RPM3/HPMS A30000/A6000-AF
Operation and Maintenance Manual

NSN 6685-01-470-8667
(2 of 2)

1 August 2000

⚠ 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.

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ABOUT THIS MANUAL

This manual provides the user with the basic information necessary to operate an RPM3/HPMS A30000/A6000-AF Reference Pressure Monitor with High Pressure Mounting System. It also includes a great deal of additional information provided to help you optimize use of the instrument and take full advantage of its many features and functions.

Before using this manual, take a moment to familiarize yourself with the Table of Contents structure. All first time users should read Chapter 2. Chapter 3 provides a comprehensive description of general RPM3/HPMS operating principles. Section 3.1.7 describes the automated Sequence function used to run calibrations and verifications of typical instruments under test. This is the way the instrument is typically used. Chapter 4 is for remote operation from an external computer. Chapter 5 provides maintenance and calibration information. Chapter 6 is a quick troubleshooting guide. Use it to troubleshoot unexpected RPM3/HPMS behavior based on the symptoms of that behavior. Certain words and expressions have specific meaning as they pertain to this product. The Glossary is useful as a quick reference for exact definition of specific words and expressions as they are used in this manual.

RPM3/HPMS A30000/A6000-AF is usually delivered as part of an HGC-30000-AF system which includes an OPG1 hydraulic pressure generator/controller. The OPG1 has its own Operation and Maintenance Manual.

FOR THOSE OF YOU WHO "DON'T READ MANUALS", GO DIRECTLY TO SECTION 2.3 TO SET UP YOUR RPM3/HPMS AND THEN 2.4 FOR POWER UP AND VERIFICATION. THIS WILL GET YOU RUNNING QUICKLY WITH MINIMAL RISK OF CAUSING DAMAGE TO YOURSELF OR YOUR NEW RPM3. 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 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 (for example **[RANGE])**.

< > indicates RPM3 screen displays (for example **<1yes>**).

NOTES

1. INTRODUCTION

1.1 PRODUCT OVERVIEW

RPM3/HPMS A30000/A6000-AF is the combination of an RPM3 A5000/A6000-AF reference pressure monitor and an HPMS High Pressure Mounting System. The combination of an RPM3/HPMS A30000/A6000-AF and an OPG1-AF oil pressure generator make up the HGC-30000-AF hydraulic gauge calibrator. The OPG1-AF has its own Operation and Maintenance manual.

RPM3 A30000/A6000-AF is a stand-alone, microprocessor driven, reference pressure monitor intended to accurately measure oil pressure in a variety of pressure calibration, measurement and testing applications. It has been designed to provide very high performance and extensive features combined with maximum versatility and ease of use. RPM3 A30000/A6000-AF is a special version of the standard **DHI** RPM3 product configured specifically for the USAF HGC-30000-AF hydraulic gauge calibrator.

The HPMS mounts the RPM3 at a convenient viewing angle and contains the hardware to isolate the RPM3's low pressure transducer (A6000) when the high pressure transducer (A30000) is in use.

RPM3 A30000/A6000-AF uses two high accuracy reference pressure transducers (RPTs) and an on-board barometer to measure pressure.

RPM3 A30000/A6000-AF is controlled locally by the operator using its front panel display, keypad and foot pedal or remotely by a computer using ASCII character command strings over its RS-232 and IEEE-488 interfaces.

RPM3 A30000/A6000-AF has six pressure measurement ranges from 0 to 2 000 psi (7 MPa) to 0 to 30 000 psi (200 MPa) in gauge and absolute measurement modes.

RPM3/HPMS A30000/A6000-AF is usually delivered as part of an HGC-30000-AF system which includes an OPG1 hydraulic pressure generator/controller. The OPG1 has its own Operation and Maintenance Manual.

1.2 SPECIFICATIONS

1.2.1 GENERAL SPECIFICATIONS

Power Requirements:	85 to 264 VAC, 47 to 440 Hz, 18 VA max consumption
Operating Temperature Range:	15 to 45 °C
Storage Temperature Range:	-20 to 70 °C
Weight:	*RPM3:* 3.5 kg (7.7 lb) *HPMS: 5.8 kg* (12.8 lb) *RPM3/HPMS:* 9.3 kg (20.5 lb)
Dimensions:	21.5 cm H x 29 cm W x 38 cm D (8.5 in. x 11.5 in. x 15.0 in.) approx.
Microprocessor:	Motorola 68302, 16 MHz
Communication Ports:	RS-232 (COM1), RS-232 (COM2), IEEE-488
Pressure Ranges:	2 000 psi (14 MPa), 4 000 psi (28 MPa), 6 000 psi (42 MPa), 10 000 psi (70 MPa), 18 000 psi (126 MPa), 30 000 psi (200 MPa) gauge and absolute.
Operating Medium:	Oil (Di-ethyl hexyl sebacate)
Pressure Connections:	
Test port (RPT > 10 000 psi):	DH500 (gland and collar type for coned and left hand threaded tube, equivalent to AE F250C, HIP HF4, etc.)
Pressure Limits:	
Maximum working pressure:	30 000 psi (214 MPa)
Maximum pressure w/o damage:	37 000 psi (255 MPa)

1.2.2 PRESSURE MEASUREMENT SPECIFICATIONS

RPM3 A30000/A6000-AF is configured with two reference pressure transducers (RPT). Each transducer has three ranges. The RPTs are of the absolute pressure type with an evacuated, permanently sealed reference. Absolute RPTs measure both absolute and gauge pressure. Gauge pressures are defined by offsetting atmospheric pressure dynamically with compensation for atmospheric changes using an on board barometer.

1.2.2.1 RPT MEASUREMENT SPECIFICATIONS (% FS OF ACTIVE RANGE)

Transducer Type:	Oscillating quartz resonator		
Warm Up Time:	30 minutes for operation within specifications		
Resolution:	To 1 ppm, user settable by individual range		
Overpressure Limits:			
Without effect on calibration:	115 % of Range 3		
Without permanent damage:	125 % of Range 3		
Temperature Effect:	± 0.008 % maximum temperature effect in normal ambient operating range of 15 to 45 °C		
Acceleration Affect:	± 0.008 % /g maximum, worst axis		
Precision[1]:	Range: H3: 0.0150 % Ranges H1, H2: 0.0125 % Ranges L1, L2, L3: 0.010 %		
Stability[2]:	*All Ranges*		
Gauge Mode (w/Autozero):	0.008 %		
Absolute Mode (w/Autozero):	0.008 %		
Measurement Uncertainty[3]:	*H3*	*H2, H1*	*L1, L2, L3*
Gauge Mode (w/Autozero):	0.017 %	0.015 %	0.013 %
Absolute Mode (w/Autozero):	0.017 %	0.015 %	0.013 %

1 Precision: Combined linearity, hysteresis, repeatability of measurements made by the reference pressure transducer. When using an absolute RPT for gauge mode measurement add ± 2.5 Pa (0.00035 psi) to the precision specification to take into account the resolution and short term stability of the on-board barometer used for dynamic atmospheric pressure compensation.

2 Stability: Maximum change in zero and span over 180 days for typical transducer used under typical conditions. As stability can only be predicted and varies from transducer to transducer, stability for a specific RPT should be established from experience.

3 Measurement Uncertainty: Combined precision, stability, temperature effect.

1.2.2.2 ON-BOARD BAROMETER

Sensor Technology:	Micro-machined silicon
Warm Up Time:	None required
Resolution:	1.25 Pa (0.00018 psi)

The on-board barometer is NOT used as a source of absolute accuracy. It is used only to measure changes in atmospheric pressure for dynamic compensation of the atmospheric pressure offset when using an absolute reference pressure transducer to make gauge pressure measurements (see Section 3.4.1, Gauge Mode with an Absolute RPT, Dynamic Compensation for Atmospheric Pressure).

2. INSTALLATION

2.1 UNPACKING AND INSPECTION

RPM3/HPMS A30000/A6000-AF is usually delivered as part of an HGC-30000-AF system which includes an OPG1 hydraulic pressure generator/controller. The OPG1-3000-AF is shipped in a separate corrugated container and has its Operation and Maintenance Manual.

2.1.1 REMOVING FROM PACKAGING

RPM3/HPMS A30000/A6000-AF is delivered, along with its accessories, in a reusable molded plastic, shipping container with polyurethane inserts to hold it in place.

Remove the RPM3/HPMS A30000/A6000-AF and its accessories from the shipping container and remove each element from its protective plastic bag.

Retain the shipping container for repacking the RPM3/HPMS A30000/A6000-AF when it is shipped for recalibration of repair.

2.1.2 INSPECTING CONTENTS

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

A standard RPM3/HPMS A30000/A6000-AF includes all items listed in Table 1.

Table 1. RPM3/HPMS A30000/A6000-AF Supplied Items

DESCRIPTION	PART NO.
RPM3/HPMS A30000/A6000-AF Reference Pressure Monitor/High Pressure Mounting System	401604
Transport case (with inserts) (used for original shipment)	123122
Foot Switch Assembly	401613
Operation and Maintenance Manual, RPM3/HPMS A30000/A6000	550115
Calibration Certificate	550100
Test Report, HGC-30000-AF (if RPM3/HPMS delivered as part of HGC-30000-AF system)	550116
Accessories:	**401605**
Power Cord (7.5 ft.)	100770
General Accessories Disk (Important: Includes system support software and documentation)	102987

2.2 SITE REQUIREMENTS

The RPM3/HPMS A30000/A6000-AF is typically delivered as part of an HGC-30000-AF hydraulic gauge calibrator that includes an OPG1-30000-AF that has its own Operation and Maintenance Manual. See the OPG1-30000-AF Operation and Maintenance Manual for information on site requirements for the HGC-30000-AF.

Install RPM3/HPMS A30000/A6000-AF on any stable surface at a convenient height. Consider the placement of the FOOT SWITCH which may need to be accessed frequently while running calibrations.

Support facilities required for RPM3/HPMS A30000/A6000-AF include an electrical power source of 85 to 264 VAC, 47 to 440 Hz.

2.3 INITIAL SETUP

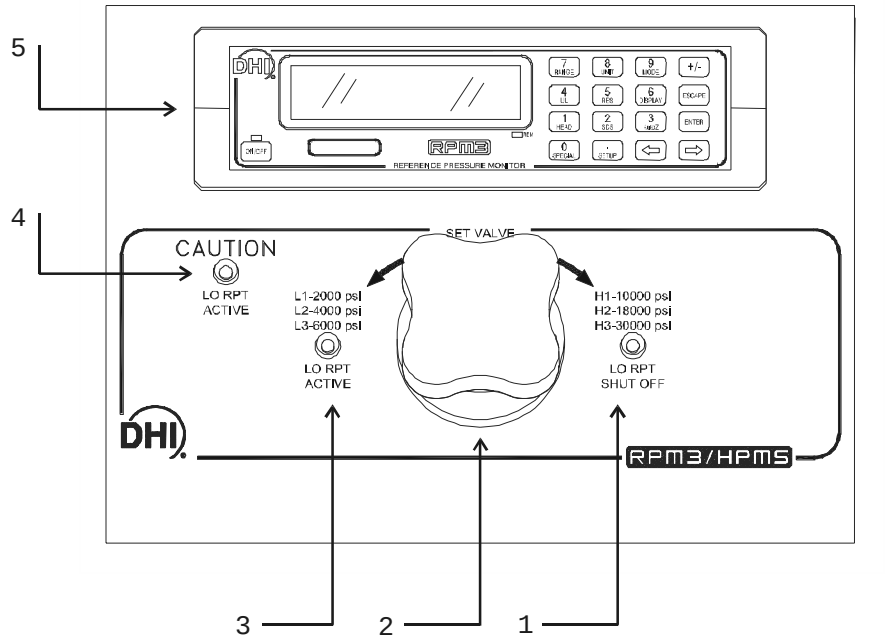
2.3.1 PREPARING FOR OPERATION

To prepare RPM3/HPMS A30000/A6000-AF for check out and operation:

- Remove the plastic plug from the RPM3/HPMS A30000/A6000-AF rear panel TEST connection.
- Remove the protective plastic sheet from the RPM3 front panel display.
- Familiarize yourself briefly with the RPM3 and HPMS front and rear panels (see Sections 2.3.2, 2.3.3).

2.3.2 RPM3/HPMS FRONT AND REAR PANELS

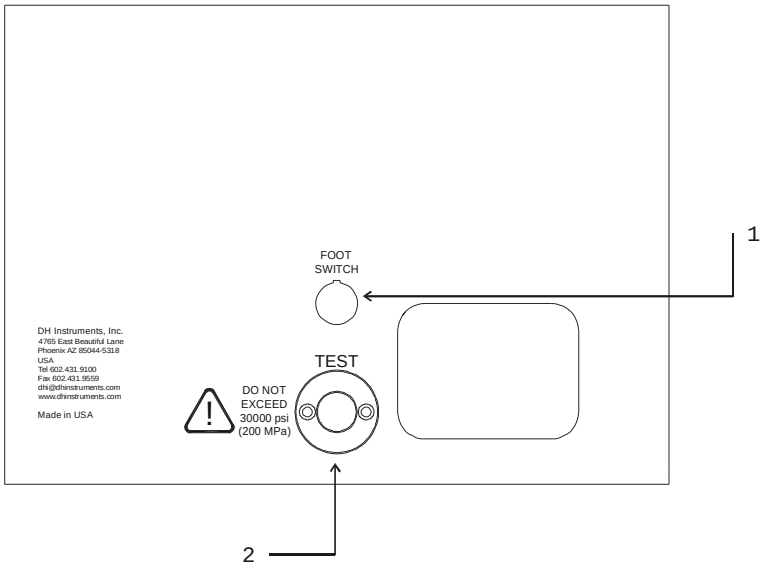
2.3.2.1 FRONT PANEL



1. Lo RPT Shut Off Valve Position LED
2. Lo RPT Shut Off Valve Knob
3. Lo RPT Active Valve Position LED
4. Caution Lo RPT Active LED
5. RPM3 A30000/A6000-AF Reference Pressure Monitor

Figure 1. RPM3/HPMS Front Panel

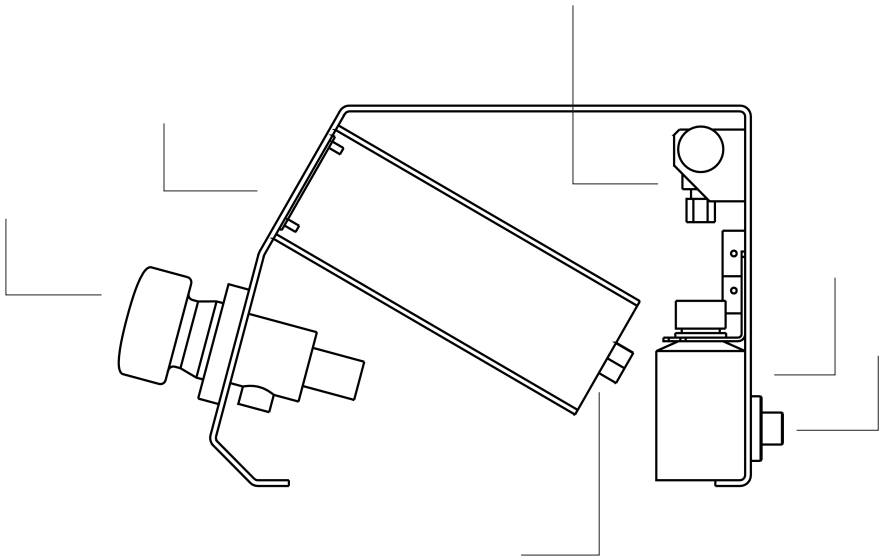
2.3.2.2 REAR PANEL



1. Foot switch (Remote [ENTER]) cable connection
2. TEST port (DH500 F)

Figure 2. RPM3/HPMS Rear Panel

2.3.2.3 SIDE VIEW

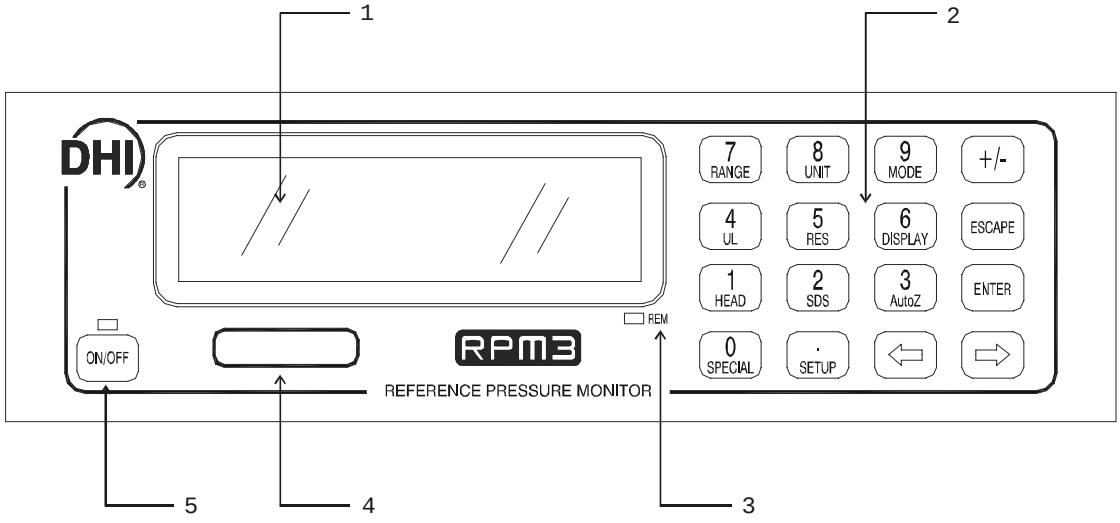


1. Lo RPT Isolation Valve Control Knob
2. RPM3 A30000/A6000-AF Reference Pressure Monitor
3. Lo RPT Pressure Relief Valve
4. Oil Collection Cup (from Relief Valve)
5. TEST port (DH500 F)
6. Electrical Power Connector (IEC320-C13)
7. Foot switch (remote [ENTER]) connector

Figure 3. RPM3/HPMS Side View

2.3.3 RPM3 FRONT AND REAR PANELS

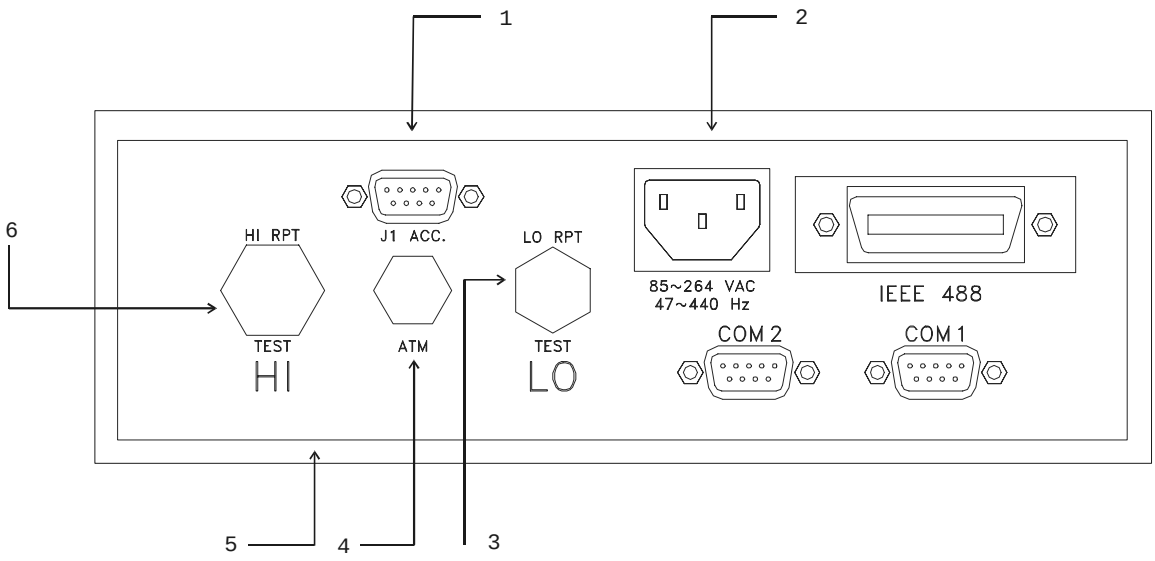
2.3.3.1 FRONT PANEL



1. Display
2. Multi-Function Keypad
3. Remote Indicator
4. RPT designator label
5. Soft ON/OFF key and indicator

Figure 4. RPM3 Front Panel

2.3.3.2 REAR PANEL



1. Accessories Connection Cable (connects to HPMS Rear panel FOOT SWITCH and HPMS LEDs)
2. Electrical Power Connector (IEC320-C13)
3. LO TEST Port (A5000 RPT) (1/8 in. NPT F)
4. ATM Post (On-Board Barometer) (10-32 UNF)
5. Label, Product (on bottom of case)
6. HI TEST Port (A30000 RPT) (DH500 F)

Figure 5. RPM3 Rear Panel

2.3.4 POWER CONNECTION

- Connect the power cable to the RPM3 rear panel electrical power connector.
- Do NOT connect the other end of the power cable to a power source yet.

RPM3 is always powered and active when power is supplied through the rear panel power connector. The front panel ON/OFF key controls a soft ON/OFF (see Section 3.1.4).

2.3.5 FOOT SWITCH CONNECTION

Connect the foot switch supplied in the RPM3/HPMS accessories to the HPMS rear panel electrical connection labeled FOOT SWITCH. Place the foot switch on the floor at a convenient location. The FOOT SWITCH function is equivalent to the RPM3 front panel **[ENTER]** key and may be used frequently while running tests and calibrations.

2.3.6 TEST PORT CONNECTION

A single high pressure TEST port is provided on the rear panel of the HPMS.

The test port connection is a DH500 F. DH500 is a gland and collar type fitting for 1/4 in. (6 mm) coned and left hand threaded tube. DH500 is equivalent to AE F250C, HIP HF4, etc.

Connection to OPG1 if the RPM3/HPMS is Part of an HGC-30000-AF System

If the RPM3/HPMS was delivered as part of an HGC-30000-AF Hydraulic Gauge Calibrator, an OPG1 Oil Pressure Generator/Controller was delivered with it. The OPG1 includes a fittings kit with the necessary fittings to interconnect the RPM3/HPMS and OPG1 and instructions on making the connection. See the OPG1-30000-AF manual.

⚠ USE THE CORRECT PRESSURE CONNECTORS: The RPM3/HPMS TEST port fitting is a DH500 F (see Section 1.2.1). It is NOT a 1/8 in. NPT F. Never use fittings other than the corresponding male fittings in these connectors. Damage to the connectors and dangerous failure under pressure could result from using incorrect fittings.

⚠ DO NOT APPLY PRESSURE UNTIL YOU ARE FAMILIAR WITH OPERATION: The RPM3/HPMS rear panel test port connects internally to both the RPM3's 6 000 psi (40 MPa) and 30 000 psi (200 MPa)RPTs. The valve on the front of the HPMS isolates the low pressure RPT when the high pressure RPT is in use. Do not apply pressure to the RPM3/HPMS until you are familiar with its operation and know how to protect the low pressure RPT from overpressure (see Section 3.1.8). FAILURE TO PROTECT THE LOW PRESSURE RPT FROM OVERPRESSURE MAY DESTROY IT. DAMAGE DUE TO RPT OVERPRESSURE IS NOT COVERED BY THE PRODUCT WARRANTY.

2.3.6.1 THE RPM3 ATM PORT

The ATM pass through on the RPM3 rear panel is connected to the RPM3's on-board barometer. This connection assures that the on-board barometer measures ambient atmospheric pressure rather than the pressure inside the RPM3 case that may vary slightly from ambient pressure. The ATM port should be left open and unobstructed.

⚠ NEVER plug or obstruct the ATM pass through as this may adversely affect gauge mode operation and autozeroing on an absolute transducer.

2.3.7 SETTING UP FILE SEQUENCES

RPM3 supports automated test/calibration sequences. Sequence parameters for testing specific DUTs can be stored in Sequence Files and recalled when a Sequence is run. Consider setting up Sequence Files for frequently tested DUTs as part of the RPM3 set up process (see Section 3.3.6).

2.4 POWER UP AND VERIFICATION

2.4.1 APPLY POWER

Connect the RPM3 power cable to an electric supply of 85 to 264 VAC (47 to 440 Hz). Observe the front panel display as RPM3 initializes, error checks and goes to the main run screen (see Section 3.1.2). Check that one of the two green Valve Status LEDs on the front panel of the HPMS is lit (the red LED should NOT be ON).

RPM3 is always powered and active when power is supplied through the rear panel power connector. The front panel ON/OFF key controls a soft ON/OFF function (see Section 3.1.4).

If the RPM3 fails to reach the main run screen, service is required. Record the sequence of operation and displays observed and contact a **DHI** Authorized Service Center (see Section 7.2, Table 18).

If neither of the green LEDs on the HPMS front panel lights, check that the 9-pin D-Sub accessory cable at the rear of the RPM3 itself is properly connected to the ACC. J1 connector.

The active range on power up is the same as the range that was active at the last power down (see Section 3.1.6).

2.4.2 CHECK PROPER PRESSURE MEASUREMENT OPERATION

2.4.2.1 CHECKING ABSOLUTE MODE PRESSURE MEASUREMENT

Check that the RPM3 RPTs operate properly in absolute mode.

Open the RPM3/HPMS TEST port to atmosphere. Put the valve knob in the HPMS front panel into the ***Lo RPT Active*** position. This opens the Lo RPT to the HPMS TEST port.

Press **[MODE]** on the RPM3 and select absolute. Change the pressure unit of measure using **[UNIT]** if desired (see Section 3.2.3).

Observe the RPM3 indicated pressure. Check that the value is equal to atmospheric pressure ± 5 psi. Repeat this process for all the ranges on both RPTs using **[RANGE]** and **[ENTER]** to change ranges. Check that the values of atmospheric pressure measured by the different ranges agree with each other within RPM3 measurement tolerances (see Section 1.2.2.1). If they do NOT agree within tolerances, RPM3 may need calibration or repair.

2.4.2.2 CHECKING GAUGE MODE PRESSURE MEASUREMENT

Open the RPM3/HPMS TEST port to atmosphere. Put the valve knob in the HPMS front panel into the ***Lo RPT Active*** position. This opens the Lo RPT to the TEST port.

Press **[MODE]** on the RPM3 and select gauge. Change the pressure unit of measure using **[UNIT]** if desired (see Section 3.2.3).

The value indicated should be near zero (± 5 psi, 35 kPa). Wait two minutes and then press **[AutoZ].** This runs AutoZ to zero the range (see Section 3.2.10). Upon return to the main run screen, observe that the indication of measured pressure has zeroed.

Use **[RANGE]** and **[ENTER]** to change ranges (see Section 3.2.2) and repeat the zeroing process for each range (the two minute wait does not need to be repeated each time).

If a range fails to zero properly, RPM3 may need repair.


It is normal for RPM3 to indicate a value other than zero when vented when gauge mode is first entered or ranges are changed, especially if AutoZ is OFF, RPM3 has been OFF for some time, its location has changed or the fluid head to which it is connected has changed.

2.5 SHORT TERM STORAGE

The following is recommended for short term storage of RPM3/HPMS:

- Vent the RPM3/HPMS TEST port.
- Disconnect the power supply.

When RPM3 will NOT be used for some time, it may be left powered, but use the **soft** ON/OFF key to turn OFF the display.

2.6 LONG TERM STORAGE AND SHIPPING

The following is recommended for long term storage and or shipping of RPM3/HPMS:

- Plug the HPMS TEST port.
- Place the RPM3/HPMS in a plastic bag.

Place the RPM3/HPMS in the custom shipping/storage container in which it was delivered.

NOTES

3. OPERATION

3.1 GENERAL/MANUAL OPERATION

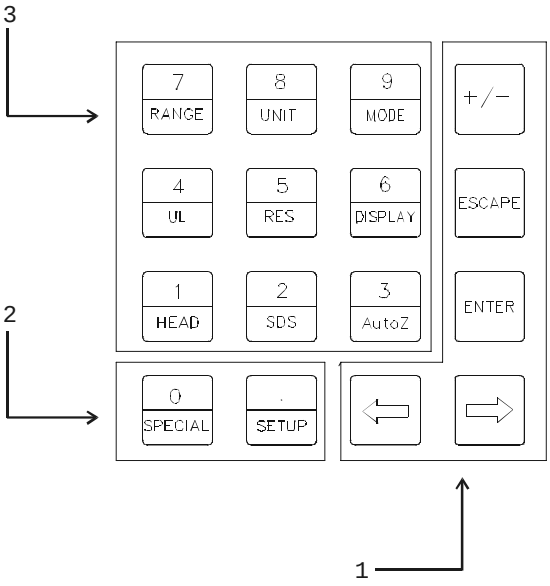
RPM3/HPMS is designed to offer the optimum balance between simple, straight forward operation and the availability of a wide variety of functions with a high level of operator discretion if desired.

The RPM3 provides the local operator interface is through a front panel 2 x 20 character alpha-numeric display, a 4 x 4 multi-function keypad and an **[ENTER]** foot switch.

The HPMS mounts the RPM3 at a convenient viewing angle and includes a valve and visual indicators to isolate and protect the RPM3's 6 000 psi RPT (Ranges L1, L2, L3) when using the 30 000 psi RPT (Ranges H1, H2, H3) (see Section 3.1.6).

3.1.1 KEYPAD LAYOUT AND PROTOCOL

The RPM3 has a 4 x 4 keypad and an **[ENTER]** footswitch for local operator access to direct functions, function menus and for data entry.



1. **The Editing and Execution keys** are for execution, suspending execution, backing up in menus and editing entries.

2. **The Menu/Data keys** provide access to function menus 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 3.3). The SPECIAL menu is for functions that are NOT generally used as a part of day to day operation (see Section 3.4). These keys enter numerical values when editing.

3. **The Function/Data keys** allow very commonly used functions to be accessed directly from the main run screen by a single keystroke. The name of the function is on the bottom half of the key (see Section 3.2.1). These keys enter numerical values when editing.

4. **[ENTER] Foot Switch (not shown)** acts in exactly the same manner as the keypad **[ENTER]** key. It serves as a remote **[ENTER]** key to be used when the operator's hands are occupied or touching the RPM3 front panel is not convenient.

Figure 6. RPM3 Keypad

Key press confirmation is provided by both tactile and audible feedback. A single tone confirms a valid entry, a descending two note tone signals an invalid entry. The audible valid entry feedback can be suppressed or modified by pressing **[SPECIAL]** and selecting **<7Intern>, <2sound>** (see Section 3.4.7.2).

Pressing the **[ENTER]** key or foot switch generally causes execution or forward movement in the menu tree.

Pressing the **[ESCAPE]** key moves back in the menu tree and/or causes execution to cease or suspend without changes being implemented. Pressing **[ESCAPE]** repeatedly eventually returns to the main run screen. From the main run screen, pressing **[ESCAPE]** allows momentary viewing of the RPM3 introduction screen.

Pressing the **[+/-]** key changes a numerical sign when editing. It also toggles through multiple screens when available.

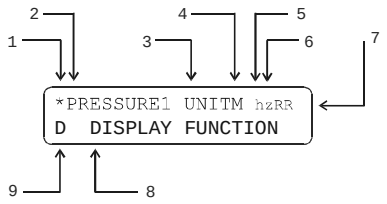
Pressing the **[←]** and **[→]** keys allow reverse and forward cursor movement when editing data entry. These keys are also used to scroll through choices.

Some screens go beyond the two lines provided by the display. This is indicated by a flashing arrow in the second line of the display. Use [←] and [→] 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.

3.1.2 MAIN RUN SCREEN

The RPM3 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 top level of all menu structures.

The main run screen is where the RPM3 is left in normal operation. It displays the current measured pressure as well as a variety of additional information if desired.



1. **<•>** ***Ready/Not Ready*** indication, **<•>** when ***Ready***, **<↑>** or **<↓>** indicating direction of measured pressure evolution when ***Not Ready*** (see Section 3.1.5).
2. **<PRESSURE1>:** Numerical value and sign of pressure measured by active RPT and range. Shows result of last average in **average** display mode (see Section 3.2.7.1).
3. **<UNIT>:** Current unit of measure (see Section 3.2.3).
4. **<M>:** Pressure measurement mode: **<g>** for gauge, **<a>** for absolute (see Section 3.2.4).
5. **<h>:** Indicates whether a head correction is applied. **<h>** if applied, blank if NOT (see Section 3.2.8).
6. **<z>:** Indicates whether the autozero function is ON or OFF. **<z>** if ON; blank if OFF (see Section 3.4.1).
7. **<RR>:** Indicates active RPT (**<H>** = high, **<L>** = low) and range (**<1>** = low, **<2>** = mid, **<3>** = hi) (see Section 3.2.2).
8. **<DISPLAY FUNCTION>**: Information displayed depends on current display function.
9. **<D>:** Indication of what is being displayed on the bottom line of the display as set by the DISPLAY function (see Section 3.2.7). Choices include:
   - **<σ>:** Current DISPLAY mode is **average** (see Section 3.2.7.1).
   - **<R>:** Current DISPLAY mode is **rate** (see Section 3.2.7.2); or if **<n avg>** is in the bottom right hand corner of the display, current DISPLAY mode is **average** and this is the instantaneous reading average screen (see Section 3.2.7.1).
   - **<H>:** Current DISPLAY mode is **hi/lo** (see Section 3.2.7.5).

- **<D>:** Current DISPLAY mode is **deviation** (see Section 3.2.7.3).
- **<✳>, <↑> or <↓>:** Current DISPLAY mode is **RPT** (see Section 3.2.7.4).
- **<F>:** Current DISPLAY mode is **freeze** (see Section 3.2.7.6).
- **Blank, NO character:** Current DISPLAY mode is **clean** (see Section 3.2.7.7).

RPM3 has a screen saver function that 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 activation time can be changed or screen saving can be completely suppressed (see Section 3.4.7.1).

3.1.3 SOUNDS

RPM3 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 3.4.7.2).
- **Invalid key press or out of tolerance reading when running an automated test sequence:** Descending two tone **blurp** (see Section 3.2.11.2).
- **In tolerance reading when running an automated test sequence:** Ascending three tone fanfare (see Section 3.2.11.2).
- **Leak check routine completed:** Three two second beeps (see Section 3.3.5).
- **UL (upper limit) exceeded:** Intermittent one second beeps (see Section 3.2.5).
- **Pmax! (overpressure limit) exceeded:** Eight second high frequency beep (see Section 3.2.5.1).
- **Lo RPT is active but a Hi RPT range is selected:** Intermittent two second high frequency beep. The audible alarm is combined with flashing of the red, ***Lo RPT Active*** LED on the HPMS (see Section 3.2.5.2).

3.1.4 SOFT [ON/OFF] KEY

RPM3 is equipped with a **soft [ON/OFF]** key and indicator LED on the bottom left hand corner of the front panel. The purpose of the soft ON/OFF key is to put RPM3 into a dormant mode in which the display is turned OFF but power is still supplied and overpressure functions are still active. When RPM3 is ON, the ON/OFF indicator is ON continuously. When RPM3 is soft OFF, the ON/OFF indicator blinks every five seconds.

The soft **[ON/OFF]** key can also be used to reset from an overpressure condition (see Section 3.2.5.1).

When RPM3 is soft OFF, receiving a remote command turns it ON.

3.1.5 PRESSURE *READY <*>/NOT READY* (<↑> OR <↓>) INDICATION

The character to the left of the measured pressure on the main run screen provides a pressure ***Ready <*>/Not Ready*** **(<↓> or <↑>)** indication. This indication is intended to provide the user with a clear and objective indication of when a stable pressure has been achieved. ***Ready <*>*** is indicated when the current stability (rate of change) of pressure is less than the stability limit. The user can set the stability limit (see Section 3.3.4). The ***Ready*** indication is often used when comparing the RPM3 and a test device to indicate when a valid reading can be made.

Ready <*>/Not Ready **(<↓> or <↑>)** character indications are:

- **<*>:** Pressure ***Ready*** (stable).
- **<↓>:** Pressure ***Not Ready*** (unstable) and decreasing.
- **<↑>:** Pressure ***Not Ready*** (unstable) and increasing.

3.1.6 MULTIPLE PRESSURE RANGES

RPM3 A30000/A6000-AF has two reference pressure transducers (RPTs) each of which has three ranges for a total of six pressure ranges. This multi-ranging feature allows measurement uncertainty to be optimized for the range of pressure in which you are working. Generally, the best range to select (see Section 3.2.2) is that whose full scale is closest to, but greater than, the maximum pressure of the device or system under test.

RPM3 handles all of the data operations needed to make range changes occur transparently to the user when the RANGE function is used for range selection. For a range change to be executed, the current pressure applied to the RPT on which the range is being selected must be lower than the current upper limit (UL) of that range (see Section 3.2.5). The RPM3 Sequence feature automatically selects the most appropriate range based on the range of the device under test (see Section 3.2.11).

When the range is changed, the upper limit automatically changes to the default for that range or to the last upper limit set for that range. In addition, most other functions and settings are range specific (see Section 3.2.2).

RPM3 A30000/A6000-AF has six ranges. In general, settings and operational adjustments are specific to the range currently in use, as if you had six instruments rather than one. The DISPLAY function, HEAD functions and AUTO READRT function are NOT range specific. In remote mode, most settings are RPT specific rather than range specific (see Section 4.3).

3.1.6.1 RANGES AND IDENTIFICATION

The active RPT and range is continuously indicated in the upper right hand corner of the main run screen and most other screens.

Hi RPT: The A30000 RPT whose maximum range is 30 000 psi (200 MPa) is referred to as the Hi RPT.

Lo RPT: The A6000 RPT whose maximum range is 6 000 psi (40 MPa) is referred to as the Lo RPT.

Range 1, 2 or 3: The three ranges of each RPT are referred to as 1 = lo range, 2 = mid range, 3 = hi range. The Lo RPT ranges, low to high, are L1, L2, L3. The high PRT ranges, low to high, are H1, H2, H3.

Table 2. RPM3 Range Identification Summary

REFERENCE PRESSURE TRANSDUCER AND RANGE	DESIGNATION	DISPLAY SYMBOL *	RANGE PSI (MPa)
Lo RPT, Lo range	Lo, 1	L1	2 000 (14)
Lo RPT, Mid range	Lo, 2	L2	4 000 (28)
Lo RPT, Hi range	Lo, 3	L3	6 000 (42)
Hi RPT, Lo range	Hi, 1	H1	10 000 (70)
Hi RPT, Mid range	Hi, 2	H2	18 000 (125)
Hi RPT, Hi range	Hi, 3	H3	30 000 (200)

* The display symbol is included in the upper, right hand corner of most RPM3 menu displays as a convenient indicator of active range.

3.1.7 AUTOMATED TEST/CALIBRATION SEQUENCES

The RPM3 SEQUENCE function supports “quick” and “file” automated calibration sequences. These automatically set the appropriate RPM3 range, resolution and stability limit based on the characteristics of the device under test. They also prompt the user through the increments of the calibration sequence and log calibration data. The SEQUENCE function should be used for most common calibration tasks, especially calibration of analog pressure gauges (see Section 3.2.11).

3.1.8 HPMS (HIGH PRESSURE MOUNTING SYSTEM)

The HPMS (high pressure mounting system) holds the RPM3 at a convenient viewing angle and includes a valve and visual indicators to isolate and protect the RPM3's 6 000 psi RPT (Ranges L1, L2, L3) when using the 30 000 psi RPT (Ranges H1, H2, H3).

❍ OPERATION

Numerical references in this Section refer to Figure 1.

In normal use, the operator's only interaction with the HPMS is to operate the isolation valve knob to connect and disconnect the Lo RPT from the TEST port. The valve's operation is prompted by the **Valve Position LEDs (1, 3)**.

The Lo RPT isolation valve (2) isolates and protects the Lo RPT from the TEST port when it is closed (knob fully CCW) and opens the Lo RPT to the TEST port when it is open (knob fully CW).

The Valve Position LEDs (1, 3) indicate the position in which the valve knob should be set based on the current range selection on the RPM3. If a range on the Hi RPT (H1, H2 or H3) is selected, the LO RPT SHUT OFF LED (1) is lit indicating that the valve knob should be turned fully CW to close the valve, protecting the Lo RPT from high pressure. If a range on the Lo RPT (L1, L2 or L3) is selected, the LO RPT ACTIVE LED (3) is lit indicating that the valve knob should be turned fully CCW to open the valve, connecting the Lo RPT to the test pressure.

⚠ *The HPMS isolation valve (2) must always be in the closed position (knob fully CCW) when operating at pressure greater than 6 000 psi (40 MPa).*

The CAUTION LO RPT ACTIVE LED (4) is used to indicate that the Lo RPT is active and provide a warning when the Lo RPT is active but a Hi RPT range is selected on the RPM3.

The **CAUTION LO RPT ACTIVE LED (4)** is driven by the value of pressure currently measured by the Lo RPT, it is not driven by the valve position as there is no sensing of the valve position.

The **CAUTION LO RPT ACTIVE LED (4)** has three possible conditions:

- **LED is OFF:** The Lo RPT is NOT active. The Lo RPT is considered active when it measures a pressure greater than 30 psig (200 kPa).

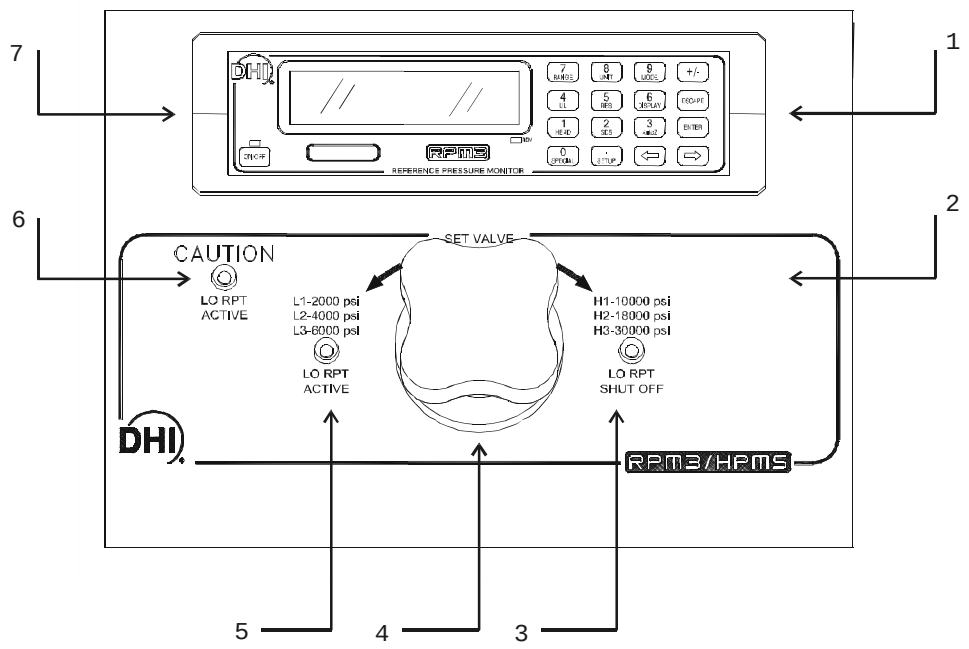
- **LED ON continuously:** The Lo RPT IS active and a Lo RPT range is selected on the RPM3. The LED is lit as a reminder that the Lo RPT is active and pressure over its maximum working pressure of 6 600 (46 MPa) should not be applied.

- **LED is flashing on accompanied by high frequency beeps and <!!!LO RPT ACTIVE!!!> displayed by RPM3:** Lo RPT IS active and a Hi RPT range is selected on RPM3. **The Lo RPT should NOT be active when a Hi RPT range is in use.** Hi RPT ranges will overpressure and damage the Lo RPT.

If a Hi RPT range is selected with the Lo RPT active, RPM3 goes into an alarm condition to avoid accidental overpressure of the Lo RPT while using a Hi RPT range. The pressure on the Lo RPT must be reduced to less than 30 psig (200 kPa) so that the CAUTION LO RPT ACTIVE LED is OFF before shutting the Lo RPT isolation valve and selecting a Hi RPT range.

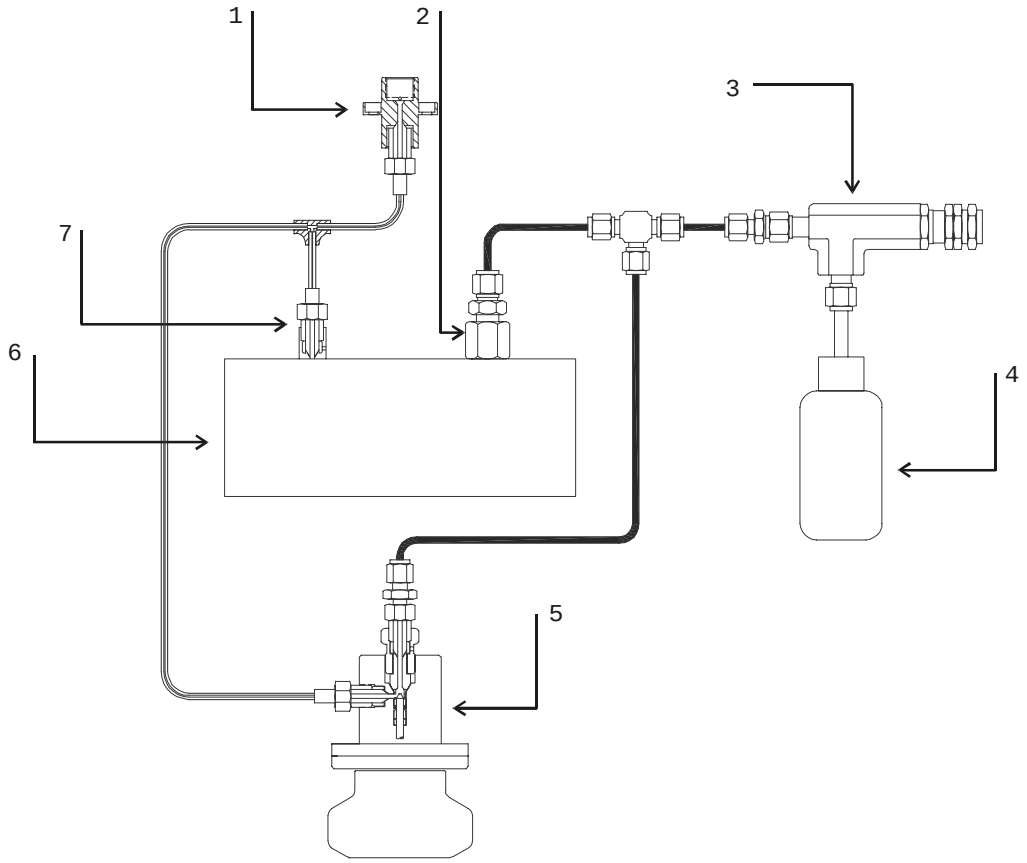
The pressure relief valve (6) is set to open at 110 % of the RPM3 range L3 (46 Mpa; 6 600 psi). When the pressure applied to the Lo RPT reaches approximately 6 600 psi (46 MPa), the pressure relief valve (6) will open reducing pressure and bleeding oil into the pressure relief run off cup (7). Prior to opening the pressure relief valve, the RPM3 will have gone into an overpressure condition (see Section 3.2.5.1). If an overpressure condition occurs, reduce pressure as soon as possible. The pressure relief valve will reseat automatically when pressure is reduced.

Do NOT overpressure the Lo RPT. The Lo RPT may be damaged beyond repair by pressure greater than 6 600 psi (46 MPa). RPT damage from overpressure is logged in user and factory maintenance pages and is not covered by the product warranty. The HPMS pressure relief valve should only be considered a last resort means of protecting the Lo RPT. Following proper operating procedures, the Lo RPT should never be overpressured.



1. Lo RPT Pressure Relief Valve (not shown)
2. Lo RPT Relief Oil Run-Off Cup (not shown)
3. Lo RPT Shut OFF Valve Position LED
4. Lo RPT Isolation Valve
5. Lo RPT Active Valve Position LED
6. Caution Lo RPT Active LED
7. RPM3 Reference Pressure Monitor

Figure 7. RPM3/HPMS Front Panel



1. HPMS TEST port (DH500 F)
2. Connection to RPM3 Hi RPT (A30000)
3. Lo RPT Pressure Relief Valve (6 600 psi)
4. Pressure Relief Valve Oil Run Off Cup
5. Lo RPT Isolation Valve
6. RPM3 Reference Pressure Monitor
7. Connection to RPM3 Lo RPT (A6000)

Figure 8. RPM3/HPMS Internal Schematic

3.2 DIRECT FUNCTION KEYS

3.2.1 DIRECT FUNCTION KEYS SUMMARY

Local operation of RPM3 is through the 4 x 4 pressure sensitive keypad and an **[ENTER]** foot switch. To minimize the use of multi-layered menu structure, the 4 x 4 keypad numerical keys also provide direct access to the most commonly used functions. The function accessed is labeled on the bottom half of the keys. Direct function keys are active whenever RPM3 is in its main run screen. Table 3 summarizes the operation of the direct function keys.

Table 3 provides a brief summary of direct function key operation. It may be useful to keep a copy of this summary near the RPM3/HPMS, especially when first becoming acquainted with its operation.

Table 3. Summary of RPM3
Direct Function Key Operation

Direct Function Keys are active from the MAIN run screen See corresponding manual sections for full detail.	
. SETUP	Menu of commonly used setup features including run LEAK CHECK.
0 SPECIAL	Menu of less frequently used internal functions and settings.
1 HEAD	Set fluid head height.
2 SDS	SDS function is not used on RPM3 A30000/A6000-AF.
3 AutoZ	Runs AutoZ to **rezero** active range. In gauge mode, should only be used after assuring the system is vented and waiting two minutes.
4 UL	View/adjust upper pressure limit alarm.
5 RES	Adjust display resolution of measured pressure and other indications and settings.
6 DISPLAY	Select **[DISPLAY]** function for second line of RPM3 display. Choices include **<average>, <rate>, <other RPT>, <Hi/Lo>, <Deviation>, <Freeze>, <Clean>.**
7 RANGE	View/Select ranges. Shows active range and then toggles through available ranges. Pressing **[ENTER]** on a range activates it.
8 UNIT	Change pressure measurement unit. Choice of units can be customized.
9 MODE	Change pressure measurement mode **(<gauge>**, **<absolute>**).
10 ENTER	ENTER data and/or run automated test/calibration sequence from MAIN RUN screen.

3.2.2 [RANGE]

- **PURPOSE**

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

- **PRINCIPLE**

  RPM3 A30000/A6000 has six ranges (see Section 3.1.6).

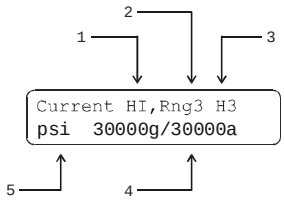
  The **[RANGE]** key allows the range values to be viewed and a range selection to be made.

  Most RPM3 settings such as pressure unit of measure (UNIT) and measurement mode (MODE), are range specific. Changes made while in one range apply to that range only and do NOT affect the other ranges (see Section 3.2.2).

- **OPERATION**

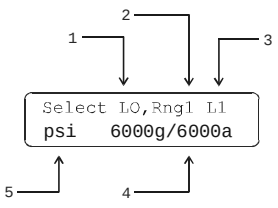
  Pressing **[RANGE]** activates the range viewing and selecting function. Pressing **[RANGE]** again or **[+/-]** while in the RANGE function steps through displays of available ranges: Lo to Hi.

  When **[RANGE]** is first pressed, the active reference pressure transducer (RPT) and range are displayed:



1. Identifies active RPT (Lo or Hi).
2. Identifies active range (1, 2 or 3) of the active RPT.
3. Range designator.
4. Full scale pressure value in the current units for the RPT and range when used in gauge (g) or absolute (a) mode.
5. Pressure unit of measure (the unit of measure currently active for this range).

Pressing **[RANGE]** again or **[+/-]** causes the screen to step through the other available ranges in sequence Lo to Hi:



1. Identifies RPT (Lo or Hi).
2. Identifies range of the RPT (1, 2 or 3).
3. Range designator.
4. Full scale pressure value in the active units of measure for the RPT and range number when used in gauge (g) or absolute (a) mode.
5. Units of measure (the unit of measure currently active for the range).

Range full scale limits are given in the pressure unit that is currently active for that range.

Pressing **[ENTER]** while in the RANGE function causes the RPM3 to attempt to change the active range to the range currently displayed. The pressure currently applied to the RPT with the new range must be lower than upper limit (UL) of the new range for the range change to be completed (see Section 3.2.5).

Any time a range change causes the active RPT to change, the HPMS Lo RPT Isolation Valve must be operated to connect or disconnect the Lo RPT from the TEST port. The green Lo RPT Valve Position LEDs indicate the correct position of the Lo RPT Valve Isolation Knob based on the RPM3 range currently in use (see Section 3.1.8).

Pressing **[ESCAPE]** while in the range function returns to the main run screen without changing ranges.

The HPMS Lo RPT Isolation Valve protects the Lo RPT (6 000 psi max) from overpressure when the Hi RPT is in use. Familiarize yourself with HPMS operation (see Section 3.1.8) before changing ranges and applying pressures. Always turn the Lo RPT Isolation Valve fully in the direction of the lighted green LED before applying pressure.

For a range change to occur, the pressure currently measured by the new range RPT must be less than the current upper limit (see Section 3.2.5) of the new range. If this condition is NOT met when a range change is attempted, a warning message is displayed and the range change is NOT completed. Reduce the pressure applied to the TEST port and reattempt the range change.

Running an automated test SEQUENCE may change the active range. The SEQUENCE function automatically sets the active range to the most appropriate range based on full scale of the device under test (see Section 3.2.11).

Range Specific Functions and Settings

In general, RPM3 functions and settings are range specific. They are set and stored for each range so that changing settings when in one range does NOT change settings in the other ranges. When returning to a range, settings are the same as they were when the range was left.

Functions and settings that are NOT range specific are:

- **Functions:** HEAD (see Section 3.2.8), DISPLAY (see Section 3.2.7).
- **Setup Menu: <3ReadRt>** (see Section 3.3.3).

Running an automated test SEQUENCE may change the active range and the UNIT, STABILITY and RESOLUTION settings for the range. The SEQUENCE function automatically sets these parameters to the most appropriate values based on the characteristics of device under test (see Section 3.2.11).

In remote mode, most settings are RPT specific rather than range specific (see Section 4.3).

3.2.3 [UNIT]

❍ **PURPOSE**

To specify the pressure unit of measure for the active range.

See also Section 3.2.4.

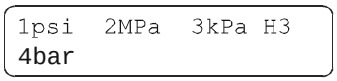
❍ **PRINCIPLE**

RPM3 allows the pressure measurement unit for a range to be changed. Internally, RPM3 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 7.1).

The pressure measurement unit selection (e.g., psi, kPa, etc.) is separate from the pressure measurement mode selection (gauge or absolute). See Section 3.2.4 for information on changing the measurement mode.

❍ **OPERATION**

To change the pressure measurement unit for the active range, press the **[UNIT]** function key. The display is:



The cursor is on the number corresponding to the active unit for the active range. The active range is indicated in the upper right hand corner. To change the pressure unit for the active range, select the desired unit. The display 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., RPT calibration coefficients) are always represented in Pa regardless of the active range unit.

See Section 7.1 for tables of the conversion factors used by RPM3.

The UNIT function provides rapid access to a choice of six units. The choice of units can be customized by the user from a wider selection (see Section 3.3.2). To return the six units of the UNIT function key to default, see Section 3.4.5.2.

3.2.4 [MODE]

❍ **PURPOSE**

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

See also Section 3.2.3.

❍ **PRINCIPLE**

The RPM3 A30000/A6000 RPTs have an evacuated and sealed reference so that they always measure absolute pressure. RPM3 supports extensive on-board measurements and logic to precisely subtract atmospheric pressure from absolute pressure when gauge pressure measurements are desired. A separate on-board barometer and unique atmospheric compensation system are used to assure highly accurate gauge pressure values are provided even if atmospheric pressure changes between zeroing opportunities (see Section 3.4.1, Gauge Mode with an Absolute RPT, Dynamic Compensation for Atmospheric Pressure). This allows simple, one step switching between gauge and absolute measurement modes without special procedures or hardware.

❍ **OPERATION**

To change the pressure measurement mode for the active range, press **[MODE]**. The display is:

```
Measurement mode:  H1
1absolute 2gauge
```

The cursor is on the number corresponding to the current measurement mode. Making a measurement mode selection returns to the main run screen with the selected mode active.

When going from absolute to gauge measurement mode, the AutoZ function should be used to update the atmospheric pressure offset (see Sections 3.2.10, 3.4.1).

3.2.5 [UL] (UPPER LIMIT)

❍ **PURPOSE**

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

❍ **PRINCIPLE**

The UPPER LIMIT function provides the user with a settable pressure limit at which an alarm will sound.

When the upper limit is reached the RPM3's beeper sounds intermittently.

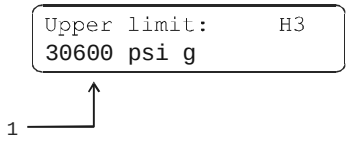
The UPPER LIMIT function has two purposes. First, when UL is set to its default value, it serves as a warning that the maximum pressure of the active range is about to be exceeded. Second, UL can be set by the user to a lower value than the default value to provide an alarm that a specific pressure limit has been exceeded. This feature is often used to help protect an external device or system to which RPM3 is connected. For example, UL might be set just over the full scale of a device under test (DUT) that is being calibrated. The UPPER limit is set automatically by the SEQUENCE function when a sequence is run to protect the device under test from overpressure (see Section 3.2.11).

Upper limit settings are specific to each range ***and measurement mode (gauge or absolute)***.

The UL function is separate and different from the over-pressure (Pmax!) function. The Pmax! function is NOT adjustable and activates regardless of UL setting when the maximum acceptable pressure for the active RPT range has been exceeded (see Section 3.2.5.1).

OPERATION

When **[UL]** is pressed from the main run screen the display is:



1. Edit field to view current upper limit value and modify if desired. The value is always in the current unit of measure.

Enter the desired upper limit value and RPM3 returns to the main run screen with the new upper limit value active.

When the upper limit has been exceeded, the display of current pressure flashes and the beeper sounds at two second intervals. Reduce the pressure applied to the RPT to lower than the upper limit to return to normal operation.

Default upper limit values are 105 % of the range full scale for ranges 1 and 2 and 102 % FS for range 3. Upper limit values may be adjusted by the user. The adjusted value must be lower than or equal to the default value and higher than the current measured pressure.

Upper limit values are specific to each range AND measurement mode. Do NOT assume that the upper limit set in one measurement mode will apply to the other. For example, if you set 3 000 psi as the upper limit in gauge mode, the upper limit will NOT be 3 000 psi in absolute mode. The upper limit setting in one mode has NO affect on the upper limit setting in another mode.

[RANGE] is disabled so range changes cannot be made when the upper limit is exceeded.

Running an automated test SEQUENCE with the SEQUENCE function automatically sets the UPPER LIMIT based on the full scale of the device under test. It may be necessary to readjust the UPPER LIMIT after running a SEQUENCE (see Section 3.2.11).

3.2.5.1 OVER-PRESSURE FUNCTION (<PMAX!>)

❍ **PRINCIPLE**

In addition to the UL (Upper Limit) function, RPM3 has an over-pressure function (Pmax!). Whereas the UL function is a settable alarm to assist the operator in monitoring a pressure limit, Pmax! is a fixed limit intended as a warning that the maximum pressure acceptable for a range has been exceeded and damage to the RPM3 may be imminent. The Pmax! function activates when the maximum acceptable pressure for the current range on the active or inactive RPT has been exceeded.

❍ **OPERATION**

When the overpressure function activates because Pmax! has been exceeded:

- The beeper sounds continuously at high frequency for 8 seconds. **<Rng "RR" RPT EXCEEDED PMAX>** and overpressure value display toggles with normal run screen (**RR** identifies the range that has exceeded Pmax! (e.g., L1, H3).
- **<!!!Pmax!!!>** displays in the main run screen instead of the measured pressure so long as the pressure read by the active RPT exceeds Pmax!.
- The **[RANGE]** key is disabled.
- The overpressure condition is logged.

To recover from an overpressure condition, remove the overpressure source and then clear the overpressure condition by cycling RPM3 power using the soft **[ON/OFF]** key (see Section 3.1.4) or by disconnecting and reconnecting the power cable. The overpressure message will continue to display until the overpressure condition has been cleared by cycling power.

The overpressure function monitors both the active and inactive RPT. When an overpressure occurs, check the <Rng "RR" RPT exceeded> message to determine which RPT and range has been overpressured.

Pmax! values are 110 % of the range full scale for ranges 1 and 2 and 104 % of the range full scale for range 3.

When Pmax! is exceeded, <!!!Pmax!!!> displays on the RPM3 display top line where the current pressure is normally displayed because the actual pressure applied can NO longer be indicated reliably.

3.2.5.2 LO RPT PROTECTION (<!!LO RPT ACTIVE!!>)

❍ **PRINCIPLE**

RPM3/HPMS A30000/A6000-AF has a special warning system to reduce the risk of overpressure to the Lo RPT. The warning system interrupts operation when a range on the Hi RPT is selected but the Lo RPT appears to be active (i.e., connected to the test port). Since all the Hi RPT ranges include pressures that are high enough to overpressure and damage the Lo RPT, if a Hi RPT range is selected, the Lo RPT should be shut off from the TEST port by the HPMS Lo RPT Isolation Valve.

If the RPM3 Lo RPT measures a pressure greater than 30 psig (200 kPa) AND a Hi RPT range (H1, H2, H3) is currently selected, the Lo RPT is assumed to be active (connected to the TEST port). If the Lo RPT is active and a HI RPT range is selected, the Lo RPT Active warning system activates. The Lo RPT Active warning system prevents further operation until pressure on the Lo RPT has been reduced to less than 30 psig (200 kPa).

❍ **OPERATION**

If the Lo RPT is active and a range of the Hi RPT (H1, H2, H3) is selected:

- The RPM3 displays **<!!LO RPT ACTIVE!!>** and sounds two second intermittent beeps.
- The red, Lo RPT Active WARNING LED on the HPMS front panel flashes.

To cancel the warning condition, reduce pressure on the Lo RPT to less than 30 psig (200 kPa). Operation returns to normal.

See Section 3.1.8.

The Lo RPT Active Warning may occur when the HPMS Lo RPT Isolation Valve is closed. If this occurs, there may be a leak through the Isolation Valve.

3.2.6 [RES] (RESOLUTION)

❍ **PURPOSE**

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

❍ PRINCIPLE

The resolution with which the pressure measured by RPM3 is displayed can be adjusted. This feature can be used to reduce the resolution when lower precision measurements are being made and additional digits might confuse or distract the operator.

The resolution setting determines the number of digits with which pressure is displayed. The desired resolution is calculated based on the full scale of the range and then rounded down to the nearest digit. For example, resolution of 0.01 % on a range of 18 000 psi is 18 000 x 0.01 % = 1.8 which is rounded down to 1 psi.

The default resolution setting is 0.001 % for each range. The maximum resolution setting is 0.0001 %.

❍ OPERATION

To access the resolution function, press **[RES].** The display is:

```
Measure resltn:  H3
0.0010% FS   < and >
```

Use the **[←]** and **[→]** keys to select the desired level of resolution. Press **[ENTER]** to set the resolution and return to the main run screen.

The resolution setting affects the display of the measured pressure as well as other indications and settings, such as quantities shown by DISPLAY functions (see Section 3.2.7), the reading of the on-board barometer, etc.

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

Running an automated test SEQUENCE with the SEQUENCE function automatically sets the RESOLUTION to the most appropriate value based on the characteristics of the device under test. It may be necessary to readjust the RESOLUTION after running a SEQUENCE (see Section 3.2.11).

3.2.7 [DISPLAY]

❍ **PURPOSE**

To select, from a variety of choices, the information that is displayed on the second line of the RPM3 display.

❍ **PRINCIPLE**

RPM3 supports a variety of advanced pressure measurement functions that are displayed on the second (bottom) line of the RPM3 display. In summary, the available display functions included are:

- **AVERAGE:** Calculates the average pressure measured over a user specified period of time and displays the average, the standard deviation about the mean and a countdown in seconds to the next average (see Section 3.2.7.1). This function is often used to filter out pressure noise in an unstable system. The magnitude of the noise is quantified by the standard deviation about the mean. A second Avg screen allows the instantaneous pressure values to be viewed during an averaging cycle.
- **RATE:** Calculates and displays the current rate of change of pressure in current pressure units/second (see Section 3.2.7.2). This function is a useful indication of the stability of the pressure being measured. It is often used as an indication of positive or negative leak rate and as a go/NO go criterion of when to take data when comparing RPM3 and a device under test, for example in a calibration. Rate is used by the ***Ready <*>/Not Ready*** (**<↑>** or **<↓>**) function to determine when a ***Ready <*>*** condition exists (see Section 3.1.5).
- **DEVIATION:** Calculates and displays the difference between the pressure measured by RPM3 and a target pressure defined by the user (see Section 3.2.7.3). This function is useful in monitoring the evolution of pressure around and/or away from a desired set point.
- **RPT:** Allows the pressure measured by both the Lo and Hi RPT to be displayed simultaneously (see Section 3.2.7.4).
- **HI/LO:** Records and displays maximum and minimum pressures measured (see Section 3.2.7.5). This function is used to keep track of the minimum and maximum pressure observed in a system over a period of time or to monitor whether a pressure min/max limit has been exceeded.
- **FREEZE:** Captures and displays the pressure measured by the active range of RPM3 when the **[ENTER]** key is pressed (see Section 3.2.7.6). This function is useful to record the pressure present at the time of an operator observed trigger event, for example when the needle of an analog gauge was on the nominal point or when a switch activates.
- **CLEAN:** Blanks out the second line of the display (see Section 3.2.7.7). This function is used when a simple display of pressure measured by the RPM3 active range without additional information is desired.


RPM3 also includes a leak check function (see Section 3.3.5).

❍ **OPERATION**

To set the DISPLAY function press **[DISPLAY]** from the main run screen.

The display is:

```
1Avg 2Rate 3Dev 4RPT
5Hi/Lo 6Freez 7Clean
```

The cursor is on the active DISPLAY function. Selecting a display function returns to the main run screen with the selected function active.

See Sections 3.2.7.1 to 3.2.7.7 for details on each DISPLAY function.

The DISPLAY selection is NOT range specific. A DISPLAY selection made in one range applies to all ranges.

The default DISPLAY function is Rate which causes the second line of the display to show "R" followed by the current rate of change of pressure in current pressure units per second.

3.2.7.1 Avg (Average)

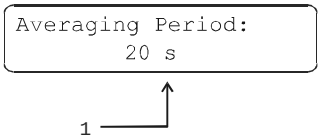
❍ **PURPOSE**

To activate the Average DISPLAY and/or adjust the period of time over which averaging occurs.

See Section 3.2.7, PRINCIPLE.

❍ **OPERATION**

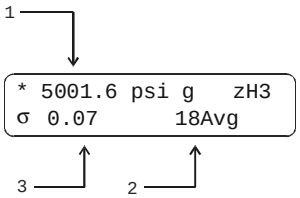
To access the Average DISPLAY, press **[DISPLAY]** and select **<1Avg>.** The display is:



1. Edit field for averaging period in seconds. Default is 20. Minimum 1, maximum 999.

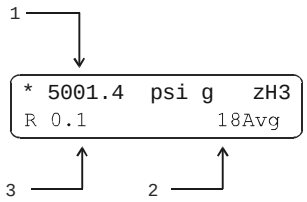
Edit the averaging time period if desired. Pressing **[ENTER]** returns to the main run screen with the Average DISPLAY active.

With the Average DISPLAY active the main run screen is:



1. Average measured over last completed averaging period.
2. Countdown in seconds until completion of on-going averaging period.
3. Standard deviation of last completed averaging period.

The Average DISPLAY has a second screen that allows the instantaneous pressure readings to be viewed while an averaging cycle is running. The instantaneous Average screen is:



1. Instantaneous pressure values at RPM3s normal integration rate.
2. Countdown in seconds until completion of on-going averaging period.
3. Current rate of change of pressure in pressure units/second.

The **[+/-]** key toggles between the main run Average screen and the instantaneous values Average screen.

In the Average DISPLAY the *Ready* <*>/*Not Ready* (<↑> or <↓>) indication applies to the result of the previous averaging period. *Ready* <*> indicates that all readings during the previous averaging period met the stability criterion (see Section 3.3.4). *Not Ready* (<↑> or <↓>) indicates that one or more readings were outside of the stability criterion (See Section 3.1.5).

Changing the pressure unit of measure, measurement mode (gauge or absolute) or range while the averaging screen is active, starts a new averaging period.

Pressing [ENTER] while in the Average DISPLAY aborts the current averaging period and causes a new one to begin. Pressing [ENTER] can thus be use to trigger a new averaging period on demand.

To go to a DISPLAY other than Average, press [DISPLAY] and make a new DISPLAY choice (see Section 3.2.7).

3.2.7.2 Rate

- **PURPOSE**

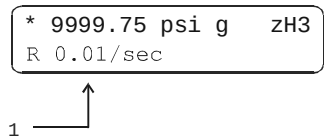
To activate the Rate DISPLAY.

See Section 3.2.7, PRINCIPLE.

- **OPERATION**

To activate the Rate DISPLAY press **[DISPLAY]** and select **<2Rate>.** Selecting **<2Rate>** returns to the main run screen with the Rate DISPLAY active.

With the Rate DISPLAY active the main run screen is:



1. Current rate of change of pressure in current pressure units per second.

The Rate DISPLAY is different and separate from the stability setting which is used to set the stability criterion on which the *Ready* <*>/*Not Ready* (<↑> or <↓>) indication is based (see Sections 3.3.4 and 3.1.5). The Rate DISPLAY only causes the current rate of change to be displayed and has NO affect on the stability setting or the *Ready* <*>/*Not Ready* (<↑> or <↓>) condition.

To go to a DISPLAY other than Rate, press [DISPLAY] and make a new DISPLAY choice (see Section 3.2.7).

3.2.7.3 Dev (Deviation)

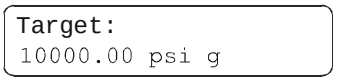
- **PURPOSE**

To activate the Deviation DISPLAY and/or set the deviation target value.

See Section 3.2.7, PRINCIPLE.

- **OPERATION**

To activate the Deviation DISPLAY press **[DISPLAY]** and select **<3Dev>**. The display is:

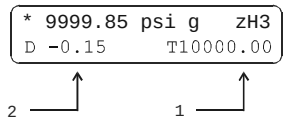


Edit the desired target value. Pressing **[ENTER]** returns to the main run screen with the Deviation DISPLAY active using the entered target value.

The target value is the value from which deviations (D) are measured by the Deviation DISPLAY following:

D = current pressure - target pressure

With the Deviation DISPLAY active the main run screen is:



1. Target value.
2. Deviation of current pressure from the target value.

Pressing [ENTER] from the main run screen when the Deviation DISPLAY is active goes directly to the Target editing screen. This allows the target value to be changed without going through the DISPLAY menu.

If the pressure measurement unit or mode (gauge or absolute) is changed while the Deviation DISPLAY is active the target value remains at the same numerical value. It is NOT converted.

To go to a DISPLAY other than Deviation, press [DISPLAY] and make a new DISPLAY choice (see Section 3.2.7).

3.2.7.4 RPT

- **PURPOSE**

To activate the RPT DISPLAY.

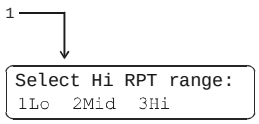
See Section 3.2.7, PRINCIPLE.

OPERATION

For the sake of clarity, when describing the RPT DISPLAY, the active RPM3 range when the RPT function is selected is referred to as the "active" range. This is the range that is displayed on the first line of the display. The other RPT and the range to be displayed on the second (bottom) line of the RPM3 display are referred to as the "inactive" RPT and range. It is "inactive" in the sense that all RPM3 functions and settings such as UNIT and RES still apply to the "active" RPT. To make changes to the "inactive" RPT, for example to change its measurement units, it must be made the active RPT by a conventional range change (see Section 3.2.2).

The RPT display function can only be used effectively when the active range is a range on the Lo RPT. If the Hi RPT is the active RPT, the "Lo RPT Active Warning" will interfere as soon as pressure is increased on the Lo RPT (see Section 3.2.5.2).

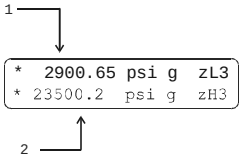
To activate the RPT DISPLAY, press **[DISPLAY]** and select **<4RPT>**. The display is:



1. Lo or Hi - whichever RPT is currently **inactive**.

Select the desired range of the inactive RPT. Making the range selection returns to the main run screen with the RPT DISPLAY active.

With the RPT DISPLAY active the main run screen is:



1. Active RPT display.
2. Inactive RPT display.

With the RPT display active, executing a range change to a range on the inactive RPT causes the range change to occur making the inactive RPT the active RPT. The DISPLAY defaults back to Rate.

To go to a DISPLAY other than RPT, press [DISPLAY] and make a new DISPLAY choice (see Section 3.2.7).

3.2.7.5 Hi/Lo

- **PURPOSE**

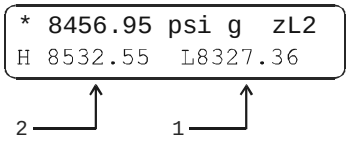
To activate the Hi/Lo DISPLAY.

See Section 3.2.7, PRINCIPLE.

- **OPERATION**

To activate the Hi/Lo DISPLAY press **[DISPLAY]** and select **<5Hi/Lo>**. Selecting **<5Hi/Lo>** resets the Hi/Lo values and returns to the main run screen with the Hi/Lo DISPLAY active.

With the Hi/Lo DISPLAY active the main run screen is:



1. Lowest pressure observed since Hi/Lo reset.
2. Highest pressure observed since Hi/Lo reset.

The Hi/Lo values change each time a new Hi or Lo pressure is observed.

The Hi/Lo record can be reset at any time by pressing [ENTER]. This allows a Hi/Lo reset without going back through the DISPLAY menu.

If the pressure measurement unit, mode (gauge or absolute) or range is changed while the Hi/Lo DISPLAY is active, Hi/Lo resets.

To go to a DISPLAY other than Hi/Lo, press [DISPLAY] and make a new DISPLAY choice (see Section 3.2.7).

3.2.7.6 Freeze

- **PURPOSE**

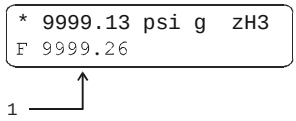
To activate the Freeze DISPLAY.

See Section 3.2.7, PRINCIPLE.

❍ **OPERATION**

To activate the Freeze DISPLAY press **[DISPLAY]** and select **<6Freez>**. Selecting **<6Freez>** returns to the main run screen with the Freeze DISPLAY active.

With the Freeze DISPLAY active the main run screen is:



1. Pressure measured by active range of RPM3 when **[ENTER]** was pressed in the current pressure units (displays 0.00 by default when Freeze DISPLAY is first activated).

Pressing **[ENTER]** causes the current pressure measured by the active RPM3 range to be captured and displayed.

If the pressure measurement unit, mode (gauge or absolute) or range is changed while the Freeze DISPLAY is active, the Freeze value defaults back to zero.

To go to a DISPLAY other than Freeze, press [DISPLAY] and make a new DISPLAY choice (see Section 3.2.7).

3.2.7.7 Clean

❍ **PURPOSE**

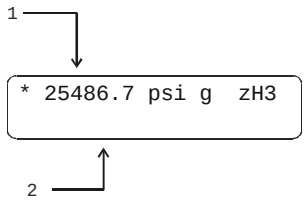
To activate the Clean DISPLAY.

See Section 3.2.7 PRINCIPLE.

❍ **OPERATION**

To activate the Clean DISPLAY press **[DISPLAY]** and select **<7Clean>**. Selecting **<7Clean>** returns to the main run screen with the Clean DISPLAY active.

With the Clean DISPLAY active the main run screen is:



1. Conventional main run screen first line.
2. “Clean” second line.

To go to a DISPLAY other than Clean, press [DISPLAY] and make a new DISPLAY choice (see Section 3.2.7).

3.2.8 [HEAD]

- **PURPOSE**

  To cause a pressure value representing a difference in height to be added to the pressure measured by the RPM3 reference pressure transducer (RPT).

- **PRINCIPLE**

  RPM3's RPTs measure 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 RPM3's TEST port. This difference in height, frequently called **head**, can cause a significant difference between the pressure measured by the RPM3 at its TEST port height and the pressure actually applied to the device under test located at a different height. In this case, it is useful to make a head correction to the pressure measured by the RPM3 RPT at its TEST port in order to accurately predict the pressure actually applied at a different height. The HEAD function allows head corrections to be applied automatically for a variety of fluids based on operator entry of the nature of the pressurized fluid and the height difference.

  RPM3 can accurately determine **head** pressures for gas (nitrogen, helium and air) and liquids (oil, water) as the pressurized medium. In calculating the head value, standard gravity (9.80665 m/s^2) is used. Gas densities are calculated from standard density correcting for temperature of 20°C and the measured pressure using the gas's compressibility factor to 1 500 psi (10 MPa) and extrapolated above 1 500 psi. Above 1 500 psi, gas heads should be minimized to minimize uncertainties due to head corrections. Oil density is taken at 850 kg/m^3, the density of typical calibration oils at 20°C. Water density is taken at 998.2321 kg/m^3 (20°C). A custom liquid density may also be specified.

  The **[HEAD]** function key is used to specify the difference in height between the RPM3 TEST port and the test. The height units and the head fluid are specified by pressing **[SETTINGS]** and selecting **<1Head>** (see Section 3.3.1).

  Use of the HEAD function to assure in tolerance measurements is particularly critical when a liquid is the test fluid due to the high density of liquids. To determine when, and how precisely, a head correction for liquids must be made, 0.03 psi/inch (90 Pa/cm) may be used as an estimation of the liquid head value.

Recommended Gauge Mode Head Setting Procedure in HGC 30000-AF

When using RPM3 A30000/A6000-AF in an HGC-30000-AF calibration system operating in gauge mode, the recommended zeroing and head setting procedure is as follows:

❶ Vent the system by opening the OPG1 Exhaust Valve. This sets the oil head in the system at the top of the OPG1 tank return tube (see the OPG1 Operation and Maintenance Manual).

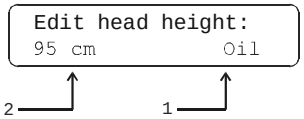
❷ Wait at least two minutes for complete system stabilization and to be sure the system is fully vented.

❸ Press **[AutoZ]** on the RPM3 keypad. This zeros the RPM3 measurement range and sets the reference level to the top of the OPG1 tank return tube.

❹ Measure the difference in height between the OPG1 tank return tube and the device under test (DUT). Following the instructions under OPERATION immediately below, use this value as the head height. The head height is positive if the DUT is above the reference level and negative if below.

❍ **OPERATION**

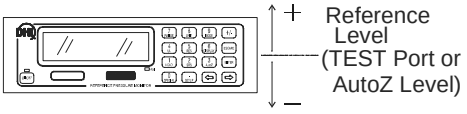
To access the HEAD function, press **[HEAD]**. The display is:



1. Test fluid currently specified for the head correction.
2. Entry field for head height (1 to 999 cm or in).

Enter a positive value if the device under test is above the reference level and a negative value if it is below the reference level. Entering a value of zero turns the HEAD function OFF. Entering a value other than zero turns the HEAD function on using the height entered. Pressing **[ESCAPE]** returns to the main run screen with NO change to the current head setting.

To change units of head height between inches and centimeters and to change the test fluid, press [SETUP] and select <1Head> (see Section 3.3.1).



The head height should be entered as a positive value if the device or system under test is higher than the RPM3 and negative if it is lower. See the Recommended Head Setting Procedure above for head setting in an HGC-30000-AF system (using an OPG1 oil pressure generator/controller.

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 specifications are independent of range.

When the HEAD function is ON (head value different from zero), this is indicated by <h> in the right side of the top line of the main run screen (see Section 3.1.2). When the HEAD function is OFF, the <h> is NOT shown.

3.2.9 [SDS] (SELF DEFENSE SYSTEM)

- **PURPOSE**

SDS is not present on RPM3 A30000/A6000-AF. It is only used on RPM3s with RPTs of A1500 or lower.

3.2.10 [AutoZ]

- **PURPOSE**

To run the AutoZ function that **rezeros** the active range.

See Section 3.4.1, PRINCIPLE for an explanation of AutoZ principles.

To assure operation within "with autozero" measurement accuracy specifications (see Section 1.2.2.1), AutoZ should be run regularly to update the value of ZOFFSET. For absolute measurement mode, it is recommended that AutoZ be run at least every 30 days or when RPM3 has been exposed to temperature changes exceeding ± 20 °C (36 °F). Absolute AutoZ doesn't need to be used if the RPM3 is not used for absolute mode measurements. For gauge measurement mode, it is recommended that AutoZ be run approximately once a day.

- **PRINCIPLE**

Run AutoZ is the function by which the current RPT reading is compared to ZSTD and a new value of ZOFFSET representing RPT zero drift is determined and applied (see Section 3.4.1).

- **OPERATION**

To run AutoZ, press **[AutoZ]** from the main run screen. If the measurement mode of the active range is gauge, ZSTD is atmospheric pressure (zero gauge) and AutoZ runs automatically (see Section 3.2.10.1). If the measurement mode of the active range is absolute, the source of ZSTD must be specified when AutoZ is run (See Section 3.2.10.2).

Run AutoZ and the value of ZOFFSET that it updates are specific to each range and operating mode (gauge or absolute).

3.2.10.1 RUNNING AUTOZ IN GAUGE MEASUREMENT MODE

- **PURPOSE**

To **rezero** the active RPT and range in gauge measurement mode.

See Section 3.4.1 for an explanation of AutoZ principles.

❍ **OPERATION**

If you are using RPM3 A30000/A6000 in an HGC-30000-AF system with an OPG1 oil pressure generation/controller, see Section 3.2.8, PRINCIPLE, Recommended Gauge Mode Head Setting Procedure in HGC-30000-AF before using the AutoZ function in gauge mode.

For the AutoZ function key to run AutoZ, AutoZ must be turned ON for the active range and measurement mode. AutoZ ON is indicated by <z> displaying to the left of the range designator on the first line of the main run screen. AutoZ ON and OFF is set by pressing [SPECIAL] and selecting <1AutoZ> (see Sections 3.4.1 and 3.4.1.1). If AutoZ is OFF for the active range, and measurement mode, <AutoZ disabled> is displayed when [AutoZ] is pressed.

To run AutoZ in gauge measurement mode, press the **[AutoZ]** function key from the main run screen. **<Running gauge AutoZ>** is displayed briefly before returning to the main run screen.

Before running AutoZ in gauge mode, ensure that the pressure applied to the RPT is truly zero gauge (atmospheric pressure) and wait two minutes for full system stabilization. If running AutoZ in gauge mode results in a zero offset that RPM3 considers unusually large, <Confirm 0 gauge P!> is displayed when [AutoZ] is pressed. Check that the TEST port is fully open to atmosphere and press [ENTER] to continue or [ESCAPE] to abort. Running AutoZ without zero pressure applied to the RPT may result in out of tolerance measurements.

If a HEAD correction is active as indicated by <h> in the first line of the display, RPM3 may NOT indicate zero even right after running AutoZ in gauge mode. The head correction is momentarily disabled when AutoZ is run. The value displayed just after RPM3 is zeroed is the value of the current head correction which is the pressure applied at the head height when the pressure at the RPM3 reference level is zero gauge (see Section 3.2.8).

3.2.10.2 RUNNING AUTOZ IN ABSOLUTE MEASUREMENT MODE

❍ **PURPOSE**

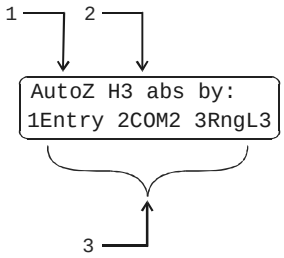
To **rezero** (redetermine ZOFFSET) for the active RPT and range in absolute measurement mode.

See Section 3.4.1 for an explanation of AutoZ principles.

❍ OPERATION

For the AutoZ function key to run AutoZ, AutoZ must be turned ON for the active range and measurement mode. AutoZ ON is indicated by <z> displaying to the left of the range designator on the first line of the main run screen. AutoZ ON and OFF is set by pressing [SPECIAL] and selecting <1AutoZ> (see Section 3.4.1.1). If AutoZ is OFF for the active range, and measurement mode, <AutoZ disabled> is displayed when [AutoZ] is pressed.

To run AutoZ in absolute measurement mode, press **[AutoZ]** from the main run screen. The display is:



1. Active range.
2. Current measurement mode (gauge or abs for absolute).
3. Selection of source of ZSTD for ZOFFSET determination.

Selecting **<1Entry>** allows the value of ZSTD to be entered from the front panel keypad (see Section 3.2.10.2).

Selecting **<2COM2>** allows the value of ZSTD to be read automatically from an RPM1, RPM2 or RPM3 connected to RPM3's COM2 serial port (see Section 3.2.10.2).

Selecting **<3RngL3>** allows the value of ZSTD to be read automatically from the Lo RPT Range 3 (available only if the active RPT is a Hi absolute RPT and there is a Lo absolute RPT) (see Section 3.2.10.2).

Allow the RPM3 to stabilize at atmospheric pressure and ambient temperature for 5 to 10 minutes before running AutoZ in absolute mode.

If running AutoZ results in values of ZOFFSET that are greater than ± 0.015 % FS of the active RPM3 measurement range, the RPM3 and/or the source of ZSTD may be out of tolerance or the AutoZ process may have been faulty. Before activating a new ZOFFSET greater than ± 0.01 % FS of the active RPM3 range, check to be sure that both the RPM3 and the source of ZSTD were in good working order, properly vented to stable atmospheric pressure, at the same reference height, and reading in the same pressure units when AutoZ was run.

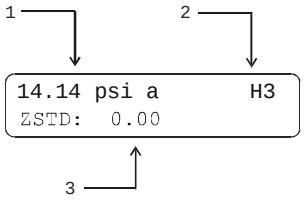
When the run AutoZ selection is made, if a HEAD correction is currently active (see Section 3.2.8), the head correction is temporarily disabled to avoid "zeroing out" the head correction.

The value of ZOFFSET in absolute mode is NOT necessarily exactly equal to the difference between the current reading and ZSTD if ZNATERR is NOT zero (see Section 3.4.1). For the same reason, RPM3 may NOT read exactly the same value as ZSTD even right after AutoZ has been run.

Run AutoZ by Entry

AutoZ by entry allows the value of ZSTD (see Section 3.4.1) to be entered manually. This provides a simple way of autozeroing relative to an independent reference device such as a house barometer that does NOT interface directly with RPM3.

To access run AutoZ by entry press **[AutoZ]** from the main run screen while in absolute measurement mode. Then select **<1Entry>**. The display is:



1. Pressure reading, units and mode of the active RPT range.
2. Active range indicator.
3. Entry field for the value of ZSTD.

Enter the value of ZSTD in the current units. The next display is:

```
Old ZOFFSET:   0.0 Pa
New ZOFFSET:1025.5 Pa
```

The old ZOFFSET is the ZOFFSET currently used.

The new ZOFFSET is the ZOFFSET resulting from this execution of run AutoZ.

Press **[ENTER]** to activate the new ZOFFSET and return to the main run screen.

Press **[ESCAPE]** to maintain the old ZOFFSET and return to the main run screen.

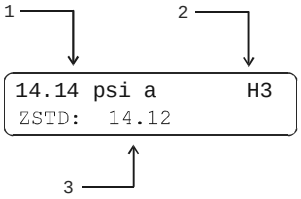
The value of ZOFFSET is always displayed and entered in Pascal (Pa).

The value of ZSTD must be entered in the current pressure units or the calculation of ZOFFSET will be incorrect.

Run AutoZ by COM2

AutoZ by COM2 allows the value of ZSTD (see Section 3.4.1) to be read automatically from a **DHI** RPM1, RPM2 or RPM3 connected by RS-232 interface to the RPM3 COM2 port.

To access **<run AutoZ by COM2>**, press **[AutoZ]** from the main run screen while in absolute measurement mode. Then select **<2COM2>**. The display is:



1. Pressure reading, units and mode of the active RPT range.
2. Active range indicator.
3. Pressure reading of the RPM connected to RPM3's COM2 port.

When ready, press **[ENTER]**. The next display is:

```
Old ZOFFSET:   0.0 Pa
New ZOFFSET: 546.9 Pa
```

The old ZOFFSET is the ZOFFSET currently used.

The new ZOFFSET is the ZOFFSET resulting from this execution of run AutoZ.

Press **[ENTER]** to activate the new ZOFFSET and return to the main run screen.

Press **[ESCAPE]** to maintain the old ZOFFSET and return to the main run screen.

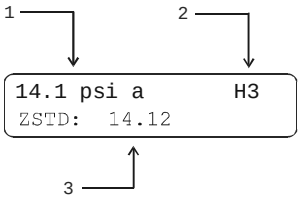
For RPM3 to communicate with an RPM connected to its COM2 port, the RPM3 and the RPM RS-232 interfaces must be set up properly (see Section 3.4.4). If, the RPM3 is unable to locate an RPM ON COM2 when running AutoZ by COM2, it times out after 6 seconds and displays <RPM NOT detected>.

The value of ZOFFSET is always displayed and entered in Pascal (Pa).

Run AutoZ by RngL3

Run AutoZ by RngL3 allows AutoZ to be run on a Hi RPT range using Lo RPT range 3 (L3) as the source of ZSTD (see Section 3.4.1). This offsets the A30000 RPT ranges to agree the range L3 of the A6000 RPT.

To access **<run AutoZ by RngL3>**, press **[AutoZ]** from the main run screen while in absolute measurement mode. Then select **[3RngL3]**. The display is:



1. Pressure reading, units and mode of the active Hi RPT range.
2. Active range indicator.
3. Pressure reading of Lo RPT range 3 (L3).

When ready, press **[ENTER]**. The next display is:

```
Old ZOFFSET:   0.0 Pa
New ZOFFSET: 156.8 Pa
```

The old ZOFFSET is the ZOFFSET currently used.

The new ZOFFSET is the ZOFFSET resulting from this execution of run AutoZ.

Press **[ENTER]** to activate the new ZOFFSET and return to the main run screen.

Press **[ESCAPE]** to maintain the old ZOFFSET and return to the main run screen.

Before running AutoZ by Lo RPT, be sure that range L3 of the Lo RPT is correctly calibrated and autozeroed. Also assure that the HPMS Lo RPT isolation valve is open so that both RPTs are open to a common pressure.

If you are running AutoZ on the Hi and Lo RPTs of an RPM3 and using run AutoZ by RngL3 to autozero the Hi RPT, be sure to run AutoZ on the Lo RPT first.

The value of ZOFFSET is always displayed and entered in Pa.

3.2.11 [ENTER] RUN TEST SEQUENCE

❍ **PURPOSE**

To run an automated test or calibration sequence (Quick Sequence or File Sequence).

❍ **PRINCIPLE**

RPM3 supports automated Sequences to assist in the testing or calibration of analog gauges and other pressure sensitive devices.

The Sequence function is intended:

- To facilitate setting the RPM3 range, resolution, stability test and upper limit appropriately for the DUT being tested.
- To step the operator through a planned sequence of test pressure increments if desired.
- To alert the operator to possible out of tolerance conditions as each test point is taken.
- To log test data in RPM3 that can be viewed following the test.

There are two types of Sequences: Quick Sequences and File Sequences.

- Quick Sequences: The DUT and test parameters are entered “on the fly” during the initialization of the test, then the test is executed if desired.
- File Sequence: The DUT and test parameters are stored in a file (see Section 3.3.6.2) and retrieved when a DUT is to be tested.

Sequences operation is oriented towards running tests in which the pressure is set to the DUT cardinal point indication and then the actual reference pressure present is read from the RPM3.

Sequence Settings and Calculations

The data required to initialize a sequence is either entered “on the fly” (Quick Sequence) or retrieved from a file (File Sequence). The data items required are:

- Pressure measurement mode (gauge or absolute).
- Pressure unit of measure.
- DUT full scale in pressure unit of measure.
- DUT tolerance in ± % FS (full scale).
- Test increment in % FS (Quick Sequence) or number of test increments and the value of each increment in the pressure unit of measure (File Sequence).
- Test point sequence: ascending, descending or both (Quick Sequence only).

The initialization data is used to determine and automatically set the RPM3 for the DUT and test to be run. At the end of the sequence initialization, the RPM3 is set as follows:

- Range: The lowest range that is greater than the maximum pressure in the Sequence.
- Pressure measurement mode and unit: As specified in the Sequence initialization.
- Display resolution: The DUT tolerance, divided by 10 and rounded to the nearest digit.
- Stability test: The DUT tolerance, divided by 10 (see Section 3.3.4).
- Upper limit (UL): The DUT full scale plus 5 %, or maximum UL, whichever is less (see Section 3.2.5).

To make the RPM3 adjustments but not execute a test sequence, the Sequence can be aborted just after the initialization. Then the proper settings for the DUT are made but the Sequence increments don’t execute.

See **OPERATION** in this Section for information on running a Quick or File Sequence.

See Section 3.3.6.2 for information on setting up File Sequence files.

See Section 3.3.6.1 for information on viewing the data files that result from running a Sequence.

❍ **OPERATION**

To run a Sequence, press **[ENTER]** from the Rate, RPT or Clean run screen; display modes that do not use **[ENTER]** (see Section 3.2.7). The display is:

```
Run sequence:
1QukSeq 2FileSeq
```

Select **<1QukSeq>** to run a Quick Sequence or **<2FileSeq>** to run a file sequence (see **PRINCIPLE** above in this Section).

If **<2FileSequence>** is selected, the File Sequence file number must be specified (see Section 3.3.6.2). The test is initialized automatically using the information in the File Sequence file and test execution begins with the **<SET VALVE FOR RNG>** screen (see Section 3.2.11.2).

If **<1QukSeq>** is selected, test initialization begins with the **<Measurement mode?>** screen (see Section 3.2.11.1).

3.2.11.1 TEST INITIALIZATION (QUICK SEQUENCE)

When running a File Sequence, the test initialization information is obtained from the file selected. Operation proceeds directly to test execution (see Section 3.2.11.2).

When a 2QukSeq is selected to run a Quick Sequence, the test initialization information must be entered. The information is entered in successive screens as follows:

- **<Measurement mode?>:** Select **<1gauge>** or **<2absolute>** depending on the measurement mode of the DUT being tested.

- **<Pressure units of measure?>:** The units of measure screen from the **[UNIT]** function key is presented. Select the desired pressure unit of measure for the Sequence. The choice of units may be modified (see Sections 3.2.3, 3.3.2).

- **<DUT full scale?>:** Enter the full scale pressure (maximum pressure) of the DUT in the measurement mode and pressure units that have been specified in the previous two steps.

- **<DUT tolerance?>:** Enter the DUT measurement uncertainty, accuracy or precision specification as desired in ± % FS (percent of full scale). This value will be used to determine proper RPM3 resolution and stability test settings (see Section 3.2.11, **PRINCIPLE**).

- **<Test increment?>:** Enter the test increment in % FS of the DUT. When executing the test, the test increments will be from zero to the DUT full scale, dividing by the value of the increment. If a non-even increment value is entered, the actual increments will be rounded to the lower number of increments. For example, if the DUT full scale is 10 000 psi and the increment specified is 42 %, the Sequence will run points of 0, 5 000 and 10 000 psi because 42 % goes into 100 less than three but more than two times.

- **<Test point sequence?>:** Select **<1up>** for the Sequence to run from zero to the DUT full scale; select **<2up&down>** for the Sequence to run from zero to the DUT full scale and back to zero; select **<3down>** for the Sequence to start at the DUT full scale and run down to zero.

Following Sequence initialization, the RPM3 changes RPM3 settings based upon the DUT characteristics (see Section 3.2.11, **PRINCIPLE**) and the Sequence proceeds to text execution (see Section 3.2.11.2).

3.2.11.2 TEST EXECUTION (QUICK SEQUENCE AND FILE SEQUENCE)

Following test initialization (see Section 3.2.11.1), test execution begins.

The first step of test execution is to set the HPMS Lo RPT isolation valve correctly for the RPT and range that will be used by the test (see Section 3.1.8). The RPM3 display is:

```
SET VALVE FOR RNG H1
DRIVE SET to <DUT FS
```

Set the HPMS isolation valve to shut off or use the RPM3's Lo RPT as indicated by the HPMS valve indicator LED (see Section 3.1.8). Turn the valve knob completely to its stop towards the lit valve indicator LED. If using an OPG1 to generate and adjust pressure, set the OPG1 drive regulator so the hydropneumatic pump output is lower that the DUT full scale (see the OPG1 Operation and Maintenance Manual). Press **[ENTER]** when ready to proceed with the test.

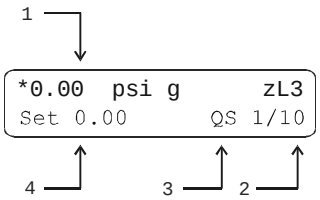
Press [ESCAPE] from the <SET VALVE FOR RANGE…> to abort the test but use the RPM3 with the settings for the DUT that was initialized. This can be useful for setting up the RPM3 to make DUT adjustments or run tests other than the one defined by the Sequence.

The display is:

```
*0.00  psi g      zL3
Exercise DUT & [ENT]
```

The top line is the standard RPM3 run screen indicating the current measured pressure (see Section 3.1.2). Exercise the DUT if desired using the top line indication of the measured pressure and press **[ENTER]** when complete.

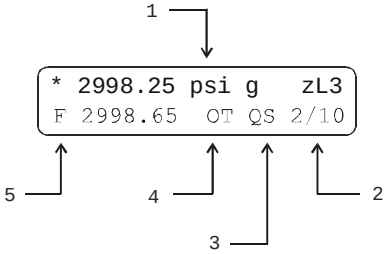
The display is:



1. Conventional RPM3 main run screen indicating current measured pressure (see Section 3.1.2).
2. Number of this test point/the total number of test points in the sequence.
3. **<QS>** indicating a Quick Sequence is being run or **<FS>** indicating a File Sequence is being run.
4. Pressure to set for this increment in current pressure unit of measure and measurement mode.

Adjust the pressure to the **<Set nnnn>** value indicated. **Set the pressure so that the DUT, NOT the RPM3, indicates the <Set nnnn> value.**

Once the desired pressure has been set, press **[ENTER]**. If the RPM3 pressure reading is in ***Not Ready*** condition (see Section 3.1.5), the RPM3 makes an invalid entry sound and displays **<Pressure NOT READY, TRY AGAIN>**. Correct the conditions that are causing the RPM3 reading to be excessively unstable and press **[ENTER]** again. If the RPM3 pressure reading is in ***Ready*** condition, the RPM3 makes a valid entry sound and the display is:



1. Conventional RPM3 main run screen indicating current measured pressure (see Section 3.1.2).
2. Number of this test point/the total number of test points in the Sequence.
3. **<QS>** indicating a Quick Sequence is being run or **<FS>** indicating a File Sequence is being run.
4. **<OT>** present only if the captured RPM3 reading was out of tolerance (definition of out of tolerance is Set point - RPM3 reading > DUT tolerance).
5. **<F>** to indicate freeze (see Section 3.2.7.6) followed by the RPM3 pressure reading in current units of measure captured when **[ENTER]** was pressed in the previous **<Set>** screen. This is the reference pressure that was present on the DUT when the DUT indicated the cardinal point. The frozen pressure value flashes if the reading was out of tolerance (definition of out of tolerance is: Set point - RPM3 reading > DUT tolerance).

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.

After the last pressure point in the sequence has been accepted the display is:

```
Sequence complete:
1data 2new 3repeat
```

Select **<1data>** to view the data collected in the Sequence that was just completed (see Section 3.3.6.1).

Select **<2new>** to run a new Quick or File Sequence.

Select **<3repeat>** to repeat the sequence that was just completed.

Press **[ESCAPE]** to return to the main run screen.

3.3 [SETUP] MENU KEY

❍ **PURPOSE**

The **[SETUP]** key accesses a menu of commonly used RPM3 functions and features that do NOT have direct function keys.

- **<Head>** - To change the height units and fluid (see Section 3.3.1).
- **<PresU>** - To customize the choices available under **[UNIT]** and to set up User Defined Units (see Section 3.3.2).
- **<ReadRt>** - To turn ON and OFF RPM3's automated, rate of change dependent, reading integration time feature (see Section 3.3.3).
- **<Stab>** - To view and adjust the stability limit that is the criterion for the ***Ready/Not Ready*** condition (see Sections 3.3.4 and 3.1.5).
- **<Leak>** - To run an automated leak checking function (see Section 3.3.5).
- **<Seq>** - To view data collected from a Sequence run and/or to view and edit File Sequence files (see Section 3.3.6 and 3.2.11).

❍ **OPERATION**

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

```
1Head  2PresU  3ReadRt
4Stab  5Leak   6Seq
```

Select the desired SETUP function.

Select **<1Head>** to select head unit of measure and fluid (see Section 3.3.1).

Select **<2PresU>** to customize the UNIT function (see Section 3.3.2).

Select **<3ReadRt>** to turn the automated read rated function ON and OFF (see Section 3.3.3).

Select **<4Stab>** to adjust the stability limit (see Section 3.3.4).

Select **<5Leak>** to run a leak test (see Section 3.3.5).

Select **<6Seq>** to read Sequence data or create/edit a File Sequence file (see Section 3.3.6).

3.3.1 HEAD

❍ **PURPOSE**

To specify the configuration of the HEAD function (see Section 3.2.8) including the length unit of measure for head height entry and the test fluid for head pressure calculations.

❍ **OPERATION**

From the main run screen, press **[SETUP]** and select **<1Head>**. The display is:

```
Head height unit:
1in  2cm
```

Select the desired head height unit. The next display is:

```
Head medium:
1Gas  2Liquid
```

If **<1Gas>** is selected, the display offers the choice of three gasses. Making a gas selection returns to the main run screen with that gas active for the HEAD function.

```
Gas type:
1N2 2He 3Air
```

If **<2Liquid>** is selected the display offers the choice of oil, water or a user defined liquid. If the user defined liquid is selected, its density must be specified. Making a liquid selection returns to the main run screen with that liquid active for the HEAD function.

```
Liquid type:
1Oil 2H2O 3User
```

3.3.2 PresU

❍ **PURPOSE**

To customize the selection of pressure units that are available for selection from the UNIT function key.

❍ **PRINCIPLE**

The **[UNIT]** function key makes available a choice of five default pressure units (see Section 3.2.3). RPM3 also supports many commonly used units in addition to those included in the default set up. These units can be made available for active selection by customizing the UNIT function by pressing **[SETUP]** and selecting **<2PresU>**. Up to six units may be set up. This allows RPM3 to offer a very wide selection of units while simplifying day to day operation.

❍ **OPERATION**

To customize the UNIT function key, from the main run screen press **[SETUP]** and select **<2PresU>**. The display is:

```
                1 ──┐
                    ↓
Set up user unit #6
```

1. Entry field to select 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:

```
Unit#6    1SI  2other
3user
```

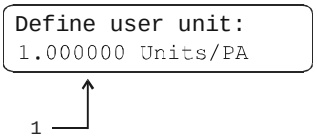
Select the desired pressure unit category (see Table 4), then select the desired unit from the unit menu.

Table 4. PresU - Available Units

<1SI>	<2other>	<4user>
<1Pa>	<1psi>	<1user>
<2kPa>	<2psf>	
<3mPa>	<3inHg>	
<4mbar>	<4inWa>	
<5bar>	<5kcm2>	
<6mmHg>		
<7mmWa>		

See Section 7.1 for the pressure unit conversion factors used by RPM3.

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 **[ENTER]** defines the user unit and returns to the **<Set up unit #>** screen.

The user defined unit can be assigned a user defined label using the UNIT: USER remote command (see Section 4.4.2.).

3.3.3 READRT (READ RATE)

- **PURPOSE**

To turn ON and OFF RPM3's automated, rate of change dependent, reading integration rate feature.

- **PRINCIPLE**

To obtain maximum resolution from RPM3 RPT pressure measurements, an integration time of about 1 second per reading is used. In most situations, maximum precision is needed when pressures are stable so a relatively slow reading rate presents no disadvantage. However, when pressure is changing quickly, more rapid pressure updates are usually more important than obtaining maximum resolution on individual readings. The RPM3 read rate function automatically adjusts pressure measurement integration time depending on the rate of change of pressure. When pressure is changing rapidly, reading rate is increased. When pressure is evolving slowly, reading rate is decreased.

When the automated read rate function is ON, three pressure rate of change dependent read rates are used. The result is three display update rates (see Table 5).

Table 5. READRT - Display Update Rates

PRESSURE RATE OF CHANGE	DISPLAY UPDATE
> 3 % FS/s	≈0.2 s
Between > 0.5 and < 3 % FS/s	≈0.5 s
< 0.5 % FS/s	≈1 s

For situations in which changes in the reading rate are NOT desired, the RPM3 automated read rate function can be turned OFF. In this case, the reading rate is always the high resolution rate of about 1 reading per second.

Auto read rate should always be left ON in normal operation.

- **OPERATION**

To turn the automated read rate function ON or OFF press **[SETUP]** and select **<3ReadRt>**.

The display is:

```
Auto read rate:    H3
1on 2off
```

The cursor is on the current selection.

Selecting **<1on>** activates the automated reading rate and returns to the main run screen. Selecting **<2off>** turns OFF the automated reading rate and returns to the main run screen.

The default RPM3 condition is auto read rate ON.

Auto read rate ON/OFF is NOT range specific. Turning auto read rate ON or OFF in one range turns it ON or OFF for all RPM3 ranges.

3.3.4 STAB (STABILITY)

- **PURPOSE**

To view and/or adjust the stability test that is the ***Ready*** **<*>**/***Not Ready*** (**<↑>** or **<↓>**) criterion for the active RPT and range.

See Section 3.1.5.

❍ PRINCIPLE

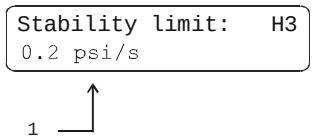
RPM3 continuously monitors the rate of change of pressure measured by the active RPT and range and compares this rate to the stability limit to make a ***Ready*** **<*>**/***Not Ready*** (**<↑>** or **<↓>**) determination (see Section 3.1.5). The stability function allows the stability limit to be adjusted by the user to increase or decrease the stability required for a ***Ready*** **<*>** condition to occur.

The default stability limit is ± 0.005 % FS of the active range.

The stability limit is separate and different from the Rate DISPLAY function (see Section 3.2.7.2) which allows the current rate of change of pressure to be displayed.

❍ OPERATION

To adjust the stability limit press **[SETUP]** and select **<4Stab>**. The display is:



1. Entry field for setting the desired stability limit. Recalls the default stability limit or the last custom stability limit for the active range in the current pressure units for that range.

Edit the desired stability limit setting if desired. Pressing **[ENTER]** activates the stability limit for the range and returns to the main run screen.

The stability setting is range specific. Changes made in one range do NOT affect any other range.

Running an automated test sequence using the SEQUENCE function automatically sets the stability limit based on the characteristics of the device under test. After running a sequence, the stability limit may need to be readjusted (see Section 3.2.11).

3.3.5 LEAK (LEAK CHECK)

❍ PURPOSE

To run an automated leak check routine using RPM3 to measure the total pressure change and average rate of change over a period of time; to edit the leak check time.

❍ PRINCIPLE

The Leak Check function is provided to assist in using RPM3 to measure leaks by measuring pressure rise or decay.

The principle of the leak check function is the measurement of pressure increase or decrease. 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 must have dissipated before a valid leak measurement can be made. In general, a 0.5 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 access the LEAK function press **[SETUP]** and select **<5Leak>**.

The display is:

```
Leak Check        H3
1run 2view
```

Select **<2view>** to view the results of the last leak check executed. Results screen displays **<Data NOT available>** briefly and returns to main run screen if NO leak check data is stored (e.g., if the RPM3 has never run a leak test or a reset has cleared previous leak test results). Pressing **[ENTER]** or **[ESCAPE]** returns to the main run screen.

Leak check is range specific in the sense that the 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 last results. 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.

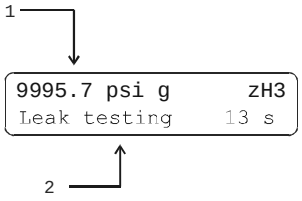
Select **<1run>** to run a leak check and/or to edit the leak check time. The display is:

```
Set leak check time:
15  s
```

1

1. Edit field for leak check time in seconds (1 min, 999 max).

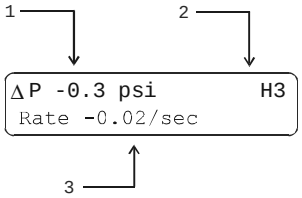
Edit the leak check time if desired. Press **[ENTER]** to run leak test. The display is:



1. Standard main run screen first line.
2. Indication that leak test is running and countdown of time remaining.

Pressing [**ESCAPE]** during the countdown offers a leak check abort option to return to the main run screen or continue leak test. Pressing **[ENTER]** during the leak check countdown causes the countdown to reset.

Once the leak check countdown has completed, the results screen is displayed:



1. Net change in pressure over the leak check time period.
2. Indicator of range in which leak check was run.
3. Average rate of change of pressure over the leak check time period.

Pressing **[ENTER]** from the leak check results screen following execution of a leak check starts a new leak check routine directly without having to go through the leak check menu. Pressing **[ESCAPE]** returns to the main run screen.

Pressing [ENTER] while counting down a leak check or when in leak check results screen starts a new leak check sequence.

3.3.6 SEQ

- **PURPOSE**

To view data collected from running a Sequence and/or to view and edit File Sequence files.

See Section 3.2.11, **PRINCIPLE** for information on the SEQUENCE function.

- **OPERATION**

To access the SEQ menu press **[SETUP]** and select **<6Seq>**. The display is:

```
Sequence:
 1data 2FileSeq
```

Select **<1data>** to view a Sequence data file (see Section 3.3.6.1).

Select **<2FileSeq>** to view or edit a File Sequence file (see Section 3.3.6.2).

3.3.6.1 Sequence, Data

- **PURPOSE**

  To view the data files that are created when a Sequence is run.

- **PRINCIPLE**

  RPM3 supports automated Test Sequences (see Section 3.2.11). When a Sequence is run, the RPM3 pressure measurement accepted by the operator at each point is logged. The logged pressure measurements 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 **<1data>**. In addition, the last ten data files recorded can be viewed anytime by pressing **[SETUP]** and selecting **<6Seq>**, **<1data>**.

  Data File Protocol

  Up to ten data files are buffered, ten at a time, in RPM3 memory. When a new Sequence run is completed, its data file goes to front of the queue and the oldest data file is deleted.

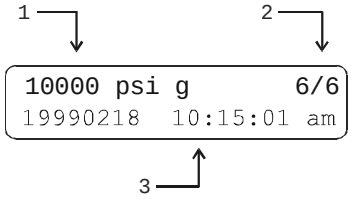
  Data files are identified by a header whose first line is the full scale of the DUT and the number of test points in the Sequence. The second line is the date (YYYYMMDD) and time (HH:MM:SS) at which the last point of the sequence was accepted.

  Following the data file header, each test point is recorded including the pressure reading of the RPM3 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 Sequence.

- **OPERATION**

  To access the Sequence data file viewing function press **[SETUP]** and select **<6Seq>**, **<1data>.**

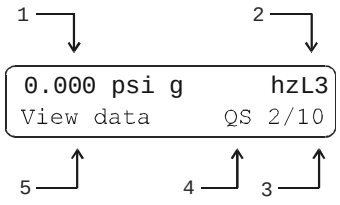
  The first display is the data file header which can be used to toggle through data files:



1. Full scale of the Sequence DUT with pressure unit of measure and measurement mode.
2. Number of test points executed/total number of points in the Sequence.
3. Date and time that the last point in the Sequence was executed.

Press **[+/-]** or **[→]** to scroll through the headers of the other Sequence data files available. RPM3 stores up to ten Sequence 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 Sequence data file you would like to view appears, press **[ENTER]** to view the first point of the identified Sequence.

The display is:



1. RPM3 reading logged for the test point.
2. Head, AutoZ and range indicator (same as in the RPM3 main run screen) (see Section 3.1.2).
3. Number of this test point or target pressure over total number of points in the Sequence.
4. **<QS>** indicating that the Sequence was a Quick Sequence or **<FS>** indicating a File Sequence. This is preceded by **<OT>** if the test point was out of tolerance (definition of out of tolerance is Set point – RPM3 reading > DUT tolerance).
5. Indication that this is a Sequence data file view screen.

Press **[ENTER]** to move to the next data point. Pressing **[←]** or **[→]** allows scrolling backward and forward through the test points. The data file header is between the first point and the last point.

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

Up to ten data files are buffered, ten at a time, in RPM3 memory. When a new Sequence run is completed, its data file goes to front of the queue and the oldest data file is deleted.

3.3.6.2 Sequence, FileSeq

❍ **PURPOSE**

To view and edit File Sequence definition files.

❍ **PRINCIPLE**

RPM3 supports automated Sequences (see Section 3.2.11, **PRINCIPLE**). There are two types of Sequences:

- Quick Sequences in which the DUT and test parameters are entered “on the fly” during the initialization of the test.
- File Sequences in which the DUT and test parameters are stored in a file and retrieved when the file is selected to run a File Sequence.

File Sequence parameters are stored in Sequence definition files. Pressing **[SETUP]** and selecting **<6FileSeq>**, **<2FileSeq>** allows File Sequence definition files to be viewed and edited. Up to 40 File Sequence definition files with up to 21 test points in each file can be created.

A File Sequence definition file defines:

- The identifying number of the File Sequence definition file.
- Pressure measurement mode (gauge or absolute).
- Pressure unit of measure.
- DUT full scale in pressure unit of measure and measurement mode.
- Number of test points or pressure targets to include in the Sequence.
- Numerical value of each test point or pressure target.

See Section 3.2.11, **OPERATION** for information on running a Quick or File Sequence.

See Section 3.3.6.1 for information on viewing the data files that result from running a Sequence.

❍ **OPERATION**

See Section 3.2.11, OPERATION, for information on RUNNING a Quick or File Sequence.

To access the Sequence definition viewing and editing functions press **[SETUP]** and select **<6Seq>**, **<2FileSeq>**. Select **<1view>** to view a Sequence definition file. Select **<2edit>** to edit a Sequence definition file. When **<2edit>** is selected the display is:

```
Select FileSeq #:
1
```

Enter the number (1 - 40) of the FileSeq to be edited.

The display is:

```
Measurement mode:
1absolute 2gauge
```

Select the desired pressure measurement mode for the Sequence (see Section 3.2.4).

The display is:

```
1psi 2MPa 3kPa      FS
4bar 5kcm2
```

Select the desired pressure unit of measure for the Sequence. The unit of measure selection screen is the current **[UNIT]** selection screen (see Section 3.2.3). Select the desired pressure measurement unit for the Sequence.

The display is:

```
DUT full scale?
0.000 psi g       Seq1
```

Enter the full scale pressure of the DUT to be calibrated with this File Sequence. The value entered will be used along with the DUT tolerance to determine RPM3 function settings when the Sequence is run (see Section 3.2.11, **PRINCIPLE**).

The display is:

```
DUT tolerance?
0.00 % FS       Seq1
```

Enter the tolerance (measurement uncertainty, precision or accuracy as desired) in % of full scale pressure of the DUT to be calibrated using this File Sequence. The value entered will be used along with the DUT full scale to determine RPM3 function settings when the Sequence is run (see Section 3.2.11, **PRINCIPLE**).

The display is:

```
Number of targets?
1                 Seq1
```

Enter the total number of pressure points or target pressures to be included in the Sequence. The maximum number of points is 21. If data is to be taken at "zero" pressure, include the "zero" points in the point count.

The display is:

```
Pressure target   N:
0.0000 psi g      Seq1
```

Enter the numerical value of the target pressure point **<N>**. Repeat until all of the points in the Sequence have been defined.

After entering the last target pressure, the display is:

```
Save as FileSeq #:
  1
```

Enter the identifying number under which this Sequence definition file should be saved. A confirmation is required to overwrite and existing sequence.

Press **[ESCAPE]** to abandon the File Sequence file edits.

To create a Sequence File similar to an existing Sequence File, without reentering all the Sequence information, edit an existing Sequence File and at the end of the editing process, save it under a different Sequence File number.

3.4 [SPECIAL] MENU KEY

❍ **PURPOSE**

Pressing **[SPECIAL]** accesses a menu of RPM3 functions and settings that are less commonly or NOT normally used in regular operation. These include:

- **<AutoZ>** - Turn AutoZ ON/OFF, view and edit ZOFFSET values (see Section 3.4.1).
- **<SDS>** - SDS is not used in RPM3 A30000/A6000-AF.
- **<ATM>** - View the current reading of the on-board barometer (see Section 3.4.3).
- **<Remote>** - Set up RPM3 RS-232 (COM) and IEEE-488 (GPIB) interfaces (see Section 3.4.4).
- **<Reset>** - Access and execute a number if reset options (see Section 3.4.5).
- **<Cal>** - View and adjust RPM3 RPT and barometer calibration coefficients (see Sections 5.3, 5.2.2).
- **<Intern>** - View and set screen saver, keypad sounds, time and ID features (see Section 3.4.7).
- **<Level>** - View and change User Level protection of RPM3 functions (see Section 3.4.8).
- **<Log>** - View the RPM3 incident log and run time clock (see Section 3.4.9).

❍ **OPERATION**

To access the SPECIAL menu, press **[SPECIAL]** from the main run screen.

This display is:

```
1AutoZ   2SDS   3ATM
4Remote 5Reset 6Cal ↓
7Intern 8Level  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. Use the [←] and [→] 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.

Select **<1AutoZ>** to turn the AutoZ function ON/OFF and view /edit ZOFFSET (see Section 3.4.1).

<2SDS> is not active as RPM3-30000/A6000 does not include the SDS function.

Select **<3Atm>** to view the current reading of the on-board barometer (see Section 3.4.3).

Select **<4Remote>** to set and adjust RPM3 remote communication interfaces (see Section 3.4.4).

Select **<5Reset>** to use reset functions (see Section 3.4.5).

Select **<6Cal>** to view/edit RPT and barometer calibrations (see Section 3.4.6).

Select **<7Intern>** to change user operating preferences (see Section 3.4.7).

Select **<8Level>** to change the security level (see Section 3.4.8).

Select **<9Log>** to view the incident log and run time clock (see Section 3.4.9).

3.4.1 AutoZ

❍ **PURPOSE**

To manage the AutoZ function for the active RPT and range including turning AutoZ ON/OFF, viewing and editing AutoZ values.


To run AutoZ (rezero the RPT range), use the [AutoZ] direct function key (see Section 3.2.10).

❍ **PRINCIPLE**

How AutoZ Works

The main component of the change over time of the RPM3 RPTs is zero drift or offset, independent of span. Rezeroing RPM3 RPTs relative to a stable reference between recalibrations allows lower measurement uncertainty specifications to be maintained with a longer interval between full recalibrations. The RPM3 autozero function (AutoZ) provides full on-board support for the rezeroing process to simplify its application by the user.

The autozeroing function uses four parameters:

1) **ZSTD:** The value of the autozero reference pressure as indicated by the reference autozero device.

For absolute *RPTs in absolute measurement mode*: The autozero pressure is always atmospheric pressure and the ZSTD value can be supplied either:

- By manual entry.
- From a DHI RPM connected to the RPM3 COM2 port.
- from the Lo RPT (A6000) for the Hi RPT (A30000).

For *gauge RPTs or absolute RPTs in gauge measurement mode*: The autozero pressure is always zero (atmospheric pressure) which is available by definition any time the RPT is vented to atmosphere.

2) **ZCURERR:** The difference between ZSTD and the RPT indication at the autozero pressure ***at some time after the RPT has been calibrated*** (ZCURERR = RPT reading w/out ZOFFSET- ZSTD).

3) **ZNATERR:** The difference between ZSTD and the RPT indication at the autozero pressure ***just after the RPT has been calibrated*** (ZNATERR = RPT reading w/out ZOFFSET - ZSTD). This value, when measured just after RPT calibration, is referred to as the **natural error** at the autozero pressure. Because NO RPT is perfectly linear and ZSTD is NOT perfectly accurate, the disagreement between the RPT reading and ZSTD at the autozero pressure is unlikely to ever be zero (except for gauge RPTs for which the zero point is **forced** at calibration).

4) **ZOFFSET**: ZCURERR corrected for ZNATERR, represents the drift of the RPT relative to the reference (ZOFFSET = ZCURERR - ZNATERR). The active RPT reading, adjusted by ZOFFSET, is the **autozeroed** RPT reading (e.g., the RPT reading corrected for zero drift since it was calibrated). For an absolute RPT used in gauge mode, ZOFFSET also includes the value of atmospheric pressure that is being subtracted to arrive at gauge pressure.

The AutoZ function manages the determination, storage and application of ZNATERR and ZOFFSET individually for each RPM3 range and measurement mode. ZNATERR error is determined at the time of calibration (see Section 5.3.1.2). ZCURRERR and ZOFFSET between calibrations are determined by **running AutoZ** using the **[AutoZ]** direct function key (see Section 3.2.10).

AutoZ On/Off

The AutoZ function can be turned ON and OFF. When AutoZ is ON, ZOFFSET is always applied to the pressure measured by RPM3 and new values of ZOFFSET can be determined by **running AutoZ** using the **[AutoZ]** key. When AutoZ is OFF, ZOFFSET is NOT applied (except for an absolute RPT in gauge mode for which ZOFFSET is the current value of atmospheric pressure which is always subtracted to achieve gauge pressure) and AutoZ cannot be run (see Section 3.4.1.1). In gauge mode, turning AutoZ OFF turns OFF the dynamic compensation for changes in atmospheric pressure (see immediately below).

Gauge Mode with an Absolute RPT, Dynamic Compensation for Atmospheric Pressure

RPM3 supports gauge pressure measurements with an absolute RPT by subtracting the value of atmosphere (tare) from the RPT's absolute measurement to arrive at a gauge value. The appropriate tare value changes with the natural evolution of atmospheric pressure at a given location. For this reason, the value of the tare should be redetermined by running AutoZ (see Section 3.2.10) when the RPT is vented to atmospheric pressure. However, if atmospheric pressure changes significantly between running AutoZ, these changes in atmospheric pressure are NOT eliminated by retaring. To compensate for changes in atmospheric pressure between autozeroing (taring) opportunities, **dynamic atmospheric pressure compensation** is used.

RPM3's on-board barometer measures atmospheric pressure independently from the RPT. Between opportunities to update the tare value by autozeroing, the difference between the on-board barometer reading at the time of the last tare and the current on-board barometer reading is used to compensate the tare value. This difference, designated ATMOFFSET, is subtracted from the tare value. This dynamic atmospheric compensation technique relies only on the resolution and short term stability of the on-board barometer, NOT its absolute accuracy or long term stability. Dynamic compensation for atmospheric pressure, allows gauge measurements with an absolute RPT with an additional uncertainty due to possible changes in atmospheric pressure of only ± 0.00035 psi (2.5 Pa) without requiring an accurate barometric reference.

Recommendations for the Use of the AutoZ Function

The AutoZ function provides a powerful and easy to use tool for improving the measurement uncertainty specifications of an RPM3 and reducing the RPM3 recalibration interval by compensating for zero drift between full recalibrations. The following simple recommendations will help assure that you use this feature to best advantage.

- Always leave AutoZ ON when operating in the gauge measurement mode. The only possible exception is in the case of a malfunction of the on-board barometer.
- Be sure the RPM3 RPT is truly vented to atmosphere and allow at least two minutes for full system stabilization before running AutoZ in or gauge mode.
- Always leave AutoZ ON when operating in the absolute measurement mode if ZNATERR was set properly at calibration and the AutoZ routine using a valid atmospheric reference has been run regularly.
- Execute the run AutoZ routine in absolute mode only when a reference whose measurement uncertainty is known to be significantly lower than that of the RPM3 RPT is available. Keep range ratios in mind when comparing measurement uncertainty. A ± 0.05 % FS barometer has roughly 37 times lower measurement uncertainty than a ± 0.013 % FS 2 000 psi (1 MPa) RPT range because the RPT/barometer range ratio is 10:1. Therefore, a ± 0.05 % barometer is more than adequate to use as an absolute mode AutoZ reference for any range of RPM3 A30000/A6000-AF.

❍ OPERATION

The AutoZ function and values are range AND mode (gauge or absolute) specific.

To access the RPM3 AutoZ function press **[SPECIAL]** and select **<1AutoZ>**. The display is:

```
1off  2view          H3
3edit
```

The menu applies to the currently active range and measurement mode.

Select **<1off> (or <1on>)** to change the AutoZ status for the active range and measurement mode from ON to OFF or vice-versa (see Section 3.4.1.1).

Selecting **<2view>** allows the current value of ZOFFSET for the active range and measurement mode to be viewed.

Selecting **<3edit>** allows the current value of ZOFFSET for the active range and measurement mode to be edited.

3.4.1.1 AUTOZ ON/OFF

To turn AutoZ ON/OFF for the current range and measurement mode, press **[SPECIAL]** and select **<1AutoZ>**.

If AutoZ is OFF for the current range and measurement mode, **<1on>** is displayed in the menu accessed by pressing **[SPECIAL]** and selecting **<1AutoZ>**. Select **<1on>** to turn AutoZ ON and return to the main run screen.

If AutoZ is ON for the current range and measurement mode, **<1off>** is displayed in the menu accessed by pressing **[SPECIAL]** and selecting **<1AutoZ>**. Select **<1off>** to turn AutoZ OFF and return to the main run screen.

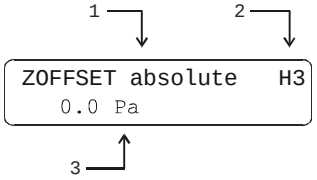
AutoZ ON is indicated by a <z> displaying in the main run screen, top line, third character from the right. When AutoZ is OFF, the character is blank.

In absolute mode, when AutoZ is OFF, the [AutoZ] key is disabled and ZOFFSET is NOT applied.

In gauge mode, when AutoZ is OFF, the [AutoZ] key is disabled and "dynamic compensation for atmospheric pressure" is OFF. ZOFFSET is still applied to tare out atmospheric pressure.

3.4.1.2 VIEW AUTOZ

To view the current ZOFFSET for the active range and measurement mode press **[SPECIAL]** and select **<1AutoZ>**, **<2view>**. The display is:



1. Current measurement mode.
2. Active range.
3. Display field of current value of ZOFFSET.

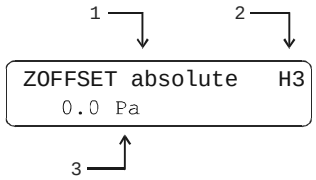
ZOFFSET should be zero in absolute mode when the RPM3 is new or has just been calibrated. ZOFFSET should be roughly equal to atmospheric pressure in gauge mode.

The value of ZOFFSET is always displayed and entered in Pascal (Pa) regardless of the current RPM3 measurement unit as RPM3's internal operations are in Pa.

3.4.1.3 EDIT AutoZ

⚠ The edit AutoZ function should be used with caution as entering inappropriate values and turning ON AutoZ may result in incorrect autozeroing and out of tolerance measurements. In normal operation, the value of ZOFFSET should be changed using the run AutoZ function (see Section 3.2.10).

To edit ZOFFSET for the active range and measurement mode press **[SPECIAL]** and select **<1AutoZ>**, **<3edit>**. The display is:



1. Current measurement mode.
2. Active range.
3. Edit field for value of ZOFFSET.

The value of ZOFFSET is always displayed and entered in Pascal (Pa) regardless of the current RPM3 measurement unit. In gauge mode, the value of ZOFFSET is approximately atmospheric pressure.

3.4.2 SDS

- **PURPOSE**

SDS is not used in RPM3 A30000/A6000-AF.

3.4.3 ATM

- **PURPOSE**

To view the value of atmospheric pressure as measured by the on-board barometer.

- **PRINCIPLE**

RPM3 has an independent on-board barometer connected to the ATM port on the RPM3 rear panel. The atmospheric pressure measurements made by the on-board barometer are only used for dynamic compensation of atmospheric pressure in gauge mode (see Section 3.4.1).

See Sections 1.2.2.2 and 5.2.2.

The on-board barometer is used only for measuring changes in atmospheric pressure over short periods of time in gauge measurement mode. RPM3 measurement uncertainty does not depend on the absolute measurement uncertainty of the on-board barometer, only on its resolution and short term repeatability (see Section 3.4.1, Gauge Mode with an Absolute RPT, Dynamic Compensation for Atmospheric Pressure).

❍ **OPERATION**

To view the current reading of the on-board barometer press **[SPECIAL]** and select **<4Internal>**, **<7Atm>**. The display is in the current pressure units and current resolution setting of the active RPM3 range.

3.4.4 REMOTE

❍ **PURPOSE**

To configure the RPM3 COM1, COM2 and IEEE-488 (GPIB) communication ports. To test COM1 and COM2 communications.

❍ **PRINCIPLE**

The RPM3 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 Chapter 4), and COM2 is reserved for communicating with an external device (e.g., a multimeter, RPM, etc.). These ports can be set up from the RPM3 front panel.

A self- test is supplied for RS-232 communications. The self- test allows verification that the RPM3 RS-232 ports (COM1 and COM2) are operating properly and that a valid interface cable is being used. The test has two steps. In the first, COM1 sends a message to COM2 and in the second COM2 sends a message to COM1. In each step, RPM3 checks the message received at the receiving COM port. If the receiving COM port times out or receives an incorrect message, that step of the test fails.

❍ **OPERATION**

To access the port configurations press **[SPECIAL]** and select **<4Remote>**. Select **<1COM1>**, **<2COM2>**, or **<3IEEE-488>** to view and edit that port's settings. Press **[SPECIAL]** and select **<4Remote>**, **<4RS232test** to access the RS-232 self test.

1) COM1 and 2COM2

The COMx ports can be set for the specific settings required by the user. These settings are baud, parity, length and stop bit. The available options are:

Baud: 300, 600, 1 200, 2 400, 4 800, 9 600, 19 200
Parity: NONE, ODD or EVEN
Length: 7 or 8
Stop Bit: 1 or 2

The default is **2 400, E, 7,1** for COM1 and COM2.

The RPM3 appends a carriage return and a line feed to all messages that are sent out of the COM1 port to the host. It looks for a carriage return to terminate incoming messages and ignores line feeds. The user MUST wait for a reply to each message sent to the RPM3 before sending another message to it.

2) IEEE-488

The IEEE-488 port address can be specified from 1 to 31.

The RPM3 sends a line feed and asserts the EOI line at the end of all transmitted messages. It looks for a line feed and/or assertion of the EOI line to terminate incoming messages.

3) RS-232 Self-Test

The RS-232 Self Test is provided to check the RPM3 COM ports and the interface cable independently of an external device or computer. If you are having difficulty communicating with RPM3 by RS-232 from a computer, the RS-232 self test can help establish that the RPM3 COM1 port you are trying to communicate with and the interface cable you are using are good.

To run a self test of the RS-232 ports (COM1 and COM2) press **[SPECIAL]** and select **<4Remote>**, **<4RS232test>**.

The display prompts you to connect COM1 to COM2 using the appropriate cable (see Section 4.2.1).

Once the connection has been made, press **[ENTER]** 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, **<RPM3 RS232 test has PASSED>**. If a test fails, execution is suspended until **[ENTER]** is pressed.

The RPM3 RS-232 test can fail for three reasons: 1) The RS-232 cable being used is incorrect (see Section 4.2.1 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 3.4.4 to set the COM ports); 3) COM1 or COM2 is defective. The reason for failed communications is almost always a cable or RS-232 interface settings problem. Be sure that these are correct before concluding that a COM port is defective.

3.4.5 RESET

❍ **PURPOSE**

To reset various RPM3 settings to default or factory values.

RPM3 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 set up, and should be used only to restore the RPM3 to a known state. RPM3 will go through its reboot routine after any type of reset is selected.

❍ **OPERATION**

To access the reset choices, select **<5Reset>** under the **[SPECIAL]** menu. The display is:

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

3.4.5.1 RESET - SETS

❍ **PURPOSE**

Clears all of the normal user settings for pressure measurements. This includes:

- Head settings set to disabled with **<cm>** as the height unit and **<N2>** as the medium (see Sections 3.2.8 and 3.3.1).
- Sets the upper limits (UL) to factory defaults (see Section 3.2.5).
- Set the stability limits to ± 0.005 % FS (see Section 3.3.4).
- Sets the auto zero ATMSTART measurement to 101.325 kPaa (see Section 3.4.1).
- Enables the auto read rate feature (see Section 3.2.3).
- Sets the resolution to factory defaults (see Section 3.2.6).
- Sets the pressure units to **<psi>** (see Section 3.3.3).
- Sets the measurement mode to **<absolute>** for ranges on absolute RPTs and **<gauge>** for ranges on gauge RPTs (see Section 3.2.4).
- Enables auto zero for all ranges and measurement modes (see Section 3.2.10).
- Sets the range to **<H3>** (see Section 3.2.2).
- Sets the beeper on valid key entry to **<mid>** (see Section 3.4.7.2).
- Sets the Screen saver period to 10 minutes (see Section 3.4.7.1).
- Clears the previous leak check results (see Section 3.3.5).

3.4.5.2 Reset - units

❍ **PURPOSE**

Resets unit and mode settings to defaults:

- Sets the six pressure unit selectable from **[UNIT]** to defaults (see Section 3.2.3).
- Sets the reference temperature for inches of water to 4 °C.
- Sets the user unit coefficient to 1.00/Pa (see Section 3.3.2).
- Sets the active pressure unit to psi for all ranges (see Section 3.2.3).
- Sets the active measurement mode to default (see Section 3.2.4).

3.4.5.3 Reset - seq

❍ **PURPOSE**

Resets all Sequence related values (see Section 3.2.11):

- Clears all File Sequence files (see Section 3.3.6.2).
- Resets the Quick Sequence settings (see Section 3.2.11.1) to default values.
- Clears all Sequence data files (see Section 3.3.6.2).

3.4.5.4 Reset - cal

❍ **PURPOSE**

⚠ Use caution with this reset as critical calibration data may be deleted.

This clears the user calibrations information, which affects the calibration of the unit:

- Clears the user defined RPT calibration coefficients. PA/PM to **0** (zero) and **1** (see Section 5.3.1.1).
- Clears the user defined barometer calibration. Sets PA/PM to **0** (zero) and **1** (see Section 5.2.2).
- Clears the ZNATERR and ZOFFSET values to **0** (zero) (see Section 3.2.10).

3.4.5.5 Reset - all

❍ **PURPOSE**

To return RPM3 to the as delivered original factory condition.

- Performs the functions of the Sets, Units, Seq, Cal resets (see Section 3.4.5).
- Resets the user security level to low (see Section 3.4.8).
- Resets communications port settings: COM1 and COM2 set to 2400,E,7,1 using **<CR>** and **<LF>** as the terminating characters. The IEEE-488 interface address is set to **<10>** (see Section 3.4.4).

3.4.6 CAL

To calibrate the RPM3 Hi and Lo RPTs and adjust the on-board barometer. These functions are considered part of RPM3 maintenance and are therefore covered in the maintenance section of this manual (see Sections 5.3 and 5.2.2).

3.4.7 INTERN

❍ **PURPOSE**

To access a menu of RPM3 internal operating preferences and functions.

- Select **<ScrSvr>** - View and change the screen saver function (see Section 3.4.7.1).
- Select **<sounds>** - View and change valid entry keypad sound settings (see Section 3.4.7.2).
- Select **<time>** - View and edit the internal time and date settings (see Section 3.4.7.3).
- Select **<ID> -** View the RPM3 serial number, view and edit the ID number (see Section 3.4.7.4).

❍ **OPERATION**

To access the Intern menu press **[SPECIAL]**, and select **<7Intern>**. The display is:

```
1ScrSav 2sound 3time
4ID
```

Select **<1ScrSvr>** to access the screen saver activation time menu (see Section 3.4.7.1).

Select **<2sound>** to access the keypad sounds choices (see Section 3.4.7.2).

Select **<3time>** to access the time and date view/edit (see Section 3.4.7.3).

Select **<4ID>** to access the S/N view and the ID view/edit (see Section 3.4.7.4).

3.4.7.1 ScrSav

- **PURPOSE**

  To adjust the RPM3 screen saver function.

- **PRINCIPLE**

  RPM3 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. This function is factory set to activate after 10 minutes of inactivity but can be adjusted by the user.

- **OPERATION**

  To access the screen saver function press **[SPECIAL]** and select **<7Intern>**, **<1ScrSav>**. Edit the time in minutes, after which screen saver will turn ON.

  Setting screen saver time to zero eliminates the screen saver function so that the display remains permanently at full brightness. The display may also be completed suppressed using the soft [ON/OFF] key (see Section 3.1.4).

3.4.7.2 Sound

- **PURPOSE**

  To adjust or suppress the RPM3 keypad valid key press sounds.

- **PRINCIPLE**

  RPM3 provides audible feedback by a brief **beep** when a valid key press is executed. The 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 (see Section 3.1.3).

- **OPERATION**

  To access the keypad sound adjustment function press **[SPECIAL]** and select **<7Intern>**, **<2sound>**.

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

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

  The sound function only affects the valid key press tone.

3.4.7.3 Time

- **PURPOSE**

  To view and edit the RPM3 internal time and date settings.

- **OPERATION**

  To access the time function press **[SPECIAL]** and select **<7Intern>**, **<3time>**. The display is:

  ```
  Edit:  1time 2date
  08:32:11 am 20000315
  ```

  Select **<1time>** to edit the time. Edit hours, then minutes, then am/pm by pressing **[ENTER]** at each entry. Seconds go to zero when minutes are entered.

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

  The RPM3 date and time are set to United States Mountain Standard Time in the final test and inspection process at the factory. If desired, used the date function to set your local time and date.

3.4.7.4 ID

- **PURPOSE**

  To view the RPM3 serial number (SN) and to view or edit the ID number.

- **PRINCIPLE**

  RPM3 has a factory programmed serial number that is included on the product label on the bottom of the case and can be viewed in the ID menu.

  RPM3 also allows the user to store a unique alpha numeric ID number. This feature is frequently used to assign an organizational control ID such as an asset number, tool number, standard number, etc. The ID function allows the ID number to be viewed and edited.

- **OPERATION**

  To access the ID function press **[SPECIAL]** and select **<7Intern>**, **<4Keypad>**. Select **<1view>** to view the current ID and serial number (SN).

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

The ID has twelve characters. When the edit screen is entered, the cursor is on the first character. Numerical values can be entered directly from the keypad. In addition, the **[←]** and **[→]** 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. Press **[ENTER]** to select a character and move to the next character.

When a character is selected the cursor moves to the next character. To leave a blank character, **[ENTER]** with the field for that character blank. Use this for the trailing characters if the ID being entered is less than 12 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 also be set remotely from a computer which is quite a bit more convenient than writing it from the keyboard (see Section 4.4.2.8). ID cannot be cleared or reset by user commands.

3.4.8 LEVEL

- **PURPOSE**

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

- **PRINCIPLE**

RPM3's front panel user interface provides the means to access all RPM3 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 or damage to the system. For these reasons, depending upon the application in which RPM3 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 This level of security is designed to protect the specific metrological information and system diagnostic and maintenance functions of the system. It is intended for an advanced operator performing many different tasks.

Medium This level of security is designed to protect specific metrological information in the system and to assure that the RPM3 is operated using consistent operational parameters.

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

RPM3 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 Section 3.4.8).

The high security level disables remote communications and returns an error message to all remote commands. All other security levels have NO effect on remote communications.

The security levels are structured to support typical levels of operation and to prevent execution of the X'd functions as shown in Table 6.

Table 6. Functions - Security Levels

FUNCTION	LOW	MEDIUM	HIGH
[RANGE]			X
[UNIT]			X
[MODE]			X
[UPPER LIMIT] (change setting)			X
[RES]			X
[RES] (change setting)		X	X
[DISPLAY]			X
[HEAD]			X
[SDS]			X
[AutoZ] (in absolute mode)		X	X
[ENTER], <1QukSeq> or <2FileSeq>)			X
[ENTER], <1QukSeq> or <2FileSeq> (make changes)		X	X
[SETUP], **<1Head>**		X	X
[SETUP], **<2PresU>**		X	X
[SETUP], **<3ReadRt>** (change status)		X	X
[SETUP], **<4Stab>** (change setting)		X	X
[SETUP], <6Seq>		X	X
[SPECIAL], **<1AutoZ>**			X
[SPECIAL], **<1AutoZ>**, **<1on/OFF>**		X	X
[SPECIAL], **<1AutoZ>**, **<3edit>**		X	X
[SPECIAL], **<2SDS>**		X	X
[SPECIAL], **<3Atm>**			X
[SPECIAL], **<4Remote>** (access)			X
[SPECIAL], **<4Remote>** (make changes)		X	X
[SPECIAL], **<5Reset>**		X	X

Table 6. Functions - Security Levels (Continued)

FUNCTION	LOW	MEDIUM	HIGH
[SPECIAL], **<5Reset>**, **<3com>**	X	X	X
[SPECIAL], **<5Reset>**, **<4cal>**	X	X	X
[SPECIAL], **<5Reset>**, **<5all>**	X	X	X
[SPECIAL], **<6Cal>**		X	X
[SPECIAL], **<6Cal>**, **<1RPT>**, **<2edit>**	X	X	X
[SPECIAL], **<6Cal>**, **<1RPT>**, **<3run ZNATERR>**	X	X	X
[SPECIAL], **<6Cal>**, **<2barometer>**, **<2edit>**	X	X	X
[SPECIAL], **<7Intern>**			X
[SPECIAL], **<7Intern>**, **<3Time>** (make changes)	X	X	X
[SPECIAL], **<7Intern>**, **<4ID>**, **<2edit>**	X	X	X
[SPECIAL], **<9Log>** (view)			X
[SPECIAL], **<9Log>** (clear log)	X	X	X
[SPECIAL], **<9Log>** (clear run time)	X	X	X
Remote communications disabled			X

❍ OPERATION

RPM3 is delivered with NO active password so 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 User Level function, press **[SPECIAL]** and select **<8Level>**. If NO password yet exists or if the correct password has been entered.

The display is:

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

Selecting **<1change>** user level brings up the restriction menu. The display is:

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

You can then select the current restriction level, or **[ESCAPE]** back to the main run screen.

Selecting **<2edit password>** displays the user password and allows it to be edited. Passwords can be up to six numbers in length and cannot start with a zero.

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

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

If **0** (zero) is entered, then the password is made inactive and a password will NOT be required to access the user level menu. This is the factory default with a security level of **<2low>.**

If there is an active password, the RPM3 password entry screen appears. The user must enter the user defined password or the factory **secondary** password to proceed any further:

```
RPM3 SN   nnnn-xx
Password: pppppp
```

The first field ***<nnnn>*** is the serial number of the RPM3, followed by a second field ***<xx>*** that represents the number of times that a **secondary** password has been used. This second field increments each time a **secondary** password is used. The third field, ***<pppppp>***, is for normal password entry.

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. The factory secondary password is different for all RPM3's and changes each time it is used.

3.4.9 LOG

- **PURPOSE**

To view and/or clear the RPM3 event log; to view the RPM3 run-time clock.

- **PRINCIPLE**

RPM3 records to a log each time one of the following events occurs:

- Pmax! is exceeded (see Section 3.2.5.1).
- A memory fault occurs.

The log may be viewed. The information can be useful in diagnosing an overpressure event. RPM3 accumulates power-on time.

RPM3 also maintains a run-time clock. The clock accumulates time that the RPM3 is under line power. Soft OFF time counts as run time (see Section 3.1.4).

- **OPERATION**

To view the event log or run-time clock press **[SPECIAL]** and select **<9Log>**.

Select **<1log>** to view the event log.

The oldest logged event appears. Pressing **[ENTER]** steps through the logged events from the oldest to the most recent and ending with the option to clear the log. Select **<YES>** or **<NO>**. If NO events have been logged, **<End of log>** displays.

RPM3 supports a duplicate factory log that cannot be viewed or cleared by the user.

Select **<2runtime>** to view the run-time clock.

The total accumulated run-time is displayed. The unit of measure is hours with 0.1 hour resolution.

4. REMOTE OPERATION

4.1 OVERVIEW

Most of the RPM3 front panel functions can also be executed by commands from a remote computer. The host computer can communicate to the RPM3 using the RPM3 COM1 RS-232 port or the IEEE-488 port.

4.2 INTERFACING

Sending a message to the RPM3 places it in remote mode. The remote indicator to the bottom right of the display lights when the RPM3 is in remote mode. It will also flicker when a message is received. The menus usually accessed from the front panel are locked out while in remote. **[ESCAPE]** returns the RPM3 to local operation unless the **SYSTEM:KLOCL ON** command was used to lock out keypad operation.

4.2.1 RS-232 INTERFACE

4.2.1.1 COM1

The RPM3 COM1 RS-232 interface is located on the rear panel. It is a 9-pin female DB-9F connector configured as a DCE device. Data is transmitted out of RPM3 using pin 2 and is received on pin 3. This allows a normal **pin-to-pin** DB-9M to DB-9F RS-232 cable to be used to connect to a DTE host. Handshaking is NOT required or supported.

Table 7. RPM3 COM1 DB-9F Pin Designations

PIN #	FUNCTION	DESCRIPTION
2	TxD	This pin transmits serial data from the RPM3 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.

Table 8. IBM PC/XT DB-9F, DB-9M Connections

IBM PC/XT DB-9F CONNECTIONS		IBM PC/XT DB-9M TO RPM3 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 COM2

The RPM3 COM2 RS-232 interface is located on the rear panel. It is a 9-pin male DB-9M connector configured as a DTE device. Data is transmitted out of the RPM3 using pin 3 and is received on pin 2. This allows a normal **pin-to-pin** DB-9F to DB-9M RS-232 cable to be used to connect to a DCE slave. Handshaking is NOT required or supported. COM2 can be used to allow communication to other RPM3s by connecting the Host port to the first RPM3's COM1 port, and then connecting COM1 of the second RPM3 to the COM2 port of the first RPM3. This method can be used to chain multiple RPM3s together using the **SYS:COMM:THRU** command.

Table 9. RPM3 COM2 DB-9M Pin Designations

PIN #	FUNCTION	DESCRIPTION
2	RxD	This pin accepts serial data from another RPM3 or another device.
3	TxD	This pin transmits serial data from the RPM3 to another RPM3 or another device.
5	Grn	This pin is the common return for the TxD and RxD signals.

4.2.2 IEEE-488 (GPIB)

The RPM3 IEEE-488 interface is located on the rear panel. 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. The RPM3 will hold off release of the NRFD handshake line until it can service and empty the receive buffer. This keeps the buffer from overflowing.

4.3 REMOTE COMMAND SYNTAX AND STYLE

4.3.1 LOCAL AND REMOTE SETTING

When in local mode, each of the three ranges of each of the (up to) two RPTs has its own settings (unit, mode, resolution, stability) (see Section 3.2.2) that are set range specifically and remain with the range. When ranges are changed, the settings change to those that were last set in that range. Settings change as ranges are changed. In remote, each RPT is treated as a channel and the settings are common to all the ranges of one RPT. The only range specific settings are calibration and AutoZ settings. When you change ranges on one RPT the settings remain the same. Changes made to the settings while in remote mode will remain when operation is switched back to local mode.

4.3.2 COMMAND SYNTAX

The remote command set for the RPM3 uses SCPI, 1992.0 (Standard Communications Protocol for Instruments) syntax and format. Commands are grouped into subsystems that contain related keywords in a hierarchical structure in a command **tree**. These keywords are strung together to create a command. A colon **(:)** is a header separator that separates each keyword as you move down each level or **node** of the command **tree**. The beginning of a command message does NOT require a colon **(:)**, but one is allowed.

Each keyword has a long form and a short form. The short form is always shown in uppercase, while the remaining lower case letters indicate the long form. Either long or short form use is allowed and the RPM3 is case insensitive to these commands. Brackets **([ ])** are used to identify optional keywords that are the default keyword for a particular node.

4.3.3 QUERIES AND REPLIES

Many commands require additional parameters, some require NO additional parameters, and many also have a query form. Some commands are only queries. A question mark **(?)** immediately following a command specifies a query. Commands for the COM1 port and the IEEE-488 port use the same style and syntax, but differ slightly in their responses from RPM3. When using the IEEE-488 port, only queries generate a reply from the RPM3. When using the COM1 port, every command generates a reply, and the user must wait for the reply before sending another command. For COM1 non-query commands, the RPM3 replies with an **<OK>** or **<ERROR>**. This maintains sync between the host and the RPM3.

4.3.4 MULTIPLE COMMANDS

Multiple commands may be sent within a single message to the RPM3 if desired. These commands must be separated by a semicolon **(;)** and the total message length cannot exceed 80 characters. Each command must be preceded by a colon **(:)** (unless you wish to reference the previous command node (discussed later)). Query replies to such messages are returned in a single reply message with each reply separated by a semicolon **(;)**. If you send multiple commands in a single message to the COM1 port, each query generates a reply and each non-query command generates an **<OK>** response, with a semicolon **(;)** separating each reply within the reply message.

Example:

PC	→	RPM3 (GPIB):	“SYST:VER?;:DISP:BLAN 10;:ABOR”
RPM3	→	PC (GPIB):	“1992.2”
PC	→	RPM3 (COM1):	“SYST:VER?;:DISP:BLAN 10;:ABOR”
RPM3	→	PC (COM1):	“1992.2;OK;OK”

When using multiple commands, you may reference the previous command level by NOT preceding the command with a colon **(:).** RPM3 interprets the command starting at the command level defined by the preceding command in the message. This level must be established by the first command of a message.

Example:

To set the RPM3 COM1 port to 2 400 baud, even parity, 7 bit word length and one stop bit, you could send:

"COMM:SERIAL:TRAN:BAUD 2400;PAR EVEN;BITS 7;STOP 1"

Because this message actually contains four commands, the reply from the RPM3 if using the RPM3 COM1 port would be:

"OK;OK;OK;OK"

4.3.5 COMMAND PARAMETERS

Command parameters can be required or optional. There must be at least one space preceding the first parameter. Additional parameters are preceded by a comma **(,)**. Parameters which depend on a unit of measure (e.g., pressure or head height) are interpreted in the current default unit unless a unit suffix follows the parameter separated by at least a space. Where indicated, specific keywords can be used in place of parameters for MIN, MAX and DEFAULT parameter values that are determined by the RPM3. Brackets (**[ ]**) are used to identify optional parameters. In some cases, queries may allow parameters.

4.3.6 SUFFIXES

In some cases, a numeric suffix can follow a keyword to differentiate between the Hi RPT and the Lo RPT. **1** accesses the Hi RPT, and is the assumed RPT if a suffix is NOT given. **2** accesses the Lo RPT (if present). The command descriptions indicate an optional suffix by the use of [*n*] where *n* can be **1** or **2**.

4.3.7 PROGRAMMING TIPS

4.3.7.1 SCPI AND IEEE-488.2

The RPM3 uses a remote command syntax and format based on the SCPI (Standard Commands for Programmable Instruments) language (see Section 4.3). SCPI has been adopted because it provides the benefits of a standardized logical structure and common command syntax for users of programmable test instruments. Those that have developed programs for other SCPI compliant instruments will find the RPM3 command set familiar and easy to understand. First time SCPI users need to take some time to become familiar with the hierarchical SCPI commands. At first, these will seem complex, especially when compared with the simple linear command set used with older **DHI** products. In fact, they offer greater versatility and commonality with other programmable test instruments.

RPM3 also supports IEEE-488.2 common and status commands.

LabVIEW® drivers are available for the RPM3. These drivers allow users of the National Instruments' LabVIEW® environment to create systems that include one or more RPM3s using LabVIEW® virtual instruments instead of using the remote commands directly. The RPM3 LabVIEW® drivers are an abstraction of the remote commands into a consistent set of common and specific instrument functions. The drivers can be obtained at NO charge from the DHI web site www.dhinstruments.com.

4.3.7.2 PROGRAMMING TECHNIQUE

The following six step procedure can be used to create a program which acquires pressure data over the RPM3's remote interface.

❶ Establish communications with the RPM3 via RS-232 or IEEE488:

RS-232 (COM1): To establish serial communications, the PC and RPM3 must be configured to have matching baud rates, parity, data bits, and stop bits. The PC's COM port must be connected to the RPM3's COM1 port using a straight-through DB9M-to-DB9F cable (see Section 4.2.1). The RPM3 COM1 port can be configured locally from the front panel by pressing **[SPECIAL]** and selecting **<4Remote>** (see Section 3.4.4).

RPM3 supports an independent RS-232 self test to verify that the RPM3 RS-232 ports are operating correctly and the interface cable being used is valid. Use this self test to trouble sheet if you are having difficulty establishing communications over RPM3 COM1 (see Section 3.4.4).

IEEE-488: To establish IEEE-488 communications, the PC must have an IEEE-488 card and the RPM3 must be correctly addressed (see Section 4.2.2). The RPM3's IEEE-488 address can be set locally from the front panel by pressing **[SPECIAL]** and selecting **<4Remote>** (see Section 3.4.4). An IEEE-488 interface cable must be used.

Send the command **"*IDN?"** and read the response (see Section 4.4.2.1). Scan the response for the string **"RPM3"**. This verifies that communications have been successfully established and that the instrument connected is actually an RPM3.

When in high security user level (see Section 3.4.8), remote commands are locked out. This mode is set from the front panel. Any attempt to communicate remotely when locked out by the user level results in an error. The error query remote command (see Section 4.4.2.8) is the only remote command that will function when remote commands are locked out by the user level.

❷ Set the pressure units for the desired RPT:

Send the command **"UNIT[n] *PRESUNIT*"** (where ***n*** equals **1** to select the Hi RPT and **2** to select the Lo RPT). For example, to set the measurement units on the lo RPT to **psi**, send the command **"UNIT:PRESsure2 PSI"**. Note that the keyword **"PRESsure"** is optional for this command, so the command **"UNIT2 PSI"** would have the same effect (see Section 4.4.2.9).

❸ Set the pressure measurement mode for the desired RPT:

Send the command **"UNIT[n]:*PRESMODE*"** (where ***n*** equals **1** to select the Hi RPT and **2** to select the Lo RPT. Where *PRESMODE* equals **A** to select absolute and **G** to select gauge. For example, to set the measurement mode on the Lo RPT to **gauge**, send the command **"UNIT:PRESsure:MODE G"** (see Section 4.4.2.9).

❹ Start and get a new pressure measurement:

Send the command **"MEASure[n]? Lo|Mid|Hi"** (where ***n*** equals **1** to select the Hi RPT and **2** to select the Lo RPT). This command allows the RPT range and resolution for a pressure measurement to be defined. For example, to read the pressure using Range 2 (the Mid range) of the Lo RPT send the command **"MEASure2:PRESsure? MID"**. Note that the resolution is an optional parameter and was NOT sent in this example (see Section 4.4.2.2).

❺ Obtain information related to the last measurement cycle:

Use the **"FETCh[n]?"** command. The **"FETCh[n]?"** command does NOT initiate a new pressure reading cycle and therefore can be used to quickly obtain previously initiated pressure readings. For example, to read the pressure rate of change that was associated with the measurement cycle of Step ❹ above, send the command **"FETCh2:Rate?"** (see Section 4.4.2.).

❻ Read the pressure ***Ready*** status associated with the last measurement cycle:

Use the **"CALCulate:STABility[n]:LIMIT:FAIL?".** This command allows the ***Ready/Not Ready*** status of the previous pressure measurement to be determined (see Section 3.1.2). For example, send the command **"CALCulate:STABility2:LIMIT:FAIL?"** to read the stability dependent r ***Ready/Not Ready*** value associated with the reading made in Step ❹ above (**<0>** if ***Ready***, **<1>** if ***Not Ready***) (see Section 4.4.2.3).

The preceding procedure utilizing the **"MEASure"** command is recommended for single pressure readings. This command is simple to use since it allows the selection of RPT, range and resolution, initiates a pressure measurement cycle and reads the result all in a single command. The drawback of combining all these functions in a single command is that it takes several seconds to execute and includes functions that are NOT necessary when repeating measurements. The preferred method when taking repeated readings from a specific RPT and range is to first use the **"CONFigure"** command to set the range and resolution and then to repeatedly use the **"READ"** command to start and get the pressure measurements on the current range. The following commands could be used to perform the same test as described above instead of using the measure command**: "CONFigure2 Mid"** followed by **"READ2?"** (see Section 4.4.2.2).

In fact, if RPM3 is already set up as needed for the measurements to be made, the only command that is needed to collect data is the **READ[n]?** command. For the test above, the command to send to read pressure from the current range is **"READ2?"**.

Table 10. Quick Programming Tips

IN ORDER TO:	USE COMMAND	NOTES
Set the pressure units.	UNIT[n] *PRESUNIT*	Use UNIT:MODE to set gauge or absolute measurement mode.
Read the pressure using the current range of the specified RPT, in current measurement units and resolution.	READ[n]?]	Remember to turn SDS OFF, if present, prior to taking a reading.
Turn SDS OFF or ON for the specified RPT.	SDS[n] OFF|ON	SDS is not present on RPM3 A30000/A6000-AF.
Set the RPT and range and read the pressure.	CONF[n] Lo|Mid|Hi followed by READ1[n]?	As an alternate, Meas[n]? Lo|Mid|Hi also works but contains redundant functions when used repeatedly on the same range.
Determine the pressure stability rate dependent ***Ready/Not Ready*** condition for a pressure reading.	CALC:STAB[n]:LIMIT:FAIL?	Returns **<0>** when previous reading was ***Ready*** (within stability criterion).
Read the pressure rate of change associated with a prior pressure reading.	FETC[n]:RATE?	Fetch can also be used to reread the last pressure.
Set the head height.	CALC:HEAD:HEIGht *HEIGHT*	Send UNIT:HEIGht IN|CM prior to setting the head height.
Turn ON AutoZ for the specified RPT.	CAL[n]:ZERO:STATe ON	This enables AutoZ on the current range. The setting applies to other ranges on the same RPT when the range is changed.
Run AutoZ on a specified RPT and range to specify the value of ZSTD and determine a new ZOFFSET for a given range and measurement mode.	CAL[n]:ZERO:AUTO [*ONCE,ZSTD*]	Prior to executing this command the range must be selected using the CONF command and the measurement mode must be selected using the UNIT:MODE command.
Check if the upper limit was exceeded.	SENS[n]:PROT:TRIP?	SENS[n]:PROT:CLE is used to clear this flag.
See if any errors have occurred.	SYST:ERR?	
Have the RPM3 screen correspond to a specific RPT and range.	CONF[n]:*RANGE*	This command affects the display. READ and MEAS commands do NOT.

4.4 COMMANDS

Table 11. Command Summary

Items inside brackets [ ] are optional. A '|' character signifies a logical 'or'.
[n] specifies the RPT channel ('1' Hi, '2' Lo. Default is '1').
[nn] specifies the optional RPT range from 1 to 3 (default is '1').

COMMAND	PARAMETERS	NOTES
*CLS	Command only	Clears the queues and status registers
*ESE	0..255	Event status enable register
*ESR?	Query only	Event status register
*IDN?	Query only	Identify software version and hardware
*OPC	None	Operation complete
*OPT?	Query only	Operation identification
*RSE	0..255	RPT ready status enable register
*RSR?	Query only	RPT ready status event register
*RST	Command only	Reset to default settings
*SRE	0..255	Service request register
*STB?	0..255	Status byte
*TST?	Query only	System self test results
:ABORt		Halt current measurement cycle
:CALCulate		
:HEAD		
:HEIGht	HeadHeight	Height difference of RPM3 and DUT
:MEDium	N2|He|Air|Oil|H20|User	The pressure medium
:DENSity	Density	The user defined pressure medium density
:STABility[*n*]		
:LIMIT	Stability	Stability limit
:FAIL?	Query only	Stability limit Ready status
:CALibration[*n*]		
:AMBient		
[:PRESsure]	Adder, Multiplier	Barometer PA/PM
:DATE	YYYY,MM,DD	Barometer calibration date
:RPT[*nn*]	Adder, Multiplier	RPT range PA/PM
:DATE	YYYY,MM,DD	RPT range calibration date
:ZERO		
:STATe	0 |1 |OFF|ON	AutoZ on/OFF
:AUTO	ONCE	Run AutoZ
:OFFSet[*nn*]		
:ABSolute	Absolute ZOFFSET	ZOFFSET for absolute mode
:GAUGe	Gauge ZOFFSET	ZOFFSET for gauge mode
:NATerr[*nn*]	ZNATERR	ZNATERR (absolute mode only)
:CONFigure[*n*]		
[:PRESsure]	range, resolution	Configure RPT for range and resolution.
:DISPlay	…...	…...
BLANking	0..99 min	Screen saver period
PAGE	1..7	Changes the DISPLAY function
RPT?	Query only	Gets all 3 of the RPT range values
:FETCh[*n*]	……	…...
:[PRESsure]?	Query only	Press result from a previous measurement
:RATE?	Query only	Rate result from a previous measurement

Table 11. Command Summary (Continued)

Items inside brackets [ ] are optional. A '|' character signifies a logical 'or'.
[n] specifies the RPT channel ('1' Hi, '2' Lo. Default is '1').
[nn] specifies the optional RPT range from 1 to 3 (default is '1').

COMMAND	PARAMETERS	NOTES
:INITiate[*n*]	…...	…...
[:IMMediate]	Command only	Starts a new single measurement cycle
:CONTinuous	0|1|OFF|ON	Disable/Enable continuous measurement
:MEASure[*n*]	…...	…...
[:PRESsure]?	range, resolution	Start and get new pressure measurement
:RATE?	range, resolution	Start and get new rate measurement
SENSe[*n*]	…...	.....
[:PRESsure]		
:PROTection		
:LEVel		
:ABSolute	Upper Limit	The absolute mode upper limit (UL) alarm
:GAUGe	Upper Limit	The gauge mode limit (UL) alarm
:TRIPped?	Query only	Check if UL has been exceeded
:CLEar	Command only	Clears the "TRIPped" flag
:AVERage		
:COUNt	0..10	The # of measurements to average
:AUTO	0 |1|OFF|ON	Disable/enable the auto read rate
:READ[*n*]	…...	…...
[:PRESsure]?	Query only	Start and get new pressure measurement
:RATE?	Query only	Start and get new rate measurement
:STATus		
:OPERation		
:CONDition?	Query Only	Read the condition register
:NTRAnsition	0..32767	Reads or sets the negative transition filter
:PTRAnsition	0..32767	Reads or sets the positive transition filter
[:EVENt]	0..32767	Reads or sets the event register
:ENABle	0..32767	Reads or sets the event enable
:INSTrument		
:CONDition?	Query Only	Read the condition register
:NTRAnsition	0..32767	Reads or sets the negative transition filter
:PTRAnsition	0..32767	Reads or sets the positive transition filter
[:EVENt]	0..32767	Reads or sets the event register
:ENABle	0..32767	Reads or sets the event enable
:ISUMmary[*n*]		
:CONDition?	Query Only	Read the condition register
:NTRAnsition	0..32767	Reads or sets the negative transition filter
:PTRAnsition	0..32767	Reads or sets the positive transition filter
[:EVENt]	0..32767	Reads or sets the event register
:ENABle	0..32767	Reads or sets the event enable

Table 11. Command Summary (Continued)

Items inside brackets [ ] are optional. A '|' character signifies a logical 'or'.
[n] specifies the RPT channel ('1' Hi, '2' Lo. Default is '1').
[nn] specifies the optional RPT range from 1 to 3 (default is '1').

COMMAND	PARAMETERS	NOTES
:QUEStionable		
:CONDition?	Query Only	Read the condition register
:NTRAnsition	0..32767	Reads or sets the negative transition filter
:PTRAnsition	0..32767	Reads or sets the positive transition filter
[:EVENt]	0..32767	Reads or sets the event register
:ENABle	0..32767	Reads or sets the event enable
:INSTrument		
:CONDition?	Query Only	Read the condition register
:NTRAnsition	0..32767	Reads or sets the negative transition filter
:PTRAnsition	0..32767	Reads or sets the positive transition filter
[:EVENt]	0..32767	Reads or sets the event register
:ENABle	0..32767	Reads or sets the event enable
:ISUMmary[*n*]		
:CONDition?	Query Only	Read the condition register
:NTRAnsition	0..32767	Reads or sets the negative transition filter
:PTRAnsition	0..32767	Reads or sets the positive transition filter
[:EVENt]	0..32767	Reads or sets the event register
:ENABle	0..32767	Reads or sets the event enable
:SYSTem	…...	…...
:AMBient		
[:PRESsure]?	Query only	Gets the most recent barometer meas
:BEEPer		
:STATe	0 |1|OFF|ON	Enable/Disable valid key press beep
:FREQuency	250..10000	Changes the key press beep frequency
:IMMediate	250..10000	Beeps the beeper once
:COMMunicate		
:DATE	YYYY,MM,DD	Reads or sets RPM3 calendar
:SERial[*x*]	[*x*] defines COM1 or COM2	
:TRANsmit		
:BAUD	1200|2400|4800|9600|19200	RS-232 baud rate
:BITS	7|8	RS-232 word length
:PARity	EVEN|ODD|ZERO|ONE|NONE	RS-232 parity type
:STOP	1|2	RS-232 number of stop bits
:[RECeive]		
:BAUD	1200|2400|4800|9600|19200	RS-232 baud rate
:BITS	7|8	RS-232 word length
:PARity	EVEN|ODD|ZERO|ONE|NONE	RS-232 parity type
:STOP	1|2	RS-232 number of stop bits

Table 11. Command Summary (Continued)

Items inside brackets [ ] are optional. A '|' character signifies a logical 'or'.
[n] specifies the RPT channel ('1' Hi, '2' Lo. Default is '1').
[nn] specifies the optional RPT range from 1 to 3 (default is '1').

COMMAND	PARAMETERS	NOTES
:GPIB		
:ADDRess	1..30	The IEEE-488 address
:THRU	message	Communicate with device on COM2
:ERRor?	Query Only	Get a message from the error queue
:IDENtify	ID number	Read or sets RPM3 ID number
:KEY	0..20	Same as a direct key press
:KLOCk	0 |1|OFF|ON	Locks/unlocks the front panel.
:POWer	0 |1|OFF|ON	Turn the RPM3 power soft ON or OFF
:RANGe[*n*]?	Query only	gets the active RPT channel and range
:SDS[*n*]	0 |1|OFF|ON	SDS ON/OFF system
:TIME	HH:MM "AM"| "PM"	Reads or sets the RPM3 clock
:VERSion?	Query only	SCPI "version" in the form "YYYY.*n*"
:UNIT	…...	….....
:HEIGht	IN|CM	Default height units
[:PRESsure][n]	pressure units text	Default pressure units
:MODE	g|a or gauge|absolute	The pressure measurement mode
:COEFficient?	Query only	Pressure unit conversion coefficient
:TEMPerature	4|20|60	Sets the ref temperature for inWa unit
:USER	coef, label	Defines a user unit

4.4.1 ERROR MESSAGES

While using COM1, the RPM3 always replies to a non-query program message with **<OK>** if an error did NOT occur or **<ERROR>** if an error was reported to the RPM3 error queue. If you are using the IEEE-488 port, then only queries reply. So, you must use the status reporting system to generate a service request when the error queue is NOT full, or you must check the error queue periodically using the **"SYSTem:ERROr?"** query.

Each error is placed into the Error Queue as it occurs. The **"SYSTem:ERROr?"** query can then be used to remove each error description (first in, first out) from the queue. The query reply **<0, No error>** signals that the error queue is empty. Table 12 lists the possible error numbers and the error description for each.

Table 12. "SYSTEM:ERROR?" QUERY REPLY

"0, No error"
"-100, Command error"
"-102, Syntax error"
"-103, Invalid separator"
"-108, Parameter NOT allowed"
"-109, Missing parameter"
"-110, Command header error"
"-114, Header suffix out of range"
"-138, Suffix NOT allowed"
"-141, Invalid character data"
"-150, String data error"
"-222, Data out of range"
"-224, Illegal parameter value"
"102, User defined coefficient cannot be 0"
"103, Not available with an absolute RPT"
"104, Not available with a gauge RPT"
"105, Not available with altitude units"
"106, Not available with absolute units"
"107, Not available with gauge units"
"110, Numeric data NOT part of set"
"111, Numeric data length too great"
"112, Remote communications is restricted by security level" (see Section 3.4.8)
"120, Data length too great"
"130, String data NOT part of set"
"131, String data length too great"
"140, Pressure exceeds range upper limit" (see Section 3.2.5)
"150, External device NOT detected"
"151, External device improperly configured"
"152, External device timeout error"
"160, SDS NOT available"
"161, RPT timeout"
"180, Ambient temperature sensor failed"
"181, Ambient pressure sensor failed"

4.4.2 COMMAND DESCRIPTIONS

Each command description gives the full syntax showing the short form in uppercase, and the long form remainder in lower case. If the command has only a query form, it is followed by a question mark **(?)**, and only a query syntax is given. If the command is NOT just a query, the command form is also given. Parameters are indicated by *italics*. Ranges of parameters or parameter types are indicated. The **'|'** character indicates multiple possible literal parameters or responses.

4.4.2.1 IEEE STD. 488.2 COMMON AND STATUS COMMANDS

The RPM3 supports a set of commands that are common to all instruments conforming to IEEE Std. 488.2 protocol. Though defined by the IEEE-488.2 standard, they also apply to RPM3 RS-232 (COM1) communications. These commands make it easy to perform basic function for any device that supports these commands. These command also cover the status reporting commands. Refer to Section 4.5 for details on the status registers mentioned in these commands. These IEEE-488.2 common commands always start with an asterisk **(*)**.

∗**CLS**	
Purpose	Clear all of the status and event structures.
Command	"∗CLS"
Notes	This program message clears the following evens and status registers: Standard Byte Register (STB) Standard Event Status Register (ESR) Error Queue Pending OPC operations

∗**ESE**	
Purpose	Read or set the Standard Event Status Enable Register.
Command	"∗ESE *n*"
Query	"∗ESE?"
Parameters	*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.
Query Reply	*n* (0 to 255)
Notes	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.

∗**ESR**	
Purpose	Read the Standard Event Register.
Query	"∗ESR?"
Query Reply	*n* (0 to 255)
Notes	The Standard Event Register contents are cleared after reading. The reply is in decimal numeric form.

∗**IDN**	
Purpose	Identify the RPM3 version, range, and serial number.
Query	"∗IDN?"
Notes	The identification reply is made up of the manufacturer, the model, the serial number and the software version. Each is separated by a comma.
Query Reply	"DH INSTRUMENTS INC, RPM3 A0100/A0015, 1234, Ver1.00 -dhf"

∗**OPC**	
Purpose	Sets the operation complete bit when all operations have completed.
Command	"∗OPC"
Query	"∗OPC?"
Notes	This Command enables the RPM3 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. Since the RPM3 does NOT support overlapping commands, this command has NO practical use.
Query Reply	"0" or "1"

∗**OPT**	
Purpose	Reads the list of installed RPM3 options.
Query	"∗OPT?"
Notes	This Query returns any registered electronic option(s) installed in the RPM3. Each option is separated by a comma.
Query Reply	"NONE"

∗**RST**	
Purpose	Resets the RPM3 settings to factory settings.
Command	"∗RST"
Notes	This Command sets the RPM3 settings to factory settings which is equivalent to a front panel executed **[SPECIAL], <5Reset>, 1sets**. This does NOT affect the communications settings.
See Also	3.4.5.1

∗**SRE**	
Purpose	Read or set the Service Request Enable Register.
Command	"∗SRE *n*"
Query	"∗SRE?"
Parameters	*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.
Notes	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.
Query Reply	*n* (0 to 255)

∗**STB?**	
Purpose	Read the Status Byte Register.
Query	"∗STB?"
Notes	The Status Byte Register reflects the general status of the RPM3. The 'MSS' bit state is represented by bit 6.
Query Reply	*n* (0 to 255)

∗**RSE**	
Purpose	Read or set the RPT ready status enable register.
Command	"∗RSE *n*"
Query	"∗RSE?"
Parameters	*n:* '0 to 255' This is the decimal representation of the bit(s) to enable. To enable the RDY2 bit, the argument would be 16.
Query Reply	*n* (0 to 255)
Notes	The RPT ready status enable register determines which bits in the RPT ready status register are enabled and included in the RPT ready status summary bit in the Status Byte Register (ESB bit), and can assert the SRQ line. The reply is in decimal numeric form.

∗**RSR?**	
Purpose	Read the RPT ready status register.
Query	"∗RSR?"
Query Reply	*n* (0 to 255)
Notes	The RPT ready status register contents are cleared after reading. The reply is in decimal numeric form.
See Also	3.1.5

∗**TST**	
Purpose	Read the power on self test status.
Query	"∗TST?"
Notes	The RPM3 system memory stores the user settings (units, mode, resolution) and retains them when the unit is shutoff. 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 returns a '1'. If the RPM3 passed the test on power up OR if the ∗TST query was used at least once since the RPM3 was powered up the reply is '0'.
Query Reply	"0" or "1"
See Also	3.4.5.1

4.4.2.2 MEASUREMENT SUBSYSTEM

The measurement subsystem provides several ways of getting a measurement from the Hi or Lo (if present) RPT. The easiest is to use the MEASure commands. These commands provide a single step configuration and measurement of pressure or rate. The READ commands can also read back a new measurement, but without options to set the resolution or RPT range. For explicit control, you may use the ABORt, CONFigure, INITiate and FETCh commands (in that order) to control every aspect of the measurement process.

The pressure measurement cycle is continuous in local and remote mode. Initiating a measurement cycle with the READ, MEASure or INITiate command restarts the measurement cycle for the specified RPT channel.

The RPM3 can have a single RPT or two RPTs (Hi and Lo). The RPTs are considered separate channels and can be CONFigured differently. They each have their own related settings (pressure units, measurement mode, resolution, range, AutoZ) but share other common settings (head settings). You must use a suffix to access each separate RPT where **1** accesses the Hi RPT and **2** accesses the Lo RPT. Commands that do NOT allow a suffix affect both RPTs. If you try to access the optional Lo RPT and the RPM3 has only a Hi RPT, the operation will NOT be completed and an error will be placed in the error queue.

Measurement can occur at three levels. **Level1** (the lowest level) is ideal if flexible control of the measurement process is required. **Level1** also requires more commands. The highest level requires only one command:

LEVEL1

“CONFigure”	Selects the range and resolution.
“INITiate”	Starts the measurement cycle.
“FETCh?”	Gets the results of the measurement cycle. You must wait until the cycle is complete before sending a FETCh command or you will get the results from the last measurement.

This level is useful if your program cannot wait for a new measurement to become available. Typically, you CONFigure once, INITiate and then have the program perform other functions before returning and using the FETCh command to get the result and INITiate again. You may use the status system registers (“*RSR?” or the STATus sub-system) to check or generate an IEEE-488 service request when the measurement cycle is complete.

LEVEL2

“CONFigure”	Selects the range and resolution.
“READ?”	Starts a new measure cycle, waits until the cycle is complete, and then gets the results of the measurement cycle.

You only need to CONFigure once, and then use the READ? query as needed to get new measurements.

LEVEL3

"MEASure?" Configures the range and resolution, starts a new measure cycle, waits until the cycle is complete, and then gets the results of the measurement cycle.

This level very simple to use, because you can specify to configure the unit prior to the measurement in one command. However, it may take several seconds for the command to complete execution.

ABORT[*M*]	
Purpose	Stops any current remote measurement cycle.
Command	"ABOR[*n*]"
Suffix	*n:* '1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Notes	Any measurements in progress are stopped. This should be done before INITiating a new measurement to ensure that you are getting a new measurement*s*, and NOT one from a previous cycle.

CONFigure[n]:[PRESsure]	
Purpose	Configures the specified RPT channel for a specific range and resolution. All measurements made will use this configuration unless otherwise specified.
Command	"CONF[*n*] [*RANGE*, [*RESOLUTION*]"
Query	"CONF[*n*]? [*RANGE*, [*RESOLUTION*]"
Suffix	*n:* '1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Parameters	*RANGE:* The expected pressure to be measured in the current default pressure units. The RPM3 will select one of the 3 possible ranges of the selected RPT. This range will be the lowest pressure range that is greater than the current and the anticipated pressure. If the *RANGE* is NOT given, then the current default range will be used. As an alternative, you may pick the range to use by specifying "LO", "MED", or "HI". *RESOLUTION* The resolution desired in the current default pressure units. This should be steps of 10^n where *n* is a whole number.
Query Reply	*RANGE, RESOLUTION* In the current default pressure unit
Notes	The reply can take up to 1 second due to range configuration. If the current pressure is greater than the upper limit of the range specified, the operation will be completed in the current range and an error will be placed in the error queue.
See Also	3.2.2, 3.2.6

FETCh[n]:[PRESsure]?	
Purpose	Returns an RPT pressure measurement that was previously INITiated.
Query	"FETC[*n*]?"
Suffix	*n:* '1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Query Reply	*PRESSURE* in the default pressure units and mode
Notes	The reply can take up to one measurement cycle (1.3 sec), depending on the current integration rate and when the measurement was INITiated. This command only gets the results of a single measurement that must be INITiated using the INITiate command. You must make sure that the SDS system for the selected RPT is turned OFF (if installed) to allow pressure to be applied to the RPT.

FETCh[n]:RATE?	
Purpose	Returns a RPT pressure rate (stability) measurement that was previously INITiated.
Query	"FETC[*n*]:RATE?"
Suffix	*n:* '1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Query Reply	*RATE* in the default pressure units per second
Notes	The reply can take up to one measurement cycle (1.3 sec), depending on the current integration rate. The rate is calculated using the previous measurement and the just completed measurement cycle. If the current pressure is greater than the upper limit of the range specified, the operation will be completed in the current range and an error will be placed in the error queue.
See Also	3.2.7.2, 3.3.4, 3.1.5

INITiate[n]:CONTinuous	
Purpose	Starts a new measurement cycle on the specified RPT.
Command	"INIT[*n*]:CONT" *BOOLEAN*
Query	"INIT[*n*]:CONT?"
Suffix	*n:* '1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Parameters	*BOOLEAN:* '0' or OFF to disable '1' or ON to enable
Query Reply	'0' if disabled '1' if enabled
Notes	Continuous mode starts a new measurement cycle as each measurement cycle completes and allows the measurements to occur without further INITiation. This allows the user to use the FETch command to read the resulting pressure or rate measurements without manually starting each measurement cycle. This is Ideal if synchronization of the measurement is NOT required.

INITiate[n]:[IMMediate]	
Purpose	Starts a new measurement cycle on the specified RPT.
Command	"INIT[*n*]"
Suffix	*n:* '1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Notes	The measurement cycle can take up to (1.3 sec), depending on the current integration rate. This command (re)starts a single measurement cycle. The FETCh command can be used to retrieve the pressure and/or rate measurement when the cycle is finished. You must make sure that the SDS system for the selected RPT is turned OFF (if installed) to allow pressure to be applied to the RPT.

MEASure[n]:[PRESsure]?		
Purpose	Configures, initiates, and fetches a new RPT pressure measurement.	
Query	"MEAS[*n*]? [*RANGE*, [*RESOLUTION*]]"	
Suffix	*n:*	'1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Parameters	*RANGE:*	The expected pressure to be measured in the current default pressure units. The RPM3 will select one of the 3 possible ranges of the selected RPT. This range will be the lowest pressure range that is greater than the current and the anticipated pressure. If the *RANGE* is NOT given, then the current default range will be used. As an alternative, you may pick the range to use by specifying "LO", "MED", or "HI".
	RESOLUTION	The resolution desired in the current default pressure units. This should be steps of 10^x where *x* is a whole number.
Query Reply	*PRESSURE* in the default pressure units and mode	
Notes	The reply can take up to 2 second due to range configuration and measurement times. You must make sure that the SDS system for the selected RPT is turned OFF (if installed) to allow pressure to be applied to the RPT. If the current pressure is greater than the upper limit of the range specified, the operation will be completed in the current range and an error will be placed in the error queue.	
See Also	3.2.2, 3.2.6	

MEASure[n]:RATE?	
Purpose	Configures, initiates, and fetches a new RPT rate measurement.
Query	"MEAS[*n*]:RATE? [*RANGE,* [*RESOLUTION*]]"
Suffix	*n:* '1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Parameters	*RANGE:* The expected pressure point at which the rate is to be measured in the current default pressure units. The RPM3 will select one of the 3 possible ranges of the selected RPT. This range will be the lowest pressure range that is greater than the current and the anticipated pressure. If the *RANGE* is NOT given, then the current default range will be used. As an alternative, you may pick the range to use by specifying "LO", "MED", or "HI". *RESOLUTION:* The resolution desired in the current default pressure units. This should be steps of 10^{x} where *x* is a whole number.
Query Reply	*RATE* in the default pressure units per second
Notes	The reply can take up to 2 second due to range configuration and measurement times. The rate is calculated using the previous measurement and the just completed measurement cycle. If the current pressure is greater than the upper limit of the range specified, the operation will be completed in the current range and an error will be placed in the error queue.
See Also	3.1.5, 3.2.2, 3.2.6, 3.3.4

READ[n]:[PRESsure]?	
Purpose	Initiates, and fetches a new RPT pressure measurement.
Query	"READ[*n*]?"
Suffix	*n:* '1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Query Reply	*PRESSURE* in the default pressure units and mode
Notes	The reply can take up to one measurement cycle. (1.3 sec), depending on the current integration rate. This command starts a single measurement cycle and returns the result when finished. You must make sure that the SDS system for the selected RPT is turned OFF (if installed) to allow pressure to be applied to the RPT.

READ[n]:RATE?	
Purpose	Initiates, and fetches a new RPT rate measurement.
Query	"READ[*n*]:RATE?"
Suffix	*n:* '1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Query Reply	*RATE* in the default pressure units and mode
Notes	The reply can take up to one measurement cycle (1.3 sec), depending on the current integration rate. The rate is calculated using the previous measurement and the just completed measurement cycle. If the current pressure is greater than the upper limit of the range specified, the operation will be completed in the current range and an error will be placed in the error queue.
See Also	3.2.7.2, 3.3.4, 3.1.5

4.4.2.3 CALCULATE SUBSYSTEM

The calculate subsystem accesses the stability limit and head settings.

CALCulate:STABility:LIMit [n]		
Purpose	Reads or sets ready stability fail limit.	
Command	"CALC:STAB:LIM[*n*] *STAB*"	
Query	"CALC:STAB?"	
Suffix	*n:*	'1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Parameters	*STAB:*	The stability rate of change limit in the default pressure units/sec.
Query Reply	*STAB* in the default pressure units/sec	
See Also	3.3.4, 3.1.5	

CALCulate:STABility:LIMit [n]:FAIL?		
Purpose	Reads if the current RPT measurement fails the stability criteria.	
Query	"CALC:STAB:LIM[*n*]:FAIL?"	
Suffix	*n:*	'1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Query Reply	*BOOLEAN*	'1' if the previous measurement has failed the stability criteria '0' if the previous measurement has passed the stability criteria
See Also	3.3.4, 3.1.5	

CALCulate:HEAD:HEIGht		
Purpose	Reads or sets height difference between the RPM3 and another reference or device under test.	
Command	"CALC:HEAD:HEIG *HEIGHT"*	
Query	"CALC:HEAD:HEIG?"	
Parameters	*HEIGHT:*	The height relative to the RPM3 in the default height units.
Query Reply	*HEIGHT*	
Notes	Set the head height to '0' to disable.	
See Also	3.3.1, 3.2.8	

CALCulate:HEAD:MEDium		
Purpose	Reads or sets the type of gas or liquid that is being used with the RPM3.	
Command	"CALC:HEAD:MED *MEDIUM*"	
Query	"CALC:HEAD:MED? "	
Parameters	*MEDIUM*	"N2"|"He"|"Air"|"Oil"|"H20"|"User"
Query Reply	*MEDIUM*	
Notes	If "User" is specified, use the "CALCulate:HEAD:MEDium:DENSity" command to specify the medium density.	
See Also	3.3.1, 3.2.8	

CALCulate:HEAD:DENSity	
Purpose	Reads or sets the density of the "User" defined medium.
Command	"CALC:HEAD:DENS *DENSITY*"
Query	"CALC:HEAD:DENS?"
Parameters	*DENSITY* The density of the medium in kg/m^2
Query Reply	*MEDIUM*
Notes	This setting is only used when the "CALCulate:HEAD:" has been set to "User".
See Also	3.3.1, 3.2.8

4.4.2.4 CALIBRATION SUBSYSTEM

The subsystem access the pressure and ambient sensor calibration and zero setting.

CALibration:AMBient[:PRESsure]		
Purpose	Reads or sets the user adder and multiplier for the Ambient sensor.	
Command	"CAL:AMB *ADDER, MULT*"	
Query	"CAL:AMB?"	
Parameters	*ADDER:*	The barometer pressure adder in the default pressure units.
	MULT:	The barometer pressure multiplier.
Query Reply	*ADDER, MULT*	
See Also	5.3	

CALibration:AMBient[:PRESsure]:DATE		
Purpose	Reads or sets the barometer calibration date.	
Command	"CAL:AMB:DATE *YEAR, MONTH, DAY*"	
Query	"CAL:AMB:DATE? "	
Parameters	*YEAR:*	The 4 digit year from 0 to 9999.
	MONTH:	The month from 1 to 12.
	DAY:	The day from 1 to 31.
Query Reply	*YEAR, MONTH, DAY*	
See Also	5.2.2	

CALibration[n]:RPT[nn]		
Purpose	Reads or sets the RPT and range calibration adder (PA) and multiplier (PM) for the RPT and RPT range.	
Command	"CAL[*n*]:RPT[*nn*] *ADDER, MULT*"	
Query	"CAL[*n*]:RPT[*nn*]? "	
Suffix	*n:*	'1' to access the Hi RPT (default) '2' to access the optional Lo RPT
	nn:	'1' to access the low range calibration data (default) '2' to access the mid range calibration data '3' to access the mid range calibration data
Parameters	*ADDER:*	The pressure adder in the default units.
	MULT:	The pressure adder.
Query Reply	*ADDER, MULT*	
See Also	5.3	

CALibration[n]:RPT[nn]:DATE		
Purpose	Reads or sets the RPT and range calibration date.	
Command	"CAL[*n*]:RPT[*nn*]:DATE *YEAR, MONTH, DAY*"	
Query	"CAL[*n*]:RPT[*nn*]:DATE? "	
Suffix	*n:*	'1' to access the Hi RPT (default) '2' to access the optional Lo RPT
	nn:	'1' to access the low range calibration data (default) '2' to access the mid range calibration data '3' to access the high range calibration data
Parameters	*YEAR:*	The 4 digit year from 0 to 9999.
	MONTH:	The month from 1 to 12.
	DAY:	The day from 1 to 31.
Query Reply	*YEAR, MONTH, DAY*	
See Also	5.3	

CALibration[n]:ZERO:AUTO		
Purpose	Runs AutoZ to update the value of ZOFFSET for the selected RPT In the currently active range and measurement mode.	
Command	"CAL[*n*]:ZERO:AUTO *ONCE [,ZSTD]* "	
Suffix	*n:*	'1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Parameters	*ONCE:*	"ONCE"
	ZSTD:	The reference used to calculate ZOFFSET. This should be always "0" if in gauge mode. If the Zstd is NOT given, "0" is assumed. To use the reading of range L3 as ZSTD, choose "lo" (valid only when running AutoZ on a Hi absolute RPT when there is also a Lo absolute RPT in the RPM3).
Notes	This runs AutoZ for the selected RPT in the currently active range and measurement mode ONLY.	
See Also	3.4.1, 3.2.10	

CALibration[n]:ZERO:NERRor[nn]		
Purpose	Reads or sets ZNATERR for the selected RPT currently active range (absolute only).	
Command	"CAL[*n*]:ZERO:NERR[*nn*] *ZNATERR*"	
Query	"CAL[*n*]:ZERO:NERR[*nn*]?"	
Suffix	*n:*	'1' to access the Hi RPT (default) '2' to access the optional Lo RPT
	nn:	'1' to access the low range data (default) '2' to access the mid range data '3' to access the high range data
Parameters	*ZNATERR:*	The natural error for the given range in the default pressure units.
Query Reply	*ZNATERR*	
See Also	3.4.1, 5.3.1.2	

CALibration[n]:ZERO:OFFSet[nn]:GAUGe **CALibration[n]:ZERO:OFFSet[nn]:ABSolute**	
Purpose	Reads or sets ZOFFSET.
Command	"CAL[*n*]:ZERO:OFFS[*nn*]:GAUG *GAOFFSET*" "CAL[*n*]:ZERO:OFFS[*nn*]:ABS *ABSOFFSET*"
Query	"CAL[*n*]:ZERO:OFFS[*nn*]:GAUG? " "CAL[*n*]:ZERO:OFFS[*nn*]:ABS?"
Suffix	*n:* '1' to access the Hi RPT (default) '2' to access the optional Lo RPT *nn:* '1' to access the low range data (default) '2' to access the mid range data '3' to access the high range data
Parameters	*GAOFFSET:* The gauge mode ZOFFSET in the default pressure units. *ABSOFFSET:* The absolute mode ZOFFSET in the default pressure units.
Query Reply	*GAOFFSET* or *ABSOFFSET*
Notes	The *ABSOFFSET* is reported but does NOT apply if the RPT is a gauge RPT.
See Also	3.4.1, 3.2.10

CALIBRATION[*N*]:ZERO:STATE	
Purpose	Reads or sets the AutoZ ON/OFF status.
Command	"CAL[*n*]:ZERO:STAT *BOOLEAN*"
Query	"CAL[*n*]:ZERO:STAT? "
Suffix	*n:* '1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Parameters	*BOOLEAN:* '0' or OFF to disable AutoZ. '1' or ON to enable AutoZ.
Query Reply	*BOOLEAN:* "0" or "1"
See Also	3.4.1, 3.4.1.1

4.4.2.5 DISPLAY SUBSYSTEM

The display subsystem controls the front panel display attributes including screen saver, time function and ID function.

DISPlay:BLANking	
Purpose	Sets or reads the period of local inactivity RPM3 waits until it dims the screen to 33 % intensity.
Command	"DISP:BLAN *PERIOD*"
Query	"DISP:BLAN? "
Parameters	*PERIOD:* The period from 1 to 99 minutes
Query Reply	*PERIOD*
See Also	3.4.7.1

DISPlay:PAGE	
Purpose	Sets the display page shown on the main run screen of the RPM3. These are the same pages available from the front panel **[DISPLAY]** function.
Command	"DISP:PAGE *PAGE*"
Query	"DISP:PAGE?"
Parameters	*PAGE:* The page number to display (default is "2Rate") '1' Display the Average screen (local data only) '2' Display the default Rate screen '3' Display the Deviation screen . (local data only) '4' Display the dual RPT screen (must have dual RPT option) '5' Display the Hi/Lo screen '6' Display the Freeze screen (local data only) '7' Display the Clean screen
Query Reply	*PAGE* from '1' to '7'
Notes	These display screens may show information that is available only through the front panel display (Average, Deviation, Freeze).
See Also	3.2.7

DISPlay:RPT?	
Purpose	Reads the actively displayed RPT channel and range. The front panel of the RPM3 is used to control and display a single RPT and RPT range at a time. This query finds out which RPT is "active" and which range it is in.
Query	"DISP:RPT?"
Query Reply	*RPT, RANGE:* *RPT:* '1' if the Hi pressure RPT is active '2' if the Lo pressure RPT is active *RANGE:* "LO" for the lowest range of the RPT "MED" for the middle range of the RPT "HI" for the highest range of the RPT

4.4.2.6 SENSE SUBSYSTEM

The sense subsystem controls the upper limit (UL) settings and the pressure reading integration functions.

SENSe[n]:AVERage:AUTO	
Purpose	Enables and disables the auto read rate function.
Command	"SENS[*n*]:AVER:AUTO *BOOLEAN*"
Query	"SENS[*n*]:AVER:AUTO?"
Suffix	*n:* '1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Parameters	*BOOLEAN* '1' to enable auto read rate. '0' to disable auto read rate.
Query Reply	*BOOLEAN* '1' or '0'
See Also	3.3.3

SENSe[n]:AVERage:COUNt	
Purpose	Sets or reads the number of samples averaged by the RPT before completing a measurement cycle.
Command	"SENS[*n*]:AVER:COUN *SAMPLES*"
Query	"SENS[*n*]:AVER:COUN?"
Suffix	*n:* '1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Parameters	*SAMPLES:* The number of samples averaged before a measurement cycle is complete. Each sample takes 200 ms to complete.
Query Reply	*SAMPLES*
Notes	This setting is automatically adjusted by the auto integration function (if enabled) to increase the integration rate when the rate of change is great. This command is only effective if auto integration is disabled using the "SENSe[n]:AVERage:AUTO" command.
See Also	3.3.3

SENSe[n][:PRESsure]:PROTection:LEVel:GAUGe SENSe[n][:PRESsure]:PROTection:LEVel:ABSolute	
Purpose	Sets or reads the upper limit (UL) for the specified RPT and the current RPT range.
Command	"SENS[*n*]:PROT:LEV:GAUG *GAUGEUL*" "SENS[*n*]:PROT:LEV:ABS *ABSUL*"
Query	"SENS[*n*]:PROT:LEV:GAUG?" "SENS[*n*]:PROT:LEV:ABS?"
Suffix	*n:* '1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Parameters	*GAUGEUL:* The Upper Limit in the current default units for gauge mode measurements. The pressure unit can optionally be specified after the *GAUGEUL* separated by a space. *ABSUL:* The Upper Limit in the current default units for absolute mode measurements. The pressure unit can optionally be specified after the *ABSUL* separated by a space.
Query Reply	*GAUGEUL* OR *ABSUL*
Notes	Separate limits are maintained for each mode (absolute and gauge) and each range of each RPT. The UL can only be set slightly above the range (1 of 3) for each RPT. If the RPT is a gauge RPT, then the *ABSUL* setting is ignored.
See Also	3.2.5

SENSe[*n*][:PRESSURE]:PROTECTION:TRIPPED?	
Purpose	Reads the upper limit (UL) exceeded flag for the specified RPT.
Query	"SENS[*n*]:PROT:TRIP?"
Suffix	*n:* '1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Query Reply	*BOOLEAN:* '1' The pressure has exceeded upper limit since power up or since the flag was last cleared. You can clear this flag with the command. "SENSe[*n*]PRESsure:PROTection:CLEar" command. '0' The pressure has NOT been exceeded.
Notes	Separate limits are maintained for each range and measurement mode (absolute and gauge) of each RPT. The UL can only be set slightly above the range (1 of 3) for each RPT. If the RPT is a gauge RPT, then the *ABSUL* setting is accepted but ignored.
See Also	3.2.5

SENSe[n][:PRESsure]:PROTection:CLEar	
Purpose	Clears the upper limit (UL) exceeded flag for the specified RPT.
Query	"SENS[*n*]:PROT:CLE"
Suffix	*n:* '1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Notes	Only this command or a power cycle will clear the upper limit flag.
See Also	3.2.5

4.4.2.7 STATUS SUBSYSTEM

For information on the status system, status reporting system and status subsystem see Section 4.5. Familiarize yourself with the status system section before attempting to use status subsystem register commands.

STATus:OPERation:CONDition?	
Purpose	Reads the operation condition register.
Query	"STAT:OPER:COND?"
Query Reply	*REGISTER:* The 16 bit operation condition register
Notes	This register reports the contents of the operation condition register without altering it's contents. Events represented by the bits in this register are always enabled and are a direct representation of the event status. The instrument summary bit (bit 13) of this register is the only valid bit. It can be set by either bit 0 or bit 1 of the INSTrument event register ("STAT:OPER:INST") if those bits are enabled to do so.

STATus:OPERation:NTRansition **STATus:OPERation:PTRansition**	
Purpose	Reads or sets the operation negative or positive transition filter.
Command	"STAT:OPER:NTRansition *REGISTER*" "STAT:OPER:PTRansition *REGISTER:*"
Query	"STAT:OPER:NTRansition?" "STAT:OPER:PTRansition?"
Query Reply	*REGISTER:* The 16 bit operation transition filter
Notes	If a bit is set in the negative and/or positive transition filter, then a TRUE to FALSE and/or FALSE to TRUE transition of the associated bit in the operation condition register will cause the associated bit in the operation event register to be set. By default, the negative transition filter bits are all 0's, and the positive filter is set to all 1's (except bit 15 which is NOT used) so that by default, a FALSE to TRUE transition will cause a bit in the operation event register to set.

STATUS:OPERATION[:EVENT]?	
Purpose	Reads and then clears the operation event register.
Query	"STAT:OPER?"
Query Reply	*REGISTER:* The 16 bit operation event register
Notes	This register represents event transitions defined by the operation condition register after the transition filter has been applied. Enabled bits in this register ("STAT:OPER:ENAB") will set the operation summary bit (bit 7) of the status byte register.

STATUS:OPERATION:ENABLE	
Purpose	Reads or sets the enable mask for the operation event enable register.
Command	"STAT:OPER:ENAB *REGISTER*"
Query	"STAT:OPER:ENAB?"
Query Reply	*REGISTER:* The 16 bit mask
Notes	If a bit is set in the mask, then the associated bit in the operation event register will set the operation summary bit (bit 7) of the status byte register. The default value for the mask is 0, with all bits masked out and NOT enabled.

STATUS:OPERATION:INSTRUMENT:CONDITION?	
Purpose	Reads the instrument condition register.
Query	"STAT:OPER:INST:COND?"
Query Reply	*REGISTER:* The 16 bit instrument condition register
Notes	This register reports the contents of the instrument condition register without altering it's contents. Events represented by the bits in this register are always enabled and are a direct representation of the event status. Bit 0 represents the summary of the ISUMmary1 register which is the operation status of the Hi RPT. Bit 1 represents the summary of the ISUMmary2 register which is the operation status of the optional Lo RPT.

STATus:OPERation:INSTrument:NTRansition STATus:OPERation:INSTrument:PTRansition	
Purpose	Reads or sets the instrument negative or positive transition filter.
Command	"STAT:OPER:INST:NTRansition *REGISTER*" "STAT:OPER:INST:PTRansition *REGISTER*:"
Query	"STAT:OPER:INST:NTRansition?" "STAT:OPER:INST:PTRansition?"
Query Reply	*REGISTER:* The 16 bit instrument transition filter
Notes	If a bit is set in the negative and/or positive transition filter, then a TRUE to FALSE and/or FALSE to TRUE transition of the associated bit in the instrument condition register will cause the associated bit in the instrument event register to be set. By default, the negative transition filter bits are all 0's, and the positive filter is set to all 1's (except bit 15 which is NOT used) so that by default, a FALSE to TRUE transition will cause a bit in the instrument event register to set.

STATUS:OPERATION:INSTRUMENT [:EVENT]?	
Purpose	Reads and then clears the instrument event register.
Query	"STAT:OPER:INST?"
Query Reply	*REGISTER:* The 16 bit instrument event register
Notes	This register represents event transitions defined by the instrument condition register after the transition filter has been applied. Enabled bits in this register ("STAT:OPER:INST:ENAB") will set the instrument summary bit (bit 13) of the operation condition register.

STATUS:OPERATION:INSTRUMENT:ENABLE	
Purpose	Reads or sets the enable mask for the instrument event enable register.
Command	"STAT:OPER:INST:ENAB *REGISTER*"
Query	"STAT:OPER:INST:ENAB?"
Query Reply	*REGISTER:* The 16 bit mask
Notes	If a bit is set in the mask, then the associated bit in the instrument event register will set the instrument summary bit (bit 13) of the operation condition register. The default value for the mask is 0, with all bits masked out and NOT enabled.

STATUS:OPERATION:INSTRUMENT:ISUMMARY[N]:CONDITION?	
Purpose	Reads the instrument summary condition register.
Query	"STAT:OPER:INST:ISUM[*n*]:COND?"
Suffix	*n:* '1' to access the Hi RPT summary condition register. '2' to access the optional Lo RPT summary condition register.
Query Reply	*REGISTER:* The 16 bit instrument summary condition register
Notes	This register reports the contents of the instrument summary condition register without altering it's contents. Events represented by the bits in this register are always enabled and are a direct representation of the event status. Bit 2 is set when the RPT is changing a range, and is cleared when it is finished changing a range . Bit 4 is set when the RPT is executing a measurement cycle, and is cleared when it is finished with the cycle.

STATus:OPERation:INSTrument:ISUMmary[*n*]:NTRansition **STATus:OPERation:INSTrument:ISUMmary[*n*]:PTRansition**	
Purpose	Reads or sets the instrument summary negative or positive transition filter.
Command	"STAT:OPER:INST:ISUM[*n*]:NTRansition *REGISTER*" "STAT:OPER:INST:ISUM[*n*]:PTRansition *REGISTER*:"
Suffix	*n:* '1' to access the Hi RPT instrument summary transition filter. '2' to access the optional Lo RPT transition filter.
Query	"STAT:OPER:INST:ISUM[*n*]:NTRansition?" "STAT:OPER:INST:ISUM[*n*]:PTRansition?"
Query Reply	*REGISTER:* The 16 bit instrument summary transition filter
Notes	If a bit is set in the negative and/or positive transition filter, then a TRUE to FALSE and/or FALSE to TRUE transition of the associated bit in the instrument summary condition register will cause the associated bit in the instrument summary event register to be set. By default, the negative transition filter bits are all 0's, and the positive filter is set to all 1's (except bit 15 which is NOT used) so that by default, a FALSE to TRUE transition will cause a bit to set.

STATUS:OPERATION:INSTRUMENT:ISUMMARY[*N*][:EVENT]?	
Purpose	Reads and then clears the instrument summary event register.
Suffix	*n:* '1' to access the Hi RPT instrument summary event register. '2' to access the optional Lo RPT event register.
Query	"STAT:OPER:INST:ISUM[*n*]?"
Query Reply	*REGISTER:* The 16 bit instrument summary event register
Notes	This register represents event transitions defined by the instrument summary condition register after the transition filter has been applied. Enabled bits in this register ("STAT:OPER:INST:ISUM:ENAB") will set bit 0 or bit 1 (depending on "*n*") of the instrument condition register ("STAT:OPER:INST:COND").

STATUS:OPERATION:INSTRUMENT:ISUMMARY[*N*]:ENABLE	
Purpose	Reads or sets the enable mask for the instrument summary event enable register.
Command	"STAT:OPER:INST:ISUM[*n*]:ENAB *REGISTER*"
Suffix	*n:* '1' to access the Hi RPT instrument summary event register. '2' to access the optional Lo RPT event register.
Query	"STAT:OPER:INST:ISUM[*n*]:ENAB?"
Query Reply	*REGISTER:* The 16 bit mask
Notes	If a bit is set in the mask, then the associated bit in the instrument summary event register will set bit 0 or bit 1 (depending on "*n*") of the instrument condition register ("STAT:OPER:INST:COND"). The default value for the mask is 0, with all bits masked out and NOT enabled.

STATUS:QUESTIONABLE:CONDITION?	
Purpose	Reads the questionable condition register.
Query	"STAT:QUES:COND?"
Query Reply	*REGISTER:* The 16 bit questionable condition register
Notes	This register reports the contents of the questionable condition register without altering it's contents. Events represented by the bits in this register are always enabled and are a direct representation of the event status. The instrument summary bit (bit 13) of this register is the only valid bit. It can be set by either bit 0 or bit 1 of the INSTrument event register ("STAT:QUES:INST") if those bits are enabled to do so.

STATus:QUEStionable:NTRansition **STATus:QUEStionable:PTRansition**	
Purpose	Reads or sets the questionable negative or positive transition filter.
Command	"STAT:QUES:NTRansition *REGISTER*" "STAT:QUES:PTRansition *REGISTER:*"
Query	"STAT:QUES:NTRansition?" "STAT:QUES:PTRansition?"
Query Reply	*REGISTER:* The 16 bit questionable transition filter
Notes	If a bit is set in the negative and/or positive transition filter, then a TRUE to FALSE and/or FALSE to TRUE transition of the associated bit in the questionable condition register will cause the associated bit in the questionable event register to be set. By default, the negative transition filter bits are all 0's, and the positive filter is set to all 1's (except bit 15 which is NOT used) so that by default, a FALSE to TRUE transition will cause a bit in the questionable event register to set.

STATus:QUEStionable[:EVENt]?	
Purpose	Reads and then clears the questionable event register.
Query	"STAT:OPER?"
Query Reply	*REGISTER:*. The 16 bit questionable event register
Notes	This register represents event transitions defined by the questionable condition register after the transition filter has been applied. Enabled bits in this register ("STAT:QUES:ENAB") will set the questionable summary bit (bit 3) of the status byte register.

STATUS:QUESTIONABLE:ENABLE	
Purpose	Reads or sets the enable mask for the questionable event enable register.
Command	"STAT:QUES:ENAB *REGISTER*"
Query	"STAT:QUES:ENAB?"
Query Reply	*REGISTER:* The 16 bit mask
Notes	If a bit is set in the mask, then the associated bit in the questionable event register will set the questionable summary bit (bit 3) of the status byte register. The default value for the mask is 0, with all bits masked out and NOT enabled.

STATUS:QUESTIONABLE:INSTRUMENT:CONDITION?	
Purpose	Reads the instrument condition register.
Query	"STAT:QUES:INST:COND?"
Query Reply	*REGISTER:* The 16 bit instrument condition register
Notes	This register reports the contents of the instrument condition register without altering it's contents. Events represented by the bits in this register are always enabled and are a direct representation of the event status. Bit 0 represents the summary of the ISUMmary1 register which is the questionable status of the Hi RPT. Bit 1 represents the summary of the ISUMmary2 register which is the questionable status of the optional Lo RPT.

STATus:QUEStionable:INSTrument:NTRansition STATus:QUEStionable:INSTrument:PTRansition	
Purpose	Reads or sets the instrument negative or positive transition filter.
Command	"STAT:QUES:INST:NTRansition *REGISTER*" "STAT:QUES:INST:PTRansition *REGISTER*:"
Query	"STAT:QUES:INST:NTRansition?" "STAT:QUES:INST:PTRansition?"
Query Reply	*REGISTER:* The 16 bit instrument transition filter
Notes	If a bit is set in the negative and/or positive transition filter, then a TRUE to FALSE and/or FALSE to TRUE transition of the associated bit in the instrument condition register will cause the associated bit in the instrument event register to be set. By default, the negative transition filter bits are all 0's, and the positive filter is set to all 1's (except bit 15 which is NOT used) so that by default, a FALSE to TRUE transition will cause a bit in the instrument event register to set.

STATUS:QUESTIONABLE:INSTRUMENT [:EVENT]?	
Purpose	Reads and then clears the instrument event register.
Query	"STAT:QUES:INST?"
Query Reply	*REGISTER:* The 16 bit instrument event register
Notes	This register represents event transitions defined by the instrument condition register after the transition filter has been applied. Enabled bits in this register ("STAT:QUES:INST:ENAB") will set the instrument summary bit (bit 13) of the questionable condition register.

STATUS:QUESTIONABLE:INSTRUMENT:ENABLE	
Purpose	Reads or sets the enable mask for the instrument event enable register.
Command	"STAT:QUES:INST:ENAB *REGISTER*"
Query	"STAT:QUES:INST:ENAB?"
Query Reply	*REGISTER:* The 16 bit mask
Notes	If a bit is set in the mask, then the associated bit in the instrument event register will set the instrument summary bit (bit 13) of the questionable condition register. The default value for the mask is 0, with all bits masked out and NOT enabled.

STATUS:QUESTIONABLE:INSTRUMENT:ISUMMARY[N]:CONDITION?	
Purpose	Reads the instrument summary condition register.
Query	"STAT:QUES:INST:ISUM[*n*]:COND?"
Suffix	*n:* '1' to access the Hi RPT summary condition register. '2' to access the optional Lo RPT summary condition register.
Query Reply	*REGISTER:* The 16 bit instrument summary condition register
Notes	This register reports the contents of the instrument summary condition register without altering it's contents. Events represented by the bits in this register are always enabled and are a direct representation of the event status. Bit 9 is set when the RPM3 is NOT within the stability limit defined by the CALC:STAB:LIMIT setting. Bit 14 is set when the RPM3 has received and executed a command that contained data that could NOT be used and may result in unexpected behavior.

STATus:QUEStionable:INSTrument:ISUMmary[*n*]:NTRansition **STATus:QUEStionable:INSTrument:ISUMmary[*n*]:PTRansition**	
Purpose	Reads or sets the instrument summary negative or positive transition filter.
Command	"STAT:QUES:INST:ISUM[*n*]:NTRansition *REGISTER*" "STAT:QUES:INST:ISUM[*n*]:PTRansition *REGISTER*:"
Suffix	*n:* '1' to access the Hi RPT instrument summary transition filter. '2' to access the optional Lo RPT transition filter.
Query	"STAT:QUES:INST:ISUM[*n*]:NTRansition?" "STAT:QUES:INST:ISUM[*n*]:PTRansition?"
Query Reply	*REGISTER:* The 16 bit instrument summary transition filter
Notes	If a bit is set in the negative and/or positive transition filter, then a TRUE to FALSE and/or FALSE to TRUE transition of the associated bit in the instrument summary condition register will cause the associated bit in the instrument summary event register to be set. By default, the negative transition filter bits are all 0's, and the positive filter is set to all 1's (except Bit 15 which is NOT used) so that by default, a FALSE to TRUE transition will cause a bit to set.

STATUS:QUESTIONABLE:INSTRUMENT:ISUMMARY[*N*][:EVENT]?	
Purpose	Reads and then clears the instrument summary event register.
Suffix	*n:* '1' to access the Hi RPT instrument summary event register. '2' to access the optional Lo RPT event register.
Query	"STAT:QUES:INST:ISUM[*n*]?"
Query Reply	*REGISTER:* The 16 bit instrument summary event register
Notes	This register represents event transitions defined by the instrument summary condition register after the transition filter has been applied. Enabled bits in this register ("STAT:QUES:INST:ISUM:ENAB") will set bit 0 or bit 1 (depending on "*n*") of the instrument condition register ("STAT:QUES:INST:COND").

STATUS:QUESTIONABLE:INSTRUMENT:ISUMMARY[*N*]:ENABLE	
Purpose	Reads or sets the enable mask for the instrument summary event enable register.
Command	"STAT:QUES:INST:ISUM[*n*]:ENAB *REGISTER*"
Suffix	*n:* '1' to access the Hi RPT instrument summary event register. '2' to access the optional Lo RPT event register.
Query	"STAT:QUES:INST:ISUM[*n*]:ENAB?"
Query Reply	*REGISTER:* The 16 bit mask
Notes	If a bit is set in the mask, then the associated bit in the instrument summary event register will set bit 0 or bit 1 (depending on "*n*") of the instrument condition register ("STAT:QUES:INST:COND"). The default value for the mask is 0, with all bits masked out and NOT enabled.

4.4.2.8 SYSTEM SUBSYSTEM

The system subsystem controls general settings such as display, keypad, beeper, and communications.

SYSTEM:AMBIENT[:PRES]?	
Purpose	Gets the most recent internal barometer measurement.
Query	"SYST:AMB?"
Query Reply	*AMBPRES* in the current default pressure units
See Also	1.2.2.2, 3.4.3

SYSTEM:BEEPER:FREQUENCY	
Purpose	Sets the beeper frequency for valid keypress feedback.
Command	"SYST:BEEP:FREQ *FREQ*"
Query	"SYST:BEEP:FREQ?"
Parameters	*FREQ:* The beeper frequency from 250 to 10 000 Hz
Query Reply	*FREQ*
See Also	3.1.3

SYSTEM:BEEPER[:IMMEDIATE]	
Purpose	Beeps the beeper for one second.
Command	"SYST:BEEP"
Notes	The beeper beeps in the default frequency.

SYSTEM:BEEPER:STATE	
Purpose	Enables and disables the beeper for valid keypress feedback. It does NOT disable error feedback or alarm events.
Command	"SYST:BEEP:STAT *BOOLEAN*"
Query	"SYST:BEEP:STAT? "
Parameters	*BOOLEAN:* '0' or OFF to disable the beeper events '1' or ON to enable the beeper events
Query Reply	'0' or '1'
See Also	3.1.3

SYSTEM:COMMUNICATE:GPIB[:ADDRESS]	
Purpose	Sets or gets the IEE-488 (GPIB) port address.
Command	"SYST:COMM:GPIB *ADDR*"
Query	"SYST:COMM:GPIB?"
Parameters	*ADDR:* The primary GPIB address from 1 to 30. Secondary addressing is NOT supported.
Query Reply	*ADDR*
See Also	3.4.4, 4.2.2

SYSTEM:COMMUNICATE:SERIAL[M][:RECEIVE]:BAUD **SYSTEM:COMMUNICATE:SERIAL[M]:TRANSMIT:BAUD**	
Purpose	Sets or gets the baud rate for the RS-232 port.
Command	"SYST:COMM:SER[*m*]:BAUD *BAUDRATE*" "SYST:COMM:SER[*m*]:TRAN:BAUD *BAUDRATE*"
Query	"SYST:COMM:SER[*m*]:BAUD?" "SYST:COMM:SER[*m*]:TRAN:BAUD?"
Section	*m:* '1' to set the COM1 baud rate (default) '2' to set the COM2 baud rate
Parameters	*BAUDRATE:* "1200"|"2400"|"4800"|"9600"|"19200"
Query Reply	*BAUDRATE*
Notes	The receive and transmit baud rates are always the same, so both commands change the transmit baud rate as well as the receive baud rate.
See Also	3.4.4, 4.2.1

SYSTEM:COMMUNICATE:SERIAL[*M*][:RECEIVE]:BITS **SYSTEM:COMMUNICATE:SERIAL[*M*]:TRANSMIT:BITS**	
Purpose	Sets or gets the RS-232 port data word length.
Command	"SYST:COMM:SER[*m*]:BITS *NUMBERBITS*" "SYST:COMM:SER[*m*]:TRAN:BITS *NUMBERBITS*"
Query	"SYST:COMM:SER[*m*]:BITS?" "SYST:COMM:SER[*m*]:TRAN:BITS?"
Section	*m:* '1' to set the COM1 word length (default) '2' to set the COM2 word length.
Parameters	*NUMBERBITS:* "7"|"8"
Query Reply	*NUMBERBITS*
Notes	The receive and transmit word lengths are always the same, so both commands change the transmit word length as well as the receive word length.
See Also	3.4.4, 4.2.1

SYSTEM:COMMUNICATE:SERIAL[*M*][:RECEIVE]:PARITY **SYSTEM:COMMUNICATE:SERIAL[*M*]:TRANSMIT:PARITY**	
Purpose	Sets or gets the parity for the RS-232 port.
Command	"SYST:COMM:SER[*m*]:PAR *PARITY*" "SYST:COMM:SER[*m*]:TRAN:PAR *PARITY*"
Query	"SYST:COMM:SER[*m*]:PAR?" "SYST:COMM:SER[*m*]:TRAN:PAR?"
Section	*m:* '1' to set the COM1 parity (default) '2' to set the COM2 parity
Parameters	*PARITY:* "EVEN"|"ODD"|"NONE"|"ONE"|"ZERO"
Query Reply	*PARITY*
Notes	The receive and transmit parity are always the same, so both commands change the transmit parity as well as the receive parity.
See Also	3.4.4, 4.2.1

SYSTEM:COMMUNICATE:SERIAL[*M*][:RECEIVE]:STOP **SYSTEM:COMMUNICATE:SERIAL[*M*]:TRANSMIT:STOP**		
Purpose	Sets or gets the number of stop bits for the RS-232 port.	
Command	"SYST:COMM:SER[m]:STOP *STOPBIT*" "SYST:COMM:SER[m]:TRAN:STOP *STOPBITS*"	
Query	"SYST:COMM:SER[m]:STOP?" "SYST:COMM:SER[m]:TRAN:STOP?"	
Section	*m:*	'1' to set the COM1 stop bits (default) '2' to set the COM2 stop bits
Parameters	*STOPBITS:*	1|2
Query Reply	*BSTOPBITS*	
Notes	The receive and transmit stop bits are always the same, so both commands change the transmit stop bits as well as the receive stop bits.	
See Also	3.4.4, 4.2.1	

SYSTEM:COMMUNICATE:THRU		
Purpose	Transfers massages to and from the specified COM2 port.	
Command	"SYST:COMM *MESSAGE*"	
Query	"SYST:COMM? [*MESSAGE*]"	
Parameters	*MESSAGE:*	The message to send to the port. It can be up to 60 char long.
Query Reply	*REPLY:*	Any message that is received by the port within 2 seconds
Notes	You can communicate with other instruments via the COM2 of the RPM3. Handshaking is NOT supported. Ensure that the COM2 is properly setup before establishing communications using the RPM3 COM2 port.	

SYSTEM:DATE		
Purpose	Reads or sets the RPM3 calendar.	
Command	"SYST:DATE *YEAR, MONTH, DAY*"	
Query	"SYST:DATE? "	
Parameters	*YEAR:* *MONTH:* *DAY:*	The 4 digit year from 1980 to 2079. The month from 1 to 12. The day from 1 to 31.
Query Reply	*YEAR, MONTH, DAY*	
Notes	The internal calendar is active even when the unit is NOT connected to a power source.	
See Also	3.4.7.3	

SYSTEM:ERROR?		
Purpose	Gets the next entry in the error message queue.	
Query	"SYST:ERR?"	
Query Reply	*ERROR:*	The error number and the error description text separated by a comma. The possible errors supported are listed in Section – Error Messages. Unlisted error messages may be added as improvements are made to the RPM3.
Notes	The RPM3 has an error queue that retains up to 20 errors. The "SYSTem:ERRor?" query is used to remove them one at a time. If an error occurs and the error queue is full, then the oldest entry will be lost to make way for the new error. You should check and empty this queue if an error is detected (by COM1 "ERROR" reply or GPIB service request). When you receive the reply "0, No error", then the error queue is empty.	

SYSTEM:IDENTIFY		
Purpose	Gets or sets the RPM3 identification string.	
Command	"SYST:IDEN *ID*"	
Query	"SYST:IDEN?"	
Parameters	*ID:*	'An alphanumeric string of (up to) 12 characters that the user can use to identify the RPM3. This string is stored in permanent memory and cannot be erased by normal user operation. The ID can be entered or edited from the front panel only. The default is the text "NONE".
Query Reply	*ID*	
Also see	3.4.7.4	

SYSTEM:KEY		
Purpose	Places a key press in the keypad queue, simulating an actual key press.	
Command	"SYST:KEY *KEYCODE*"	
Parameters	*KEYCODE:*	'0' to '9' to simulate keys '1' through '9' being pressed '10' for the decimal point key '11' for the ⇐ key '12' for the ⇒ key '13' for the ESCAPE key '14' for the ENTER key '15' for the ± key '16' for the POWER key
Notes	The RPM3 keypad queue can hold up to 20 entries before additional entries are ignored.	

SYSTEM:KLOCK		
Purpose	Locks and unlocks the RPM3 keypad.	
Command	"SYST:KLOC *BOOLEAN*"	
Query	"SYST:KLOC?"	
Parameters	*BOOLEAN:*	'0' or 'OFF' to unlock the keypad '1' or 'ON' to lock the keypad
Query Reply	*BOOLEAN:*	'0' or '1'
Notes	The RPM3 keypad can only be unlocked using this command, or by cycling the power button.	

SYSTEM:POWER	
Purpose	Turns the RPM3's power ON or OFF.
Command	"SYST:POW *BOOLEAN*"
Query	"SYST:POW?"
Parameters	*BOOLEAN:* '0' or 'OFF' to turn the RPM3 OFF '1' or 'ON' to turn an RPM3 ON
Query Reply	*BOOLEAN:* '0' or '1'
Notes	The RPM3 will NOT respond to remote commands except the SYSTem:POWer command when it is OFF. You must use this command to turn it ON before usage if it is OFF. You should also use the SYSTem:POWer? Query to check that the RPM3 has turned back ON after requesting that the unit turn ON to ensure that it has completed it's power on startup routines.
See Also	3.1.4

SYSTEM:RANGES[*N*]?		
Purpose	Reads all of the defined ranges and range units for the specified RPT.	
Query	"SYSTem:RANGes[*n*]?"	
Suffix	*n:*	'1' to access the high pressure RPT (default) '2' to access the optional Lo RPT
Query Reply	*LABEL, UNITS, TYPE, SDS, LOABS, MEDABS, HIABS, LOGA, MEDGA, HIGA:*	
	LABEL:	The text label that appears on power up and in the "*IDN" query that identifies this RPT.
	UNITS:	The pressure units that the range values to follow are defined in. This will be "Psi" if the unit is a US version. If the unit is an Si version, the unit will be "kPa" or "MPa" depending on the range values.
	TYPE:	'0' if the RPT is an absolute type. '1' if the RPT is a gauge type.
	SDS:	'0' if the "SDS" option is not available on this RPT. '1' if the "SDS" option is available on this RPT.
	LOABS: *MEDABS:* *HIABS:*	The 'LO' range absolute value. The 'MED' range absolute value. The 'HI' range absolute value.
	LOGA: *MEDGA:* *HIGA:*	The 'LO' range gauge value. The 'MED' range gauge value. The 'HI' range gauge value.
Notes	The absolute range values for gauge type RPTs are of NO use, but are given anyway.	
See Also	3.1.6, 3.2.2	

SYSTEM:SDS[*N*]		
Purpose	Turns the SDS system for the specified RPT ON or OFF.	
Command	"SYST:SDS[*n*] *BOOLEAN*"	
Query	"SYST:SDS[*n*]?"	
Suffix	*n:*	'1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Parameters	*BOOLEAN:*	'0' or 'OFF' to turn the SDS OFF for the specified RPT '1' or 'ON' to turn the SDS ON for the specified RPT
Query Reply	*BOOLEAN:*	'0' or '1'
Notes	Caution must be used when turning the SDS OFF, as this connects the RPT to the test port. SDS should be turned ON when an RPT is NOT being used, and must be turned OFF when you need to use an RPT to measure with. If an over-pressure occurs, the SDS will automatically turn ON.	
See Also	SDS is not present on RPM3 A30000/A6000-AF.	

SYSTEM:TIME		
Purpose	Reads or sets the RPM3 real time clock.	
Command	"SYST:TIME *TIME*"	
Query	"SYST:TIME? "	
Parameters	*TIME:*	The time in the form HH:MM "AM"|"PM" in 12 hour format. The seconds are reset to 0 when the time is set.
Query Reply	*YEAR, MONTH, DAY*	
Notes	The internal clock is active even when the unit is NOT connected to a power source.	

SYSTEM:VERSION?		
Purpose	Gets the SCPI date and version.	
Query	"SYST:VERS?"	
Query Reply	*VER:*	The SCPI compatibility date and revision number in the form YYYY:*n*: where YYYY is the date and n is the revision

4.4.2.9 UNIT SUBSYSTEM

Each RPT channel has a separate default pressure unit. The default unit is the last unit used on the RPT channel. All pressure dependent communications sent to the RPM3 are interpreted in the current default pressure unit for the specified RPT channel unless a pressure unit suffix follows the setting, with at least one white space between the setting and the unit text. There is also a user defined unit available whose definition is NOT RPT specific.

UNIT:HEIGHT		
Purpose	Changes the default head height for both RPTs.	
Command	"UNIT:HEIG *UNIT*"	
Query	"UNIT:HEIG?"	
Parameters	*UNIT:*	"in" to specify the default head height in inches "cm" to specify the default head height in centimeters
Query Reply	*UNIT:*	"in" or "cm"
Notes	The head units and height apply to both RPT channels.	
See Also	3.2.8, 3.3.1	

UNIT[*N*][:PRESSURE]		
Purpose	Changes the default pressure unit for the specific RPT.	
Command	"UNIT[*n*] *PRESUNIT*"	
Query	"UNIT[*n*]?"	
Suffix	*n:*	'1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Parameters	*PRESUNIT:*	"psi" "psf" "inHg" "inWa" "kcm2" "Pa" "kPa" "MPa" "mbar" "bar" "mmHg" "mmWa" "mWa" "ft" "m" "user" (Text is user definable)
Query Reply	*PRESUNIT*	
Notes	Each RPT can be assigned a different pressure unit. The "user" unit can be configures by the user using the "UNIT[*n*]:USER" command.	
See Also	3.2.3, 3.3.2	

UNIT[*N*][:PRESSURE]:COEFfICIENT?		
Purpose	Converts a pressure from Paa to the default pressure unit.	
Query	"UNIT[*n*]:COEF? [*PRESSURE*]"	
Suffix	*n:*	'1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Parameters	*PRESSUREIN:*	An optional pressure value to convert from Paa to the default pressure unit (default is 1 Paa).
Query Reply	*PRESSOUT:*	The Pressure value converted in the default pressure units
See Also	7.1	

UNIT[n][:PRESsure]:MODE		
Purpose	Changes the default measurement mode for the specific RPT.	
Command	"UNIT[*n*]:MODE *PRESMODE*"	
Query	"UNIT[*n*]:MODE?"	
Suffix	*n:*	'1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Parameters	*PRESMODE:*	"a" or "ABSOLUTE" for absolute measurement mode. "g" or "GAUGE" for gauge measurement mode.
Query Reply	*PRESMODE:*	"a" or "g"
Notes	Each RPT can be assigned a different pressure mode. The pressure units "m" and "ft" are always absolute. Gauge RPTs must use gauge units.	
See Also	3.2.4	

UNIT[n]: PRESsure: TEMPerature		
Purpose	Reads or sets the temperature to use if the selected pressure unit is "inWa".	
Command	"UNIT:PRES[*n*]:TEMP *TEMPERATURE*"	
Query	"UNIT:PRES[*n*]:TEMP?"	
Suffix	*n:*	'1' to access the Hi RPT (default) '2' to access the optional Lo RPT
Parameters	*TEMPERATURE:*	"4" for 4°C (default) "20" for 20°C "60" for 60°F
Query Reply	*TEMPERATURE:*	"4"|"20"|"60"
Notes	Each RPT can be assigned a different "inWa" temperature setting. This only affects the "inWa" pressure unit.	
See Also	3.3.2	

UNIT[:PRESsure]:USER		
Purpose	Get or set the user definable pressure unit.	
Command	"UNIT:USER *COEF*"	
Query	"UNIT:USER?"	
Parameters	*COEF:*	Coefficient to multiply pressure in Pascal to get pressure in the current default pressure units.
	LABEL	'The text label to assign to the user unit (1 to 4 characters. NO white spaces).
Query Reply	*COEF, LABEL*	
See Also	3.3.2	

4.5 STATUS SYSTEM

The status system includes the status reporting system which reports general RPM3 events and the status subsystem which reports RPT dependent events to the status reporting system. The user can select which RPM3 events will cause a status change event. These events are then reported to the status system (bit 7 and bit 3 of the status byte register), which also must be configured for the STATus subsystem to generate the service requests described in Section 4.5.1.

There are two 16 bit event registers that make up the top layer of the status subsystem. The OPERation status register handles conditions that are normal for the RPM3, while the QUEStionable status register handles events that could cause measurements to be made under questionable conditions. Other registers layered below these two registers provide the structure necessary to handle the two RPT channels and to enable the events and event transitions. Bit 15 of all of these registers is NOT used because bit 15 represents a sign bit on some computer systems.

4.5.1 STATUS REPORTING SYSTEM

The RPM3 status reporting system is used to track and report system status and errors. The status subsystem is layered under and reports to the status reporting system. It follows the model of the IEEE Std 488.2 and works for the COM1 and the IEEE-488 port with slight differences. The RPM3 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 this manner, so polling must be used. Descriptions of the commands that support the status report system are covered in Section 4.4.2.1.

4.5.1.1 SCPI STATUS SUBSYSTEM

The STATus subsystem commands support the status system by providing registers that allow selection of RPM3 events that are reported to the status system. A description of this subsystem and its commands is provided (see Section 4.4.2.7).

4.5.1.2 ERROR QUEUE

The RPM3 uses an error queue to keep track of remote errors. When an error occurs, it is pushed onto the error queue. If you are using the COM1 port, a reply to each command **must** be read before issuing another command. The COM1 will reply **<ERROR>** whenever an error message is placed in the error queue.

The “SYSTem:ERRor?” query can then be used to read and remove the error(s) one at a time from the error queue in it’s numeric and descriptive text format. The error queue will accumulate errors until 20 entries are in the queue unless they are read and removed from the queue. If you do NOT have the RPM3 setup for issue of a service request when the error queue is NOT empty or you are using the COM1 port, you should periodically check the error queue for new entries and make sure to read and empty it. The error queue should also be checked following a query response timeout to see if the query resulted in an error rather than a response. If you receive the reply **<0, No error>** to the error query, then the error queue is empty.

4.5.1.3 STATUS BYTE REGISTER

The RPM3 contains an 8 bit status byte register that reflects the general status of the RPM3:

Table 13. 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 RPM3 reply output queue, the error queue, the Standard Event Status register the Ready Event Status register, and the STATus subsystem:

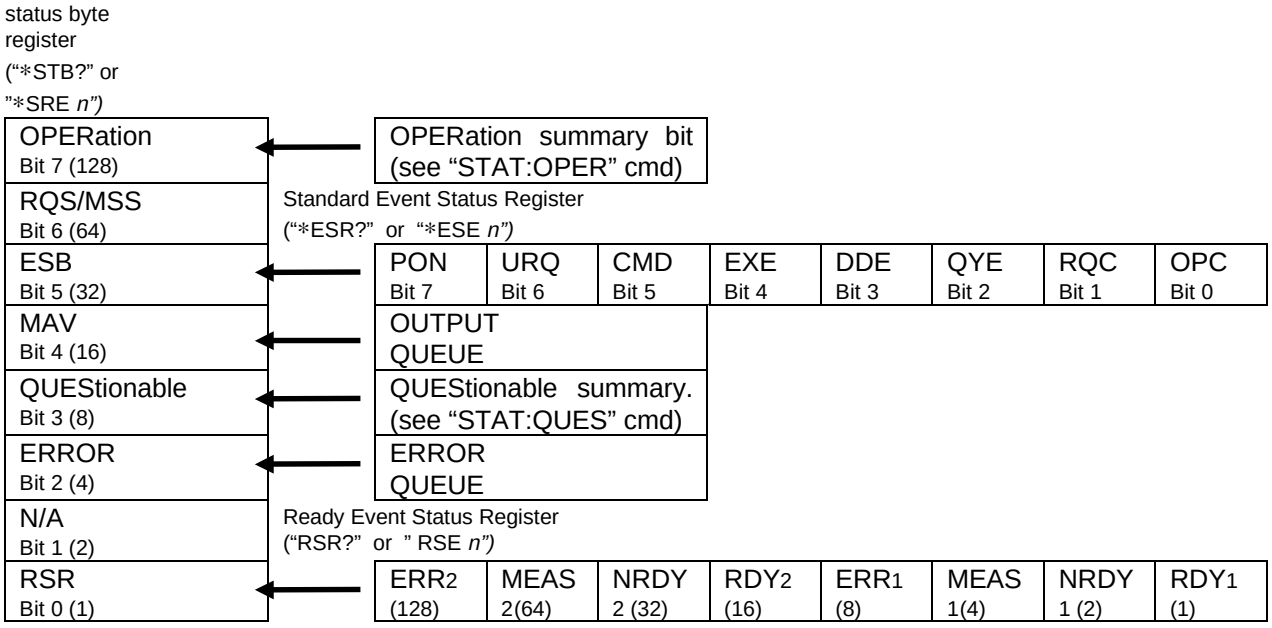


Figure 9. Status Byte Register

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: OPERational event register summary bit (Bit 7)

  This bit is set and clears by the OPERational summary bit controlled by the STATus subsystem (see the "STATus:OPERation" commands below).

- RQS: Requested Service (Bit 6)

  Indicates that the SRQ line of the IEEE-488 interface has been asserted by the RPM3. This bit is cleared when a serial poll is performed on the RPM3, 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)

  Indicates that an event or events occurred that caused the RPM3 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 (Bit 5)

  Indicates if an enabled bit in the Standard Event Status Register became set (see Section 4.5.1.4).

- MAV: Message Available Bit (Bit 4)

  Indicates that at least one reply message is waiting in the RPM3 IEEE-488 output queue.

- QUES: QUEStionable event register summary bit (Bit 3)

  This bit is set and clears by the QUEStionabl summary bit controlled by the STATus subsystem (see the "STATus:QUEStionable" commands following).

- ERR: Error Queue NOT empty (Bit 2)

  Indicates that at least one command error message is waiting in the RPM3 IEEE-488 error message queue. Use the "SYSTem:ERRor?" query to get this message.

- RSB: RPT ready summary bit (Bit 0)

  Indicates that an enabled bit in the RPT ready status register became set.

4.5.1.4 STANDARD EVENT REGISTER

The RPM3 contains an 8 bit Standard event register that reflects specific RPM3 events that are NOT RPT dependent. Enabled events in this register will set or clear the ESB bit of the status byte register.

Table 14. Standard Event Register

PON (128)	URQ (64)	CMD (32)	EXE (16)	DDE (8)	QYE (4)	RQC (2)	OPC (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 RPM3 power has been cycled since the last time this bit was read or cleared.

- URQ: User Request (Bit 6)

  Indicates that the RPM3 was set to local operation manually from the front panel by the user (pressing the **[ESCAPE]** key).

- 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 RPM3 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 RPM3 without reading a waiting reply.

- RQC: Request Control (Bit 1)

  This bit is NOT supported as the RPM3 cannot become the active controller in charge.

- OPC: Operation Complete (Bit 0)

  Indicates that the RPM3 has completed all requested functions.

4.5.1.5 RPT READY STATUS REGISTER

The RPM3 contains an 8 bit RPT ready status register the reflects RPM3 RPT measurement and stability ready events for the high or (optional) Lo RPT. Enabled events in this register will set or clear the RSB bit of the Status Byte Register.

Table 15. 8 Bit RPT Ready Status Register

ERR2 (128)	MEAS2 (64)	NRDY2 (32)	RDY2 (16	ERR1 (8)	MEAS1 (4)	NRDY1 (2)	RDY1 (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:

- MEAS1: Measurement complete (Bit 1)

  This bit is set when the Hi RPT (channel1) measurement is complete. You do NOT have to initiate the measurement cycle to use this bit.

- NRDY1: Stability NOT ready (Bit 2)

  Indicates that the Hi RPT (channel1) has made a transition from inside the stability limit to outside the stability limit as defined by the control settings (see the "CALCulate:STABility1:LIMIT" command).

- RDY1: Stability ready (Bit 4)

  Indicates that the Hi RPT (channel1) has made a transition from outside the stability limit to inside the stability limit as defined by the control settings (see the "CALCulate:STABility1:LIMIT" command).

- ERR1: RPT error (Bit 8)

  Indicates that the Hi RPT (channel1) has exceeded the maximum pressure for the current Hi RPT range.

- MEAS2: Measurement complete (Bit 16)

  This bit is set when the Lo RPT (channel2) measurement is complete. You do NOT have to initiate the measurement cycle to use this bit.

- NRDY2: Stability NOT ready (Bit 32)

  Indicates that the Lo RPT (channel2) has made a transition from inside the stability limit to outside the stability limit as defined by the control settings (see the "CALCulate:STABility2:LIMIT" command).

- RDY2: Stability ready (Bit 64)

  Indicates that the Lo RPT (channel2) has made a transition from outside the stability limit to inside the stability limit as defined by the control settings (see the "CALCulate:STABility2:LIMIT" command).

- ERR2: RPT error (Bit 128)

  Indicates that the Lo RPT (channel2) has exceeded the maximum pressure for the current Lo RPT range (see Section 3.2.5).

4.5.2 STATUS SUBSYSTEM

The status subsystem reports RPT channel dependent events to the status report system (see Section 4.5.1). This subsystem is a hierarchy of registers that allow selection and monitoring of RPT events that are reported to the status report system. If a user sets up and enables events to be report in the sub system, the status report system also must be setup to allow these events to generate a IEEE-488 service request. The top level of the status subsystem includes the OPERation and QUEStionable register structures. These two are very similar in structure and usage, and provide independent event reporting for each of the (up to) two RPT's in the RPM3.

4.5.2.1 OPERATION REGISTER STRUCTURE

The OPERation status register has only one bit that is used by the RPM3. Bit 13 is set by either bit 0 or bit 1 of the operation instrument event register. These bits are in turn set whenever enabled bits of either the ISUMmary1 or :ISUMmary2 event registers are set. This allows separate status registers for the Hi or Lo RPT channels. When bit 13 of the OPERation register is set, this can set bit 7 of the status byte register (see Section 4.5.1), which can cause a service request if configured to do so.

Only a few of the ISUMMARY event bits are supported by the RPM3. The definition of the bits that are defined and used by this register are as follows:

- Bit 2: The RPM3 is currently changing a range.

- Bit 4: The RPM3 is executing a remote measurement cycle.

Each register has an associated positive and negative transition filter register, an EVENT register, and an ENABle register that determine if a FALSE to TRUE and/or a TRUE to FALSE event bit causes the event to be reported. The condition register (OPERation, INSTrument or ISUMmary) is the start of the events that occur and is fed into the positive and negative transition filters (PTRansition / NTRansition) where it is determined if a FALSE to TRUE or TRUE to FALSE transition will create an event. This result is stored in the EVENt register (OPERation, INSTrument or ISUMmary). The ENABle register determines which of these events will be reported to the next level. All of these registers exist within the OPERation, INSTrument and ISUMmary registers.

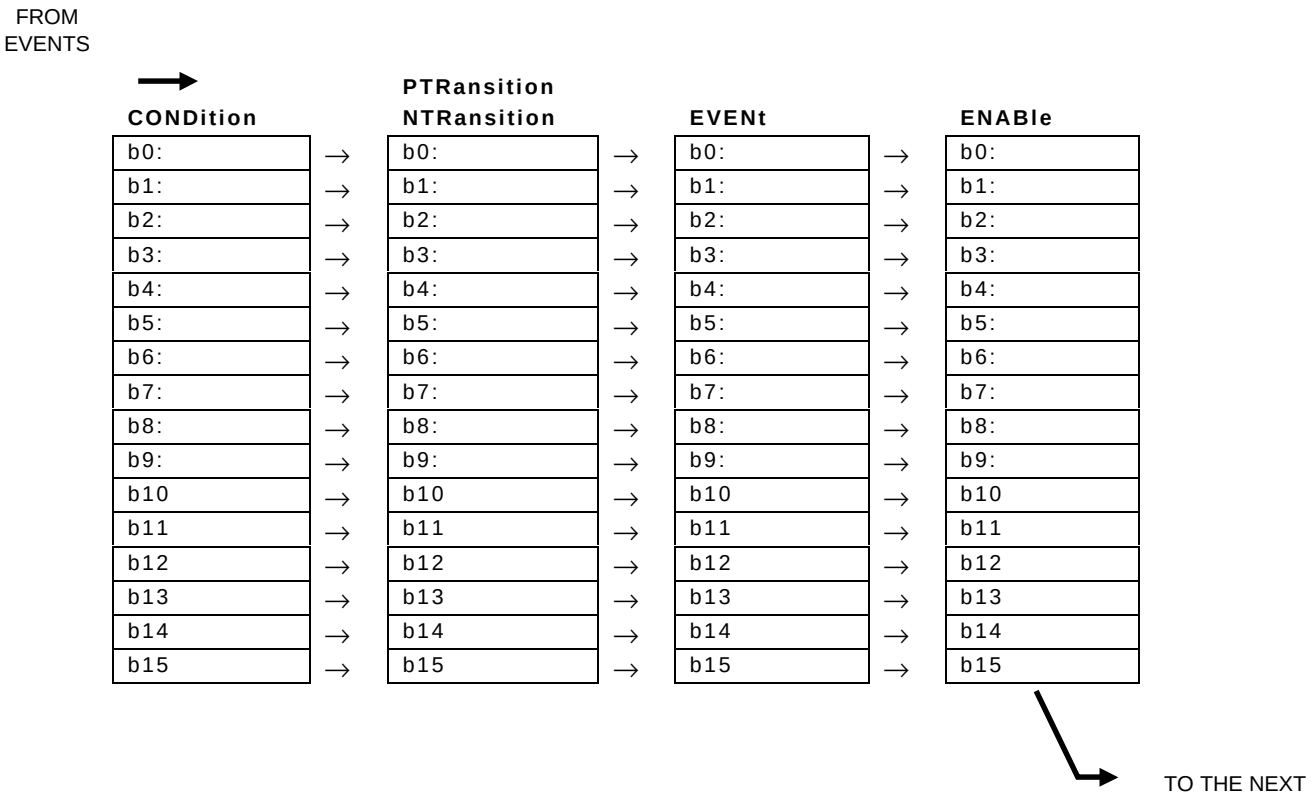


Figure 10. Illustration of this Structure Duplicated for Each of the OPERation, INSTrument, and ISUMmary Registers

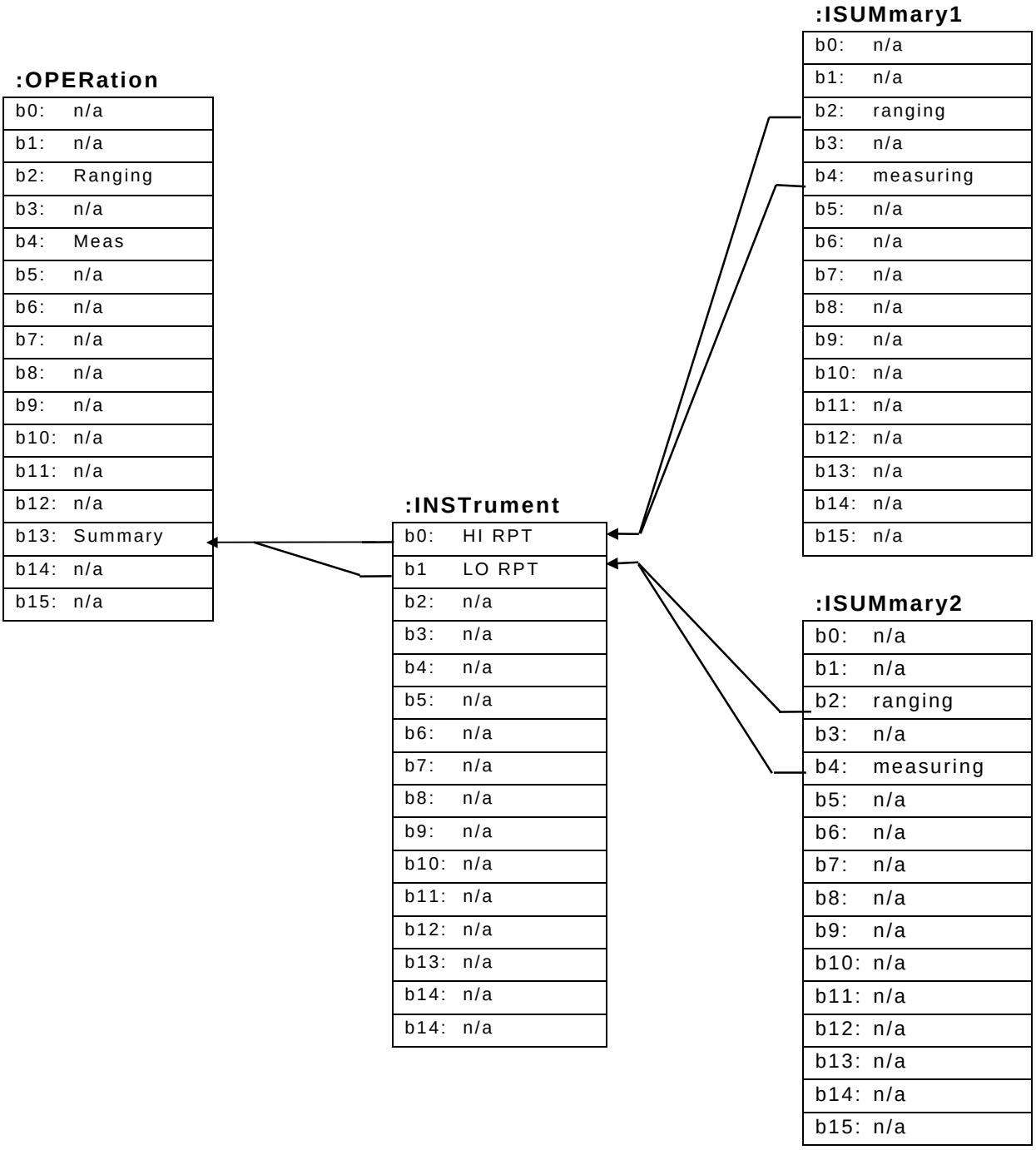


Figure 11. Relationship of the OPERation Register and Its Support Registers

4.5.2.2 QUESTIONABLE REGISTER STRUCTURE

The QUEStionable status register has only one bit that is used by the RPM3. Bit 13 is set by either bit 0 or bit 1 of the questionable instrument event register. These bits are in turn set whenever enabled bits of either the ISUMmary1 or :ISUMmary2 registers are set. This allows separate status registers for the Hi or Lo RPT channels. When bit 13 of the QUEStionable register is set, this can set bit 3 of the status byte register, which can cause a service request if configured to do so (see Section 4.5.1).

Only a few of the ISUMMARY bits are supported by the RPM3. The definition of the bits that are defined and used by the RPM3 QUEStionable register as follows:

- Bit 9: The RPM3 is NOT within the stability limit defined by the CALC:STAB:LIMIT setting.

- Bit 14: The RPM3 has received and executed a command that contained data that could NOT be used and may result in unexpected behavior.

Each register has an associated positive and negative transition filter register, an EVENT register, and an ENABle register that determine if a FALSE to TRUE and/or a TRUE to FALSE event bit causes the event to be reported. The condition register (QUEStionable, INSTrument or ISUMmary) indicates the start of events that occur and is fed into the positive and negative transition filters (PTRansition / NTRansition) where it is determined if a FALSE to TRUE or TRUE to FALSE transition will create an event. This result is stored in the EVENt register (QUEStionable, INSTrument or ISUMmary). The ENABle register determines which of these events will be reported to the next level. All of these registers exist within the QUEStionable, INSTrument and ISUMmary registers.

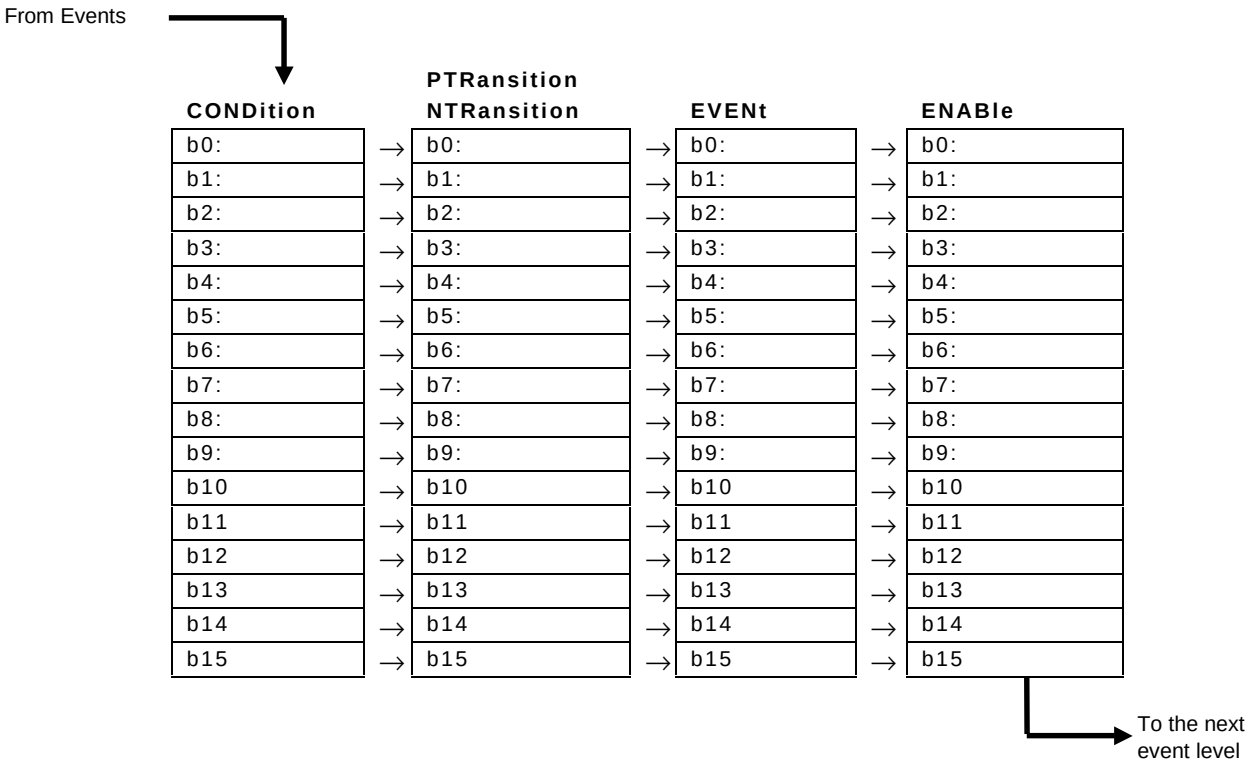


Figure 12. Illustration of this Structure Duplicated for Each of the OPERation, INSTrument, and ISUMmary Registers

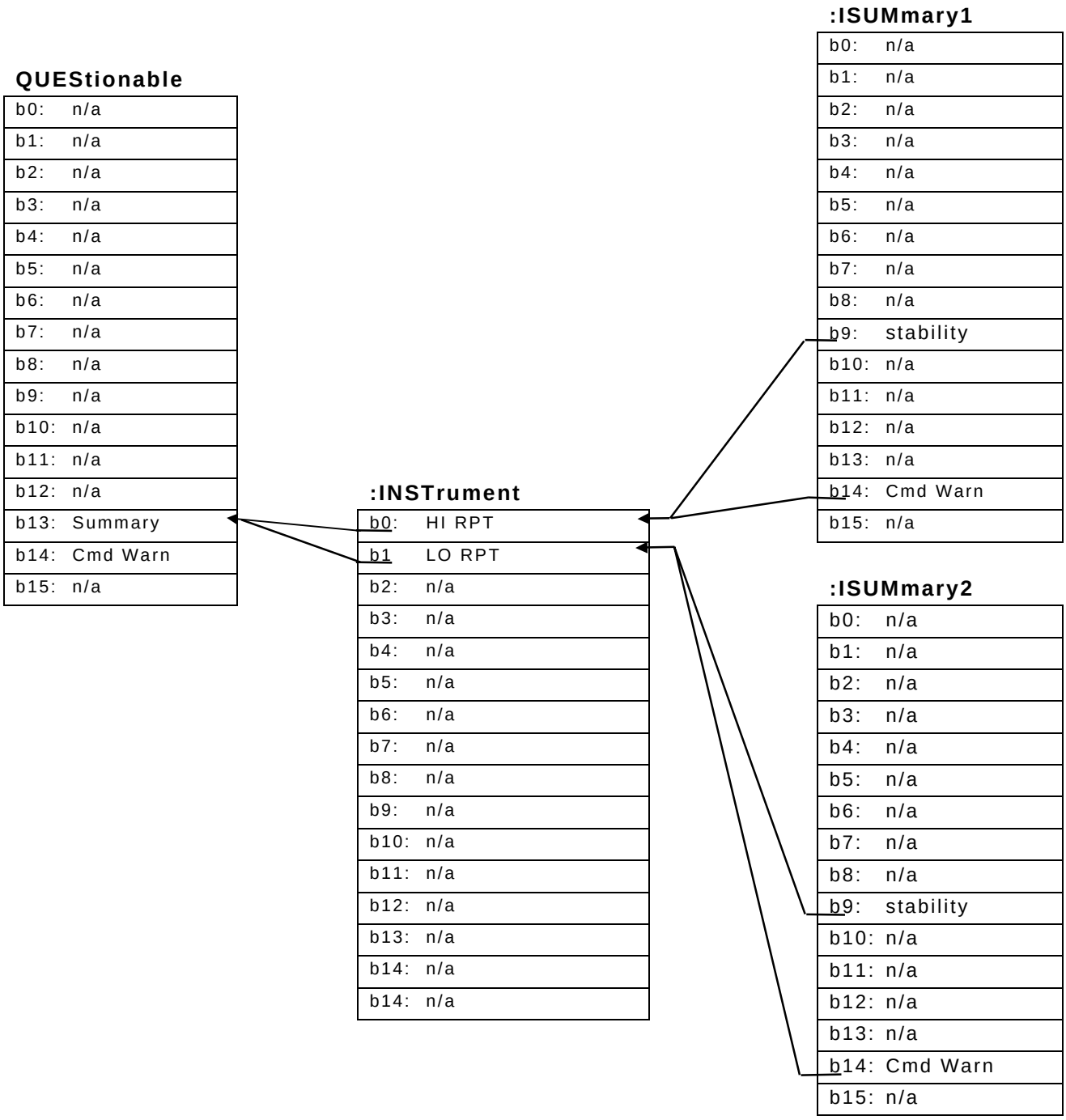


Figure 13. Relationship of the QUEStionable Register and Its Support Registers

NOTES

5. MAINTENANCE, CALIBRATION AND REPAIR

5.1 INTRODUCTION

RPM3/HPMS A30000/A6000-AF was designed for maintenance free operation. No maintenance is required other than:

- Rezeroing of reference transducers (RPT) as needed (see Section 3.2.10).
- Regular reference transducer calibration (see Section 5.3).
- Adjustment of the on-board barometer as needed (see Section 5.2.2).

This section provides information on maintenance, calibration and repair procedures.

From a maintenance, calibration and repair point of view, the RPM3 and HPMS are treated as separate sub-systems.

⚠ RPM3/HPMS A30000/A6000-AF is a sophisticated pressure measuring instrument with advanced on-board features and functions. Before assuming that unexpected behavior is caused by system defect or breakdown, use this manual and other training facilities to become thoroughly familiar with RPM3/HPMS operation. For rapid assistance in specific situations, see Section 6.

⚠ RPM3/HPMS A30000/A6000-AF is covered by a limited 1 year warranty (see Section 7.2). Units purchased under AFMETCAL Contract F33660-99-C7003 are covered by an extended 5 year warranty (see Section 7.2). 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 RPM3 MAINTENANCE

5.2.1 AUTOZERO OF RPTs

See Section 3.2.10 for complete information on Autozeroing of RPTs.

5.2.1.1 GAUGE MODE OPERATION

When operated in gauge mode, a measurement range should be Autozeroed if the pressure reading observed when zero (atmospheric) pressure is applied, is different from zero by more than ± 0.015 % full scale of the active range. When evaluating zero errors allow at least two minutes for full system stabilization after venting; be sure that the pressure applied is truly zero (i.e., the RPT is truly vented/connected to atmosphere with no back pressure) and be sure to consider the influence of fluid heads.

To cause the range to Autozero, press **[AutoZ]**. Always wait at least two minutes after venting for full system stabilization before pressing **[AutoZ]**.

If the RPM3 is only used in gauge mode, Autozeroing in absolute mode is not necessary and vice-versa. Gauge and absolute mode Autozeroing are completely independent one from the other.

5.2.1.2 ABSOLUTE MODE OPERATION

When operated in absolute mode, a measurement range should be Autozeroed about once a month. Follow the procedures described in Section 3.2.10.2 to perform absolute mode Autozeroing. The exact procedure depends on the reference relative to which the RPM3 will be autozeroed.

If the RPM3 is only used in absolute mode, Autozeroing in gauge mode is not necessary and vice-versa. Gauge and absolute mode Autozeroing are completely independent one from the other.

5.2.2 ADJUSTMENT OF ON-BOARD BAROMETER

❍ **PURPOSE**

To adjust the output of the on-board barometer (see Section 3.4.3).

❍ **PRINCIPLE**

The on-board barometer output can be adjusted using PA and PM values following the same principles as for the RPTs (see Section 5.3.1.1).

Since the on-board barometer is not a source of traceable pressure values, it does not have to be formally calibrated. It should be offset to agree with a reference barometer. To offset the barometer, change the barometer pressure adder (PA).

The on-board barometer is used only for measuring changes in atmospheric pressure over short periods of time (see Section 3.4.1, Gauge Mode with an Absolute RPT, Dynamic Compensation for Atmospheric Pressure). RPM3 measurement accuracy does NOT depend on the absolute accuracy of the on-board barometer.

❍ **OPERATION**

To view or edit the values of PA and PM for RPM3's on-board barometer, press **[SPECIAL]** and select **<6cal>**, **<2barometer>**. Pressing **[ENTER]** steps through displays of the calibration date [YYYYMMDD] and PA/PM. In edit mode, the values can be edited. Pressing **[ENTER]** after the last screen activates the edited values.

To view the current atmospheric pressure measurement made by the on-board barometer press [SPECIAL] and select <3Atm>.

A pressure standard may be connected to the on-board barometer by connecting to the ATM port on the RPM3 rear panel (10-32 UNF). The operating span of the barometer is 10 psi (70 kPa) to 16 psi (110 kPa).

Never apply a pressure greater than 16 psi (110 kPa) to the barometer port. Overpressure and possible damage can result.

5.2.3 RPM3 OVERHAUL

The RPM3 A30000/A6000-AF is overhauled as part of the RPM3/HPMS A30000/A6000 assembly. See Section 5.5.1 for the overhaul procedure.

5.3 RPM3 RPT CALIBRATION

5.3.1 PRINCIPLE

RPM3 A30000/A6000-AF has two reference pressure transducers (RPTs) that are the source of accurate pressure measurement for the system. Each transducer has three independent ranges.

To calibrate a range, pressures from a standard are applied to the RPT at ascending and descending points over the range. The pressure defined by the standard and the corresponding RPT readings are recorded at each point. After all of the pressures have been applied and recorded, adjustments are made to the RPT to fit the RPT pressure readings to the standard. Fitting the readings means performing a least squares linear regression to arrive at the lowest value of the residuals of errors of the transducer relative to the standard. The transducer readings are adjusted by user settable coefficients: PA (an adder or offset) and PM (a multiplier or span set) (see Section 5.3.1.1).

The calibration process is performed independently on each range of each RPT to arrive at the optimal fit for each range. This technique allows reduced measurement uncertainties by taking into account specific transducer performance characteristics, in particular localized non-linearity and/or excursion dependent hysteresis. Independent range calibration also makes it possible to calibrate only certain ranges if ranges are on different calibration intervals or NOT all ranges are needed.

The RPM3 A30000/A6000-AF RPTs are of the absolute type: they measure pressure relative to a sealed, evacuated, reference. Gauge pressure measurements are made by offsetting absolute measurements for atmospheric pressure. For this reason, RPM3 A30000/A6000-AF RPTs must be calibrated in the absolute mode by applying absolute pressures, even if they will not be used for absolute pressure measurement.

If the RPT will be used to measure absolute pressure, the normal calibration process includes a second step which is the determination of the value of ZNATERR (see Sections 5.3.1.2). This added step is necessary to receive the full benefit of the Autozero function for absolute mode measurements between calibrations (see Section 3.2.10). It is only needed if the RPT will be operated in absolute measure mode.

CalTool software, provided as part of the standard delivery of each new RPM3, supports the RPT calibration process. CalTool is supplied on a 3.5 in. installation disc and includes a complete manual. Most users should use CalTool software to assist in the calibration of RPM3.

RPM3 is delivered with an interactive RPT calibration utility that steps the operator through the complete RPT calibration procedure including applying reference pressures, collecting data, calculating new PA/PM values, previewing the results of the new calibration, determining ZNATERR and activating the results of the new calibration (see the CalTool for RPM3 manual). RPM3 also provides complete local and remote access and control of RPT calibration parameters so that RPT calibrations can be performed without using CalTool software (see Section 5.3.7).

5.3.1.1 PA/PM COEFFICIENTS

The coefficients used to adjust RPT readings are designated PA (an adder or offset) and PM (a multiplier or span set). The coefficients affect the RPT reading following:

Corrected reading = (uncorrected reading • PM) + PA

PA is expressed in units of pressure (always the SI unit, Pascal [Pa]).

PM is dimensionless.

There are individual PA/PM values for each of RPM3's six ranges. The PA/PM values currently in use can be viewed in the calibration function (see Section 5.3.5). PA/PM values are automatically edited when CalTool software is used and the results are activated. PA/PM values can also be edited manually under the RPM3 calibration function (see Section 5.3.5).

⚠ As editing PA/PM values will change RPT calibration, they should only be edited by qualified personnel as part of the calibration process. Caution should be taken to avoid accidental editing (see Section 3.4.8).

A new RPM3 is delivered with PA/PM values set to zero and 1 respectively for all ranges. This does NOT mean that the RPM3 has NOT been calibrated. For the original factory calibration, privileged factory coefficients are used for calibration adjustment.

PA/PM calibration coefficients are applied to the ABSOLUTE pressure measured by the RPT range. GAUGE pressures are derived by subtracting atmospheric pressure from ABSOLUTE pressures.

5.3.1.2 SETTING ZNATERR

Setting ZNATERR is only necessary if the RPM3 will be used in the absolute measurement mode and the AutoZ function that **rezeros** the reference transducers between calibrations is to function optimally (see Section 3.2.10).

Setting ZNATERR is procedurally identical to running the AutoZ function but the result is changes to the ZNATERR value rather than the ZOFFSET value. The ZNATERR setting procedure is prompted automatically by CalTool software. It can also be run separately by pressing **[SPECIAL]** and selecting **<4Internal>**, **<2Cal>**.

⚠ As ZNATERR must reflect the "natural" error between the RPT and ZSTD at the time the reference transducer is calibrated, the run ZNATERR function should NOT be executed between calibrations. Only the AutoZ function should be used to "rezero" the reference transducer between calibrations (see Section 3.2.10).

5.3.1.3 ORDER OF OPERATIONS

If the RPM3 is going to be used in the absolute measurement mode and the Hi RPT (A30000) will be autozeroed by the Lo RPT (A6000) (see Section 3.2.10), calibrate and determine the ZNATERR of the Lo RPT Range3 prior to calibrating the Hi RPT. This is necessary since the ZNATERR determinations for the Hi RPT ranges will be made relative to the Lo RPT Range 3 (L3).

5.3.1.4 AS RECEIVED/AS LEFT DATA

Frequently, calibration reports 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 RPM3 RPTs can be obtained in several ways.

When the RPM3 CalTool calibration assistance software is used, as received data is displayed while running the calibration and is automatically recorded and provided in the calibration report, if desired. As left data is also calculated and presented.

As received/as left values can be calculated at any time after a calibration using the reference pressures applied, the associated RPT readings, PA/PM, ZOFFSET. For example, backing out PA/PM on the as left data yields the transducer readings with PA = 0 and PM = 1. Then applying the as received PA/PM and ZOFFSET values to the readings calculates **as received** readings (the readings that the transducer would have made with the old PA/PM and ZOFFSET).

⚠ It is recommended that "as received" values of PA/PM (and ZOFFSET for absolute RPTs if autozero is used in normal operation) be recorded for each range prior to running the calibration. The current PA/PM for the active range can be viewed by pressing [SPECIAL] and selecting <6Cal>, <1PRT>, <1view>. ZOFFSET's current value can be viewed by pressing [SPECIAL], and selecting <1AutoZ>, <2view>.

5.3.2 EQUIPMENT REQUIRED

DHI manufactures piston gauges and barometers suitable for calibration of RPM3 A30000/A6000-AF. Contact DHI for additional information.

1) **Oil operated piston gauge (deadweight tester),** with the following characteristics:

   - **Pressure range of 75 to 30 000 psi (2.75 to 300 MPa).**
   - **Measurement uncertainty of ± 0.005 % of reading or better**, if minimum RPM3 measurement uncertainty is to be obtained. A standard with higher measurement uncertainty may be used but RPM3 measurement uncertainty will be increased proportionally (see Section 1.2.2.1). Piston gauges in this range set GAUGE pressures (pressure relative to atmosphere). Calibration of the RPM3 A30000/A6000 RPTs requires the application of ABSOLUTE pressures (pressure relative to vacuum). To obtain ABSOLUTE pressure values with a high pressure oil piston gauge, barometric pressure read from a barometer (see 2) below) is added to the GAUGE pressures defined by the piston gauge to arrive at ABSOLUTE reference pressures.

- **Able to apply pressures at 20 % increments in the range to be calibrated and a low point of 75 psia (600 kPa):** It is NOT necessary that the calibration pressure standard used apply precisely the nominal pressure value requested for a calibration point as long as the exact value of the applied pressure is known. Best results will be obtained if the pressure actually applied is within ± 2 % FS of the range being calibrated from the nominal increment. Due to fluid head and density influences, low absolute pressure set with an oil piston gauge tend to have high uncertainties. For this reason, the minimum test point should not be less than 400 kPa (50 psia), atmospheric pressure (system vented is not a valid low point).

2) Barometer: The barometer is used to measure atmospheric pressure which is added to the gauge pressure defined by the piston gauge to arrive at absolute reference pressures. The barometer reading is also used to set ZNATERR (see Section 5.3.6). The barometer used should have measurement uncertainty of ± 0.015 psi (0.1 kPa) or better to avoid deteriorating RPM3 measurement uncertainty.

5.3.3 SET-UP AND PREPARATION

To set-up and prepare the RPM3/HPMS A30000/A6000-AF for calibration:

- **THE RPM3 SHOULD NOT BE REMOVED FROM THE HPMS BRACKET FOR CALIBRATION. THE RPM3/HPMS SHOULD ALWAYS BE KEPT TOGETHER AS AN INTEGRATED UNIT UNLESS DISASSEMBLY IS REQUIRED FOR MAINTENANCE OR REPAIR.**

- Set the RPM3/HPMS A30000/A6000-AF on a stable surface near the calibration standard. Consider the high pressure oil connection to be made to the HPMS rear panel and access to the front panel display, keypad and Lo RPT Isolation valve.

- Connect the calibration standard output to the HPMS rear panel TEST port. The TEST port connection is DH500 F (DH500 F: gland and collar type fitting for coned and left hand threaded 1/4 in. OD tube, equivalent to AE F250C, HIP HF4, etc.). The HPMS TEST port connects to BOTH of the RPM3 A30000/A6000 reference pressure transducers (see Section 3.1.8).

⚠ Take caution to avoid overpressure of the Lo RPT (A6000). If you are calibrating the RPM3 mounted in the HPMS, the HPMS TEST port connects to both the A6000 and the A30000 RPT. Use the Lo RPT Isolation Valve on the HPMS front panel to isolate the Lo RPT when applying pressure to the Hi RPT (see Section 3.1.8). If RPM3 is removed from the HPMS for calibration, note that the RPM3 has separate Lo and Hi TEST ports, one for each RPT. Exposing the Lo RPT to pressure greater than 6 600 psi (46 MPa) may damage it beyond repair. The product warranty does not cover RPT damage due to overpressure.

5.3.4 RPT CALIBRATION USING RPM3 CALTOOL SOFTWARE

To calibrate RPM3 using CalTool software (supplied with the RPM3), refer to Sections 5.3.1, 5.3.2, and 5.3.3 of this manual and then follow the CalTool for RPM3 Software Manual.

5.3.5 EDITING AND VIEWING RPT CALIBRATION INFORMATION

❍ PURPOSE

RPT calibration information fields include:

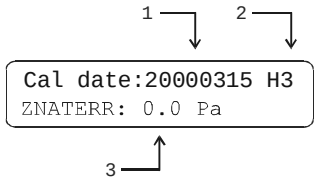
- The calibration date.
- The value of ZNATERR.
- The value of PA.
- The value of PM.

These fields can be viewed and/or edited using **[SPECIAL]**, **<6Cal>**, **<1RPT>**. Viewing and editing calibration information is range specific.

❍ OPERATION

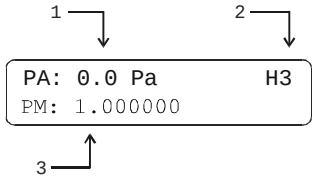
If CalTool for RPM3 software is used for RPM3 calibration, PA and PM are adjusted automatically and do not need be edited using this function.

Activate the desired range from the main run screen using **[RANGE]** (see Section 3.2.2). Then, to view or edit calibration information for the active range, press **[SPECIAL]**, and select **<6Cal>**, **<1RPT>**. Select **<1view>** or **<2edit>**. The **<1view>** selection displays the calibration information fields. The **<2edit>** function displays the fields and allows them to be edited. The display is:



1. Edit field for calibration date if in edit mode.
2. Active RPT measurement range.
3. Edit field for value of ZNATERR if in edit mode.

Pressing **[ENTER]** from the **<ZNATERR:>** field goes to the next view/edit screen:



1. Edit field for value of PA if in edit mode.
2. Active RPT measurement range.
3. Edit field for value of PM if in edit mode.

Pressing **[ENTER]** from the **<PM:>** field returns to the view/edit screen. If editing, and changes have been made, confirmation of change activation is requested. Pressing **[ESCAPE]** in any edit screen exits the edit screen without activating any changes.

⚠ As editing PA/PM values will change the calibration of the 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 (see Section 3.4.8).

The value of PA is always in Pascal (Pa). The value of PM is dimensionless.

There are individual PA/PM values for each RPT range but NOT for gauge and absolute measurement modes. The RPM3 A30000/A6000-AF RPTs are of the absolute type: they measure pressure relative to a sealed, evacuated, reference. Gauge pressure measurements are made by offsetting absolute measurements for atmospheric pressure (see Section 3.4.1, Gauge Mode with an Absolute RPT, Dynamic Compensation for Atmospheric Pressure).

5.3.6 SETTING ZNATERR

- **PURPOSE**

Setting ZNATERR is required as part of the calibration process if the RPM3 is to be used in the absolute measurement mode AND the autozeroing feature will be used between calibrations (see Sections 3.2.10).

ZNATERR is range and operating mode specific. There is NO ZNATERR for gauge mode.

Running ZNATERR in an active range and activating the new ZNATERR value automatically sets ZOFFSET to zero for that range.

- **OPERATION**

If CalTool for RPM3 software is used for RPM3 calibration, ZNATERR is set automatically and ZNATERR does not need to be run using this function.

To set ZNATERR for the active range press **[SPECIAL]** and select **<6Cal>**, **<1RPT>**, **<3run ZNATERR>**. Procedurally, running ZNATERR is identical to running AutoZ in absolute measurement mode (see Section 3.2.10.2).

⚠ Changing the value of ZNATERR between RPT calibrations may invalidate the autozero function for that range. <3 Run ZNATERR> should NOT be used between calibrations.

5.3.7 RPT CALIBRATION/ADJUSTMENT WITHOUT RPM3 CALTOOL SOFTWARE

❍ PRINCIPLE

It is recommended that RPM3 A30000/A6000-AF be calibrated using RPM3 CalTool software.

The reference pressure transducers can be calibrated and adjustments made without using RPM3 CalTool software. This requires:

- Applying pressures with a calibration standard and recording the pressures measured by RPM3.
- Calculating new PA/PM values and entering them.
- Setting ZNATERR for the calibrated range (if the RPM3 will be operated in absolute measurement mode AND the autozero function will be used between calibrations).

Before proceeding to calibrate a reference pressure transducer without using RPM3 CalTool software. Sections 5.3.1, 5.3.2 , and 5.3.3 of this manual should be reviewed thoroughly.

❍ OPERATION

A typical procedure for calibrating an RPT range is:

❶ Set-up and prepare the RPM3 for calibration (see Sections 5.3.2 and 5.3.3).

❷ From the main run screen:

- Using **[RANGE],** select the RPT and range to be calibrated (see Section 3.2.2).
- Using **[HEAD],** set the HEAD to zero (see Section 3.2.8).
- Using **[MODE]**, set the measurement mode to absolute (see Section 3.2.4).
- Using **[SPECIAL], <1Autoz>**, turn AutoZ ON if it is left ON in normal RPM3 operation (see Section 3.4.1.1).

❸ Press **[SPECIAL]** and select **<6Cal>**, **<1RPT>**, **<1view>.** Read and record the current values of PA/PM.

❹ Press **[SPECIAL]**, and select **<1Autoz>**, **<2View>**, to read and record the current value of ZOFFSET.

❺ Run the calibration pressures (generally 20 % increments ascending and descending) for the range recording the pressure applied by the standard and the RPM3 reading at each calibration point. Do not use atmospheric pressure (vented) as the low point. Use a pressure between 50 and 100 psia (400 and 700 kPa). Dwell at least one minute after setting the reference pressure at each point to allow full stabilization The data recorded is the **as received** data for this calibration.

❻ Enter the calibration pressures and RPM3 readings into a spreadsheet. Calculate the **non-corrected** RPM3 readings by backing out the PA, PM and ZOFFSET (absolute RPTs only) recorded in Steps ❸ and ❹ above, following:

non-corrected reading = (corrected reading - PA + ZOFFSET)/PM

❼ Perform a linear regression to find the offset and slope that best fit the non-corrected RPM3 readings to the calibration standard pressures. The offset is the new value of PA, the slope is the new value of PM.

❽ Press **[SPECIAL]** and select **<6Cal>**, **<1RPT>**, **<2edit>** to write the new calibration date and the new values of PA/PM for the RPT and range calibrated (see Section 5.3.5).

❾ Press **[SPECIAL]**, and select **<6Cal>**, **<1RPT>**, **<3run ZNATERR>** to run the ZNATERR routine (see Section 5.3.6).

❿ Calculate **as left data** for the calibration, if desired:

as left reading = (non-corrected reading • new PM) + new PA

⓫ Verify **as left data** for the calibration by reapplying reference pressures, if desired.

5.4 RPM3 REPAIR

5.4.1 REMOVING AND REINSTALLING RPM3 IN THE HPMS

The RPM3/HPMS is an integrated assembly. The RPM3 should not be removed from the HPMS unless it is necessary for RPM3 repairs. The RPM3 should be calibrated in the HPMS mounting system as the RPM3 orientation affects its calibration.

To remove the RPM3 A30000/A6000 from the HPMS High Pressure Mounting System, proceed as follows (numerical references refer to Figure 14):

❶ Turn the HPMS upside down. Set it on its top on a flat surface (2).

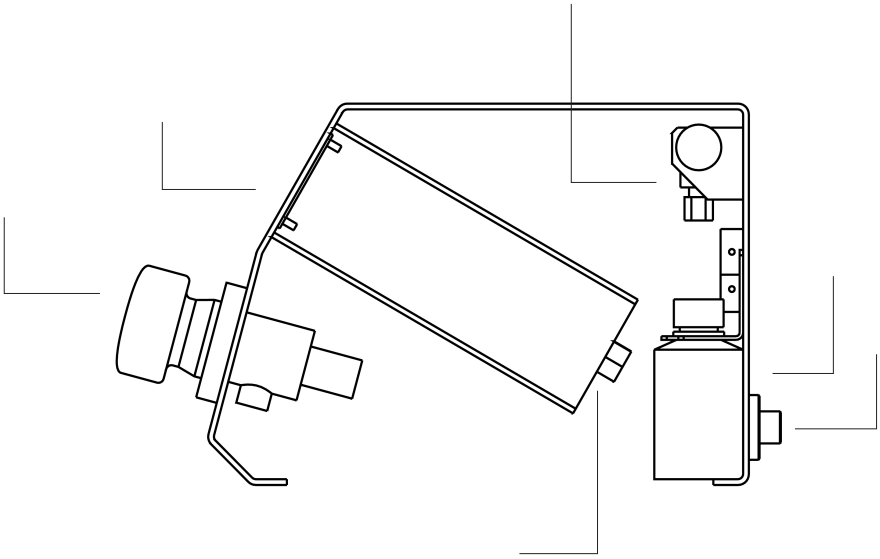
❷ Disconnect the J1 ACC. 9-pin D-sub connector from the RPM3 rear panel (3) and remove the power cable.

❸ Fully loosen the two RPT connections on the RPM3 rear panel (3). Use a 5/8 in. wrench on the gland nut of the Hi RPT DH500 connection. Use a 7/16 in. wrench on the gland nut of the Lo RPT swage connection. Gently push the high pressure tubes away from the RPM3 rear panel.

❹ Remove the nuts on the four RPM3 rack mount bracket studs (1) using a 7 mm wrench.

❺ Slip the RPM3 in its rack mount bracket away for the HPMS front panel until the assembly clears the bracket studs. Remove the RPM3 in its rack mount bracket from the HPMS.

❻ To reassemble, reverse the procedure. When reassembling in the DH500 fitting, be sure that the collar is fully threaded on the nipple (left hand thread) before tightening the gland nut. Leak check the connections after reassembly.



1. RPM3 Rack Mount Bracket Studs and Nuts.
2. HPMS Top Surface.
3. RPM3 Rear Panel (Hi and Lo RPT Connections, J1 Acc. Connection, Power Connection)

Figure 14. RPM3/HPMS Side View

5.4.2 OPENING AND CLOSING THE RPM3 CASE

To open the RPM3 case:

❶ Remove the pop-OFF screw covers on the top four corners of the case.

❷ Remove the four case screws located under the pop-off covers.

❸ Lift OFF the cover taking care NOT to damage the electrical leads connecting the RPM3 main board to the cover mounted cooling fan. Disconnect the cooling fan at the main board terminal to completely remove the cover. Reconnect when reassembling.

5.4.3 RELOADING RPM3 EMBEDDED SOFTWARE INTO FLASH MEMORY

The embedded software that controls RPM3 A30000/A6000-AF's operation is stored in FLASH memory. This allows RPM3's embedded software to be loaded from a personal computer with a simple FLASH loading utility.

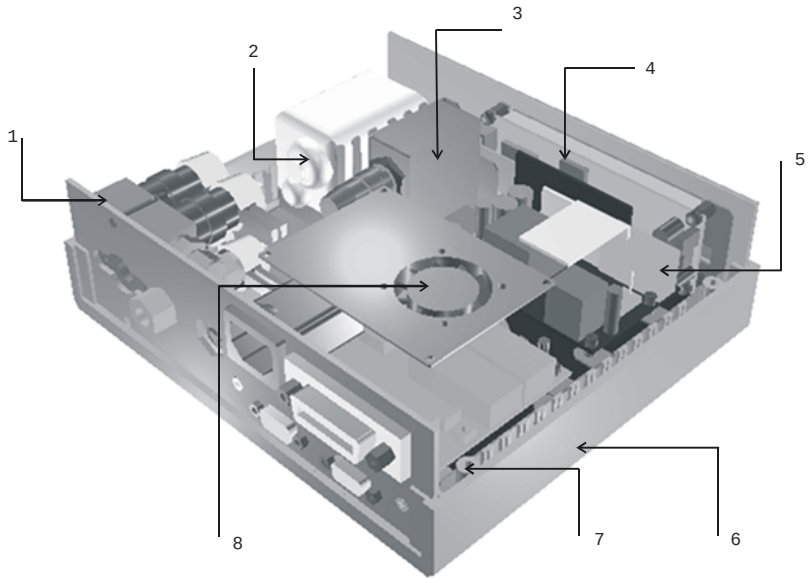
The **DHI** FLASH loading utility and RPM3 A30000/A6000-AF software are available for free download from the SOFTWARE section of **DHI's** worldwide web site (www.dhinstruments.com). RPM3 A30000/A6000-AF has its own, unique software. **Be sure to download RPM3 A30000/A6000-AF software and not the standard RPM3 software.**

To load software into RPM3's FLASH memory, connect the RPM3's COM1 port to the personal computer using a standard 9-pin cable (see Section 4.2.1.1). Check that the RPM3 COM1 port settings are compatible with the computer's COM port settings (see Section 3.4.4).

Run the **DHI** FLASH loading utility and follow the instructions given by the program. When asked to power down the RPM3, unplug it (do not use the soft ON/OFF key).

When downloading FLASH software from www.dhinstruments.com, be sure to select the RPM3 A30000/A6000-AF software, not the standard RPM3 software. There are significant differences between the standard RPM3 and RPM3 A30000/A6000-AF.

5.4.4 RPM3 INTERNAL VIEW



1. SDS module (NOT present in RPM3 A30000/A6000-AF).
2. Lo RPT
3. Hi PRT
4. Display
5. Power Supply
6. On-board barometer (on main board)
7. Micro Board
8. Cooling Fan
9. Main Board (NOT visible, under micro board and power supply)

Figure 15. RPM3 Internal View

5.4.4.1 SDS MODULE

Not present in RPM3 A30000/A6000-AF.

5.4.4.2 RPTs

There are two RPTs in RPM3 A30000/A6000-AF. The Hi RPT is an A30000. The Lo RPT is an A6000.

5.4.4.3 POWER SUPPLY

RPM3 has one power supply with two voltage outputs:

- **V DC (± 5%) @ 0.9 Amps:** For valve excitation, b Type RPT supply and analog circuit.
- **V DC (± 5%) @ 2.5 Amps:** For micro board, main board, display fan and standard RPT supply.

5.4.4.4 COOLING FAN

The cooling fan is mounted to the RPM3 top cover and connected to the main board. It is a 5V brushless DC fan, max. air flow 0.13 m3 (4.6 cfm).

5.4.4.5 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 RPM3.

5.4.4.6 MAIN BOARD

The main board is controlled by the micro board (see Section 5.4.4.5). This board supports the 12V drivers for SDS solenoid valve excitation; the on-board barometer with digital thermometer and the beeper. It also includes a two channel frequency counter for reading standard RPTs.

5.4.4.7 ON-BOARD BAROMETER

The on-board barometer is mounted on the main board and tubed to the rear panel ATM port.

The on-board barometer includes a piezoresistive micro-machined silicon pressure sensor and digital thermometer for temperature compensation.

5.4.4.8 DISPLAY

2 x 20 vacuum fluorescent alpha-numeric display mounted to front panel.

5.5 HPMS MAINTENANCE

There are no HPMS maintenance procedures other than the overhaul procedure.

5.5.1 HPMS OVERHAUL

RPM3/HPMS A30000/A6000-AF is generally overhauled as one common assembly. Removal of RPM3 from the HPMS is not recommended unless required to perform RPM3 repairs.

Any or all of the following items may be included as part of a RPM3/HPMS A30000/A6000-AF overhaul:

- Check that RPM3 top cover mounted cooling fan operates when RPM3 is powered.
- Clean and inspect HPMS rear panel TEST port connection.
- Check that internal fittings, screws, bolts and nuts are tight.
- Perform system leak and operational check.
- Check Lo RPT pressure relief valve.
- Clean RPM3 and HPMS front panel.
- Verify that RPM3 internal barometer reads atmospheric pressure within ± 0.15 psi (1 kPa). Adjust if necessary (See Section 5.2.2).
- Perform calibration of reference pressure transducers (RPTs), if necessary (see Section 5.3).

NOTES

6. TROUBLESHOOTING

6.1 OVERVIEW

RPM3 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 RPM3 operation. This troubleshooting guide is intended as an aid in identifying the cause of unexpected RPM3 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 included references to manual sections providing information that may be of assistance.

Table 16. Troubleshooting Symptom/Probable Cause/Solution List

SYMPTOM	PROBABLE CAUSE	SOLUTION
Will NOT power up.	Blown fuse.	Replace fuse.
Measured pressure display has too much/NOT enough resolution.	Resolution setting needs to be changed.	Use **[RES]** to change resolution setting. (3.2.6)
Resolution of values other than measured pressure is too high or too low.	Display resolution of values other than the measured pressure are controlled by the RES setting of the current range and current RES setting is too high or to low.	Change ranges to a range with desired resolution or change resolution setting for active range. (3.2.2, 3.2.6)
Front panel keys seem to be disabled.	"Remote" command has been sent from a host computer.	Send "local" command from host computer or cycle RPM3 power.
Front panel display is dim.	Screen saver option has activated.	Press any key to resume full screen power, adjust activation time if desired. (3.4.7.1)
Keypad presses make undesired sounds or NO sounds.	Keypad sound settings are incorrect.	Use keypad function to set keypad sounds as desired. (3.1.3, 3.4.7.2)
Cannot access certain functions. **<>ACCESS RESTRICTED<>**	User level has been set that restricts access to certain functions.	Change user level or consult system manager. (3.4.8)
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 enter is pressed and report to **DHI** Authorized Service Provider.
Displays **<TIME-OUT>.**	RPM3 cannot read internal RPT.	Cycle RPM3 power. If problem persists contact **DHI** Authorized Service Provider. (7.2, Table 18)

Table 16. Troubleshooting Symptom/Probable Cause/Solution List (Continued)

SYMPTOM	PROBABLE CAUSE	SOLUTION
Bottom line of display has changed and you want to change it back.	The DISPLAY function has been used to change the display.	Use **[DISPLAY]** to set bottom line to desired display. (3.2.7)
Bottom line of display is blank.	DISPLAY mode is **clean**.	Operation is normal. Use **[DISPLAY]** to change bottom line display if desired. (3.2.7)
Pressure display is flashing and beeper is sounding.	Current upper limit of active range has been exceeded.	Reduce pressure applied to TEST port to correct UL condition. Change UL and/or active range if desired. (3.2.2, 3.2.5)
<RR RPT EXCEEDED PMAX> is displayed alternating with normal display.	RPM3 has been overpressured (Pmax exceeded).	Correct the overpressure condition and cycle power ON and OFF to clear. (3.2.5, 3.1.6)
<!!!PMAX!!!> is displayed.	Current measured pressure is greater than the maximum acceptable pressure (Pmax!) for the active range.	Reduce pressure and recycle power to clear overpressure condition. (3.2.5.1, 3.1.6)
<!!!!LO RPT ACTIVE!!!!> is displayed and RPM3 is beeping.	A Hi RPT range is active but the Lo RPT is measuring a pressure. RPM3 is alerting you to the danger of overpressuring the Lo RPT.	Remove the pressure to the Lo RPT and close the Lo RPT Shut Off valve before using Hi RPT pressure. ranges. (3.1.8)
Pressure indicated by RPM3 never becomes stable.	These is a leak in the pressure system to which RPM3 is connected.	Find and correct leak. Consider using RPM3 leak check function. (3.3.5)
A ***Ready*** indication is never achieved.	Stability criterion is never being met.	Adjust stability criterion or stabilize applied pressure. (3.1.5, 3.3.4)
Range will NOT change. Displays **<Pressure on RR RPT exceeds RR upper limit>.**	The pressure currently applied to the range that is being selected exceeds the UL (upper limit) currently set for that range.	Reduce pressure applied to test port to less than UL of target range. (3.2.2, 3.2.5)
Display update rate of indicated pressure changes when changing pressure.	RPM3 automated read rate function is ON to automatically adjust read rate depending upon rate of change of pressure.	Operation is normal. Turn automated read rate function OFF if desired. (3.3.3)
Display update of indicated pressure is too slow when pressure is changing quickly.	RPM3 automated read rate function is OFF.	Turn automated read rate function ON to automatically adjust read rate depending on pressure rate of change. (3.3.3)
Pressure is changing but display of pressure is NOT and the bottom right hand corner of the display is a numerical countdown followed by **<avg>.**	Average DISPLAY function is ON and pressure display is updating only with the average value at the end of each averaging cycle.	Go to a DISPLAY function other than average or press **[+/-]** to get the instantaneous value Average DISPLAY. (3.2.7.1, 3.2.7)
Is NOT reading pressure applied to one of the Lo RPT ranges.	HPMS Lo RPT Shut Off Valve is closed shutting off the Lo RPT from the HPMS TEST port.	Familiarize yourself with the HPMS configuration and operation. Open the Lo RPT Shut Off Valve. (3.1.8)

Table 16. Troubleshooting Symptom/Probable Cause/Solution List (Continued)

SYMPTOM	PROBABLE CAUSE	SOLUTION
Is NOT reading pressure applied to TEST port.	RPM3 has two TEST ports and pressure to be measured is connected to correct port but active RPT is NOT the RPT on that TEST port.	Familiarize yourself with your RPM3 configuration. Set active RPT and range to read on desired test port. (3.1.6, 3.8.8, 2.3.3.2)
Disagreement between Hi and Lo reference transducer or between transducer ranges appears excessive.	Difference is actually in tolerance and represents **natural** disagreement.	Compare differences observed to tolerances on reference transducer measurements. (1.2.2.1)
Disagreement between measurements made by different ranges at the same pressure is NOT zero but an autozero routine was just executed.	Readings by different ranges at the same pressure can disagree even after a valid autozero due to ZNATERR.	Check that ZOFFSET value is in tolerance and verify value of ZNATERR. (3.4.1, 3.4.1.2, and 5.3.6)
AutoZ was just run in gauge mode but measurement indication is NOT zero. **<h>** is displayed on top line of screen.	A head correction is applied and current indication is the value of the head.	Operation is normal. (3.2.8, 3.4.1, 3.2.10.1)
Pressure applied is zero gauge but reading is NOT zero.	Need to run AutoZ to rezero in gauge mode.	Run AutoZ, check head setting. (3.2.10, 3.2.8)
Poor pressure measurement characterized by instability and sudden small pressure changes.	The measurement system is contaminated with gas or solids.	Purge and clean affected systems. (see OPG1-30000-AF Operation and Maintenance Manual).
Apparent inaccurate pressure measurements and little or NO response from reference transducer.	Reference transducer destroyed by overpressure.	Contact **DHI** Authorized Service Provider. (7.2, Table 18)
Apparent inaccurate pressure measurement and **<h>** is displayed on top line of screen.	An unplanned **head** correction is active or head height or medium is incorrect.	Remove or change **head** correction. (3.2.8, 3.3.1)
Apparent inaccurate pressure measurement.	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. (3.2.3, 3.2.4, 3.3.2)
Pressure applied is zero gauge but reading is NOT zero.	Current measurement mode is absolute and RPM3 is indicating atmospheric pressure.	Check measurement mode setting and set to gauge if gauge pressure measurements are desired. (3.2.4)
Pressure applied is atmospheric but RPM3 indicates near zero.	Current measurement mode is gauge and RPM3 is indicating zero gauge pressure.	Check measurement mode setting and set to absolute if absolute pressure measurements are desired. (3.2.4)
Apparent inaccurate pressure measurement.	RPT calibration coefficients have been altered or lost.	Check and correct calibration coefficients if needed. (5.3)
Apparent inaccurate pressure measurement and **<z>** is displayed on top line of screen.	AutoZ has been run with incorrect ZSTD applied.	Check value of ZOFFSET. Rerun AutoZ with a valid ZSTD reference. (3.2.10, 3.4.1)

Table 16. Troubleshooting Symptom/Probable Cause/Solution List (Continued)

SYMPTOM	PROBABLE CAUSE	SOLUTION
Apparent inaccurate pressure measurement and **<z>** is NOT displayed on top line of the screen.	AutoZ is OFF and it should be ON.	Turn AutoZ ON. (3.2.10, 3.4.1)
[ENTER] is not accessing the automated test Sequence routine.	You are in a Display mode other than Rate that uses the **[ENTER]** key.	Press **[DISPLAY]** and set the Display mode to Rate. (3.2.7.2)

7. APPENDIX

7.1 PRESSURE UNIT CONVERSIONS

RPM3 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 17 provides the conversion coefficients used by RPM3 to convert numerical values expressed in SI units to corresponding values expressed in other units.

Table 17. Pressure Unit of Measure Conversions

TO CONVERT FROM PA TO		MULTIPLY BY
Pa	*Pascal*	1.0
mbar	*millibar*	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
user	*user*	User defined coefficient

7.2 WARRANTY STATEMENT

Except to the extent limited or otherwise provided herein, **DH Instruments, Inc**. warrants for one year from purchase (five years for RPM3 A30000/A6000-AF units purchased under AFMETCAL Contract F33660-99-C7003, as labeled on the instrument rear panel), 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, Inc. 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** or its Authorized Service Provider after receiving authorization from **DH Instruments** or its Authorized Service Provider. The buyer assumes all liability vis-à-vis third parties in respect of its acts or omissions involving use of the products. In NO event shall **DH Instruments** 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** 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, Inc.**

The above warranty and the obligations and liability of **DH Instruments, Inc.** and its Authorized Service Providers exclude any other warranties or liabilities of any kind.

The five year warranty provided on purchases made under AFMETCAL Contract F33660-99-C7003 extends the one year commercial warranty defined above. This warranty provides for remedy of defects in material, workmanship, manufacturing and design only. It is NOT an extended service contract. Units returned for service not covered under the warranty terms are subject to normal service charges including charges for evaluation and/or analysis of warranty claims when no defect is found.

Ship RPM3/HPMS as an integrated assembly in its original molded, shipping case. Do not remove the RPM3 from the HPMS for shipping.

Table 18. DH Instruments, Inc. Authorized Service Providers

DH INSTRUMENTS, INC. AUTHORIZED SERVICE PROVIDERS 2000 JAN			
COMPANY	**ADDRESS**	**TELEPHONE, FAX EMAIL**	**NORMAL SUPPORT REGION**
DH Instruments, Inc.	4765 East Beautiful Lane Phoenix AZ 85044-5318 USA	Tel 602.431.9100 Fax 602.431.9559 jbaines@dhinstruments.com	Worldwide
Minerva I.P.&M. B.V.	Handelsweg 13 Postbus 76-1270 AB Huizen NETHERLANDS	Tel 31/35.52.54.887 Fax 31/35.52.64.560 minervaipm@compuserve.com	European Union
Nippon CalService, Inc.	2-9-1 Sengen, Tsukuba-Shi Ibaraki Prefecture 305 JAPAN	Tel 0298-55-8778 Fax 0298-55-8700 aohte@ohtegiken.co.jp	Japan/Asia

NOTES

8. GLOSSARY

Absolute Mode	Measurement mode in which the RPT indicates absolute pressure (difference from vacuum).
Active RPT	The RPT of which a range is currently the active range.
ATM Ref	The on-board barometer reading.
ATMOFFSET	The difference between the reading of the on-board barometer at the last tare and the current reading of the on-board barometer. Used to dynamically compensate the atmospheric offset (ZOFFSET) when operating in gauge measurement mode with an absolute RPT and AutoZ ON.
Autozero	A process by which an RPT range and measurement mode is rezeroed (offset) relative to a standard.
Barometer	RPM3's on-board atmospheric pressure measuring sensor. Also referred to as on-board barometer.
Clean	A DISPLAY function in which the second line of the display is blank (clean).
CCW	Counter-clockwise.
CW	Clockwise.
Deviation	A DISPLAY function in which the deviation from a target value is calculated and displayed. The value of the difference between the target and the current pressure reading.
DUT	Device Under Test.
File Sequence	A Sequence whose parameters are recorded in a file that can be selected and run (see also Sequence and Quick Sequence).
Freeze	A DISPLAY function in which the current reading of the RPT can be captured and displayed by pressing **[ENTER]**.
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.
Gauge Mode	Measurement mode in which the RPT indicates gauge pressure (difference from atmospheric pressure).

Head	A difference in height between the RPM3 reference level and another level at which pressure is to measured.
Hi/Lo	A DISPLAY function in which the highest and lowest pressure measurements since reset are recorded and displayed.
HGC-30000-AF	The Hydraulic Gauge Calibrator system made up and an RPM3 A30000/A6000-AF and an OPG1-30000-AF.
HPMS	High Pressure Mounting System. A mounting system for RPM3 A30000/A6000 that positions the units and supports the hardware to isolate the Lo RPT when it is not in use.
Inactive RPT	The RPT on which NO range is currently the active range. A range of the inactive RPT maybe displayed on the second line of the RPM3 display using the RPT DISPLAY function.
Measurement Mode	Whether pressure is being measured relative to absolute zero or vacuum (absolute mode) or relative to atmospheric pressure (gauge mode).
Pa	Pressure adder, used to offset an RPT range or barometer in calibration.
PM	Pressure multiplier, used to adjust span of an RPT range or barometer in calibration.
Pmax!	The maximum pressure limit of a range. If the pressure measured by a range exceeds Pmax! An overpressure condition occurs.
Quick Sequence	A Sequence whose parameters are entered “on the fly” when the sequence is run (see also Sequence and File Sequence).
Rate	The rate of change of the current pressure. Indicated in the main run screen when control is suspended.
ReadRt or Automated Read Rate	An RPM3 feature that automatically adjusts the pressure reading and display update rate as a function of the rate of change of the measured pressure.
Ready <*>/Not Ready (<↑> or <↓>)	Indication of when pressure is stable within stability limit.
RPM	Reference pressure monitor manufactured by **DHI**. Models are RPM1, RPM2, RPM3.
RPT (Reference Pressure Transducer)	The transducer used by RPM3 for high accuracy pressure measurement. The RPT in a single RPT RPM3 or the higher pressure range RPT in a dual RPT RPM3 is referred to as the Hi RPT. The lower pressure range RPT in a dual RPT RPM3 is referred to as the Lo RPT. RPTs are designated by a leading A or G (absolute or gauge) followed by four or five numbers indicating the maximum range of the RPT in psi (e.g., A0100). These are standard b type RPTs.
Sequence	An automated calibration or test sequence in which RPM3 range, resolution and stability test settings are made automatically based on DUT full scale and tolerance, test points are prompted automatically and RPM3 output is recorded into a data file at each point. Quick Sequences are set up “on the fly”, File Sequences run using data stored in a Sequence file.

Stability Limit	A rate of change of pressure limit expressed in units of pressure per second (e.g., psi/second). The stability limit is used as the ***Ready/Not Ready*** criterion (***Ready*** if inside stability limit, ***Not Ready*** if stability limit is exceeded).
SDS (Self Defense System)	A system to protect RPTs from overpressure made up of isolation and vent valves and internal operating logic. Applies only to RPTs designated A1500 or lower.
Target	The value from which deviations are measured in the Deviation DISPLAY function.
UL	See **Upper Limit**.
Upper Limit (UL)	A range specific maximum value of pressure NOT be exceeded and at which RPM3 will sound an intermittent beep.
User Level	Level of security that can be set to protect certain RPM3 functions from being accessed.
ZNATERR	The disagreement between the RPT indication and ZSTD at the autozero pressure just after an RPT range has been calibrated.
ZCURERR	The disagreement between the RPT indication and ZTSD at some time after an RPT range has been calibrated.
ZOFFSET	ZCURERR corrected for ZNATERR (the value used to autozero the RPT range).

NOTES