separate them. If you are using the IEEE-488 port, multiple command type program messages can be sent in one message if you separate them with a semicolon. There will be no reply from the PPC3 using the IEEE-488 port unless the command is immediately followed by the query operator "?". If you are using the COM1 port, the PPC1 will reply and you **must** wait for this reply. If this field is not listed in the program message description, then the Command type is not supported when using the Enhanced format.
Query	This is the Enhanced program message syntax to request data from the PPC3. The PPC3 **must** be set to use the enhanced format (see Section 3.5.2.3). The PPC3 will always reply to a query. You **must** wait for this reply before issuing another program message. If this field (Query) is not listed in the program message description, then the Query type for the program message is not supported when using the Enhanced format.
Classic	This is the Classic program message syntax to send data to the PPC3, to execute a PPC3 function, or to query for data. The PPC3 **must** be set to use the classic format (see Section 3.5.2.3). The command may be followed by a '(=)' and additional argument characters to show that argument(s) can be passed. If there are multiple arguments, then commas must separate them. The PPC3 will always reply to a Classic program message. You **must** wait for this reply before issuing another program message. If this field is not listed in the program message description, then it is not supported when using the classic format.
Arguments	If the program message can be used to set data inside the PPC3, then this section describes the arguments and their limits.
Default	If the program message can be used to set data inside the PPC3, then this line shows (using the enhanced format) the default setting from the factory.
Remarks	This field has the details and remarks about the command.
Example	Examples are given for the enhanced and classic methods. **Enhanced:** An example of the use of an enhanced format program message to be sent to the PPC3 is shown. The message sent to the PPC3 appears after the **"Cmd sent:"** label. If only a Query type exists, the **"Query sent:"** label is shown instead. Directly under this label, **"Query reply"** shows a typical reply to a query type. **"Reply:"** shows that a query format does not exist. It may have a short description next to it. **Classic:** An example of the use of a classic program message to be sent to the PPC3 is shown. The command sent to the PPC3 appears after the **"Cmd sent:"** label. The **"Reply"** label shows a typical reply to the **"Sent"** example. It may have a short description next to it.
Errors	If the program message can report an argument error, the types of errors are listed. If using the classic format or the COM1 port, the error message is replied after receiving the program message. If using the enhanced format via the IEEE-488 port, the error condition is handled by the status reporting model which stores the errors in an Error Queue and can be programmed to assert the IEEE-488 SRQ line to signal an error has occurred. In either case, the **"ERR"** or **"ERR?"** program message can be used to retrieve a text description of the error.
See Also	Indicates related command (**"----"**) and refers to manual sections giving detail on PPC3 operation corresponding to the program message.

4.4.4 PROGRAM MESSAGE DESCRIPTIONS

#	
Purpose	To allow the host PC to communicate with a device connected to the PPC3 COM2 port. The preferred method is to use the "PASSTHRU" program message.
Classic	*"#xx"*
Arguments	*xx:* The string to send out of the COM2 port. It must be less than 40 characters long.
Remarks	The PPC3 COM2 port can be used to communicate to another RS232 device (such as another PPC3). This allows the user to use one COM port or IEEE-488 port on the host computer to communicate with the PPC3 and another device. A carriage return and a line feed (**<CR><LF>**) are added to the string. After this program message is issued, the PPC3 will reply back the first string received by the PPC3 COM2 port that is terminated with a carriage return. Line feeds are discarded. This will discontinue when the next program message is sent to the PPC3. There is no other reply from this program message. Prior to using this program message, you must ensure that the PPC3 COM2 port is correctly set up to communicate with the device on COM2. Refer to the **"COM2="** program message.
Example (classic)	Sent: "#VER" Reply: "DH INSTRUMENTS, INC PPC3 us A1000/A0015 Ver2.00 " This example assumes that a second PPC3's COM1 port is connected to the PPC3 COM2 port. This example gets the version of the second PPC3.
See Also	"PASSTHRU", "COM2" 3.5.2 *COM2 is generally used for connecting DHI RPM4s to supply external measurement devices in which case communications are handled automatically by the PPC3,*

ABORT	
Purpose	Stops active pressure generation/control. All control valves are closed. The exhaust and transducer isolation valves are not affected.
Command Classic	"ABORT" "ABORT"
Remarks	This program message has no effect if the PPC3 is not using automated pressure control. When using automated pressure control, it aborts the control. This command is recommended to idle the PPC3 before setting a new target pressure.
Example (enhanced)	Cmd sent: "ABORT" Reply: "ABORT" (no reply if IEEE-488)
Example (enhanced)	Cmd sent: "ABORT?" Reply: "ABORT"
Example (classic)	Sent: "ABORT" Reply: "ABORT"
See Also	3.3.10, 3.2.1

ARANGE		
Purpose	Read or set a new AutoRange range to use.	
Command Query	"ARANGE *Range, unit, mode (,RptLabel)*" "ARANGE?"	
Classic	"ARANGE= *Range, units, mode (,RptLabel)*" "ARANGE"	
Arguments	*Range* *Unit:* *Mode:* *RptLabel:* (optional)	The AutoRange maximum pressure. Cannot be negative. The unit of measure of the *Range* argument. The measurement mode of the *Range* argument: "A" for absolute "G" for gauge "N" for negative gauge Measured pressure values are returned with "g" to identify measurement mode for both gauge and negative gauge measurement modes. One of the Internal or External RPTs that is available. "IH": Internal, Hi Q-RPT "IL": Internal, Lo Q-RPT "X1H": First external RPM4, Hi Q-RPT "X1L": First external RPM4, Lo Q-RPT "X2H": Second external RPM4, Hi Q-RPT "X2L": Second external RPM4, Lo Q-RPT
Remarks	The ARANGE command is used to define a PPC3 range by specifying a desired unit of measure, measurement mode and maximum pressure, and have the PPC3 pick the best available Q-RPT and make operational adjustments to optimize that range. Available Q-RPTs may be determined by the use of the "RPT" command to search for external RPM4 devices or use of the [RPT] function key. The optional "*RptLabel*" argument can be used to specify which Q-RPT you wish to use for the AutoRange range instead of allowing the PPC3 to pick the best Q-RPT. By using this option you can override the internal logic that picks the most suitable Q- RPT. This Q-RPT must have been previously found using the "RPT" command or the [RPT] function key and must be valid for the maximum pressure and measurement mode specified. The reply indicates the current range data, including the *RptLabel* used for the range. If "inWa" is specified for the pressure unit of measure, the temperature reference can be given after the unit text ("inWa4", "inWa20" or "inWa60" corresponding to inWa at 4 °C, 20 °C or 60 °F). If no temperature is specified, a default of 20 °C is assumed. There is no indication of the temperature reference in the reply.	
Example (enhanced)	Cmd sent: Query reply:	"ARANGE?" (read the current range in the current units) "100.00, psi, A, IH"
Example (classic)	Cmd sent: Query reply:	"ARANGE" (read the current range in the current units) "100.00, psi, A, IH"
Example (enhanced)	Cmd sent: Query reply:	"ARANGE? 250, inWa4, G (range of 250 inWa @ 4 °C in gauge mode) "250.000 inWa, G, X2H" (Hi RPT of 2nd external RPM4 used)
Example (classic)	Cmd sent: Query reply:	"ARANGE=250, kPa, G (set a range of 250 kPa in gauge mode) "250.00 kPa, G, X1L" (Lo RPT of 1st external RPM4 used)
Example (enhanced)	Cmd sent: Query reply:	"ARANGE 50, psi, A, X1L (set a range of 50 psi in absolute mode on Lo RPT of 1st RPM4) "50.000 psi, A, X1L" (No reply if IEEE-488)
Errors	ERR# 4: ERR# 5: ERR# 6: ERR# 19: ERR# 20: ERR# 29:	RPT previously found not detected. Usually occurs when the external RPM4(s) have been disconnected since the last RPT "search" RPT previously found not the same as now found. Usually occurs when the external RPM4(s) connections to the PPC3 have been changed since the last RPT "search". "*Range*" maximum pressure exceeds available RPTs or is negative. Cannot Range to '0' with absolute units. Cannot Range to '0' with gauge units. Correct type of RPT for the selected "*Mode*" is not available.
See Also	"RPT", "RANGE" 3.3.4, .3.2.4, 3.2.5, 3.3.3	

ATM	
Purpose	Reads the next measured pressure from PPC3's on-board barometer (if present).
Query Classic	"ATM?" "ATM"
Remarks	The atmospheric pressure as measured by the PPC3 on-board barometer is returned in the current pressure units (always absolute). This measurement is followed by the units text. Not all PPC3s are equipped with an on-board barometer.
Example (enhanced)	Query sent: "ATM?" Query reply: "97.12348 kPaa"
Example (classic)	Sent: "ATM" Reply: "97.12384 kPaa"
Errors	ERR# 23: PPC3 is not equipped with a barometer.
See Also	3.5.7.3

AUTOPURGE	
Purpose	Read or set the status of the automatic purge function.
Command Query	"AUTOPURGE n" "AUTOPURGE?"
Classic	"AUTOPURGE=*n*" "AUTOPURGE"
Default	"AUTOPURGE 0"
Arguments	*n*: '0' To disable AUTO mode. '1' To enable AUTO mode.
Remarks	The PPC3 can automatically control the external SPLT functions to purge the test system before running a test, if desired.
Example (enhanced)	Cmd sent: "AUTOPURGE 1" Query reply: "1" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "AUTOPURGE 1" Query reply: "1"
Example (classic)	Sent: "AUTOPURGE=1" Query reply: "AUTOPURGE=0"
Errors	ERR# 6: The argument was other than a '0' or a '1'.
See	3.3.8, 3.5.7.4

AUTOVAC	
Purpose	Read or set the status of the automated Control Ref determination mode.
Command Query	"AUTOVAC *n*" "AUTOVAC?"
Classic	"AUTOVAC=*n*" "AUTOVAC"
Default	"AUTOVAC 1"
Arguments	*n*: '0' To disable AUTO mode. ("VAC" cmd determines status) '1' To enable AUTO mode. This will override the manual selection.
Remarks	At low pressures, PPC3 control is affected by whether the EXHAUST port is open to atmosphere or connected to vacuum. The PPC3 has an internal sensor that can be used to automatically determine if the EXHAUST port is open to atmosphere or to a vacuum. You can disable it to manually override it. It is recommended to use the "VAC" command to disable this feature instead of the "AUTOVAC=0" command, as you can also specify vacuum or atmospheric reference at the same time with the VAC command.
Example (enhanced)	Cmd sent: "AUTOVAC 1" Query reply: "1" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "AUTOVAC 1" Query reply: "1"
Example (classic)	Sent: "AUTOVAC=0" Query reply: "AUTOVAC=0"
Errors	ERR# 6: The argument was other than a '0' or a '1'.
See Also	"VAC" 3.5.7.2

AUTOZERO	
Purpose	Read or set the status of the AutoZ function.
Command Query	"AUTOZERO *n*" "AUTOZERO?"
Classic	"AUTOZERO=*n*" "AUTOZERO"
Default	"AUTOZERO 1"
Arguments	*n*: '0' Autozero OFF '1' Autozero ON
Remarks	The PPC3 AutoZ function can be turned ON and OFF. There is a separate AutoZ flag for the gauge and absolute modes for each RPT. This command sets the AutoZ status for the current mode of the active internal or external RPT only.
Example (enhanced)	Cmd sent: "AUTOZERO 0" Query reply: "0" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "AUTOZERO 0" Query reply: "0"
Example (classic)	Sent: "AUTOZERO=1" Query reply: "AUTOZERO=0"
Errors	ERR# 6: The argument was other than a '0' or a '1'.
See Also	"ZOFFSET", "MMODE" 3.5.1

CALAMB	
Purpose	Read or set the on-board barometer calibration coefficients.
Command Query	"CALAMB *adder, mult, CalDate*" "CALAMB?"
Classic	"CALAMB=*adder, mult, CalDate*" "CALAMB"
Defaults	"CALAMB = 0.0, 1.0, 19800101"
Arguments	*Adder:* The Barometer calibration adder (PA).In Pascal. *Mult:* The Barometer calibration multiplier (PM) from 0.1 to 100. *CalDate:* The date of the calibration in the format "YYYYMMDD"
Remarks	The barometer calibration information can be accessed with this program message. Using this program message overwrites the current calibration coefficients, so caution must be used. Changes made take effect immediately.
Example (enhanced)	Cmd sent: "CALAMB? 2.1, 1.000021, 20011201" Query reply: " 2.10, 1.000021, 20011201" (No reply if IEEE-488)
Example (classic)	Sent: "CALAMB=2.1, 1.000021, 20011201" Reply: " 2.1, 1.000021, 20011201"
Errors	ERR# 6: One of the arguments is out of range.
See Also	3.5.7.3, 5.3

COM1	
Purpose	Read or set the RS232 settings for the COM1 port.
Command Query	"COM1 *baud, parity, data, stop*" "COM1?"
Classic	"COM1=*baud, parity, data, stop*" "COM1"
Arguments	*Baud:* The baud rate. This may be '300', '600','1200','2400','4800', '9600' or '19200'. *Parity:* The data parity. This may be 'O' for odd, 'E' for even, or 'N' for none. *Data:* The number of data bits. This may be '7' or '8'. *Stop:* The number of stop bits. This may be '1' or '0'.
Defaults	"COM1 2400,E,7,1"
Remarks	The COM1 port is used to communicate to the PPC3. When the COM1 port configuration of the PPC3 is changed, the program message reply (COM1 use only) is sent at the old COM1 settings, but all subsequent communications are accomplished at the new COM1 settings. A 200ms or longer delay after receiving the reply to this command will ensure that the PPC3 has changed the COM port settings and is ready for communications at the new settings.
Example (enhanced)	Cmd sent: "COM1 9600,N,8,1" Query reply: "9600,N,8,1" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "COM1? 9600,N,8,1" Query reply: "9600,N,8,1"
Example (classic))	Sent: "COM1=9600,N,8,1" Reply: "9600,N,8,1"
Errors	ERR# 7: Missing or improper program message argument(s).
See Also	"PASSTHRU" 3.5.2.1

COM2	
Purpose	Read or set the RS232 settings for the COM2 port.
Command Query	"COM2 *baud,parity,data,stop*" "COM2?"
Classic	"COM2= *baud,parity,data,stop*" "COM2"
Arguments	*baud*: The baud rate. This may be '300', '600','1200','2400','4800', '9600' or '19200'. *parity*: The data parity. This may be 'O' for odd, 'E' for even, or 'N' for none. *Data:* The number of data bits. This may be '7' or '8'. *stop*: The number of stop bits. This may be '1' or '0'.
Defaults	"COM2 2400,E,7,1"
Remarks	COM2 is generally used to connect **DHI** RPM4 external measurement devices. The COM2 port can also be used to allow the host computer to communicate through the PPC3 to an additional device connected to COM2. This can be useful if the host computer does not have 2 serial ports available.
Example (enhanced)	Cmd sent: "COM2 9600,N,8,1" Query reply: "9600,N,8,1" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "COM2? 9600,N,8,1" Query reply: "9600,N,8,1"
Example (classic)	Sent: "COM2=9600,N,8,1" Reply: "9600,N,8,1"
Errors	ERR# 7: Missing or improper program message argument(s).
See Also	"#", "PASSTHRU" 3.5.2.1

CONFIG	
	This is a legacy PPC2 command
Purpose	PPC3 does not support a remotely activated configuration routine. The "CONFIG" command from PPC2 will reply as if CONFIG had occurred.
See	3.4.7.1

DATE	
Purpose	Read or set the PPC3 date.
Command Query	"DATE *date*" "DATE?"
Classic	"DATE= *date*" "DATE"
Arguments	*date*: The date in the numerical only format YYYYMMDD or YYMMDD with no spaces or separators.
Remarks	The PPC3 has an internal real time calendar clock. It is used for date stamping calibrations. The reply is always in the YYYYMMDD format.
Example (enhanced)	Cmd sent: "DATE 20030115" Query reply: "20030105" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "DATE? 20030105" Query reply: "20020105"
Example (classic)	Sent: "DATE=021201" Reply: "20021201"
Errors	ERR# 7: Missing or improper program message argument(s).
See Also	"TIME" 3.5.5.3

DF	
Purpose	Decrease the pressure quickly (fast).
Command	"DF *n*"
Classic	"DF=*n*"
Arguments	'0' Closes the fast down valve. '1' Opens the fast down valve.
Remarks	Opening the fast down valve causes the pressure to decrease quickly.
Example (enhanced)	Cmd sent: "DF 1" Reply: "1" (no reply if IEEE-488)
Example (enhanced)	Cmd sent: "DF? 1" Reply: "1"
Example (classic)	Sent: "DF=1" Reply: "DF=1"
Errors	ERR# 6: The *n* argument is a '0' or a '1'.
See Also	"IF" , "DS", "IS", "IP", "DP", Figure 12

DP	
Purpose	Decrease the pressure slowly a given amount using the slow speed.
Command	"DP *n*"
Classic	"DP=*n*"
Arguments	*n:* The decrease in pressure desired (current pressure units). This can be from 0 to 2 % FS of the active range.
Remarks	The slow speed will be used for a calculated amount of time (up to 5 seconds) to create the desired change. The PPC3 will not attempt to control the pressure to a target, so the change in pressure will be approximate. This is the equivalent of using the step up direct pressure control key.
Example (enhanced)	Cmd sent: "DP 2" Reply: "2.000 kPa" (no reply if IEEE-488)
Example (enhanced)	Cmd sent: "DP? 2" Reply: "2.000 kPa"
Example (classic)	Sent: "DP=2" Reply: "2.000 kPa"
Errors	ERR# 6: The *n* argument is not within given limits.
See Also	"IP", "DS", "IS", "DF", "IF" 3.4.3, 3.1.3

DRV*n*	
Purpose	Read or set the status of external electrical drivers.
Command Query	"DRV*n* *x*" "DRV*n*?"
Classic	"DRV*n*=*x*" "DRV*n*"
Arguments	*n:* The driver to operate. This can be from 1 to 8. *x:* The state to change the driver to; '0' to de-activate it, '1' to activate it.
Remarks	The PPC3 control has eight optional external drivers. Driver is used by the optional PURGE function.
Example (enhanced)	Cmd sent: "DRV1 1" Query reply: "1" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "DRV2? 1" Query reply: "1"
Example (classic)	Sent: "DRV1=1" Reply: "DRV1=1"
Errors	ERR# 6: The *n* or *x* arguments are not within given limits.
See Also	3.4.7

DS	
Purpose	Decrease the pressure slowly.
Command	"DS *n*"
Classic	"DS=*n*"
Arguments	*n:* *'0'* Closes the slow down valve. *'1'* Opens the slow down valve.
Remarks	Opening the slow down valve causes the pressure to decrease slowly.
Example (Enhanced)	Cmd sent: "DS 1" Reply: "1" (no reply if IEEE-488)
Example (Enhanced)	Cmd sent: "DS? 1" Reply: "1"
Example (Classic)	Sent: "DS=1" Reply: "DS=1"
Errors	ERR# 6: The *n* argument is a '0' or a '1'.
See Also	"IS", "DF", "IF", "DP, "IP" Figure 12

ERR	
Purpose	Read the new available error message from the Error Queue.
Query	"ERR?"
Classic	"ERR"
Remarks	This program message obtains additional details about an error that has occurred. If the user receives an "ERR# nn" reply, or the enhanced mode is enabled using the IEEE-488 interface and an error has been detected, the error is put into a FIFO Error Queue. The "ERR" program message pulls and replies the oldest error message available. "OK" is replied if there are no error messages left.
Example (enhanced):	Query sent: "ERR?" Query reply: "Numeric argument missing or out of range"
Example (classic)	Sent: "ERR" Reply: "Numeric argument missing or out of range"
See Also	4.4.2

GPIB	
Purpose	Read or set the GPIB interface address.
Command *Query*	"GPIB *addr*" "GPIB?"
Classic	"GPIB=*addr*" "GPIB"
Defaults	"GPIB 10"
Arguments	*addr:* The address of the GPIB488 interface (1 to 31)
Remarks	The GPIB address is changed following the reply of this command. Each device on a GPIB interface bus requires a unique address.
Example (enhanced)	Cmd sent: "GPIB 21" Query reply "21" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "GPIB? 21" Query reply "21"
Example (classic)	Sent: "GPIB=21" Reply: "21"
Errors	ERR# 6: The argument is not within given limits.
See Also:	3.5.2.2

HEAD	
Purpose	Read or set the fluid head settings.
Command Query	"HEAD *h,u,f*" "HEAD?"
Classic	"HEAD=*h,u,f*" "HEAD"
Defaults	"HEAD 0,cm,N2"
Arguments	*h:* The height of the test in relation to the PPC3. This is positive if the test is above the PPC3, or negative if below the PPC3. This value can be between - 9999 and 9999. Setting this value to '0' disables the head correction. *u:* The height units. This must be "in" or "cm". *f:* The fluid type. This must be "N2", "Air", "He", "Oil", "H2O", or "User".
Remarks	The PPC3 can make a fluid head correction to allow it to display the pressure at the level of the device under test instead of at the level of the PPC3.
Example (enhanced)	Cmd sent: "HEAD 10,in,N2" Query reply: "10, in, N2"
Example (classic)	Sent: "HEAD=10,in,N2" Reply: "10, in, N2"
Errors	ERR# 6: The arguments are not within given limits.
See Also:	3.3.7, 3.5.3

HS	
Purpose	Read or set the automated pressure control hold limit as a pressure value.
Command Query	"HS *hold*" "HS?"
Classic	"HS=*hold*" "HS"
Arguments	*Hold:* The hold limit in the current pressure unit of measure.
Remarks	The hold limit can be read and set as a pressure.
Example (enhanced)	Cmd sent: "HS .1" Query reply: "0.1 kPa" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "HS? .1" Query reply: "0.1 kPa"
Example (classic)	Sent: "HS=0.1" Reply: "0.1 kPa"
Errors	ERR# 6 The *'hold'* argument was invalid.
See Also	"HS%" 3.4.6.1, 3.2.2

HS%	
Purpose	Read or set the automated pressure control hold limit for as a percent of range span.
Command Query	"HS% *hold*" "HS%?"
Classic	"HS%=*hold*" "HS%"
Arguments	*hold:* The hold limit in % span of the active range.
Remarks	The hold limit can be read and set as a pressure or as a percent of the span.
Example (enhanced)	Cmd sent: "HS .01" Query reply: "0.0100 %" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "HS? .01" Query reply: "0.0100 %"
Example (classic)	Sent: "HS=.01" Reply: "0.0100 %"
Errors	ERR# 6 The *'hold'* argument was invalid.
See Also	"HS" 3.4.6.1, 3.2.2

ID	
Purpose	Read or set the user defined instrument identification label.
Command *Query*	"ID *string*" "ID"
Classic	"ID=*string*" "ID"
Arguments	*String:* An alphanumeric string up to 12 characters long.
Remarks	The user defined ID label can be used to allow the user to "tag" the PPC3 with a unique identifier. This ID is stored in non-volatile memory and cannot be erased by a power failure, system fault or reset
Example *(enhanced)*	Cmd sent: "ID PPCK #A01" Query reply "PPCK #A01" (No reply if GPIB-488)
Example *(enhanced)*	Cmd sent: "ID PPCK? #A01" Query reply "PPCK #A01"
Example *(classic)*	Sent: "ID=PPCK #A01" Reply: "PPCK #A01"
Errors	ERR# 6 The *'string'* argument was longer than 12 char.
See Also	3.5.5.4

IF	
Purpose	Increase the pressure quickly (fast).
Command	"IF *n*"
Classic	"IF=*n*"
Arguments	*n:* *'0'* Closes the fast up valve. *'1'* Opens the fast up valve.
Remarks	Opening the fast up valve causes the pressure to increase quickly. Care must be used, as the pressure will not stop increasing until the valve is closed, or the upper limit is exceeded.
Example (enhanced)	Cmd sent: "IF 1" Reply: "1" (no reply if IEEE-488)
Example (enhanced)	Cmd sent: "IF? 1" Reply: "1"
Example (classic)	Sent: "IF=1" Reply: "IF=1"
Errors	ERR# 6: The *n* argument is a '0' or a '1'.
See Also	"DF", "IS" , "DS", "IP", "DP", Figure 12

IP	
Purpose	Increase the pressure a given amount using the slow speed.
Command	"IP *n*"
Classic	"IP=*n*"
Arguments	*n:* The increase in pressure desired (current pressure units). This can be from 0 to 2 % FS of the active range.
Remarks	The slow speed will be used for a calculated amount of time (up to 5 seconds) to create the desired change. The PPC3 will not attempt to control the pressure to a target, so the change in pressure will be approximate. This is the equivalent of using the step down direct pressure control key.
Example (enhanced)	Cmd sent: "IP 2" Reply: "2.000 kPa" (no reply if IEEE-488)
Example (enhanced)	Cmd sent: "IP? 2" Reply: "2.000 kPa"
Example (classic)	Sent: "IP=2" Reply: "2.000 kPa"
Errors	ERR# 6: The *n* argument is not within given limits.
See Also	"DP", "IF" , "DF", "IS", "DS" 3.4.3, 3.1.3

IS	
Purpose	Increase the pressure slowly.
Command	"IS *n*"
Classic	"IS=*n*"
Arguments	*n:* *'0'* Closes the slow up valve. *'1'* Opens the slow up valve.
Remarks	Opening the slow up valve causes the pressure to increase slowly. Care must be used, as the pressure will not stop increasing until the valve is closed, or the upper limit is exceeded.
Example (enhanced)	Cmd sent: "IS 1" Reply: "1" (no reply if IEEE-488)
Example (enhanced)	Cmd sent: "IS? 1" Reply: "1"
Example (classic)	Sent: "IS=1" Reply: "IS=1"
Errors	ERR# 6: The *n* argument is a '0' or a '1'.
See Also	"DS" , "IF" , "DF", "IP", "DP" Figure 12

L2 / L3	
Purpose	Read or set the type of program command format to use (classic or enhanced).
Command	"L2"enables "classic" mode "L3"enables "enhanced" mode
Defaults	"L2" (Classic mode)
Remarks	The user can select the type of remote command format using these simplified commands. There is no query format. This format must agree with the format sent to the RPM4. This command is a replacement for the "MSGFMT" command.
Example (enhanced)	Cmd sent: "L3" Query reply: "L3" (No reply if IEEE-488)
Example (classic)	Sent: "L2" Reply: "L2"
See Also	"MSGFMT" 3.5.2.3, 4.3

LL(=)	
Purpose	Read or set the lower pressure limit for the active range and measurement mode (negative gauge measurement mode only).
Command	"LL *n*"
Classic	"LL=*n*"
Arguments	*n:* The lower pressure limit for the current pressure range in the current unit of measure. Value is always a negative value of gauge pressure.
Remarks	Negative gauge mode in PPC3 has a lower limit. New automated pressure control targets can not be less than this value. If the pressure exceeds the lower limit, the pressure display flashes, and pressure control is aborted. Manual decreases in pressure are not allowed as long as the pressure is below the lower limit. Increases in pressure are allowed. This feature should always be used to prevent accidental over (under) pressure of a device under test.
Example (enhanced)	Cmd sent: "LL -4" Reply: "-4 kPa g" (no reply if IEEE-488)
Example (enhanced)	Cmd sent: "LL? -4" Reply: "-4 kPa g"
Example (classic)	Sent: "LL=-4" Reply: "-4 kPa g"
Errors	ERR# 6: The *n* argument is invalid. ERR# 23 The mode must be negative gauge to specify a lower limit.
See Also	"UL" 3.4.4

LOCAL	
Purpose	Returns control to the PPC3 front panel.
Command	"LOCAL"
Classic	"LOCAL"
Remark	The REMOTE program message can lock the front panel out completely. The user can return to local operation by sending the LOCAL program message, sending the IEEE-488 'GTL' command (if in enhanced format), or by cycling PPC3 power.
Example (enhanced)	Cmd sent: "LOCAL" Reply: "LOCAL" (no reply if IEEE-488)
Example (enhanced)	Cmd sent: "LOCAL?" Reply: "LOCAL"
Example (classic)	Sent: "LOCAL" Reply: "LOCAL"
See Also	"REMOTE"

MEM	
Purpose	Read the status from the power-up memory test.
Query	"MEM?"
Classic	"MEM"
Remarks	The PPC3 system memory stores the user settings (units, resolution, generation settings) and retains them when the unit is OFF. On power-up, this memory is checked. If this memory is corrupted, all user settings are reset to default , and the MEM status will be set to reflect this.
Example (enhanced)	Query sent: "MEM?" Reply: "0" PPC3 data corrupted and was set to factory defaults. "1" The memory was found to be OK on power-up.
Example (classic)	Sent: "MEM" Reply: "MEM=0" PPC3 data corrupted and was set to factory defaults. "MEM=1" The memory was found to be OK on power-up.
See Also	3.5.9

MODE	
Purpose	Read or set the automated pressure control mode.
Command Query	"MODE *n*" "MODE?"
Classic	"MODE=*n*" "MODE"
Arguments	*n:* '0' for static pressure control. '1' for dynamic pressure control.
Remarks	The method which the PPC3 controls pressure is selected with the "MODE" program message. When the control mode is set, control parameters go to default parameters for that range. The control mode setting is range dependent.
Example (enhanced)	Cmd sent: "MODE 1" Query reply: "1" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "MODE? 1" Query reply: "1"
Example (classic)	Sent: "MODE=1" Reply: "MODE=1"
Errors	ERR# 6 The argument is invalid.
See Also	"HS", "SS" 3.4.6, 3.2.1

MMODE	
Purpose	Read or change the active measurement mode.
Command Query	"MMODE=*mode*" "MMODE"
Classic	"MMODE=*mode*" "MMODE "
Arguments	*Mode:* "A" Absolute mode "G" Gauge mode "N" Negative gauge mode  Measured pressure values are returned with "g" to identify measurement mode for both gauge and negative gauge measurement modes.
Remarks	The active RPT or an AutoRange range should selected before setting measurement mode since measurement mode is range specific. The measurement mode can also be set using the "UNIT" command but the "UNIT" command does not distinguish between gauge and negative gauge while the "MMODE" does.
Example (enhanced)	Cmd sent: "MMODE A" Query reply: "A" (No reply if IEEE-488)
Example (enhanced)	Cmd sent: "MMODE? A" Query reply: "A"
Example (enhanced)	Cmd sent: "MMODE=G" Query reply: "G"
Errors	ERR# 6: Invalid argument text. ERR# 7: Abs mode only with altitude units or gauge mode only with gauge RPT. Absolute or negative gauge mode not available with gauge RPT or absolute ERR# 20: RPT with an absolute and negative gauge OFF calibration. The current range cannot support gauge mode. ERR# 53: Not available.
See Also	"UNIT" 3.3.3

MSGFMT	
Purpose	Read or set the type of program command format to use (enhanced or classic).
Command Query	"MSGFMT *n* "MSGFMT?"
Classic	"MSGFMT=*n* "MSGFMT"
Arguments	*n:* '1' to use the enhanced command format. '0' to use the classic command format.
Defaults	"MSGFMT 0"
Remarks	The user can select the type of remote command format to use. This format must agree with the format sent to the PPC3. The enhanced query form of this command ("MSGFMT? *n*") should always be used to set the desired format, as it will be accepted regardless of the current format (classic or enhanced).
Example (enhanced)	Cmd sent: "MSGFMT 1" Query reply: "1" (No reply if IEEE-488)
Example (enhanced)	Cmd sent: "MSGFMT? 1" Query reply: "1"
Example (classic)	Sent: "MSGFMT=1" Reply: "MSGFMT=1"
Errors	ERR# 6: Missing or improper program message argument(s).
See Also	4.3

NVENT	
Purpose	Read or set the status of low (negative) vent valve (Gxxx or BGxxx Q-RPT only)
Command Query	"NVENT *n*" "NVENT?"
Classic	"NVENT=*n*" "NVENT"
Default	"NVENT AUTO"
Arguments	*n:* '0' to close the low vent valve. '1' to open the low vent valve. 'AUTO' for the PPC3 to automatically open and close the low vent valve.
Remarks	A PPC3 with at least one Gxxx or BGxxx Q-RPT has a low vent valve that is used to vent the TEST(-) port. This valve is normally controlled automatically depending on current PPC3 operation but it can be commanded to open or close using the "NVENT" command. The PPC3 may not immediately open the negative vent valve when commanded to do so, as it checks to make sure that such an action will not cause harm to the low pressure Q-RPT. The reply includes two fields. The first indicates the low vent status. The second indicates whether the low vent function is AUTO or MANUAL
Example (enhanced)	Cmd sent: "NVENT 0" Query reply: "0, MANUAL"
Example (enhanced)	Cmd sent: "NVENT? AUTO" Query reply: "1, AUTO"
Example (classic)	Sent: "NVENT=1" Query reply: "0, MANUAL"
See Also	"VENT" 3.5.7.5

PASSTHRU	
Purpose	To allow the host PC to communicate with a device connected to the PPC3 COM2 port.
Command Query	"PASSTHRU *n* "PASSTHRU?"
Classic	"PASSTHRU= *n*" "PASSTHRU"
Arguments	*n*: The string to send out of the COM2 port. It must be less than 40 characters long.
Remarks	Generally, the PPC3 COM2 port is used for communication with DHI RPM4s used as PPC3 external measurement devices. The COM2 port can alternatively be used to communicate to another RS232 device (such as another PPC3). This allows the user to use one COM port or IEEE-488 port on the host computer to communicate with the PPC3 and another device. The Command format specifies and sends the argument. A carriage return and a line feed (<CR><LF>) are added to the string that is sent. The Query format is used to check the PPC3 COM2 receive buffer to see if a message has been received on COM2 from the device. The message received by the COM2 port must be terminated with a carriage return or a carriage return and a line feed. Only one message is retained by the COM2 port. The label "COM2:" precedes the message text. If the COM2 receive buffer is empty, then the reply is just be 'COM2:"
Example (enhanced)	Cmd sent: "PASSTHRU=VER" Query reply: "COM2:DH INSTRUMENTS, INC PPC3 VER1.01a" Query reply: "COM2:" (If the COM2 buffer is empty)
Example (classic)	Sent: "PASSTHRU=VER" Reply: "COM2:DH INSTRUMENTS, INC PPC3 VER1.01a" Reply: "COM2:" (If the COM2 buffer is empty)
See Also	"#" , "COM2"

PCAL*n*:HI and PCAL*n*:LO (PPC2+ legacy version)	
Purpose	**This command is included for reverse compatibility with PPC2+, and should only be used if needed for command compatibility.** **Otherwise, use "PCAL:IH" and "PCAL:IL"** Read or set the RPT calibration information. See the PPC2 or PPC2+ manual for details on the use of this command. PPC3 does not operate with three specific range (1, 2, 3) on a single RPT. In PPC3, the "n" prefix corresponding to the H, M or L range on a PPC2 or PPC2+ RPT, is ignored.
See Also	"PCAL:IH", "PCAL:IL" 5.2

PCAL:IH and PCAL:IL	
Purpose	Read or set the Q-RPT or utility sensor calibration information for the "IH" (internal high) and "IL" (internal low) RPTs. "IH" is equivalent to "IuH".
Command Query	"PCAL:IH *adder, mult, CalDate, (GaOnly)*" "PCAL:IL *adder, mult, CalDate, (GaOnly)*" "PCAL:IH?" "PCAL:IL?"
Classic	"PCAL:IH =*adder, mult, CalDate, (GaOnly)*" "PCAL:IL =*adder, mult, CalDate, (GaOnly)*" "PCAL:IH" "PCAL:IL"
Defaults	"PCAL:IH = 0.0, 1.0, 19800101, 0" "PCAL:IL = 0.0, 1.0, 19800101, 0"
Arguments	*Adder:* The RPT calibration adder (PA). In Pascal. *Mult:* The RPT calibration multiplier (PM) from 0.1 to 100. *CalDate:* The date of the calibration in the format "YYYYMMDD" by default. The format "YYMMDD" is also be accepted, and the replied format is in the previously entered format. *GaOnly* Optional "Gauge only" flag. Indicates that the an Axxx Q-RPT is set to operate in gauge measurement mode only. This field does not apply and is ignored for Gxxx and BGxxx Q-RPTs or utility sensors. '0' Absolute, negative gauge and gauge modes are available. '1' Gauge mode only.
Remarks	The user defined pressure calibration information for the specified RPT (HI or IL pressure) can be accessed with this program message. Using this program message overwrites the current calibration coefficients, so caution must be used. If the "*GaMode*" flag is set and the RPT is an Axxx Q-RPT, then the RPT will only be allowed to operate in gauge mode. Changes made using this program message take effect immediately. The calibration information of **DHI** RPM4s connected to PPC3 must be adjusted directly on the RPM4. The information cannot be adjusted through the PPC3.
Example (enhanced)	Cmd sent: "PCAL:LO 2.1, 1.000021, 20011201, 0" Query reply: " 2.10 Pa, 1.000021, 20011201, 0" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "PCAL:LO? 2.1, 1.000021, 20011201, 0" Query reply: " 2.10 Pa, 1.000021, 20011201, 0"
Example (classic)	Sent: "PCAL:LO=2.1, 1.000021, 20011201, 1" Reply: " 2.10 Pa, 1.000021, 20011201, 1"
Errors	ERR# 6: One of the arguments is out of range.
See Also	5.2

PR	
Purpose	Read the next available pressure.
Query	"PR?"
Classic	"PR"
Remarks	The next available pressure value for the active Q-RPT or utility sensor is read in the current pressure units. The data returned also contains *Ready/Not Ready* information, and the pressure unit of measure and measurement mode. The reply field is always 20 characters long. The first 3 characters of the reply are reserved for the ready status (R or NR). The ready status is described in the "SR" program message. The pressure value and pressure unit of measure are right justified in this field. After receiving this program message, the PPC3 replies back with the data after a new pressure measurement cycle is complete. This can take up to 1.5 seconds.
Example (enhanced)	Query sent: "PR?" Query reply: "R 1936.72 kPaa"
Example (classic)	Query sent: "PR" Reply: "R 1936.72 kPaa"
See Also	"PRR", "QPRR", "SR" 3.1.1, 3.2.2

PRR	
Purpose	Read the next available pressure, rate and on-board barometer reading.
Query	"PRR?"
Classic	"PRR"
Remarks	The next available *Ready* condition, Q-RPT or utility sensor pressure, rate of pressure change, and barometric pressure is replied in the current pressure unit of measure. Each data field is separated by a comma, and is returned in the following order: ready, pressure UNITS, rate UNITS/s, atm UNITS Here are the field descriptions: ready: 'R' if the current pressure *Ready* criteria has been met, 'NR' if the criteria has not been met (see the "SR" program message). pressure: The measured pressure for the active Q-RPT or utility sensor in the current pressure unit. This is followed by the current pressure unit. rate: The measured rate of pressure change for the active Q-RPT or utility sensor in the current pressure unit per second. This is followed by the current pressure unit of measure. atm: The pressure measured by the PPC3 on-board barometer in the current pressure unit (and always absolute). This is followed by the current pressure unit. Not all PPC3s are equipped with an on-board barometer. This field is missing if the PPC3 is not equipped with an on-board barometer. After receiving this program message query, the PPC3 replies back with the data once a new pressure measurement cycle is complete. This can take up to 1.5 seconds.
Example (enhanced)	Query sent: "PRR?" Query reply: "R,2306.265 kPaa,0.011 kPa/s,97.000 kPaa" "R,2306.265 kPaa,0.011 kPa/s" (no barometer)
Example (classic)	Query sent: "PRR" Reply: "R,2306.265 kPaa,0.011 kPa/s,97.000 kPaa"
See Also	"PR", "QPRR", "SR" 3.1.1, 3.5.7.3

PS	
Purpose	Set a new target pressure and start a new pressure generation cycle. Allows the test volume to be specified which causes the pressure generation cycle to be executed omitting the automated control configuration routine.
Command	"PS *n (,v)*"
Classic	"PS=*n (,v)*"
Arguments	*n:* The target pressure in the current pressure units. *v:* The volume of the system connected to the PPC3 TEST(+) port in cm^3 (cc). This argument is optional and should be used only to reduce pressure setting time in know volumes.
Remarks	The PPC3 sets the specified target pressure using the current control settings and mode. Control continues until a new target pressure is set, the PPC3 goes into LOCAL mode, or an "ABORT" program message is executed. If the given target is '0' and the pressure units are gauge, the PPC3 vents. The "PR?", "PRR?", "STAT?", or "SR?" program message queries can be used to monitor the progress of the pressure setting routine. If the optional "*v*" argument is used, the PPC3 does not perform its test volume determination routine at the beginning of the pressure setting procedure, but instead uses the volume specified for the pressure generation. This can reduce pressure set times when operating into a consistent volume since the configuration routine takes 5 to 6 seconds to execute. The "v" argument should only be used in automated conditions, where the test volume is constant and the configuration does not change. This argument is only an approximation value, and it may be adjusted empirically for correct operation. A higher "v" setting speeds up the generation with a higher risk of significant control overshoot. A lower "v" setting slows down the generation and reduces overshoot. Note: When using a BG15K low gauge pressure Q-RPT with a DVU, the volume size specified should NOT include the DVU volume.
Example (enhanced)	Cmd sent: "PS 1000" Reply: "1000.000 kPa a " (no reply if IEEE-488)
Example (enhanced)	Cmd sent: "PS? 1000" Reply: "1000.000 kPa a "
Example (classic)	Sent: "PS=1000, 75" (includes test volume definintion) Reply: "1000.000 kPa a "
Errors	ERR# 6 The target pressure is out of range.
See Also	"PR", "PRR", "STAT", "SR", "QPRR" 3.2.1, 3.3.10

PSF	
Purpose	Set a new target pressure, using only the fast control valve(s) and aborting pressure control once the pressure target is reached..
Command	"PSF *n*"
Classic	"PSF=*n*"
Arguments	*N:* The target pressure in the current pressure unit of measure.
Remarks	The PPC3 sets the given target pressure using just the fast speed, and stops controlling when the pressure has reached or passed the given target. The system does not attempt to maintain the target pressure. The "PR?", "PRR?", "STAT?", or "SR?" program message queries can be used to monitor the progress of the generation.
Example (enhanced)	Cmd sent: "PSF 1000" Reply: "1000.000 kPaa (no reply if IEEE-488)
Example (classic)	Sent: "PSF=1000" Reply: "1000.000 kPaa
Errors	ERR# 6 The target pressure is out of range.
See Also	"PR", "PRR", "STAT", "SR", "PSS", "PS" Figure 12

PSS	
Purpose	Set a new target pressure using only the slow control valve(s) and aborting pressure control once the target is reached.
Command	"PSS *n*"
Classic	"PSS=*n*"
Arguments	*N:* The target pressure in the current pressure units.
Remarks	The PPC3 sets the given target pressure using just the slow speed, and stops controlling when the pressure has reached or passed the given target. The system does not attempt to maintain the target pressure. The "PR?", "PRR?", "STAT?", or "SR?" program message can be used to monitor the progress of the generation.
Example (enhanced)	Cmd sent: "PSS 1000" Reply: "1000.000 kPaa" (no reply if IEEE-488)
Example (enhanced)	Cmd sent: "PSS? 1000" Reply: "1000.000 kPaa"
Example (classic)	Sent: "PSS=1000" Reply: "1000.000 kPaa"
Errors	ERR# 6 The target pressure is out of range.
See Also	"PR", "PRR", "STAT", "SR", "PSF", "PS" Figure 12

QPRR	
Purpose	Read the last RPT pressure, pressure rate and on-board barometer output as quickly as possible.
Query	"QPRR?"
Classic	"QPRR"
Remarks	The last measured *Ready/Not Ready* condition, active Q-RPT or utility sensor pressure, rate of pressure change, and barometric pressure is replied in the current pressure unit of measure. This program message is useful when a rapid response of measured pressure is needed. Each data field is separated by a comma, and is returned in the following order: ready, pressure UNITS, rate UNITS/s, atm UNITS Here are the field descriptions: ready: 'R' if the current pressure *Ready* criteria has been met, 'NR' if the criteria has not been met (see the "SR" program message). pressure: The measured pressure for the selected Q-RPT or utility sensor in the current pressure units. This is followed by the current pressure unit and measurement mode. rate: The measured rate of pressure change for the active Q-RPT or utility sensor in the current unit of pressure per second. This is followed by the current pressure unit of measure. atm: The pressure measured by the PPC3 on-board barometer in the current pressure unit (but always absolute). This is followed by the current pressure unit. Not all PPC3s are equipped with an on-board barometer. This field is missing the PPC3 is not equipped with a barometer.
Example (enhanced)	Query sent: "QPRR?" Query reply: "R,2306.265 kPaa,0.011 kPa/s,97.000 kPaa" "R,2306.265 kPaa,0.011 kPa/s" (no barometer)
Example (classic)	Query sent: "QPRR" Reply: "R,2306.265 kPaa,0.011 kPa/s,97.000 kPaa"
See Also	"PR", "PRR", "SR" 3.1.1, 3.5.7.3

RANGE (PPC2+ legacy version)	
Purpose	**This command is included for reverse compatibility with PPC2+, and should only be used if needed for command compatibility.** **Otherwise, use "ARANGE" with PPC3 to set the desired operating range or "RANGE" (PPC3 version) to set an RPT default range.** Read or select of one of three available predefined "Legacy" ranges for the Q-RPT(s). PPC3 does not operate with three specific ranges (1, 2, 3) on each RPT. In PPC3, requested RPT is AutoRanged to full scale corresponding to the the "n" prefix 3, 2 or 1 range on a PPC2 or PPC2+ RPT. See the PPC2 or PPC2+ manual for details on the use of this command.
See Also	"ARANGE", "RANGE" (PPC3 version) 3.3.4, 3.2.4

RANGE (PPC3 version)		
Purpose	Change the active range to one of the available internal or external default RPT ranges. Read the active range full scale, pressure unit and measurement mode.	
Command Query	"RANGE *Rng*" "RANGE?"	
Classic	"RANGE= *Rng*" "RANGE "	
Default	"RANGE IH"	
	Rng:	"IH" for the internal, hi Q-RPT or utility sensor "IL" for the internal lo Q-RPT "X1H" for the first external RPM4, hi Q-RPT "X1L" for the first external RPM4, lo Q-RPT "X2H" for the second external RPM4, hi Q-RPT "X2L" for the second external RPM4, lo Q-RPT
Remarks	The active RPT must be selected before making changes to settings that are dependent on the range. The system MUST BE VENTED to change active RPTs. RPTs selected with this command are used with their full default pressure range. External RPTs must be found and initialized using the "RPT" command or function key before the can be selected The reply indicates the active range in psi if the PPC3 is a "US" version or in kPa if the PPC3 is an "SI" version. Used as a simple query, the active range is returned, which can be an AutoRanged range or a default range (see "ARANGE" cmd).	
Example (enhanced)	Cmd sent: Query reply:	"RANGE IL" (select internal Lo Q-RPT in it's full default range) "50 psia"
Example (classic)	Sent: Reply:	"RANGE=IH" (select internal Hi Q-RPT in it's full default range) "1000 psia"
Example (classic)	Sent: Reply:	"RANGE=X2H"(select external 2nd RPM4, HI Q-RPT) "500 psia"
Example (classic)	Sent: Reply:	"RANGE" (request current range) "220 psia"
Errors	ERR# 6: ERR# 22: ERR# 38:	Invalid *Rng* argument. System must be vented for the requested operation. The selected RPT is not available.
See Also	"ARANGE", "RPT" 3.2.5, 3.3.1, 3.3.4,	

RATE		
Purpose	Read the next available pressure rate of change.	
Query	"RATE?"	
Classic	"RATE"	
Remarks	The next available pressure rate of change in the current pressure unit per second is returned. After receiving this program message, the PPC3 replies back with the data once a new pressure measurement cycle is complete. This can take up to 1.5 seconds.	
Example (enhanced)	Query sent: Query reply:	"RATE?" "0.01 kPa/s"
Example (classic)	Sent: Reply:	"RATE" "0.01 kPa/s"
See Also	"PRR", "QPRR"	

READYCK	
Purpose	Read or set the *Ready* check flag.
Command Query	"READYCK 1" "READYCK?"
Classic	"READYCK=1" "READYCK"
Remarks	The internal ready check flag is cleared whenever the PPC3 reaches a *Not Ready* (NR) condition. The "READYCK" query returns the status of the flag. The flag is set by sending the "READYCK 1" program message while the PPC3 is in a *Ready* condition. The "READYCK" program message query can then be used at a later time to determine whether a *Not Ready* condition has occurred since the ready check flag was set.
Example (enhanced)	Cmd sent: "READYCK 1" Query reply: "1" (no reply if GPIB-488)
Example (enhanced)	Cmd sent: "READYCK?" Query reply: "1"
Example (enhanced)	Cmd sent: "READYCK?" Query reply: "1" (if PPC3 condition has stayed *Ready*) "0" (if PPC3 condition has NOT stayed *Ready*)
Example (classic)	Sent: "READYCK=1" Query reply: "READYCK=1"
Example (classic)	Sent: "READYCK" Query reply: "READYCK=1" (if PPC3 condition has stayed *Ready*) "READYCK=0" (if PPC3 condition has NOT stayed *Ready*)
Errors	ERR# 6: Argument is not a '0' or a '1'.
See Also	"SR" 3.2.2

REMOTE	
Purpose	Lock out the front panel keypads during remote operation.
Command	"REMOTE"
Classic	"REMOTE"
Remarks	The PPC3 goes into remote mode whenever communications take place. The user can return to local operation by pressing the [ESC] key. The REMOTE program message locks out the front panel completely. The only way to unlock the front panel after the "REMOTE" command is using the "LOCAL" program message, the IEEE-488 "GTL" command, or by cycling the PPC3 power.
Example (enhanced)	Cmd sent: "REMOTE" Reply: "REMOTE" (no reply if IEEE-488)
Example (enhanced)	Cmd sent: "REMOTE?" Reply: "REMOTE"
Example (classic)	Sent: "REMOTE" Reply: "REMOTE"
See Also	"LOCAL"

RES	
Purpose	To read or set the pressure display resolution for the active range.
Command Query	"RES *n*" "RES"
Classic	"RES=*n*" "RES"
Default	"RES 0.001"
Arguments	*n:* The pressure display resolution in % span of the current RPT range (0.0001 to 1 % FS).
Remarks	The pressure display resolution is defined as % span of the active range. The setting is separate for each range, and changes as the range is changed.
Example (enhanced)	Cmd sent: "RES .01" Query reply: "0.01" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "RES? .01" Query reply: "0.01"
Example (classic)	Sent: "RES=.01" Reply: "0.01"
Errors	ERR# 6 The argument is invalid.
See Also	3.4.2

RESET	
Purpose	Reset the user's settings to factory defaults.
Command	"RESET"
Classic	"RESET"
Remarks	The PPC3 has user settings (units, resolution, control modes, etc.) that can be reset to factory defaults. System calibration coefficients and communications settings are not affected. The remote "RESET" program message corresponds to the front panel "Reset - Sets." The reset cycle takes up to 3 seconds to complete. Remote communications should not take place during this period.
Example (enhanced)	Cmd sent: "RESET" Reply: "RESET" (no reply if IEEE-488)
Example (enhanced)	Cmd sent: "RESET?" Reply: "RESET"
Example (classic)	Sent: "RESET" Reply: "RESET"
See Also	3.5.4.1

RETURN	
Purpose	Start a new pressure setting sequence equivalent to the "PS" command using the last target pressure.
Command	"RETURN"
Classic	"RETURN"
Remarks	The "RETURN" program message starts a new pressure setting sequence using the current settings and target pressure. Pressure control continues until a new target pressure is set, the PPC3 is put into LOCAL mode, or an "ABORT" program message is executed.
Example (enhanced)	Cmd sent: "RETURN" Reply: "1000.000 kPaa" (no reply if IEEE-488)
Example (classic)	Sent: "RETURN" Reply: "1000.000 kPaa"
Errors	ERR# 6 The current target pressure is invalid.
See Also	"PS", "TP" 3.3.10

RPT(*n*)	
Purpose	Read the available Q-RPT data or initiate the Q-RPT search and initialize process.
Command Query	"RPT" "RPT(*n)*"
Classic	"RPT" "RPT(*n*)"
Default	"RPT"
Prefix (optional)	*n* Specify the position locator of the RPT about which to collect information: '1' The internal, Hi RPT '2' The internal, Lo, Q-RPT '3' The first external RPM4, Hi Q-RPT '4' The first external RPM4, Lo Q-RPT '5' The second external RPM4, Hi Q-RPT '6' The second external RPM4, Lo Q-RPT
Remarks	Up to six Q-RPTs can be available for use in one PPC3 system. Two of these can be internal, and the other four are external. These Q-RPTs must be identified and initalized before the can be used by the PPC3. This command allows the search process to be executed (by omitting the prefix 'n') and allows review of the Q-RPTs identified. Note that the search process can take up to 10 seconds to complete, and that the communications settings for the PPC3's COM2 port and the external RPM4 devices should be setup prior to this. If you are querying the unit for information about a particular Q-RPT Using the prefix 'n'), then the Q-RPT data found during the execution of the last search is returned in the following format: *RPTType, RPTLocator, Serial#, RngGa, RngAbs, RptMode* *RngLabe:* RPT type label. This label identifies the RPT type and range. This is the same label used on the PPC3 front panel screen. RptLocator*:* Text field identifying the Q-RPT position in the PPC3 system. "IH" identifies this as an internal, Hi Q-RPT "IuH" identifies this as an internal, Hi utility sensor "IL" identifies this as an internal, Lo Q-RPT "X1H" identifies this as the first external RPM4, Hi Q-RPT "X1H" identifies this as the first external RPM4, Lo Q-RPT "X2H" identifies this as the second external RPM4, Hi Q-RPT "X2H" identifies this as the second external RPM4, Lo Q-RPT *Serial#:* The serial number of the PPC3 or RPM4 in which the Q-RPT is located. *RngGa:* The Q-RPT gauge mode range in the current pressure unit. *RngAbs:* The Q-RPT absolute mode range in the current pressure unit. "NONE" appears in the field if the Q-RPT is a Gxxx, BGxxx or Axxx with absolute and negative gauge modes OFF. *RptMode:* 'A' if Q-RPT is Axxx and supports absolute, gauge and negative gauge measurement modes. 'G' if Q-RPT is gauge Gxxx or Axxx with absolute and negative gauge modes OFF and supports only gauge measurement mode. 'N' if Q-RPT is BGxxx and supports gauge and negative gauge measurement modes.
Example (enhanced)	Cmd sent: "RPT? (find external Q-RPTs in RPM4(s)) Query reply: "OK" (takes up to 10 seconds to reply)
Example (classic)	Cmd sent: "RPT (find external Q-RPTs in RPM4(s)) Query reply: "OK" (takes up to 10 seconds to reply)
Example (enhanced)	Cmd sent: "RPT2?" (Get information on internal, Lo Q-RPT) Query reply: "A350K, IL, 82345, 35, 50,A"
Example (classic)	Cmd sent: "RPT6" (Get information on Q-RPT in ext RPM4, Lo position) Query reply: "A7M, IH, 82345, 1000, 1000,A"
Errors	ERR# 4: RPT not previously found ERR# 10: Invalid prefix.
See Also	"ARANGE", "COM2" 3.3.5, 3.2.4

SCRSAV	
Purpose	Read or set the front panel display screen saver activation time.
Command Query	"SCRSAV *n*" "SCRSAV?"
Classic	"SCRSAV=*n*" "SCRSAV"
Arguments	*n:* The inactivity period. (minutes) after which screen saver activates.
Default	"SCRSAV 10"
Remarks	The PPC3 front panel will dim after a period of keyboard and remote inactivity. Setting this value to '0' disables this feature.
Example (enhanced)	Cmd sent: "SCRSAV 30" Query reply: "30" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "SCRSAV? 30" Query reply: "30"
Example (classic)	Sent: "SCRSAV=30" Reply: "30"
Errors	ERR# 6 The argument was invalid.
See Also	3.5.5.1

SN	
Purpose	To read the serial number of the PPC3.
Query	"SN?"
Classic	"SN"
Remarks	The PPC3 is serialized. The serial number can be read using this program message.
Example (enhanced)	Query sent: "SN?" Query reply: "321"
Example (classic)	Sent: "SN" Reply: "321"
See Also	3.5.5.4

SR	
Purpose	Read the next available *Ready/Not Ready* status.
Query	"SR?"
Classic	"SR"
Remarks	The current *Ready* status can be read using this program message. Possible replies: "NR" The pressure is Not Ready within the limits defined by the control mode and current control parameters. "R " The pressure meets the ready criteria. The status is replied when the next pressure measurement is finished. "OL" The pressure of one of the active Q-RPTs has exceeded the user defined upper or lower limits . "OP" The pressure of one of the Q-RPTs has exceeded the Q-RPT's maximum limits. "ER" An internal device failure has occurred.
Example (enhanced)	Query sent: "SR?" Query reply: "NR"
Example (classic)	Sent: "SR" Reply: "NR"
See Also	"PR", "PRR", "HS", "SS", "UL", "LL" Commands 3.2.2, 3.4.4, 3.4.4.1

SS%	
Purpose	Read or set the current stability limit as a % of range.
Command Query	"SS% *n*" "SS%?"
Classic	"SS%=*n*" "SS%"
Arguments	*n:* The stability limit in %FS of the current active range.
Remarks	The stability limit can be read and set as a percent of the full scale range of the Q-RPT range. If this program message is used to set the stability limit, the PPC3 will then use CUSTOM control settings.
Example (enhanced)	Cmd sent: "SS% .1" Query reply: "0.10 %"(No reply from GPIB-488)
Example (enhanced)	Cmd sent: "SS%? .1" Query reply: "0.10 %"
Example (classic)	Sent: "SS%=.1" Reply: "0.10 %"
Errors	ERR# 6 The argument was invalid.
See Also	"SS" 3.4.6.1

SS	
Purpose	Read or set the current pressure stability limit.
Command Query	"SS *n*" "SS?"
Classic	"SS=*n*" "SS"
Arguments	*N:* The stability limit in the current pressure unit of measure.
Remarks	The stability limit can be read and set as a pressure. The stability limit is used as the *Ready/Not Ready* criterion in static control mode and when PPC3 not controlling.
Example (enhanced)	Cmd sent: "SS .1" Query reply: "0.10 kPa/s" (No reply from GPIB-488)
Example (enhanced)	Cmd sent: "SS? .1" Query reply: "0.10 kPa/s"
Example (classic)	Sent: "SS=.1" Reply: "0.10 kPa/s"
Errors	ERR# 6 The argument was invalid.
See Also	"HS" 3.4.6.1

STAT	
Purpose	Read the pressure control status.
Query	"STAT?"
Classic	"STAT"
Remarks	The pressure control cycle status can be checked using this program message. The reply is a numeric code which references a specific pressure control action: Multiple codes are returned by logically arranging them together. 0 The system is not generating or holding a pressure. 1 A new generation is preparing to start. 2 Quick ramping to the target. 4 Quick pulsing to the target. 8 Slow ramping to the target. 16 Slow pulsing to the target. 32 Reached the target, will re-adjust as needed to stay ready. 64 Quick ramping to a vent condition. 128 Vented with the exhaust valve open. 256 Quickly decreasing the pressure to reach a hard vacuum. 1024 A new target has been requested but generation has not started. 4096 Dynamic pulsing is being used to control a pressure. 8192 Static pulsing is being used to control a pressure. 16394 Low pressure control is active. 32768 Very low pressure control is active.
Example (enhanced)	Query sent: "STAT?" Query reply: "32"
Example (classic)	Sent: "STAT" Reply: "32"
See Also	"PS" 3.2.1, 3.3.10

TIME	
Purpose	Read or set the PPC3 internal clock.
Command Query	"TIME *hh:mmXX*" "TIME?"
Classic	"TIME=*hh:mmXX*" "TIME"
Arguments	*hh:mm:* The time in a 12 hour format using a colon delimiter *XX:* "am" or "pm"
Remarks	The PPC3 has an internal real time clock. It is used for date stamping calibrations and log data.
Example (enhanced)	Cmd sent: "TIME 12:52PM" Query reply: "12:52pm" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "TIME? 12:52PM" Query reply: "12:52pm"
Example (classic)	Sent: "TIME=12:52PM" Reply: "12:52pm"
Errors	ERR# 7: Missing or improper program message argument(s).
See Also	"DATE" 3.5.5.3

TP	
Purpose	To read the current target pressure.
Query	"TP?"
Classic	"TP"
Remarks	The current target pressure is replied in the current pressure unit of measure.
Example (enhanced)	Query sent: "TP?" Query reply: "1000.00 kPa a"
Example (classic)	Sent: "TP" Reply: "1000.00 kPa a"
See Also	"PS" 3.2.10

UCOEF	
Purpose	To convert 1 Pascal to the current pressure units.
Query	"UCOEF?"
Classic	"UCOEF"
Remarks	The PPC3 handles all pressure values internally in Pascal. The coefficient replied is equivalent of 1 Pa in the current pressure unit of measure. This program message allows the user to convert pressures
Example (enhanced)	Query sent: "UCOEF?" Query reply: "0.0010000000 kPa"
Example (classic)	Sent: "UCOEF" Reply: "0.0010000000 kPa"
See Also	3.3.2, 3.5.6, 7.2.1

UDU	
Purpose	Read or set the user defined pressure unit.
Command Query	"UDU *label, ucoef*" "UDU?"
Classic	"UDU=*label, ucoef*" "UDU" *label:* User unit label (4 alphanumeric char maximum). It cannot be an already supported unit label. *ucoef*: "User unit conversion coefficient (units/Pa).
Default	"UDU USER,1.0"
Remarks	The user defined unit must be set up with the program message prior to remote or local selection.
Example (enhanced)	Cmd Sent: "UDU MYUN, .001" Query reply: "MYUN, 0.0010" (No reply if GPIB-488)
Example (enhanced)	Cmd Sent: "UDU? MYUN, .001" Query reply: "MYUN, 0.0010"
Example (enhanced)	Sent: "UDU=MYUN, .001" Reply: "MYUN, 0.0010"
See Also	3.5.6, 3.3.2

UL	
Purpose	Read or set an upper limit for the current range.
Command Query	"UL *n*" "UL?"
Classic	"UL=*n*" "UL"
Arguments	*n:* The upper limit pressure in the current pressure unit and measurement mode.
Remarks	The PPC3 has an upper limit for each range and for each measurement mode (gauge and absolute). New automated pressure control targets cannot be greater than this value. If the pressure does exceed the upper limit, the pressure display flashes, and pressure control stops. Manual increases in pressure are not allowed as long as the pressure is above the upper limit. Decreases in pressure are allowed. This feature should always be used to prevent accidental over pressure of a device under test.
Example (enhanced)	Cmd sent: "UL 1000" Query reply: "1000.00 kPaa" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "UL? 1000" Query reply: "1000.00 kPaa"
Example (classic)	Sent: "UL=1000" Reply: "1000.00 kPaa"
Errors	ERR# 6: The argument is out of range.
See Also	"LL" 3.4.4

UNIT	
Purpose	Read or set the pressure unit of measure unit and measurement mode.
Command Query	"UNIT *unit (, ref*")" "UNIT *unit*g *(, ref*")" "UNIT *unit*a *(, ref*")" "UNIT?"
Classic	"UNIT=*unit (, ref*")" "UNIT=*unit*g *(, ref*")" "UNIT=*unit*a *(, ref*")" "UNIT"
Arguments	*unit:* The text corresponding to the pressure unit of measure. *ref:* The optional unit reference temperature only if the unit is "InWa".
Remarks	This program message determines what unit of measure and what measurement mode is used to display pressure values. Refer to Table 13 for a detailed list of the units available and their labels. The unit text must be followed by 'a' if absolute measurement mode is desired, or gauge mode is assumed. The unit text can optionally be followed by a 'g' to specify gauge measurement mode. There can be a space between the unit text and the 'a' or the 'g'. If the unit specified is "InWa", an optional second argument "*ref*" can be set. The "ref" can be 4, 20, or 60 corresponding to InWa at 4 °C, 20 °C or 60 °F. If this second argument is not given when the unit is "InWa", then the reference temperature is assumed to be 20 °C. The reference temperature can also be added directly onto the end of the *Unit* argument if desired ("inWa4", "inWa20" or "inWa60" corresponding to inWa at 4 °C, 20 °C or 60 °F) The fifth character of the reply is always 'a' for absolute mode, or 'g' for gauge mode. White spaces proceed this character if needed. The temperature reference is added to the reply only if the unit is "InWa". "MMODE" must be used to set the measurement mode to negative gauge. The "MODE" command can also be used to set the desired measurement mode only.
Example (enhanced)	Cmd sent: "UNIT kPaa" Query reply: "kPaa" Sent: "UNIT InWag, 4" Query reply: "inWag, 4" Sent: "UNIT InWag60" Query reply: "inWag, 60"
Example (classic)	Sent: "UNIT=kPaa" Reply: "kPaa" Sent: "UNIT=InWag, 4" Reply: "inWag, 4"
Errors	ERR# 7: The *unit* is invalid. ERR# 6: The *ref* is invalid. ERR# 20: Absolute measurement mode and altitude units are not allowed with a gauge Q-RPT.
See Also	"MMODE", "MODE" 3.3.2, 3.3.3

VAC	
Purpose	Read or set the status of the PPC3 EXHAUST port vacuum or atmosphere monitoring system.
Command Query	"VAC *n*" "VAC?"
Classic	"VAC=*n*" "VAC"
Default	"VAC 0"
Arguments	*n:* '0' To disable auto mode and specify that the PPC3 EXHAUST port is open to atmosphere. '1' To disable auto mode and specify that the PPC3 EXHAUST port is connected to a vacuum source. NOTE: Use "AUTOVAC" to enable automated determination of EXHAUST port conditions.
Remarks	The PPC3 has an internal sensor that determines if the EXHAUST port is open to atmosphere or to vacuum. You can manually override it if desired. The query can also be used to see the sensor status (if auto is enabled). If the auto function is disabled, then the query returns the last VAC setting.
Example (enhanced)	Cmd sent: "VAC 1" Query reply: "1" (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "VAC? 1" Query reply: "1"
Example (classic)	Sent: "VAC=1" Query reply: "VAC=1"
Errors	ERR# 6: The argument is not a '0' or a '1'.
See Also	"AUTOVAC" 3.5.7.2

VENT	
Purpose	Read, execute or abort a vent process.
Command Query	"VENT *n*" "VENT?"
Classic	"VENT=*n*" "VENT"
Arguments	*N:* '1' to start a vent process. '0' to abort a vent process and close the exhaust valve.
Remarks	The PPC3 vents by setting pressure close to atmospheric and then opening the vent valve. This program message query returns a '0' if the vent valve is closed, or a '1' if the vent valve is open. In gauge measurement modes, a "PS" command of zero is interpreted as a vent command.
Example (enhanced)	Cmd sent: "VENT 1" Query reply: "0" (if not finished venting) (No reply if GPIB-488) "1" (if vented) (No reply if GPIB-488)
Example (enhanced)	Cmd sent: "VENT? 1" Query reply: "0" (if not finished venting) "1" (if vented)
Example (classic)	Sent: "VENT=1" Reply: "VENT=0" (if not finished venting) "VENT=1" (if vented)
Errors	ERR# 6: The argument is not a '0' or a '1'.
See Also	"PS" 3.1.3 , 3.3.10.2

VER	
Purpose	Identify the PPC3, US or SI units, the Q-RPT labels and the software version.
Query	"VER?"
Classic	"VER"
Remarks	The software version of the PPC3 can be read. This is useful for checking for the presence of the PPC3 and for reference purposes. It indicates the internal Q-RPT(s) and software version.
Example (enhanced)	Query sent: "VER?" Query reply: "DH INSTRUMENTS, INC PPC3 us A350K/BG15K Ver1.00 "
Example (classic)	Query sent: "VER" Query reply: "DH INSTRUMENTS, INC PPC3 us A350K/BG15K Ver1.00 "
See Also	None

ZNATERR*n*:HI and ZNATERR*n*:LO (PPC2+ legacy version)	
Purpose	**This command is included for reverse compatibility with PPC2+. PPC3 has not ZNATERR. The command has no effect on PPC3 and always returns "0", regardless of the value set.** See the PPC2 or PPC2+ manual for details on the use of this command.
See Also	"ZOFFSET:IH", "ZOFFSET:IL" 3.5.1

ZOFFSET*n*	
Purpose	Read or set the AutoZ pressure offsets (P_{offset}) for the specified or active RPT (preferred method).
Command Query	"ZOFFSET*n GaOffset , AbsOffset*" "ZOFFSET*n?*"
Classic	"ZOFFSET*n =GaOffset , AbsOffset"* "ZOFFSET*n*"
Defaults	"ZOFFSET*n* = 0.0 Pa, 0.0 Pa" (Gauge Q-RPT) "ZOFFSET*n* = 101325 Pa, 0.0 Pa" (Absolute Q-RPT)
Optional Suffix	*"n"* The active RPT is assumed if no suffix is given. '1' Specify the Hi Q-RPT. '2' Specify the Lo Q-RPT
Arguments	*GaOffset* The RPT pressure offset ("Poffset") for Gauge measurement mode (Pa). *AbsOffset:* The RPT pressure offset for absolute measurement mode (Pa)
Remarks	The pressure offset (P_{offset}) for the specified internal RPT (IH or IL) or the active Q-RPT can be accessed with this program message. There is a separate offset for gauge and absolute measurement modes, but not all modes apply in all cases. (Gauge RPTs do not support "*AbsOffset)*. Using this program message overwrites the current offset, so caution must be used. Changes made using this program message take effect immediately. If no suffix is given and the active RPT is in an external RPM4, then the P_{offset} for that RPM4's Q-RPT will be accessed.
Example (enhanced)	Cmd sent: "ZOFFSET1 2.1, 0" Query reply: " 2.10 Pa, 0.00 Pa"
Example (classic)	Sent: "ZOFFSET=97293.1, 3.02" Reply: " 97293.10, 3.02"
Errors	ERR# 6: One of the arguments is out of range.
See Also	3.5.1

ZOFFSET:IH and ZOFFSET:IL	
Purpose	Read or set the AutoZ pressure offset (P_{offset}) for the high ("IH") or low ("IL") Q-RPT and current measurement mode. New designs should use the "ZOFFSET*n*" command.
Command Query	"ZOFFSET:IH *offset*" "ZOFFSET:IL *offset*" "ZOFFSET:IH?" "ZOFFSET:IL?"
Classic	"ZOFFSET:IH =*offset"* "ZOFFSET:IL =*offset"* "ZOFFSET:IH" "ZOFFSET:IL"
Defaults	"ZOFFSET:IH = 0.0" "ZOFFSET:IL = 0.0"
Arguments	*Offset:* The Q-RPT pressure offset ("Poffset") for the current measurement mode (gauge or absolute) in Pa.
Remarks	The pressure offset (P_{offset}) for the specified Q-RPT (HI or Lo) in the current measurement mode can be accessed with this program message. External Q-RPTs' P_{offset} cannot be adjusted from PPC3. There is a separate offset for gauge and absolute measurement modes. Using this program message will overwrite the current offset, so caution must be used. Changes made using this program message take effect immediately.
Example (enhanced)	Cmd sent: "ZOFFSET:IL 2.1" Query reply: " 2.10 Pa"
Example (classic)	Sent: "ZOFFSET:IL=2.1" Reply: " 2.10 Pa"
Errors	ERR# 6: One of the arguments is out of range.
See Also	3.5.1

ZOFFSET*n*:HI and ZOFFSET*n*:LO (PPC2+ legacy version)	
Purpose	**This command is included for reverse compatibility with PPC2+, and should only be used if needed for command compatibility.** **Otherwise, use "ZOFFSET:IH and "ZOFFSET:IL" with PPC3 to set value of AutoZ P_{offset}.** See the PPC2 or PPC2+ manual for details on the use of this command.
See Also	"ZOFFSET:IH", "ZOFFSET:IL", "ZOFFSETn" 3.5.1

4.5 STATUS REPORTING SYSTEM

The PPC3 status reporting system is used to track and report system status and errors. It follows the model of the IEEE Std 488.2 and works for the COM1 and the IEEE-488 port with slight differences. The PPC3 can be programmed to respond to various status conditions by asserting the SRQ of the IEEE-488 interface. The COM1 port cannot be supported in such a way, so polling must be used.

4.5.1 ERROR QUEUE

The PPC3 keeps track of remote errors by using an error queue. If an error occurs, it is pushed onto the Error Queue. If you are using the COM1 port, the error number is immediately replied in the form "ERR#nn where nn is the error code from 0 to 99. The "ERR?" (or "ERR") query can then be used to pull the error from the Error Queue in it's descriptive text format. If you are using the enhanced program message format, the Error Queue will accumulate errors until full unless they are pulled from the queue. If you are using the classic program format, the Error Queue is cleared every time a new program message is received.

4.5.2 STATUS BYTE REGISTER

The PPC3 contains an 8 bit Status Byte Register that reflects the general status of the PPC3.

Table 18. 8 Bit Status Byte Register

OPER (128)	RQS/MSS (64)	ESB (32)	MAV (16)	N/A (8)	ERROR (4)	N/A (2)	RSR (1)

This register is affected by the PPC3 reply output queue, the Error Queue, the Standard Event Status register and the *Ready Event* Status register.

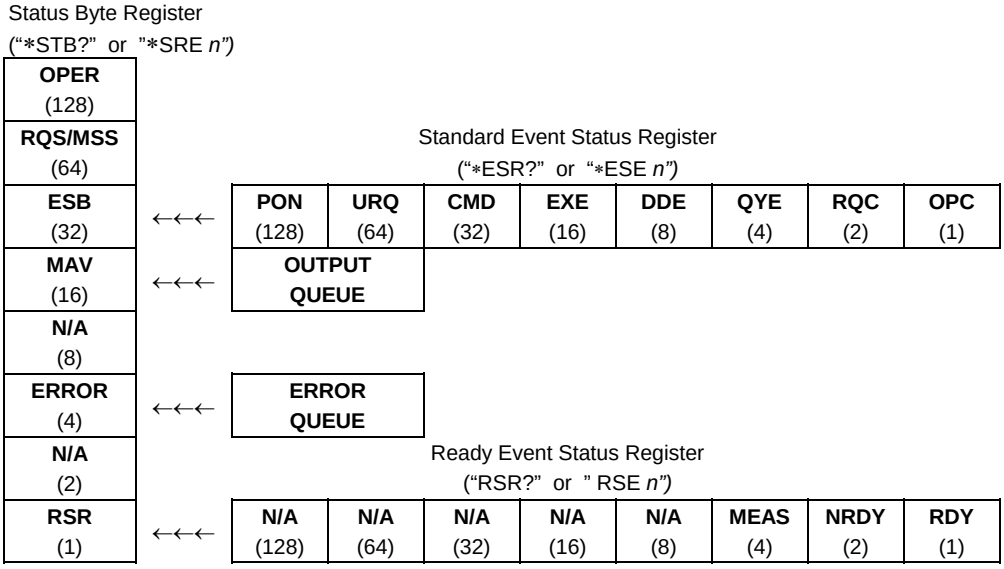


Figure 10. Status Register Schematic

The Status Byte Register can be read using the **"*STB?"** query, or by performing a serial poll on the IEEE-488 bus. If you read this using a serial poll then Bit 6 is the RQS. If the **"*STB?"** query is used, then bit 6 is the MSS bit. All of the other bits are common to both types of query.

Each of these status bits can cause a SRQ to occur. The Service Request Enable Register (**"*SRE"** program message) determines which of these flags are able to assert the SRQ line. This enable register has a matching set of bits that each will enable the designated bit to cause a SRQ, except for the RQS/MSS bit(s) which cannot cause a SRQ. If you set this

register to 20 ($14 hex), an SRQ will occur if the MAV or the ERROR bit are set. The description of these bits are given as:

OPER N/A Bit 7 (128)

RQS Requested Service Bit 6 (64)

Indicates that the SRQ line of the IEEE-488 interface has been asserted by the PPC3. This bit is cleared when a serial poll is performed on the PPC3, and is a part of the Status Byte Register when read using a serial poll. This bit does not apply if the COM1 port is being used.

MSS Master Summary Status Bit 6 (64)

Indicates that an event or events occurred that caused the PPC3 to request service from the Host, much like the RQS bit. Unlike the RQS bit, it is READ ONLY and can be only cleared when the event(s) that caused the service request are cleared.

ESB Event Summary Bit 5 (32)

Indicates if an enabled bit in the Standard Event Status Register became set (see Section 4.5.3).

MAV Message Available Bit 4 (16)

Indicates that at least one reply message is waiting in the PPC3 IEEE-488 output queue.

ERROR Error Queue Not Empty Bit 2 (4)

Indicates that at least one command error message is waiting in the PPC3 IEEE-488 error message queue. Use the **"ERR?"** query to get this message.

RSR Ready Summary Bit 0 (1)

Indicates that an enabled bit in the Ready Status Register became set.

4.5.3 STANDARD EVENT REGISTER

The PPC3 contains an 8 bit Standard event register that reflects specific PPC3 events. Enabled events in this register will set or clear the ESB bit of the Status Byte Register.

Table 19. 8 Bit Standard Event Register

PON	URQ	CMD	EXE	DDE	QYE	RQC	OPC
(128)	(64)	(32)	(16)	(8)	(4)	(2)	(1)

This register can be read using the "*ESR?" query, Each of these status bits can set the ESB bit of the Status Byte Register, causing a SRQ to occur IF the ESB bit is enabled to do so. The Standard Event Status Enable Register ("*ESE" program message) determines which of these flags are able to assert the ESB bit. The description of these bits are given as:

PON Power On (Bit 7)

Indicates that the PPC3 power has been cycled since the last time this bit was read or cleared.

URQ User Request (Bit 6)

Indicates that the PPC3 was set to local operation manually from the front panel by the user (pressing the **[ESC]** key).

CMD Command Error (Bit 5)

Indicates that a remote command error has occurred. A command error is typically a syntax error in the use of a correct program message.

EXE Execution Error (Bit 4)

Indicates if a remote program message cannot be processed due to device related condition.

DDE Device Dependent Error (Bit 3)

Indicates that an internal error has occurred in the PPC3 such as a transducer time-out.

QYE Query Error (Bit 2)

Indicates that an error has occurred in the protocol for program message communications. This is typically caused by a program message being sent to the PPC3 without reading a waiting reply.

RQC Request Control (Bit 1)

This bit is not supported as the PPC3 cannot become the active controller in charge.

OPC Operation Complete (Bit 0)

Indicates that the PPC3 has completed all requested functions.

4.5.4 READY STATUS REGISTER

The PPC3 contains an 8 bit Ready Status Register that reflects specific PPC3 measurement and generation ready events. Enabled events in this register will set or clear the RSB bit of the Status Byte Register.

Table 20. 8 Bit Ready Status Register

N/A	N/A	N/A	N/A	N/A	MEAS	NRDY	RDY
(128)	(64)	(32)	(16)	(8)	(4)	(2)	(1)

This register can be read using the **"*RSR?"** query, Each of these status bits can set the RSB bit of the Status Byte Register, causing a SRQ to occur IF the RSB bit is enabled to do so. The Standard Event Status Enable Register (**"*RSE"** program message) determines which of these flags are able to assert the RSB bit. The description of these bits are given as:

MEAS Measurement ready (Bit 2)

Indicates that the PPC3 has completed a Q-RPT measurement.

NRDY Generation Not Ready (Bit 1)

Indicates that the PPC3 made a transition from *Ready* to *Not Ready* as defined by the control settings (see Section 3.2.2).

RDY Generation Ready (Bit 0)

Indicates that the PPC3 has reached a target pressure and is *Ready* as defined by the control settings (see Section 3.2.2).

4.6 IEEE STD. 488.2 COMMON AND STATUS PROGRAM MESSAGES

The PPC3 supports a set of commands that are common to all instruments conforming to IEEE Std. 488.2. These command make it easy to perform basic function for any device that supports these commands. These commands also cover the status reporting commands. See Section 4.5 for details on the status registers mentioned in these commands.

Table 21. Program Message List

∗CLS	Clear all of the status & event structures.
∗ESE	Read or set the Standard Event Status Enable Register.
∗ESR	Read the Standard Event Status Register.
∗IDN	Identify the PPC3 version, range, and serial number.
∗OPC	Set the operation complete bit when all operations have completed.
∗OPT	Read the list of installed PPC3 options.
∗RST	Reset the PPC3 control settings to factory settings.
∗TST	Read the power on self test status.
∗SRE	Read or set the Service Request Enable Register.
∗STB	Read the Status Byte Register.
∗RSE	Read or set the Ready Status Enable Register.
∗RSR	Read the Ready Status Register.

4.6.1 PROGRAM MESSAGE DESCRIPTIONS

∗CLS	
Purpose	Clear all of the status & event structures.
Command	"∗CLS"
Remarks	This program message clears the following events and status registers: Standard Byte Register (STB) Standard Event Status Register (ESR) Error Queue Pending OPC operations
Example (classic)	Sent: "∗CLS" Reply: none

∗ESE	
Purpose	Read or set the Standard Event Status Enable Register.
Command Query	"∗ESE *n*" "∗ESE?"
Default	"∗ESE 0"
Arguments	*n:* '0 to 255' This is the decimal representation of the bit(s) to enable. To enable the PON and QYE bits, the argument would be 128 + 4 = 132.
Remarks	The Standard Event Status Enable register determines which bits in the standard Event Status Register are enabled and included in the Status Byte Register (ESB bit), and can assert the SRQ line. The reply is in decimal numeric form.
Example (enhanced)	Sent: "∗ESE=128"(enables the PON bit) Query reply: "128" (no reply if IEEE-488)
Errors	ERR# 6: *n* is not valid.

∗ESR	
Purpose	Read the Standard Event Register.
Command	"∗ESR?"
Remarks	The Standard Event Register contents are cleared after reading. The reply is in decimal numeric form.
Example (enhanced)	Sent: "∗ESR?" Reply: "20" (the QYE and EXE bits are set)

∗IDN	
Purpose	Identify the PPC3 version, range, and serial number.
Query	"∗IDN?"
Remarks	The identification reply is made up of the manufacture, the model, the serial number and the software version. Each is separated by a comma.
Example (enhanced)	Sent:"∗IDN?" Reply:"DH INSTRUMENTS INC, PPC3 A0100/A0015, 1234, Ver2.00 -dhf"

∗OPC	
Purpose	Sets the operation complete bit when all operations have completed.
Command Query	"∗OPC" "∗OPC?"
Remarks	This Command enables the PPC3 to set the OPC bit in the Standard Event Status Register when it has completed all pending functions. The Query replies with a "1" when all functions are complete.
Example (enhanced)	Sent: "∗OPC" Query reply: "1"

∗OPT	
Purpose	Reads the list of installed PPC3 options.
Query	"∗OPT?"
Remarks	This Query returns any registered option(s) installed in the PPC3. Each option is separated by a comma. Possible options: "IEEE-488:0" The IEEE-488 option is installed. "ANALOG:n" The analog option is installed. 'n' is the revision on the analog option hardware from 'A' to 'Z' or '-' if original revision.
Example (enhanced)	Sent: "∗OPT?" Reply: "IEEE-488:0, ANALOG:-"

∗RST	
Purpose	Resets the PPC3 control settings to factory settings.
Command	"∗RST""
Remarks	This Command sets the PPC3 settings to factory settings. This equivalent to a front panel executed RESET/SET. This does not affect the communications settings.
Example (enhanced)	Sent: "∗RST" Reply: "∗RST" (no reply if IEEE-488)
See Also	Section 3.5.4.1, Reset - Sets

∗SRE	
Purpose	Read or set the Service Request Enable Register.
Command Query	"∗SRE *n*" "∗SRE?"
Default	"∗SRE 0"
Arguments	*n:* '0 to 255' This is the decimal representation of the bit(s) to enable. To allow the MAV and ESB bits to assert the SRQ line, the argument would be 32 + 16 = 48. Bit 6 (64) is reserved and cannot be set.
Remarks	The Service Request Enable Register determines which bits of the Status Byte can set the MSS bit of the Status Byte and request service by asserting the SRQ line of the IEEE-488 interface.
Example (enhanced)	Sent: "∗SRE=48" (enables the MAV and ESB bits) Query reply: "48" (no reply if IEEE-488)
Errors	ERR# 6: *n* is not valid.

∗STB	
Purpose	Read the Status Byte Register.
Command	"∗STB?"
Remarks	The Status Byte Register reflects the general status of the PPC3. The 'MSS' bit state is represented by bit 6.
Example (enhanced)	Sent: "∗STB?" Reply: "80" (The MSS and MAV bits are set)

∗TST	
Purpose	Read the power on self test status.
Query	"∗TST?""
Remarks	The PPC3 system memory stores the user settings (units, resolution, generation settings) and retains them when the unit if OFF. On power-up, this memory is checked. If this memory is corrupted, all user settings are reset to default (as if the "∗RST" program message was executed), and the ∗TST query will return a non zero value. If the PPC3 passed the test on power-up OR if the ∗TST query was used at least once since the PPC3 was powered up the reply will be a '0'.
Example (enhanced)	Sent: "∗RST?" Reply: "1"

***RSE**	
Purpose	Read or set the Ready Status Enable Register.
Command Query	"RSE *n*" "RSE?"
Default	"RSE 0"
Arguments	*n:* '0 to 255' This is the decimal representation of the bit(s) to enable. To enable the RDY bit, the argument would be 1.
Remarks	The Ready Status Enable Register determines which bits in the Ready Status Register are enabled and included in the Status Byte Register (RSR bit), and can assert the SRQ line. The reply is in decimal numeric form.
Example (enhanced)	Sent: "∗RSE=1" (enables the RDY bit) Query reply: "1" (no reply if IEEE-488)
Errors	ERR# 6: *n* is not valid.

***RSR**	
Purpose	Read the Ready Status Register.
Command	"RSR?"
Remarks	The Ready Status Register contents are cleared after reading. The reply is in decimal numeric form.
Example (enhanced)	Sent: "RSR?" Reply: "6" (The MEAS and NRDY)

NOTES

5. MAINTENANCE, ADJUSTMENTS AND CALIBRATION

5.1 OVERVIEW

PPC3 was designed for maintenance free operation. No maintenance is required other than:

- Regular rezeroing of quartz reference pressure transducers (Q-RPT), if present (see Section 3.5.1).
- Periodic calibration of Q-RPTs, if present (see Section 5.2).
- Adjustment of the on-board barometer and/or utility sensor, if present (see Sections 5.3, 5.4).
- Automated adjustment of pressure controlling parameters, as needed (see Section 5.5).

This section provides information on maintenance, adjustment and calibration procedures, and recommended overhaul procedures.

PPC3 is a sophisticated pressure setting and measuring instrument with advanced on-board features and functions. Before assuming that unexpected behavior is caused by a system defect or breakdown, use this manual and other training facilities to become thoroughly familiar with PPC3 operation. For rapid assistance in specific situations use the troubleshooting guide in Chapter 6.

PPC3 is covered by a limited one (1) year warranty. Unauthorized service or repair during the warranty period is undertaken at the owner's risk and may cause damage that is not covered under warranty and/or may void the warranty.

5.2 CALIBRATION OF QUARTZ REFERENCE PRESSURE TRANSDUCERS (Q-RPTS)

5.2.1 PRINCIPLE

PPC3 may be equipped with one or two quartz reference pressure transducers (Q-RPTs) that are the source of low uncertainty pressure measurement for the system.

To calibrate a Q-RPT, pressures from a standard are applied to the Q-RPT at ascending and descending points over the range. The recommended pressure sequence for a calibration varies depending on whether the Q-RPT is of Standard or Premium class (see Section 1.2.2.1). The pressure defined by the standard and the corresponding Q-RPT readings are recorded at each point. After all of the pressures have been applied and recorded, adjustments are made to fit the Q-RPT pressure readings to the standard. Fitting the readings means performing a linear regression to arrive at the lowest value of the residuals of errors of the Q-RPT relative to the standard. The Q-RPT output is adjusted by user settable coefficients: PA (an adder or offset) and PM (a multiplier or span adjustment) (see Section 5.2.1.1).

The calibration process is performed independently on each Q-RPT to arrive at its optimal fit.

When running calibrations, collecting as received data and calculating PA and PM adjustments, whether AutoZ is normally used, whether it is ON or OFF and what the value of Zoffset is should be considered (see Section 3.5.1, ❍ PRINCIPLE).

CalTool for RPTs software provided with the PPC3 supports the calibration process of PPC3 Q-RPTs. CalTool and its documentation are provided on a General Accessories Disk with the new PPC3. Most users should use CalTool software to assist in the calibration of PPC3.

PPC3 is delivered with an interactive Q-RPT calibration utility that steps the operator through the complete Q-RPT calibration procedure including applying the necessary pressures, collecting data automatically, calculating new PA and PM values, previewing the results of the new calibration and activating the results of the new calibration (see the CalTool for RPTs manual on the General Accessories Disk). PPC3 also provides complete front panel and remote access to Q-RPT calibration parameters so that Q-RPT calibrations can be performed without using CalTool software (see Section 5.2.8).

PPC3 may also use external Q-RPTs mounted in RPM4 Reference Pressure Monitors. RPM4 Q-RPTs are calibrated independently of PPC3 (see the RPM4 Operation and Maintenance Manual).

5.2.1.1 PA AND PM COEFFICIENTS

The coefficients used to adjust Q-RPT readings are designated PA (an adder or offset) and PM (a multiplier or span set). The coefficients affect the Q-RPT reading following:

Corrected reading = (uncorrected reading • PM) + PA

PA is expressed in units of pressure (always the SI unit, Pascal).

PM is dimensionless.

Each Q-RPT has its own unique PA and PM values. The PA and PM values currently in use can be viewed and edited in the CAL function (see Section 5.2.7). PA and PM values are automatically edited when CalTool software is used and the results are activated.

As editing PA and PM values will change Q-RPT calibration, they should only be edited by qualified personnel as part of the calibration process. Caution should be taken to avoid accidental editing and a security system is available to prevent access (see Section 3.5.5.5). Incorrect editing of PA and PM values can cause out of tolerance measurements.

A new PPC3 is delivered with PA and PM values set to zero and 1 for all ranges. This does not mean that the PPC3 has not been calibrated. In the original factory calibration, privileged factory coefficients are used for calibration with the user PA and PM set to zero and 1.

5.2.1.2 AS RECEIVED AND AS LEFT DATA

Frequently, calibration procedures require that as received and as left data be reported. The necessary information to report as received and as left data on the calibration of PPC3 Q-RPTs can be obtained in several ways.

When the PPC3 CalTool calibration assistance software is used, as received data is displayed while running the calibration and is automatically recorded and provided if desired. As left data is also calculated and presented.

At any time, a) reference pressures applied, b) associated transducer readings, c) PA and PM and P_{offset} values can be used to calculate as received and as left values. For example, backing out PA and PM on the as left data yields the transducer readings with PA = 0 and PM = 1. Then applying the as received PA and PM and P_{offset} values to the readings calculates *as received* readings (the readings that the transducer would have made with the old PA, PM and P_{offset}).

A new PPC3 is delivered with PA and PM values set to zero and 1 for all ranges. This does not mean that the PPC3 has not been calibrated. In the original factory calibration, privileged factory coefficients are used for calibration with the user PA and PM set to zero and 1.

It is recommended that "as received" values of PA, PM and P_{offset} (for absolute mode calibrations if if AutoZero is used in normal operation) be recorded for each range prior to running the calibration. The current PA and PM and absolute mode P_{offset} an be viewed by pressing [SPECIAL], <8cal>, <1view>. The current value of gauge mode P_{offset} can be viewed by pressing [SPECIAL], <1AutoZ>, <2view>.

A new PPC3 is delivered with PA and PM values set to zero and 1 for all ranges. This does not mean that the PPC3 has not been calibrated. In the original factory calibration, privileged factory coefficients are used for calibration with the user PA and PM set to zero and 1.

5.2.2 EQUIPMENT REQUIRED

The recommended calibration standards for PPC3 Q-RPTs are DHI PG7000 gas operated piston gauges (PG7201, PG7202, PG7601). Contact DHI for additional information.

Gas operated piston gauge (deadweight tester), with the following characteristics:

- **Measurement uncertainty of ± 0.0025 % of reading for Standard Class Q-RPTs or ± 0.002 % of reading for Premium Class Q-RPTs**. A standard with higher measurement uncertainty may be used but PPC3 measurement uncertainty may be degraded proportionally from published specifications.
- **If the Q-RPT is an Axxx (absolute) type and will be used in the absolute and/or negative gauge measurement modes, the reference must be able to apply absolute pressures:** Absolute pressures may be arrived at either by operation relative to an evacuated bell jar or, for higher pressures, by addition of atmospheric pressure measured by a high accuracy barometer. **Axxx (absolute) Q-RPTs that will not be used in absolute of negative gauge measurement modes (as is very often the case for higher pressure Q-RPTs) do not require the application of absolute pressure for calibration and may be calibrated using a gauge pressure standard.**

Axxx (absolute) Q-RPTs calibrated in gauge measurement mode by applying gauge reference pressure values should be used in gauge mode only (see Sections 3.3.3, ❍ PRINCIPLE, 5.2.5).

- **Able to supply the recommended sequence of pressure points in the range to be calibrated:** See Section 5.2.4 for information on the recommended calibration point sequence for various Q-RPT types and classes.

5.2.3 SET-UP AND PREPARATION

To set-up and prepare the PPC3 for calibration of an internal Q-RPT:

❶ Set the PPC3 on a stable surface near the calibration standard at a height as close as possible to the calibration standard's reference height. Consider the connections that may need to be made to the rear panel and access to the front panel display and keypad.

❷ Connect a pressure supply greater than the maximum pressure to be applied during the calibration to the PPC3 rear panel **SUPPLY** port (1/8 in. NPT F). (See Section 2.3.5.)

❸ If the calibration will include pressures under atmospheric pressure, connect a vacuum pump to the PPC3 rear panel **EXHAUST** port (1/4 in. NPT F). There will be a constant bleed of gas through the **EXHAUST** port so the vacuum pump should be self-venting or disconnected when OFF (see Section 2.3.6).

❹ Connect the calibration standard output to the PPC3 rear panel **TEST(+)** port (1/8 in. NPT F).

DO NOT apply pressure to the TEST(+) port without having a pressure supply greater than the applied pressure connected to the SUPPLY port. Do not cause sudden external pressure changes. Damage to internal PPC3 components could result. Unless the piston gauge used to calibrate the PPC3 has automated pressure control, it is highly recommended that the PPC3 direct pressure control keys (see Section 3.1.3) be used to slew and adjust pressure during the calibration. This will minimize the risk of accidental overpressure of the PPC3 Q-RPTs.

5.2.4 RECOMMENDED CALIBRATION POINT SEQUENCE

Calibration adjustments to PPC3 Q-RPTs are made by adjusting calibration coefficients, PA and PM (see Section 5.2.1.1). To adjust these coefficients to optimum values giving the best results over the Q-RPTs complete operating range, specific calibration point sequences are recommended. The recommended point sequence depends upon whether the Q-RPT being calibrated is a Standard or Premium Class (see Section 1.2.2.1). The class of the PPC3 Q-RPTs is indicated on the model number on the product label and on the rear panel Q-RPT model (**<s>** for standard, **<p>** for premium, for example A7Ms or A7Mp).

Prior to running the calibration point sequence, the Q-RPT should be exercised by:

a) Setting full scale pressure.

b) Dwelling at full scale pressure for 5 minutes.

c) Returning to atmospheric pressure (vented). If the Q-RPT is a gas operated Axxx type, use vacuum rather than atmospheric pressure.

d) Dwelling for twenty minutes.

A dwell time after setting the pressure of at least 60 seconds before taking data at each point is recommended.

Section 5.2.4.1 gives calibration point sequences for Standard Class Q-RPTs and Section 5.2.4.2 gives calibration point sequences for Premium Q-RPTs.

It is not required that the calibration pressure standard apply precisely the nominal pressure value of each calibration point as long as the exact value of the applied pressure is known. Best results are obtained if the actual applied pressure is within 2 % of the nominal point definition.

5.2.4.1 STANDARD CLASS Q-RPTS

See additional information in Section 5.2.4 concerning exercising the Q-RPT and dwell time at pressure points.

Table 22. Calibration Point Sequence, Standard Class, Axxx and Gxxx Q-RPTs

CALIBRATION SEGMENT	POINT NO.	POINT [% OF SPAN]
Ascending	1	Lowest Pressure[1]
	2	25 %
	3	50 %
	4	75 %
	5	100 %
Descending	6	75 %
	7	50 %
	8	25 %
	9	Lowest Pressure[1]

1 In absolute mode, the lowest point that can be set reliably by the \reference piston gauge. Zero (vented) in gauge mode.

Axxx (absolute) Q-RPTs that will NOT be used in absolute or negative gauge measurement modes may be calibrated in gauge measurement mode with a gauge pressure standard. Axxx (absolute) Q-RPTs calibrated in gauge measurement mode by applying gauge reference pressure values should be used in gauge mode only (see Section 5.2.5).

Table 23. Calibration Point Sequence, Standard Class, BGxxx Q-RPTs

CALIBRATION SEGMENT	POINT NO.	POINT [% OF SPAN][1]
Ascending	1	0 %
	2	25 %
	3	50 %
	4	75 %
	5	100 %
Descending	6	75 %
	7	50 %
	8	25 %
	9	0 %

1. The BG15K span is – 15 to + 15 kPa, 30 kPa total. Therefore, 0 % is – 15 kPa, 25 % is – 7.5 kPa, 100 % is + 15 kPa, etc.

BGxxx (bi-directional gauge) Q-RPTs that will NOT be used in negative gauge measurement mode may be calibrated in gauge (positive pressures) measurement mode only. Use the gauge mode (Gxxx) calibration point sequence (see Table 22). BGxxx Q-RPTs calibrated in gauge measurement mode only should not be used in negative gauge mode.

Table 24. Calibration Point Sequence, Standard Class, BA100K Q-RPT

CALIBRATION SEGMENT	POINT NO.	POINT [% OF SPAN][1]
Ascending	1	0 %
	2	25 %
	3	50 %
	4	75 %
	5	100 %
Descending	6	75 %
	7	50 %
	8	25 %
	9	0 %

1. The BA100K span is 70 to 110 kPa absolute.

5.2.4.2 PREMIUM CLASS Q-RPTS

See additional information in Section 5.2.4 concerning exercising the Q-RPT and dwell time at pressure points.

Verification of Premium Class Q-RPTs

When verifying (as opposed to calibrating) a Premium Q-RPT it is not necessary to include the higher density of points that is recommended for determination of the calibration coefficients. A standard ascending/descending 9 or 11 point run is adequate. To verify that the uncertainty turndown with AutoRange is in tolerance (see Sections 3.3.4, 1.2.2.1), it is recommended that the verification of a Premium Q-RPT include a verification of an AutoRanged span of 30 % of the maximum Q-RPT span. For example, verify an A7M Q-RPT in the default range of 0 to 7 MPa (1 000 psi) and in the AutoRange range of 2.1 MPa (300 psi).

Table 25. Calibration Point Sequence, Premium Class, Axxx and Gxxx Q-RPTs

CALIBRATION SEGMENT	POINT NO.	POINT [% OF SPAN]
Ascending	1	Lowest Pressure[1]
	2	5 %
	3	10 %
	4	15 %
	5	20 %
	6	30 %
	7	40 %
	8	50 %
	9	60 %
	10	80 %
	11	100 %
Descending	12	80 %
	13	50 %
	14	20 %
	15	Lowest Pressure[1]

1 In absolute mode, lowest point that can be set reliably by the reference piston gauge. Zero (vented) in gauge mode.

Axxx (absolute) Q-RPTs that will NOT be used in absolute or negative gauge measurement modes may be calibrated in gauge measurement mode with a gauge pressure standard. Axxx (absolute) Q-RPTs calibrated in gauge measurement mode by applying gauge reference pressure values should be used in gauge mode only (see Section 5.2.5).

Table 26. Calibration Point Sequence, Premium Class, BGxxx Q-RPTs

CALIBRATION SEGMENT	POINT NO.	POINT [% OF SPAN][1]
Ascending	1	0 %
	2	15 %
	3	30 %
	4	40 %
	5	45 %
	6	50 %
	7	55 %
	8	60 %
	9	70 %
	10	85 %
	11	100 %
Descending	12	70 %
	13	50 %
	14	30 %
	15	0 %

1. The BG15K span is – 15 to + 15 kPa, 30 kPa total. Therefore, 0 % is – 15 kPa, 25 % is – 7.5 kPa, 100 % is + 15 kPa, etc.

BGxxx (bi-directional gauge) Q-RPTs that will not be used in negative gauge measurement mode may be calibrated in gauge (positive pressures) measurement mode only. Use the gauge mode (Gxxx) calibration point sequence (see Table 25). BGxxx Q-RPTs calibrated in gauge measurement mode only should not be used in negative gauge mode.

5.2.5 TURNING OFF ABSOLUTE AND NEGATIVE GAUGE MEASUREMENT MODES FOR AXXX (ABSOLUTE) Q-RPTS

❍ PURPOSE

To prevent operation in absolute and negative gauge measurement modes with an Axxx (absolute) Q-RPT.

❍ PRINCIPLE

Axxx (absolute) Q-RPTs are frequently used in gauge measurement mode only (see Section 3.3.3, ❍ PRINCIPLE). Axxx Q-RPTs that are used in gauge mode only, may be calibrated in gauge mode with a reference that applies gauge pressures. Calibration with an absolute reference is not necessary. However, if an Axxx Q-RPT is calibrated in gauge mode, it is not possible to know if it is in or out of tolerance in absolute and negative gauge modes. To avoid using absolute and negative gauge measurement modes on an Axxx Q-RPT that is calibrated for gauge mode only, access to absolute and negative gauge modes can be turned ON and OFF. This is accomplished in the **[SPECIAL]**, **<8cal>** menu.

❍ OPERATION

See Section 5.2.7 for more detailed information on editing and viewing Q-RPT calibration information.

Turning absolute and negative gauge mode operation ON and OFF for a Q-RPT occurs in the same area in which calibration coefficients are edited. To access the Q-RPT calibration editing area press **[SPECIAL]**, **<8cal>** and select the desired Q-RPT. Then select **<1edit>** to make changes.

[ENT] through the calibration information. After viewing the values of PA and PM the display is:.

```
Allow abs and      HI
neg g mode? 1yes 2no
```

The cursor is on the number corresponding to the current selection. Make the desired selection. **<1no>** causes absolute and negative gauge modes to be unavailable for the Q-RPT.

PPC3 may also use external Q-RPTs mounted in RPM4 Reference Pressure Monitors. Viewing and adjustment of RPM4 calibration information is performed locally on the RPM4, not through PPC3 (see the RPM4 Operation and Maintenance Manual).

5.2.6 Q-RPT CALIBRATION USING CALTOOL FOR RPTS SOFTWARE

To calibrate PPC3 Q-RPTs using CalTool software, refer to Sections 5.2.1, ❍ PRINCIPLE, 5.2.2, and 5.2.3 in this manual and then refer to the CalTool for RPTs Software Manual.

CalTool for RPTs software and manual are supplied on the PPC3 General Accessories Disk (white CD) and can be downloaded from **www.dhinstruments.com**.

5.2.7 EDITING AND VIEWING Q-RPT CALIBRATION INFORMATION

❍ PURPOSE

View and/or edit Q-RPT calibration information fields including:

- **The calibration date** – This field is normally used to record the date on which the Q-RPT is calibrated.
- **The value of absolute mode AutoZero P_{offset} (Axxx Q-RPTs only)** – See Section 3.5.1 for complete AutoZero information. This value is normally set to zero following absolute measurement mode calibration of an Axxx Q-RPT.
- **The value of PA** – The pressure adder for the selected Q-RPT (see Sections 5.2.1.1).
- **The value of PM** – The pressure multiplier for the selected Q-RPT (see Sections 5.2.1.1).
- **Absolute and negative gauge measurement modes ON or OFF (Axxx Q-RPTs only)** – See Section 3.3.3, ❍ PRINCIPLE for complete information on measurement modes. This is set to OFF if the Axxx Q-RPT was calibrated in gauge mode with a gauge pressure standard (see Section 5.2.5).

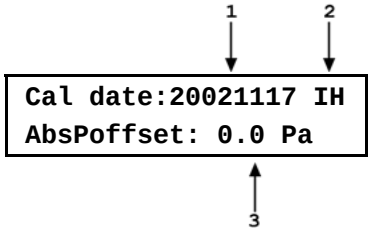
❍ OPERATION

As editing PA and PM values will change the calibration of the Q-RPTs, the edit function should only be used by qualified personnel as part of the calibration process. Caution should be taken to avoid accidental editing. A user level security system is available to control access (see Section 3.5.5.5).

A new PPC3 is delivered with PA and PM values set to zero and 1 for all ranges. This does not mean that the PPC3 has not been calibrated. In the original factory calibration, privileged factory coefficients are used for calibration with the user PA and PM set to zero and 1.

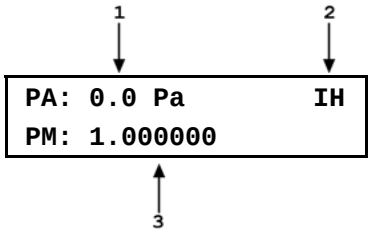
To access Q-RPT calibration information viewing or editing press **[SPECIAL]**, **<8Cal>**. Select the desired Q-RPT. The **<1view>** selection displays the calibration information fields. The **<2edit>** function displays the fields and allows them to be edited. The display is:

1. Date of last calibration in YYYYMMDD format.
2. Position designator of the Q-RPT being viewed.
3. Current value of absolute mode P_{offset}.
   This line is blank if the Q-RPT is not an Axxx type.



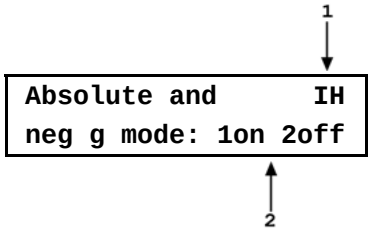
If in **edit** mode, the calibration information fields can be edited. Edits to P_{offset} are common with changes made in the AutoZ edit or run function (see Section 3.5.1). Pressing **[ENT]** on the last field goes to the next view/edit screen:

1. Value of PA.
2. Position designator of the Q-RPT being viewed.
3. Value of PM.



If in **edit** mode, the calibration fields can be edited. If the selected Q-RPT is an Axxx Q-RPT, pressing **[ENT]** in the PM field goes to the next calibration information display (this display is skipped if the Q-RPT is an Gxxx or BGxxx):

1. Position designator of the Q-RPT being viewed.
2. Cursor is on current ON or OFF selection.



If in **edit** mode, the ON or OFF status can be changed by selecting **<1on>** or **<2off>** (see Section 5.2.5). **[ENT]** in view mode returns to the view/edit screen. **[ENT]** in edit mode goes to confirmation of change activation if changes have been made. Pressing **[ESC]** in any edit screen exits the edit screen without activating any changes.

The value of PA is always in Pascal (Pa). The value of PM is dimensionless.

PPC3 may also use external Q-RPTs mounted in RPM4 Reference Pressure Monitors. Viewing and adjustment of RPM4 calibration information is performed locally on the RPM4, not through PPC3 (see the RPM4 Operation and Maintenance Manual).

5.2.8 Q-RPT CALIBRATION/ADJUSTMENT WITHOUT CALTOOL FOR RPTS SOFTWARE

❍ PRINCIPLE

The PPC3 Q-RPTs can be calibrated and adjustments made without using CalTool for RPTs software. This requires:

- Applying pressures with a calibration standard and recording the pressures measured by PPC3.
- Calculating new PA and PM values and entering them.
- Setting P_{offset} to zero for Axxx Q-RPTs.

Before proceeding to calibrate a reference pressure transducer without using CalTool for RPTs software, Sections 5.2, Calibration of Reference Pressure Transducers, 5.2.1 ❍ PRINCIPLE, 5.2.2 Equipment Required, 5.2.3 Setup and Preparation should be reviewed thoroughly.

❍ OPERATION

The typical procedure for calibrating a Q-RPT is:

❶ Set-up and prepare the PPC3 for calibration (see Sections 5.2.2, 5.2.3).

❷ Use the **[RPT]** function key to select the Q-RPT to be calibrated (see Section 3.3.5). Be sure to set the DF range (not an AutoRanged range).

❸ Use **[HEAD]** to set the HEAD to zero (see Section 3.3.7). Use **[UNIT]** to set the desired pressure unit of measure (see Section 3.3.2). Use **[MODE]** to set the desired pressure measurement mode (see Section 3.3.3). Axxx (absolute) Q-RPTs that will be used in gauge measurement mode only, may be calibrated in gauge measurement mode with a gauge pressure standard (see Section 5.2.5).

❹ Use **[SPECIAL]**, **<1AutoZ>** to access the AutoZ function (see Section 3.5.1).

If calibrating in absolute measurement mode, turn AutoZ ON if it is left ON in normal PPC3 operation. If calibrating in gauge measurement mode, always turn AutoZ ON.

❺ Use **[SPECIAL]**, **<8cal>**, **<1Hi RPT>** or **<2Lo RPT>**, **<1view>**, read and record the current values of PA and PM for the Q-RPT to be calibrated. If calibrating in absolute mode, also record the value of P_{offset}.

❻ Run the recommended calibration point sequence for the Q-RPT (see Section 5.2.4) recording the pressure applied by the standard and the PPC3 reading at each calibration point. Dwell at least 90 seconds at each point after setting the reference pressure to allow full stabilization before taking data. The data recorded is the "as received" data for this calibration.

❼ Enter the calibration pressures and PPC3 readings into a spreadsheet. Calculate the "non-corrected" PPC3 readings by backing out the PA, PM and P_{offset} (P_{offset} only in the case of Axxx (absolute) Q-RPTs in absolute mode) recorded in Step ❺ above, following:

$$\textbf{non-corrected reading} = ((\text{corrected reading} - PA)/PM) + P_{offset}$$

❽ Perform a linear regression to find the offset and slope that best fit the non-corrected PPC3 readings to the calibration standard pressures. The offset is the new value of PA, the slope is the new value of PM.

❾ Press **[SPECIAL]**, **<8Cal>**, **<1Q-RPT>**, **<2edit>** and write the new calibration date and the new values of PA and PM for the Q-RPT and range calibrated. If this is an Axxx Q-RPT used in absolute mode, edit the value of P_{offset} to zero. If this is an Axxx Q-RPT and the

calibration was performed in gauge mode, turn absolute and negative gauge modes OFF to avoid their being used after the calibration.

⑩ Calculate as left data for the calibration if desired following:

as left reading = (non-corrected reading • new PM) + new PA

⑪ Perform additional verification pressure runs as desired.

5.3 ADJUSTMENT OF ON-BOARD BAROMETER

❍ PURPOSE

To adjust the output of the on-board barometer (see Section 1.2.2.3).

PPC3's that have only Gxxx Q-RPTs (no Axxx or BGxxx) are NOT equipped with an on-board barometer.

❍ PRINCIPLE

The on-board barometer output can be adjusted using PA and PM values in the same manner as Q-RPTs (see Section 5.2.1.1).

The on-board barometer is a low accuracy sensor used only for measuring changes in atmospheric pressure over short periods of time (see Section 3.2.3) and the line pressure for G15K and BG15K line pressure compensation. PPC3 measurement uncertainty does not depend on the measurement uncertainty of the on-board barometer.

❍ OPERATION

To edit the values of PA and PM for the barometer, press **[SPECIAL]**, **<8cal>**, **<2barometer>**. Pressing **[ENT]** steps through displays of the calibration date **[YYYYMMDD]** and PA and PM. In **edit** mode, the values can be edited. Pressing **[ENT]** after the last screen activates the edited values.

To view the current output of the on-board barometer, press [SPECIAL], <7Internal>, <3baro>.

5.4 ADJUSTMENT OF UTILITY SENSOR

❍ PURPOSE

To adjust the output of the utility sensor, if present (see Section 1.2.2.2).

❍ PRINCIPLE

PPC3s that do not have a Q-RPT in the Internal, Hi position, have a utility sensor.

The utility sensor output can be adjusted using PA and PM values in the same manner as for the Q-RPTs (see Section 5.2.1.1).

The utility sensor is not intended to serve as a pressure reference for low uncertainty, traceable measurement. It is for indication, pressure control and system maintenance functions only. PPC3 measurement uncertainty when using Q-RPTs does not depend on the measurement uncertainty of the utility sensor.

❍ OPERATION

The procedure to adjust the output of the utility sensor is that same as for the calibration of an Internal, Hi (IH), Standard Class, Q-RPT (see Section 5.2.1), but the calibration reference uncertainty can be between 0.01 and 0.05 % FS. To view/edit the calibration information for a utility sensor, use **[SPECIAL]**, **<8cal>**, **<1Hi RPT>**. The position designator of a PPC3 utility sensor is always **<IuH>**.

5.5 PNEUMATIC CONTROL MODULE CONFIGURATION (<CONFIG>)

❍ PURPOSE

To run an automated routine that automatically adjusts automated pressure control coefficients or to return automated pressure control coefficients to factory default values.

❍ PRINCIPLE

PPC3 uses factory configuration coefficients in the pressure control algorithms used for automated pressure control. Changes in the pressure control elements over time or operation into an unusually large test volume can cause pressure control performance to change. The PPC3 on-board configuration routine automatically retunes the factory configuration coefficients to take these changes into account.

The CONFIG function should be considered a maintenance function and only used to attempt to improve pressure control when all other factors affecting pressure control have been examined and eliminated (for example leaks, restrictions in test lines, unstable pressure supply, unstable vacuum supply). The configuration function may also be useful to speed up PPC3 pressure control when the minimum test volume is in excess of 500 cc.

In addition, the CONFIG function allows pressure control parameters to be returned to factory default values. This feature can be useful to return to known conditions after the on-board configuration function has been run.

❍ OPERATION

Poor control is usually caused by invalid control parameters, excessive leaks and restrictions in the test system or other set up problems. These problems should be identified and eliminated before resorting to use of the configuration function (see Section 6).

To access the CONFIG function press **[SPECIAL]**, **<7internal>**, **<1config>**.

Select **<2factory>** to cause PPC3 to load factory default control coefficients. This feature can be useful to return to standard conditions if a faulty CONFIG routine has been activated or the current configuration is no longer valid.

Select **<1run>** to cause the pressure control module configuration routine to execute. Before running CONFIG, remove any external volume and plug the **TEST(+)** port. However, if there is a minimum anticipated test volume, for example, the G15K or BG15K DVU (see Section 2.3.8.2), leave the volume connected. Connect the normal supply pressure to the rear panel **SUPPLY** port and perform a leak check.

If the PPC3 Hi Q-RPT or utility sensor is an A350K or lower, the configuration routine should be run twice, once with a vacuum source attached to the EXHAUST port and once without. If the PPC3 Hi Q-RPT or utility sensor is greater than A350K, the configuration routine can be run with or without a vacuum pump connected to the EXHAUST port (use your most common configuration).

If the PPC3 Hi Q-RPT or utility sensor is greater than A350K, proceed directly to the **<CAUTION:>** screen below. If not, the display is:

```
Config type:
1vac 2atm
```

Select **<1vac>** or **<2atm>** depending on whether the **EXHAUST** port is at vacuum or atmosphere. If the ControlRef setting (see Section 3.5.7.2) does not correspond to your choice, you will receive an error.

The next display is:

```
CAUTION: About to
set nn MPa g
```

This display warns the user that pressure will increase to roughly 50 % of the Hi Q-RPT default range. Press **[ENT]** to continue if it is safe for PPC3 to set the indicated pressure.

<CFG> flashes in the lower right corner of the display. PPC3 pulses and slews pressure. After about ten minutes, the user is asked whether or not to save the new configuration. If the CONFIG function ran completely and without incident, select **<1Yes>**. Select **<2No>** to return to the MAIN RUN screen with no change to the pressure control coefficients.

If the PPC3 has a Hi Q-RPT less than or equal to A350K, repeat the configuration routine in the other **operating** mode (**<1vac>** or **<2atm>**). If you never use the PPC3 in one of the two conditions, it is not necessary to configure it in that condition.

The configuration routine must be run with NO external volume connected to the PPC3 (TEST(+) port plugged) unless a known minimum test volume is always connected. After configuring with a volume connected to the TEST(+) port, controlling pressure with a lower volume may result in poor pressure control.

The effect of the CONFIG function can be eliminated and control coefficients returned to factory defaults by pressing [SPECIAL], <4Internal>, <1Config>, <1factory>.

5.6 OVERHAUL

If calibration of the reference pressure transducers (Q-RPT) is included as part of the overhaul procedure, the calibration procedure should be performed last.

Any or all of the following items may be included as part of a system maintenance overhaul:

- Disassemble pressure control module filters and clean filter elements. Replace, if necessary.
- Clean front panel.
- Clean threads of rear panel fittings. Check for damage and replace, if necessary.
- Check that rear panel cooling fan operates when PPC3 is ON.
- Check that internal screws, bolts and nuts are tight.
- Verify that internal barometer, if present, reads atmospheric pressure within ± 0.1 kPa (0.015 psi). Adjust if necessary (see Section 5.3)
- Verify that utility sensor, if present, indicates pressure with ± 0.1 % FS over its range. Adjust if necessary (see Section 5.4).
- Pressurize PPC3 to 90 % of maximum pressure and leak test. Use **[LEAK CK]** function (see Section 3.3.9). Leak rate, after stabilization, should not exceed 0.001 % of maximum pressure/ second.
- Check the PPC3 controls within specifications over its range (see Section 1.2.3).
- Perform calibration of Q-RPTs if necessary (see Section 5.2).

5.7 RELOADING EMBEDDED SOFTWARE INTO FLASH MEMORY

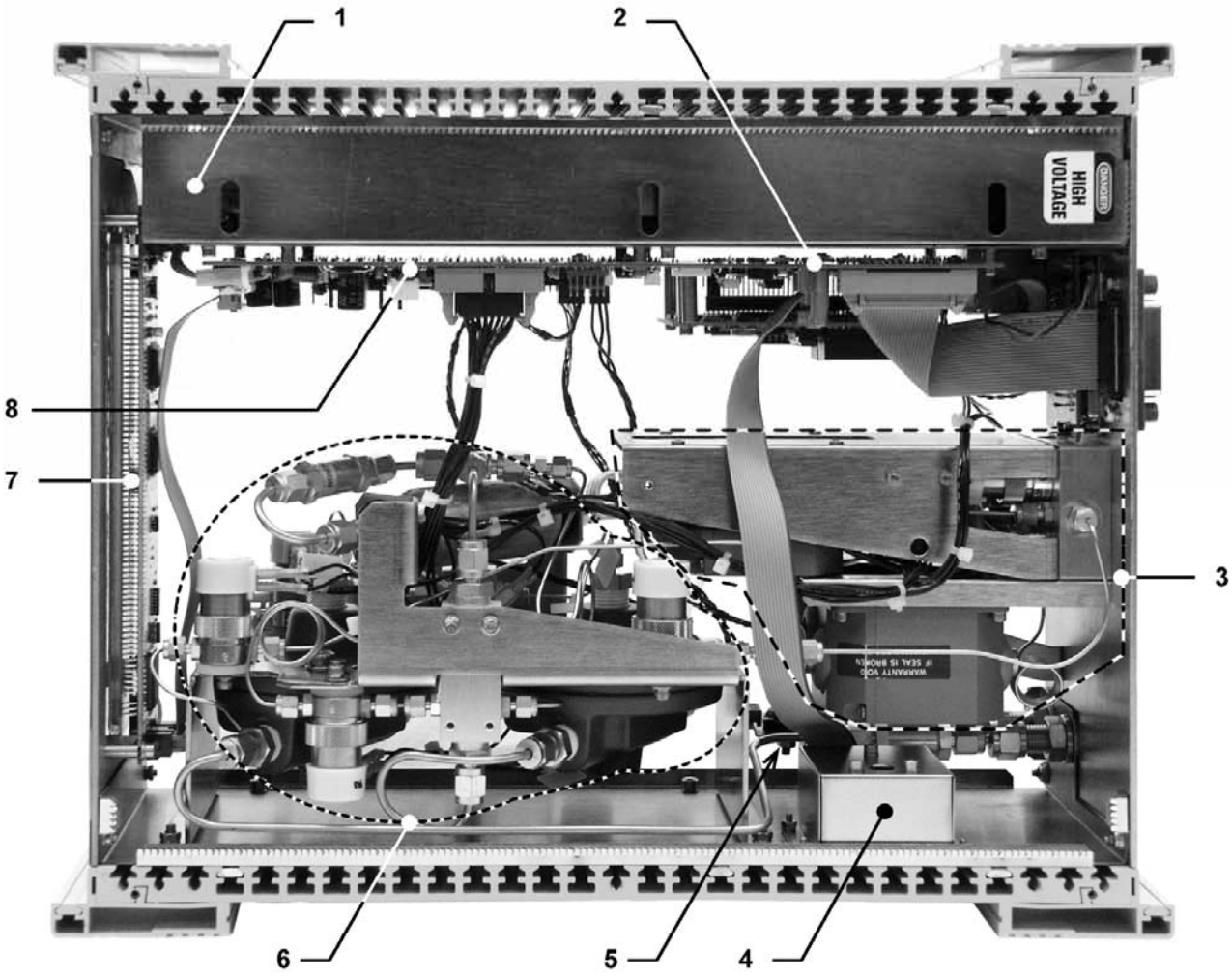
PPC3 uses FLASH memory. This allows the embedded software that controls PPC3 operations and functions to be loaded into PPC3 over its COM1 port from a computer with a simple FLASH loading utility program.

To replace corrupted software or upgrade your software, access the **DHI** worldwide web site at **www.dhinstruments.com** and go to **SOFTWARE** located under **SUPPORT**. A FLASH loading utility and the latest PPC3 software are available for download at no charge. If you do not have access to the web or have difficulty downloading or loading software, contact your **DHI** representative or a **DHI** Authorized Service Provider for assistance.

If you believe you have discovered an error or "bug" in PPC3 software, please report it with complete details by email to **cal.repair@dhinstruments.com** or submit an on-line **Quality Feedback Report** at **www.dhinstruments.com**.

The DHI flash software loading utility and PPC3 embedded software are available for download from DHI web site, www.dhinstruments.com.

5.8 SUBASSEMBLY DESCRIPTION AND LOCATION



1. Power Supply Module
2. Micro Card
3. Q-RPT Module (configuration varies)
4. On-Board Barometer (if present)
5. Vacuum Sensor
6. Pressure Control Module
7. Display
8. Driver Board

Figure 11. Internal View

5.8.1 POWER SUPPLY MODULE

- + 12 V DC (± 2 %) @ 3.3 Amps: For internal and external valve actuation.
- + 5 V DC (± 1 %) @ 3.0 Amps; + 15 V DC (± 3 %) @ 1.5 Amps; - 15 V DC (± 3 %) @ 0.35 Amps: For the supply of the micro board and driver board electronics.

5.8.2 MINI MICRO BOARD

The micro board supports a Motorola 68302 micro-controller, EPROM, EEPROM, 128k x 16 bit NVRAM, 8 Mbit flash memory; RS-232 and IEEE-488.2 communications; keypad and display control. An I/O port controls other ports and devices in RPM4.

5.8.3 Q-RPT MODULE

The Q-RPT module is an integrated assembly that mechanically manages the PPC3's pressure transducers. The module includes a Hi Q-RPT (quartz reference pressure transducer) or utility sensor and may also have a Lo Q-RPT, brackets to hold the transducer(s) interconnecting tubing, a manifold with the PPC3's **TEST(-)**, **TEST(+)** and **VENT** ports and solenoid valves for AutoZeroing, measurement mode changes and switching of the active transducer.

See Figure 13 for pneumatic schematics of different Q-RPT module configurations.

5.8.3.1 HI Q-RPT OR UTILITY SENSOR

The higher range pressure transducer in a PPC3 may be a Q-RPT (quartz reference pressure transducer) or a utility sensor depending on the specified PPC3 configuration.

A Q-RPT is intended to provide very high precision, low uncertainty, traceable pressure measurement. The basic sensing principle is the measurement of the change in the natural oscillating frequency of a quartz tuning fork in response to changes in temperature and mechanical stress resulting from the change in pressure applied to a connecting bellows or bourdon tube. Two independent quartz elements are used. One quartz element is subjected to pressure related stress. The other quartz element is used only to monitor temperature. See Section 1.2.2.1 for Q-RPT specifications.

The utility sensor is for pressure indication, safety and housekeeping functions. It is a temperature compensated micro-machined silicon sensor module.

5.8.3.2 LO Q-RPT

PPC3 may be equipped with a Lo Q-RPT. The Lo Q-RPT provides a lower measurement range than the Hi Q-RPT or utility sensor. See Section 5.8.6.1 for a description of Q-RPTs and section 1.2.2.1 for complete Q-RPT specifications.

5.8.4 ON-BOARD BAROMETER

The on-board barometer supports a board mounted, barometric range, micromachined silicon sensor and an ambient temperature sensor. The barometer readings are used for dynamic atmospheric pressure compensation when measuring gauge pressure with an absolute reference transducer (see Section 3.2.3). The temperature sensor is used for temperature compensation of the barometric sensor.

PPC3s that have only Gxxx Q-RPTs (no Axxx or BGxxx) are NOT equipped with an on-board barometer.

5.8.5 VACUUM SENSOR

The vacuum sensor is a silicon solid state pressure sensor in the barometric range. The vacuum sensor readings are used to determine whether a atmospheric pressure or a vacuum pressure is applied to the PP3 **EXHAUST** port (see Section 3.5.7.2).

5.8.6 PRESSURE CONTROL MODULE

The pressure control module is an integrated assembly that includes two inlet (fast and slow); two exhaust (fast and slow) control valves; vent valve and differential pressure regulators. The differential pressure regulators use pressure feedback to maintain a constant differential pressure across the control valves. The control valves are solenoid type, actuated by 12 V. See Figure 13 for the pneumatic module schematic.

5.8.7 DISPLAY

2 x 20 character vacuum fluorescent display.

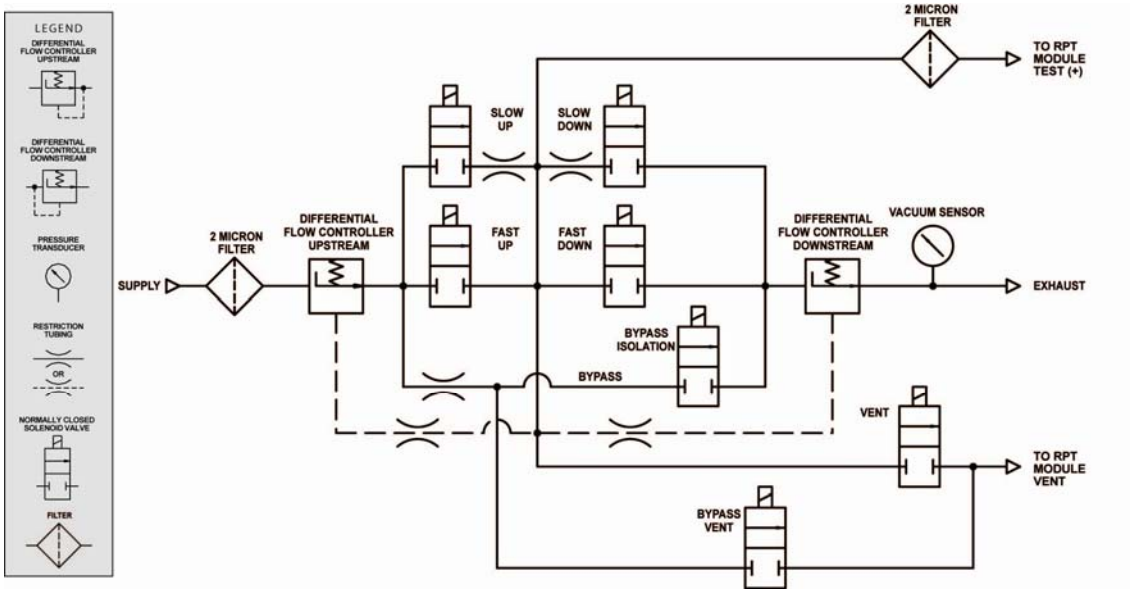
5.8.8 DRIVER BOARD

The driver board is controlled by the micro card (see Section 5.8.5). It supports:

- 12 V drivers for internal and external solenoid valve actuation
- Frequency counters (2) for Q-RPTs (see Section 5.8.6.1)
- On-board barometer power and output (see Section 5.8.4)
- Vacuum sensor power and output for ControlRef function (see Section 3.5.7.2)
- Utility sensor power and output
- Power to the system cooling fan
- Remote **[ENT]**
- Keypad and display
- Beeper

5.9 PNEUMATIC SCHEMATICS

5.9.1 PRESSURE CONTROL MODULE



The bypass vent valve is not included in model PPC3-10M.

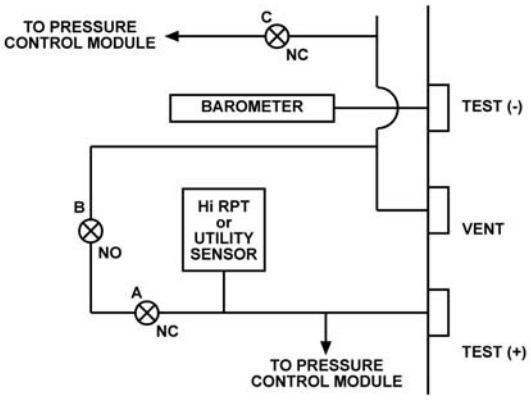
Figure 12. Pressure Control Module Schematic

5.9.2 Q-RPT MODULE CONFIGURATIONS (PRESSURE MEASUREMENT)

ONE Q-RPT-Axxx or utility sensor only (A10M)

CONDITION	VALVE STATE		
	A	B	C
Vent	O	O	O
Measure/Control	C	O	C
Power off	C	O	C

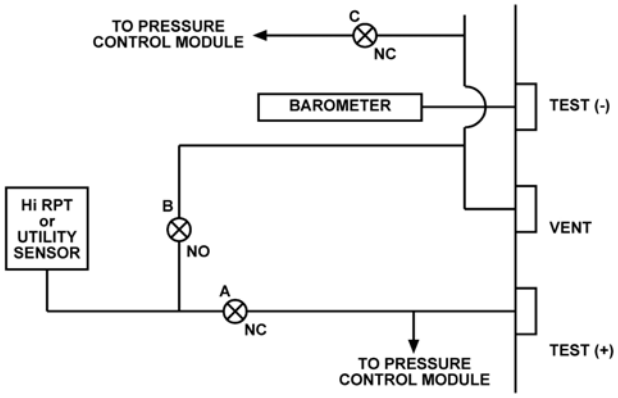
Valve C is shown for reference. It is in the pressure control module.



ONE RPT-Axxx or utility sensor (<A10M)

CONDITION	VALVE STATE		
	A	B	C
Vent	O	O	O
Measure/Control	O	C	C
Power off	C	O	C

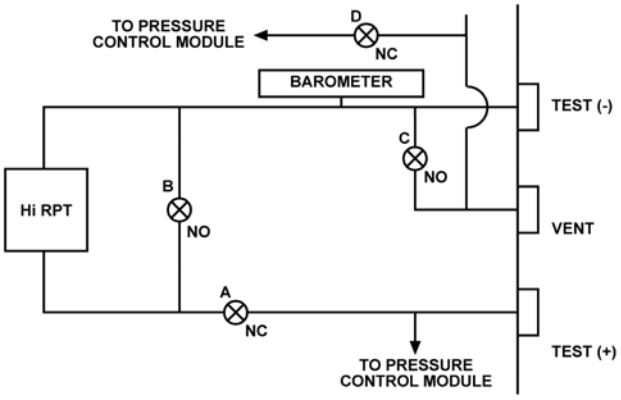
Valve C is shown for reference. It is in the pressure control module.



ONE RPT – Gxxx or BGxxx

CONDITION	VALVE STATE			
	A	B	C	D
Vent	O	O	O	O
Measure/Control	O	C	O/C	C
Power off	C	O	O	C

Valve C is the TEST(-) vent valve. In normal operation with BGxxx or Gxxx Q-RPTs, this valve is closed during fine pressure control (see Section 3.5.7.5).
Valve D is shown for reference. It is in the pressure control module.



TWO RPTs – No Gxxx or BGxxx

CONDITION	VALVE STATE		
	A	B	C
Vent	O	O	O
Measure/Control Hi	C	O	C
Measure/Control Lo	O	C	C
Power off	C	O	C

Valve C is shown for reference. It is in the pressure control module.

TWO RPTs – One or Two Gxxx or BGxxx

CONDITION	VALVE STATE			
	A	B	C	D
Vent	O	O	O	O
Measure/Control Hi	C	O	C/O	C
Measure/Control Lo	O	C	C/O	C
Power off	C	O	O	C

Valve D is shown for reference. It is in the pressure control module.
Valve C is the TEST(-) vent valve. In normal operation with BGxxx or Gxxx Q-RPTs, this valve is closed during fine pressure control (see Section 3.5.7.5).

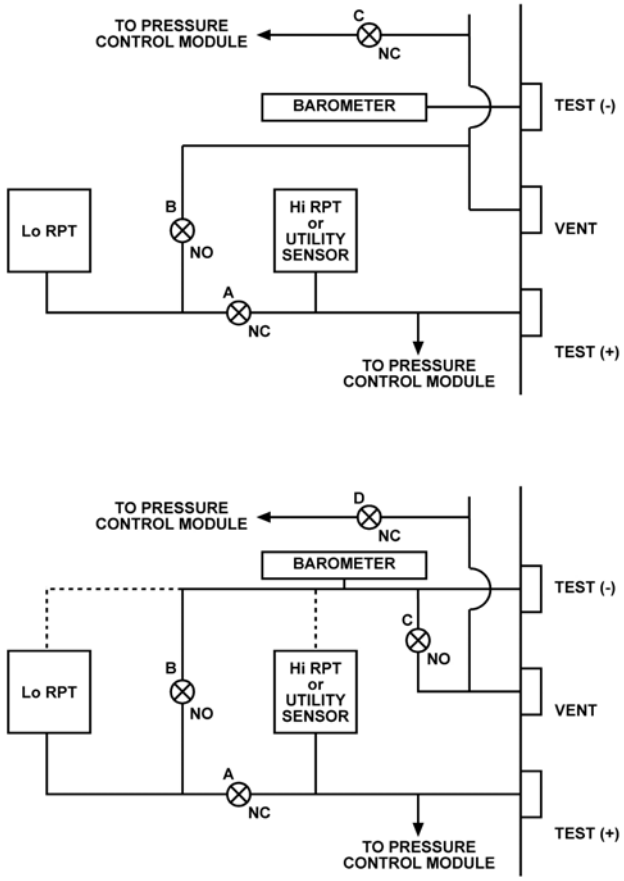


Figure 13. Q-RPT Module Schematics for Various Configurations

NOTES

6. TROUBLESHOOTING

PPC3 is a sophisticated pressure setting and measuring instrument with advanced on-board features and functions. Before assuming that unexpected behavior is caused by a system defect or breakdown, the operator should use this manual and other training facilities to become thoroughly familiar with PPC3 operation. This troubleshooting guide is intended as an aid in identifying the reason for PPC3 behavior and determining whether the behavior is due to normal operation or an internal or external problem.

Identify the symptom or unexpected behavior you are observing from the **SYMPTOM** list below. A **PROBABLE CAUSE** is provided and a **SOLUTION** is proposed including references to manual sections that provide information that may be of assistance.

Table 27. Troubleshooting Guide

SYMPTOM	PROBABLE CAUSE	SOLUTION
Will not power up.	Blown fuse.	Replace fuse.
Cannot access certain functions **>ACCESS RESTRICTED<**	User levels have been set that restrict access to certain functions.	Change user level or consult system manager. 3.5.5.5
Displays **<FATAL ERROR>** or **<FATAL FAULT>**.	Encountered unresolved internal software conflict.	Cycle power to clear. Please record conditions leading up to event including the numbers displayed when **[ENT]** is pressed and report to your **DHI** Authorized Service Provider. Table 31
There is a leak through the PPC3 **EXHAUST** port.	Normal flow through bypass of internal pressure controllers when pressure supply is connected and system is not vented or OFF.	Operation is normal if flow rate is normal. If there is flow through the **EXHAUST** port when system is vented or OFF and controller is not a PPC3-10M, contact **DHI** Authorized Service Representative. 5.6, Table 31
Front panel keys seem to be disabled.	**<remote>** command has been sent from a host computer.	Send **<local>** command from host computer or cycle PPC3 power. 4, 4.4.4
External RPM4 is not being identified when PPC3 is powered up or **[RPT]** is pressed. PPC3 is unable to find external RPM4 and Q-RPT.	The RPM4 COM1 port settings are not correct.	Set RPM4 COM1 port to settings required for use with PPC3. 2.3.7, 3.3.5
Valve driver #8 seems to be operating erratically without being told to do so.	Driver #8 is used automatically by the automated purge function when purge is activated.	Deactivate purge function or don't use driver #8 other than to support an SPLT. 3.5.7.4
Measured pressure display has too much/not enough resolution.	Resolution setting needs to be changed.	Use RES function to change the resolution setting. 3.4.2
Can't increase resolution to level desired in AutoRanged range.	Resolution setting is limited when AutoRanging under 10 % of Q-RPT default range.	Operation in normal. Table 6
Values that should be non-zero are displayed as zero.	Resolution setting needs to be increased to view significant digits.	Use RES function to change the resolution setting. 3.4.2
The pressure units available under the **[UNIT]** function key are not the ones desired.	UNIT function needs to be customized.	Use PresU function to customize the UNIT function or reset units to default. 3.5.6
Front panel display is dim.	Screen saver option has activated.	Operation is normal. Press any key to resume full screen power. Adjust screen saver time, if desired. 3.5.5.1

SYMPTOM	PROBABLE CAUSE	SOLUTION
AutoRange is not selecting the desired Q-RPT for the specified range.	The external (RPM4) Q-RPT is not initialized.	Check that the external RPM4 is connected and initialized properly. 2.3.7, 3.3.5
	The Q-RPT range does not cover the desired AutoRange.	Check that Q-RPT default range is high enough to cover the AutoRange. Table 1
	The specified operating mode is absolute or negative gauge and absolute mode and negative are OFF for the desired Q-RPT	Check that the Q-RPT type supports the desired measurement mode. 3.3.3, 1.2.2.1
	The Q-RPT is Gxxx (gauge only).	Check that absolute/negative gauge is ON for the Q-RPT. 5.2.5
There is a **<C>** to the right of the **<D>** or **<S>** control mode character on the bottom line of the display and it won't go away.	The custom control function has been used.	Reset control parameters to default by selecting a control mode using the CONTROL function. 3.4.6.2
Pressure display is flashing and beeper is sounding intermittently.	Current upper or lower limit of active range has been exceeded.	Correct overpressure condition. Change UL and/or active range if needed. 3.4.4, 3.4.4.1
Pressure display is flashing, no beeper is sounding and direct pressure control keys are inactive.	PPC3 and/or external RPM4 has been over-pressured.	Correct the overpressure condition and cycle power ON and OFF. 3.4.4.1
Display is <Check Xaa aaa RPT, wdog: nnnnn uuuum> and pressure control is aborted.	PPC3 internal watchdog measurement system has detected that active external Q-RPT does not appear to be connected as its pressure is not changing as expected when PPC3 controls the pressure.	Check that external RPM4 Q-RPT is connected properly to PPC3 **TEST(+)** port. Cycle PPC3 power. 2.3.7
A *Ready* (green *Ready/Not Ready* indicator) indication is never achieved.	Control parameter settings are too tight and/or existing conditions will not allow *Ready* to be achieved.	Adjust control parameters or correct other conditions. 3.1.3, 3.4.6
Q-RPT is Gxxx (gauge) but cannot select absolute or negative gauge measurement mode.	Q-RPT is Gxxx and does not support absolute and gauge measurement modes or	Operation is normal. 3.3.3
Q-RPT is Axxx (absolute) but cannot select absolute or negative gauge measurement mode.	Absolute and negative gauge measurement mode have been turned off in the calibration function.	Check that absolute/negative gauge is ON. 5.2.5
Will not accept pressure command.	Target exceeds UL and/or current range.	Check UL, range and measurement mode. 3.3.1, 3.3.3, 3.4.4
Will not set pressure.	Pressure and/or vacuum supply incorrectly connected or not adequate.	Correct pressure and/or vacuum supply. 2.3.5, 2.3.6
	There is a very large leak in the test system or **TEST(+)** port is not connected.	Correct leak. 2.3.8, 3.3.9
Will not set negative gauge pressure.	Measurement mode is not negative gauge.	Set negative gauge mode if supported by Q-RPT. 3.3.3
Poor pressure control at low gauge pressure.	Vacuum source on **EXHAUST** port is needed.	Connect vacuum source to **EXHAUST** port. 2.3.6
	Ambient (atmospheric pressure) is too noisy and/or not consistent on **TEST(-)** port and DUT.	Connect **TEST(-)** ports of PPC3, RPM4s if present and DUT together and consider isolating from atmospheric pressure. 2.3.8, 2.3.7
Poor pressure control at low gauge and/or absolute pressure.	ControlRef not properly set to reflect pressure conditions at **EXHAUST** port.	Set ControlRef properly. 3.5.7.2
Poor pressure control at very low gauge pressure.	DVU is needed, particularly if the Q-RPT is a G15K or BG15K.	Install DVU on **TEST(+)** and **TEST(-)** ports. 2.3.8.2
Poor pressure control at pressures under atmosphere or inability to reach pressures under atmosphere.	Vacuum supply is incorrectly connected, is not low enough or is unstable.	Correct vacuum supply to **EXHAUST** port. 2.3.6
Poor pressure control characterized by control interrupting near the target pressure.	Control mode is set to static mode rather than dynamic mode.	Set control mode to dynamic. 3.4.6, 3.1.2

SYMPTOM	PROBABLE CAUSE	SOLUTION
Poor pressure control characterized by excessive overshooting/ undershooting and/or "hunting" around target.	There is a restriction in the test connection between the PPC3 and the test or the PPC3, the RPM4 and the test.	Remove the restriction to allow free flow between the PPC3, the RPM4 (if present) and the test. 2.3.8
	Pneumatic control module needs to be reconfigured.	Reconfigure control module after all other possible control issues are considered. 5.5
	The volume connected to the **TEST(+)** port is too small.	Add volume to the system connected to the **TEST(+)** port. 1.2.3
	A filter in the PPC3, the SPLT or an accessory is dirty and causing a restriction.	Clean and dry or replace the filter element.
	Excessive leak present in system.	Correct internal or external leak or increase hold limit. 3.3.9, 3.4.6
	Test volume too small.	Increase test volume. Consider use of DVU (Dual Volume Unit) if Q-RPT is G15K or BG15K. Consider reconfiguration of pneumatic module after all other possible control issues have been evaluated. 2.3.8.2, 5.5
Poor pressure control characterized by minor overshooting.	Some overshooting is part of normal operation to speed up pressure stabilization.	Check whether overshooting is within normal limits. Objectively evaluate significance of overshoot relative to DUT span and specifications. Increase test volume.
Poor pressure control characterized by very slow slew rate.	Test volume is too large. Severe restriction in a test line.	Reduce test volume if slew rate is unacceptable. Remove restrictions in line connected to **TEST(+)** port.
Poor pressure control.	Unstable or incorrect pressure supply.	Connect regulated pressure supply set to correct supply pressure to **SUPPLY** port. 2.3.5
Poor pressure control and measurement.	The PPC3 and/or the connection to the test system is contaminated with liquids.	Purge and clean affected systems. Consider use of Self-Purging Liquid Trap. Contact **DHI** Authorized Service Provider if PPC3 is contaminated internally. 2.3.8.1, Table 31.
Disagreement between two Q-RPTs in system appears excessive.	Difference is actually within tolerance and acceptable disagreement. Note the Internal, Hi transducer may be a utility sensor which has a much wider tolerance than a Q-RPT.	Compare differences observed to tolerances on Q-RPT and/or utility sensor measurements. 1.2.2.1, 1.2.2.2
Apparent inaccurate pressure control/measure and little or no response from Q-RPT or utility sensor:	Reference transducer destroyed by overpressure.	Contact **DHI** Authorized Service Provider. Table 31
Apparent inaccurate pressure control/measure when using Internal, Hi (IH) RPT.	The IH transducer is a utility sensor, not a Q-RPT.	Operation is normal for lower specifications of utility sensor.1.2.2.2
Apparent inaccurate pressure measurement/control.	Incorrect pressure units and/or measurement mode (gauge or absolute).	Set desired pressure units and/or measurement mode. Consider reference temperature if unit is inWa. 3.3.2, 3.3.3
	Q-RPT calibration coefficients have been altered.	Check and correct calibration coefficients if needed. 5.2
	AutoZ has been run and turned ON with an incorrect standard for zero.	Check value of P_{offset}. Rerun AutoZ with a valid reference. 3.5.1
Apparent inaccurate pressure measurement/control and **<h>** is displayed on top line of screen.	An unplanned "head" correction is active or head height or gas is incorrect.	Operation is normal. Remove or change "head" correction. 3.3.7
Will not vent.	System is vented but does not indicate zero because measurement mode is absolute.	Check measurement mode setting and current value of atmospheric pressure if absolute. 3.3.3
	VENT port is plugged.	Open **VENT** port to atmosphere.
	Vent valve not operating.	Contact **DHI** Authorized Service Provider. Table 31
Will not vent while purging. Stuck at pressure during purging.	Purge function is not activated, Purge function is activated but no SPLT is connected or SPLT valve is not operating.	Activate SPLT; correct SPLT connection or repair SPLT exhaust valve. 3.5.7.4, 2.3.8

NOTES

7. APPENDIX

7.1 DRIVERS

The PPC3 drivers option provides eight open collector drivers for operating external valves, solenoids, indicators, etc. When operating from the setup-driver screen (see Section 3.4.7), pressing **[ENT]** allows the **operating** mode of the drivers to be set. The two modes of operation are momentary and toggle. A **momentary** driver changes ON/OFF state while the corresponding driver number on the keyboard is being pressed. In **toggle** mode, the driver ON/OFF state toggles each time the corresponding key is pressed and released.

Each driver output can sink 500 mA at 12 V. However, the total output of all the activated drivers cannot exceed one Amp. Therefore, refer to Table 28 if multiple drivers are being activated simultaneously.

Table 28. External Drivers Current Output

# 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

The male connector (P/N 401382) for the **DRIVERS** port is delivered with the PPC3 accessories.

Table 29 and Figure 14 should be referred to when building a cable to utilize the drivers port.

Table 29. External Drivers Pin Outs

EXTERNAL DRIVERS		
PIN	**DESCRIPTION**	
A	D1	Driver #1 (Open Collector)
C	D2	Driver #2 (Open Collector)
E	D3	Driver #3 (Open Collector)
G	D4	Driver #4 (Open Collector)
M	D5	Driver #5 (Open Collector)
J	D6	Driver #6 (Open Collector)
K	D7	Driver #7 (Open Collector)
L	D8	Driver #8 (Open Collector)
B		Drivers (+ 12 V)
D		Drivers (+ 12 V)
F		Drivers (+ 12 V)
H		Drivers (+ 12 V)

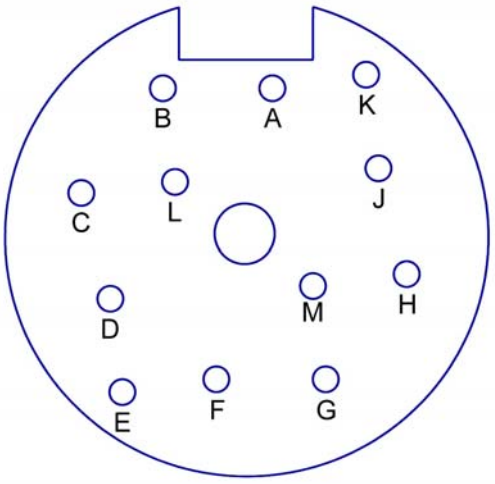


Figure 14. Drivers Connector Schematic

7.2 UNIT CONVERSION

7.2.1 PRESSURE

PPC3 performs all internal calculations in SI units. Numerical values input or output in other units are converted to SI immediately after entry and back to other units just before output as needed.

Table 30 provides the conversion coefficients used by PPC3 to convert numerical values expressed in SI units to corresponding values expressed in other units.

Table 30. Pressure Unit of Measure Conversion Coefficients

TO CONVERT FROM Pa To		MULTIPLY BY
Pa	*Pascal*	1.0
mbar	*millibar*	1.0 E-02
hPa	*hecto Pascal*	1.0 E-02
kPa	*kilo Pascal*	1.0 E-03
bar	*bar*	1.0 E-05
mmWa @ 4°C	*millimeter of water*	1.019716 E-01
mmHg @ 0°C	*millimeter of mercury*	7.50063 E-03
psi	*pound per square inch*	1.450377 E-04
psf	*pound per square foot*	1.007206 E-06
inWa @ 4°C	*inch of water*	4.014649 E-03
inWa @ 20°C	*inch of water*	4.021732 E-03
inWa @ 60°F	*inch of water*	4.018429 E-03
inHg @ 0°C	*inch of mercury*	2.953 E-04
kcm^2	*kilogram force per centimeter square*	1.019716 E-05
mTorr	*milliTorr (micron of mercury*	7.50063
Torr	*Torr (millimeter of mercury)*	7.50063 E-3
user	*user*	User defined coefficient
ft	*feet of altitude*	see **Altitude Note** below
m	*meter of altitude*	see **Altitude Note** below

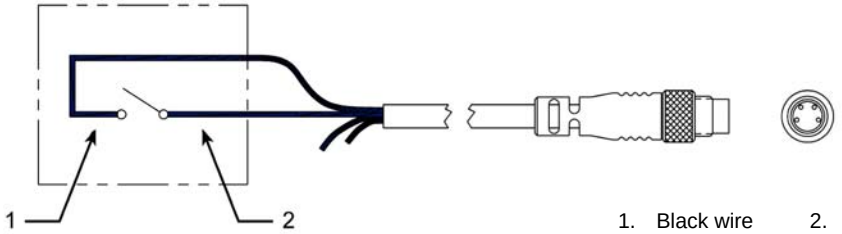
Altitude Note: Quantities expressed in units of altitude follow MIL-STD-859A "Static Pressure, p, in Inches of Mercury for Values of Pressure Altitude, H, in Geopotential Feet." MIL-STD-859A provides tables of pressure in inches of mercury as a function of altitude in feet. PPC3 uses a set of equations to model the pressure/altitude relationship. The worst case deviation between the MIL-STD-859A table and the calculated pressure is 0.0001 inches of mercury (0.3 Pa). The pressure quantity expressed in inches of mercury is converted to Pascal following Table 30 above. For altitude expressed in meters, meters are converted to feet using 1 m = 3.28084 ft.

7.3 REMOTE [ENT]

The PPC3 remote ENTER function operates by detecting the open or closed status of the REMOTE ENTER switch.

The normal status of the ENTER switch is OPEN. When PPC3 detects a CLOSED condition held for 300 ms, it is interpreted as equivalent to a press of the **[ENT/SET P]** key.

Any switch may be used to accomplish the remote ENTER function. The switch should be installed on the optional remote ENTER cable (**DHI** P/N 103128). Install the switch by connecting its two terminals to the black and white wires of the remote ENTER cable.



1. Black wire 2. White wire

Figure 15. Remote [ENT/SET P] Connector Schematic

8. WARRANTY

8.1 OVERVIEW

Except to the extent limited or otherwise provided herein, **DH Instruments, a Fluke Company** warrants for one year from purchase, each new product sold by it or one of its authorized distributors, only against defects in workmanship and/or materials under normal service and use. Products which have been changed or altered in any manner from their original design, or which are improperly or defectively installed, serviced or used are not covered by this warranty.

DH Instruments, a Fluke Company and any of its Authorized Service Providers' obligations with respect to this warranty are limited to the repair or replacement of defective products after their inspection and verification of such defects. All products to be considered for repair or replacement are to be returned to **DH Instruments, a Fluke Company** or its Authorized Service Provider after receiving authorization from **DH Instruments, a Fluke Company** or its Authorized Service Provider. The purchaser assumes all liability vis a vis third parties in respect of its acts or omissions involving use of the products. In no event shall **DH Instruments, a Fluke Company** be liable to purchaser for any unforeseeable or indirect damage, it being expressly stated that, for the purpose of this warranty, such indirect damage includes, but is not limited to, loss of production, profits, revenue, or goodwill, even if **DH Instruments, a Fluke Company** has been advised of the possibility thereof, and regardless of whether such products are used individually or as components in other products.

The provisions of this warranty and limitation may not be modified in any respect except in writing signed by a duly authorized officer of **DH Instruments, a Fluke Company**

The above warranty and the obligations and liability of **DH Instruments, a Fluke Company** and its Authorized Service Providers exclude any other warranties or liabilities of any kind.

Table 31. DHI Authorized Service Providers

DH INSTRUMENTS, A FLUKE COMPANY AUTHORIZED SERVICE PROVIDERS			
COMPANY	**ADDRESS**	**TELEPHONE, FAX & EMAIL**	**NORMAL SUPPORT REGION**
DH Instruments, a Fluke Company	4765 East Beautiful Lane Phoenix AZ 85044-5318 USA	Tel 602.431.9100 Fax 602.431.9559 cal.repair@dhinstruments.com	Worldwide
Minerva Meettechniek B.V.	Chrysantstraat 1 3812 WX Amersfoort the NETHERLANDS	Tel (+31) 33.46.22.000 Fax (+31) 33.46.22.218 info@minervaipm.com	European Union
Ohte Giken, Inc. Technology Center	258-1, Nakadai, Kasumigaura-machi, Niihari-Gun Ibaraki, 300-0133 JAPAN	Tel 81.29.840.9111 Fax 81.29.840.9100 tech@ohtegiken.co.jp	Japan/Asia
DHI Products Technical Service Division	National Institute of Metrology Heat Division Pressure & Vacuum Lab NO. 18, Bei San Huan Donglu Beijing 100013 PR CHINA	Tel 010.64291994 ext 5 Tel 010.64218637 ext 5 Fax 010.64218703 cxcen@mx.cei.gov.cn	Peoples Republic of China

NOTES

9. GLOSSARY

Axxx	A type of Q-RPT with a built-in vacuum reference that is intrinsically absolute (e.g. A10M). Axxx Q-RPTs support absolute, gauge and negative gauge measurement modes.
Absolute Mode	Measurement mode in which the Q-RPT indicates absolute pressure (difference from vacuum).
AutoRange	A function that optimizes PPC3 measurement and control for a specific, user defined range of operation.
AutoRanged Range	A PPC3 range created using the AutoRange function.
AutoTest or ATest	PPC3 on-board automated testing sequences and their results.
AutoZero or AutoZ	A process by which a Q-RPT and measurement mode is rezeroed (offset) relative to a standard.
Barometer	PPC3's on-board atmospheric pressure measuring sensor. Also referred to as on-board barometer.
BGxxx	A type of Q-RPT that is intrinsically gauge and is capable of operating bi-directionally, above and below atmosphere, through zero). BGxxx Q-RPTs support gauge and negative gauge measurement modes.
Bi-directional Gauge	Measurement mode in which the Q-RPT indicates gauge pressure (difference from atmospheric pressure), in both positive and negative directions (above and below atmosphere)
Control Mode	Type of automated pressure control (static or dynamic).
Control Parameters	Parameters affecting pressure control and the *Ready/Not Ready* determination (target, hold limit, stability limit).
Custom Control	Automated pressure control in which the control parameters are not the default control parameters.
Default Range (DF)	A Q-RPT or utility sensor's maximum range that is always available on **[RANGE]** and cannot be deleted.
Deviation	The deviation of the current pressure from the target pressure control value. Indicated in MAIN RUN screen when in dynamic control mode.
DUT	Device Under Test. The device or devices pneumatically connected to the PPC3 **TEST** port that the PPC3 is being used to test or calibrate.
Dynamic Control	Control mode in which the pressure is constantly adjusted to remain as close as possible to the target value.
External device or External Q-RPT	A Q-RPT in an RPM4 external to PPC3 used by PPC3 for precise pressure measurement.
FS	Abbreviation of "full scale". The full scale value is the maximum pressure or the span of a measurement range. Limits and specifications are often expressed as % FS.
Gxxx	A type of Q-RPT that is intrinsically gauge but only measures pressure greater than atmosphere. Gxxx Q-RPTs support gauge measurement mode only.
Gauge Mode	Measurement mode in which the Q-RPT indicates gauge pressure (difference from atmospheric pressure), but only in the positive direction (above atmosphere).
Head	A difference in height between the PPC3 reference level and the DUT.
Hold Limit	An automated pressure control parameter. Maximum acceptable difference between the current pressure and the target pressure value.
IH or IuH	Internal, Hi. The Q-RPT (IH) or utility sensor (IuH) internal to PPC3 if there is only one or, if there are two, the one that has the highest full scale default range.
IL	Internal, Lo. Refers to a Q-RPT internal to the PPC3 that is the lower of the two if there is a second Q-RPT or utility sensor in the PPC3.
Measurement Mode	Whether pressure is being measured relative to absolute zero or vacuum (absolute mode) or relative to atmospheric pressure (gauge mode).

Negative gauge, compound gauge	Measurement mode in which the Q-RPT indicates gauge pressure (difference from atmospheric pressure), in both positive and negative directions (above and below atmosphere).
P_{offset}	The difference between a Q-RPT reading and the AutoZero reference at the time AutoZ is run. Used by the AutoZ function when Auto Z is ON to compensate Q-RPT readings for changes in zero over time.
$P_{std,0}$	AutoZero reference value. Value indicated by the device against which the Q-RPT is zeroed by AutoZ.
PA	Pressure adder, used to offset a Q-RPT, utility sensor or barometer to calibrate it.
PM	Pressure multiplier, used to adjust span of a Q-RPT, utility sensor or barometer to calibrate it.
Q-RPT (Reference Pressure Transducer)	1. The transducer used by PPC3 for low uncertainty pressure measurement. The Q-RPT in a single Q-RPT PPC3, or the higher pressure range Q-RPT in a dual Q-RPT PPC3, is referred to as the Hi or Q-RPT. 2. The lower pressure range Q-RPT in a dual Q-RPT PPC3 is referred to as the Lo Q-RPT. Q-RPTs are designated by a leading A, G or BG (absolute, gauge or bi-directional gauge) followed by three numbers and a letter indicating the maximum range of the Q-RPT in kPa (nnnK) or MPa (nnnM).
Rate	The rate of change of the current measured pressure. Indicated in the MAIN RUN screen when control is suspended.
Ready/Not Ready	Indication used to indicate when control PPC3 pressure meets specific criteria for distance from target pressure and stability. *Ready/Not Ready* is indicated by an LED on the PPC3 front panel and is used to determine when test readings should be taken.
RPM4	Reference Pressure Monitor manufactured by **DHI**. RPM4s can be set up to act as external measurement devices to operate with PPC3.
Span	The difference between FS and the lowest point in a range. For example, the span of a 100 kPa FS range in negative gauge mode is nominally 200 kPa (from - 100 kPa to 100 kPa).
SPLT	Self Purging Liquid Trap. An optional device to automatically protect PPC3 from liquid and particulate contamination returned from a DUT.
Stability Limit	A limit expressed in units of pressure per second (e.g., kPa/second). The stability limit is used as the *Ready/Not Ready* criterion. *Ready* if rate of change is less than stability limit. *Not Ready* if rate of change is greater than stability limit.
Static Control	Control mode in which the pressure is set near the target value and then shut OFF and allowed to evolve freely.
Target	The value to which automated pressure control sets and maintain the pressure.
UL	Same as Upper Limit.
Upper Limit	A range specific maximum value of pressure not be exceeded and at which PPC3 will abort pressure setting and beep. In negative gauge measurement mode there is also a lower limit.
Utility Sensor	The internal, high (IuH) transducer in a PPC3 if when there is no Q-RPT in the IH position. A utility sensor is a low accuracy pressure transducer used for pressure indication, safety and housekeeping functions, not for low uncertainty measurement.
User Level	Levels of security that can be set to protect certain PPC3 functions from being accessed.
QDUT	On-board automated test sequence that AutoRanges PPC3 based on characteristics of the Device Under Test (DUT).
X1H, X1L, X2H, X2L	External 1, Hi; External 1, Lo; External 2, Hi; External 2, Lo. Position designators of Q-RPTs external to a PPC3 (in RPM4s) that have been connected to PPC3 and initialized so that they can be used by PPC3 for pressure measurement. "1" is the first RPM4 in the communications daisy chain and "2" is the second. "Hi" is the Q-RPT in the RPM4 if there is only one or the one that has the highest full scale default range if there are two. "Lo" is the lower of the two Q-RPTs if there are two Q-RPTs in the RPM4.

